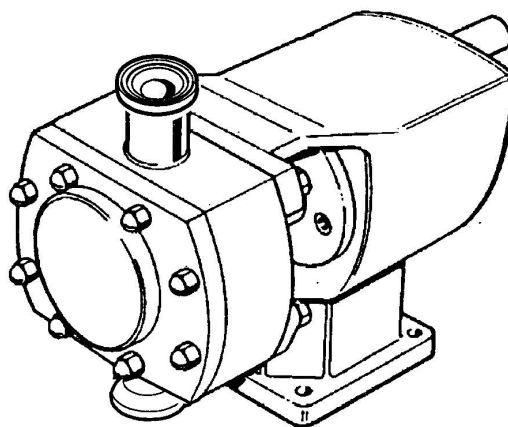


INSTRUCTION
MANUAL

**GHPD
ROTARY LOBE
DISPLACEMENT PUMP**



322	332
422, 422P	432, 432P
522, 522P	532, 532P
622, 622P	632, 632P
722, 722P	732, 732P
822, 822P	832, 832 P

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9710**

G&H RESERVE THE RIGHT TO
MINOR CHANGES IN DESIGN
AND FUNCTION

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IMPORTANT INFORMATION

Throughout each of G&H Product Corp's instruction manuals, certain safety signal words and symbols will appear. These are in the form of, warning, caution or note

WARNING!

: Indicates that special procedures **must** be followed to avoid severe personal injury.

CAUTION!

: Indicates that special procedures **must** be followed to avoid damage to the equipment.

NOTE!

: Denotes actions or procedures to follow for optimum, safe use of equipment.

Follow Safety Directions

Read this manual thoroughly before working on equipment.

Leave all safety stickers on equipment and keep them maintained in legible condition. In the event that stickers become damaged or are missing, contact G&H Products Corp. for replacements.

Maintain equipment in good working condition.

Do Not Make Machine Modifications

G&H Products Corp. offers a full range of products to suit all of your needs. Therefore, product modification is never necessary.

Keep Maintenance Safe

Replace damaged or worn parts immediately. Never allow old product, debris, or any lubricants to build up on equipment. Never operate unless equipment is in proper working order.

Before attempting to service the machine, disconnect all power and compressed air. Allow machine to come to a complete stop. Never service a machine while it is operating. Keep all limbs away from moving equipment. Be sure that product pressure has been relieved before beginning maintenance.



SAFETY PRECAUTIONS

All warnings in this manual are summarized on this page.

Pay attention to the instructions below so that severe personal injury or damage to the pump can be avoided.

Only authorized, experienced personnel should be allowed to perform installation, operation or maintenance of the pump.

WARNING SIGNS :



General safety instructions are preceded by this symbol.



Electrical safety instructions are preceded by this symbol.



Take great care when using caustic agents.

INSTALLATION



: **Always** observe the technical data.



: The pump **must** be electrically connected by authorized personnel. (See the motor instructions supplied with the drive unit).



: **Never** start in the wrong direction of rotation with liquid in the pump.



: **Never** put your hands or fingers inside the port connections.

OPERATION



: **Always** observe the technical data.



: **Never** touch the pump or the pipelines when pumping hot liquids or when sterilizing.



: **Never** stand on the pump or pipelines.



: **Never** run the pump with both the suction side and the pressure side blocked.



: **Always** handle toxic and acid liquids with great care.



: **Never** put your hands or fingers inside the port connections.

MAINTENANCE



: **Always** observe the technical data.



: **Always** disconnect the pump from the drive unit and power supply when servicing the pump.



: The pump must **never** be hot when servicing it.



: The pump and pipelines must **never** be pressurized when servicing the pump.



: **Never** put your hands or fingers inside the port connections.



1.1 PUMP LIMITS OF APPLICATION OR USE

This range of pumps has been designed for pumping a variety of media in the following industries :-

food processing, beverages, pharmaceuticals, cosmetics, chemicals, dairy and biotechnology products.

Pressures of up to 290 psi, speeds to 1000rpm and temperatures to 392°F can be obtained on this range of pumps depending on type/size. These conditions cannot always be obtained simultaneously. The model type/size will be shown on the nameplate.

If the user has not specified the pumping application or needs to change it, it is important to confirm that the materials of construction and product seals are compatible with the pumping applications and that adequate NPSH is available.

For specific guidelines, contact your supplier, obtain your :- pump model, serial number and system details (e.g. product, pressure, flow rate) before you call.

1.2 PUMP DUTY CONDITIONS

The pump should only be used for the purpose for which it has been specified. The operating pressure, speed and temperature limits have been selected at the time of order and **MUST NOT** be exceeded for the pump. These details are stated on the original documentation and if not available may be obtained from your supplier. Know your pump model and serial number.

1.3 NOISE LEVELS

Depending upon the pumping system and duty condition the pump noise levels may vary. The sound pressure level measurement below is given for typical pumps/pump units at maximum pressures/speeds. The results being taken on water at ambient temperature:-

Recorded sound pressure level :- 85 dB(A) : (ref 20μPa)

NOTE : Readings taken in accordance with ISO3746

1.4 UTILITY REQUIREMENT

Electrical Supply :

This pump may be supplied bareshaft or coupled to a drive unit for which a drive unit/electrical supply will be required.

Water Supply

Additional water supplies may be required if the pump is fitted with a product seal flushing arrangement. Consult your supplier for flush fluids compatible with products pumped.

Steam Supply :

A supply of steam will be required if heating jackets and saddles are fitted.

POTENTIAL SAFETY HAZARDS

The following section gives information on handling, storage and disposal of parts and materials used in the pumps which may be considered hazardous to health.

Please pass this information on to your Safety Officer, they may need it to comply with Health and Safety, and OSHA regulations.

Electric motors - if the pump is fitted with an electric motor, ensure that the relevant fire safety equipment is available.

GENERAL FIRST AID

If potentially hazardous substances are accidentally inhaled, or skin or eyes contaminated, then the following basic precautions should be taken:

- Inhalation - Remove to fresh air
- Skin - Wash with soap and water
- Eyes - Flush with water, seek medical attention

In all cases, if symptoms persist, seek medical attention.

MATERIAL	USE	MAJOR HAZARD
SILICON SEALANT	GEARBOX SEAL RETAINERS, REAR COVER, GENERAL SEALANT.	RELEASES VAPOR AT ROOM TEMPERATURE.
SEALANT (RED HERMETITE)	GEARBOX SEAL RETAINERS, REAR COVER, GENERAL SEALANT.	RELEASES VAPOR AT ROOM TEMPERATURE, HIGHLY FLAMMABLE, TREAT AS FIRE HAZARD.
ANTI-SEIZE COMPOUNDS	BEARINGS	APPLIED FROM AEROSOL. RELEASES VAPOR. DISPOSE OF CONTAINER AS IF PRESSURISED.
ADHESIVES (E.G. PERMABOND)	BEARING NUTS, ADJUSTMENT NUTS.	RELEASES VAPOR AT ROOM TEMPERATURE.
OIL AND GREASE	OIL - GENERAL LUBRICATION GREASE - PRODUCT SEALS, TIMING GEARS, GENERAL LUBRICATION.	SKIN AND EYE IRRITANT.
PLASTIC COMPOUNDS (PTFE, POLYPROPYLENE, PVC)	PTFE - 'O' RINGS, LIP SEALS, GLAND PACKING. POLYPROPYLENE - GLAND GUARDS. PVC - GLAND GUARDS.	RELEASES FUMES WHEN HEATED.
ELASTOMERIC COMPOUNDS (EP, FPM, NITRILE, NEOPRENE)	ALL - 'O' RINGS, LIP SEALS. NITRILE, POLYURETHANE - ROTORS (KNOWN AS RUBBER AND URETHANE).	RELEASES FUMES WHEN HEATED.
ARAMID FIBRE	GLAND PACKING.	EMMITS HARMFUL DUST. RELEASES FUMES WHEN HEATED.
PAINT	EXTERNAL PUMP SURFACES.	RELEASES DUST AND FUMES IF MACHINED. TREAT AS A FIRE HAZARD.

To avoid any problems, on receipt of your pump always use the following procedure.

2.1 DOCUMENTS

1. Check the packing list note against the goods received.
2. Check if the pump has been delivered with an electric motor that the motor instructions are available.

2.2 UNPACKING

Care must be taken when unpacking the pump, and the following stages must be completed:-

1. Inspect the packing for any possible signs of damage in transit.
2. Carefully remove the packing away from the pump.
3. Inspect the pump for any visible signs of damage.
4. Clean away the packing from the pump port connections.
5. Ensure that any additional equipment such as seal flushing pipework is not damaged.

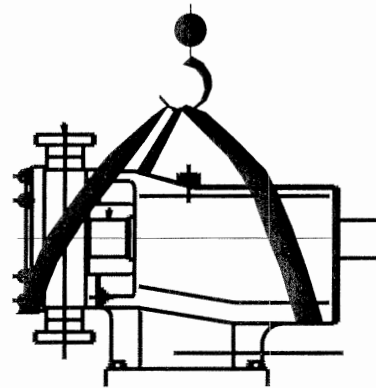
2.3 HANDLING

Refer to the pump weights guide, prior to using any lifting gear. Use the correct lifting slings for the pump weight (or pump and drive if applicable).

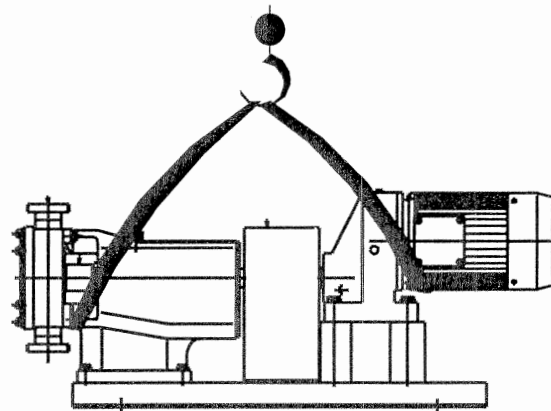
The following details show how the pumps should be lifted.

BARESHAFT PUMP - Slings should be wrapped around the front of the pump as shown and drive shaft.

PUMP WITH DRIVE UNIT - The slings should be positioned around the pump gearbox and under the motor as shown.



BARESHAFT PUMP



PUMP WITH DRIVE UNIT

After receipt and inspection, if the pump is not to be installed immediately, the pump should be repacked and placed in suitable storage. The following points should be noted:-

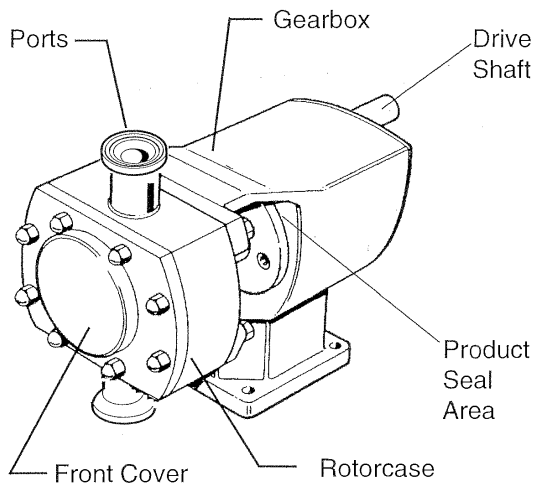
1. Plastic or gasket type port covers should be left in place.
2. Pumps received wrapped with corrosion inhibiting treatment material should be rewrapped.
3. A clean, dry storage location free from vibration should be selected. If a moist dusty atmosphere must be used for storage, further protect the pump or unit with a moisture repellent cover until it is to be installed.
4. Rotate pump/pump unit by hand weekly, to prevent bearing damage.
5. All associated ancillary equipment should be treated similarly.

DESCRIPTION OF PUMP OR PUMP UNIT

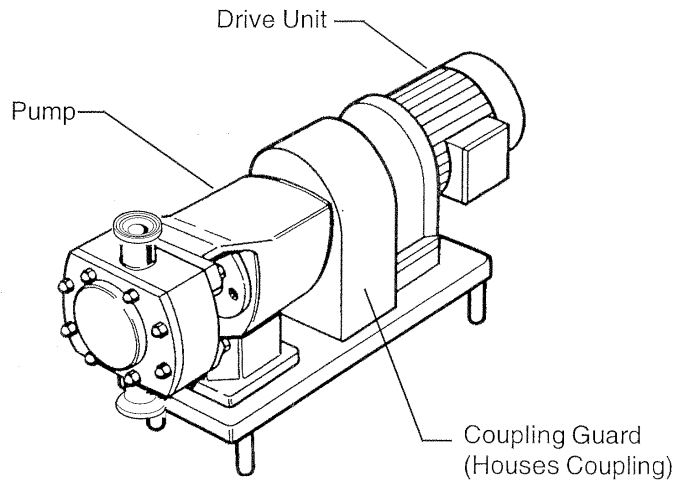
3.0

3.1 GENERAL PUMP DESCRIPTION

The pump supplied is a positive displacement pump, which may be supplied with or without a drive unit (see below). The drawing below indicates various parts of the pump.



BARESHAF PUMP

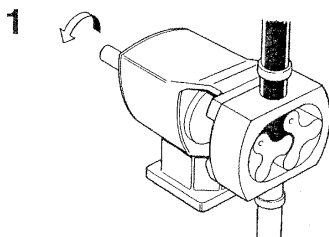


Pump with Drive Unit

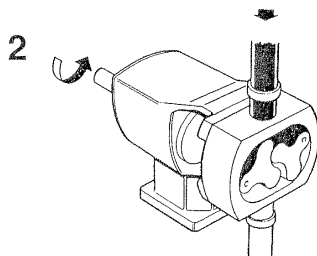
3.2 PRINCIPLE OF OPERATION

The rotors are timed such that when they rotate no contact occurs. The direction of flow is reversed by changing the pump's drive shaft. The pumping principle is as follows :

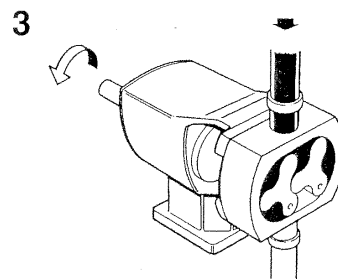
The rotors have just come out of mesh creating a reduction in pressure in the chamber which is then filled with product.



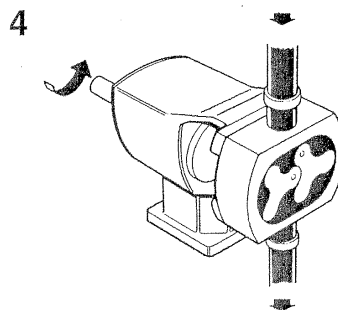
The product is contained in the rotorcase chamber.



As the rotors continue to rotate the product is transferred around the outside of the rotorcase to the discharge side.



The rotors' lobes go into mesh and the product is discharged from the pump.



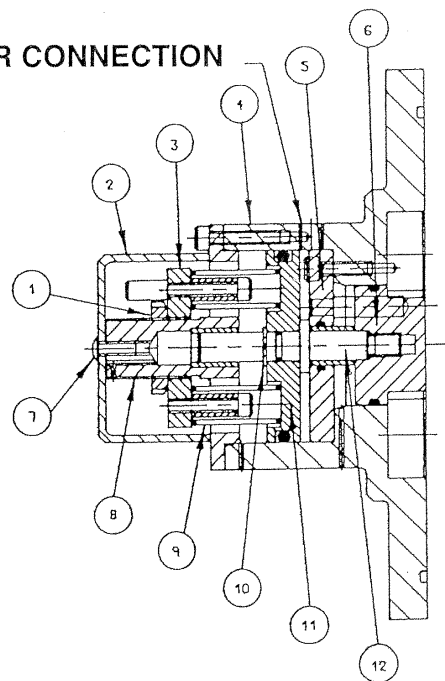
The pump may be supplied with a pressure relief valve as a non-standard option.

The relief valve is designed to protect the pump from the damage that can be caused through over-pressurization. When overpressurization occurs the hydraulic piston moves therefore allowing a slip path for the product.

