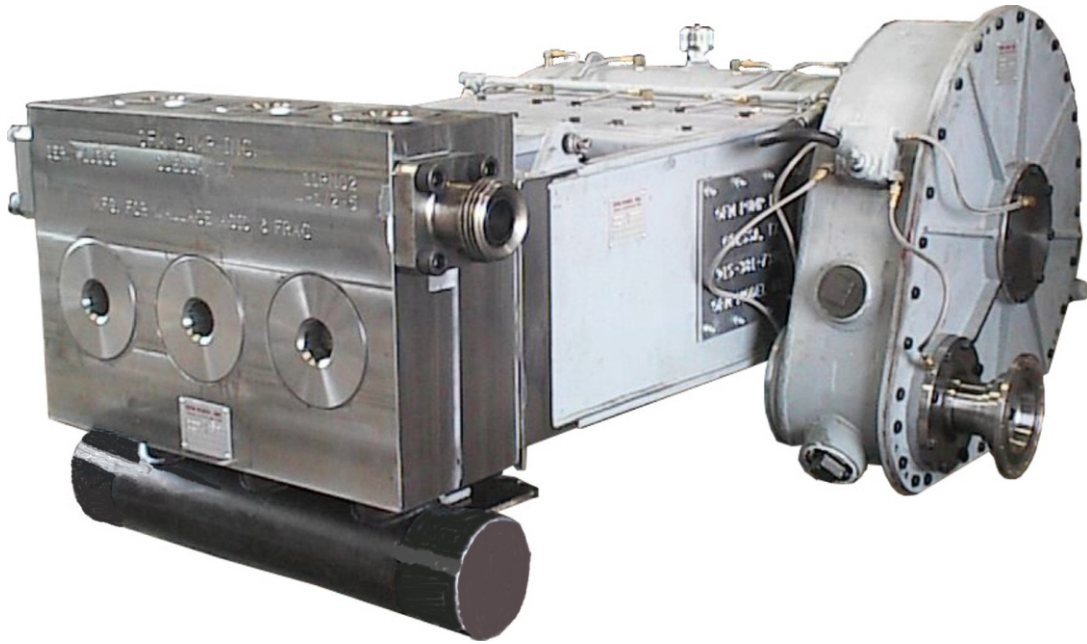


OFM PUMP, INC.



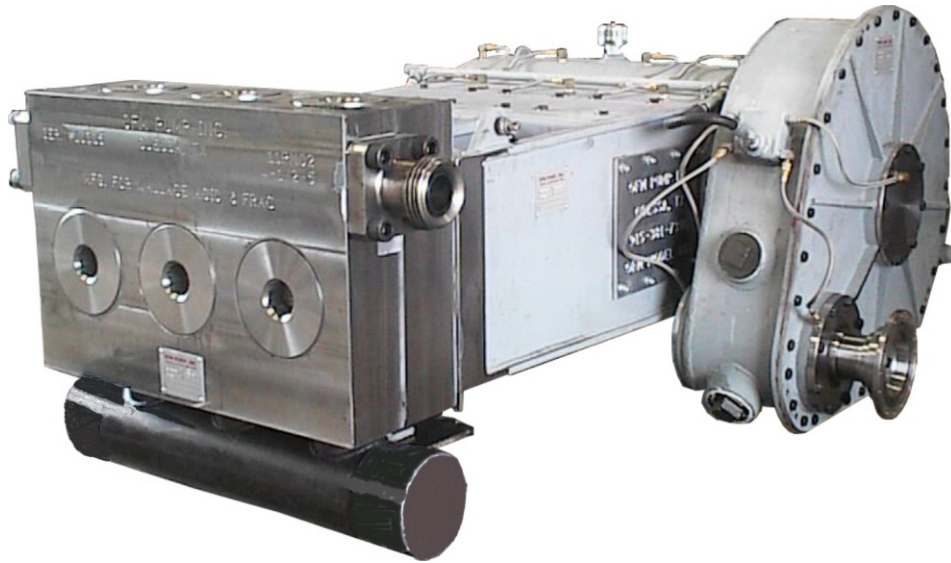
600 HP Maintenance and Operation Manual

**P.O. Box 12192
Odessa, Texas 79768
2243 FM 1936
Odessa, Texas 79763**

**Phone: (432) 381-7390
(877) 381-7390
Fax: (432) 385-1205**

December 2005

OFM WELL SERVICE PUMPS



OFM 600 HP PUMP

PUMP SPECIFICATIONS

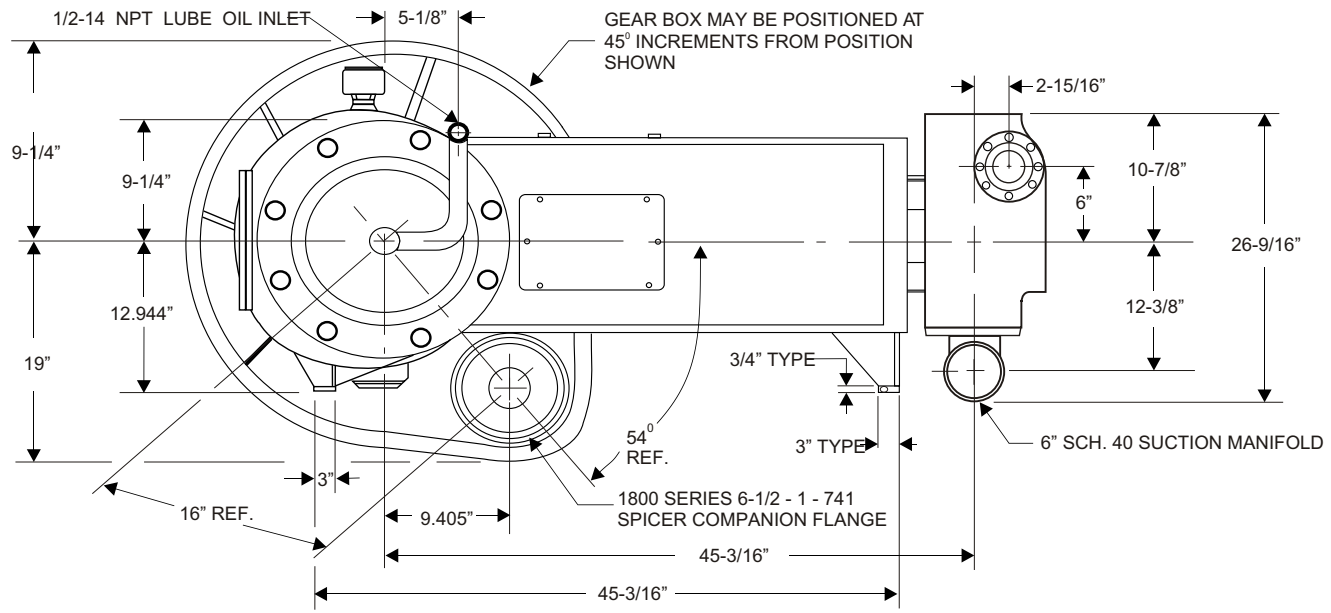
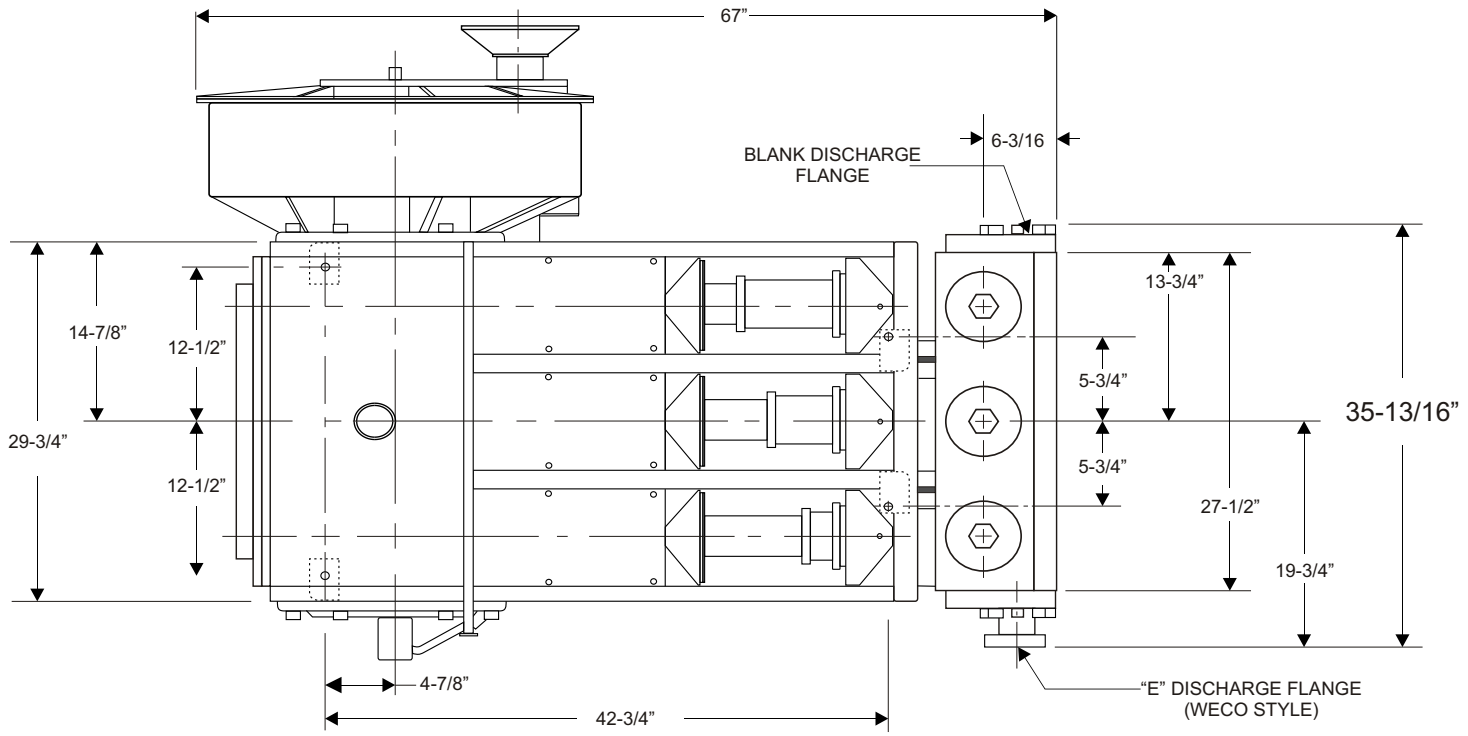
Rated Brake Horsepower.....	600
Maximum Rod Load.....	100,000 Lbs.
Stroke Length.....	6 Inches
Overall Length.....	67 Inches
Overall Width.....	53-7/16 Inches
Overall Height.....	31- 1/2 Inches
Approximate Weight.....	5,000 Lbs.
Gear Ratio.....	4.68 : 1

PERFORMANCE DATA**

PLUNGER DIAMETER (INCHES)	GALLONS PER REV.	GALLONS PER MINUTE (GPM) AT PUMP REVOLUTIONS PER MINUTE (RPM)									
		50		100		200		300		450	
		GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI
5	1.53	76	5093	153	4760	306	2860	459	1904	668	1270
4-1/2	1.24	62	6288	124	5877	248	3526	372	2351	557	1568
4	0.98	49	7958	98	7437	196	4463	294	2975	440	1984
3-1/2	0.75	37	10394	75	9713	150	5829	225	3886	337	2591
3	0.55	28	14147 *	55	13220	110	7934	165	5289	248	3526
2-3/4	0.46	23	16836 *	46	15733 *	93	9442	139	6295	208	4197
BRAKE HORSEPOWER		267		500		600		600		600	
PINION RPM		234		468		936		1404		2160	

* Application to be approved by OFM PUMP, INC.

** Based on 85% ME and 100% VE - Intermittent service only.



NOT A SCALE DRAWING
INSTALLATION DETAIL OF OFM MODEL 600 LEFT HAND 4.68 : 1 DRIVE
OFM PUMP, INC.
APPROXIMATE WEIGHT 5,000 Lbs.

MAINTENANCE AND OPERATION
MANUAL
OFM 600 HP TRIPLEX PLUNGER PUMP

CUSTOMER: _____

SERIAL NUMBER: _____

PURCHASE ORDER #: _____

SALES ORDER #: _____

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GENERAL INFORMATION

The OFM 600 HP triplex is a horizontal single-acting 600 horsepower pump with a 6" stroke and various plunger sizes from 2-3/4" through 5" diameter. The weight of this pump will vary slightly due to various accessories but will not exceed 5,000 lbs. All sizes of plunger fluid ends are interchangeable on the power end. This pump was designed for displacement of frac fluids on mobile equipment.

The power end is a high strength steel fabrication designed for a force-fed lube system throughout to supply gear oil to the rod bearings, main bearings, etc. Because of the various drive arrangements powering these pumps, the lube pump itself is not built-in but must be mounted externally in the best way suited to each application.

The fluid end is available in 2-3/4" through 5" plunger sizes. All fluid ends are of an alloy steel design with replaceable stuffing boxes. 12 alloy steel bolts join the fluid end and power end. The plunger is also separable from the rod so that the inside of the power end is never exposed during fluid end maintenance.

The speed reducer is fabricated from high strength steel and has a variety of mounting options. The 4.68:1 ration helical gears are made from alloy steel, which is induction hardened and the pinion is carborized.

PARTS ORDERING

Listed below are address and phone numbers where you can obtain assistance, parts and service:

OFM PUMP, INC.
P.O. BOX 12192
2243 FM 1936
ODESSA, TEXAS 79763

(432) 381-7390 OFF.
(877) 381-7390 OFF.
(432) 385-1205 FAX.

When placing an order for spare parts, you can speed up the process by having the following information when you place your call:

The fluid end or power end model number and serial number – see identification tags on the pump.

Pump model and fluid end size.

OFM part number and description of part.

The quantity of each part required.

The name of your company.

Name of person placing order.

Your purchase order or requisition number.

Complete shipping address (where the parts are to be shipped).

Telephone number and contact person.

Telephone number to call on arrival if a shipment is made to a different address.

Complete billing address (where the invoice is to be sent).

SHIPPING AND STORAGE

All pumps are shipped dry and must be flushed before operating. All pumps should be flushed with diesel or some other light oil regardless of how they were shipped or what type of container shipped in. Where pumps are shipped ocean cargo, care should be taken to crate the pump in a watertight container and ship below deck to prevent excess rust and salt-water contamination.

Pumps are not prepared for dry storage and should be put in service as soon as possible. To prepare a pump for storage after prior use, clean the fluid end and flush it with some type of rust preventative. Plug all discharge and suction openings at the fluid end. Drain Oil from the power end, clean and flush with some type of rust preventative, which will not clog oil passages. Remove crankcase breather and tape or plug all openings. Coat the pinion extensions and pony rods with a heavy rust preventative and store pump inside in a warm, dry place.

STANDARD TERMS AND CONDITIONS OF SALE

- (1) This quotation is an offer to sell. Hereinafter OFM Pump, Inc. will be "Seller". Hereinafter the person to whom this quotation is addressed will be "Buyer". Hereinafter the products and services offered for sale in this quotation will be "the goods". The agreement formed by Buyer's acceptance of this quotation hereinafter will be the "Contract".
- (2) Delivery of the goods will be F.O.B. Seller's plant, Odessa, Texas, unless otherwise provided. All shipping dates are based on receipt of a purchase order with complete information contained therein. Shipping dates are based on standard quality control checks as part of a normal production sequence. Additional inspection or testing required by Buyer which affects the normal production sequence, will extend the shipping dates accordingly. Such additional inspection or testing will be charged to Buyer.
- (3) Seller shall not be liable for its failure or delay in delivery due to acts of God, orders bearing priority ratings established pursuant to law, differences with workmen, local labor shortages, fire, flood, or other casualty, governmental regulations or requirements, shortages or failures of all materials, supplies, fuel, power or transportation, breakdown of equipment or any other causes also beyond Seller's reasonable control whether of similar or of dissimilar nature to those enumerated. Seller shall have such additional time within which to perform as may be reasonably necessary under the circumstances and shall have the right to apportion its production among its customers in such a manner as it may consider to be equitable, giving such priorities to delivery hereunder as may be reasonably possible. In no event shall Seller be liable for any consequential damages or claims resulting from failure or delay in delivery.
- (4) Seller will replace, F.O.B. Seller's plant, Odessa, Texas, any goods furnished hereunder found to be defective or otherwise failing to conform to this quotation, or at Seller's option, Seller will allow appropriate credit not to exceed the price paid for such goods. Claims must be made promptly after receipt of the goods by Buyer and Seller must be given reasonable opportunity to investigate Buyer's remedies with respect to any goods that are found to be defective or otherwise not in conformity with this quotation shall be limited exclusively to the right of replacement thereof or the allowance of appropriate credit not to exceed the quotation price. In addition, the goods are guaranteed against defects of material and workmanship for a period of six months from the date of shipment from Seller's plant, Odessa, Texas, when such goods are used in a service and within the design parameters for which they were manufactured. Seller's liability shall be limited to free replacement, F.O.B. Seller's plant, Odessa, Texas, of any goods found to be defective in material or workmanship by Seller's inspection and shall not include claims for labor, costs, expenses of Buyer resulting from such defects, damages, arising from delays, loss of use or other direct, indirect, incidental, or consequential damages of any kind. In case of any goods not wholly of Seller's manufacture, Seller's liability shall be limited the extent of its recovery from manufacturer of such goods under its liability Seller.
- (5) Except in the particulars specified by Buyer and expressly agreed to in writing by Seller, the goods furnished hereunder shall be produced in accordance with the manufacturer's standard practices. All products however, including those produced to meet an exact specification, shall be subject to tolerances and variances consistent with good mill practice in respect to dimension, weight, straightness, section, composition, and mechanical conditions and quality; to deviations from tolerances and variations consistent with practical testing and inspection methods; and to regular mill practice on over and under shipment.
- (6) Seller warrants the goods are merchantable and conform to the specifications set forth in this quotation. Seller further warrants the use of the goods will not infringe any claim of United States patent covering the goods themselves. However, Seller does not warrant the goods will not infringe any such patent when not manufactured by or for Seller, or when specially made, in whole or in part, to Buyer's design specifications. In addition, Seller does not warrant the goods will not infringe any such patent if used or sold in combination with other material for use in any process. EXCEPT FOR THE WARRANTIES CONTAINED IN THIS PARAGRAPH AND PARAGRAH (4) ABOVE SELLER MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE WARRANTY OF FITNESS FOR PARTICULAR PURPOSE.

STANDARD TERMS AND CONDITIONS OF SALE (Con't.)

- (7) Seller shall not be liable for any damage or deterioration of the goods occurring while the goods are in transit after leaving Seller's plant, Odessa, Texas.
- (8) Buyer agrees to tender payment for the goods in United States dollars according to terms stated in this quotation. Consular fees for legalizing invoices, stamping bills of lading or other documents required by the laws of any country are not included in quotation or selling prices. If instructed in writing Seller will make arrangements for said documents as agent for Buyer, but Seller assumes no liability whatsoever for making such arrangements. Any tax or other charges imposed by law on the sale or production of the goods or the performance of service hereunder shall be paid by Buyer. In the event the law specifically imposes such tax or charges upon Seller, Buyer will indemnify Seller for the payment of such taxes or charges.
- (9) Seller reserves the right to change or to modify the design or construction of any of its products, in due course of its manufacturing procedure without incurring any obligation to furnish or to install such changes or modifications on products previously or subsequently sold.
- (10) Buyer shall not be entitled to change or to modify, except with the written consent of Seller, any specifications, details, or instructions, comprised in this quotation.
- (11) Insistence by buyer on suspension of manufacture or of shipment, if not agreed in writing by Seller, may be treated by Seller as a wrongful termination of Contract and Buyer thereupon shall be liable for all damages arising out of such wrongful termination.
- (12) Seller reserves the right at any time to require from Buyer satisfactory security for the due performance of all its obligations and Buyer's refusal to furnish satisfactory security or its failure to perform any of its obligations under this or any other existing contract will entitle Seller, upon the dispatch of notice to Buyer, to suspend shipment or to cancel the Contract, or so much of it as remains unexecuted, without prejudice to any claim for damages Seller may be entitled to make.
- (13) No terms or conditions other than those stated herein and no agreement or understanding, oral or written, in any way purporting to modify these terms and conditions shall be binding upon Seller unless hereinafter agreed in writing by Seller. Seller hereby objects to and rejects any and all additional terms and conditions imposed by Buyer, whether contained in Buyer's purchasing or shipping release forms or elsewhere. All proposals, negotiations and representations, if any, made prior to or with reference hereto are merged herein.
- (14) Waiver by Seller of any default, breach, or non-performance hereunder neither shall constitute nor be construed as a waiver of any subsequent default, breach, or non-performance hereunder whether of a similar or dissimilar nature to the previous default, breach or non-performance.
- (15) Any clause required to be included in a contract of this type by any applicable and valid federal, state, or local law, or administrative rule or regulation having the effect of law shall be deemed to be incorporated herein.
- (16) The Contract will be governed by and construed according to the laws of the State of Texas insofar as applicable and by the laws of the United States of America.

OFM PUMP, INC.

