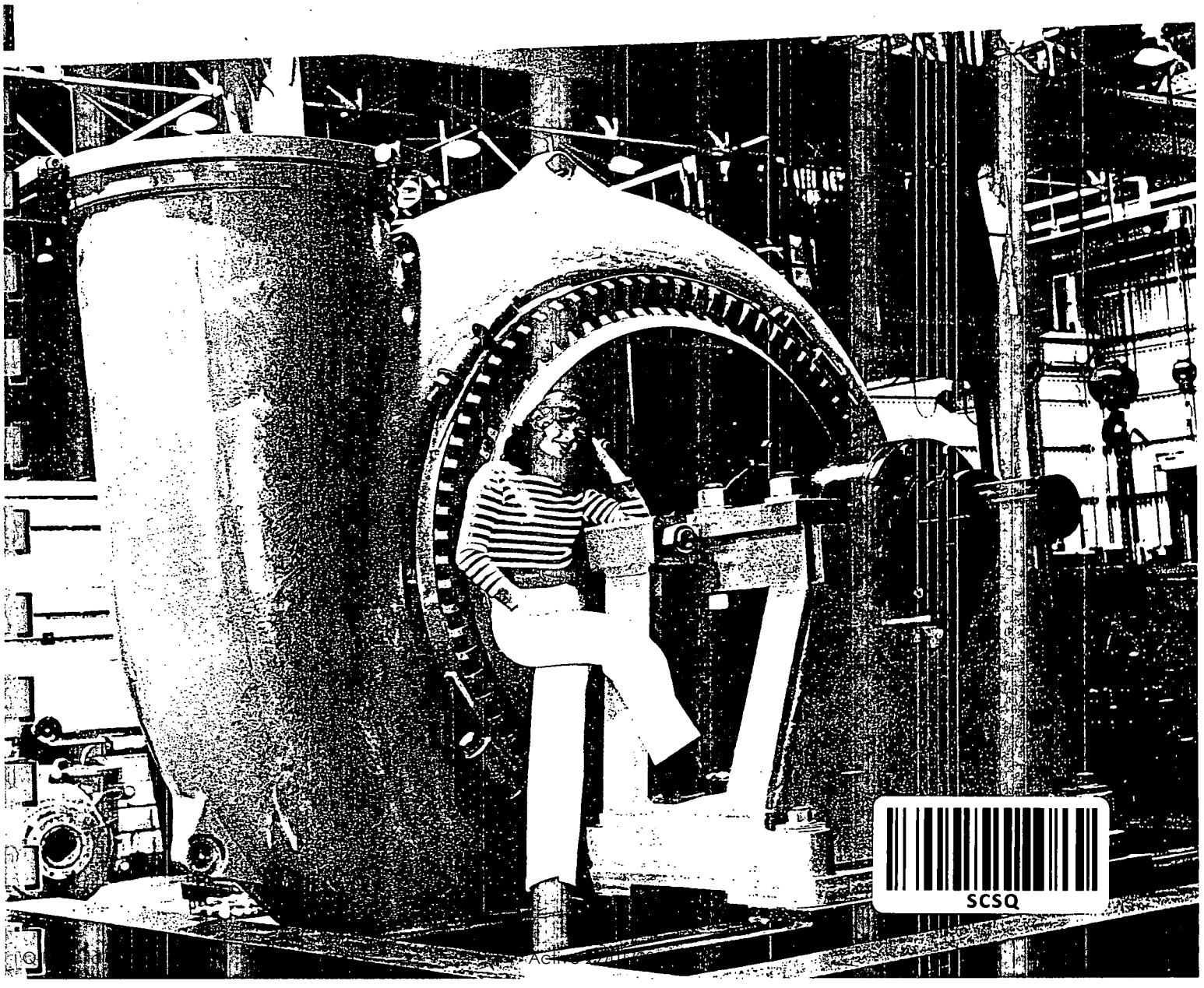
MANUAL NUMBER 523

Warman

WARMAN PUMPS

ASSEMBLY AND MAINTENANCE INSTRUCTIONS



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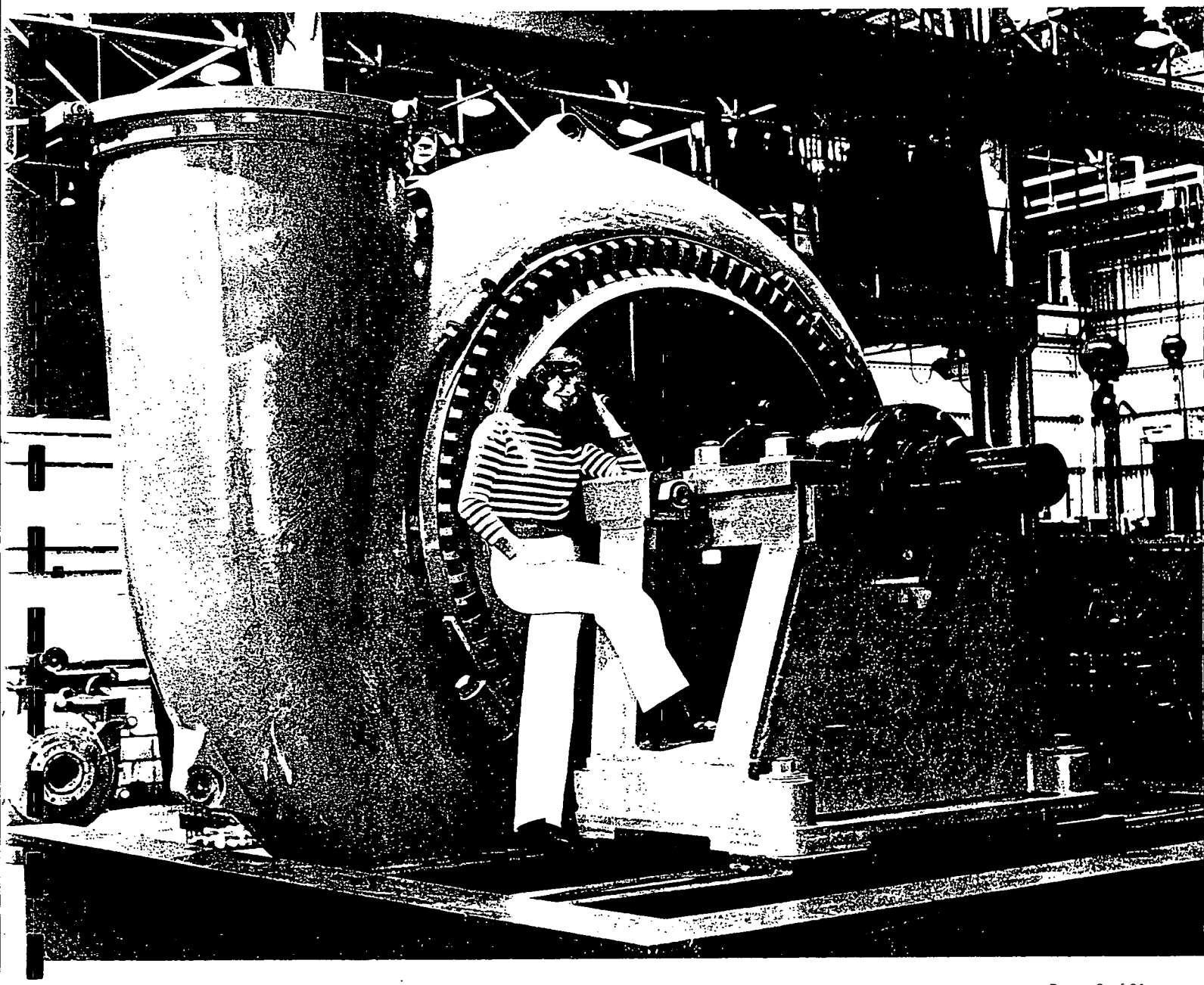

WARMAN INTERNATIONAL LTD

WARMAN PUMPS

ASSEMBLY AND MAINTENANCE INSTRUCTIONS

SUPPLEMENT 'M1'

GENERAL INSTRUCTION APPLICABLE TO ALL TYPES OF WARMAN PUMPS

WARNINGS

WARMAN PUMPS - ASSEMBLY AND MAINTENANCE INSTRUCTION MANUALS AND SUPPLEMENTS IMPORTANT SAFETY INFORMATION

•

The **WARMAN PUMP** is both a **PRESSURE VESSEL** and a piece of **ROTATING EQUIPMENT.** All standard safety precautions for such equipment should be followed before and during installation, operation and maintenance.