Overpressurization will occur if :

- A **valve** is **closed** against the pump discharge
- The product **viscosity** in the system is significantly **increased**
- The pump **speed** is **increased**

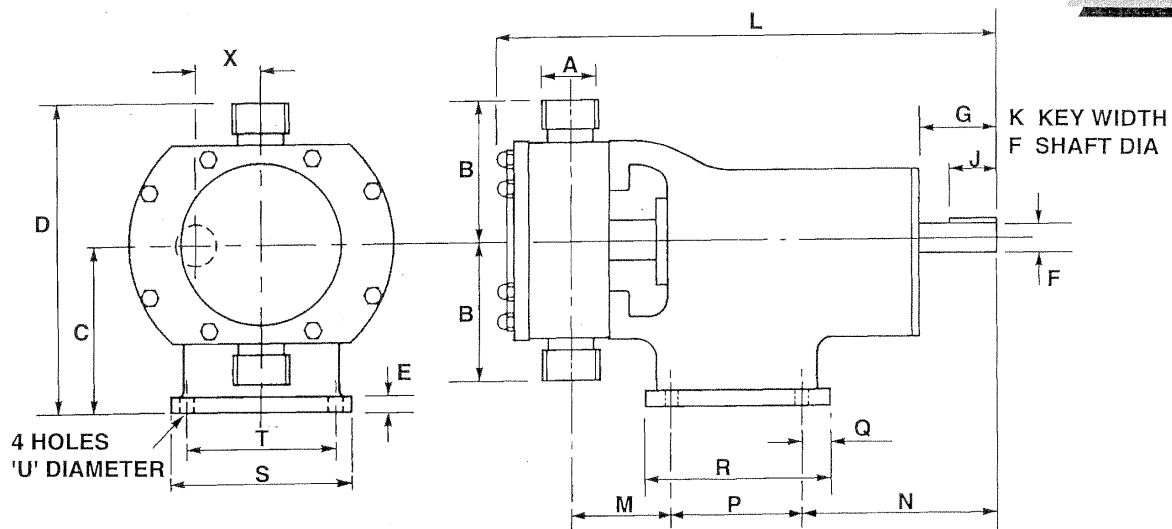
AIR CONNECTION



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	NOTCHED NUT	7	BUTTON HEAD SCREW
2	VALVE CANNISTER	8	VALVE GUIDE
3	SPRING ADJUSTER	9	SPRINGS
4	VALVE FRONT COVER	10	CIRCLIP
5	BACKSTOP DISC	11	PNEUMATIC PISTON
6	HYDRAULIC PISTON	12	VALVE SHAFT

PUMP DIMENSIONS

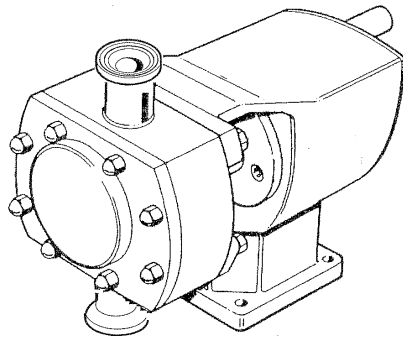
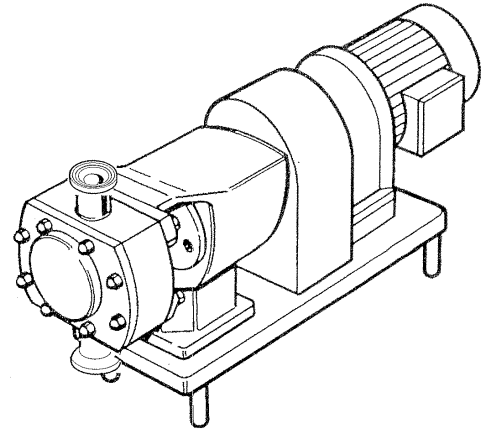
3.4



ALL DIMENSIONS IN INCH. (Except noted)

MODEL REF	A	B	C	D	E	F mm	G	J	K mm	L	M	N	P	Q	R	S	T	U	X
322	1	3.74	4.45	8.19	0.65	16	1.57	1.18	5	11.1	1.97	4.61	3.15	0.47	4.09	4.09	3.15	0.39	0.89
332	1.5	3.74	4.45	8.19	0.65	16	1.57	1.18	5	11.5	2.17	4.61	3.15	0.47	4.09	4.09	3.15	0.39	0.89
422	1.5	4.13	5.77	9.90	0.85	22	1.97	1.26	6	13.50	2.64	4.88	3.94	0.47	4.88	4.88	3.94	0.47	1.18
432	2	4.13	5.77	9.90	0.85	22	1.97	1.26	6	13.82	2.80	4.88	3.94	0.47	4.88	4.88	3.94	0.47	1.18
522	2	4.92	6.87	11.79	0.91	28	2.28	1.57	8	17.19	2.68	6.34	6.10	0.59	7.28	6.06	4.92	0.47	1.48
532	2.5	4.92	6.87	11.79	0.91	28	2.28	1.57	8	17.7	2.85	6.34	6.10	0.59	7.28	6.06	4.92	0.47	1.48
622	2.5	5.91	8.37	14.27	0.98	38	3.15	2.48	10	21.22	3.07	7.78	7.87	0.67	9.21	7.24	5.91	0.55	1.89
632	3	5.91	8.37	14.27	0.98	38	3.15	2.48	10	21.89	3.43	7.78	7.87	0.67	9.21	7.24	5.91	0.55	1.89
722	3	6.89	10.1	16.99	1.18	45	4.33	2.76	14	24.67	3.62	10.39	7.87	0.79	9.45	8.66	7.09	0.55	2.36
732	4	6.89	10.1	16.99	1.18	45	4.33	2.76	14	25.57	4.06	10.39	7.87	0.79	9.45	8.66	7.09	0.55	2.36
822	4	7.48	11.61	19.09	1.18	48	4.33	2.76	14	29.09	4.72	10.51	10.24	0.79	11.81	9.84	8.27	0.55	2.76
832	6	7.48	11.61	19.09	1.18	48	4.33	2.76	14	30.43	5.47	10.51	10.24	0.79	11.81	9.84	8.27	0.55	2.76

The above dimensions are for guidance only. Certified dimensions are available upon request.

**BARESHAF T PUMP****PUMP UNIT - PUMP COMPLETE WITH
DRIVE UNIT**

PUMP REFERENCE	BARESHAF T PUMP lbs.	PUMP WITH DRIVE UNIT lbs.
322	38	110
332	42	132
422	62	165
432	64	176
522	110	308
532	115	319
622	214	572
632	225	583
722	326	880
732	348	913
822	572	1155
832	583	1199

The above weights are for guidance only and will vary depending upon the specification of the pump, baseplate and drive unit.

PUMP DISPLACEMENT AND CAPACITIES

3.6

The following table details the pump capacities for the pump models. This figure will change depending upon speed, pressure, temperature and product being pumped.

PUMP MODEL	DISPLACEMENT GPM/100 REV	MAXIMUM SPEED (RPM)	MAXIMUM CAPACITY AT MAXIMUM SPEED GPM
322	1.4	1000	14
332	2.3	1000	22
422	3.38	1000	32
432	4.78	1000	45
522	7.03	1000	63
532	10.15	1000	93
622	14.64	1000	135
632	20.87	1000	193
722	30.65	600	212
732	44.39	600	311
822	65.00	500	324
832	93.20	500	466

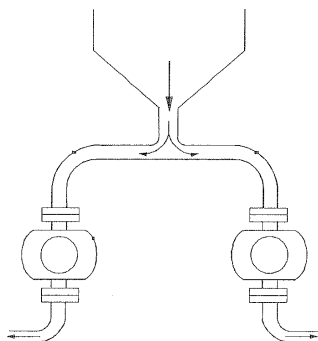


4.1 SYSTEM DESIGN ADVICE

When designing the pumping system :-

DO - confirm with the supplier the Net Positive Suction Head (NPSH) requirements for the system. This is crucial for ensuring the smooth operation of the pump and preventing cavitation.

DO - avoid suction lifts and manifold/common suction lines for two pumps running in parallel. This may cause vibration or cavitation.



DO - protect the pump against blockage from hard solid objects e.g. nuts, bolts etc. Also protect the pump from accidental operation against a closed valve by using one of the following methods :- relief valves, pressure switch, current monitoring device.

DO - fit suction and discharge pressure gauges to monitor pressures for diagnostic purposes.

DO - install a non-return valve to prevent turbinng when high pressures are applied to the pump while it is not in use. Valves are also recommended if two pumps are to be used on manifold/common discharge lines.

DO - make the necessary piping arrangements if flushing is required for the seal or if steam is required for heating jackets.

DO - provide a hose cleaning facility to assist maintenance, ensuring the drive unit meets the specification for hose cleaning.

DO NOT - subject the pump to rapid temperature changes during C.I.P. (Cleaning in Place) procedures. **PUMP SEIZURE CAN RESULT FROM THERMAL SHOCK.** The differential pressure across the pump should be near zero when cleaning. A suitable by-pass is recommended.

Depending on your requirements, the pump and drive (if supplied) may arrive mounted on a baseplate.

To provide a permanent, rigid support for securing the pump unit, a foundation is required, this will also absorb vibration, strain or shock on the pumping unit.

FOUNDATION SIZE

The foundation should be approximately 6 inches longer and wider than the mounting base of the unit. The depth of foundation should be proportional to the size of the pump unit (pump complete with drive and baseplate). For example, a large pump unit foundation depth should be at least 20 times the diameter of the foundation bolts.

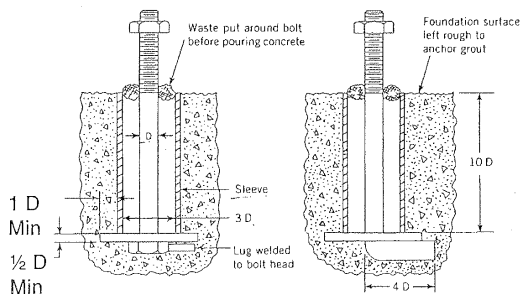
BOLT LOCATION DIMENSIONS

The location and sizes of the relevant bolting down holes can be provided on a certified drawing from your supplier.

TYPICAL FOUNDATION BOLTS

The drawing below shows two methods for foundation bolt retaining. The sleeve allows for 'slight' lateral movement of the bolts after the foundation is poured. Use rag or paper to prevent the concrete from entering the sleeve while the foundation is poured. A minimum of 14 days is required to allow the airing of the concrete prior to operation.

D = Diameter of foundation bolt

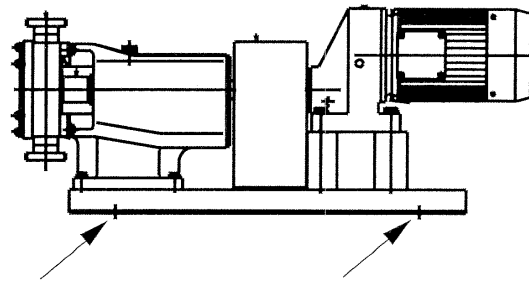


4.3 INSTALLATION

Before the pump is installed it is advisable to consider the following:

ALWAYS - Ensure that the mounting surface is flat to avoid distortion of the baseplate. This will pump/motor shaft misalignment and pump/motor unit damage.

CHECK - Pump shaft to motor shaft alignment once the baseplate has been secured. Adjust as necessary.



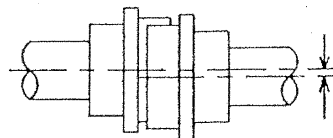
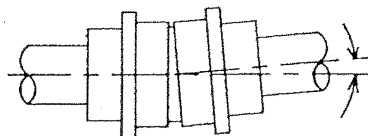
NOTE : Always allow at least **3 feet** for pump access/maintenance all around the pump.

WEIGHT - Consider the weight of the pump, drive and lifting gear requirements.

ELECTRICAL SUPPLY - Ensure that there is an adequate electrical supply close to the pump drive unit. This should be compatible with the electric motor selected.

When installing the pump and drive unit, it is **ESSENTIAL** to ensure that the coupling is **NOT** twisted during installation. The main cause of misalignment is by fitting the baseplate to an uneven surface.

Check the maximum angular and parallel allowable misalignments for the couplings before operating the pump.

**CAUTION****PARALLEL MISALIGNMENT****ANGULAR MISALIGNMENT**

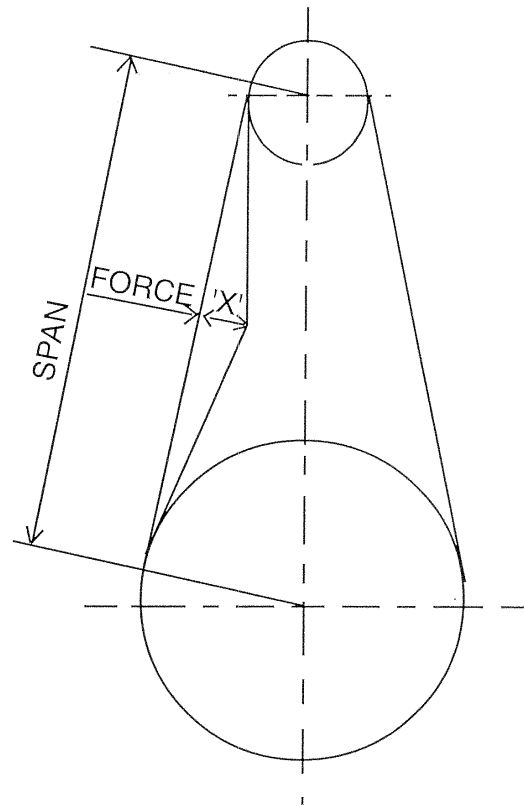
PULLEY BELT TENSION ADJUSTMENT

4.5

An incorrectly tensioned belt will cause belt slip and shorten belt life. **An excessively tensioned** belt will overload both belts and bearings. ALWAYS USE A BELT TENSION GAUGE FOR SETTING UP.

ISOLATE the drive unit and pump from all power and control supplies before attempting to work on adjusting the belts.

1. Measure the span length.
2. Calculate the required deflection: ('x')
 100mm span length = 1mm deflection
 therefore :
 400mm span length = 4mm deflection
3. Refer to the table for recommended minimum and maximum deflection force for small pulley diameter range.
 To convert Newtons to **pounds force** multiply by 0.2248.
 To convert Newtons to **kilograms force** multiply by 0.1020.
4. Use a belt tension gauge with the figures to determine the belt adjustment required.
5. Belt tension adjustment is achieved by adjusting the nuts on the pedestal frame.
6. Finally check that all nuts are re-tightened and the belts can move 'freely' by hand (depending upon pump size and system design).



BELT SECTION	SMALL PULLEY DIAMETER RANGE	RECOMMENDED DEFLECTION FORCE NEWTONS	
		MIN	MAX
XPZ SPZ	56	7	11
	60-63	8	13
	67-71	9	14
	75-80	10	15
	85-95	11	16
	100-125	13	19
	132-180	16	24
XPA SPA	80-125	18	27
	132-200	22	31

NOTE : The above table indicates the common pulley types used on the pump ranges. Details for other pulley types will be available on request.

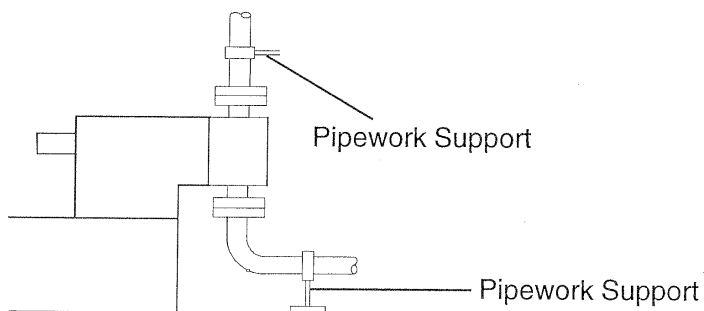


All pipework **MUST** be supported. The pump **MUST NOT** be allowed to support any of the pipework weight.

REMEMBER - Pipework supports must also support the weight of the product being pumped.

ALWAYS :-

- Have short straight suction lines to reduce friction losses in the pipework thereby improving the NPSH available.
- Avoid bends, tees and any restraints close to either suction or discharge side of pump. Use long radius bends wherever possible.
- Provide isolating valves on each side of the pump to isolate the pump when necessary.
- Keep pipework horizontal where applicable to reduce air locks. Include eccentric reducers on suction lines.
- Check coupling alignment during installation to highlight pipework alignment/support problems.



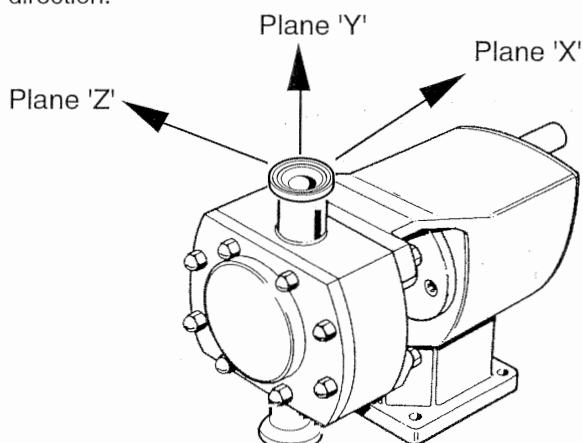
GENERAL

Rotary lobe pumps are precision machines running at speed with minimal clearances and sometimes utilizing high precision mechanical seals. It is therefore in the interest of long life that no external loading be applied to the pump units greater than those recommended.

Summation forces and moments are the resultant vector addition of the components, and represent a single force or moment in a secondary plane.

The loads given apply to both connections.

Assuming direction of arrows are positive, loads will be of the same magnitude in a negative direction.



- 1 No increase in loadings is allowable for reinforced or grouted baseplates.
- 2 No increase in loadings is allowable for shutdown pumps.
- 3 Loadings given are for up to 230°F operation only, above this temperature reference should be made to your supplier.
- 4 It is recommended that alignment of pump and driver be checked before and after applying loads to ensure alignment remains within manufacturer's tolerances, i.e. with pump flanges in a bolted and unbolted condition.
- 5 Initial alignment should be made with due regard to operating temperatures of the pump unit and pipework flooded.

TABLE OF MAXIMUM FORCES AND MOMENTS

PUMP REF	FORCES				MOMENTS			
	FZ (N)	FY (N)	FX (N)	EF (N)	MZ (NM)	MY (NM)	MX (NM)	EM (NM)
322/332	80	60	70	120	75	90	115	165
422/432	125	100	110	195	90	105	130	190
522/532	165	135	150	260	100	115	140	205
622/632	165	135	150	260	100	115	140	205
722/732	300	250	250	460	125	145	175	260
822/832	300	250	250	460	125	145	175	260

5.1 RECOMMENDED LUBRICANTS

Pumps specified oil filled :-

The pump will **NOT** be supplied prefilled with oil therefore the table below must be used to select a recommend oil.

Pumps specified grease filled :-

The pump can be supplied grease filled, as an option. When changing the grease the table below must be used to select a recommended grease.