600 HP Triplex Plunger Pump Maintenance and Operation Manual

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March 2004

PUMP DESIGN DATA

POWER ENDS

Power End Case:

- (1) High strength steel, stress relieved, line bored
- (2) Light weight aluminum covers with silicone seal gaskets
- (3) Aluminum seal retainers
- (4) Replaceable bearing brass crosshead guides (shim adjusted)
- (5) Four (4) heavy duty roller bearings at main journals
- (6) 1/2" pipe lubrication inlet
- (7) 3" pipe oil drain back outlet
- (8) 1/2" pipe braided metallic oil hose to the crankshaft lubrication inlet
- (9) 1/4" braided metallic oil hose to main bearings and crossheads

Crankshaft:

- (1) One piece, forged alloy steel
- (2) Heat treated and ground
- (3) Drilled for lubrication to rod journals
- (4) Diameter at:
 - (a) Main journals-----11.250"
 - (b) Rod journals-----4.500"
 - (c) Gear fit-----6.500"
with 1-1/4"
standard keyway

Crosshead:

- (1) Ductile iron casting with oiling grooves
- (2) Precision fit wrist pin retained by snap rings
- (3) Dimensions-----9.000" O.D.
9-1/16" long

Power End Case:

- (1) Cast high strength steel with press fit wrist pin bushing
- (2) Cap retained by two (2) 1" screws

Rod Bearing:

- (1) Full precision type plated bearings
- (2) 1/2" dowel pin to prevent bearing spin
- (3) Dimensions-----4-1/2" I.D. x 3/8"
wall thickness
x 4-1/2" long

Wrist Pin:

- (1) Precision fit type retained by snap rings
- (2) Alloy steel with ground finish

Wrist Pin Bushing:

- (1) Plated bronze with oil grooves
- (2) Press fit in connecting rod

Pony Rod:

- (1) Clamp type connection to plunger
- (2) Mild steel with hard overlay seal surface
- (3) Attached to crosshead with 1-1/2" 8V thread

FLUID ENDS

Plunger Type Fluid End:

- (1) Machined from heat treated and sonic tested alloy steel forging
- (2) Available in 2-3/4" thru 5" plunger sizes
- (3) Plungers are mild steel with hard overlay surface and clamp connection
- (4) Available with Chevron, non-adjustable or spring loaded packing
- (5) Utilizes a discharge flange at each end with a variety of thread connections
- (6) Uses wing guided valves with tapered seats
- (7) Uses 6" Sch. 40 suction manifold open at each end with a variety of connections
- (8) Replaceable alloy steel stuffing boxes

SPEED REDUCER

Bull Gear:

- (1) Helical gearing
- (2) Machined from alloy steel, heat treated and crown shaved
- (3) 4.68:1 Ratio
- (4) Attached to crankshaft with 1-1/4" keyway and snap ring

Pinion Gear:

- (1) Integrally machined on alloy pinion shaft
- (2) Supported by two (2) heavy-duty tapered roller bearings

Speed Reducer Housing:

- (1) Precision machined from high strength steel
- (2) Attached to power end case with eight (8) 1" cap screws

LUBRICATION SYSTEM

This pump must be lubricated by extreme pressure gear oil at a flow rate of 15 to 20 GPM to the power end's lube inlet (see the LUBE OIL RECOMMENDATION CHARTS). These specifications must be adhered to due to the pumps light weight/high horsepower design utilizing bronze rod bearings rather than the heavy roller bearings usually associated with massive high horsepower pumps. Due to the various applications and drive arrangements, the lube pump and other lube system components are not built into the power end and must be equipped separately for each individual application. The selection and mounting arrangement of all the lube system components becomes critical with the use of heavy gear oil. All the hydraulic components required such as filters, strainer, etc., are designed and rated for use with light hydraulic oils. Obviously the resistance to flow of heavy gear oil through strainers and even hoses is much greater than with light hydraulic oil. This higher resistance to flow must be compensated for in all the components selected except the lube pump itself.

The following specifications pertaining to the lube system components are absolutely vital to the life of this pump even under low horsepower conditions:

THE LUBE PUMP

Because of its positive displacement design and its reliability in so-called contaminated systems, the gear type pump should always be used as a lube pump. In order to select the proper gear pump, the mounting and drive arrangement must first be known.

On these triplex pumps, which have an engine and transmission or torque converter drive, the lube pump should be driven from one of the accessory drive locations provided on that equipment so that the lube pump always runs at engine speed. This will provide the most lubrication when it is needed even at high pressure/low speed operation of the triplex. It will also be very important to mount the lube pump as low as possible, preferably at the transmission PTO, so that the lube pump suction does not have to lift the heavy gear oil any higher than absolutely necessary. The lube pump should be set up with a positive drive so that any possibility of belt slippage, etc., is eliminated. This can be accomplished by the use of a flange mount pump with a splined shaft or a foot mount pump with a small drive line. The engine speed must now be known. If the engine is to be operated at 2000 RPM, 1200 RPM or whatever, a gear pump must be selected that will deliver 15 GPM minimum at that speed. As most gear pumps are offered with several different sizes of inlet and outlet ports, the largest porting arrangement available should be chosen for reasons to be determined later.

THE LUBE PUMP SUCTION PIPING

These requirements are usually the most misunderstood of all and have frequently led to triplex pump damage because of a restricted flow of oil to the lube pump suction inlet. These specifications are based on four simple but very important hydraulic “rule of thumb” requirements:

- (1) The flow velocity of the oil through the suction piping should not exceed 2 feet per second except, if necessary, for a short distance of no more than a few inches. Therefore, for a flow rate of 15 GPM to the lube pump inlet, a pipe or hose no smaller than 1-3/4” I.D. must be used. (This explains the need for the largest porting available on the gear pump so that the hose does not have to be reduced down with a bell reducer any more than is absolutely necessary at the lube pump inlet).
- (2) The vacuum reading directly at the lube pump inlet while it is operating at full speed must not exceed 8” Hg or 4 PSI. This reading should be checked at whatever temperatures will be experienced by the triplex pump on a cold start-up.
- (3) The suction strainer should be sized 3 times larger than the actual flow of oil that is to pass through it. Therefore, for a flow rate of 15 GPM, a strainer should be used that is rated at no less than 45 GPM. Also, to compensate for the use of the heavy gear oil, a 30-mesh strainer should be used instead of the usual 200-mesh strainer. This will decrease the vacuum caused by the oil flow being restricted as it flows through the strainer and will also increase the length of time between strainer cleaning intervals. A strainer with a 3 or 5 PSI relief valve should always be used so that if the strainer does become clogged, the oil pump will not starve for oil. Two basic types of strainers are available. The “in-ump” type strainer, if used, should be installed in such a way that it can be easily removed for periodic cleaning. The “in-line” canister-type strainer, if used will probably require bell reducers on the inlet and outlet to accommodate the large suction piping. This type strainer should also be clearly marked to use only strainer type elements, as it generally looks identical to a filter assembly using paper elements.
- (4) Since every additional foot of suction piping adds to the oil flow resistance and raises the vacuum reading, the suction piping should be kept as short and free of bends as possible. If the suction piping or hose has to be longer than 10 feet or so, a 2” I.D. hose or pipe is highly recommended. Where hose is to

be used, a suction type hose with wire reinforcement will be needed to prevent from collapsing especially in areas where there might be a bend in the hose. All connections in the suction should be taped and made up tight to eliminate air from being drawn in.

THE OIL RESERVOIR

A well designed oil reservoir or sump tank not only serves as a place to store the oil but also: (1) gives foreign particles such as dirt and cuttings a place to settle out of the oil, (2) allows the oil to cool down more effectively, (3) allows small air bubbles to purge themselves from the oil and, (4) in this case, should compensate for the slow gravity return of the heavy gear oil to the tank without the suction intake becoming exposed.

The Reservoir should have a 45-gallon capacity with an additional 10% air space above and should be built as deep as possible to cut down on the possibility of the suction intake becoming exposed, (Some mobile applications may not have room for a 45-gallon tank but in these cases, the reservoir must not be less than 30 gallons capacity). The reservoir should have a large weatherproof breather/filter cap with a built-in strainer and a sight glass or dipstick, which are easily accessible. If the suction strainer is to be mounted in the tank, it should be mounted as low as possible and in such a way that it can be easily removed for periodic cleaning. A suction line fitting no smaller than 2" and a return fitting no smaller than 3" should be installed. The tank should also have a drain fitting no smaller than 1" and a clean out opening, which are easily accessible, a baffle should be installed which will force the oil to flow around the outside walls of the tank in order to reach the suction inlet. This will allow more time for particles to settle and air bubbles to be purged plus at the same time will allow more oil to come in contact with the cool outer walls.

In many cases, a sump heater may be required to keep the oil warm and if so, there should be a fitting installed of the right size and in the appropriate location. A fitting for a removable magnet can also be installed.

THE FILTER ASSEMBLY

Selecting the right filter for the pressure side of the lube system becomes a little tricky because of the heavy gear oil. It is an item that should not be overlooked, because of the bronze rod bearings in this triplex pump. Foreign particles such as dirt will not embed in the bronze, as they will with babbitt. An ineffective filter will allow scoring of the crankshaft and rod bearings, which will obviously shorten the life of the triplex.

A dual element filter rated at 45 GPM and 150 PSI working pressure and having a 20-PSI built-in-relief-valve will be the minimum acceptable arrangement that will perform with any degree of satisfaction. This is due to the fact that even this filter will become

clogged to the extent that it starts to bypass after only 30 to 50 hours. One of these filters can be used with this short time between element change intervals or two. Such filter assemblies could be used thereby decreasing the amount of maintenance required and putting it more in line with maintenance intervals on engines, etc. Filter elements with a micron rating of 33 to 75 are preferred and a 25-micron element is the smallest that should be used.

THE PRESSURE LINE PIPING

Due to the positive displacement design of the gear pump and an allowable 15 feet per second flow velocity, the pressure line pipe or hose carrying the oil to the triplex may be 5/8" on short to medium distance runs or 1" on runs of 15 feet or more. Either Sch. 40 pipe or single wire braided hose will be adequate.

THE RELIEF VALVE

A relief valve is necessary in the lube system. The relief valve is used to protect the filter assembly and all hoses, etc. In the triplex system, the filter assembly and hoses are capable of withstanding several hundred pounds of pressure. A non-shattering type relief valve with a spring pressure rating no less than 100 PSI should be used. The relief valve should be installed on the triplex lube tube on the opposite side from the lube oil inlet. This location of the relief valve will assure that it dumps excess lube oil only when the true oil pressure in the triplex requires it. The relief valve should be set for 100-120 PSI on the cool startup with the engine running at maximum RPM/ The return line from the relief valve should dump into the oil reservoir rather than the triplex, so that the excess oil is forced into the reservoir rather than having gravity flow back from the triplex. There should be no other relief valve in the lube system, which diverts oil back to the reservoir before reaching the triplex first. If the oil pressure reaches an alarming level in some part of the lube system, it means that the equipment in that part of the system is not functioning as it should and the problem corrected rather than installing a new relief valve.

GAUGES AND WARNING DEVICES

The triplex should have a liquid-filled oil pressure gauge with a pressure range of 0-150 PSI installed at the lube inlet. Any other sensors for a warning device or remote gauge should also be installed directly at the triplex lube inlet so that the true pressure in the triplex is sensed.

Since the vacuum at the lube pump is the only reliable way to determining when it is safe to operate the pump in cold weather, a liquid-filled vacuum gauge should be installed directly at the lube pump inlet and should have a vacuum range of 0-30" Hg. In cold weather, the gear oil's viscosity will become so high that even through the pressure gauge shows sufficient pressure, the bypass is most likely dumping much of the oil into the reservoir. A vacuum gauge will detect when the oil begins to thin and flow better and the triplex could safely begin operating when the vacuum falls to 8-10" Hg. at full engine

A temperature gauge will also be helpful, and used if, should also be installed at the triplex lube tube on the opposite side from the lube inlet. The temperature gauge's sensor should be installed in such a way that it is in the flow path of the oil for a more true reading.

Some type of warning device to monitor at least the oil pressure and temperature is highly recommended. As this triplex operates at maximum with 100,000lbs. load on each rod bearing, an early warning of the lube system problems is essential for successful operation. If used, the warning device should be set up to operate according to the following operating limits: (1) minimum oil pressure – 40 PSI; (2) maximum oil temperature – 175° F or 80° C; (3) maximum lube system vacuum at the lube inlet – 10° Hg. or 5 PSI.

OIL COOLER

An oil cooler may be required in many warm weather areas for successful continuous or intermittent operation of this triplex depending on operating conditions. Even though the maximum allowable oil temperature has been established at 175°F, a much more favorable oil viscosity and resulting oil pressure will be experienced with an oil temperature not exceeding 150°F. Also, the rate of oil oxidation (which causes harmful acid and sludge formations) doubles for each 18° rise in temperature above 150°F. Operating conditions and cooler results will vary considerably but the following recommendations will serve as a general guideline for cooler selection and installation. The cooler should be rated at no less than 35,000 BTU/Hr., no less than 30 GPM flow capacity, no less than 200-PSI working pressure and, have inlet and outlet fittings no smaller than 1" NPT or #16 JIC. The cooler should be plumbed into the lube system downstream from the oil filter so that the warmer thinner oil will flow through the filter better. If the cooler is used with a radiator and fan already present, it should be mounted upwind of the radiator for best results. If the cooler is used in an area that occasionally experiences cold weather, the plumbing should be installed with a ball valve and 100 PSI relief valve to route the oil around the cooler during cold weather.

HEAT EXCHANGER AND SUMP HEATER

A heat exchanger preferably a sump heater both will be required for those triplex pumps which will be operating frequent cold weather areas and that will be exposed to the cold. This will be necessary because the only other means of thinning the oil sufficiently is from the heat generated by the rod bearings under pressure, which obviously will damage the bearings before sufficient oil flow is obtained. Operating conditions and the resulting time it will take to heat the oil before the triplex can be engaged will vary but the following recommendations for selection and installation should be used.

The heat exchanger should be a single pass type, should have a diameter no less than 3" and an effective heating area length no shorter than 10", a tube minimum working pressure of 150 PSI, and a minimum 150,000 BTU/Hr., rating with oil/water use. When

used, the heat exchanger must be plumbed into the lube system with a ball valve and 100 PSI relief valve to route the oil around the exchanger after it heats sufficiently so that the engine water doesn't eventually overheat the oil. This manner of plumbing will also protect the exchanger tubes from bursting when the oil is extremely cold and viscous. For the best results, the flow of the engine water through the exchanger should be in the opposite direction as the flow of oil. The heat exchanger should be plumbed into the system upstream from the filter so that the heated oil will begin to flow through the filter elements sooner.

Sump heaters, when used, should have a switch or thermostat to prevent overheating the oil. Two basic types of sump heaters are available - the circulating type heater (approximately 10 watts per square inch) can be used only while the oil is circulating, and the non-circulating type (approximately 4 watts per square inch) may be left on overnight, for example, as long as it has a thermostat to prevent overheating. The use of the sump heater will be especially beneficial for preventing damage to the lube pump from cavitations on a cold startup.

PLUNGER LUBRICATION

All plunger fluid ends must be equipped with an air-over-all type plunger lube device with the maximum air pressure set at 40 PSI. Oil should be pumped into the 1/4" port above each plunger at the rate of approximately one pint per plunger per hour while operating.

MISCELLANEOUS LUBE SYSTEM INFORMATION

Minimum oil pressure at operating temperature-----25 PSI or 1.7 bar

Minimum oil pressure on cold startup-----100 PSI or 7 bar

Maximum lube temperature (w/90 wt. oil only)-----175°F or 80°C

Maximum lube system vacuum at lube pump inlet at
full operating speed-----10”Hg or 5 PSI

Minimum lube viscosity at operating temperature
(based on minimum standards for
gear and bearing protection)-----150 SSU or 32 CST

Additional vacuum created by height of lube pump section
inlet above oil level in reservoir
(based on oil weight of 4 PSI)-----4 PSI or 8”HG
for each additional
inch above oil level

*Loss at lube pump suction from altitudes higher than sea level:

1,000 ft-----	1.0”HG or 0.5 PSI
2,000 ft-----	2.2”HG or 1.1 PSI
4,000 ft-----	4.2”HG or 2.1 PSI
6,000 ft-----	6.0”HG or 3.0 PSI
8,000 ft-----	7.8”HG or 3.9 PSI
10,000 ft-----	9.5”HG or 4.8 PSI

*This will not show up as a higher reading on the vacuum gauge, but that the lube pump will begin to cavitate or starve for oil much sooner than the 10”Hg maximum allowable vacuum at sea level.

THE FORMULA FOR DETERMINING THE VELOCITY OF OIL IN A PIPE

Flow rate (in GPM) X 3208 divided by the area of the inside of the pipe (in square inches).

OIL VISCOSITY COMPARISONS

150 SSU - 90 wt. gear oil at 175⁰F

1,000 SSU - 90 wt. gear oil at 100⁰F

5,000 SSU - 90 wt. gear oil at room temperature

100,000SSU - The maximum thickness at which oil will flow through the lube system, or for example, 90 wt. gear oil at 20⁰F.

RECOMMENDED LUBE OILS

AS noted in the Lubrication System section of this manual, the pump must be lubricated by extreme pressure industrial gear oil. The gear oil must meet the AGMA (American Gear Manufacturers Association) specification 250.04. The AGMA grade required is dependent upon the oil temperature during pump operation. Due to ambient temperatures a heat exchanger to heat or cool the oil may be required.

Listed below are AGMA grade classifications for general service, extreme cold and extreme warm weather service.

A list of lubricants, by manufacturer's brand designations, meeting the recommended lube requirements is included, intended to be used as a guide in selecting the proper gear oil.

TYPE OF SERVICE	NORMAL AMBIENT TEMPERATURE	LUBE OIL OPERATING TEMPERATURE	LUBE GRADE CLASSIFICATION	NOTES
Extreme Cold Weather	Below 10 ⁰ F for extended periods	-10 ⁰ F to 90 ⁰ F <u>Do Not Exceed</u>	Synthetic gear oil	Pre-heat may be required
General Service	0 ⁰ F to 95 ⁰ F	30 ⁰ F to 130 ⁰ F 45 ⁰ F to 150 ⁰ F 60 ⁰ F to 180 ⁰ F	AGMA 2EP AGMA 3EP AGMA 5EP	
Extreme Warm Weather	Above 90 ⁰ F for extended periods	60 ⁰ F to 180 ⁰ F 80 ⁰ F to 200 ⁰ F	AGMA 5EP AGMA 7EP	Cooler may be required

***OFM recommends maximum lube oil temperature not to exceed 180⁰F.**

LUBRICANT MAINTENANCE

INITIAL OIL CHANGE INTERVAL

The initial startup and operating oil of a new pump should be thoroughly drained after a period of 100 operating hours or two months whichever comes first

SUBSEQUENT OIL INTERVAL

Under normal operating conditions, the lubricant should be changed every 1,000 operating hours or 4 months whichever comes first. Extended change periods may be established through periodic testing of oil or when using synthetics. Change oil immediately if the lubricant becomes contaminated, bring certain that the contaminant is completely removed.

SUMP HEATERS

If suitable low temperature gear oil is not available, the unit must be provided with a sump heater to bring then oil up to temperature at which it will circulate freely for starting. The heater should be so designed as to avoid excessive localized heating, which could result in rapid degradation of the lubricant.

EXTREME COLD WEATHER SERVICE
SYNTHETIC GEAR OIL

Conoco.....DN 600

Mobil.....SHC 624:

GENERAL SERVICE

AGMA 2EP

Mobil	Mobilgear 626
Arco	Pennant NL S-315
Pennzoil	Maxol EP Gear Oil #56
Exxon	Spartan EP Grade 68
Gulf	EP Lubricant HD 68
Texaco	Meropa 68
Shell	Omala 68
Amoco	Permagear Ep68

AGMA 3EP

Pennzoil	Maxol EP 64
Mobil	Mobilgear 627
Chevron	NL 100
Gulf	HD 100
Shell	Omala 100

AGMA 5EP

Mobil	Mobilgear 630
Arco	Pennant NL S-1000
Pennzoil	Maxol EP Gear Oil #98
Exxon	Spartan EP Grade 220
Gulf	EP Lubricant HD 220
Texaco	Meropa 220
Shell	Omala 220
Amoco	Permagear EP 220

EXTREME WARM WATER

AGMA 5EP

Mobil	Mobilgear 630
Arco	Pennant NL S-1000
Pennzoil	Maxol EP Gear Oil #91
Exxon	Spartan EP Grade 220
Gulf	EP Lubricant HD 220
Texaco	Meropa 220
Shell	Omala 220
Amoco	Permagear Ep220

AGMA 7EP

Exxon	Spartan EP 460
Arco	Pennant NL S-2150
Pennzoil	Maxol EP 152
Mobil	Mobilgear 634
Chevron	NL 634
Gulf	HD 460
Texaco	Meropa 460
Shell	Omala 460
Amoco	Permagear EP 460

PUMP INSTALLATION INFORMATION

The following recommendations should serve as a general guideline in the installation of a new pump on mobile or skid mounted units.

All information in the **LUBRICATION SYSTEM** Section of this manual should be read and adhered to closely. All of the lubrication information given is vital to the life of this pump as used on an otherwise well-designed pumping unit.

The power end should have each bracket bolted securely to its skid. Alignment bars welded to the mounting skid which hold against the sides of the mounting brackets will help hold the pump against lateral movement plus help re-align the pump when removed from its mounting skid.

The power input to the pinion shaft is an 1800 Series Spicer companion flange. The direction of rotation of the pinion shaft must always be so that the top of the pinion shaft rotates toward the rear of the power end. If the pump drive is equipped with a torque converter, the pump drive should be equipped with some type of brake to prevent creeping.

A centrifugal should be sized according to the volume to be pumped with the triplex so that there is no less than 20 PSI pre-charge when the triplex is operating at maximum volume. A suction dampener is recommended for reducing shock loads and cavitations, which can severely damage the pump.

NEW PUMP RUN-IN PROCEDURE

The following inspection and run-in procedures have been established as a general guideline for maintenance personnel during the critical break-in process during the first several hours of pump operation. The first few hours of the run-in pertaining to pressure testing are normally done at the OFM Pump, Inc. plant, but because the wearing-in process may continue for 80 to 100 hours, the bulk of the break-in maintenance will be the responsibility of each user. As virtually all-moving parts of the pump go through this wearing-in process, particles of bronze, cast iron, and steel will be emitted into the lube oil. The contamination of the lube system with those particles, especially the filters and suction strainers, may cause serious problems if not attended to on a frequent basis during this period.

- (1) Fill the lube oil reservoir with the correct grade of gear oil according to climate (See **RECOMMENDED LUBE OILS** Section of this manual) Also, fill the plunger lube reservoir with the proper fluid. Prime the lube pump and others as needed. Check to see that all drain plugs and fittings are tight and not leaking.
- (2) Remove the inspection covers from the power end so that the oil flow to all parts of the pump can be observed. With the pump drive locked, start the engine and check to see that all crossheads, wrist pin bearings, main bearings, rod bearings, pinion bearings, and gear oilers are oiling.
- (3) Rev the engine up to full RPM and check for an acceptable vacuum reading of less than 10" Hg at the lube pump suction inlet. Providing the vacuum reading is acceptable, check for an oil pressure reading of at least 100 PSI. With the engine still revved up, check the entire lube system for leaks. Adjust the relief valve at the triplex lube manifold to obtain 100 to 125 PSI oil pressure if necessary. Temporary gauges at other points throughout the system might also be checked at this time to see that all components are functioning, as they should. Only slightly higher pressure should be present at points further toward the lube pump kill the engine and after a few minutes, check to see if the oil reservoir needs topping off. Check to see that the oil flow from the triplex back to the reservoir is satisfactory. Replace all power end covers using a silicone seal type gasket material..