For **AUXILIARY EQUIPMENT** (motors, belt drives, couplings, gear reducers, variable speed drives, etc.) standard safety precautions should be followed and appropriate instruction manuals consulted before and during installation, operation and maintenance.

•

DRIVER ROTATION MUST BE CHECKED before belts or couplings are connected. Personnel injury and damage could result from operating the pump in the wrong direction.

•

DO NOT OPERATE THE PUMP AT LOW OR ZERO FLOW CONDITIONS FOR PROLONGED PERIODS, OR UNDER ANY CIRCUMSTANCES THAT COULD CAUSE THE PUMPING LIQUID TO VAPORISE. Personnel injury and equipment damage could result from the pressure created.

•

DO NOT APPLY HEAT TO IMPELLER BOSS OR NOSE in an effort to loosen the impeller thread prior to impeller removal. Personnel injury and equipment damage could result from the impeller shattering or exploding when the heat is applied.

•

DO NOT FEED VERY HOT OR VERY COLD LIQUID into a pump which is at ambient temperature. Thermal shock may cause the pump casing to crack.

•

FOR THE SAFETY OF OPERATING PERSONNEL, please note that the information supplied in this Manual only applies to the fitting of genuine Warman parts and Warman recommended bearings to Warman pumps.

•

Tapped Holes (for Eye Bolts) and Lugs (for Shackles) on Warman Parts are for lifting **Individual Parts Only**.

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WARMAN PUMPS
ASSEMBLY AND MAINTENANCE INSTRUCTIONS
SUPPLEMENT 'M1'

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INTRODUCTION

GENERAL

This Supplement sets out general instructions for the installation, operation and maintenance applicable to all TYPES of Warman Pumps. These instructions should be read in conjunction with the other separate Warman Supplements relating to the assembly and maintenance of the PUMP and BEARING ASSEMBLY pertaining to the particular TYPE of Warman Pump installed.

A list of Warman Assembly and Maintenance Instruction Supplements pertaining to Warman pumps is given in Supplement 'M3'.

PUMP IDENTIFICATION

Every Warman pump has a nameplate attached to the frame. The pump serial number and identification code are stamped on the nameplate.

The pump identification code is made up of digits and letters arranged as follows:

DIGITS	LETTERS	LETTERS
(a)	(b)	(c)
PUMP SIZE	*FRAME SIZE*	*WET END TYPE*

(a) The PUMP SIZE is expressed in one of the following two ways:

1. The pump size is taken as the discharge diameter. It is given in millimetres, it is expressed by a number such as 100, 150, 200 etc.

2. The pump size is given as two numbers separated by a slash viz.:

DIGITS		DIGITS
(a1)	/	(a2)
INTAKE DIAMETER		*DISCHARGE DIAMETER*

(i) The intake diameter is given in inches. It is expressed as a number such as 1, 1.5, 2, 10, etc. (1 in = 25.4 mm).

(ii) The discharge diameter is given in inches. It is expressed as a number such as 1, 1.5, 2, 10, etc. The discharge diameter is usually smaller

than the intake diameter, however, in some pumps the two are equal (1 inch = 25.4 mm).

(b) The frame of the pump comprises the base and the bearing assembly. The FRAME SIZE of a horizontal pump is identified by either single or multiple letters viz: Basic frames A to H; Modified Basic frames CC to GG and Heavy Duty frames N to V. The first letter in the range denotes the smallest frame working through the alphabet to the largest frame.

Frames with a vertical shaft the letter(s) are followed by a 'V'

Frames that are oil filled the letter(s) are followed by a 'K'

Frames that are oil lubricated the letter(s) are followed by a 'Y'

(c) The WET END TYPE is identified by one or a multiple of letters. Some of these are:

AH, M, L, SC, HH, H: Slurry pumps with replaceable liners

D, G, GH: Dredge and gravel pumps

S, SH: Solution pumps

TC: Cyklo pumps

PC, PCH: Process chemical pumps

SP, SPR, GPS: Sump pumps

AF: Froth pumps

High head pumps are generally denoted by a 'H' at the end of the wet end identification such as in the HH, GH, SH, PCH pump types.

High pressure pumps are generally denoted by a 'P' at the end of the wet end identification such as in the AHP and HP pump types.

EXAMPLES:

200 PG-PCH	200 mm discharge diameter
	PG frame
	PCH type wet end (high head PC pump)
10/8 FFK-AHP	10 inch intake and 8 inch discharge diameters
	FF frame (oil filled as denoted by 'K')
	AHP type wet end (high pressure AH pump)

FOUNDATIONS

Efficient pump service can be obtained only by installing the pump on adequate foundations. Steel foundations should be robust, concrete foundations heavy. Both should be designed to take all loads from the pump and motor and to absorb any vibrations. All holding down bolts should be fully tightened.

The pump should be located such that the length of the intake pipe is as short as possible. Adequate space to provide access for installation and dismantling to replace worn components should be allowed.

A suggested procedure for aligning and grouting Warman Base plates is given on Warman Drawing A3-100-0-19810 attached.

Where a pump base is mounted directly onto a steel framework this should be designed with sufficient strength to withstand normal pumping operational stress and to ensure that there is no distortion to the base frame when the pump and pump base are installed.

SHAFT ALIGNMENT

Whether direct coupled or vee-belt driven, the pump and motor shafts should be accurately aligned. In direct coupled drives, misalignment causes unnecessary vibration and wear of the coupling. In vee-belt drives, non-parallel shafts cause excessive belt wear. Rigid couplings must be avoided.

It should be noted that pump sets which have been accurately aligned in the factory can become misalign during transportation so alignment must be rechecked during installation.

Vee-belt and flexible transmissions should be aligned (and tensioned) in accordance with the suggested recommendations below.

Direct coupling large pumps to diesel prime movers must also be avoided as sudden stoppage of the diesel can cause unscrewing of the pump impeller and consequent pump damage. A clutch or fluid coupling fitted between the pump and diesel prime mover is recommended.

ALIGNMENT, TENSIONING AND ADJUSTMENT OF VEE-BELT DRIVES

For optimum performance of Vee-Belts, only new matched sets of belts should be used (belts should lie within a range of 2 to 4 set numbers according to the belt length). Always place belts with the lowest code numbers closest to the bearings.

Clean any oil or grease from the pulleys and remove any burrs and rust from the grooves before fitting belts.

ALIGNMENT

Good alignment of pulleys is important, otherwise the belt flanks will wear quickly.

Reduce the centre distance by jacking the motor towards the pump using the jacking bolts supplied, until the belts can be put onto the pulley grooves without forcing.

Use a good straight edge across both motor and pump pulley faces. It is important to align the two pulleys to a tolerance whereby daylight is non existent or at a minimum between the pulleys and the straight edge.

AFTER PUMP IMPELLER ADJUSTMENTS RECHECK PULLEY ALIGNMENT AND ADJUST AS NECESSARY BEFORE RESTARTING PUMP.

TENSIONING:

Proper tensioning of the belts ensures a longer life both for the belts and the roller bearings.

The high performance required from modern belts cannot be achieved without correct tensioning. To check the belt for correct tensioning refer to figure below and proceed as follows:

(a) Measure the length of span

(b) Apply a force at right angles to the belt at the centre of the span sufficient to deflect one belt by 16 mm per metre of span

(c) Compare the force required with the value stated in the table.

If the measured force is within the values stated in the table the belt tensioning should be satisfactory. If the force measured is below or above the value stated, the belt should be tightened or slackened respectively. Provision should be made for periodic checking of belt wear during the life of a belt and adjusting the belts to correct tension as necessary.

NOTE: New belts should be tensioned at the higher level stated (using a Vee-Belt Tension Indicator) to allow for a drop in tension during the normal running in period. New belts should be run under load for two hours, stopped, and the tension re-checked, re-setting the adjustment to achieve the correct tension as necessary. During the first 24 hours running, it is recommended that a further check is carried out and the belts adjusted as required.