RECOMMENDED LUBRICANTS

GREASE FILLED -4°F to +266°F	OIL FILLED	
	-4°F to +266°F	+266°F to 392°F
BP Energrease GSF Castrol Alpha Gel Mobil Glygoyle 00 Shell Tivela Compound A	BP Energol GR Castrol Alpha SP150 Mobil Gear 629 Shell Omala 150 Texaco Meropa 150 Esso Spartan EP150	BP GRS15 Castrol Alpha SN150 Mobil Glycoyle 30 Shell Tivela WA Texaco Synlube SAE90 Esso IL1947

CHANGING THE OIL :-

The pump will **NOT** be supplied oil filled.

First change - After 150 hours of operation.

Next changes - Every 3000 hours of operation.

Only use the oil/grease types recommended by your supplier.

OIL FILLING -

Fill with oil through the filler plug to the level indicated in the sight glass.

GREASE FILLING -

Fill with grease by pumping grease into the rear of the gearcase.

CHANGING THE GREASE :-

Pump supplied grease filled.

Change - every two years (dusty air conditions)

Change - every six years (clean air conditions)

LUBRICATION CAPACITIES

	QUARTS
322/332	0.35
422/432	0.80
522/532	1.50
622/632	2.90
722/732	4.80
822/832	8.00

A flushed seal arrangement is fitted in order to cool the seal area.

It is **IMPORTANT** that:-

- The flush is correctly **CONNECTED**. (See overleaf).
- A suitable flushing **FLUID** is used.
- The fluid is **SUPPLIED** at the **CORRECT PRESSURE** and **FLOW** rate.
- The flush is **TURNED ON** at the **SAME TIME/PRIOR** to **STARTING** the pump, and turned off at the same time/after stopping the pump.

5.4 CONNECTING THE FLUSH

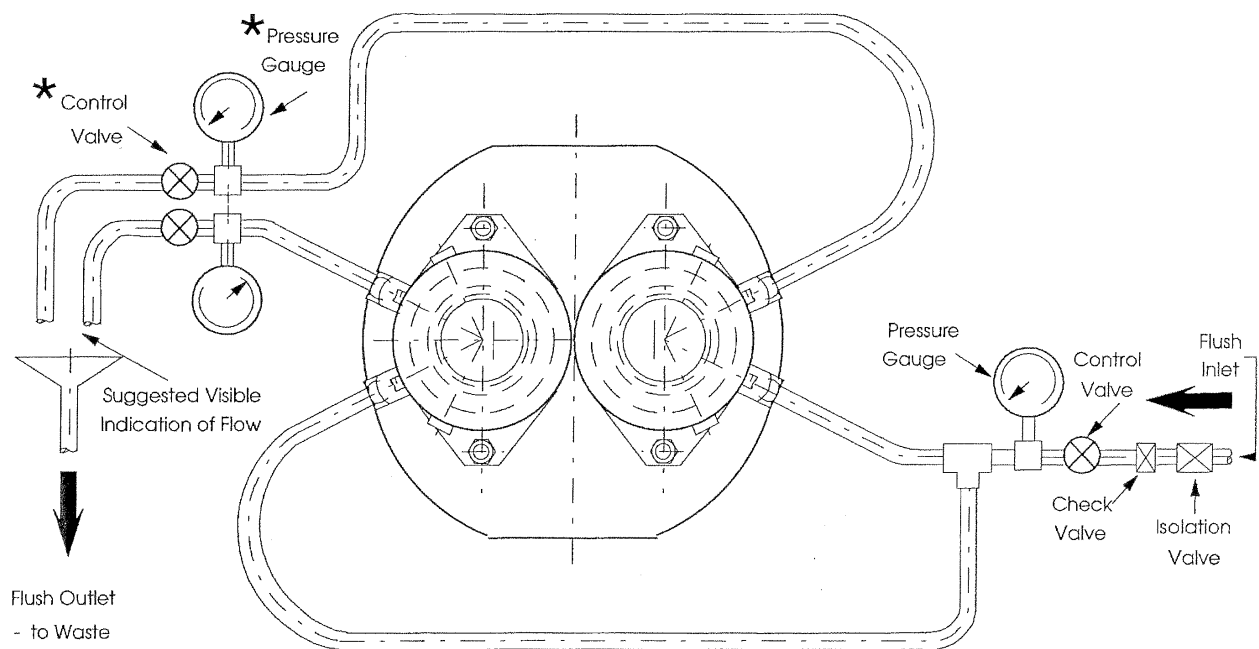
**CAUTION**

The following equipment is **STRONGLY RECOMMENDED** when using a flushing system.

- **CONTROL VALVE** and **PRESSURE GAUGE**, to enable the correct flushing pressure to be obtained and monitored. (A constant flow valve can be used).
- **ISOLATION VALVE** and **CHECK VALVE**, so that the flush can be turned off, and to stop any unwanted substances flowing in the wrong direction.
- A method of visibly indicating flushing fluid flow e.g. using a sight glass.

This suggested arrangement is for **SINGLE MECHANICAL SEALS** or **HYCLEAN SEALS**. If the pump is fitted with **DOUBLE MECHANICAL SEALS** or **PACKED GLANDS** the **PRESSURE GAUGES** and **CONTROL VALVES** should be fitted on the **OUTLET SIDE** of the system.

* Double mechanical seal/packed gland only



PIPEWORK & FITTINGS NOT SUPPLIED WITH PUMPS

FLUSHED SEAL HOUSING CONNECTIONS

PUMP REF	SINGLE/DOUBLE MECHANICAL SEAL	HYCLEAN SEAL	PACKED GLAND
322/332	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{1}{8}$ "
422/432			
522/532			
622/632			
722/732	$\frac{1}{4}$ "	$\frac{1}{4}$ "	$\frac{1}{4}$ "
822/832	$\frac{1}{4}$ "	$\frac{1}{4}$ "	

All connections BSPT or NPT as specified at the time of order.

5.7 FLUSHING FLUID

The choice of flushing fluid is dependant upon the pumping media and duty conditions i.e. pressure and temperature. Usually water is used for cooling or flushing water soluble products. For advice on selecting a suitable flushing fluid please contact the supplier.

5.8 FLUSHING PRESSURE AND FLOW RATE

Single Mechanical Seal/Hyclean - 7.3 psi maximum.
Any further increase in pressure will result in lip seal failure.

Double Mechanical Seal/Packed Gland Seal - 15 psi greater than the pressure at the seal.

For guidance the pressure at the seal is approximately $\frac{2}{3}$ of the pumping pressure.

The flushing **FLOW RATE** must be adequate to ensure that the temperature limitation of the seals is not exceeded. Contact your supplier for further information on recommended flow rate for the product fitted.



ADJUSTING THE RELIEF VALVE

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ITEM	DESCRIPTION
1	NOTCHED NUT
2	VALVE CANNISTER
3	SPRING ADJUSTER
4	VALVE FRONT COVER
5	BACKSTOP DISC
6	HYDRAULIC PISTON
7	BUTTON HEAD SCREW
8	VALVE GUIDE
9	SPRINGS
10	CIRCLIP
11	PNEUMATIC PISTON
12	VALVE SHAFT

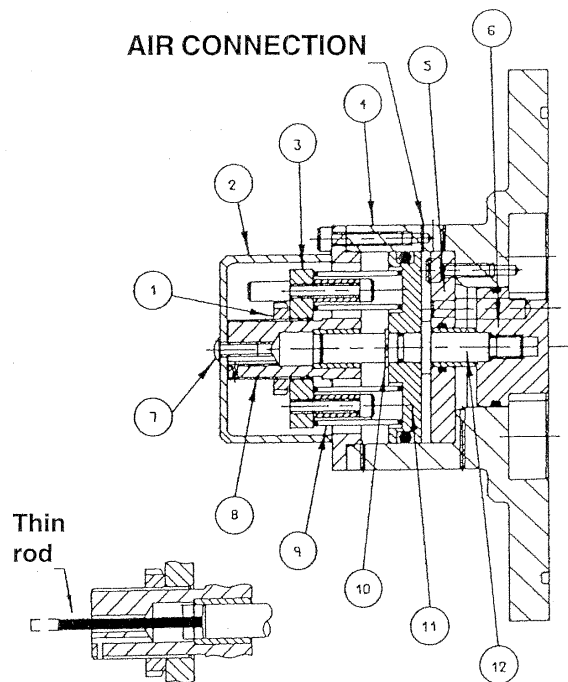
RELIEF VALVE PRESSURE RANGE

The following table indicates the pressure ranges for the pumps with standard or lever operated valves

VALVE TYPE	PUMP REF	PRESSURE RANGE (psi)
STANDARD	30-80	101-275
LEVER OPERATED	30-70 80	101-145 101

THE RELIEF VALVE WILL REQUIRE SETTING TO SUIT THE SITE CONDITIONS.

1. Ensure a pressure gauge is fitted to the discharge side of the pump.
2. Remove the valve cannister.
3. Check the notched nut is fully released, so that the springs are uncompressed.
4. Insert a thin rod through the button screw hole onto the end of the piston shaft and mark the rod by the valve guide.
5. Re-start the pump and note the pressure gauge reading when the rod starts to move, or the end of the shafts starts to protrude (manual override). This indicates the valve is beginning to open and the pressure is dropping slightly.
6. Tighten the notched nut inwards by fine adjustments until the correct system pressure is achieved and therefore any increase in system pressure will activate the valve.
7. Apply nut locking adhesive to the notched nut once the relief valve is set.



The relief valve may be released by supplying air through the air connection, which makes it ideal for a CIP system. Air supplies must be clean and dry and supplied between the following pressure limits:

AIR PRESSURE	
MIN	MAX
4 BAR (60psi)	8 BAR (120 psi)

The air connection is positioned on the outside of the valve housing and will be threaded according to the pump size as follows:

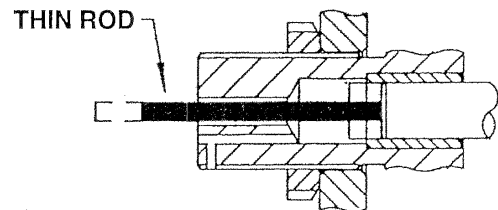
PUMP	CONNECTION
322/332 422/432 522/532	$\frac{1}{8}$ " BSPT/NPT
622/632 722/732 822/832	$\frac{1}{4}$ " BSPT/NPT

The connections must be made via a standard instrument valve which vents the air from the chamber if no air is being supplied.

5.11 CHECKING THE AIR OPERATION OF THE RELIEF VALVE

It is possible to check the air operation of the valve with the pump operating, but this should only be done when there is no pressure in the pump and system, the pump may therefore need to be stopped. To check if the valve is correctly operating using air, the following procedure should be adopted.

1. Remove the button head screw followed by the valve housing.
2. Insert a thin rod through the button screw hole onto the end of the piston shaft and mark the rod at the end of the valve guide.
3. Open the air supply to the valve and push the rod onto the new position of the piston shaft, marking the rod as before.



4. Close the air supply and check that the piston has moved back to its original position by noting the position of the first mark on the rod.

NOTE : On manual override valves, note the end of the valve shaft moves away from the valve cannister.

Careful attention should be taken when piping up and connecting to steam jackets and saddles. (see below)

If new steam jackets and saddles are being fitted use Loctite Multigasket 576 (or equivalent).

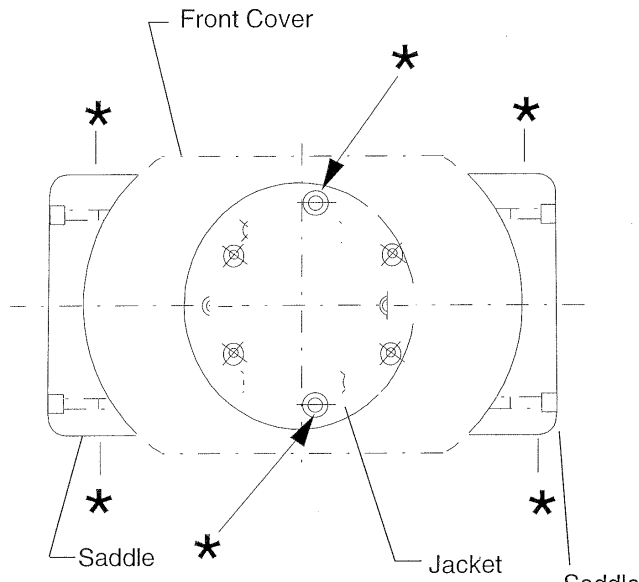


CAUTION

Prior to operation a hydrostatic test should be completed on the new steam jackets and saddles. Pumps supplied with jackets and saddles are hydrostatically tested at the time of manufacture. If they must be replaced for any reason, it is recommended for safety that this test is carried out before use.

Hydrostatic test pressure (water) :- 87psi

Maximum working pressure :- 50psi



Connection for steam, hot/cold fluid entry and exit.

6.1 PUMP START-UP CHECK**YES****NO**

1. Has the pipework system been flushed through to purge welding slag and any other hard solids?
2. Have all **obstructions** been removed from the pipework or pump?
3. Are the pump **connections** and pipework joints **tight** and **leak-free**?
4. Is there **lubrication** in the **pump** and **drive** unit?
5. If your product seals require flushing has the flushing supply been fitted?
6. Are the pipework **valves open**?
7. Are **all safety guards** in place?
8. Start then stop the pump, is the product **flowing** in the correct **direction**?
9. Are the pump **speed/pressure** settings below the pump maximum limitations?
10. Is the location of the '**stop**' button clear?

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐**ALL ANSWERS SHOULD BE YES BEFORE PROCEEDING**

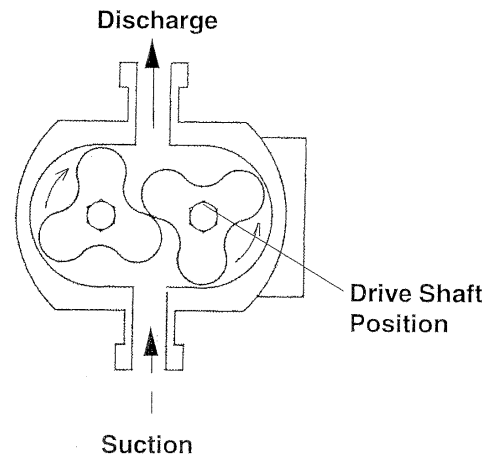
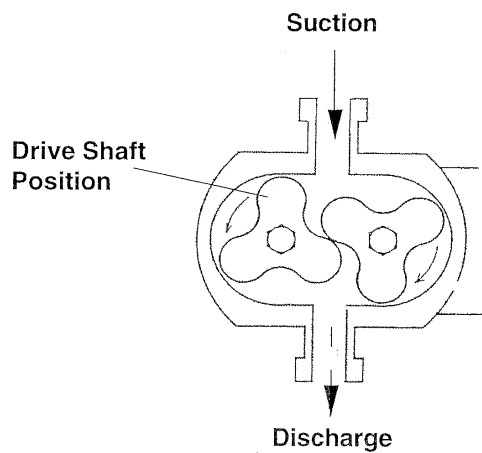
**IF THERE ARE ANY PUMPING PROBLEMS
REFER TO THE FAULT FINDING CHART**



1. Turn the pump off.
2. Isolate the pump/drive unit from all power and control supplies.
3. Close the pipework valves to isolate the pump.
4. If the pump is to be disassembled refer to the disassembled section.

6.3 DIRECTION OF ROTATION

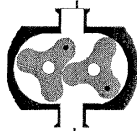
The direction of flow is dictated by the location of the drive shaft. Different drive shaft positions have opposite flow directions as illustrated.



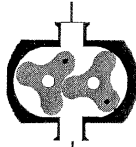
CLEANING IN PLACE (C.I.P.)

The pump can be manually cleaned or cleaned in place (C.I.P.). The following is an example of a typical CIP procedure. However specific advice for each application should be sought from the pump supplier.

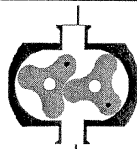
1. Flush through the system with cold water (42°F). See note at the bottom of this page.



2. Run hot caustic soda (158-176°C) at 2.5% dilution through the system for 20-30 minutes. See note at the bottom of this page.



3. Final flush through with cold water again. See note at the bottom of this page.



NEVER touch the pump or pipes as they will be extremely **HOT!**



DO NOT subject the pump to rapid temperature changes during C.I.P. procedures, as pump seizure can result from thermal shock. A suitable by-pass is recommended.



ALWAYS use rubber gloves and protective when handling caustic agents.



ALWAYS rinse with clean water using a cleaning agent.



ALWAYS store/discharge cleaning agents in accordance with current rules d/directives.

7.1 MAINTENANCE SCHEDULE

It is advisable to install pressure gauges on either side of the pump so that any problems within the pump/pipework will be highlighted.

YOUR WEEKLY SCHEDULE SHOULD INCLUDE:

- CHECKING THE **OIL LEVEL** IN THE GEARCASE (IF APPLICABLE)
- CHECKING THE **MECHANICAL SEALS** FOR LEAKAGE AND REPLACING AS NECESSARY
- ADJUSTING THE **PACKED GLANDS** TO CONTROL LEAKAGE
- CHECKING THE **OIL SEALS** FOR LEAKAGE
- CHECK **PUMPING PRESSURES**

7.2 RECOMMENDED SPARE PARTS

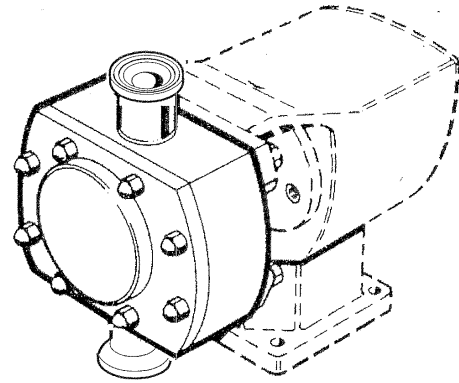
The following table details the recommended spare parts which should be retained within your maintenance stock.