- (4) With the charge pump operating, bleed any trapped air from the fluid end. Start the plunger lube and check to see that it is adjusted properly. Run the pump at 80 to 90 strokes per minute and 20% of its rated pressure for approximately one-half hour (see performance data charts at the end of this section). During this time, observe closely the oil pressure, oil temperature and lube pump vacuum. If, during this procedure or any of the following, the lube pump vacuum starts to rise, it probably is an indication that the suction strainer should be cleaned. As the oil temperature begins to rise and the oil thins, check covers, etc., for any new oil leaks.
- (5) Run the pump at 80 to 90 strokes per minute for approximately one half hour each at 40%, 60%, 80% and 100% of its rated pressure observing closely the oil pressure, oil temperature and lube pump vacuum. During this time, the oil pressure normally will not fall below 50 PSI.
- (6) On those pumps equipped with a transmission, run the pump for one-half hour each in the higher gear ranges pulling full horsepower in each gear and observe closely the oil pressure, oil temperature, and lube pump vacuum.
- (7) Shut the pump down and let it cool thoroughly before starting normal operations with it. All filter elements should be changed and the suction strainer should be cleaned. The lube oil should be changed and the reservoir cleaned to get rid of the metal particles now present in the oil. This will help prevent the suction strainer from becoming clogged during “on the job” pumping operations.
- (8) During the next several hours of operating, the filters and strainer will require maintenance as often as every 10 to 15 hours until it is apparent that the wearing-in process has about stopped. After approximately 100 hours, the lube oil should be changed again as well as changing the filters and cleaning the strainer. After this length of time, the strainer should not need cleaning but once every 80 to 100 hours. Depending on the type of filters being used, the filters may still have to be changed as often as every 20 hours and no less often than every 50 hours.

PUMP DATA FORMULAS

To Find Fluid Displacement

Diameter of piston X itself X .785 X length of stroke X 3 divided by 231 = GPM

GPR X RPM = GPM

GPM divided by 42 = BPM

Formula above is based on 100% volumetric efficiency

To Find Hydraulic Horsepower Of Fluid Displacement

GPM X PSI divided by 1714 = HHP of fluid output

BPM X PSI X .0245 = HHP of fluid output

Formula above is based on 100% volumetric efficiency

Approximately 15% loss in efficiency will occur in the pump itself due to friction and gearing. Approximately 5% will be lost to any other gearing in the pump drive. Loss through a torque converter can run from 20% to 50%.

GPM X PSI divided by 1457 = Input Horsepower Required (based on 85% mechanical efficiency.)

To Find Rod Load

Diameter of piston X itself X .785 X PSI = Rod Load

Notes

GPR = Gallons Per Revolution

RPM = Revolution Per Minute

GPM = Gallons Per Minute

BPM = Barrels Per Minute

HHP = Hydraulic HorsePower

PSI = Pounds per Square Inch

231 cubic inches = One Gallon

42 gallons = One Barrel

PERIODIC ROUTINE MAINTENANCE

The most economical and trouble-free service will be obtained from this pump only if a certain amount of routine maintenance is performed on it. It is highly recommended that the customer establish a maintenance program at time of purchase. Special emphasis should be placed on lube systems maintenance. The operator or maintenance personnel should be familiarized with the maintenance requirements before the pump is put into service. The following items should serve as a guideline for establishing a maintenance program:

Check Daily While Operating

- (1) Check the oil level in the oil reservoir.
- (2) Check the oil pressure - 50 to 60 PSI at operating temperature is normal (25 PSI is the danger point at which the pump should be shut down).
- (3) Check the oil temperature - 175⁰F maximum with a 90-wt oil (130⁰F maximum with 75 wt. winter oil, 200⁰F maximum with a 140 wt. summer oil).
- (4) Check the lube pump vacuum - any reading higher than 10" Hg or 5 PSI indicates that the suction strainer must be cleaned as soon as the pump can be shut down for a short period.
- (5) During the first 100 hours of operation, the filter elements will require changing every 10 to 15 hours due to the high amount of foreign particles present during break-in.
- (6) Check for any abnormal noise or rough operation, which might indicate the need for fluid end maintenance such as changing valves or seats.
Due to the higher pressure usually associated with a triplex pump, worn valves and seats should be changed as soon as possible to prevent washing through into the fluid end seat deck.
- (7) Check the plunger lube device to see that it is operating properly.

Check Monthly

- (1) Change the filter elements.
- (2) Change the lube oil and clean the reservoir thoroughly after the first 100 hours of break-in operation.
- (3) Clean the lube system suction strainer unless the vacuum reading during the operation remains below 8" Hg.
- (4) Check for any new oil leaks and eliminate any that are found.
- (5) Check all fluid end expendables such as valves and seats for wear and replace them as needed.

- (6) Check the fluid end mounting screws for proper torque.
- (7) Check the pony rod seals for leakage and replace if necessary.

Check Every Three to Four Months

- (1) Change the lube oil and clean the reservoir thoroughly.
- (2) Clean the lube system suction strainer.
- (3) Check to see that all fluid ends to power end screws are tight. Check for any cracked or broken screws and replace if needed.
- (4) Check mounting bolts for tightness.
- (5) Clean or replace the breather cap.
- (6) Check supplies on hand needed for frequent maintenance such as lube oil, filter elements, o-rings, seals, packing, valves and seats, and maintenance tools.
- (7) Check all pressure, vacuum and temperature gauges and replace if found defective.
- (8) Check the lube system alarm device by some artificial method to assure that it is still operational.

GENERAL MAINTENANCE PROCEDURES

FLUID END

To Remove Fluid End from Power End

- (1) Disconnect suction and discharge lines and any accessories such as stroke counter or pressure gauge.
- (2) Remove plunger from pony rod and push into fluid end a short distance to protect it.
- (3) Connect hoist to fluid end and tighten the line until it is snug only. **Do not pull the line too tight.**
- (4) Remove all twelve (12) 1-1/2" hex head bolts from the fluid end..
- (5) Pull the fluid end straight away from the power end until it clears the 1/4" diameter dowel pins before raising or lowering.
- (6) When replacing the fluid end, make sure that the stuffing box faces are clean and free from burrs and replace the seal. Clean the mating faces on the fluid end and orient the stuffing boxes so that the 1/4" dowel pins are on top. Lift the fluid end until the dowel pins match and push towards the stuffing boxes. Install the twelve (12) 1-1/2" hex head bolts and torque to 1250 ft. lbs.

To Remove Plungers and Packing

- (1) To remove the suction cover retainer nut with the hex wrench provided with the pump. Remove the suction cover with a threaded knocker puller.
- (2) Using a 3/8" Allen wrench, remove the two cap screws holding the pony rod clamp together.
- (3) Loosen the packing nut and remove the plunger through the front of the fluid end being careful not to damage the clamp end of the plunger.
- (4) Remove the packing nut, packing and brass being careful not to damage the packing brass or packing bore.
- (5) Before re-packing the pump, check the plunger and packing brass for excessive wear or nicks and burrs. Also, clean and grease the packing bore in the fluid end.
- (6) Install packing and brass in the fluid end with the packing lips facing the front of the fluid end. See the packing diagrams included in this manual for a detailed view of the packing ring sequence.

- (7) Install the packing nut and tighten slightly to align the packing, and then loosen to permit installation of the plunger. Slide the plunger through the suction cover bores and into the packing. It may be necessary to bump the plunger through the packing with a hammer handle or some other soft object.
- (8) Making certain that the mating surfaces of the pony rod and plunger are clean, install the clamp on them and tighten the packing nut.
- (9) Replace the suction cover, with a new seal if necessary, and install the suction cover nut. Do not hammer the retainer nut excessively after it is tight, as this may eventually cause the threads to start cracking out.
- (10) Reinstall the plunger oiler line to the stuffing box before operating the pump. Adjust the packing nut as needed after the pump is running.

To Remove Wing Guided Valves and Seats.

- (1) Remove the discharge cover retainer nut with the hex wrench provided with the pump. Remove the discharge cover with a knocker puller. Remove the valve spring and valve.
- (2) The valve seat should be removed with a seat puller and seat puller jack. Do not remove a seat by heating and quenching or welding on it as heat adversely affects the alloy steel, which the fluid end is made of. A seat puller and jack are available through **OFM Pump, Inc.**, for each type and size fluid end.
- (3) If the seat to be removed is a suction seat, it will not be necessary to remove the discharge valve, as the puller rod will pass through it. Remove the suction cover and its retainer nut.
- (4) Using the suction valve spring compressor tool, compress the suction valve spring just enough to allow removal of the suction valve spring retainer cage. (It may be necessary to flush out the fluid end to remove trapped sand behind the cage. Use the suction valve spring retainer cage puller tool if necessary). Remove the cage, spring retainer, spring and suction valve.
- (5) The suction seat should also be removed with a puller and jack. If your seat puller is made of a plate, which fits below the seat, it may be necessary to remove the suction connection at one end of the manifold in order to place the plate under the seat. A seat puller is available through **OFM Pump, Inc.**, with which this is not necessary.
- (6) Before replacing the assembly, clean the seat deck bore thoroughly. Snap the seat into the taper by hand and check to see that it is snug. Place the valve on top of the seat and use a heavy bar to bump the seat into the taper two or three times until it is tight.

- (7) Should a new suction valve retainer or discharge cover be installed, check to see that the valve clearance is approximately 1/2"
- (8) When replacing the suction valve, valve spring, spring retainer, and cage, make sure that the chamfered spring retainer engages the slot in the cage.
- (9) When replacing the covers and their retainer nuts, do not hammer the nuts excessively after they are tight as this may eventually cause the threads to crack.
- (10) Run the pump to maximum discharge pressure with water in order to seat the valve seats prior to pumping "dirty" fluids.

POWER ENDS

To Remove a Pony Rod

- (1) Remove the plunger and push it into the fluid end and out of the way.
- (2) Unscrew the pony rod with a pipe wrench on the knurled portion of the pony rod. (Be careful not to damage the seal surface). Remove the pony rod out through the top of the cradle section.
- (3) Before replacing the pony rod, inspect the threads in the crosshead and on the pony rod for cracks. Replace if necessary.
- (4) Before replacing the pony rod, check the double lip seal for wear and replace if needed. Torque pony rod to 150 ft. lbs. with Loctite no. 242 on threads.
- (5) Check to see that the pony rod and plunger mating faces are free of nicks and burrs which can cause misalignment and premature failure and excessive wear to packing.
- (6) Replace the plunger, checking to be sure that it is tight before operating the pump.

To Remove a Rod Bearing

- (1) Disconnect the pump drive in some way to prevent personal injuries or damage to the pump should it accidentally be put in gear while disassembled.
- (2) Remove the rear cover from the power end.
- (3) Remove the two cap screws from each rod cap to be removed. Remove the rod cap noting that it and the other half are doweled for correct reassembly.
- (4) Using a rubber hammer or wooden hammer handle, tap on one edge of the bearing to work it around in the connecting rod and out. Use a screwdriver to remove that cap bearing.
- (5) Clean the bearings and connecting rod thoroughly before replacing bearings. The grooved bearing half goes in the cap and the non-grooved bearing half goes in the connecting rod. (Make sure that the bearings are centered in the connecting rod).
- (6) When replacing the rod cap, check to see that the 1/4" dowel is in place in the rod and the cap is oriented to match the 1/4" dowel.
- (7) When tightening the rod cap bolts, 450 ft. lbs. of torque should be used. If a torque wrench is not available, tighten the rod cap bolts with a 3/4" break over and a two foot cheater.

- (8) Before operating the pump again, move the connecting rod from side to side with a large screwdriver to make sure that it is free on the crankshaft. If new bearings have been installed, refer to the **RUN-IN PROCEDURE** Section Included in this manual before field operation of the pump.

To Remove a Connecting Rod and Crosshead

- (1) Disconnect the pump drive in some way to prevent personal injuries or damage to the pump should it accidentally be put in gear while disassembled.
- (2) Remove the plunger clamps and push the plungers into the fluid end. Remove the pony rods, side and rear covers. Using snap ring pliers, remove the wrist pin snap rings. Using a 1"-8UNC bolt, pull the wrist pins out of the crosshead. (**NOTE:** One outer crosshead will need to be removed before the middle wrist pin and crosshead can be removed).
- (3) Remove the two connecting rod bolts of the connecting rod to be removed. Remove the cap. Remove the main bearing retainer (1/2" 13UNC bolt, nut and washers) opposite the crank-throw. Rotate the crankshaft to the backstroke of the rod to be removed and push the rod forward until it clears the throw and lower it to the bottom of the power end rotate the crankshaft until the throw is on top (90⁰ from back position) and remove the connecting rod out the back of the power end being careful not to damage the crank-throw. **REMOVE ONLY ONE CONNECTING ROD AT A TIME.**
- (4) Rotate the crosshead about the axial axis until it is free from the crosshead guide shoes and remove from power end out the side windows.
- (5) Thoroughly clean and inspect all bearings and bearing surfaces and replace all defective parts. When replacing the wrist pin bushing in a connecting rod, make sure that the oil grooves are placed toward the rear (crank end of rod). Use a hydraulic press to replace the wrist pin bushing as hammering will destroy the bushing.
- (6) Re-install the crosshead with one snap ring in place through the side window of the power end. Rotate the crosshead about the axial axis (with the installed snap ring towards the inside) until it is in place in the crosshead guide shoes. Push as far forward as possible.

- (7) Install the non-grooved rod bearing into the connecting rod (make sure that it is centered). With the crank-throw at the top position, feed the connecting rod into the power end and place as far forward as possible. Rotate the crank-throw to the backstroke position and lift and pull connecting rod back until it is in place. Install the grooved rod bearing into the cap and install onto the connecting rod using the two (2) 1" rod bolts and torque to 450 ft/lbs. Lift the front of the connecting rod and slide the crosshead back until the wrist pin bores align and install the wrist pin. Install the snap ring into the groove in the crosshead. Re-install the 1"-8NC bolt, nut and washers opposite crank-throw. Repeat this procedure until all connecting rods and crossheads are replaced. **DO ONLY ONE CONNECTING ROD AT A TIME.** If a crosshead is replaced, the clearances should be checked. (See crosshead guide shoe removal section).
- (8) Re-install the pony rods and reconnect the plungers. Make sure that all parts are oiling properly before installing the rear and side covers. (Use a silicone seal for cover gaskets). If new bearings have been installed, refer to the **RUN-IN PROCEDURE** Section included in this manual before field operation of the pump.

To Remove the Crosshead Guide Shoes

- (1) Remove the connecting rod and crosshead of the crosshead guides, which are to be serviced. (**NOTE:** One outer crosshead will need to be removed in order to remove the middle crosshead).
- (2) Remove the lube system connections to the crosshead guides. Remove the four (4) 1/2"-13UNC x 4" cap screws from each crosshead guide and remove the crosshead guide. Keep track of the crosshead guide shim packs if the same guide and crosshead is to be replaced.
- (3) Thoroughly clean and inspect guide for pits, cracks, or scoring and replace if necessary.
- (4) If replacing a crosshead guide or crosshead, it must be re-shimmed as follows. Install crosshead guide into power end making sure it is engaged in the front keeper base. Install the crosshead and pony rod. Using an inside micrometer, measure the distance from the pony rod to the pony rod seal bore on both the top and bottom. Subtract these two dimensions and divide by two to obtain the proper shim pack to center the pony rod in its seal bore (should be within $\pm .005$ "). Also, check run-out from front to rear stroke and adjust rear shim pack to have no more than .005" run-out.

- (5) Install the lower shim packs and crosshead guide using four (4) 1/2" 13UNC x 4" long hex cap screws. Use a silicone seal and rubber seal washers under the heads of the cap screws.
- (6) Install the upper crosshead guide with no shims using the bolts. Install the crosshead and measure the clearance with a feeler gauge between the crosshead and upper crosshead guide and adjust upper shim packs for .008" to .012" clearance. Remove the crosshead and guide and then re-install the crosshead guide with the shim packs in place. Install the four (4) 1/2"-13UNC x 4" long cap screws (with silicone seal under the heads) and tighten.
- (7) Re-assemble crossheads, connecting rods, etc., as per previous procedure.

To Remove the Crankshaft

- (1) Remove the pump from its skid and place it in an open area with a hoist where it can be eventually turned over on its side. Remove the speed reducer, connecting rods and crossheads (see appropriate sections in this manual).
- (2) Remove the rotary lube union. Remove the crankshaft cover bolts (eight (8) 1"-8UNC x 2" hex socket head cap screws and four (4) 1/2"-13UNC x 3-3/4" cap screws), and remove the crankshaft cover.
- (3) Place the power end on its side with the crankshaft extension pointing upwards. Lift the crankshaft upwards using a lifting eye screwed into the end of the crankshaft. It may be necessary to heat the power end around spherical bearing retainer slightly (keep it less than 250⁰F) to get it to break free. Be careful when pulling the crankshaft roller bearings through the races so that they don't catch. Rotating the crank when removing usually helps.
- (4) Remove the bearing retainer, adapter and spherical bearing. It may be necessary to heat the adapter and bearing to remove.
- (5) Remove all the roller bearing retainers (1/2"-13UNC x 3-5/8" cap screws, nuts, and washers) and remove bearing races by heating.
- (6) Remove all the roller bearing retainers in the power end and remove the bearings by knocking them out with a soft metal bar.
- (7) Thoroughly clean and inspect all parts for cracks, pits, or scoring and replace if necessary.
- (8) Install three cylindrical bearings into the power frame and retain with the 1/2"-13UNC x 3-5/8" hex cap screws, nuts, and washers. Loctite the nut threads and tighten. (**NOTE:** Outboard bearing bore on input side should be left open).

- (9) Install three (3) 1/2"-13UNC x 3-5/8" cap screws through one washer each into the three holes in one crankshaft cheek and screw on one nut each. This will make a stop for the bearing race as it is heated and installed over the crankshaft cheek. After the race is in place, remove the 1/2" nut and install a washer and Loctite and tighten the nuts. Repeat this process until all bearings are installed.
- (10) Heat and install the spherical bearing onto the crankshaft. Install the spherical bearing retainer with four (4) 1/2"-13UNC x 1" hex socket head cap screws. Heat and install the spherical bearing adapter onto the spherical bearing.
- (11) Lift the crankshaft with a lifting eye screwed into the end of the crankshaft and lower into the power frame. (The power frame should be on its side with the input end upwards). It may help to rotate the crankshaft as it is lowered. It may also be necessary to tap the spherical bearing adapter into its bore.
- (12) Re-install the crankshaft cover using silicone seal as a gasket and the eight (8) 1"8UNC x 2 hex socket head cap screws and the four(4) 1/2"-13UNC x 3-5/8" hex cap screws and washers.
- (13) Re-install the rotary union, crossheads and connecting rods, and the speed reducer. Remount pump.
- (14) If new bearings were installed, refer to the **RUN-IN PROCEDURE** Section included in this manual before field operation.

To Remove the Speed Reducer

- (1) Remove the 1/2"-13UNC x 1" hex cap screw and the pinion shaft end retainer.
- (2) Pull the companion flange off the pinion shaft.
- (3) Remove all the bearing and seal retainers and pinion shims. Remove the housing cover. (It will be necessary to hold the pinion shaft in place while the cover is being removed).
- (4) Remove the pinion shaft races and the pinion shaft. Replace pinion bearings or pinion shaft if severely pitted, scored or worn.
- (5) Remove the crankshaft bearing snap ring and bearing. Remove the gear snap ring. Remove the gear with the puller holes provided. Inspect the gear for pitting, cracks and scoring and replace if necessary.
- (6) Hammer out the 1-3/4" diameter freeze plugs and remove the eight (8) 1" 8UNC x 2" hex socket head cap screws that retain the speed reducer housing. Remove the speed reducer housing from the power end.
- (7) Thoroughly clean and inspect all parts before re-assembly.

- (8) Using a silicone seal, form a gasket around the outside of the spherical bearing adapter on the power end. Then install the speed reducer housing onto the power end in the correct orientation with eight (8) 1"-8UNC x 2" hex. socket head cap screws. Hammer in the eight (8) 1-3/4" diameter freeze plugs (use silicone sealer).
- (9) Coat the crankshaft extension with some anti-seize compound and install the gear with the long hub side inward, install the gear snap ring with snap ring pliers. Install the crankshaft bearing and snap ring.
- (10) Install the pinion bearings onto the pinion shaft and install in the pinion bore in the housing.
- (11) While holding the pinion shaft in place, install the housing cover. Use silicone seal as gasket material.
- (12) Install the pinion bearing races into the housing. Install the bearing and seal retainers and shim adjust for .002" to .005" pre-load. The bearing retainer needs to be shimmed, and needs silicone seal for a gasket.
Install the tach drive cable.
- (13) Install the companion flange, pinion shaft end retainer with the 1/2" 13UNC x 1" cap screw.