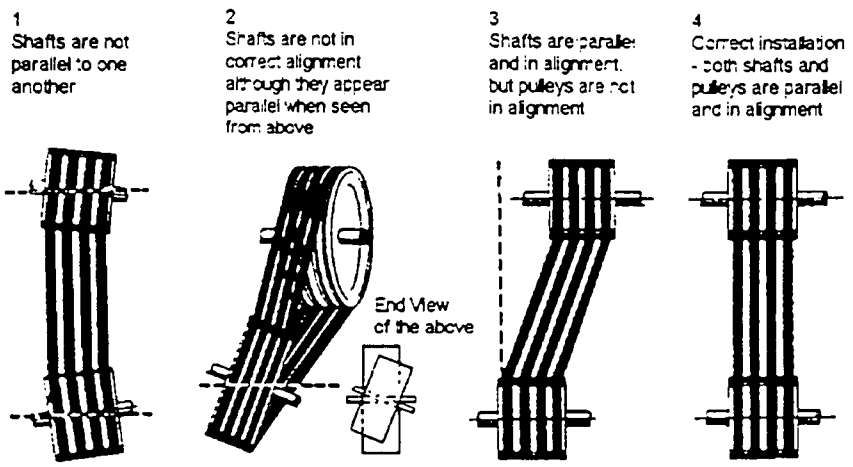
Under tensioning: Under tensioning of the drive can cause vibration resulting in damage to the bearing cartridge, as well as the loss of transmission efficiency. It can also cause the belts to slip and overheat, resulting in belt fatigue and subsequently a shortening of the belt life.

Over Tensioning: Over tensioning belts also shortens their life. Furthermore, bearings will tend to overheat due to excessive radial forces on the rolling elements and this will lead to premature bearing failure.

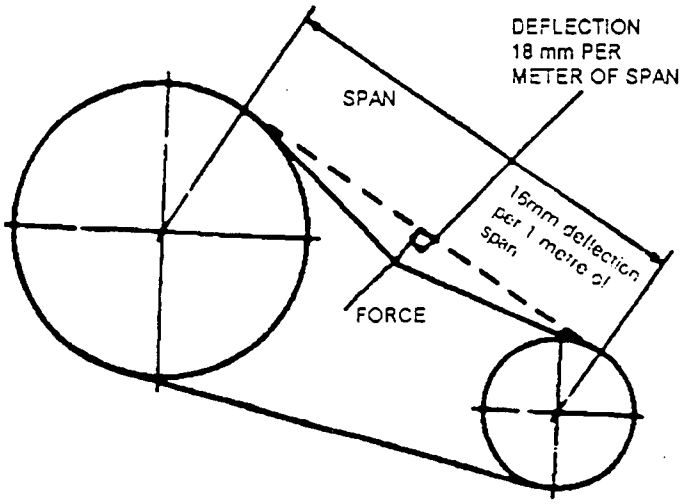
ADJUSTMENT

After new belts have been fitted or a new installation has been completed, when the drive has been running for approximately 2 hours the tension of the belts should be re-checked

and re-adjusted. The drive should be subsequently checked at regular maintenance intervals.



The dotted lines emphasise the faults by indicating the correct position.



Belt Section	Force required to deflect belt 16 mm per metre of span		
	Small Pulley Diameter (mm)	Newton (N)	Kilogram force (Kgf)
SPZ	66 to 97	10 to 15	1.0 to 1.5
	113 to 141	15 to 20	1.5 to 2.0
SPA	100 to 132	20 to 27	2.0 to 2.7
	140 to 200	28 to 35	2.8 to 3.5
SPB	160 to 224	35 to 50	3.5 to 5.1
	236 to 315	50 to 65	5.1 to 6.6
SPC	224 to 355	60 to 90	6.1 to 9.2
	375 to 560	90 to 120	9.2 to 12.2
A	80 to 40	10 to 15	1.0 to 1.5
B	125 to 200	20 to 30	2.0 to 3.1
C	200 to 400	40 to 60	4.1 to 6.1

Figure 1: Alignment, Tensioning and adjustment of Vee-Belt

ALIGNMENT OF DIRECT COUPLED PUMPS

In a direct coupled drive, misalignment causes unnecessary vibration and wear on the bearings. Rigid couplings should be avoided and must not be used without consultation with Warman International.

The following procedures outline a suggested practice for checking shaft alignment. This method is independent of the truth of the coupling or shaft and is therefore not affected by canted coupling faces or eccentricity of the outside diameter of the coupling.

CAUTION:

CHECK THAT NO DAMAGE CAN BE CAUSED WHEN THE SHAFT OF THE DRIVEN UNIT IS TURNED.

Before commencing alignment rotate each shaft independently to check that the shaft and bearings turn without undue friction and that the shaft is true to within 0.04 mm or better as measured on a Dial Indicator (DI).

Couplings should be loosely coupled, each half must be free to move relative to the other or the resulting Dial Indicator readings can be incorrect. Where tightly fitting pins or springs prevent loose coupling, the pins or springs should be removed, a line scribed across both half couplings and the readings taken only when the two are aligned. On couplings with a serrated rim, ensure that as the couplings are rotated, the gauge plungers do not fall into a groove and become damaged.

Angular shaft alignment: To ensure correct angular shaft alignment proceed as follows:

(a) Isolate the driving unit from the power supply

(b) Refer to the left hand figure below and clamp two Dial Indicators (DI) at diametrically opposite points (180°) on one half coupling, with the plungers resting on the back of the other half coupling

(c) Rotate the couplings until the gauges are in line vertically, and set the gauges to read zero

(d) Rotate the couplings through half a revolution (180°) and record the reading on each DI. The readings should be identical though not necessarily zero because of possible end float. Either positive or negative readings are acceptable provided they are equally positive or equally negative. Refer to the paragraphs below headed "Tolerances" for the maximum allowable tolerance and adjust the position of one of the units if necessary.

(e) Rotate the couplings until the gauges are in line horizontally and reset the gauges to read zero

(f) Repeat operation (d) and adjust the unit position until the correct tolerance is achieved and no further adjustment is necessary.

Radial shaft alignment: To ensure that radial shaft alignment is correct proceed as follows:

(a) Clamp a DI to one half coupling or to the shaft, as shown in right hand portion of figure below, with the plunger resting on the rim of the other half coupling

(b) Set the gauge to read zero

(c) Rotate the couplings and note the reading at each quarter revolution (90°). Any variation in the readings indicates a deviation from alignment and the position of one of the units must be adjusted until the readings at each quarter revolution are identical or within the tolerances given. Refer to paragraphs below headed "Tolerances".

NOTE: Provisional alignment can be carried out with the unit cold, however, where the working temperature of the pump has the effect of raising the centre line of one machine relative to the other allowances must be made. The units should then be realigned when each have attained their correct operating temperature.

Tolerances: The limits of accuracy within which adjustments must be made cannot be specifically defined because of differences in the size of and speed of units, but the following variations which can be tolerated when checking alignment, are suggested.

1. **Angular Alignment:**

   Couplings up to 300 mm diameter 0.05 mm

   Couplings more than 300 mm diameter 0.07 mm

2. **Radial Alignment:**

   Not to exceed 0.1 mm on Dial Indicator (i.e. 0.05 mm eccentricity)

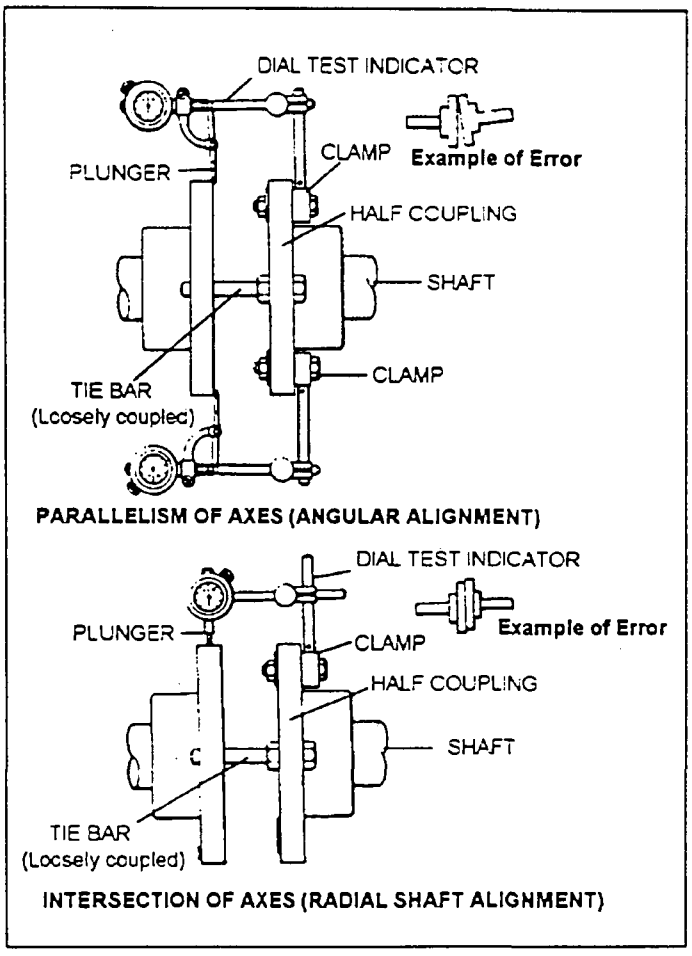


Figure 2: Alignment of Direct Coupled Pumps

PIPEWORK

Pipelines and valves should be properly aligned with pump flanges and they should be supported independently of the pump. All pipe design should be on the basis of zero pump flange loading - if this condition cannot be achieved then values for the maximum allowable external loads and moments on the pump flanges is available from the Head Office of Warman International.