Part Description	Quantity
Lip Seal Drive End	2
'O' Ring Front Cover	1
Lip Seal Gland End	2
Rotors	2
'O' Ring Rotor Sealing	2
'O' Ring Rotor Nuts	2
Product Seals	2

THE PUMP HEAD

Tools needed:

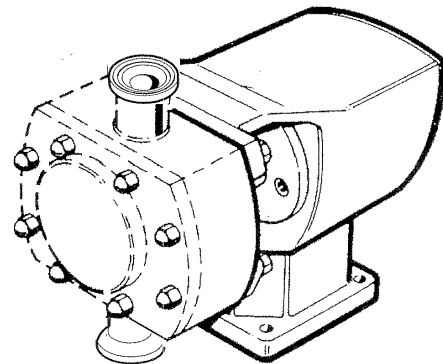
- Allen keys
- Wrenches
- Socket set
- Wooden wedge
- Soft mallet
- Cleaning hose
- Silicon grease
- (Food Quality if necessary)



THE GEARBOX

You will need -

- A Work Shop equipped with:
- A heavy duty vice
- A press and pressing tools
- Lifting gear
- Induction heater
- A method of lubrication collection
- Lever soft ended
- Wooden wedge
- 'C' wrench
- Liquid gasket
- Permabond 145 (or equivalent)



8.1 BEFORE DISASSEMBLING THE PUMP

Before starting to disassemble the pump ALWAYS:-

**ISOLATE -**

pump/drive unit from all power and control supplies.

**CLOSE -**

pipework valves to isolate the pump

**PURGE -**

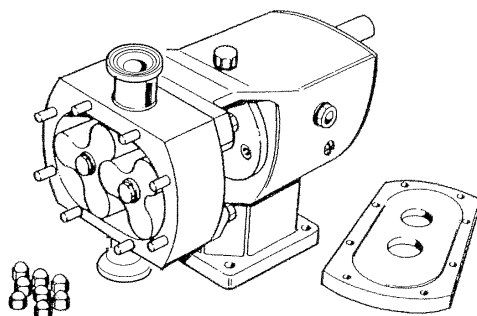
the pump and system if any noxious products have been pumped.

**DISCONNECT -**

the pump from the drive unit.

**READ THIS SECTION FIRST BEFORE
CONTINUING TO DISASSEMBLE THE PUMP**

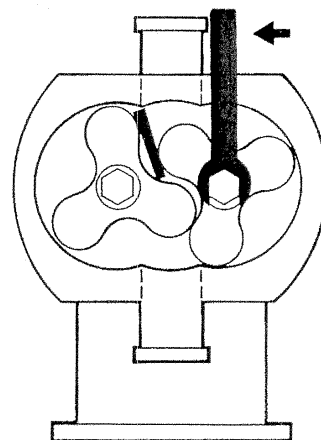
1. Carefully loosen the front cover retaining nuts as there may still be residual pressure in the system. Release lower nuts first, any product will be directed down.
2. Remove the front cover nuts and take off the cover.
3. Flush out the pumphead before continuing.



FRONT COVER NUT SPANNER SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	13	17	17	17	17	19

8.3 REMOVING THE ROTORS

1. Insert a plastic/wooden block between the two rotors to stop them turning.
2. The drive shaft is a righthand thread and the rotor nut should be released counter-clockwise. The lay shaft has a left hand thread and the rotor nut should be released clockwise.
3. Extract the rotors which should slide out from the splines.



ROTOR NUT SPANNER SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	17	24	24	36	36	36
TLA KEY SIZE mm	N/A	N/A	N/A	N/A	N/A	5

ALP/MM022/01

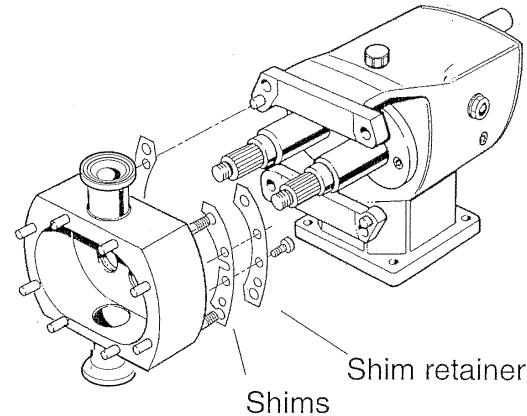
REMOVING THE ROTORCASE

8.4

1. On packed gland seals loosen the gland followers to relieve the packing pressure on the shaft.

On flushed seal arrangements, remove the housing retaining nuts and ease the housing back away from the rotorcase.

2. Remove the gearcase nuts and washers.
3. Tap the rotorcase with a soft mallet on both sides of the rotorcase.



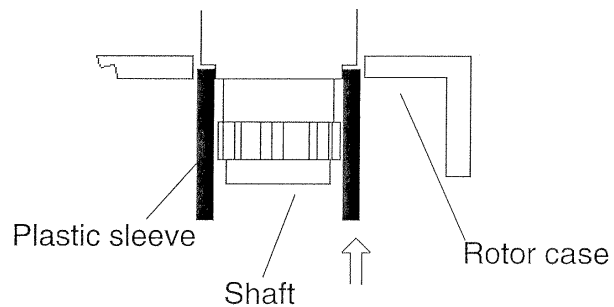
CAUTION

4. **TAKE CARE NOT TO DAMAGE MECHANICAL SEALS.** The rotorcase must not be allowed to drop onto the shafts during the removal process, **apply shaft sleeves to shaft to guide seal and prevent damage.**

ROTORCASE NUT SPANNER SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	13	17	17	19	19	24

5. The **SHIMS** are fitted to adjust the rotor clearances, and should only be removed when the clearance requires resetting.

NOTE : Shims have different colors for different thicknesses, and are grouped in packs at the top and bottom of the rotorcase and held in place by the shim retainer.



8.5 DRAINING THE PUMP LUBRICATION

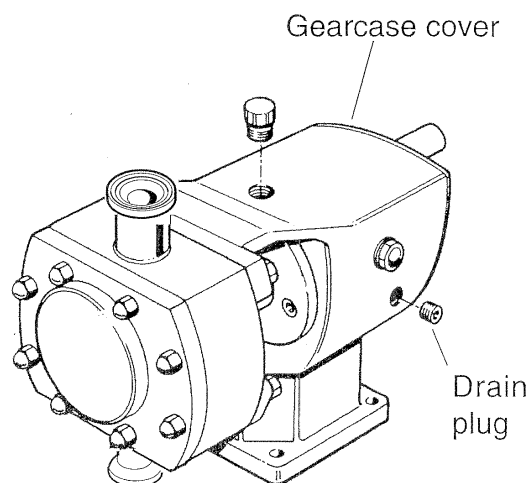
DRAIN THE PUMP LUBRICATION BEFORE CONTINUING.

GREASE FILLED GEARBOX

- Remove the gearcase cover
- The top chamber on double lubrication chambers is drained by removing the shaft.

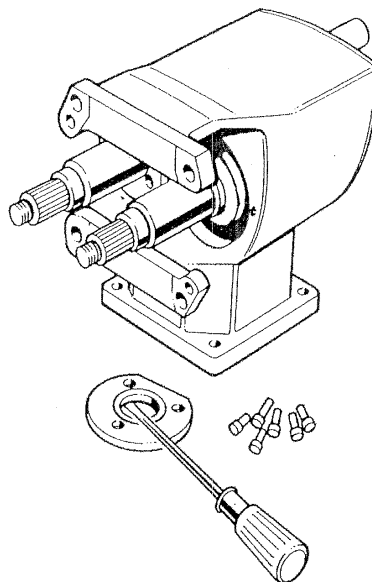
OIL FILLED GEARBOX

- Remove the draining plugs at the side of the gearcase and in the gearcase cover.



REMOVING THE FRONT SEAL RETAINERS

1. Remove the socket head cap screws
2. Use a lever to remove the seal retainers as a sealant is used as a gasket to the gearcase.
3. The lip seals can be removed using a screwdriver/lever. It is essential to renew the lip seals prior to re-assembly.



RETAINER SCREW KEY SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	5	5	5	6	6	6

8.7 REMOVING THE GEARCASE COVER

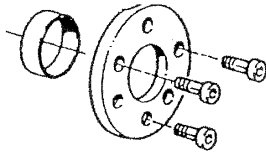
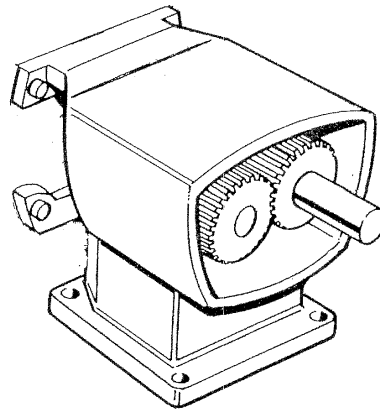
1. Remove the socket head cap screws.
2. Tap the gearcase cover (which is sealed with liquid gasket) sharply in the center between the socket head screw holes using a mallet and punch to break the sealant joint.
3. Slide the cover from the shaft and press out the lip seal. It is essential to renew the lip seals prior to re-assembly.

COVER SCREW KEY SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	5	5	5	6	6	6

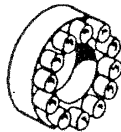
REMOVING THE TIMING GEARS

8.8

1. Release the clamp plate socket head cap screws (30,40,50). Release the torque locking assembly screws in several stages (60,70,80).
2. Remove the torque locking elements or assemblies.
3. Pull off the timing gear using the tapped extraction holes provided, or tap the shafts through the gears.



30,40,50



60,70,80

TLA/CLAMP PLATE SCREWS KEY SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	5	5	5	5	6	6

8.9 SHAFT ASSEMBLY REMOVAL

1. Using a soft mallet gently tap the rear end of each shaft, to remove it through the front of the gearcase.
2. Support each shaft during removal from the gearcase.
3. A shaft abutment spacer is located in:-

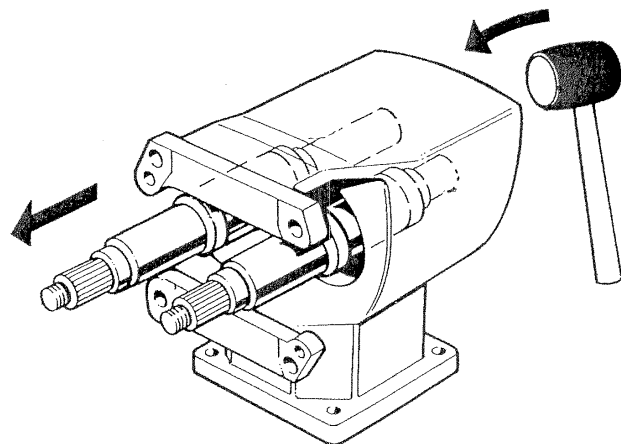
SINGLE BEARING ASSEMBLIES -

The rear bearing bore on the right hand side of the gearcase looking from the front of the pump.

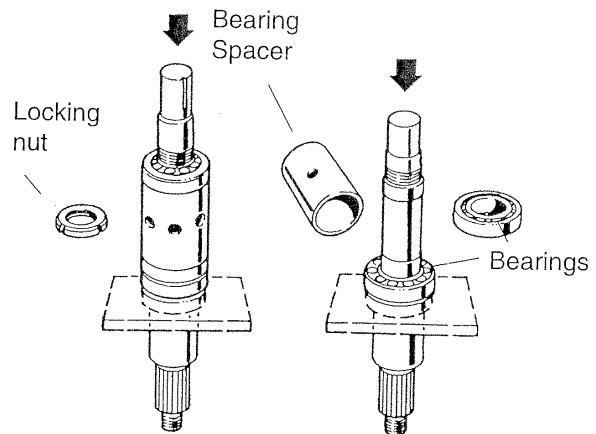
DOUBLE BEARING ASSEMBLIES -

The front bearing bore on the right hand side looking from the front of the pump.

and must be retained for re-assembly.

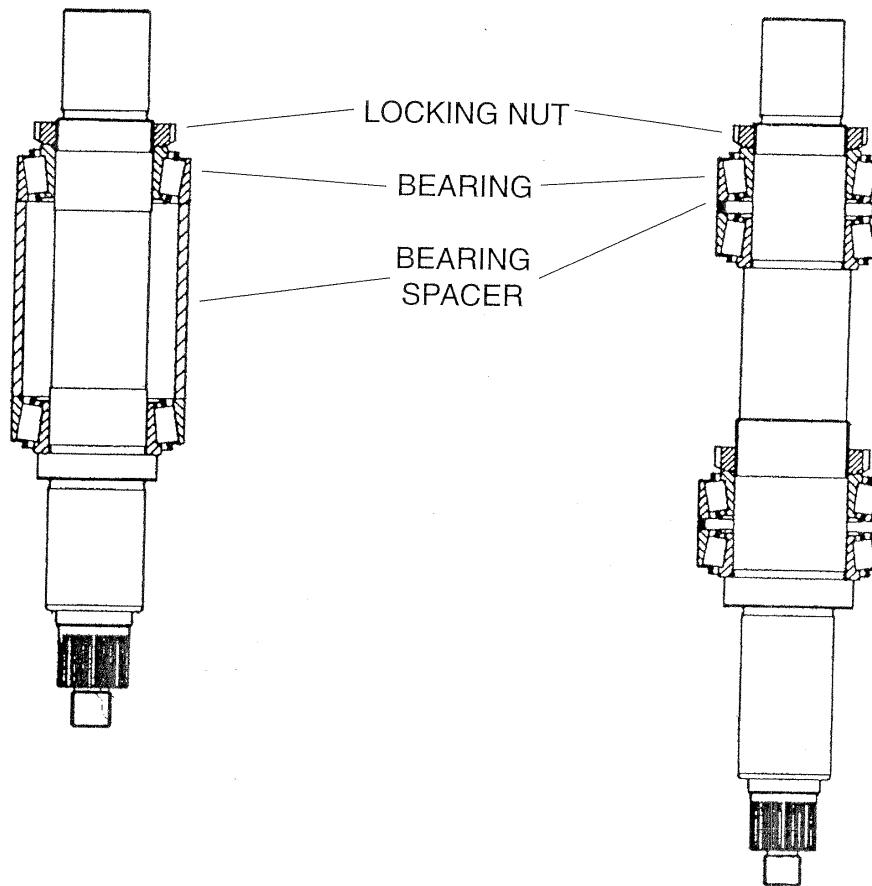


1. Remove the locking nuts, which have thread locking adhesive on them, with a 'sharp tap' on a 'C' spanner.
2. Mount the shaft vertically in the press with a pressing tool located against the bearing inner as shown.
3. Apply pressure to the top of the shaft so that the shaft moves through the bearing.
4. Remove each bearing set (inner and outer cones) and **MAINTAIN IN SETS**. To assist assembly note the positions on the shaft from which the bearings were pressed.



SINGLE BEARING ASSEMBLY

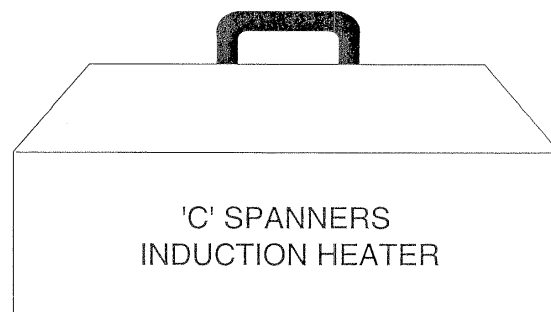
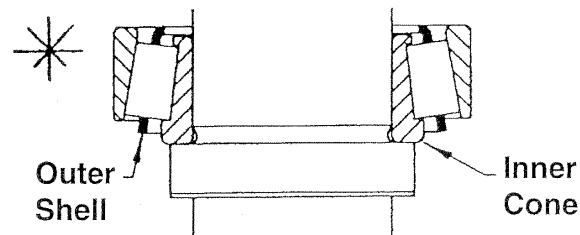
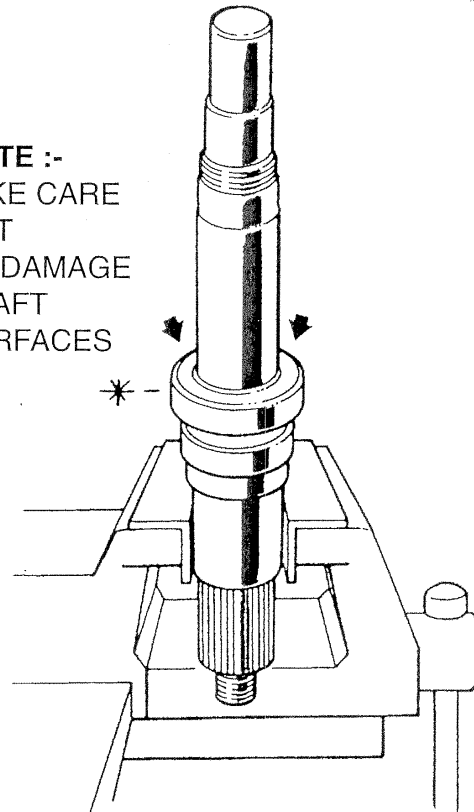
DOUBLE BEARING ASSEMBLY



9.1 FITTING BEARINGS TO THE SHAFT

1. Position shaft vertically into the vice and apply anti-seize compound to the bearing diameters.
2. Use an approved induction heater to heat the front inner cone bearing to 230°F on pumps 60,70,80. Pumps 30,40 and 50 do not require heating.
DO NOT USE ANY FORM OF LIVE FLAME WHEN HEATING AS THIS WILL DAMAGE BEARINGS.
3. Pass the heated/unheated bearing over the shaft ensuring a positive fit against the shaft shoulder.
4. Locate outer shell.
5. Locate bearing spacer.
6. Locate rear bearing shell.
7. Heat rear inner bearing (60,70,80 pumps only) cone and drop onto rear bearing shell.
8. **ALLOW BEARINGS TO COOL. (60,70,80 pumps only)**
NOTE: Failure to do so will result in incorrectly set bearings.
9. Apply Permabond Grade 145 or equivalent to the shaft lock nut thread and screw on the lock nut.
10. Continue to tighten the locking nut while at the same time rotating the bearings and spacer. The bearings are correctly seated when the spacer can only be moved with a light tap of a mallet.
11. **Repeat** the above for **double bearing assemblies.**
12. Apply oil to the bearings.