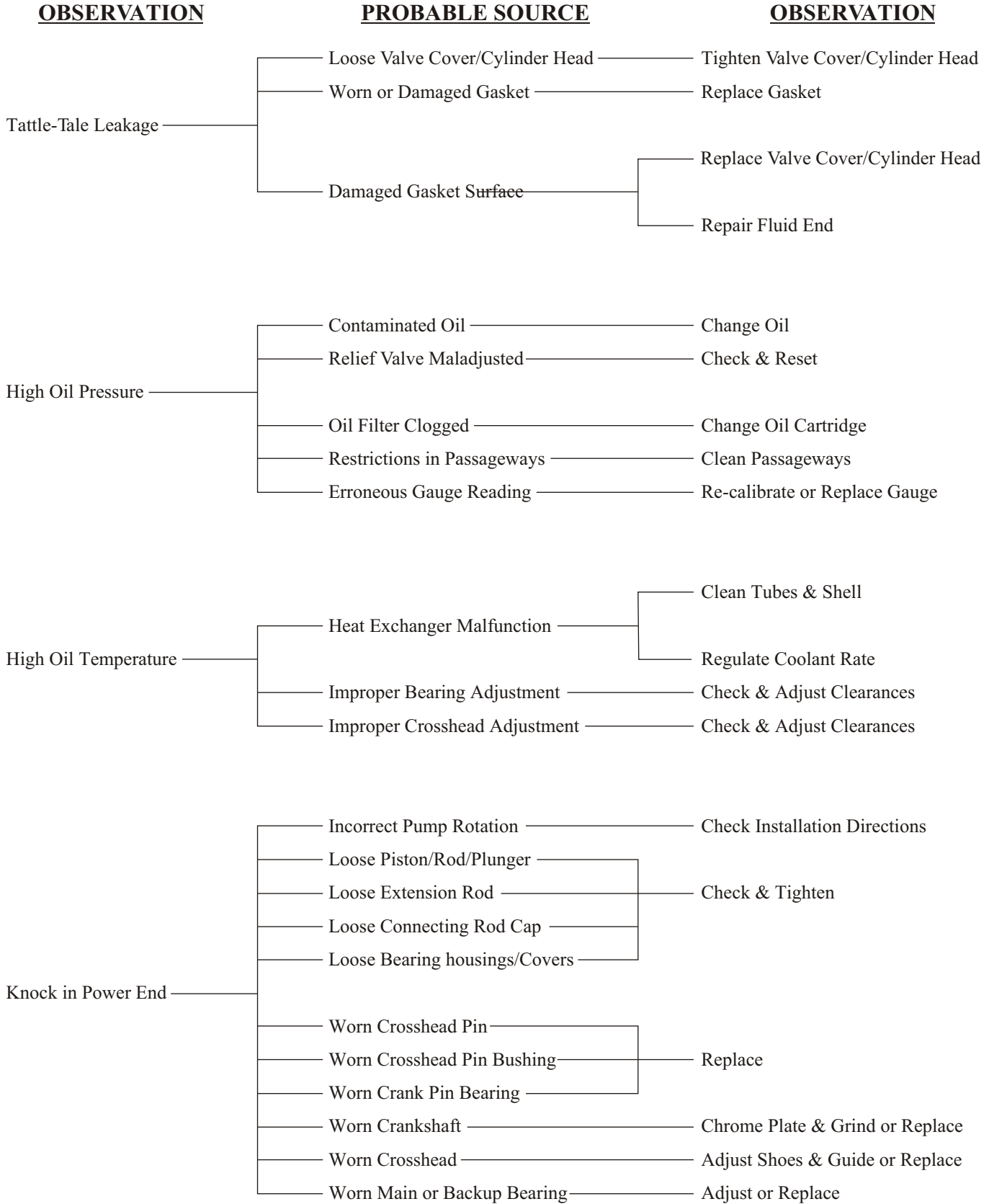
TROUBLE SYMPTOMS

<u>OBSERVATION</u>	<u>PROBABLE SOURCE</u>	<u>OBSERVATION</u>
Diaphragm Leakage	Worn or Damaged Extension Rod	Replace Extension Rod
	Corroded Extension Rod	Clean & Polish or Replace Extension Rod
	Worn Wiper Rings	Replace Wiper Rings
	Wiper Rings Improperly Seating	Check Installation Directions
		Clean & Polish Diaphragm Base
	Worn Lantern	Replace Lantern Ring
	Oil Baffle Misplaced	Check Installation Directions
	Reservoir in Diaphragm Housing	Install Drain Hole at Bottom
		Clean Drain Hole
Pressure in Crankcase	Clean or Replace Air Breather	
Oil Seal Leakage	Worn Seating Lip	Replace Seal
	Damaged Seating Lip	Replace Seal
	O.D. Not Sealed	Clean & Polish Bore of Oil Seal Housing
	Foreign Material At Seal Point	Clean & Polish Shaft
		Clean & Polish or Replace Shaft Sleeve
	Pressure in Crankcase	Clean or Replace Air Breather
Low Oil Pressure	Low Oil Level	Check & Add Oil if Necessary
	High Oil Temperature	See Observation "High Oil Temperature"
	Contaminated Lubricant	Change Oil
	Relief Valve Maladjusted	Check & Reset
	Leakage in Piping System	Repair All Leaks
	Choke Washers Misplaced	Check Installation Directions
	Oil Pump Worn	Repair or Replace Oil Pump
	Clogged Suction Screen	Clean Screen & Change Oil
	Worn Oil Pressure Ring	Replace Ring & Housing
	Erroneous Gauge Reading	Re-calibrate or Replace Gauge

TROUBLE SYMPTOMS

<u>OBSERVATION</u>	<u>PROBABLE SOURCE</u>	<u>OBSERVATION</u>
Low Discharge Pressure	Worn or Fluid Cut Valve Assembly	Replace Valve Assembly
	Valve Propped Open	Remove Propping Agent
	Improper Filling	Remove Restrictions from Suction Line
		Increase Level of Fluid Supply
		Increase Charging Pump Speed
	Fluid Slippage	Decrease Pump Speed
Prime Fluid Chambers		
Erroneous Gauge Reading	Replace Piston/Liner or Plunger/Packing	
		Re-calibrate or Replace Gauge
Low Suction Pressure	Low Head	Increase Level of Fluid Supply
	Charging Pump Capacity	Increase Charging Pump Speed
	Retarded Fluid Flow	Remove Restrictions from Suction Line
	Erroneous Gauge Reading	Re-calibrate or Replace Gauge
Low Oil Pressure	Air Entering Suction Line	Repair Suction Line
	Air Entering Charging Pump	Tighten or Replace Shaft Packing or Seal
	Air Entering Suction Stabilizer	Repair & Re-balance
	Air/Gas in Pumped Fluid	Impose Vacuum on Supply Tank
		Allow More Setting Time
		Reduce Pump Speed
Adjust Suction Stabilizer		
	Same as Low Discharge Pressure	Same as Low Discharge Pressure
Discharge Line Vibration	Discharge Pulsation Dampener	Repair & Recharge or Replace
	Unsupported Discharge Line	Provide Supports or Hangers
	Same as Low Discharge Pressure	Same as Low Discharge Pressure
	Same as Low Suction Pressure	Same as Low Suction Pressure
	Same as Fluid Knock or Hammer	Same as Fluid Knock or Hammer

TROUBLE SYMPTOMS



OFM PUMP, INC.

600 HP Assembly Drawings

**P.O. Box 12192
Odessa, Texas 79768
2243 FM 1936
Odessa, Texas 79763**

**Phone: (432) 381-7390
(877) 381-7390
Fax: (432) 385-1205**

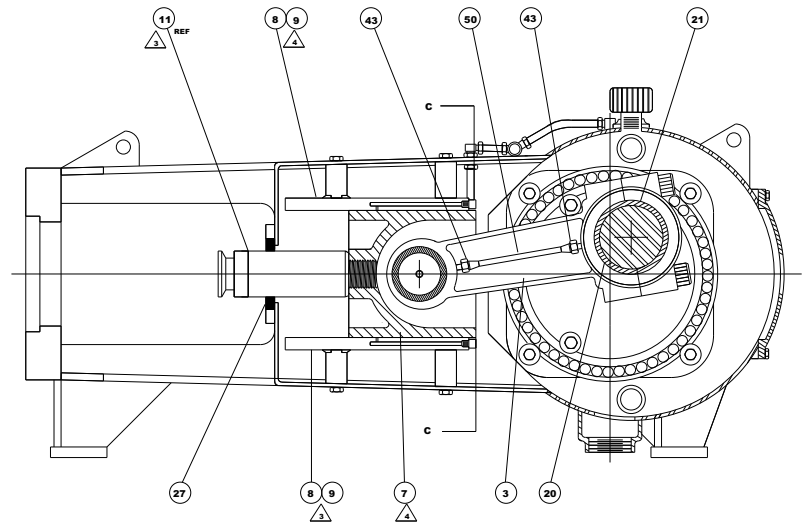
March 2004

OFM PUMP 600 HP POWER END ASSEMBLY
LEFT HAND DRIVE
330AD003

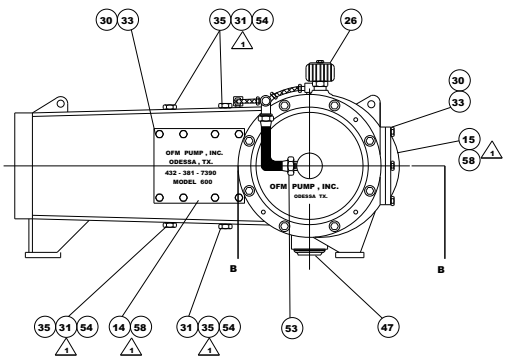
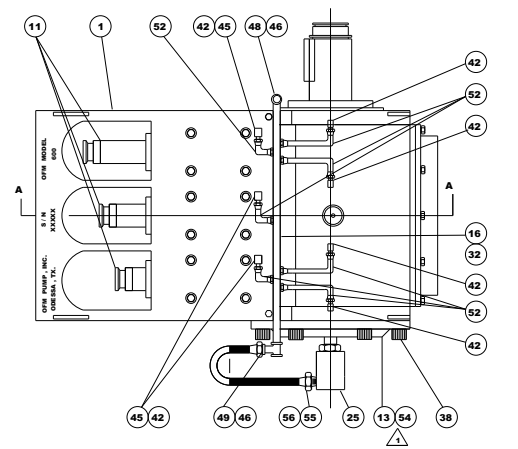
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	330PN03	1	POWER END
2	473PN01	1	CRANKSHART , HEAVY DUTY
3	550PN001	3	CONNECTING ROD
4	441PN03	1	BEARING ADAPTER
5	490PN09	1	BEARING RETAINER
6	480PN09	38	WASHER , BEARING RETAINER
7	540PN01	3	CROSSHEAD
8	545PN01	6	SLIDE , CROSSHEAD
9	481PN09	1	CROSSHEAD SLIDE SHIM
10	630PN01	3	WRIST PIN
11	285PN004	3	PONY ROD , THREADED W/ CLAMP TYPE END
12	498PN03	1	ROTARY UNION ADAPTER
13	580PN04	1	CRANKSHAFT COVER
14	580PN10	2	CROSSHEAD COVER
15	581PN06	1	POWER FRAME COVER
16	574PN01	1	LUBE MANIFOLD
17	631PN02	1	BULL GEAR KEY
18	919PN001	1	OFM IDENTIFICATION PLATE (NOT USED)
19	917PN01	3	BUSHING , WRIST PIN
20	917PN02	3	BEARING , ROD HALF
21	917PN03	3	BEARING , CAP HALF
22	925SH01-5	3	BEARING , MAIN
23	925SH01-6	1	BEARING , SPHERICAL
24	926SH01-3	6	SNAP RING , WRIST PIN
25	922PN01	1	ROTARY UNION
26	910PN05	1	BREATHER CAP
27	901SH02-31	3	OIL SEAL , PONY ROD
28	901SH02-7	1	OIL SEAL , ROTARY UNION
29	901SH05-222	1	" O " RING , ROTARY UNION
30	452VP001-003	28	LOCKWASHER

ITEM NO.	PART NO.	QTY.	DESCRIPTION
31	452VP004	24	SEALING WASHER
32	454VP002-004	2	CAPSCREW , HEX HEAD , 5/16" ~ 18 UNC - 2A X 1/2"
33	454VP003-006	28	CAPSCREW , HEX HEAD , 3/8" ~ 16 UNC - 2A X 3/4"
34	454VP004-036	21	CAPSCREW , HEX HEAD , 1/2" ~ 13 UNC - 2A X 3-3/4"
35	454VP004-042	12	CAPSCREW , HEX HEAD , 1/2" ~ 13 UNC - 2A X 4-1/4"
36	454VP024-005	4	CAPSCREW , SOCKET HEAD , 5/16" ~ 18 UNC - 3A X 5/8"
37	454VP026-010	4	CAPSCREW , SOCKET HEAD , 1/2" ~ 13 UNC - 3A X 1"
38	454VP030-020	8	CAPSCREW , SOCKET HEAD , 1" ~ 8 UNC - 3A X 2"
39	454VP054-002	4	ROUND HEAD DRIVE SCREW NO. 4 (NOT USED)
40	454VP009-004	17	NUT , FLEX LOCK THIN 1/2" ~ 13 UNC
41	968VP003-003	3	HOSE ADAPTER , 90° MALE ELBOW
42	968VP003-004	7	HOSE ADAPTER , 90° MALE ELBOW
43	968VP004-004	9	HOSE ADAPTER , 45° MALE ELBOW
44	968VP005-003	3	HOSE ADAPTER , 1/4" MALE BRANCH TEE
45	968VP006-002	3	HOSE ADAPTER , BULKHEAD COUPLING
46	968VP001-018	2	HOSE ADAPTER , MALE CONNECTION
47	971VP002-011	1	PIPE PLUG , 3" NPT
48	971VP004-004	1	PIPE FITTING , 1/2" 90° ELBOW
49	971VP007-004	1	PIPE FITTING , 1/2" TEE
50	916VP001-080	3	HOSE , TEFLON
51	916VP001-150	6	HOSE , TEFLON
52	916VP007-090	7	HOSE , TEFLON
53	916VP015-260	1	HOSE , RUBBER
54	509000000	AR	ZEP FAST GASKET (RTV SILICONE GASKRT MAKER)
55	971VP076-004	1	PIPE FITTING , 1/2" MALE RUN TEE
56	971VP002-004	1	PIPE PLUG , 1/2" NPT
57	454VP004-044	12	CAPSCREW. HEX HEAD , 1/2" ~ 13 UNC - 2A X 4-1/2"
58	565PN28	1	1/8" X 1-1/8" WIDE GASKET (DK 153)

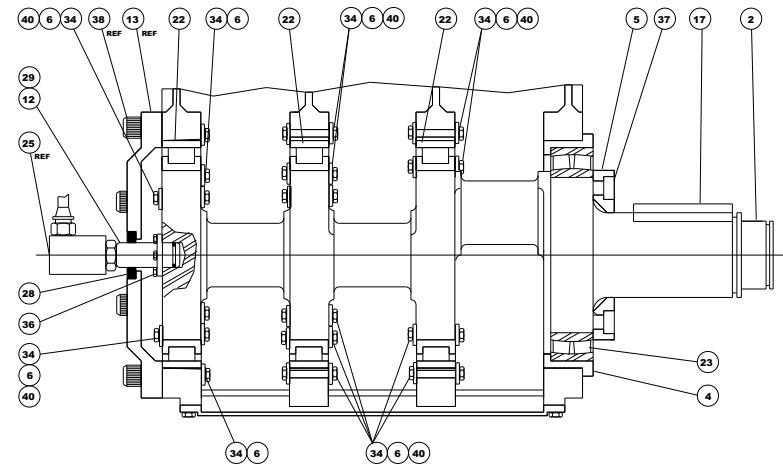
OFM PUMP , INC.			
DRAWN L. GORRELL	8/28/03	PART LIST FOR	
PARTS LIST FOR OFM 600 HP POWER END WITH GEAR BOX ON LEFT HAND SIDE		600 HP PUMP	
		LEFT HAND DRIVE	
APPROVED C. FRY	8/28/03	SIZE C	DWG NUMBER 330AD003-1
SCALE 1 : 1	REV -	SHEET 1 OF 1	



SECTION A - A



SECTION C - C
TYP 3 PLACES



SECTION B - B

- NOTES:**
- ▲ FABRICATE GASKET AS REQUIRED USING ITEM 54
 - ▲ PRESS ITEM 19 (BUSHING - WRISTPIN) INTO ITEM 3 (CONNECTING ROD) WITH OIL GROOVE TOWARD CAP END
 - ▲ ADJUST ITEM 9 (CROSSHEAD SHIM) TO ALIGN ITEM 11 (PONY ROD) WITH C OF ITEM 1 (POWER FRAME)
 - ▲ ADJUST ITEM 9 (CROSSHEAD SLIDE SHIM) FOR .008 / .012 CLEARANCE BETWEEN ITEM 8 (CROSSHEAD SLIDE) & ITEM 7 (CROSSHEAD)

OFM PUMP , INC.			
DRAWN	L. GORRELL	8/21/03	600 HP POWER END ASSLY FOR RIGHT HAND DRIVE
CHECKED	SEE 330AD028-1	FOR PARTS LIST	
APPROVED	C. FRV	8/21/03	SIZE D 330AD028
SCALE	3"-1"	REV	SHEET 1 OF 1

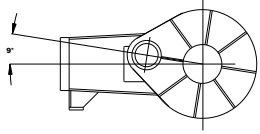
OFM PUMP 600 HP POWER END ASSEMBLY
RIGHT HAND DRIVE
330AD028

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	330PN03	1	POWER END
2	473PN01	1	CRANKSHART , HEAVY DUTY
3	550PN001	3	CONNECTING ROD
4	441PN03	1	BEARING ADAPTER
5	490PN09	1	BEARING RETAINER
6	480PN09	38	WASHER , BEARING RETAINER
7	540PN01	3	CROSSHEAD
8	545PN01	6	SLIDE , CROSSHEAD
9	481PN09	1	CROSSHEAD SLIDE SHIM
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19	917PN01	3	BUSHING , WRIST PIN
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21	917PN03	3	BEARING , CAP HALF
22	925SH01-5	3	BEARING , MAIN
23	925SH01-6	1	BEARING , SPHERICAL
24	926SH01-3	6	SNAP RING , WRIST PIN
25	922PN01	1	ROTARY UNION
26	910PN05	1	BREATHER CAP
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28	901SH02-7	1	OIL SEAL , ROTARY UNION
29	901SH05-222	1	" O " RING , ROTARY UNION
30	452VP001-003	28	LOCKWASHER

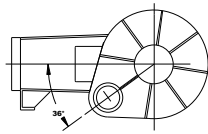
ITEM NO.	PART NO.	QTY.	DESCRIPTION
31	452VP004	24	SEALING WASHER
32	454VP002-004	2	CAPSCREW , HEX HEAD , 5/16" ~ 18 UNC - 2A X 1/2"
33	454VP003-006	28	CAPSCREW , HEX HEAD , 3/8" ~ 16 UNC - 2A X 3/4"
34	454VP004-036	21	CAPSCREW , HEX HEAD , 1/2" ~ 13 UNC - 2A X 3-3/4"
35	454VP004-042	12	CAPSCREW , HEX HEAD , 1/2" ~ 13 UNC - 2A X 4-1/4"
36	454VP024-005	4	CAPSCREW , SOCKET HEAD , 5/16" ~ 18 UNC - 3A X 5/8"
37	454VP026-010	4	CAPSCREW , SOCKET HEAD , 1/2" ~ 13 UNC - 3A X 1"
38	454VP030-020	8	CAPSCREW , SOCKET HEAD , 1" ~ 8 UNC - 3A X 2"
39	454VP054-002	4	ROUND HEAD DRIVE SCREW NO. 4 (NOT USED)
40	454VP009-004	17	NUT , FLEX LOCK THIN 1/2" ~ 13 UNC
41	968VP003-003	3	HOSE ADAPTER , 90° MALE ELBOW
42	968VP003-004	7	HOSE ADAPTER , 90° MALE ELBOW
43	968VP004-004	9	HOSE ADAPTER , 45° MALE ELBOW
44	968VP005-003	3	HOSE ADAPTER , 1/4" MALE BRANCH TEE
45	968VP006-002	3	HOSE ADAPTER , BULKHEAD COUPLING
46	968VP001-018	2	HOSE ADAPTER , MALE CONNECTION
47	971VP002-011	1	PIPE PLUG , 3" NPT
48	971VP004-004	1	PIPE FITTING , 1/2" 90° ELBOW
49	971VP007-004	1	PIPE FITTING , 1/2" TEE
50	916VP001-080	3	HOSE , TEFLON
51	916VP001-150	6	HOSE , TEFLON
52	916VP007-090	7	HOSE , TEFLON
53	916VP015-260	1	HOSE , RUBBER
54	509000000	AR	ZEP FAST GASKET (RTV SILICONE GASKRT MAKER)
55	971VP076-004	1	PIPE FITTING , 1/2" MALE RUN TEE
56	971VP002-004	1	PIPE PLUG , 1/2" NPT
57	454VP004-044	12	CAPSCREW. HEX HEAD , 1/2" ~ 13 UNC -2A X 4-1/2"
58	565PN28	1	1/8" X 1-1/8" WIDE GASKET (DK 153)

OFM PUMP , INC.			
<small>DRAWN</small> L. GORRELL	<small>DATE</small> 8/28/03	PART LIST FOR	
<small>PARTS LIST FOR OFM 600 HP POWER END WITH GEAR BOX ON RIGHT HAND SIDE</small>		600 HP PUMP	
		RIGHT HAND DRIVE	
<small>APPROVED</small> C. FRY	<small>DATE</small> 8/28/03	<small>SIZE</small> C	<small>DWG NUMBER</small> 330AD028-1
<small>SCALE</small> 1 : 1	<small>REV</small> -	<small>SHEET</small> 1	<small>OF</small> 1

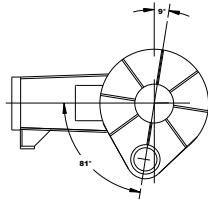
POSITION 1 THRU 8 ARE LEFT HAND MOUNT



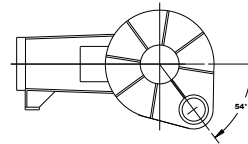
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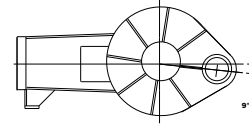
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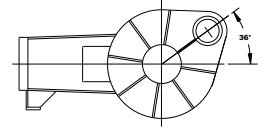
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POSITION NO 4
332AD037

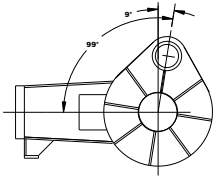


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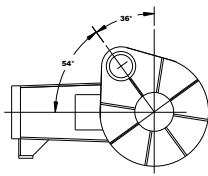


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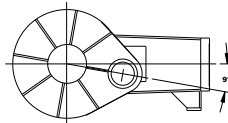
POSITION 9 THRU 17 ARE RIGHT HAND MOUNT



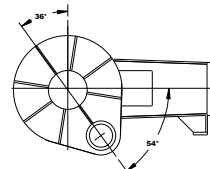
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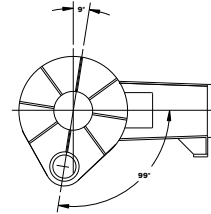
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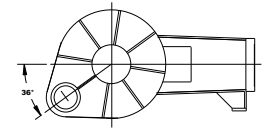
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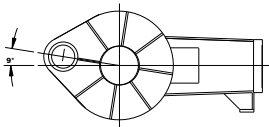
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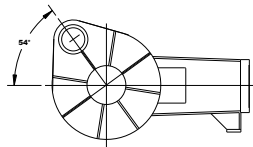
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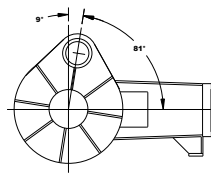
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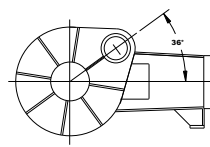
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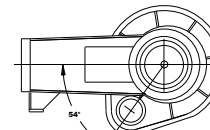
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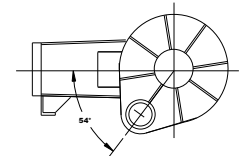
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POSITION NO 16
332AD049