APPROPRIATE WARMAN JOINT RINGS (when required) MUST BE USED AT THE PUMP FLANGES. THE JOINT RINGS FORM AN EFFECTIVE SEAL BETWEEN PIPEWORK AND PUMP CASING. In some pumps, the metal liner projects a short distance past the flange. Care should be taken in such instances not to over tighten the flange bolts so as not to damage the Joint Rings.

A removable piece of pipe should be used on the intake side of the pump. This pipe should be of sufficient length to allow removal of the pump cover plate or casing and to enable access to pump wearing parts and impeller.

Removal of the intake pipe is facilitated if a flexible joint is used in place of the flanged connection. All pipe joints must be airtight to ensure priming of the pump.

Recommendations and procedures for inter-stage piping for multi-stage installations are available from the Head Office of Warman International.

FLANGES

Matching flanges on the pump intake and discharge must be flush as shown on attached drawing A4-111-1-121595. Keeping flanges flush is important in providing proper backup support and compression for Intake and Discharge Joint Rings to prevent leakage.

Warman Intake and Discharge slip-on matching Flanges can be supplied on request.

INTAKE CONDITIONS

Suitable isolation should be fitted in the intake pipe as near to the pump as possible. The intake pipe should be as short as possible. An arrangement of intake pipework which is common to two or more pumps operating on suction lift is not recommended. If such an arrangement is unavoidable any points of possible air ingress, such as valve glands should be liquid sealed and isolating valves should be fitted at appropriate points.

The diameter of the intake pipe required depends upon its length and bears no fixed relationship to the diameter of the intake branch of the pump. The size of the pipe must be such that the velocity is kept to a minimum, but above the solids particle critical settling velocity to reduce friction losses, i.e. a long intake pipe, (or one with numerous bends) which passes a given quantity or liquid must be of larger bore than a short straight one passing the same quantity of liquid.

When the bore of the intake pipe is increased to a size larger than that of the pump intake branch, the form of taper pipe used must not allow the formation of air pockets. To avoid air pockets, the installation of intake pipework must be arranged with as few bends as possible and the pipework must be completely airtight.

OPERATION

GENERAL

The principle requirements for operation of Warman pumps are as follows:

- Priming arrangements to raise water in the intake pipe and fill the pump
- Gland sealing water (on gland sealed pumps) provided at adequate pressure and flow
- Impellers adjusted to maintain minimum clearance with front liner
- Wearing parts replaced when performance falls below required operating pressure
- Volute liner seal and stuffing box seal maintained to prevent leakage
- Grease purged labyrinths (where used) lubricated regularly to prolong bearing life by excluding dust and dirt from the bearing assembly.

SHAFT SEAL

For gland sealed pumps, check gland water is available and that it is of sufficient quantity and at the correct pressure. Gland water pressure should be approximately 35 kPa above the pump discharge pressure. Slacken off gland and adjust it so that a small flow is obtained along the Shaft. Note that pumps supplied directly from Warman factories usually have tight glands to minimise Shaft vibration during transport.

For centrifugally sealed pumps, screw the grease cup down a few turns to charge the static seal chamber with grease.

SHAFT UNLOCKING

For transport of Warman pumps the bearings should be locked to prevent vibration and consequent damage. This is done by attaching the shaft clamp to the shaft. A set screw in the handle of the clamp is then screwed up hard against the pump base to lock the bearings. Alternatively, the pump is supplied with the vee-belts tensioned to reduce shaft movement.

Before use of the pump, the set screw must be removed to free the bearings or alternatively the vee-belt tension must be checked and adjusted if necessary. The shaft should then be rotated by hand (clockwise) by means of the clamp to ensure that the impeller turns freely within the pump. At any sign of scraping noises from the pump, the impeller must be adjusted (see Assembly and Maintenance Instructions for the particular TYPE of Warman pump). The shaft clamp must then be removed.

MOTOR ROTATION CHECK

Remove all vee-belts or completely disconnect shaft coupling, as the case may be. *THIS IS IMPORTANT!*

Start motor, check rotation and correct it if necessary to produce pump Shaft rotation indicated by arrow on the pump casing. Refit vee-belts or reconnect Shaft coupling. When tensioning belts maintain Shaft alignment and check belt tension.

WARNING

ROTATION IN DIRECTION OPPOSITE TO THE ARROW THE PUMP WILL UNSCREW THE IMPELLER FROM THE SHAFT CAUSING SERIOUS DAMAGE TO THE PUMP

PRIMING

Arrangements for raising water in the intake pipe and filling the pump (or first stage of a multi-stage installation) must be provided in preparation to starting up. Gland sealing water should then be turned on to the pump(s). To ensure trouble free operation of glands the gland sealing water pressures should be approximately 35 kPa higher then the pumps operating discharge pressure.

IMPORTANT NOTE:

Gland sealing water must be left on during all subsequent operations, namely, start up, running, shut down and run back. Gland water may be turned off only after shut down and then only after all the slurry in the pipeline has drained back to the pit.

NORMAL PUMP START UP

Check once more that all bolts are tight and that the Impeller turns freely. Ensure that Shaft Seal is in order and that pressure of gland water supply, where used, is correct.

It is good practice whenever possible to start up pumps on water before introducing solids or slurry into the stream. On shutting down it is also desirable that pumps should be allowed to pump water only for a short period before shut down.

Open intake valve (if any) and check that water is available at the inlet. Start pump and motor and run up to speed, if pump is on suction lift execute priming procedure for facilities provided.

When the pump is primed, isolate prime facilities (if any). Check intake and discharge pressures (if gauges have been provided). Check flow rate by inspection of meters or pipe discharge.

Check Gland leakage. If leakage is excessive tighten gland nuts until flow is reduced to the required level. If leakage is insufficient and gland shows signs of heating, then try loosening gland nuts. If this is ineffective and the gland continues to heat up, the pump should be stopped and the gland allowed to cool. Gland nuts should not be loosened to such an extent that the gland follower is allowed to disengage the stuffing box.

NOTE

It is normal for gland leakage water to be hotter than the supply because it is conducting away the heat generated by friction in the gland.

At low pressures (single stage operation) very little leakage is required and it is possible to operate with only a small amount of water issuing from the gland. It is not essential to stop a pump because of gland heating unless steam or smoke is produced.

This difficulty is normally only experienced on initial start up on gland sealed pumps. When initial heat up of the gland is encountered, it is only necessary to start up -- stop -- cool and start the pump two or three times before the packing beds in correctly and the gland operates satisfactorily.

It is preferable at start to have too much leakage than not enough.

After the pump has run for 8-10 hours, gland bolts can be adjusted to give optimum leakage. If heating of gland persists, the packing should be removed and the gland repacked.

Warman pumps are normally packed with non-asbestos packing, Warman material code Q05, for general duties and pressures up to 2000 kPa. Above 2000 kPa it is usually

necessary to use an anti-extrusion ring between the gland follower and the last ring of packing. High pressure packing recommendations are available from the Head Office of Warman International.

For multi-stage installations it is usually necessary to time the starting of the second and subsequent stage pumps to prevent motor overload. Recommendations and procedures for start up are available from the Head Office of Warman International.