NOTE :-
TAKE CARE
NOT
TO DAMAGE
SHAFT
SURFACES



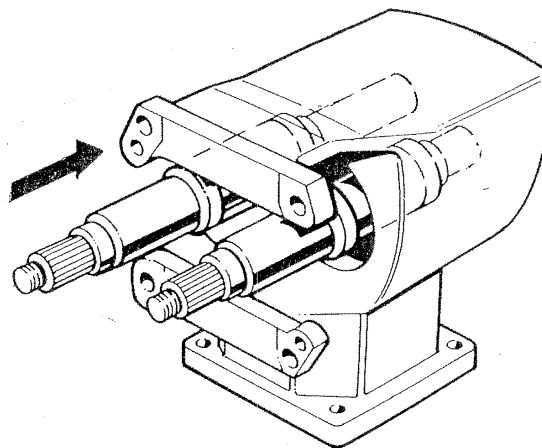
1. Replace the shaft abutment spacer located in:-

Single Bearing Assemblies - The rear bearing bore on the right hand side of the gearcase looking from the front of the pump.

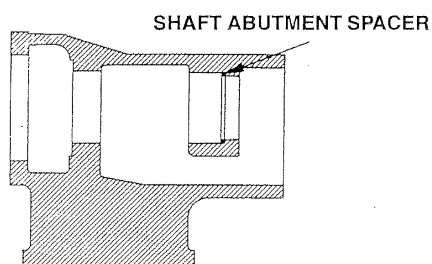
Double Bearing Assemblies -The front bearing bore on the right hand side looking from the front of the pump.

2. Identify if pump is to be built left or right hand shaft drive.
3. Fit auxiliary shaft into the gearcase.
4. Fit drive shaft into the gearcase.

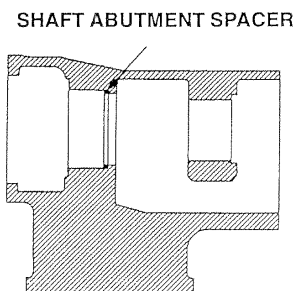
NOTE : If the bearings have been replaced the new abutment spacer will need adjustment. See checking the rotor abutment alignment section.



SINGLE BEARING ASSEMBLIES



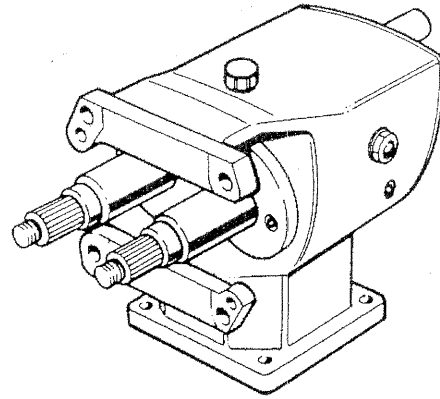
DOUBLE BEARING ASSEMBLIES



FITTING THE FRONT SEAL RETAINERS

9.3

1. Clean and examine for grooving the surfaces where the lip seals will seat, and remove the old sealant from the rear face.
2. If the rotor abutment **alignment** is set apply sealant to the retainer face, otherwise refer to the checking rotor abutment alignment section.
3. Press the new lip seal into the seal retainer..
4. Push the retainers onto the shaft. Make sure the lip seals do not distort by using a suitable tool to guide the lip seals onto the shaft.
5. Replace and tighten the socket head cap screws. As shown.



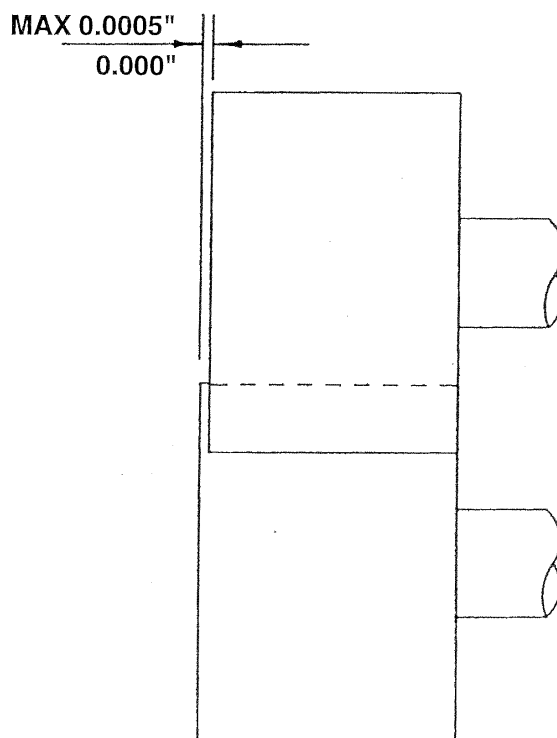
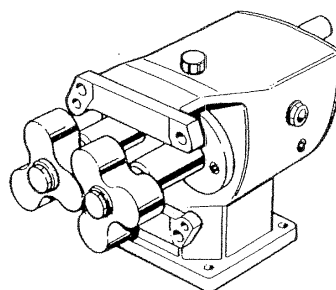
	322/332	422/432	522/532	622/632	722/732	822/832
SOCKET SCREWS KEY SIZE mm	5	5	5	6	6	6
TORQUE lb-FT	7	7	7	19	19	19

**CAUTION**

ROTOR NUT SPANNER SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	17	24	24	36	36	36
DEPTH MICROMETER						

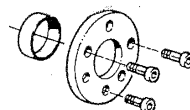
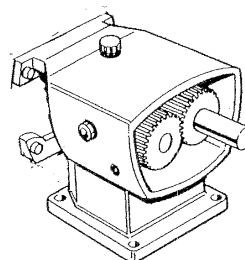
INCORRECT SETTING OF THE ROTOR ABUTMENT ALIGNMENT WILL DAMAGE THE PUMP.

1. Fit the rotors onto the shafts and tighten the rotor nuts.
2. Using a depth micrometer ensure the axial alignment is within tolerance 0.0005".
3. If the tolerance is not achieved the shaft abutment spacer must be replaced/reground to give the correct tolerance.



1. Slide each timing gear onto the shafts, realign marks if gears were previously marked in pairs.
2. Fit the torque locking elements (30,40,50), (high pressure pumps have two sets) or torque locking assemblies (60,70,80)
3. Fit the timing gear clamp plates. (30,40,50 only).
4. Timing adjustment is now required:-

Tighten one of the clamp plates/torque locking assemblies only, therefore allowing rotation of the shaft in the remainder for timing adjustment. See adjusting the Rotor Timing Section.



30,40,50

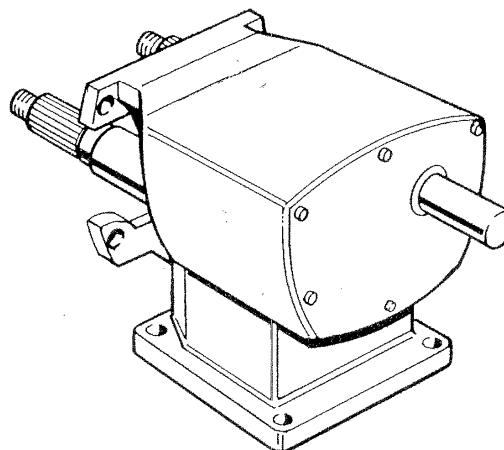


60,70,80

TLA/CLAMP SCREWS KEY SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
KEY SIZE mm	5	5	5	5	6	6
TORQUE lb-FT	9	13	9	10.5	26.5	26.5

9.6 FITTING THE GEARCASE COVER

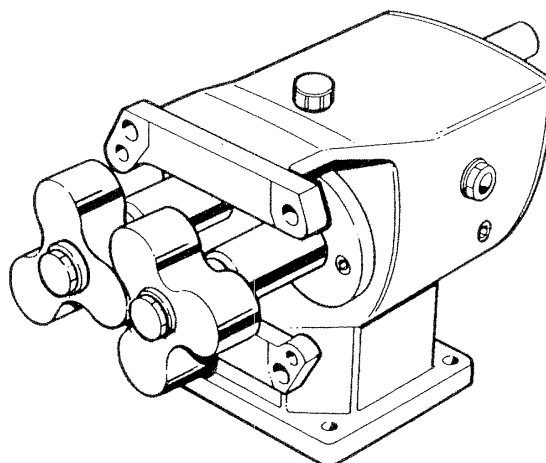
1. Clean the gearcase cover bore and press the lip seal into the cover.
2. Clean the faces of the cover removing all the liquid gasket.
3. Coat liquid gasket on the inner face of the cover that will mate with the gearcase edge.
4. Carefully push the cover over the shaft and tighten the socket head cap screws.



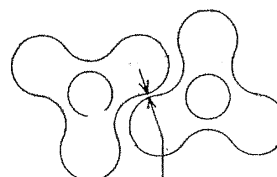
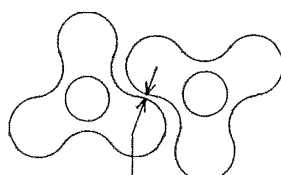
COVER SCREWS KEY SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
KEY SIZE mm	5	5	5	6	6	6
TORQUE lb-FT	7.5	7.5	7.5	19	19	19

If the rotor timing requires adjustment it is important to establish the cause for the rotors mis-timing before proceeding.

1. To allow rotor timing adjustment ensure that one shaft is 'free' to move within the torque locking assembly/clamp plate.
2. Set the rotors to the positions shown with the rotor dimples in the 3-9 o'clock plane.
3. Turn the shaft so that the rotors are in the new positions below.
4. Using feeler gauges measure between the points shown below turning the shaft as required.
5. If the measurement points are unequal tap the rotor which is on the free turning shaft until equal measurement through 6 points is achieved as far as possible.
6. Tighten the torque locking assemblies (TLA) and clamp plate screws.
7. Remove the rotors.



9.8 ROTOR MEASUREMENT POINTS



TIMING GEAR TLA/CLAMP SCREWS KEY SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	5	5	5	6	6	6
TORQUE lb-FT	9	13	9	10.5	26.5	26.5

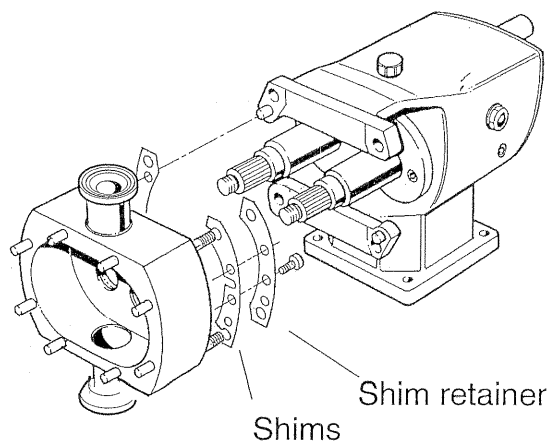
ROTOR NUT SPANNER SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	5	5	5	6	6	6
FEELER GAUGES						

The rotorcase may require re-shimming if new components have been fitted to the shaft assemblies or the gearbox changed. The back clearances should be checked before operating the pump.

If the rotorcase has previously been shimmed, the shim retainer and shims should not be removed.

New shims should be fitted using the following procedure:

1. Insert the smallest thickness shim between the top and bottom of the rotorcase and gearcase.
2. Fit the rotorcase to the gearcase, tighten the gearcase nuts and fit the rotors.
3. The back clearance can now be measured using feeler gauges. The additional shimming required to bring the clearances within tolerance can be determined.
NOTE : For the correct clearance dimensions please contact your supplier.
4. Fit the additional shims and re-check the clearances and if necessary repeat the re-shimming procedure.
5. Remove the rotorcase with the shims (secured by the shim retainer) ready for fitting the product seal.

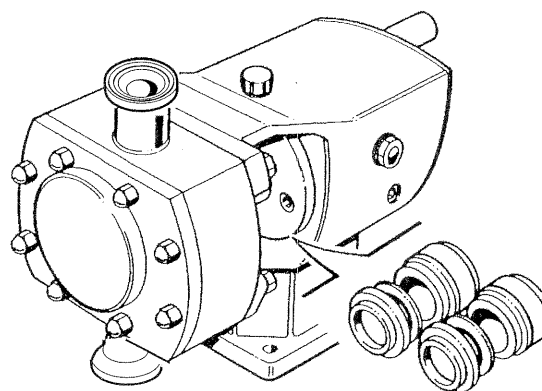


ROTORCASE/ GEARCASE NUT SPANNER SIZE mm	322/332	422/432	522/532	622/632	722/732	822/832
	13	17	17	19	19	24
TORQUE lb-FT	15	30	30	48	112.5	131

9.10 FITTING THE PUMP SEALS

REFER TO THE TYPE OF SEAL TO BE FITTED FOR FURTHER INSTRUCTIONS.

SEAL FACES ARE BRITTLE. ANY MARKS ON THE SEAL FACES WILL CAUSE FAILURE TAKE EXTREME CARE WHEN HANDLING.

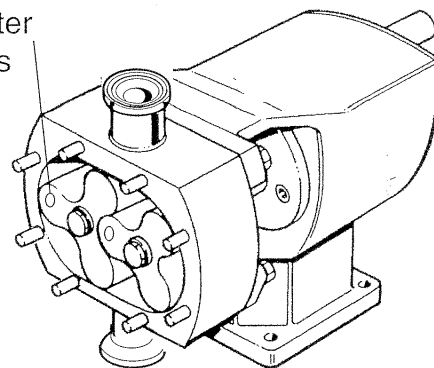


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1. Fit new rotor 'O' rings.
2. Fit the rotors onto the shafts with both dimpled rotor master lobes in the 3 - 9 o'clock position.
BILOBES : Fit the dimpled rotor in the 6 - 12 o'clock plane onto the left hand shaft and the remaining rotor in the 3 - 9 o'clock.
3. Fit the Rotor Nuts.
4. Use a wooden/plastic rotor lock to assist in tightening the rotor nuts. (Note: 80 series requires TLA Key for rotor nut tightening).
5. To check that the rotors are correctly synchronized turn the drive shaft by hand and check the meshing clearances with feeler gauges against clearance charts. (available on request from you supplier).

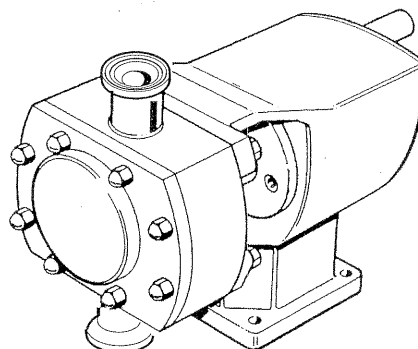
Dimpled
Master
lobes



	322/332	422/432	522/532	622/632	722/732	822/832
ROTOR NUT SPANNER SIZE mm	17	24	24	36	36	36
TORQUE lb-FT	10.5	58	90	121	121	121
TLA Key mm	N/A	N/A	N/A	N/A	N/A	5
Torque Ft/lb	N/A	N/A	N/A	N/A	N/A	10.5



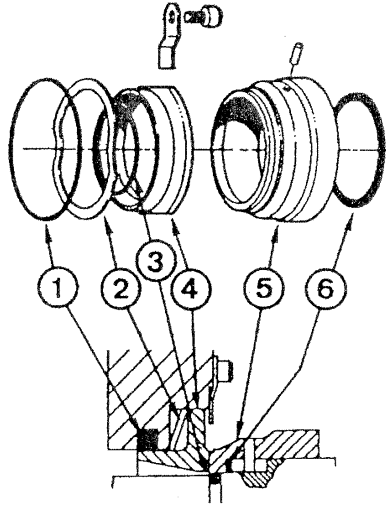
1. Fit new front cover 'O' ring.
2. Lightly smear the 'O' ring in grease (food quality if necessary) and locate it in the front cover groove.
3. Fit the cover onto the rotorcase studs and tighten the front cover nuts.
4. The pump can now be mounted with its drive unit.
5. Prior to start up the pump must be filled with either grease or oil.



READ THE START-UP CHECK LIST BEFORE PROCEEDING TO START THE PUMP.

	322/332	422/432	522/532	622/632	722/732	822/832
ROTOR NUT SPANNER SIZE mm	13	17	17	17	17	19
TORQUE lb-FT	15	29	29	29	29	29





ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	ROTORCASE 'O' RING	4	STATIONARY FACE
2	WAVE SPRING	5	ROTARY FACE
3	SHAFT 'O' RING	6	WASHER

The seal rotary face is driven by a pin which locates in a slot on the shaft. A washer is located between the shaft shoulder and rotary face. A seal between the rotary face and shaft is provided by an 'O' ring. The stationary face is prevented from rotating as it has a flat side which sits in the rotorcase bore. Face to face contact is provided by a wave spring. Axial movement of the stationary face is prevented by a retaining clip. An 'O' ring within the rotorcase bore provides a seal onto the stationary face.