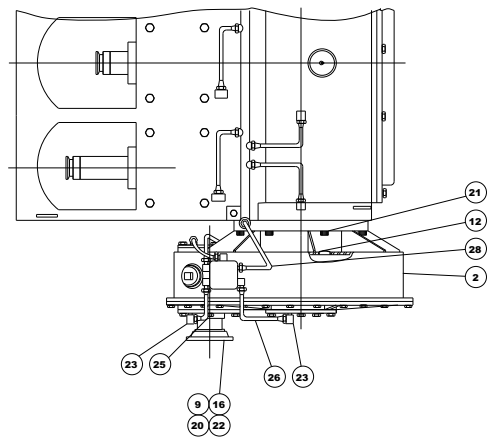
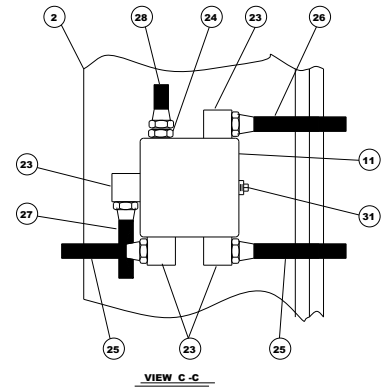
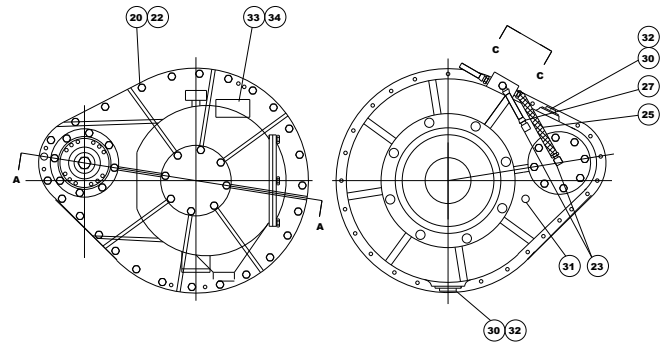
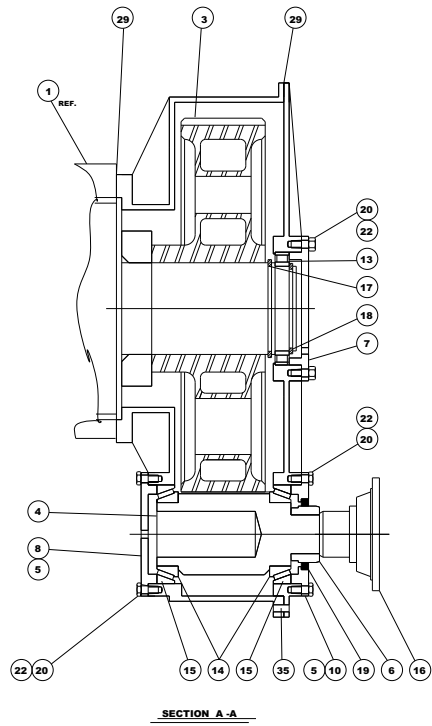
POSITION NO 17
RIGHT HAND UNDERSIDE DRIVE
332AD050



POSITION NO 18
LEFT HAND UNDERSIDE DRIVE
332AD051

OFM PUMP, INC.

DRAWN L. GORRELL 8/30/03 OPTIONS FOR GEAR BOX FOR LEFT HAND DRIVE AND RIGHT HAND DRIVE LOCATION APPROVED C. FRY 8/30/03 SCALE 3/4"=1"	GEAR BOX / POWER END ASSY. OPTIONS DWG NUMBER D 330AD003-3 REV - SHEET 1 OF 1
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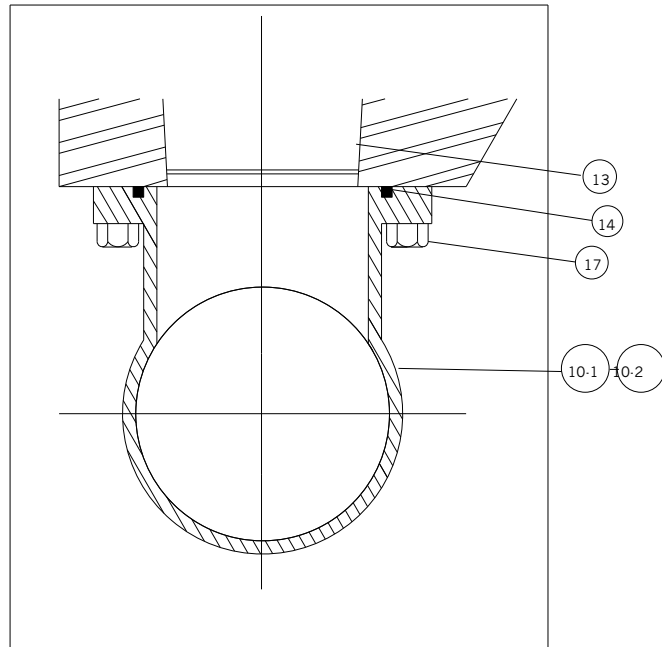
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	330A003	1	POWER FRAME
2	331PND8	1	GEAR HOUSING
3	556PND2	1	BULL GEAR 4.68:1
4	557PND2	1	PINION GEAR 4.68:1
5	481BD038	1	PINION BEARING SHIM PACK
6	485PND9	1	PINION SHAFT SLEEVE
7	450PMT3	1	BEARING RETAINER
7-1	490AD001	1	BEARING RETAINER W/ TACH DRIVE (SEE OPTION LIST)
8	450PND8	1	PINION BEARING RETAINER
9	451PND2	1	PINION SHAFT RETAINER
10	525PND5	1	PINION SEAL RETAINER
11	338PND3	1	LUBE MANIFOLD
12	974VPD01	8	PLUG
13	925SH01-7	1	BEARING
14	930SH01-1	2	BEARING CONE
15	930SH01-2	2	BEARING CUP
16	932PND1	1	COMPANION FLANGE
17	925SH01-4	1	SNAP RING
18	925SH01-5	1	SNAP RING
19	801SH02-8	1	OIL SEAL
20	454VPD04-010	53	CAPSCREW, HEX HEAD, 1/2" - 13 UNC - 2A X 1"
21	454VPD030-020	8	CAPSCREW, SOCKET HEAD, 1" - 8 UNC - 3A X 2"
22	452VPD01-004	53	LOCKWASHER, 1/2"
23	908VPD03-004	8	HOSE ADAPTER, 90° ELBOW
24	908VPD01-017	1	HOSE ADAPTER, MALE CONNECTION
25	916PND08-200	2	HOSE, RUBBER
26	916PND08-300	1	HOSE, RUBBER
27	916PND08-140	1	HOSE, RUBBER
28	916PND10-200	1	HOSE, RUBBER
29	509000000	1	ZEP FAST GASKET (RED)
30	971VPD02-011	2	PIPE PLUG, 3" NPT
31	971VPD02-022	2	PIPE PLUG, 1/4" NPT
32	971VPD03-260	2	PIPE WELD FLANGE, 3" NPT
33	919PND01	1	L.D. PLATE, OFM STANDARD
34	454VPD05-002	4	POUND HEAD DRIVE SCREW NO. 4
35	634VPD07-010	3	DOWELL PIN

NOTE :
 LEFT HAND GEAR BOX MOUNTS, POSITION 1, SHOWN SEE
 GEAR BOX / POWER FRAME ASSEMBLY OPTION, FOR
 ALL POSSIBLE GEAR BOX POSITIONS

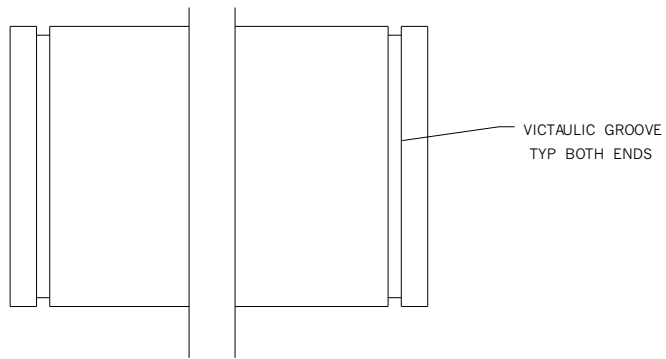
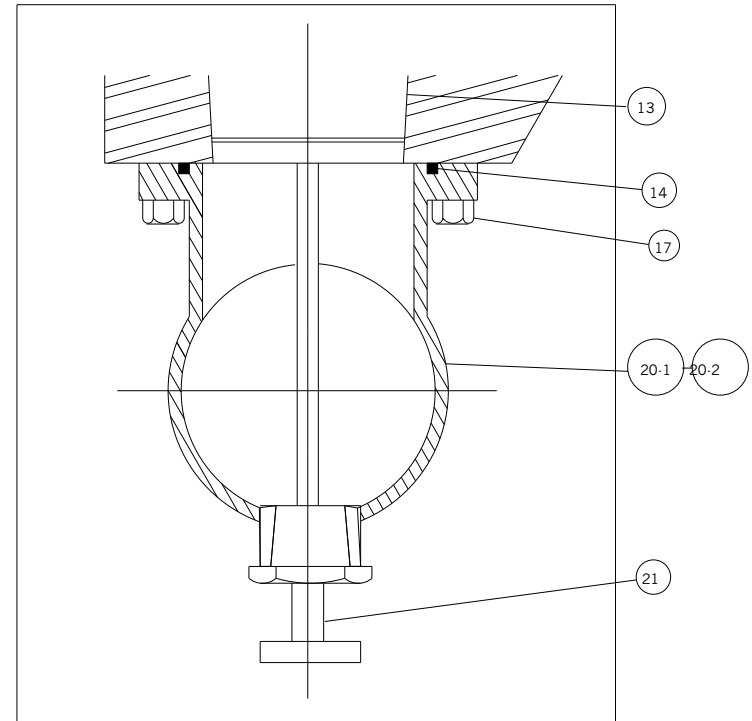
OFM PUMP, INC.			
DRAWN L. GORRELL	9/1/03	OFM 600 HP GEAR BOX ASSEMBLY	
APPROVED C. FRY	9/1/03		
SCALE 3"=1"	REV -	SIZE D	OFM NUMBER 330AD003-2
		SHEET 1 OF 1	

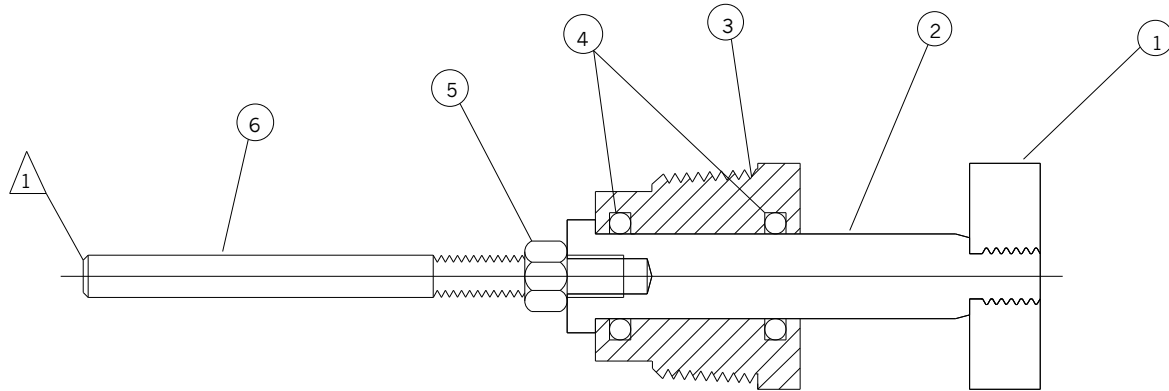
10 OL 004 - 2

SUCTION MANIFOLD
(STANDARD)



SUCTION MANIFOLD
(OPTION)





ITEM NO.	PART NO.	QTY	DESCRIPTION
1	595PN001	1	LIFTER DISC
2	595PN002	1	SHAFT
3	595PN003	1	COUPLING
4	901SH05-210	2	" O " RING
5	458VP002-003	1	NUT 3/8" ~ 16 UNC
6	595PN004	1	PUSH ROD

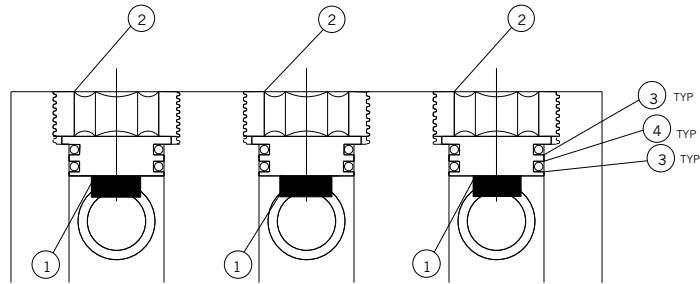
NOTE :



CUT LENGTH OF ITEM 6 TO HAVE APPROXIMATELY
1/2' CLEARANCE BETWEEN THE SUCTION VALVE
BOTTOM AND THE PUSH ROD TOP

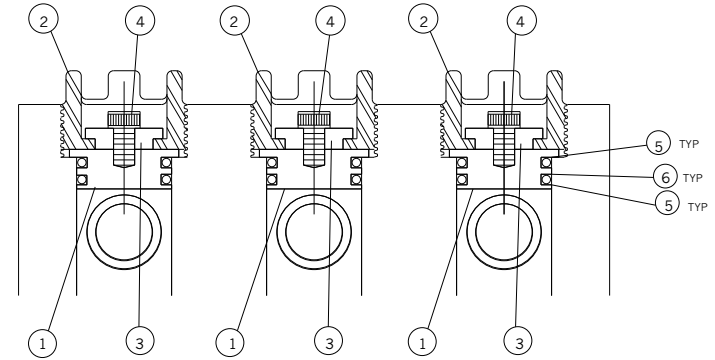
OFM PUMP ,INC.			
DRAWN LDG	10/02/02	SUCTION VALVE LIFTER ASSEMBLY	
APPROVED FCF	10/02/02	SIZE B	DWG NUMBER 210AD01
SCALE 1 : 1	REV .	SHEET 1 OF 1	

SUCTION COVER ASSEMBLY (86AD011)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	86PN04	3	SUCTION COVER
2	50PN08	3	RETAINER NUT
3	901SH05-427	6	* O * RING
4	901PN017-005	3	SEAL , * O * RING , BACK - UP

SUCTION COVER ASSEMBLY - HAMMER LUG (86AD012)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	86PN04	3	SUCTION COVER
2	52PN01	3	RETAINER NUT WITH HAMMER LUGS
3	495PN08	3	ADAPTER , COVER BUSHING
4	454VP004-015	3	CAPSCREWS , HEX HEAD
5	901SH05-427	6	* O * RING
6	901PN017-005	3	SEAL , * O * RING BACK - UP

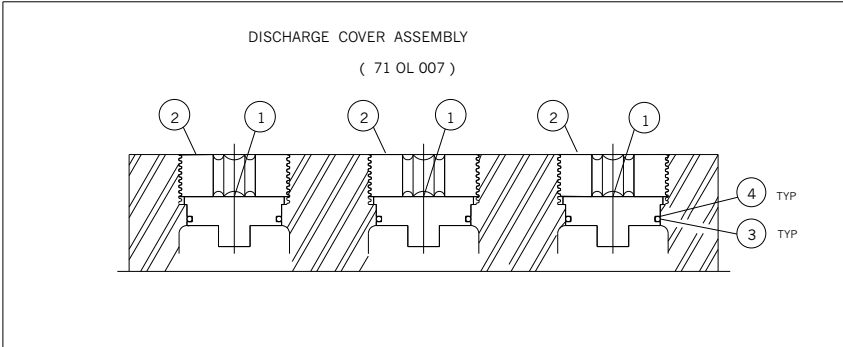
600 HP SUCTION COVER OPTION
 86 OL 001
 USED WITH 3-1/2" & 4" INCH FLUID END

OFM PUMP , INC.			
DRAWN LDG	10/11/02	600 HP SUCTION COVER OPTION	
600 HP FLUID END		SIZE C	DWG NUMBER 86OL001
APPROVED FCF	10/11/02	REV	SHEET 1 OF 1
SCALE			

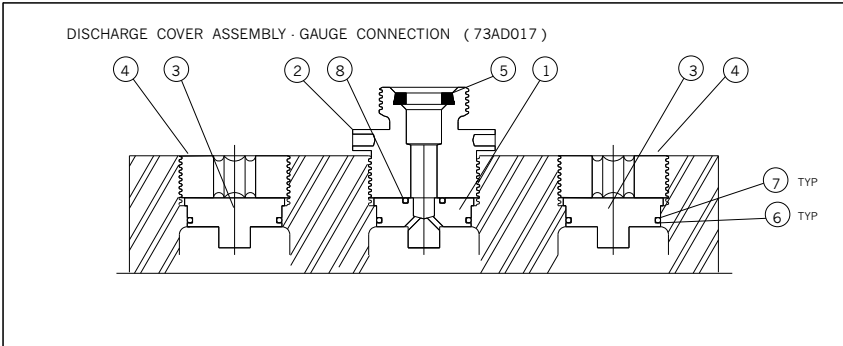
600 HP DISCHARGE COVER OPTION (71 OL 007)

NOTE ;

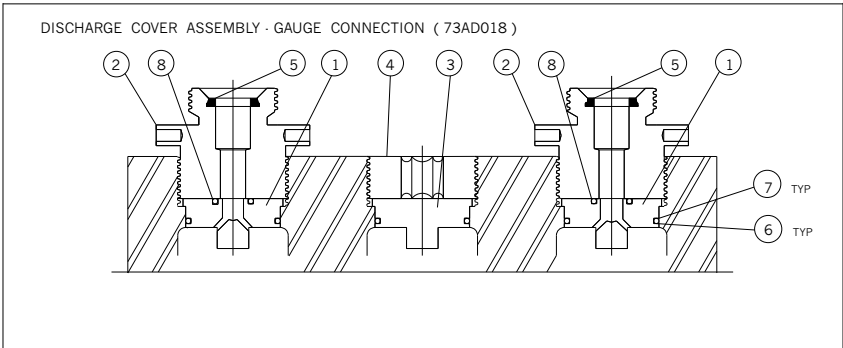
THESE OPTION FOR USE WITH
2-1/4" FLUID END



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	71PN007	3	DISCHARGE COVER
2	50PN07	3	DISCHARGE COVER RETAINER NUT
3	901SH05-333	3	" O " RING
4	901PN017-010	3	SEAL , " O " RING , BACK - UP



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	73PN017	1	DISCHARGE COVER , WITH GAUGE CONNECTION
2	54PN007	1	RETAINER NUT , GAUGE CONNECTION
3	71PN007	2	DISCHARGE COVER
4	50PN07	2	DISCHARGE COVER , RETAINER NUT
5	901SH06-1	1	SEAL RING
6	901SH05-333	3	" O " RING
7	901PN017-010	3	SEAL , " O " RING BACK - UP
8	910SH05-326	1	" O " RING



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	73PN017	2	DISCHARGE COVER , GAUGE CONNECTION
2	54PN007	2	RETAINER NUT , GAUGE CONNECTION
3	71PN007	1	DISCHARGE COVER
4	50PN07	1	DISCHARGE COVER , RETAINER NUT
5	901SH06-1	2	SEAL RING
6	901SH05-333	3	" O " RING
7	901PN017-010	3	SEAL , " O " RING BACK - UP
8	901SH05-326	3	" O " RING

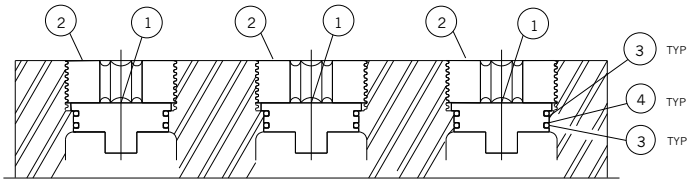
600 HP DISCHARGE COVER OPTION (71 OL 006)

NOTE ;

THESE OPTION FOR USE WITH
2-3/4" & 3" FLUID END

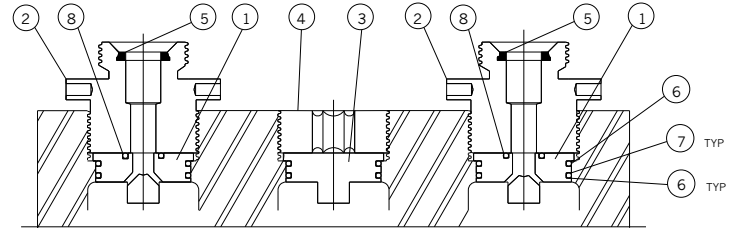
DISCHARGE COVER ASSEMBLY

(71 OL 005)



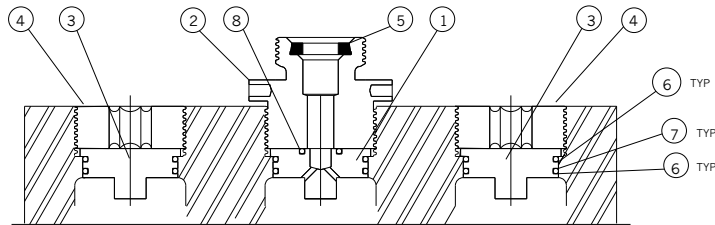
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	71PN05	3	DISCHARGE COVER
2	50PN07	3	DISCHARGE COVER RETAINER NUT
3	901SH05-336	6	" O " RING
4	901PN017-001	3	SEAL , " O " RING , BACK - UP

DISCHARGE COVER ASSEMBLY - GAUGE CONNECTION (73AD014)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	73PN012	2	DISCHARGE COVER , GAUGE CONNECTION
2	54PN007	2	RETAINER NUT , GAUGE CONNECTION
3	71PN05	1	DISCHARGE COVER
4	50PN07	1	DISCHARGE COVER , RETAINER NUT
5	901SH06-1	2	SEAL RING
6	901SH05-336	6	" O " RING
7	901PN017-001	3	SEAL , " O " RING BACK - UP
8	901SH05-326	2	" O " RING