ABNORMAL START UP

If the pump fails to prime, one or more of the following faults may be the cause:

BLOCKED INTAKE PIPE

When the pump has not been operated for some time, it is possible for slurry to settle in the intake pipe or around it if operating from a pit and thereby prevent water rising to the pump impeller. The pressure gauge on the intake side of the pump may be used to check the level of water in the pump.

AIR ENTERING GLAND

If one of the following conditions apply, air may be induced into the pump through the gland. This may prevent the pump "picking up" its prime or cause it to loss its prime during operation.

- Sealing water pressure too low
- Packing is excessively worn
- Shaft sleeve is excessively worn
- Gland sealing water connection into stuffing box is blocked.

Inspection of the gland will readily reveal if above faults are occurring and remedial action is self evident.

OPERATING FAULTS

Refer to the FAULT FINDING CHART at the back of this Supplement to determine the most likely cause of any problems. Some of the major faults that can occur are more fully detailed below.

Overloading can occur when the pump is discharging into an empty system when the delivery head will be temporarily lower and the throughput in excess of that for which the pump is designed. Careful regulation of the delivery valve until the system is fully charged will prevent this.

WARNING: PUMPS THAT ARE NOT FITTED WITH A LEAK-OFF DEVICE MUST NOT BE RUN FOR A LONG PERIOD AGAINST A CLOSED DISCHARGE VALVE.

LOW PIT LEVEL

Pumps (or first stage pumps in a multi-stage installation) may lose their prime if air is induced through the gland. Pumps may also lose their prime if the water level in the pit falls sufficiently low to allow air to be induced into the pump intake by vortex action.

In order to obtain the best possible pump operation, sump (or hopper) makeup water controls should be arranged to maintain as high a level in the sump (or hopper) as runback requirements will allow and should be arranged to maintain this level within as close limits as is practical.

BLOCKED INTAKE PIPE

It is possible during operation of pump for a piece of foreign material to be drawn across the bottom of the intake pipe and thereby cause a partial obstruction. Such an obstruction may not be sufficient to stop operation completely but will result in a reduced output from the pump. It will also cause a drop in discharge pressure and amps, and will increase the vacuum reading on the pump intake. Rough running and vibration of the pump may also occur due to the high induced suction causing cavitation within the pump.

BLOCKED IMPELLER

Impellers are capable of passing a certain size particle. If a particle larger in size enters the intake pipe it may become lodged in the eye of the impeller thereby restricting the output of the pump. Such an obstruction will usually result in a drop of amps and a drop in both discharge pressure and intake vacuum readings.

Pump vibrations will also occur due to the out of balance effects.

BLOCKED DISCHARGE PIPE

Blocked discharge pipe may be caused by abnormally high concentration of coarse particles in the pump discharge pipe or by the velocity in the discharge pipe being too low to adequately transport the solids. Such a blockage will be shown up by a rise in discharge pressure and a drop in amps and intake vacuum readings.

SHUTTING DOWN PROCEDURE

Whenever possible, the pump should be allowed to operate on water only for a short period to clear any slurry through the system before shut down.

1. Close the delivery valve (if fitted) to reduce load on driving unit
2. Shut down the pump
3. Shut valves (if any)
4. Gland sealing water (if any) must be left on during all subsequent operations, namely: Start up, running, shut down and run back.

Gland water may only then be turned off.

MAINTENANCE

RUNNING MAINTENANCE

GENERAL

Warman pumps are of sturdy construction and when correctly assembled and installed, they will give long trouble-free service with a minimum amount of maintenance.

The only maintenance required for pumps in operation is as follows:

- Gland adjustment
- Gland re-packing
- Impeller adjustment
- Tightening down
- Possible periodic greasing of Bearings

SHAFT SEAL CARE

Gland

The gland sealing water supply should be steady as pressure fluctuations will make gland adjustment for optimum performance difficult.

Glands must be adjusted to provide reasonable leakage when seal water pressure is at a minimum and therefore when this pressure rises leakage will necessarily be excessive. If glands are adjusted to provide optimum leakage at the higher seal water pressures, insufficient lubrication will be obtained when this pressure falls.

The gland sealing water should be as clean as possible as even small amounts of solids can quickly wear gland components.

Requirements for gland operation on the first stage of a multi-stage installation are different from the other stages.

For the second and succeeding stages the gland water is only required to flush slurry away from the shaft sleeve and provide lubrication for the gland packing. Gland water for the first stage pumps as well as carrying out the above functions must also pressurise the gland to prevent ingress of air when the pressure at the shaft falls below atmospheric.

Check periodically gland seal water supply and discharge. Always maintain a very small amount of clean water leakage along the shaft by regularly adjusting gland. When gland adjustment is no longer possible replace full pack.

Gland sealing water requirements can be reduced to a minimum using Warman Low Flow Lantern Restrictors (Warman basic part N° 118-1).

Centrifugal

In centrifugally sealed pumps lubricate the static seal chamber sparingly but regularly by means of the grease cup. Two turns of the grease cup per 12 hours running time is recommended to form an adequate seal at the packing rings, to lubricate the gland packing and to enable them to run in a dry condition. Use only recommended, clean lubricant.

REPLACKNG GLAND

When gland packing has deteriorated to such an extent that no further adjustment can be obtained by tightening down the gland follower, it is not good practice to attempt to correct this by inserting one new ring of packing on top of the old rings.

When the gland follower has reached the limit of its travel all the old packing should be removed from the gland and the gland repacked with new packing.

To repack a gland the gland bolts and gland clamp bolts should be taken out and the two halves of the gland follower removed from the pump. Old packing may then be removed and the stuffing box recess cleaned out. It is not necessary to remove the lantern restrictor during this operation. Rings of new packing should then be placed in position and tamped home one ring at a time, making sure that the ends of each ring come hard together and joints in successive rings are staggered around the stuffing box.

Gland halves may then be replaced, secured with clamp bolts and nipped down with gland bolts. Nuts on gland bolts should then be slacked off and left finger tight until pump is started. After start-up glands maybe adjusted until leakage is at the required flow rate.

These glands are designed for water lubrication and some leakage is necessary during operation to lubricate and cool the packing and shaft sleeve. Gland leakage at all times must be clean and free from solids. If there is any sign of slurry leaking from a gland then one of the following must be occurring:-

- Gland sealing water pressure is too low
- Gland packing and/or shaft sleeve requires replacement
- Gland sealing water connection to stuffing box is blocked

When a gland is being repacked during a complete pump overhaul it is easier to pack the stuffing box and assemble the gland while the stuffing box is out of the pump (refer to instructions in the particular Warman Instruction Supplement depending on the TYPE of pump).

The lantern restrictor, packing and gland maybe assembled into the stuffing box with the shaft sleeve in position in the stuffing box. The stuffing box, assembled gland and shaft sleeve may then be fitted to the pump as one unit.

IMPELLER ADJUSTMENT

Warman pump performance changes with the clearance existing between an open Impeller and the intake side liner. This is less pronounced with closed Impellers.

With wear, the clearance increases and the pump efficiency drops. For best performance it is necessary, therefore, to stop the pump occasionally and move the impeller forward (this applies to metal, rubber and high efficiency style impellers). This adjustment can be carried out in a few minutes without any dismantling. The correct setting of the impeller is when the clearance between the impeller and the intake side liner is a minimum.

AFTER PUMP IMPELLER ADJUSTMENTS RECHECK PULLEY ALIGNMENT AND ADJUST AS NECESSARY.

TIGHTENING DOWN

Although Warman pump impellers are balanced before they leave the works, precise balance cannot be achieved in operation because of uneven wear which can take place. Pumps are therefore subject to some vibration while running and this can result in loosening of some bolts. It is recommended therefore that a routine maintenance program be established whereby a check be made at regular intervals to ensure that all nuts are tight. To avoid any possible movement between the Bearing Assembly and the Base, the Bearing Housing Clamp Bolt must be maintained fully tightened. (See Table 1) A convenient time for this check to be carried out would be at the same time as impeller adjustment is made. If any location is found where bolts consistently loosen then 'Nylock' nuts or other suitable locking devices should be fitted.

LABYRINTH GREASE PURGING

To improve the sealing properties of the labyrinths on the end covers of some types of Warman bearing assemblies, grease purging is utilised to purge out grit and moisture. Less contaminants entering the bearing assembly will result in longer bearing life and ultimately cost savings. Therefore careful attention paid to labyrinth purging is an essential maintenance requirement.