**CAUTION**

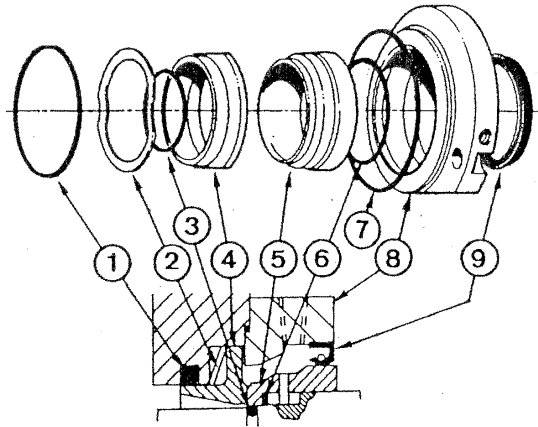
SEAL FACES ARE BRITTLE - TAKE EXTREME CARE WHEN HANDLING.

REMOVING THE HYCLEAN SEAL

1. Carefully support and remove the rotorcase with the stationary sealing face still within its bore.
2. Slide the remaining rotary face from the shaft.
3. Release the retaining clip and remove the stationary face for inspection.

FITTING THE HYCLEAN SEAL

1. Use solvent to wipe the lapped surface of the seal faces until **PERFECTLY** clean, being extremely careful not to scratch the faces.
2. Lightly lubricate the 'O' rings and washer with grease (food quality if necessary).
3. Locate the 'O' rings on the shaft and within the rotorcase bore respectively.
4. Press the washer into the rotary face and slide onto the shaft, locating the pin in the shaft slot.
5. Position the wave spring over the stationary face, push into the rotorcase and tighten the retaining clips.
6. Refit the rotorcase.



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	ROTORCASE 'O' RING	6	WASHER
2	WAVE SPRING	7	'O' RING
3	SHAFT 'O' RING	8	SEAL HOUSING
4	STATIONARY FACE	9	LIP SEAL
5	ROTARY FACE		

The seal rotary face is driven by a pin which locates in a slot on the shaft. A washer is located between the shaft shoulder and rotary face. A seal between the rotary face and shaft is provided by an 'O' ring. The stationary face is prevented from rotating as it has a flat side which sits in the rotorcase bore. Face to face contact is provided by a wave spring. Axial movement of the stationary face is prevented by a retaining clip. An 'O' ring within the rotorcase bore provides a seal onto the stationary face.

A seal housing encloses the hyclean seal and is seal by an 'O' ring and retained to the rotorcase by socket head cap screws. A lip seal sits within the seal housing and runs on the rotary face, thus providing a seal.



CAUTION

SEAL FACES ARE BRITTLE - TAKE EXTREME CARE WHEN HANDLING.

REMOVING THE FLUSHED HYCLEAN SEAL

1. Carefully support and remove the rotorcase with the seal housing and stationary face still attached.
2. Slide the rotary face from the shaft.
3. Remove the seal housing screws to inspect the seal.

FITTING THE FLUSHED HYCLEAN SEAL

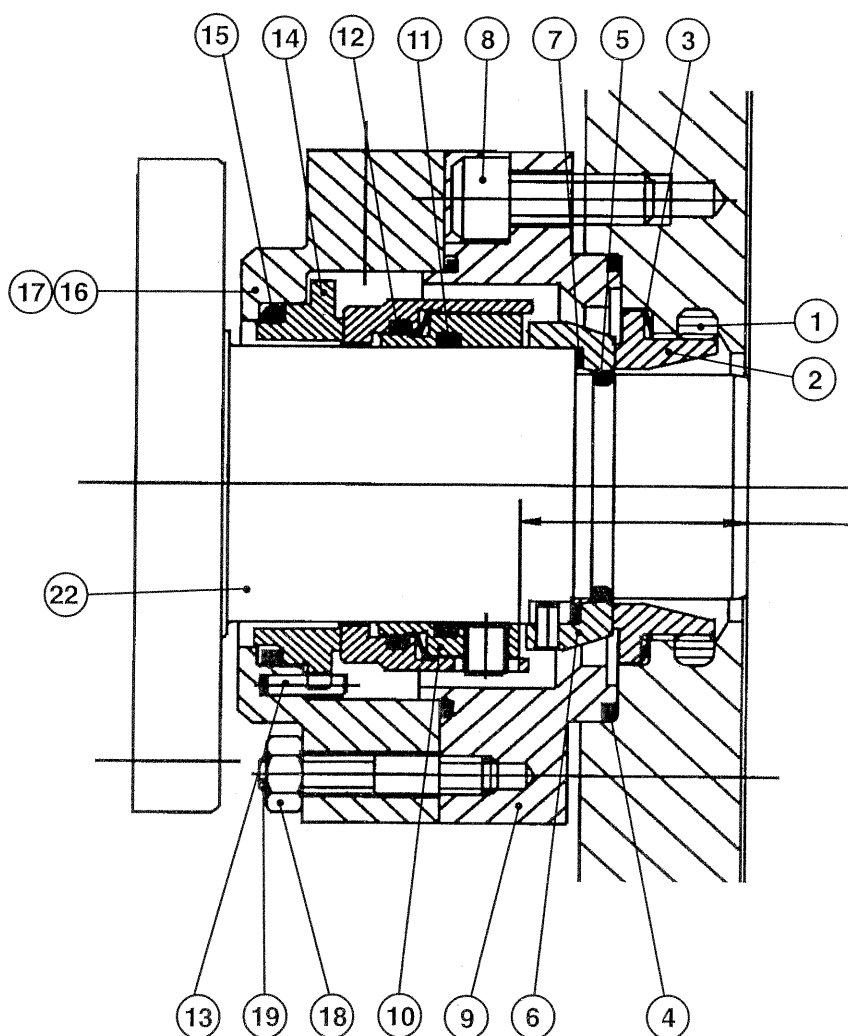
1. Wipe the lapped surface of the seal faces until **PERFECTLY** clean, being extremely careful not to scratch the faces.
2. Lightly lubricate the 'O' rings and washer with silicon grease (food quality if necessary).
3. Locate the 'O' rings on the shaft and within the rotorcase bore respectively.
4. Press the washer into the rotary face and slide onto the shaft, locating the pin in the shaft slot.
5. Position the wave spring over the stationary face, push into the rotorcase.
6. Press the lip seal into the seal housing bore and 'O' ring onto the lip.
7. Locate and tighten the seal housing retaining screws.
8. Carefully refit the rotorcase ensuring the lip seal does not distort

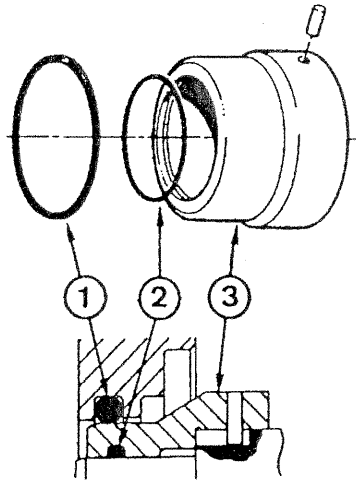
DOUBLE HYCLEAN SEAL SETTING INSTRUCTIONS

1. Firmly press on the o-rings (15) to the rear stationary faces (14) and locate them within the rear flush housing (16,17).
2. Carefully fit the rear seal housings (16,17) with the stationary face onto the shaft (22). (Caution: do not chip stationary face).
3. Push outboard rotary assembly (10,11) onto pump shaft (22) to the setting dimension (A) indicated on the assembly drawing and tighten set screws.
4. Locate o-rings on the shaft (5, rotary) and within the rotorcase bore (1, stationary).
5. Press washer (7) underneath the inside drive pin into the rotary face (6) and gently slide onto the shaft, locating the pin in the shaft slot.
6. Position the wave spring (3) over the stationary face (2), push into the rotorcase.
7. Position front seal housing (9) onto rotorcase and hex head tighten screws (8). Be sure not to over tighten.
8. Refit the rotorcase, using the shaft sleeve to ensure stationary seal is not chipped during assembly.
9. Fit rear seal housings (16,17) and o-rings (12) to front flush housings (9) and tighten the hex nuts (18). (Caution: Be sure not to overtighten the hex nuts).

Pump Model	A (mm)
322/332	29.0+.3/-0
422/432	29.5+.3/-0
522/532	31.5±.3
622/632	35.4±.3
722/732	36.2±.3
822/832	47.6±.3

ITEM	DESCRIPTION	ITEM	DESCRIPTION (CONT.)
1	Stationary O-ring (Rotorcase)	12	Flush Housing O-ring (Face)
2	Inboard Stationary Seal	13	Pin
3	Wavespring	14	Outboard Stationary Seal
4	Flush Housing O-ring (Front)	15	O-Ring Outboard Stationary
5	Rotary O-ring (Shaft)	16	Rear Flsh Hsg - LH
6	Inboard Rotary Seal	17	Rear Flsh Hsg - RH
7	Washer (Rotary)	18	Flsh Hsg Nut
8	Flsh Hsg Hex Head Cap Screw	19	Flsh Hsg Stud
9	Double Housing (Front)	20	Stud Coupling/Female (Not Shown)
10	Outboard Seal Face (Rotary)	21	Flush tube (Not Shown)
11	Rear Rotary Housing O-Ring	22	Shaft





ITEM	DESCRIPTION
1	'O' RING ROTORCASE
2	'O' RING SHAFT SLEEVE
3	SHAFT SLEEVE

The large 'O' ring sits within the rotorcase bore and runs on the shaft sleeve. Rotation for the shaft sleeve is provided by a spring which locates in a slot on the shaft. An 'O' ring seals the shaft sleeve to the shaft.

REMOVING THE 'O' RING SEAL

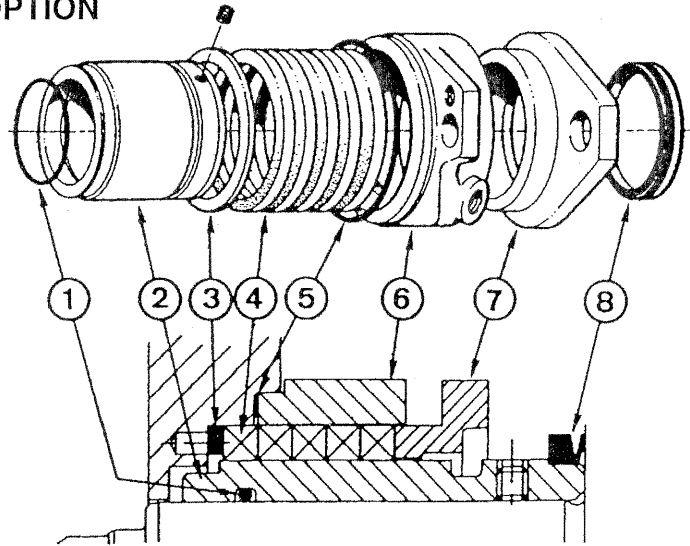
1. Remove the rotorcase.
2. Slide the shaft sleeve from the shaft and inspect the 'O' rings.

FITTING THE 'O' RING SEAL

1. Lightly lubricate the 'O' rings with grease (food quality if necessary), locate in the shaft sleeve and rotorcase bore.
2. Slide the shaft sleeve onto the shaft and locate the pin into the slot on the shaft.



NON STANDARD OPTION



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	SHAFT SLEEVE 'O' RING	5	GASKET
2	SHAFT SLEEVE	6	GLAND HOUSING
3	SPACER	7	GLAND FOLLOWER
4	PACKING RINGS	8	RING SLINGER

PACKED GLANDS ARE DESIGNED TO BE ADJUSTED.

The packing rings are located within the gland housing and are tightened onto the shaft sleeve by adjusting the gland follower. On flushed packed glands a lantern ring replaces the middle ring of packing. The shaft sleeve is retained to the shaft by three socket set screws and is sealed by an 'O' ring.

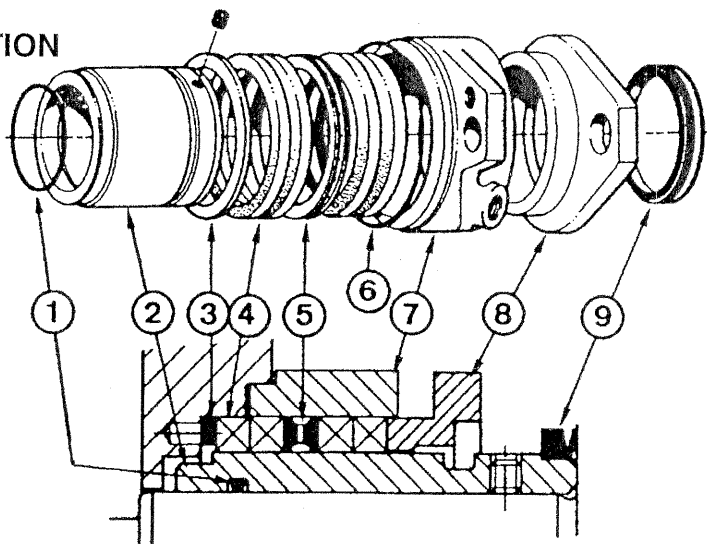
REMOVING THE PACKED GLAND

1. Release and pull back the gland follower.
2. Remove the rotorcase with gland housing, packing and gland follower still assembled.
3. Loosen the shaft sleeve socket set screws and extract the sleeve from the shaft.
4. Inspect and replace the packing and shaft sleeve if necessary.

FITTING THE PACKED GLAND

1. Lubricate the 'O' ring, locate in shaft sleeve and slide onto the shaft.
2. Tighten up the socket set screws.
3. Fit gland spacer, gasket and gland housing to the rotorcase.
4. Insert the packing rings and lantern ring (if flushed packed gland). Make sure they are in the correct order and positioned with the scarf joints 120° apart.
5. Loosely locate the gland follower and nuts.
6. Refit the rotorcase with packed assembly over the shaft sleeves.
7. Adjust the packed gland see next page.

NON STANDARD OPTION



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	SHAFT SLEEVE 'O' RING	6	GASKET
2	SHAFT SLEEVE	7	GLAND HOUSING
3	SPACER	8	GLAND FOLLOWER
4	PACKING RINGS	9	RING SLINGER
5	LANTERN RING		

ADJUSTING THE PACKED GLAND



CAUTION

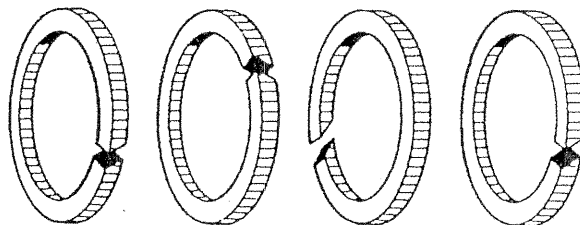
DRIP LEAKAGE IS ESSENTIAL TO PREVENT OVER HEATING OF THE GLAND AREA WHICH WILL CAUSE SEAL FAILURE.

Important :

Stop and remove gland guard for checking temperature of housing and observing leakage. **ALWAYS REPLACE THE GUARD BEFORE RESTARTING.**

1. Lightly tighten up the gland follower.
2. Flood the pumphead and determine if the gland leakage is acceptable. Tighten the gland follower nuts until an acceptable leakage is achieved.
3. Start the pump and allow to run for 10 minutes. If the gland becomes significantly hotter than other parts of the pump, the gland is too tight.

4. Stop the pump and allow it to cool then repeat the above until the gland temperature is stable and gland slightly weeping.
5. Run the pump at 10 minute intervals tightening the gland follower nuts by a $\frac{1}{6}$ of a turn until the leak is at an acceptable rate.



11.1 RELIEF VALVE DISASSEMBLY

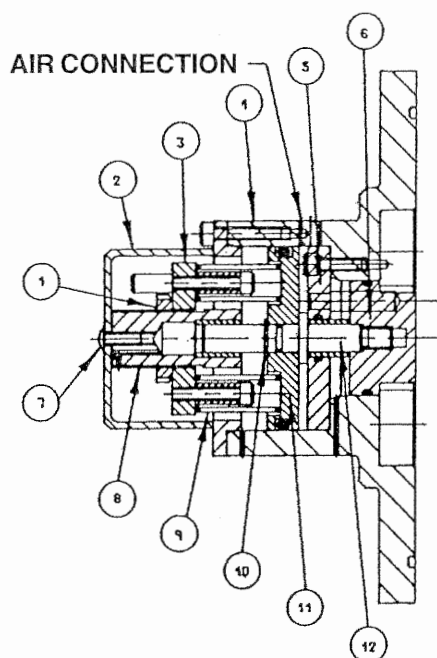
COMPLETE DISASSEMBLY IS ONLY REQUIRED IF THE 'O' RINGS OR SPRINGS ARE TO BE REPLACED.



WARNING

The relief valve should not be disassembled while the plug is in operation. Always observe the safety precautions detailed at the front of this manual. Take extreme care when removing the springs as they have been compressed.

1. Remove the valve housing.
2. Release and remove the notched nut(s) with the spring adjuster.
3. Take off the springs, release the socket head cap screws and remove the valve guide.
4. Access to the pneumatic piston 'O' rings is achieved by releasing the circlip which locates in the valve shaft.
5. The hydraulic piston with the shaft may be lifted out of the front cover once the backstop disc is removed.
6. Unscrew the hydraulic piston from the valve shaft, and inspect the 'O' ring.
7. It is recommended that all 'O' rings are renewed after disassembly for spring replacement.

**WARNING**

The relief valve should not be assembled while the pump is in operation. Always observe the safety precautions detailed at the front of this manual.

ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	NOTCHED NUT	7	BUTTON HEAD SCREW
2	VALVE CANNISTER	8	VALVE GUIDE
3	SPRING ADJUSTER	9	SPRINGS
4	VALVE FRONT COVER	10	CIRCLIP
5	BACKSTOP DISC	11	PNEUMATIC PISTON
6	HYDRAULIC PISTON	12	VALVE SHAFT

1. Lubricate all the valve 'O' rings.
2. Locate the backstop disc with its 'O' ring, against the threaded side of the valve shaft shoulder.
3. Fit the 'O' ring onto the hydraulic piston and screw the piston onto the valve shaft.
4. Push the assembly into the front cover and tighten the backstop disc socket head cap screws.
5. Locate the piston 'O' rings and push the assembly onto and upto the valve shaft shoulder. The circlip may now be fitted. Fit the springs.
6. Each spring guide should carry the same amount of disc springs. Take care in positioning them in the correct orientation.

NOTE : The number of disc springs are selected to suit the duty conditions, if the duty conditions change contact the supplier for advice on re-selection.

7. Place the valve guide over the spring guides (Series 80 pumps only) and tighten the socket head cap screws into the front cover.
8. Fit the spring adjuster, stiff nuts and notched nut followed by the valve housing and button head screw/manual override.
9. **Refer to Valve Adjustment** section to set the valve for the correct site conditions.



No Discharge	Under Capacity	Irregular Discharge	Prime lost after starting	Pump stalls when starting	Pump overheats	Motor overheats	Excessive power absorbed	Noise & vibration	Pump element wear	Excessive gland seal wear	Product loss through gland	Seizure	CAUSES	REMEDIES
*													1	Reverse motor.
*													2	Expell gas from supply line and pumping chamber and introduce liquid.
*	*	*	*	*	*	*	*	*	*	*	*	*	3	Increase supply line diameter. Increase suction head. Simplify supply line configuration and reduce length. Reduce speed on available and permitted power inputs.
*	*	*	*	*	*	*	*	*	*	*	*	*	4	Decrease product temperature - check effect of increased viscosity on available and permitted power inputs.
*	*	*	*	*	*	*	*	*	*	*	*	*	5	Remake pipework joints. Adjust or repack gland.
*	*	*	*	*	*	*	*	*	*	*	*	*	6	Expell gas from supply line and pumping chamber and introduce liquid.
*	*	*	*	*	*	*	*	*	*	*	*	*	7	Raise product level. Lower outlet position. Increase submergence of supply line.
*	*	*	*	*	*	*	*	*	*	*	*	*	8	Service fittings.
*	*	*	*	*	*	*	*	*	*	*	*	*	9	Decrease pump speed. Increase product temperature.
*	*	*	*	*	*	*	*	*	*	*	*	*	10	Increase pump speed. Decrease product temperature.
*	*	*	*	*	*	*	*	*	*	*	*	*	11	Cool the product pumping chamber.
*	*	*	*	*	*	*	*	*	*	*	*	*	12	Heat the product pumping chamber. (Check with pump maker).
*	*	*	*	*	*	*	*	*	*	*	*	*	13	Clean the system. Fit strainer to supply line.
*	*	*	*	*	*	*	*	*	*	*	*	*	14	Check for obstructions. Service system and revise to prevent problem recurring. Simplify delivery line.
*	*	*	*	*	*	*	*	*	*	*	*	*	15	Slacken and re-adjust gland.
*	*	*	*	*	*	*	*	*	*	*	*	*	16	Adjust gland. See not on packed glands under "Installation and Maintenance" heading.
*	*	*	*	*	*	*	*	*	*	*	*	*	17	Check that fluid flows freely into gland. Increase flow rate.
*	*	*	*	*	*	*	*	*	*	*	*	*	18	Decrease pump speed.
*	*	*	*	*	*	*	*	*	*	*	*	*	19	Increase pump speed.
*	*	*	*	*	*	*	*	*	*	*	*	*	20	Check alignment of pipes. Fit flexible pipes or expansion fittings. Support pipework.
*	*	*	*	*	*	*	*	*	*	*	*	*	21	Re-tension to maker's recommendations.
*	*	*	*	*	*	*	*	*	*	*	*	*	22	Check flange alignment and adjust mountings accordingly.
*	*	*	*	*	*	*	*	*	*	*	*	*	23	Fit lock washers to slack fasteners and re-tighten.
*	*	*	*	*	*	*	*	*	*	*	*	*	24	Refer to pump maker for advice and replacement parts.
*	*	*	*	*	*	*	*	*	*	*	*	*	25	Refer to pump maker for advice and replacement parts.
*	*	*	*	*	*	*	*	*	*	*	*	*	26	Refer to pump maker's instructions.
*	*	*	*	*	*	*	*	*	*	*	*	*	27	Check rated and duty pressures. Refer to pump maker.
*	*	*	*	*	*	*	*	*	*	*	*	*	28	Fit new components.
*	*	*	*	*	*	*	*	*	*	*	*	*	29	Check pressure setting and re-adjust if necessary. Examine and clean seating surfaces. Replace worn parts.
*	*	*	*	*	*	*	*	*	*	*	*	*	30	Check for wear sealing surfaces, guides etc - replace as necessary. Headjust spring compression. Valve should lift about 10% above duty pressure.
*	*	*	*	*	*	*	*	*	*	*	*	*	31	

DIAGNOSIS WILL BE GREATLY ASSISTED BY TAKING ON-STREAM PRESSURE READINGS AT THE PUMPS INLET AND OUTLET PORTS

13.1 PUMP INFORMATION CHART

The following table details technical data regarding the pump range, for further details contact your supplier. The technical data below must not be used for pump selection purposes.

STD = STANDARD PRESSURE
HIGH = HIGH PRESSURE

PUMP MODEL	PRESSURE	DISPLACEMENT			SUCTION & DISCHARGE CONNECTIONS				DIFFERENTIAL PRESSURE		MAXIMUM SPEED	MAXIMUM CAPACITY AT 1000 RPM
		STANDARD PORT										
		Nominal Bore Diameter (Standard)		Connection Size (International Standards)								
litres/rev	Imp gal/ 100 rev	US gal/ 100 rev	mm	inches	mm	inches	bar	ibf/in ²				
322	STD	0.053	1.17	1.40	20	0.8	25	1.0	8.0	115	1000	14
332	STD	0.085	1.87	2.3	26	1.0	40	1.5	5.0	75	1000	22
422	STD	0.128	2.82	3.2	26	1.0	40	1.5	10.0	145	1000	34
422P	HIGH	0.128	2.82		26	1.0	40	1.5	15.0	215	1000	
432	STD	0.181	3.98	4.78	35	1.4	50	2.0	7.0	100	1000	47
432P	HIGH	0.181	3.98		35	1.4	50	2.0	10.0	145	1000	
522	STD	0.266	5.85	7.03	35	1.4	50	2.0	10.0	145	1000	71
522P	HIGH	0.266	5.85		35	1.4	50	2.0	15.0	215	1000	
532	STD	0.384	8.45	10.15	48	1.9	65	2.5	7.0	100	1000	100
532P	HIGH	0.384	8.45		48	1.9	65	2.5	10.0	145	1000	
622	STD	0.554	12.19	14.64	48	1.9	65	2.5	10.0	145	1000	145
622P	HIGH	0.554	12.19		48	1.9	65	2.5	20.0	290	1000	
632	STD	0.790	17.38	20.87	63	2.5	80	3.0	7.0	100	1000	208
632P	HIGH	0.790	17.38		63	2.5	80	3.0	15.0	215	1000	
722	STD	1.160	25.52	30.65	63	2.5	80	3.0	10.0	145	600	184
722P	HIGH	1.160	25.52		63	2.5	80	3.0	20.0	290	600	
732	STD	1.680	36.95	44.39	78	3.1	100	4.0	7.0	100	600	266
732P	HIGH	1.680	36.95		78	3.1	100	4.0	15.0	215	600	
822	STD	2.460	54.11	64.99	78	3.1	100	4.0	10.0	145	500	325
822P	HIGH	2.460	54.11		78	3.1	100	4.0	20.0	290	500	325
832	STD	3.530	77.65	93.26	120	4.7	150	6.0	7.0	100	500	465
832P	HIGH	3.530	77.65		120	4.7	150	6.0	15.0	215	500	465

TORQUE SPECIFICATION CHART

13.2

PUMP REFERENCE	FRONT COVER NUTS			ROTOR NUTS			GEARCASE NUTS			TIMING GEARS SCREWS		
	TORQUE		SPANNER SIZE	TORQUE		SPANNER SIZE	TORQUE		SPANNER SIZE	TORQUE		KEY SIZE
	Nm	lbft	MM	Nm	lbft	MM	Nm	lbft	MM	Nm	lbft	MM
322	20	15	13	14	10	17	20	15	13	12	9	5
332	20	15	13	14	10	17	20	15	13	12	9	5
422	39	29	17	77	56	24	40	30	17	17	12.5	5
432	39	29	17	77	56	24	40	30	17	17	12.5	5
522	39	29	17	120	88	24	40	30	17	12	9	5
532	39	29	17	120	88	24	40	30	17	12	9	5
622	39	29	17	161	120	36	64	47	19	14	10	5
632	39	29	17	161	120	36	64	47	19	14	10	5
722	39	29	17	161	120	36	64	47	19	35	26	6
732	39	29	17	161	120	36	64	47	19	35	26	6
822	105	77	19	161	120	36	175	129	24	35	26	6
832	105	77	19	161	120	36	175	129	24	35	26	6



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FRONT SEAL AND REAR COVERS

322/332, 422/432, 522/532 : TORQUE 10 Nm (7 lbft) - KEY SIZE 5MM
 622/632, 722/732, 822/832 : TORQUE 25 Nm (19 lbft) - KEY SIZE 6MM

TIGHTENING TORQUES FOR SHAFT SLEEVE SET SCREWS

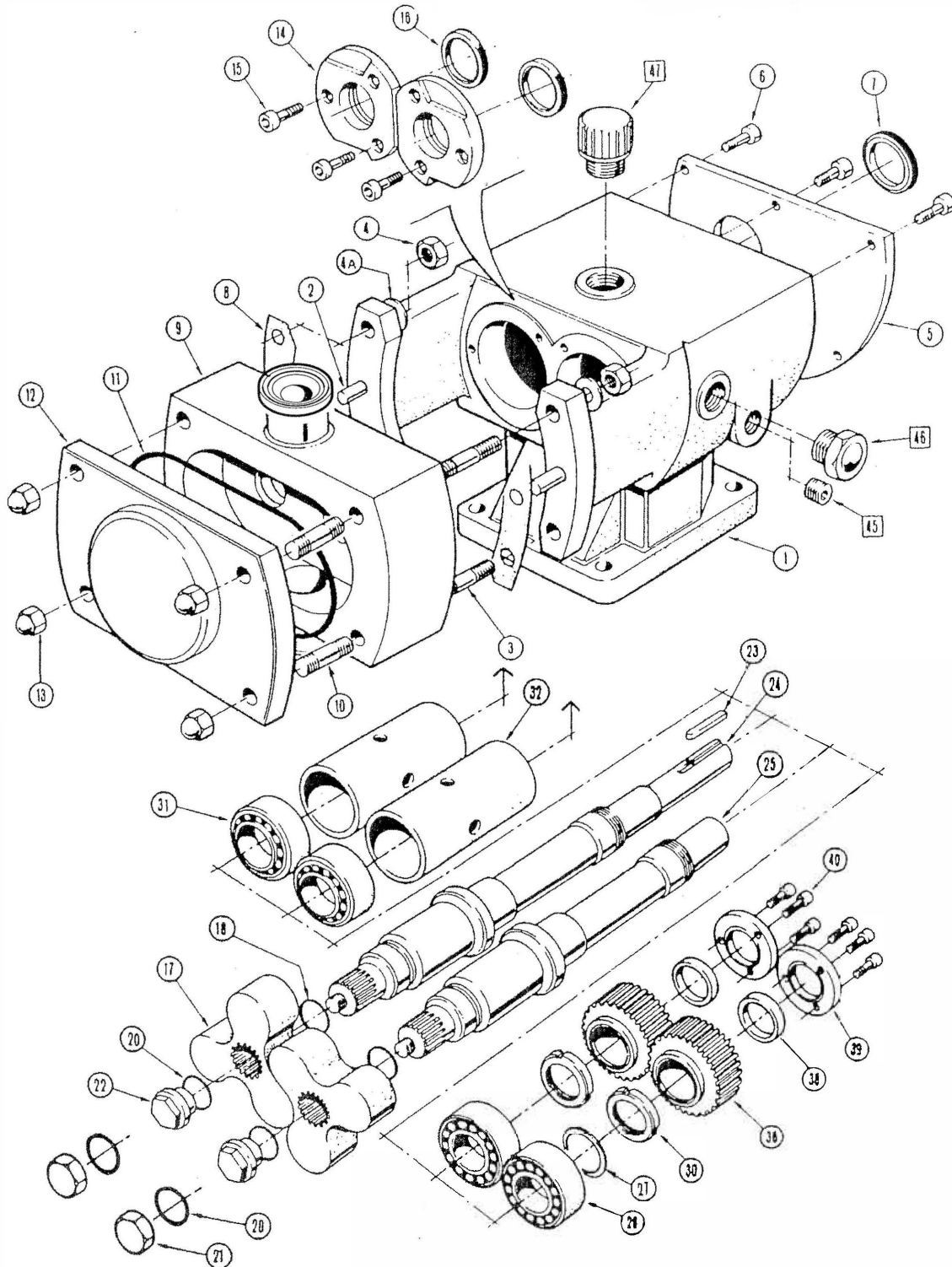
PUMP REF	TORQUE		KEY mm
	Nm	lbft	
30	3	2.2	2.5
40	4	2.9	3
50	4	2.9	3
60	4	2.9	3
70	14	10.3	4
80	14	10.3	4



EXPLODED PUMP DRAWING AND PARTS LIST

14.0

322, 332



14.1 PUMPS (322/332)

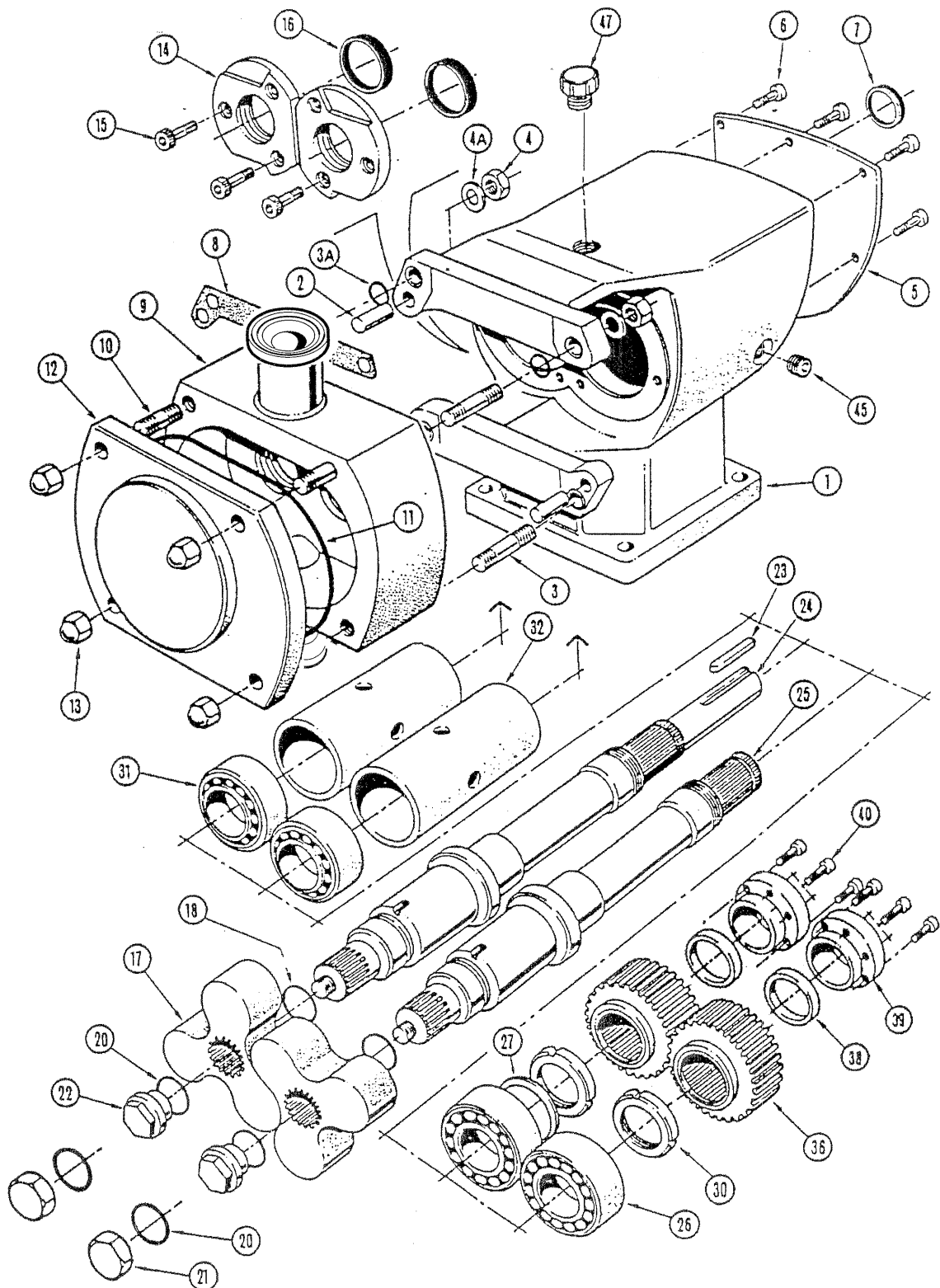
ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	GEARCASE	37	
2	DOWEL	38	TORQUE LOCKING
3	STUD, GEARCASE		ELEMENT
4	NUT, GEARCASE STUD	39	CLAMP PLATE
4A	WASHER, GEARCASE STUD	40	CAPHEAD SCREWS,
5	COVER, GEARCASE		CLAMP
6	SCREW, REAR COVER	41	PLATEPLUG
7	LIP SEAL DRIVE END	42	
8	SHIM	43	
8A	SHIM RETAINER	44	DRAIN PLUG, OIL
8B	SHIM RETAINING SCREW	45	SIGHT LEVEL, OIL
9	ROTORCASE	46	FILLER PLUG, OIL
10	STUD, ROTORCASE	47	WASHER
11	'O' RING FRONT COVER	48	
12	COVER, ROTORCASE		
13	DOME NUTS, FRONT COVER		
14	RETAINER, SEAL		
15	SCREWS, FRONT SEAL CARRIER		
16	LIP SEALS, GLAND END		
17	ROTORS		
18	'O' RING, ROTOR SEALING SHAFT END		
19			
20	'O' RING, ROTOR SEALING NUT END		
21	NUT, ROTOR RETENTION		
22	NUT, ROTOR RETENTION		
23	KEY		
24	SHAFT, DRIVE		
25	SHAFT, AUXILIARY		
26	BEARINGS, REAR		
27	SPACER, SHAFT ABUTMENT		
28			
29			
30	NUT, BEARING		
31	BEARINGS, FRONT		
32	SPACER, SHAFT		
33			
34			
35			
36	TIMING GEAR		