DISCHARGE COVER ASSEMBLY - GAUGE CONNECTION (73AD013)

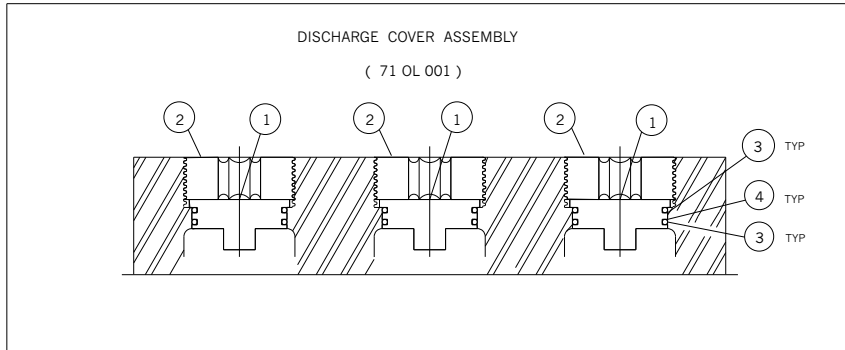


ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	73PN012	1	DISCHARGE COVER , WITH GAUGE CONNECTION
2	54PN007	1	RETAINER NUT , GAUGE CONNECTION
3	71PN05	2	DISCHARGE COVER
4	50PN07	2	DISCHARGE COVER , RETAINER NUT
5	901SH06-1	1	SEAL RING
6	901SH05-336	6	" O " RING
7	901PN017-001	3	SEAL , " O " RING BACK - UP
8	910SH05-326	1	" O " RING

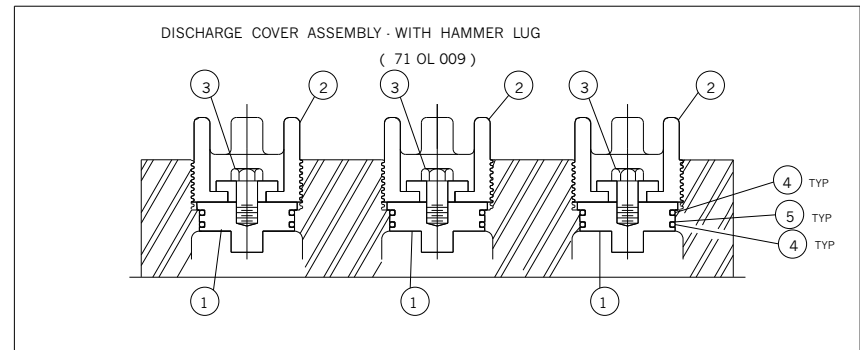
710L006

600 HP DISCHARGE COVER OPTION (71 OL 001)

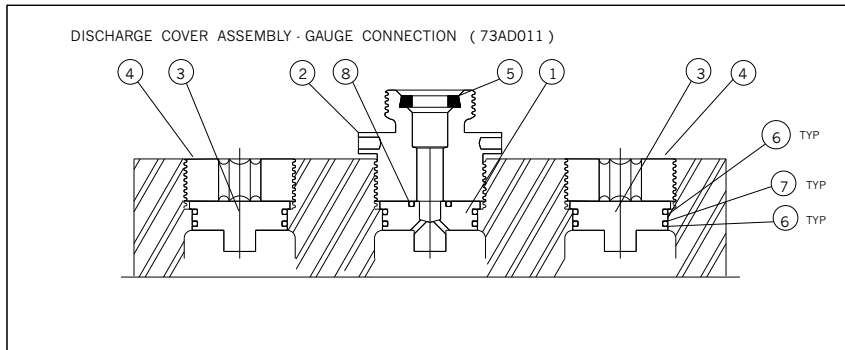
USE WITH 3-1/2" & 4" FLUID END



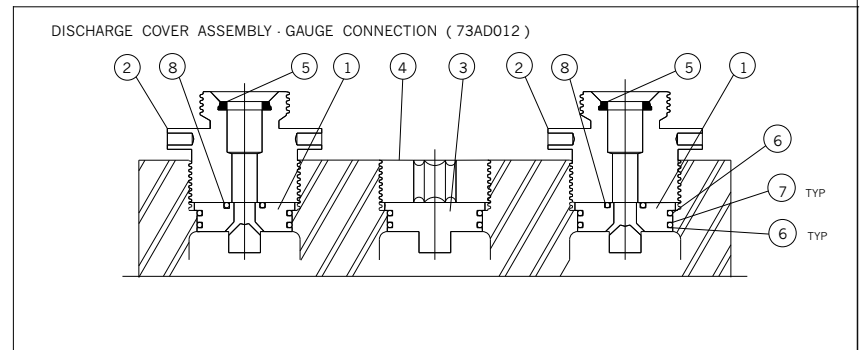
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	71PN04	3	DISCHARGE COVER
2	50PN06	3	DISCHARGE COVER RETAINER NUT
3	901SH05-344	6	" O " RING
4	901PN017-002	3	SEAL , " O " RING , BACK · UP



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	71PN04	3	DISCHARGE COVER
2	52PN002	3	DISCHARGE COVER RETAINER NUT
3	454VP008-016	3	CAPSCREW , HEX HEAD
4	901SH05-344	6	" O " RING
5	901PN017-002	3	SEAL , " O " RING , BACK · UP



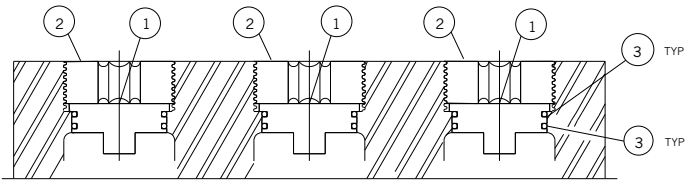
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	73PN011	1	DISCHARGE COVER , WITH GAUGE CONNECTION
2	54PN009	1	RETAINER NUT , GAUGE CONNECTION
3	71PN04	2	DISCHARGE COVER
4	50PN06	2	DISCHARGE COVER , RETAINER NUT
5	901SH06-1	1	SEAL RING
6	901SH05-344	6	" O " RING
7	901PN017-002	3	SEAL , " O " RING BACK · UP
8	910SH05-326	1	" O " RING



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	73PN011	2	DISCHARGE COVER , GAUGE CONNECTION
2	54PN009	2	RETAINER NUT , GAUGE CONNECTION
3	71PN04	1	DISCHARGE COVER
4	50PN06	1	DISCHARGE COVER , RETAINER NUT
5	901SH06-1	2	SEAL RING
6	901SH05-344	6	" O " RING
7	901PN017-002	3	SEAL , " O " RING BACK · UP
8	901SH05-326	2	" O " RING

DISCHARGE COVER ASSEMBLY

(70 OL 001)

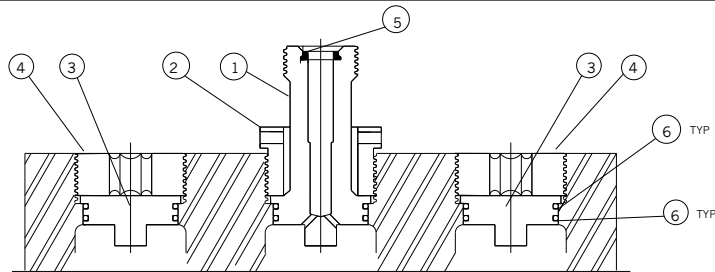


600 HP DISCHARGE COVER OPTION (70 OL 001)

NOTE ;

THESE OPTION FOR USE WITH
4-1/2" & 5" INCH FLUID END

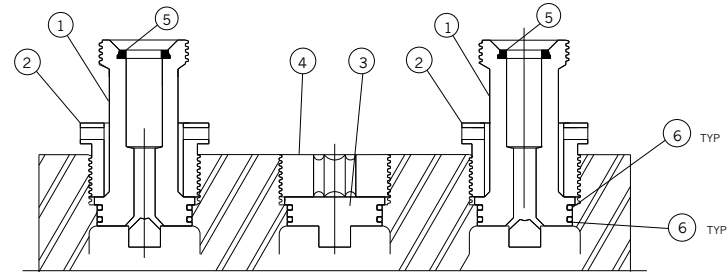
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	71PN02	3	DISCHARGE COVER
2	50PN04	3	DISCHARGE COVER RETAINER NUT
3	901SH05-427	6	* O * RING



DISCHARGE COVER ASSEMBLY - GAUGE CONNECTION (72AD001)

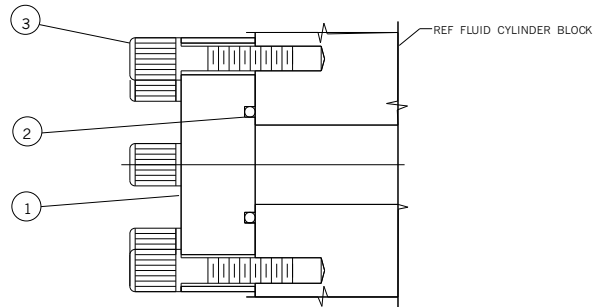
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	72PN10	1	DISCHARGE COVER , WITH GAUGE CONNECTION
2	54PN05	1	RETAINER NUT , GAUGE CONNECTION
3	71PN02	2	DISCHARGE COVER
4	50PN04	2	DISCHARGE COVER , RETAINER NUT
5	901SH06-1	1	SEAL RING
6	901SH05-427	6	* O * RING

DISCHARGE COVER ASSEMBLY - GAUGE CONNECTION (72AD004)



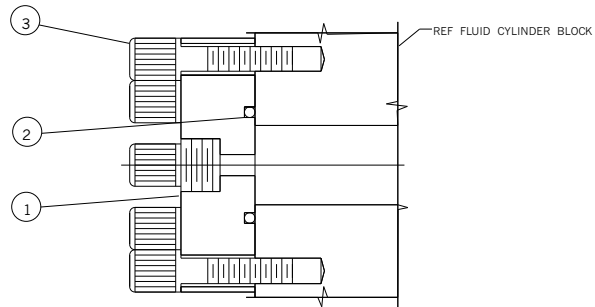
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	72PN10	2	DISCHARGE COVER , GAUGE CONNECTION
2	54PN05	2	RETAINER NUT , GAUGE CONNECTION
3	71PN02	1	DISCHARGE COVER
4	50PN04	1	DISCHARGE COVER , RETAINER NUT
5	901SH06-1	2	SEAL RING
6	901SH05-427	6	* O * RING

DISCHARGE FLANGE , BLIND , 15,000 PSI
(265AD004)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	265PN005	1	DISCHARGE FLANGE , BLIND , 15,000 PSI
2	901SH05-330	1	" O " RING
3	454VP026-022	8	CAPSCREW , SOCKET HEAD

DISCHARGE FLANGE , BLEEDOFF VALVE , 15,000 PSI
(265AD005)



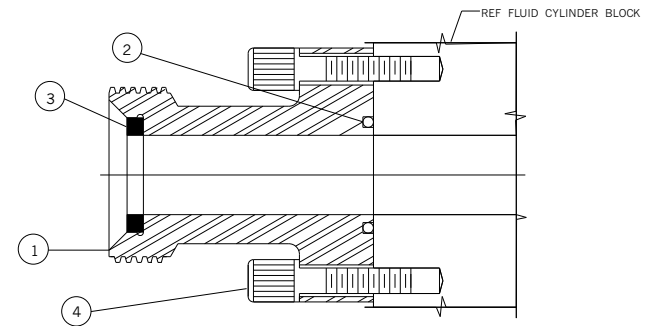
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	268PN04	1	DISCHARGE FLANGE , BLEEDOFF , 15,000 PSI
2	901SH05-330	1	" O " RING
3	454VP026-022	8	CAPSCREW , SOCKET HEAD

600 HP DISCHARGE FLANGE OPTION
(265 OL 001)

NOTE ;

THESE OPTION FOR USE WITH
2-1/4" - 3" INCH FLUID END

DISCHARGE FLANGE , 2" 1502 HAMMER UNION
(267AD006)

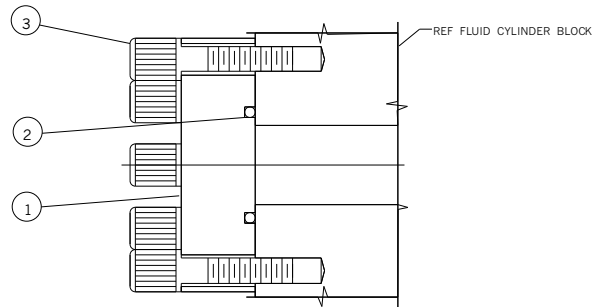


ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	267PN06	1	DISCHARGE FLANGE , HAMMER UNION 2" 1502
2	901SH05-330	1	" O " RING
3	901SH06-1	1	SEAL RING
4	454VP028-022	8	CAPSCREW , SOCKET HEAD

OFM PUMP , INC.

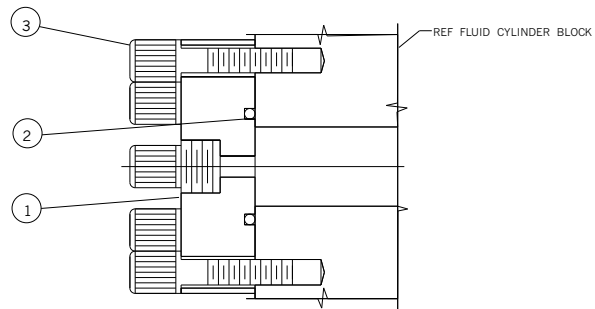
DRAWN LDG	10/22/02	DISC. FLANGE OPTION FOR 600 HP F.E.	
DISC. , OPTION		SIZE C	DWG NUMBER 265OL001
APPROVED FCF	10/22/02	REV	SHEET 1 OF 1

DISCHARGE FLANGE , BLIND , 15,000 PSI
(265AD006)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	265PN006	1	DISCHARGE FLANGE , BLIND , 15,000 PSI
2	901SH05-335	1	" O " RING
3	454VP026-022	8	CAPSCREW , SOCKET HEAD

DISCHARGE FLANGE , BLEEDOFF VALVE , 15,000 PSI
(268AD005)



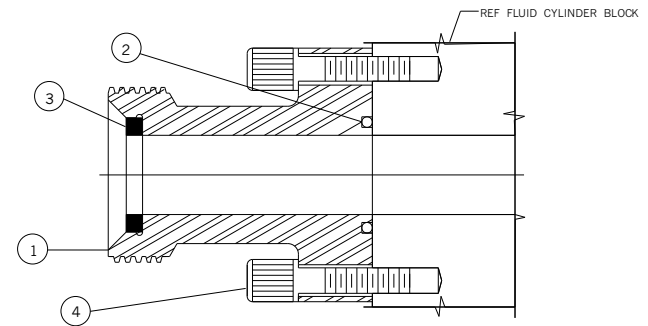
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	268PN05	1	DISCHARGE FLANGE , BLEEDOFF , 15,000 PSI
2	901SH05-335	1	" O " RING
3	454VP028-024	8	CAPSCREW , SOCKET HEAD

600 HP DISCHARGE FLANGE OPTION
(265 OL 002)

NOTE ;

THESE OPTION FOR USE WITH
3-1/2" · 4" INCH FLUID END

DISCHARGE FLANGE , 2" 1502 HAMMER UNION
(267AD026)

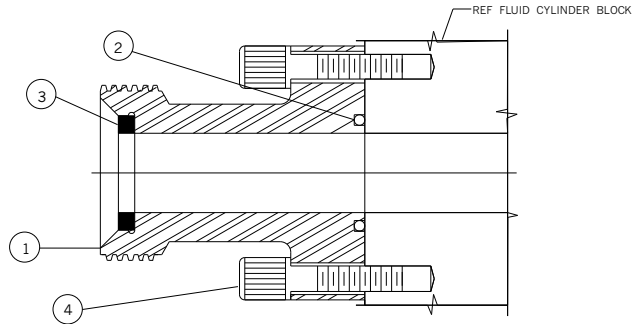


ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	267PN26	1	DISCHARGE FLANGE , HAMMER UNION 2" 1502
2	901SH05-335	1	" O " RING
3	901SH06-1	1	SEAL RING
4	454VP028-024	8	CAPSCREW , SOCKET HEAD

OFM PUMP , INC.

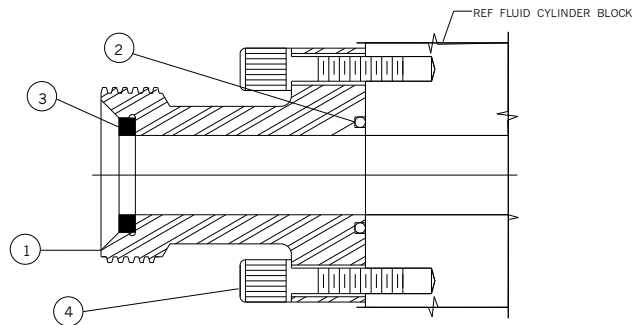
DRAWN LDG	10/22/02	DISC. FLANGE OPTION FOR 600 HP F. E.	
DISC. , OPTION		SIZE C	DWG NUMBER 2650L002
APPROVED FCF	10/22/02	REV	SHEET 1 OF 1

DISCHARGE FLANGE , 2-1/2" 1002 HAMMER UNION
(267AD008)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	267PN08	1	DISCHARGE FLANGE , HAMMER UNION 2-1/2" 1002
2	901SH05-335	1	" O " RING
3	901SH06-3	1	SEAL RING
4	454VP028-024	8	CAPSCREW , SOCKET HEAD

DISCHARGE FLANGE , 3" 1002 HAMMER UNION
(267AD013)



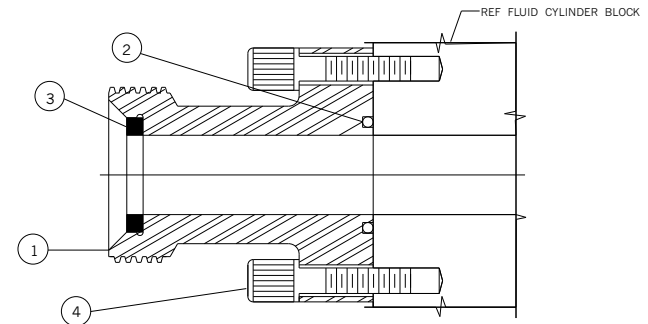
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	267PN13	1	DISCHARGE FLANGE , HAMMER UNION 3" 1002
2	901SH05-335	1	" O " RING
3	901SH06-2	1	SEAL RING
4	454VP028-024	8	CAPSCREW , SOCKET HEAD

600 HP DISCHARGE FLANGE OPTION
(265 OL 002-1) (CONT.)

NOTE ;

THESE OPTION FOR USE WITH
3-1/2" · 4" INCH FLUID END

DISCHARGE FLANGE , 3" 1502 HAMMER UNION
(267AD029)

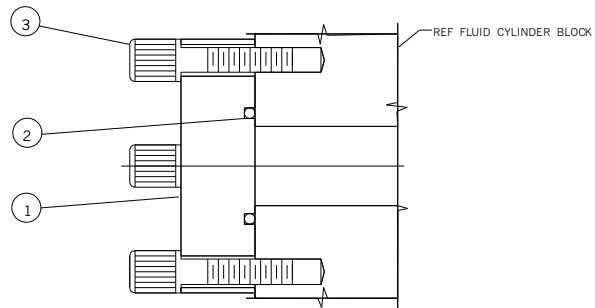


ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	267PN29	1	DISCHARGE FLANGE , HAMMER UNION 3" 1502
2	901SH05-335	1	" O " RING
3	901SH06-2	1	SEAL RING
4	454VP028-024	8	CAPSCREW , SOCKET HEAD

OFM PUMP , INC.

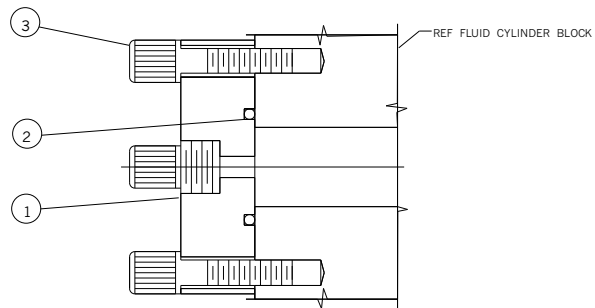
DRAWN LDG	10/22/02	DISC. FLANGE OPTION FOR 600 HP F. E.	
DISC. , OPTION		SIZE C	DWG NUMBER 265OL002-1
APPROVED FCF	10/22/02	REV	SHEET 1 OF 1

DISCHARGE FLANGE , BLIND , 15,000 PSI
(265AD004)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	265PN004	1	DISCHARGE FLANGE , BLIND , 15,000 PSI
2	901SH05-339	1	" O " RING
3	454VP030-024	8	CAPSCREW , SOCKET HEAD

DISCHARGE FLANGE , BLEEDOFF VALVE , 15,000 PSI
(268AD001)



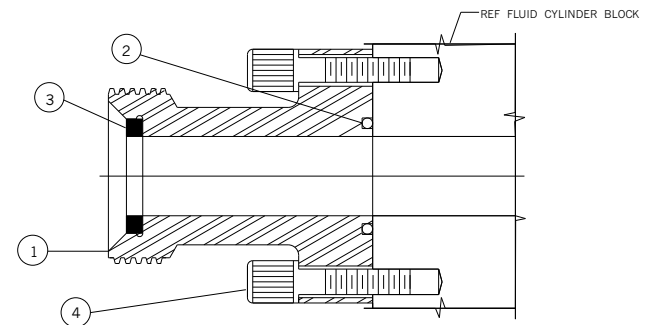
ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	268PN01	1	DISCHARGE FLANGE , BLEEDOFF , 15,000 PSI
2	901SH05-339	1	" O " RING
3	454VP030-024	8	CAPSCREW , SOCKET HEAD

600 HP DISCHARGE FLANGE OPTION
(265 OL 003)

NOTE ;

THESE OPTION FOR USE WITH
4-1/2" & 5" INCH FLUID END

DISCHARGE FLANGE , 2" 1502 HAMMER UNION
(267AD007)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	267PN07	1	DISCHARGE FLANGE , HAMMER UNION 2" 1502
2	901SH05-339	1	" O " RING
3	901SH06-1	1	SEAL RING
4	454VP030-024	8	CAPSCREW , SOCKET HEAD

OFM PUMP , INC.