Full details are given in the relevant Warman Bearing Assembly Instruction Supplement.

BEARING LUBRICATION

A correctly assembled and pre-greased bearing assembly will have a long trouble free life, provided it is protected against ingress of water or other foreign matter and that it is adequately maintained.

It must be left to the good judgement of maintenance personnel, to open bearing housings at regular intervals (not longer than twelve months) to inspect bearings and grease and to then determine each time the course of action for the period up to the next inspection.

If a regular addition of grease is judged to be necessary, then the plugs on the bearing assembly should be replaced with grease nipples. It is preferable to lubricate often and sparingly, than to add large amounts at long intervals. Bearings must never be over greased.

Use only recommended, clean grease.

For oil lubricated bearings, it is recommended that a full oil change is carried out every 6 months or 4,000 hours.

Additional information and recommendations on bearing lubrication are contained in the relevant Warman Bearing Assembly Instruction Supplements and in Section 6.2.3 below.

OVERHAUL MAINTENANCE

GENERAL

When the pump has worn to such an extent that the performance obtained no longer is satisfactory then the pump(s) should be dismantled for inspection and/or replacement of wearing parts (impeller and liners).

If the bearing assembly requires maintenance, then the pump wet end must be dismantled before the bearing assembly can be removed from the pump.

NOTE: Bearing assemblies should only be reconditioned in a workshop preferably in a specific area set aside for the work. A clean environment is essential.

PUMP DISMANTLING

Isolate the pump from the system and wash down as much as possible. Remove drive items as necessary after noting alignment of drive.

Dismantling can be done in situ if suitable lifting facilities and working space are available otherwise the complete pump should be removed to a maintenance workshop.

NOTE:

i. It is recommended that bearing assemblies should only be dismantled and overhauled in the workshop.

ii. When bearing components are removed from a pump, they should be identified with suitable tags so that if they are reused they may be replaced in the same position in the pump with their correct mating parts.

iii. Bearing components which are an interference fit on the shaft should be removed only if replacement is necessary.

The procedure for removing the pump or bearing assembly is simply a reversal of the assembly procedure as set out in the relevant Instruction Supplements for the pump and bearing assembly.

Note that the pump must be dismantled before the bearing assembly can be removed for reconditioning.

All Warman pumps utilise a thread to fasten the impeller to the pump shaft. The larger pumps incorporate an impeller release collar to facilitate impeller removal. Full details can be found in Warman Supplement 'M2'.

INSPECTION AND REMOVAL OF BEARINGS

Since greasing requirements vary with operating conditions and environment the following general recommendations should be used as a guide.

When new bearings are fitted or re-assembled after overhaul they should be correctly packed with grease. It is then recommended that a systematic program of investigation be instituted in order to ascertain the following:

i. whether the grease addition is required between overhauls

ii. how frequently grease addition is required

iii. what quantity of grease addition is required.

Proposals regarding the amount and frequency are given in the relevant manual Supplements depending on pump speed.

A suggested program of investigation is briefly described below for the case of a number of the same pumps operating on similar or the same duties (i.e. the pumps have identical bearings).

(a) Start with two pumps with bearings correctly packed with grease

(b) After a set number of hours (depending on the duty and environment) dismantle the bearing assembly of one pump and inspect condition and disposition of the grease

(c) From inspection assess whether grease addition is required at this interval and if grease addition is not required assess whether the second pump can safely run to twice the set number of hours without greasing

(d) By repeating this procedure on the remaining pumps in turn, the maximum time interval before re-greasing may be determined and it may be found possible to run pumps for the life of the wearing parts without re-greasing bearings.

If these conditions can be achieved then bearing contamination is avoided and an overall saving in labour effected.

It is recommended that a spare drive shaft unit should be carried in store so that the assembly may be changed over when wearing parts are being replaced. The assembly taken out may then be reconditioned in the workshop ready for installation in the next drive assembly overhaul.

With correct care and maintenance, deterioration of bearings should be detected during routine overhauls before malfunctions become obvious in operation.

The criteria for examination of a bearing is contained in the question "Will the bearing operate until the next overhaul?" Where there is any doubt regarding the condition of a bearing it is far more economical to replace it while the pump is dismantled for overhaul than to risk a failure in operation which may result in damage to other parts of the pump.

When to Remove Bearings

Bearings should be renewed when any of the following faults are observed:

i. Face of race is worn to such an extent that a detectable shoulder is evident at the edge of the rolling track

ii. Cage is worn to such an extent that there is excessive slackness or burrs

iii. Any roughness or pitting of rollers or rolling track.

The rolling track will often be slightly darker than the unused portion of the race. This does not mean that the bearing has reached the end of its useful life provided no other symptoms are present.

Removing Bearings

Care should be exercised during dismantling. When driving bearing cups out of the assembly with shaft and rollers, the shaft should be held hard in the direction of driving so that rollers are seated hard up against the face of the cup and the effects of impact on the bearing faces are thereby minimised.

If inspection of bearings shows that they require replacement then a press or suitable puller should be set up to bear on the end of the shaft and on the bearings.

When bearing components are removed from an assembly, they should be identified with suitable tags so that if they are reused they maybe replaced in the same position in the assembly with their correct mating parts.

If any portion of a bearing required replacing then the bearing should be replaced in its entirety. Worn parts must not be mixed with new parts. A complete new bearing at one end of a bearing assembly may be installed with a used bearing at the other if required; however, if one bearing requires replacement, economics usually favour renewing the pair.

REPLACEMENT OF WEARING PARTS

The wear rate of a solids handling pump is a function of the severity of the pumping duty and of the abrasive properties of the material handled. Therefore, the life of wearing parts, such as impellers and liners, varies from pump to pump and from one installation to another.

As pump impellers and liners become worn the head developed by the pump decreases. As the head decreases a consequent drop in rate of discharge will occur. When the rate of discharge has fallen to such a level that either the required quantity of slurry cannot be discharged or the line velocity is too low for satisfactory transportation of the slurry then the pump(s) should be dismantled for inspection of impeller and liners.

Replacement of the impeller only, will result in the pump regaining almost new pump performance. Whether liners require replacement should be assessed by estimating whether the proportionate thickness remaining will provide reasonable further life before replacement is required.

Where a pump is used on a particular duty for the first time and especially where failure of a wearing part during service could have serious consequences, it is recommended that the pump be opened at regular intervals, parts be inspected and their wear rate estimated so that the remaining life of the parts may be established.

For installation of new wearing parts refer to relevant Warman Pump Supplement.

REASSEMBLING PUMP OVERHAUL

When pumps have been dismantled for complete overhaul all parts should be closely inspected and new parts checked for correct identification.

Used parts being replaced should be thoroughly cleaned and painted. Mating faces should be free from rust, dirt and burrs and given a coat of grease before they are fitted together.

It is preferable to renew small bolts and set screws during overhaul and all threads should be coated with graphite grease before reassembly.

It is recommended that all rubber seals should be replaced during major overhauls as rubber tends to harden and seals lose their effectiveness.

STAND BY PUMPS

Where stand-by pumps are standing idle for long intervals, it is advisable to turn their shaft a quarter of a turn by hand once per week. In this way all the bearing rollers in turn are made to carry static loads and external vibrations.

SPARE PARTS

Spare parts for Warman pumps consist in the main of liners, impellers, bearings, shaft sleeves, seals and shaft seal parts. Depending on the expected life of each part, a number of spares of each should be kept in stock to ensure maximum use of the pump.

In major plants it is usual to stock an additional bearing assembly for every ten (or less) pumps of the same size. This enables a quick change of the bearing assembly in any one of the pumps. Often this operation is carried out when wearing parts are being replaced. The removed bearing assembly can then be inspected in a workshop, overhauled if required and kept ready for the next pump.

In this way damage is prevented and all pumps are always kept in optimum condition with a minimum of down time.