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422/432



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14.2 PUMPS (422/432, 522/532)

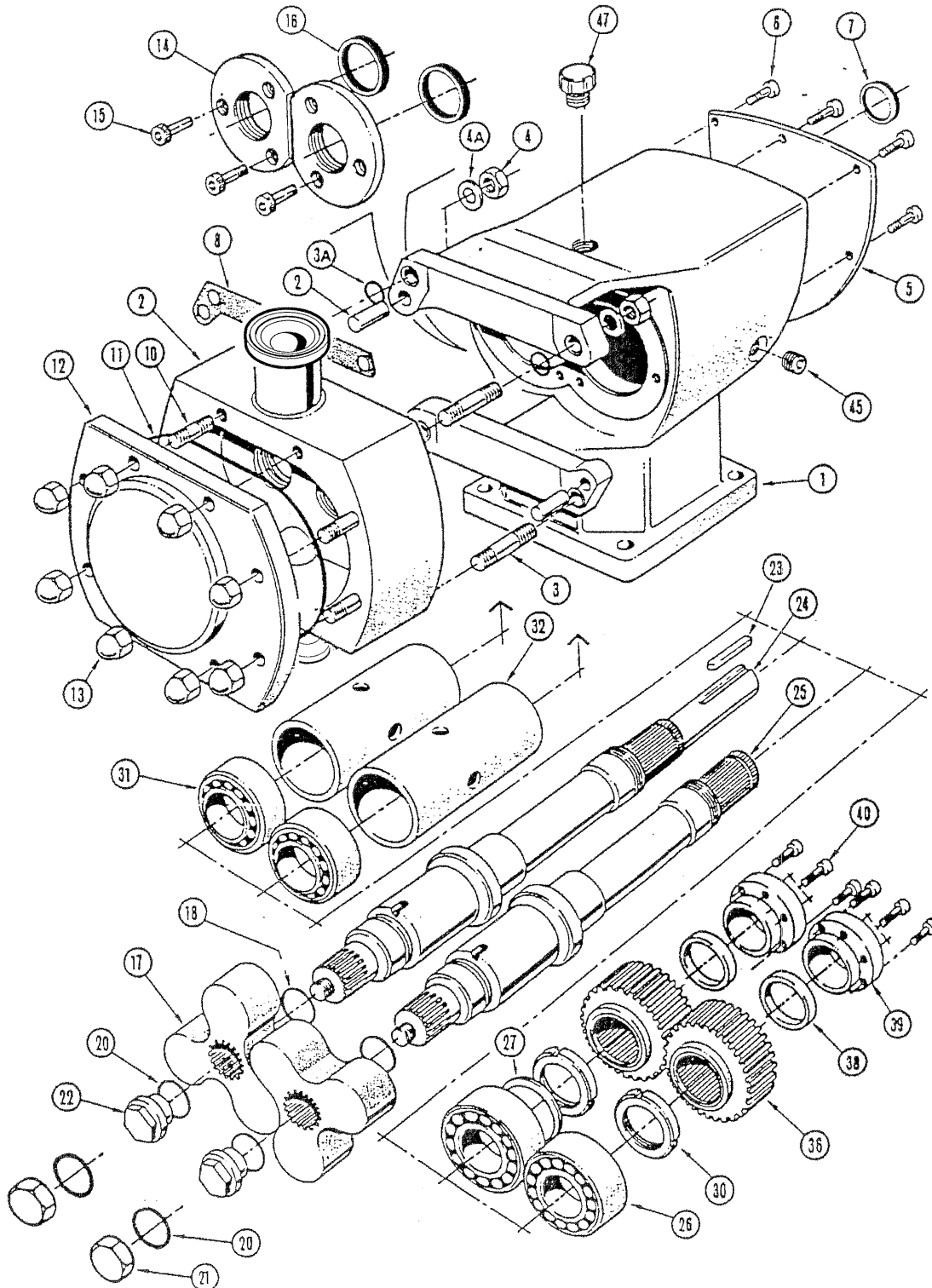
ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	GEARCASE	37	
2	DOWEL	38	TORQUE LOCKING ELEMENT
3	STUD, GEARCASE	39	CLAMP PLATE
4	NUT, GEARCASE STUD	40	CAP HEAD SCREWS
4A	WASHER, GEARCASE STUD	41	
5	COVER, GEARCASE	42	
6	SCREW, REAR COVER	43	
7	LIP SEAL DRIVE END	44	
8	SHIM	45	DRAIN PLUG, OIL
8A	SHIM RETAINER	46	SIGHT LEVEL, OIL
8B	SHIM RETAINER SCREW	47	FILLER PLUG, OIL
9	ROTORCASE	48	
10	STUD, ROTORCASE		
11	'O' RING FRONT COVER		
12	COVER, ROTORCASE		
13	DOME NUTS, FRONT COVER		
14	RETAINER, SEAL		
15	SCREWS, FRONT SEAL CARRIER		
16	LIP SEALS, GLAND END		
17	ROTORS		
18	'O' RING, ROTOR SEALING SHAFT END		
19			
20	'O' RING, ROTOR SEALING NUT END		
21	NUT, ROTOR RETENTION		
22	NUT, ROTOR RETENTION		
23	KEY		
24	SHAFT, DRIVE		
25	SHAFT, AUXILIARY		
26	BEARINGS, REAR		
27	SPACER, SHAFT ABUTMENT		
28			
29			
30	NUT, BEARING		
31	BEARINGS, FRONT		
32	BEARING SPACER		
33			
34			
35			
36	TIMING GEAR		



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522/532



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14.3 PUMPS (622/632, 722/732)

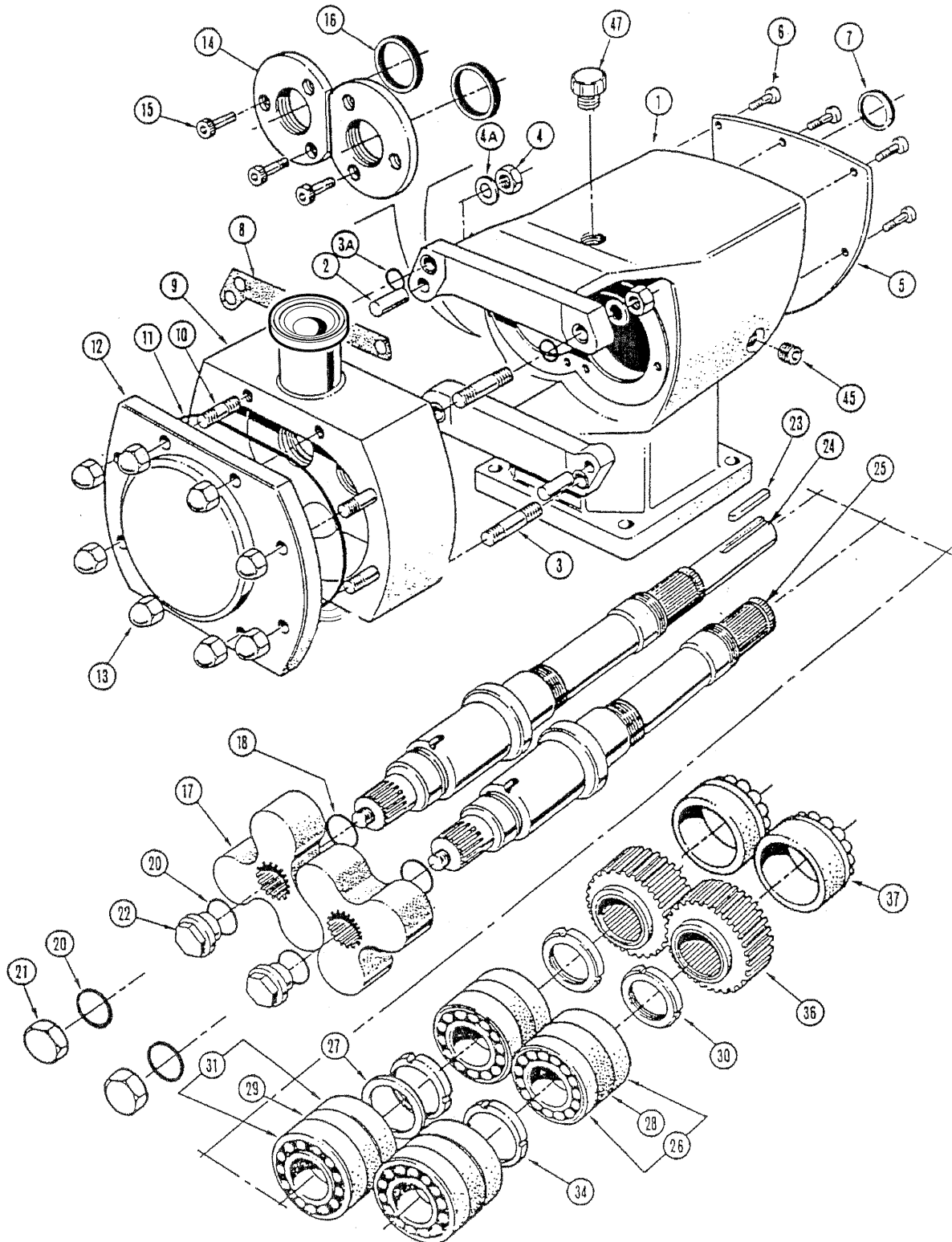
ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	GEARCASE		
2	DOWEL	37	TORQUE LOCKING ELEMENT
3	STUD, GEARCASE	38	
4	NUT, GEARCASE STUD	39	
4A	WASHER, GEARCASE STUD	40	
5	COVER, GEARCASE	41	
6	SCREW, REAR COVER	42	
7	LIP SEAL DRIVE END	43	
8	SHIM	44	
8A	SHIM RETAINER	45	DRAIN PLUG, OIL
8B	SHIM RETAINER SCREWS	46	SIGHT LEVEL, OIL
9	ROTORCASE	47	FILLER PLUG, OIL
10	STUD, ROTORCASE	48	
11	'O' RING FRONT COVER		
12	COVER, ROTORCASE		
13	DOMENUTS, FRONT COVER		
14	RETAINER, SEAL		
15	SCREWS, FRONT SEAL CARRIER		
16	LIP SEALS, GLAND END		
17	ROTORS		
18	'O' RING, ROTOR SEALING SHAFT END		
19			
20	'O' RING, ROTOR SEALING NUT END		
21	NUT, ROTOR RETENTION		
22	NUT, ROTOR RETENTION		
23	KEY		
24	SHAFT, DRIVE		
25	SHAFT, AUXILIARY		
26	BEARINGS, REAR		
27	SPACER, SHAFT ABUTMENT		
28	SPACER, BEARING		
29	SPACER, BEARING		
30	NUT, BEARING		
31	BEARINGS, FRONT		
32			
33			
34	NUT, BEARING		
35			
36	TIMING GEAR		



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622/632, 722/732



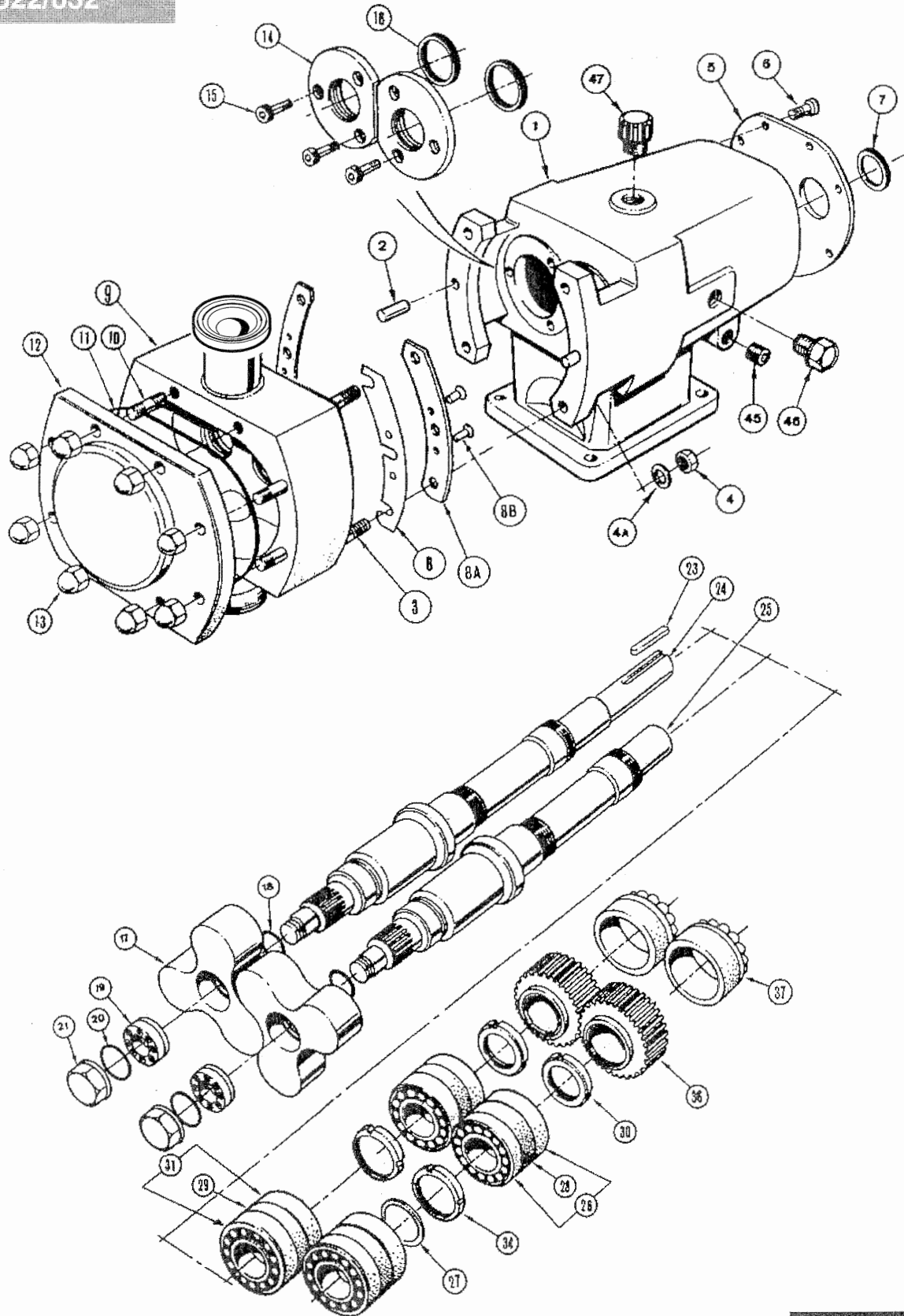
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14.4 PUMPS (822/832)

ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	GEARCASE		
2	DOWEL	37	TORQUE LOCKING ELEMENT
3	STUD, GEARCASE	38	
4	NUT, GEARCASE STUD	39	
4A	WASHER, GEARCASE STUD	40	
5	COVER, GEARCASE	41	
6	SCREW, REAR COVER	42	
7	LIP SEAL DRIVE END	43	
8	SHIM	44	
8A	SHIM RETAINER	45	DRAIN PLUG
8B	SHIM RETAINER SCREWS	46	SIGHT GLASS
9	ROTORCASE	47	OIL FILLER
10	STUD, ROTORCASE	48	
11	'O' RING FRONT COVER		
12	COVER, ROTORCASE		
13	DOMES NUTS, FRONT COVER		
14	RETAINER, SEAL		
15	SCREWS, FRONT SEAL CARRIER		
16	LIP SEALS, GLAND END		
17	ROTORS		
18	'O' RING, ROTOR SEALING SHAFT END		
19	TLA ROTOR		
20	'O' RING, ROTOR SEALING NUT END		
21	NUT, ROTOR RETENTION		
22	NUT, ROTOR RETENTION		
23	KEY		
24	SHAFT, DRIVE		
25	SHAFT, AUXILIARY		
26	BEARINGS, REAR		
27	SPACER, SHAFT ABUTMENT		
28	SPACER, BEARING		
29	SPACER, BEARING		
30	NUT, BEARING		
31	BEARINGS, FRONT		
32			
33			
34	NUT, BEARING		
35	LIP SEAL BEARING		
36	TIMING GEAR		

822/832



ALP/MM022/01