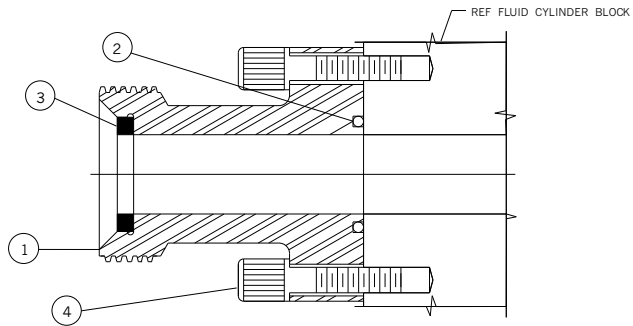
DRAWN LDG	10/22/02	DISC. FLANGE OPTION FOR 600 HP F.E.	
DISC. , OPTION		SIZE	DWG NUMBER
APPROVED FCF	10/22/02	C	265OL003
REV		SHEET	1 OF 1

600 HP DISCHARGE FLANGE OPTION
(265 OL 003-1) (CONT.)

NOTE ;

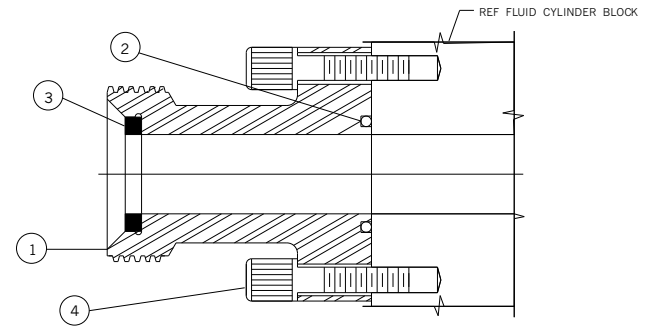
THESE OPTION FOR USE WITH
4-1/2" - 5" INCH FLUID END

DISCHARGE FLANGE , 3" 1002 HAMMER UNION
(267AD005)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	267PN05	1	DISCHARGE FLANGE , HAMMER UNION 3" 1002
2	901SH05-339	1	" O " RING
3	901SH06-2	1	SEAL RING
4	454VP028-024	8	CAPSCREW , SOCKET HEAD

DISCHARGE FLANGE , 3" 1502 HAMMER UNION
(267AD030)



ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	267PN30	1	DISCHARGE FLANGE , HAMMER UNION 3" 1502
2	901SH05-339	1	" O " RING
3	901SH06-2	1	SEAL RING
4	454VP028-024	8	CAPSCREW , SOCKET HEAD

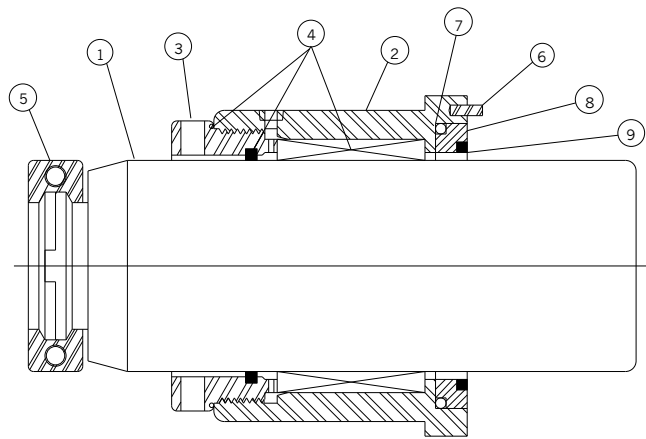
OFM PUMP , INC.

DRAWN LDG	10/22/02	DISC. FLANGE OPTION FOR 600 HP F. E.	
APPROVED FCF	10/22/02	SIZE C	DWG NUMBER 265OL003-1
REV		SHEET 1 OF 1	

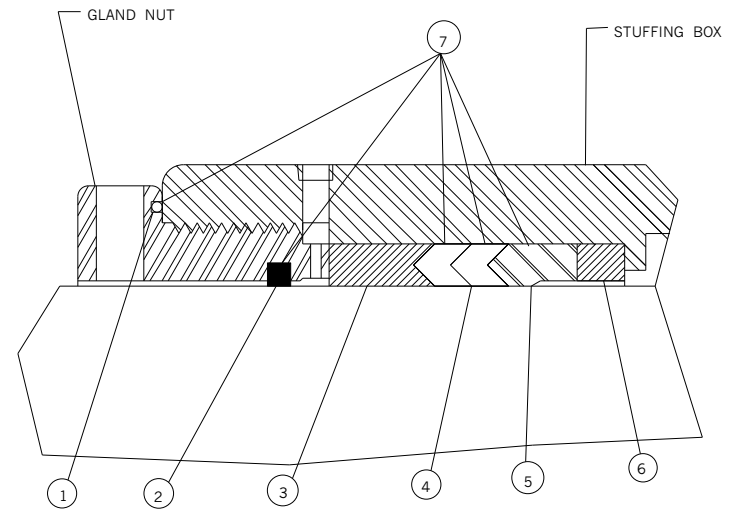
ITEM NO.	PART NO.	QTY	DESCRIPTION
1	13PN002	1	FLUID CYLINDER BLOCK , 2-1/4"
2	131PN017	3	SUCTION VALVE SPRING RETAINER CAGE
3	130PN011	3	VALVE SPRING RETAINER
4	918PN020	6	VALVE SPRING
5	86PN010	3	SUCTION COVER
6	50PN07	3	SUCTION COVER RETAINER NUT
7	710L007	REF	DISCHARGE COVER ASSEMBLY (SEE OPTION LIST)
8	2650L006	REF	DISCHARGE FLANGE (SEE OPTION LIST)
9	2650L006	REF	DISCHARGE FLANGE (SEE OPTION)
10-1	117PN004	1	SUCTION MANIFOLD . 4" RUN , 9" CENTERS
10-2	117PN005	1	SUCTION MANIFOLD , 6" RUN , 9" CENTERS
11	454VP063-040M	12	FLUID END RETAINER BOLT
12	NF-2-V1	6	VALVE WITH INSERT
12-1	NF-2-I	—	VALVE INSERT (REPLACEMENT , 1 EACH VALVE)
13	NF-2S-1	6	VALVE SEAT
13-1	901SH05-230	6	VALVE SEAT " O " RING
14	901SH05-344	3	SUCTION MANIFOLD " O " RING
15	901SH05-333	3	SUCTION COVER " O " RING
16	901PN017-010	3	SEAL , " O " RING , BACK - UP
17	454VP004-010	12	CAPSCREW , HEX HEAD , 1/2" ~ 13 UNC · 2A X 1" LONG
20-1	116AD006	1	SUCTION MANIFOLD , VALVE LIFTER COUPLING , 4" RUN WITH 9" CENTERS (OPTION TO ITEM 10)
20-2	116AD004	1	SUCTION MANIFOLD , VALVE LIFTER COUPLING , 6" RUN WITH 9" CENTERS (OPTION TO ITEM 10)
20-3	118AD003	1	SUCTION MANIFOLD , FLANGED ENDS , VALVE LIFTER COUPLING , 4" SCH 80 RUN , 9" CENTERS (OPTION TO ITEM 10)
21	210AD001	3	SUCTION VALVE LIFTER ASSEMBLY , (FOR ABOVE MANIFOLDS)

2-1/4" PLUNGER FLUID END

OFM PUMP , INC.			
DRAWN	10/07/02	2-1/4" PLUNGER FLUID END PARTS LIST	
APPROVED	10/07/02	SIZE	DWG NUMBER
LDG	FCF	C	13AD006
SCALE	REV	SHEET 1 OF 1	



(PLUNGER SEPARATE) STUFFING BOX ASSEMBLY



RUBBER SPRING LOADED PACKING

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	160PN010	1	PLUNGER , 2-1/4" O.D. X 14-3/4" LONG
2	295PN027	1	STUFFING BOX
3	182PN025	1	GLAND NUT , 2-1/4"
4	208AD026	1	RUBBER SPRING LOADED PACKING ASSY.
5	170PN008	1	PONY ROD CLAMP
6	634VP003-004	1	DOWEL PIN
7	901SH05-340	1	* O * RING
8	491PN027	1	SEAL RETAINER , STUFFING BOX , 2-1/4"
9	901SH05-334	1	* O * RING

ITEM NO.	PART NO.	QTY.	DESCRIPTION
*****	208AD026	SET	PACKING ASSEMBLY, 2-1/4"
	INCLUDES		
1	901SH05-248	1	* O * RING
2	901SH01-17	1	ROD WIPER
3	203PN001-015	1	PACKING TOP ADAPTER
4	901VP002-019	2	SEAL , PRESSURE RING
5	901VP014-019	1	SEAL , HEADER RING
6	199PN001-015	1	SPACER ADAPTER SPACER
* 7	OFM1067-225SS325		2-1/4" X 3-1/4" SEAL SET

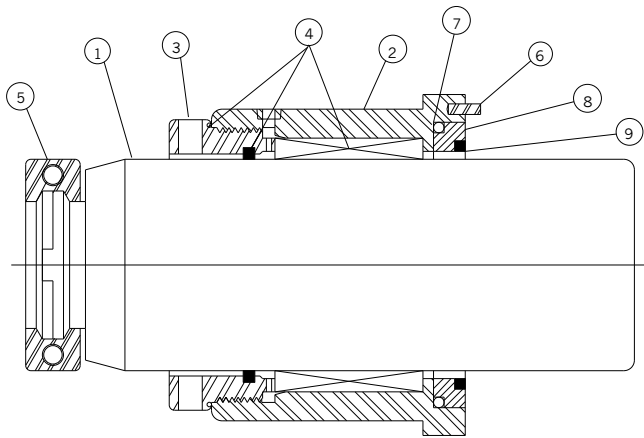
2-1/4" PLUNGER ; STUFFING BOX ; PACKING ASSY.

OFM PUMP , INC.			
DRAWN LDG	10/08/02	2-1/4" PLUNGER STUFFING BOX PACKING ASSY.	
OFM 600 F. E.		SIZE C	DWG NUMBER 600SD008
APPROVED FCF	10/08/02	REV	SHEET 1 OF 1
SCALE 1 : 2			

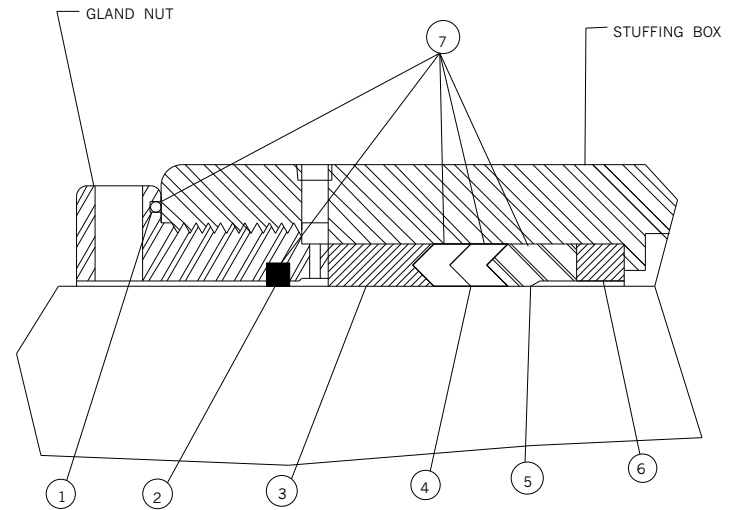
ITEM NO.	PART NO.	QTY	DESCRIPTION
1	11PN04	1	FLUID CYLINDER BLOCK , 2-3/4" - 3"
2	131PN06	3	SUCTION VALVE SPRING RETAINER CAGE
3	130PN09	3	VALVE SPRING RETAINER
4	918PN04	6	VALVE SPRING
5	86PN05	3	SUCTION COVER
6	50PN06	3	SUCTION COVER RETAINER NUT
7	710L006	REF	DISCHARGE COVER ASSEMBLY (SEE OPTION LIST)
8	2650L001	REF	DISCHARGE FLANGE (SEE OPTION LIST)
9	2650L001	REF	DISCHARGE FLANGE (SEE OPTION)
10-1	117PN005	1	SUCTION MANIFOLD . 6" RUN , 9" CENTERS
10-2	117PN004	1	SUCTION MANIFOLD , 4" RUN , 9" CENTERS
11	454VP063-040M	12	FLUID END RETAINER BOLT
12	NF-2-V1	6	VALVE WITH INSERT
12-1	NF-2-I	—	VALVE INSERT (REPLACEMENT , 1 EACH VALVE)
13	NF-2-S1	6	VALVE SEAT
13-1	901SH05-147	6	VALVE SEAT " O " RING
14	901SH05-344	3	SUCTION MANIFOLD " O " RING
15	901SH05-344	3	SUCTION COVER " O " RING
16	901PN017-002	3	SEAL , " O " RING , BACK - UP
17	454VP004-010	12	CAPSCREW , HEX HEAH , 1/2" ~ 13 UNC · 2A X 1" LONG
20-1	116AD004	1	SUCTION MANIFOLD , VALVE LIFTER COUPLING , 6" RUN WITH 9" CENTERS (OPTION TO ITEM 10)
20-2	116AD006	1	SUCTION MANIFOLD , VALVE LIFTER COUPLING , 4" RUN WITH 9" CENTERS (OPTION TO ITEM 10)
21	210AD001	3	SUCTION VALVE LIFTER ASSEMBLY (FOR ABOVE MANIFOLD)

2-3/4" · 3" PLUNGER FLUID END

OFM PUMP , INC.			
DRAWN LDG	10/07/02	2-3/4"·3" PLUNGER FLUID END PARTS LIST	
APPROVED FCF	10/07/02	SIZE C	DWG NUMBER 13AD003
SCALE	REV	SHEET	1 OF 1



(PLUNGER SEPARATE) STUFFING BOX ASSEMBLY



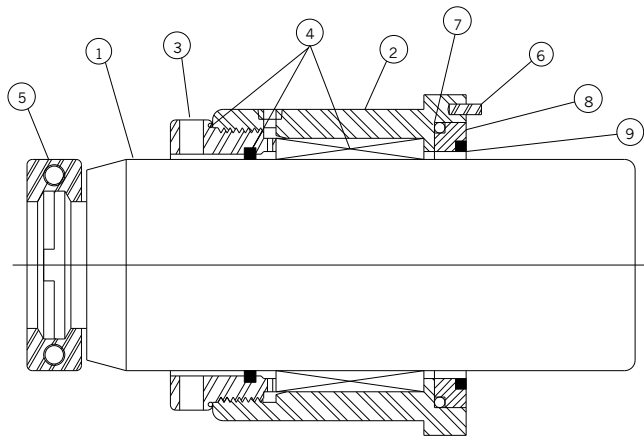
RUBBER SPRING LOADED PACKING

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	160PN006	1	PLUNGER , 2-3/4" O.D. X 14-3/4" LONG
2	295PN029	1	STUFFING BOX
3	182PN11	1	GLAND NUT , 2-3/4"
4	208AD013	1	RUBBER SPRING LOADED PACKING ASSY.
5	170PN04	1	PONY ROD CLAMP
6	634VP003-004	1	DOWEL PIN
7	901SH05-348	1	* O * RING
8	491PN016	1	STUFFING BOX SEAL RETAINER
9	901SH13-7	1	SEAL

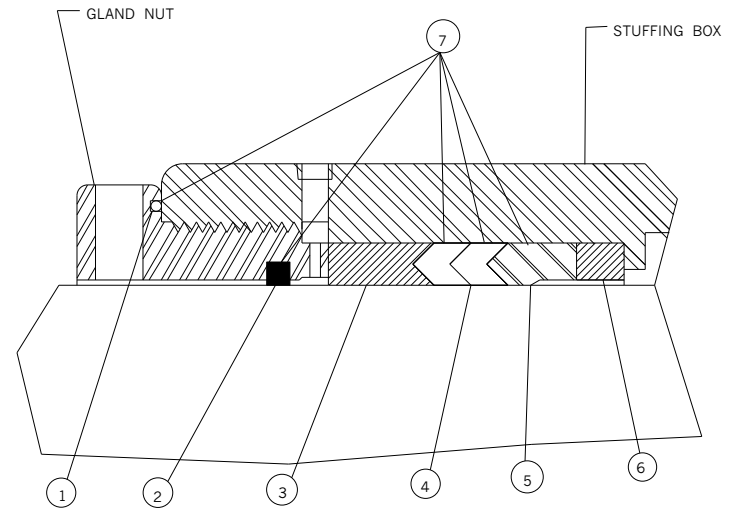
ITEM NO.	PART NO.	QTY.	DESCRIPTION
*****	208AD013	SET	PACKING ASSEMBLY, 2-3/4"
	INCLUDES		
1	901SH05-248	1	* O * RING
2	901SH01-1	1	ROD WIPER
3	203PN001-009	1	PACKING TOP ADAPTER
4	901VP002-013	2	SEAL , PRESSURE RING
5	901VP014-013	1	SEAL , HEADER RING
6	199PN001-001	1	SPACER ADAPTER SPACER
* 7	OFM1067-275SS375		2-3/4" X 3-3/4" SEAL SET

2-3/4" PLUNGER ; STUFFING BOX ; PACKING ASSY.

OFM PUMP , INC.			
DRAWN LDG	10/08/02	2-3/4" PLUNGER STUFFING BOX PACKING ASSY.	
APPROVED FCF	10/08/02	SIZE C	DWG NUMBER 600SD002
SCALE 1 : 2	REV .	SHEET	1 OF 1



(PLUNGER SEPARATE) STUFFING BOX ASSEMBLY



RUBBER SPRING LOADED PACKING

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	160PN005	1	PLUNGER , 3" O.D. X 14-3/4" LONG
2	295PN030	1	STUFFING BOX
3	182PN10	1	GLAND NUT , 3"
4	208AD014	1	RUBBER SPRING LOADED PACKING ASSY.
5	170PN04	1	PONY ROD CLAMP
6	634VP003-004	1	DOWEL PIN
7	901SH05-348	1	* O * RING
8	491PN016	1	STUFFING BOX SEAL RETAINER
9	901SH13-7	1	SEAL

ITEM NO.	PART NO.	QTY.	DESCRIPTION
*****	208AD014	SET	PACKING ASSEMBLY, 3"
	INCLUDES		
1	901SH05-248	1	* O * RING
2	901SH01-2	1	ROD WIPER
3	203PN001-001	1	PACKING TOP ADAPTER
4	901VP002-002	2	SEAL , PRESSURE RING
5	901VP014-002	1	SEAL , HEADER RING
6	199PN001-002	1	SPACER ADAPTER SPACER
* 7	OFM1067-300SS400		3" X 4" SEAL SET

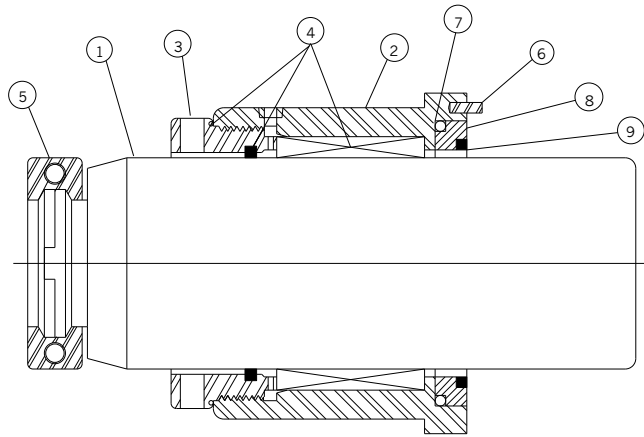
3" PLUNGER ; STUFFING BOX ; PACKING ASSY.