TABLE 1: BEARING HOUSING CLAMP BOLT TORQUE

FRAME SIZE	MAXIMUM TORQUE (Nm)	FRAME SIZE	MAXIMUM TORQUE (Nm)
A	10		
B	10	N	25
C	45	P	45
D	45	Q	45
E	185	R	185
F	185	S	185
G	325	T	525
H	1500	U	1500

Fault Finding Chart

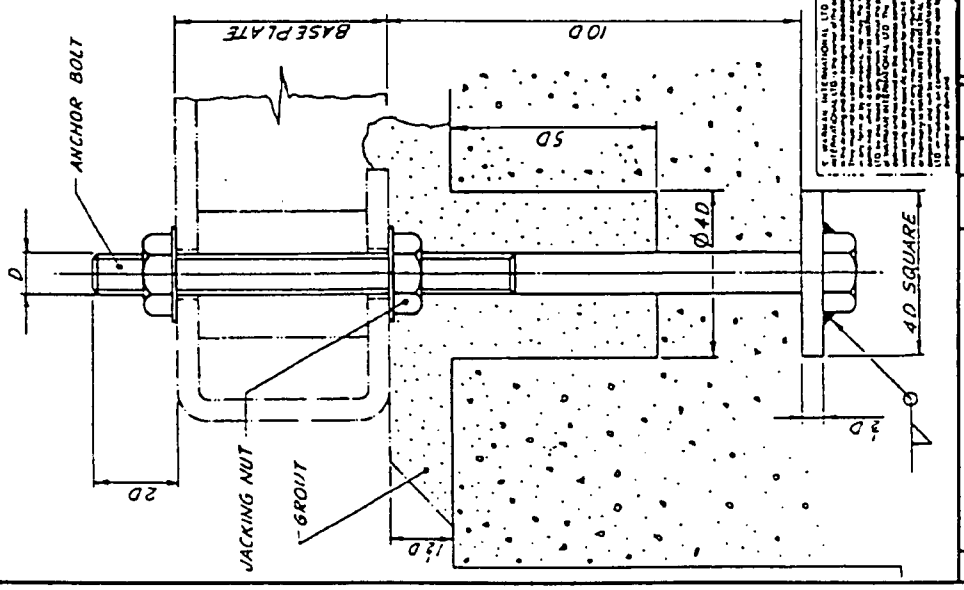
SYMPTOMS

FAULTS

Hopper overflows	Overheating or seizure of pump	Short life of bearings	Vibration and noise from pump	Packing has short life	Leakage from stuffing box	Excessive horsepower required	Pump loses prime	Insufficient Pressure	Reduced discharge delivery	Discharge failure		
■	■									■	Pump not primed	INTAKE FAULTS
			■				■		■	■	Pump or suction pipe not completely filled with liquid	
			■				■		■	■	Suction lift too high	
	■		■						■	■	Insufficient margin between suction pressure and vapour pressure	
■							■	■	■		Excessive amount of air or gas in liquid	
							■		■	■	Air pocket in suction line	
							■		■		Air leaks into suction line	
							■		■		Air leaks into pump through stuffing box	
			■						■		Foot valve too small	
			■						■		Foot valve partially clogged	
■			■				■		■	■	Inlet of suction pipe insufficiently submerged	
■							■		■	■	Blocked suction line	
■							■		■	■	Inlet pipe diameter too small or length of inlet pipe too long	
■								■	■	■	Speed too low	SYSTEM FAULTS
						■			■		Speed too high	
■						■		■	■	■	Wrong direction of rotation	
■						■		■	■	■	Total head of system higher than design	
						■					Total head of system lower than design	
■						■					Specific gravity of liquid different from design	
						■		■	■		Viscosity of liquid differs from that for which designed	
	■		■								Operation at very low capacity	
■							■	■	■	■	Entrained air in pump. Pump hopper requires baffles	
■			■				■	■	■	■	Badly installed pipe line or gaskets partly blocking pipe	
	■	■	■	■	■	■					Misalignment	MECHANICAL FAULTS
			■								Foundations not rigid	
		■	■	■	■	■					Shaft bent	
	■	■	■			■					Rotating part rubbing on stationary part	
	■	■	■	■							Bearings worn	
			■					■	■	■	Impeller damaged or worn	
■								■	■	■	Casing gasket defective, permitting internal leakage	
				■	■						Shaft or shaft sleeves worn or scored at the packing	
				■	■						Packing improperly installed	
					■	■					Incorrect type of packing for operating conditions	
	■	■	■	■	■						Shaft running off-centre because of worn bearings or misalignment	
	■	■	■	■	■						Impeller out of balance, resulting in vibration	
				■		■					Gland too tight, resulting in no flow of liquid to lubricate packing	
■			■				■	■	■	■	Foreign matter in impeller	
				■	■						Dirt or grit in sealing liquid, leading to scoring shaft sleeve	
	■	■	■								Excessive thrust caused by a mechanical failure inside the pump	
	■	■	■								Excessive amount of lubricant in bearing housing causing high bearing temperature	
	■	■	■								Lack of lubrication	
	■	■	■								Improper installation of bearings	
		■	■								Dirt getting into bearings	
		■	■								Rusting of bearings due to water getting into housing	
				■	■						Expeller worn or blocked	
				■	■						Excessive clearance at bottom of stuffing box, forcing packing into pump	

Probable Faults ■

1. INITIAL MOUNTING : PLINTH IS GENERALLY FORMED 50 mm LARGER ALL ROUND THAN THE RESPECTIVE BASEPLATE.
2. PLINTHS ARE NORMALLY FORMED IN A HIGH COMPRESSIVE STRENGTH CONCRETE WITH SUITABLE ANCHOR BOLTS LOCATED AS PER THE INDIVIDUAL CERTIFIED DIMENSION DRAWING AND GENERALLY ARRANGED AS SHOWN ON ADJACENT SKETCH.
3. FOLLOWING A SUITABLE PERIOD FOR CURING OF THE PLINTH ALL ANCHOR BOLTS SHOULD BE CLEANED AND ALIGNED TO ENABLE FITTING OF THE BASEPLATE. IT IS RECOMMENDED THAT EACH THREAD BE CHECKED WITH A SUITABLE DIE NUT.
4. FIT A SINGLE NUT (THE 'JACKING NUT') TO EACH ANCHOR BOLT AND SCREW DOWN AS FAR AS POSSIBLE ON THE THREAD. FIT FLAT WASHER ON NUT.
5. FIT THE BASEPLATE TO THE ANCHOR BOLTS
6. ALIGN THE BASEPLATE TO THE CORRECT LEVEL BY MEANS OF THE JACKING NUTS.
7. FIT THE WASHERS AND LOCKING NUTS TO ANCHOR BOLTS AND LIGHTLY TIGHTEN ONCE THE DESIRED LEVEL IS ACHIEVED.
8. FORCE GROUT OF THE CORRECT CONSISTENCY BETWEEN THE BASEPLATE AND THE PLINTH AROUND THE FULL EXTREMITY OF THE BASEPLATE AND DRESS GROUT TO A 45° ANGLE AS GENERALLY SHOWN ON SKETCH.
9. TIGHTEN ALL ANCHOR BOLTS AFTER SUFFICIENT CURING TIME FOR GROUTING HAS ELAPSED NB. IT SHOULD BE NOTED THAT WARMAN BASEPLATES ARE MANUFACTURED IN A FOLDED PLATE BOX TYPE CONTRUCTION AND ARE DESIGNED TO PROVIDE FULL STRUCTURAL STRENGTH AND SUPPORT AT THE OUTER EDGES OF THE BASEPLATE ONLY. GROUTING THEREFORE NEED ONLY PENETRATE THE OUTER EDGES AND IS NOT REQUIRED UNDER THE FULL AREA OF THE BASEPLATE.