OFM PUMP , INC.			
DRAWN LDG	10/08/02	3" PLUNGER STUFFING BOX PACKING ASSY.	
OFM 600 F. E.			
APPROVED FCF	10/08/02	SIZE C	DWG NUMBER 600SD003
SCALE 1 : 2	REV .	SHEET	1 OF 1

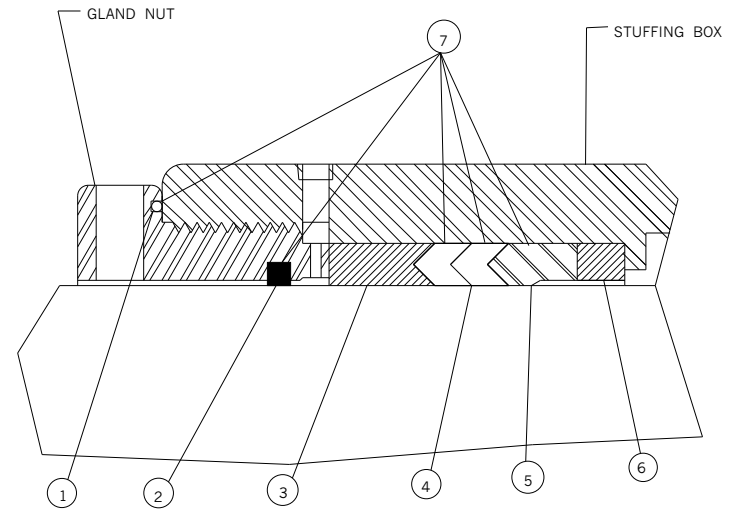
ITEM NO.	PART NO.	QTY	DESCRIPTION
1	11PN03	1	FLUID CYLINDER BLOCK , 3-1/2" · 4"
2	131PN07	3	SUCTION VALVE SPRING RETAINER CAGE
3	130PN08	3	VALVE SPRING RETAINER
4	918PN01	6	VALVE SPRING
5	86PN04	3	SUCTION COVER
6	86OL001	REF	SUCTION COVER RETAINER NUT , (SEE OPTION LIST)
7	71OL001	REF	DISCHARGE COVER ASSEMBLY (SEE OPTION LIST)
8	265OL002	REF	DISCHARGE FLANGE (SEE OPTION LIST)
9	265OL002	REF	DISCHARGE FLANGE (SEE OPTION)
10-1	117PN006	1	SUCTION MANIFOLD . 6" RUN , 9" CENTERS
10-2	117PN010	1	SUCTION MANIFOLD , 4" RUN , 9" CENTERS
11	454VP063-040M	12	FLUID END RETAINER BOLT
12	NF-4-V2	6	VALVE WITH INSERT
12-1	NF-4-IA	—	VALVE INSERT (REPLACEMENT , 1 EACH VALVE)
13	NF-4-S2	6	VALVE SEAT
13-1	901SH05-153	6	VALVE SEAT " O " RING
14	901SH05-258	3	SUCTION MANIFOLD " O " RING
15	901SH05-427	3	SUCTION COVER " O " RING
16	901PN017-005	3	SEAL , " O " RING , BACK · UP
17	454VP005-014	12	CAPSCREW , HEX HEAD , 1/2" ~ 13 UNC · 2A X 1" LONG
20-1	116AD002	1	SUCTION MANIFOLD , VALVE LIFTER COUPLING , 6" RUN WITH 9" CENTERS (OPTION TO ITEM 10)
20-2	116AD005	1	SUCTION MANIFOLD , VALVE LIFTER COUPLING , 4" RUN WITH 9" CENTERS (OPTION TO ITEM 10)
21	210AD001	3	SUCTION VALVE LIFTER ASSEMBLY (FOR ABOVE MANIFOLD)

3-1/2" · 4" PLUNGER FLUID END

OFM PUMP , INC.			
DRAWN LDG	10/07/02	3-1/2"·4" PLUNGER FLUID END PARTS LIST	
APPROVED FCF	10/07/02	SIZE C	DWG NUMBER 13AD004
SCALE	REV	SHEET 1 OF 1	



(PLUNGER SEPARATE) STUFFING BOX ASSEMBLY



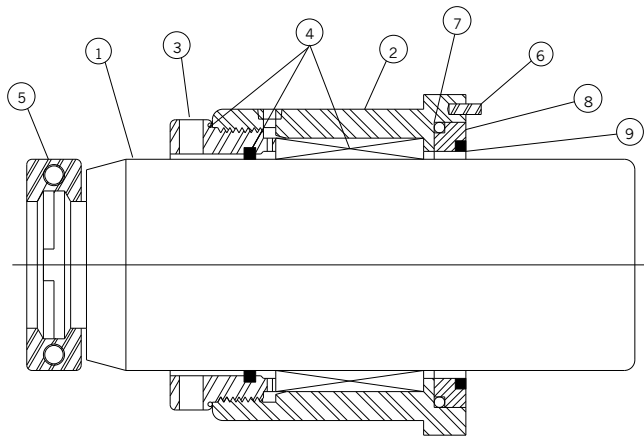
RUBBER SPRING LOADED PACKING

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	160PN004	1	PLUNGER , 3-1/2" O.D. X 14-3/4" LONG
2	295PN031	1	STUFFING BOX
3	182PN12	1	GLAND NUT , 3-1/2"
4	208AD015	1	RUBBER SPRING LOADED PACKING ASSY.
5	170PN03	1	PONY ROD CLAMP
6	634VP003-004	1	DOWEL PIN
7	901SH05-431	1	" O " RING
8	491PN017	1	STUFFING BOX SEAL RETAINER
9	901SH13-2	1	SEAL

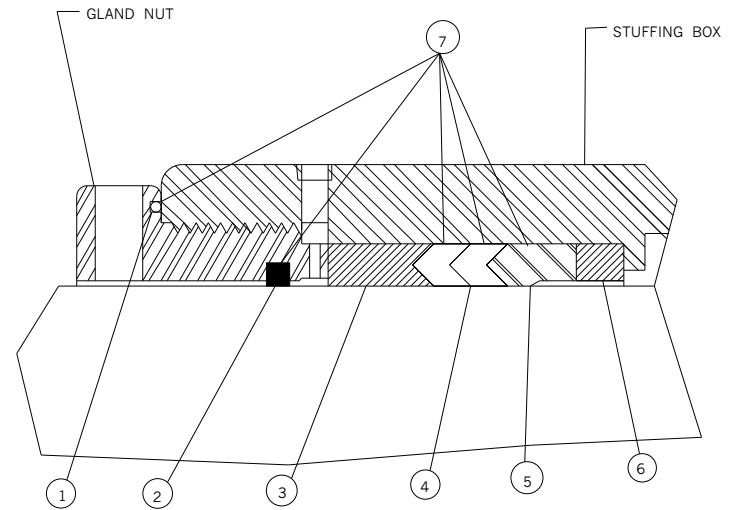
ITEM NO.	PART NO.	QTY.	DESCRIPTION
*****	208AD015	SET	PACKING ASSEMBLY, 3-1/2"
	INCLUDES		
1	901SH05-256	1	" O " RING
2	901SH01-3	1	ROD WIPER
3	203PN001-007	1	PACKING TOP ADAPTER
4	901VP002-012	2	SEAL , PRESSURE RING
5	901VP014-012	1	SEAL , HEADER RING
6	199PN001-003	1	SPACER ADAPTER SPACER
* 7	OFM1067-350SS450		3-1/2" X 4-1/2" SEAL SET

3-1/2" PLUNGER ; STUFFING BOX ; PACKING ASSY.

OFM PUMP , INC.			
DRAWN LDG	10/08/02	3-1/2" PLUNGER STUFFING BOX PACKING ASSY.	
OFM 600 F. E.			
APPROVED FCF	10/08/02	SIZE C	DWG NUMBER 600SD004
SCALE 1 : 2	REV .	SHEET 1 OF 1	



(PLUNGER SEPARATE) STUFFING BOX ASSEMBLY



RUBBER SPRING LOADED PACKING

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	160PN003	1	PLUNGER , 4" O.D. X 14-3/4" LONG
2	295PN032	1	STUFFING BOX
3	182PN13	1	GLAND NUT , 4"
4	208AD005	1	RUBBER SPRING LOADED PACKING ASSY.
5	170PN03	1	PONY ROD CLAMP
6	634VP003-004	1	DOWEL PIN
7	901SH05-431	1	" O " RING
8	491PN017	1	STUFFING BOX SEAL RETAINER
9	901SH13-2	1	SEAL

ITEM NO.	PART NO.	QTY.	DESCRIPTION
*****	208AD005	SET	PACKING ASSEMBLY, 4"
	INCLUDES		
1	901SH05-256	1	" O " RING
2	901SH01-5	1	ROD WIPER
3	203PN001-003	1	PACKING TOP ADAPTER
4	901VP002-005	2	SEAL , PRESSURE RING
5	901VP014-005	1	SEAL , HEADER RING
6	199PN001-005	1	SPACER ADAPTER SPACER
* 7	OFM1067-400SS500		4" X 5" SEAL SET

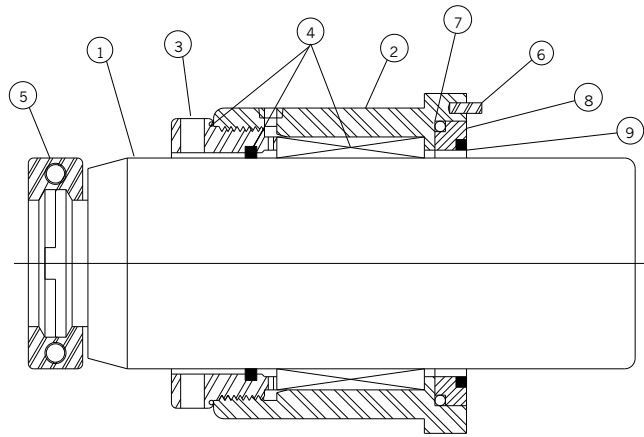
4" PLUNGER ; STUFFING BOX ; PACKING ASSY.

OFM PUMP , INC.			
DRAWN LDG	10/08/02	4" PLUNGER STUFFING BOX PACKING ASSY.	
OFM 600 F. E.		SIZE	DWG NUMBER
APPROVED FCF	10/08/02	C	600SD005
SCALE 1 : 2	REV	SHEET	1 OF 1

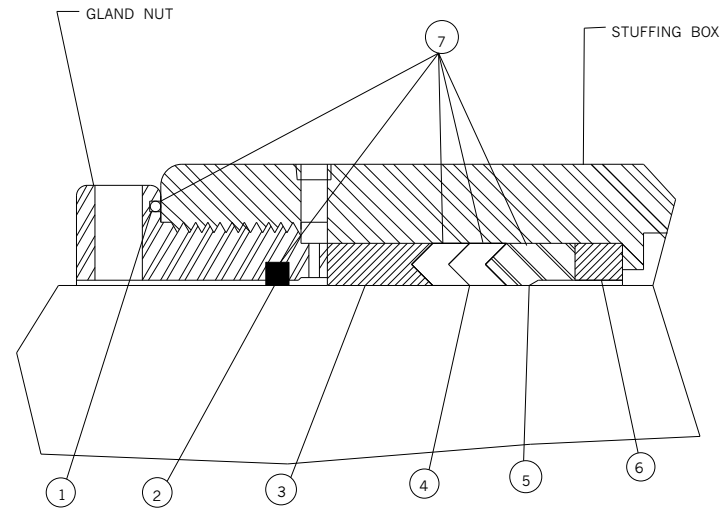
ITEM NO.	PART NO.	QTY	DESCRIPTION
1	11PN02	1	FLUID CYLINDER BLOCK , 4-1/2" · 5"
2	131PN04	3	SUCTION VALVE SPRING RETAINER CAGE
3	130PN06	3	VALVE SPRING RETAINER
4	918PN06	6	VALVE SPRING
5	86PN02	3	SUCTION COVER
6	50PN05	3	SUCTION COVER RETAINER NUT
7	700L001	REF	DISCHARGE COVER ASSEMBLY (SEE OPTION LIST)
8	2650L003	REF	DISCHARGE FLANGE (SEE OPTION LIST)
9	2650L003	REF	DISCHARGE FLANGE (SEE OPTION)
10-1	117PN006	1	SUCTION MANIFOLD , 6" RUN , 9" CENTERS
10-2	117PN010	1	SUCTION MANIFOLD , 4" RUN , 9" CENTERS
11	454VP063-040M	12	FLUID END RETAINER BOLT
12	NF-5-V1	6	VALVE WITH INSERT
12-1	NF-5-I	—	VALVE INSERT (REPLACEMENT , 1 EACH VALVE)
13	NF-5-S2	6	VALVE SEAT
13-1	901SH05-244	6	VALVE SEAT " O " RING
14	901SH05-258	3	SUCTION MANIFOLD " O " RING
15	901SH05-435	3	SUCTION COVER " O " RING
16	NOT USED	—	—
17	454VP005-014	12	CAPSCREW , HEX HEAD , 1/2" ~ 13 UNC · 2A X 1" LONG
20-1	116AD002	1	SUCTION MANIFOLD , VALVE LIFTER COUPLING , 6" RUN WITH 9" CENTERS (OPTION TO ITEM 10)
20-2	116AD005	1	SUCTION MANIFOLD , VALVE LIFTER COUPLING , 4" RUN WITH 9" CENTERS (OPTION TO ITEM 10)
21	210AD001	3	SUCTION VALVE LIFTER ASSEMBLY (FOR ABOVE MANIFOLD)

4-1/2" · 5" PLUNGER FLUID END

OFM PUMP , INC.			
DRAWN LDG	10/07/02	4-1/2"-5" PLUNGER FLUID END PARTS LIST	
APPROVED FCF	10/07/02	SIZE C	DWG NUMBER 13AD005
SCALE	REV	SHEET	1 OF 1



(PLUNGER SEPARATE) STUFFING BOX ASSEMBLY



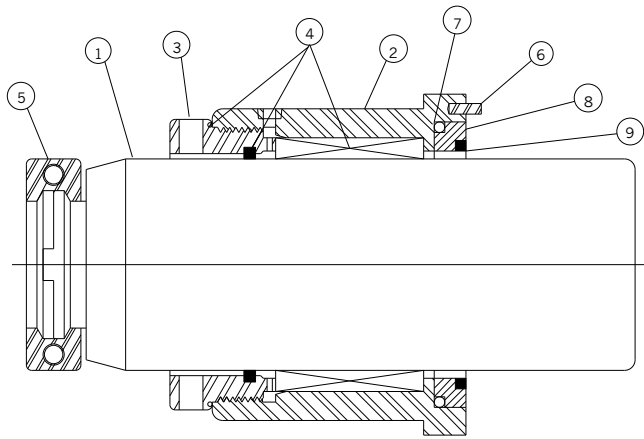
RUBBER SPRING LOADED PACKING

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	160PN001	1	PLUNGER , 4-1/2" O.D. X 14-3/4" LONG
2	295PN033	1	STUFFING BOX
3	182PN03	1	GLAND NUT , 4-1/2"
4	208AD017	1	RUBBER SPRING LOADED PACKING ASSY.
5	170PN03	1	PONY ROD CLAMP
6	634VP003-004	1	DOWEL PIN
7	901SH05-438	1	" O " RING
8	491PN018	1	STUFFING BOX SEAL RETAINER
9	901SH13-5	1	SEAL

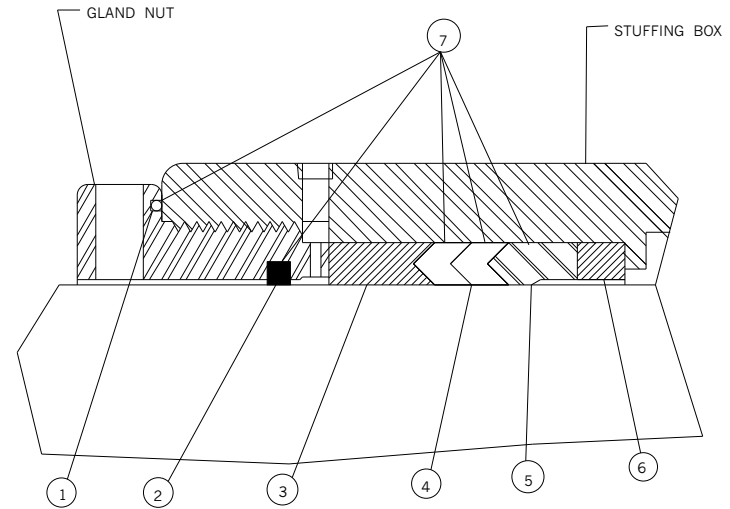
ITEM NO.	PART NO.	QTY.	DESCRIPTION
*****	208AD017	SET	PACKING ASSEMBLY, 4-1/2"
	INCLUDES		
1	901SH05-261	1	" O " RING
2	901SH01-6	1	ROD WIPER
3	203PN001-005	1	PACKING TOP ADAPTER
4	901VP002-014	2	SEAL , PRESSURE RING
5	901VP014-014	1	SEAL , HEADER RING
6	199PN001-006	1	SPACER ADAPTER SPACER
* 7	OFM1067-450SS550		4-1/2" X 5-1/2" SEAL SET

4-1/2" PLUNGER ; STUFFING BOX ; PACKING ASSY.

OFM PUMP , INC.			
DRAWN LDG	10/08/02	4-1/2" PLUNGER STUFFING BOX PACKING ASSY.	
APPROVED FCF	10/08/02	SIZE C	DWG NUMBER 600SD006
SCALE 1 : 2	REV -	SHEET 1 OF 1	



(PLUNGER SEPARATE) STUFFING BOX ASSEMBLY



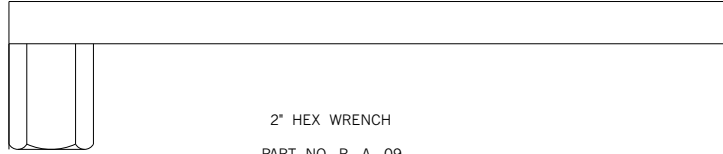
RUBBER SPRING LOADED PACKING

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	160PN002	1	PLUNGER , 5" O.D. X 14-3/4" LONG
2	295PN034	1	STUFFING BOX
3	182PN14	1	GLAND NUT , 5"
4	208AD009	1	RUBBER SPRING LOADED PACKING ASSY.
5	170PN03	1	PONY ROD CLAMP
6	634VP003-004	1	DOWEL PIN
7	901SH05-438	1	" O " RING
8	491PN018	1	STUFFING BOX SEAL RETAINER
9	901SH13-5	1	SEAL

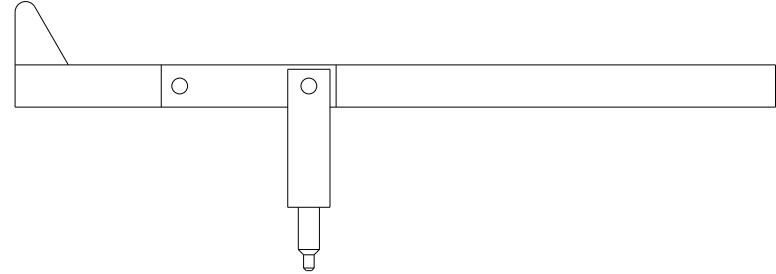
ITEM NO.	PART NO.	QTY.	DESCRIPTION
*****	208AD009	SET	PACKING ASSEMBLY, 5"
	INCLUDES		
1	901SH05-261	1	" O " RING
2	901SH01-7	1	ROD WIPER
3	203PN001-006	1	PACKING TOP ADAPTER
4	901VP002-009	2	SEAL , PRESSURE RING
5	901VP014-009	1	SEAL , HEADER RING
6	199PN001-007	1	SPACER ADAPTER SPACER
* 7	OFM1067-500SS600		5" X 6" SEAL SET

5" PLUNGER ; STUFFING BOX ; PACKING ASSY.

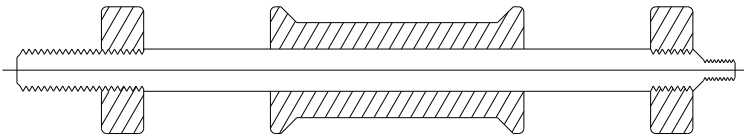
OFM PUMP , INC.			
DRAWN LDG	10/08/02	5" PLUNGER STUFFING BOX PACKING ASSY.	
OFM 600 F. E.			
APPROVED FCF	10/08/02	SIZE C	DWG NUMBER 600SD007
SCALE 1 : 2	REV .	SHEET 1 OF 1	



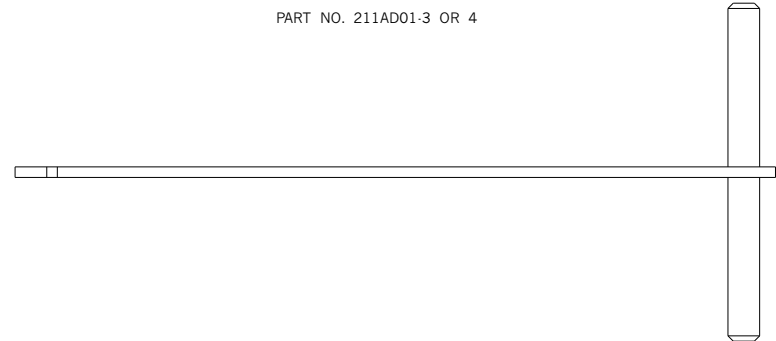
2" HEX WRENCH
PART NO. P - A - 09



SUCTION VALVE SPRING COMPRESSOR ASSY.
PART NO. 211AD01-3 OR 4



VALVE COVER PULLER
PART NO. 590PN006



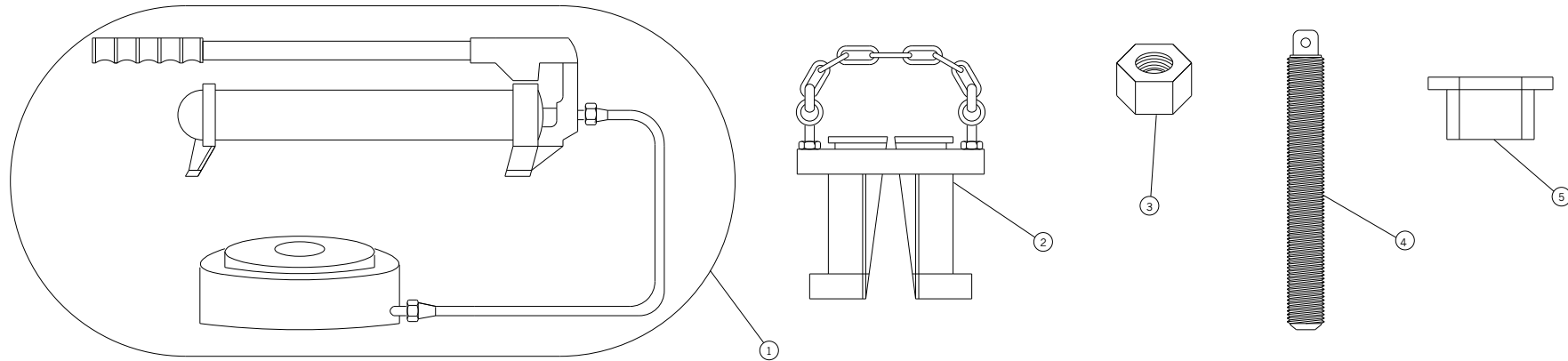
SUCTION SPRING RETAINER PULLER
PART NO. 590PN01



PACKING NUT WRENCH
PART NO. 608PN01

MAINTENANCE TOOLS

OFM PUMP , INC.			
DRAWN LDG	11/01/02	MAINTENANCE TOOLS FOR 600 FLUID END	
APPROVED FCF	11/01/02	SIZE C	DWG NUMBER 600MT001
SCALE 1:2	REV -	SHEET	1 OF 1



VALVE SEAT PULLER (OPTIONAL)

	①	②	③	④	⑤	
PLUNGER SIZE	COMPLETE ASSEMBLY W / METAL TOOL BOX	VALVE SEAT PULLER NO.	PULLER HEAD NO.	HEX NUT NO.	CENTER STEM STUD NO.	CENTER STEM BUSHING NO.
2-3/4" - 3" YELLOW	590AD014	590AD004	590VP005-005	458VP006-002	450VP014-001	145VP002-001
3-3/4" - 4" GREEN	590AD015	590AD004	590VP005-003	458VP004-012	450VP014-002	145VP002-002
4-1/2" - 5" RED	590AD016	590AD004	590VP005-001	458VP004-014	450VP014-003	N / R
5-1/2" - 6" BLUE	590AD017	590AD004	590VP005-004	458VP004-014	450VP014-003	N / R
6-1/2" - 7-1/2" BROWN	590AD018	590AD004	590VP005-006	458VP001-014	450VP014-003	N / R

PANCAKE JACK	PART NO. 953SH01-1
HAND PUMP	PART NO. 954VP001

OFM PUMP , INC.			
DRAWN L. GORRELL	10/31/03	VALVE SEAT PULLER ASSEMBLY	
APPROVED C. FRY	10/31/03	SIZE D	OWB NUMBER 590SD001
SCALE 1-2	REV -	SHEET	1 OF 1