WARMAN BASEPLATES
SUGGESTED PROCEDURE FOR ALIGNING AND GROUTING

WARMAN INTERNATIONAL LIMITED

A3-100-0-19810

REV. 1

OFFICE OF ORIGIN : SYDNEY

APP.
CHECK
DRN. V.CH.S.
DATE 23-8-79
SCALE

No.	DESCRIPTION	BY	DATE
1	CHECKED COLUMN & NEW COPYRIGHT ADDED	TM	7/10/83
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3			
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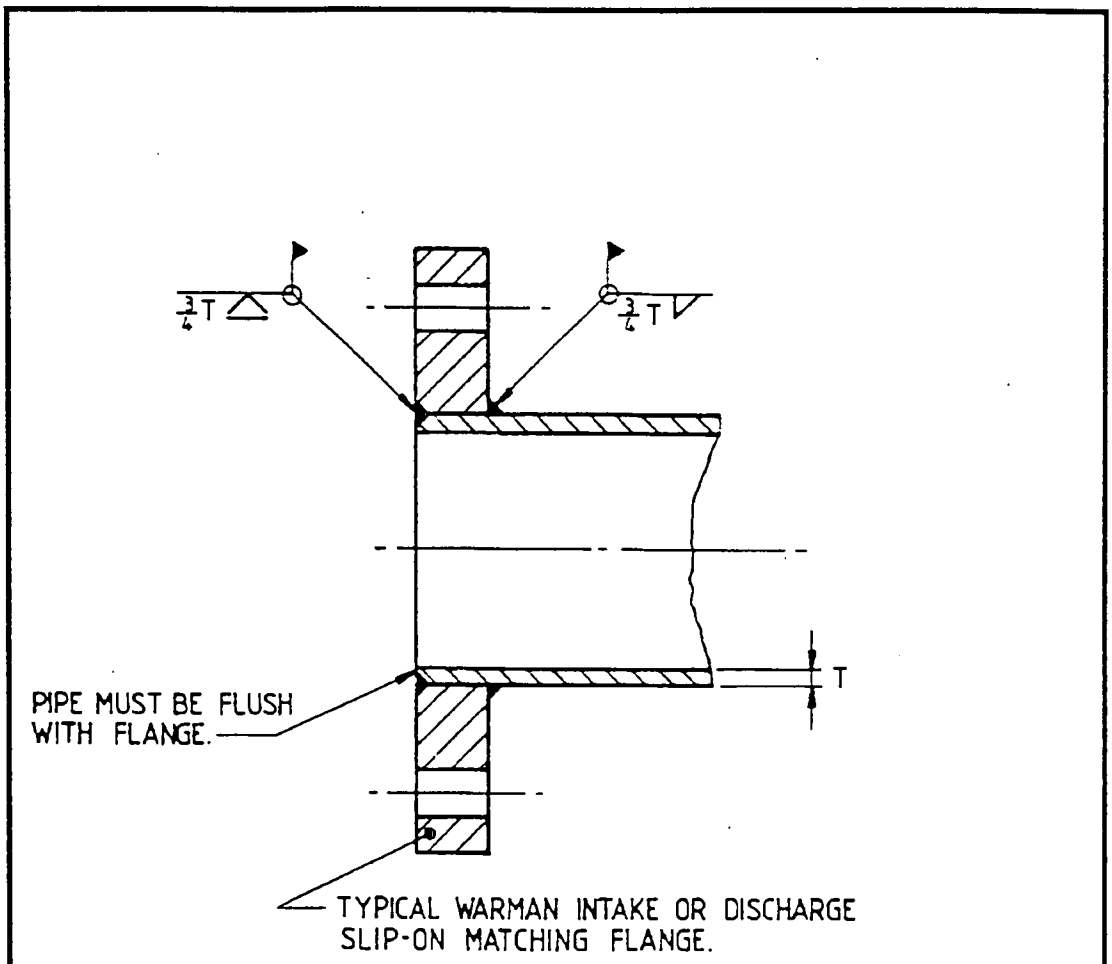
REVISIONS

Warman Baseplates: Drawing A3-100-0-19810 Suggested Procedure for Aligning and Grouting



NOTE: 1. ALL WELDS TO BE CONTINUOUS, TO SEAL ALL OVER AND CONFORM TO AS1554.

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DATE	8-12-88	DRN.	B.M.H
SCALE	———		

WARMAN SLIP-ON MATCHING FLANGES
METHOD OF WELDING FLANGE TO PIPE

WARMAN INTERNATIONAL LTD.

OFFICE OF ORIGIN : SYDNEY

A4-111-1-121595

REV. 1

Warman Slip-on Matching Flanges: Drawing A4-111-1-121595

WARMAN INTERNATIONAL LTD

WARMAN PUMPS

ASSEMBLY AND MAINTENANCE INSTRUCTIONS

SUPPLEMENT 'BA2'

BASIC BEARING ASSEMBLIES

(WARMAN BASIC NUMBER 005)

(FRAME SIZES A, B, C, D, E, F, G & H)

MANUAL SUPPLEMENT 'BA2'

WARMAN PUMPS - ASSEMBLY AND MAINTENANCE INSTRUCTION MANUALS AND SUPPLEMENTS IMPORTANT SAFETY INFORMATION

WARNING

The **WARMAN PUMP** is both a **PRESSURE VESSEL** and a piece of **ROTATING EQUIPMENT.** All standard safety precautions for such equipment should be followed before and during installation, operation and maintenance.

For **AUXILIARY EQUIPMENT** (motors, belt drives, couplings, gear reducers, variable speed drives, etc.) standard safety precautions should be followed and appropriate instruction manuals consulted before and during installation, operation and maintenance.

WARNING

DRIVER ROTATION MUST BE CHECKED before belts or couplings are connected. Personnel injury and damage could result from operating the pump in the wrong direction.

WARNING

DO NOT OPERATE THE PUMP AT LOW OR ZERO FLOW CONDITIONS FOR PROLONGED PERIODS, OR UNDER ANY CIRCUMSTANCES THAT COULD CAUSE THE PUMPING LIQUID TO VAPORISE. Personnel injury and equipment damage could result from the pressure created.

WARNING

DO NOT APPLY HEAT TO IMPELLER BOSS OR NOSE in an effort to loosen the impeller thread prior to impeller removal. Personnel injury and equipment damage could result from the impeller shattering or exploding when the heat is applied.

WARNING

DO NOT FEED VERY HOT OR VERY COLD LIQUID into a pump which is at ambient temperature. Thermal shock may cause the pump casing to crack.

WARNING

FOR THE SAFETY OF OPERATING PERSONNEL, please note that the information supplied in this Manual only applies to the fitting of genuine Warman parts and Warman recommended bearings to Warman pumps.

WARNING

Tapped Holes (for Eye Bolts) and Lugs (for Shackles) on Warman Parts are for lifting **Individual Parts Only.**

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WARMAN PUMPS
ASSEMBLY AND MAINTENANCE INSTRUCTIONS
SUPPLEMENT 'BA2'
BASIC BEARING ASSEMBLIES
(FRAME SIZES A, B, C, D, E, F, G & H)

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1. INTRODUCTION

Supplement 'BA2' should be read in conjunction with the appropriate Assembly and Maintenance Instruction Manual Supplement for the particular TYPE of WARMAN Pump when Basic Bearing Assemblies (as denoted by a single letter after the pump size eg. A, B, C, etc) are used.

2. PARTS IDENTIFICATION

Every WARMAN part has a name and a three-digit Basic Part Number. Parts with the same name, irrespective of size, have the same Basic Part Number. Thus the shaft of every WARMAN Pump has the Basic Number 073.

Additional letters and digits are added before and after a given Basic Number to identify a specific component part of a particular pump. This then becomes the part number of that component. Every part has its part number cast or otherwise marked on.

For example: F073M = Shaft for F005M Bearing Assembly.

For full description and part number identification, refer to the appropriate WARMAN Components Diagram. Names and Basic Numbers are used in assembly instructions in this manual. The relevant WARMAN Basic Numbers are listed at the end of this supplement (Section 9).

In all correspondence with WARMAN INTERNATIONAL LTD., or their representatives, and especially when ordering spare parts, it is advisable to use correct names as well as full part numbers to prevent misunderstandings or wrong deliveries. When in doubt, the pump serial number should be quoted as well.

3. BEARING LUBRICATION

It is recommended that lubricating grease used in rolling bearings should have the following characteristics:

A lithium complex soap thickener grease with EP additives and oxidation inhibitors.

N. L. G. I. Consistency No 2
Drop Point .....≥260°C
Work penetration @ 25°C (A.S.T.M.) .....265 to 295

RECOMMENDED BEARING GREASE:
MOBIL HP or equivalent.

A correctly assembled and pre-greased bearing assembly, (see ASSEMBLY INSTRUCTIONS) will have a long trouble free life, provided that it is protected against ingress of water or other foreign matter and that it is adequately maintained. Careful attention paid to purging of the labyrinth (refer to section 4) with grease will provide extra protection against ingress of dirt and prolong bearing life.

It must be left to the good judgement of maintenance personnel, to open the bearing housing at regular intervals (not longer than twelve months) to inspect bearings and grease and to then determine each time the course of action for the period up to the next inspection. This is the preferred method.

The frequency and amount of lubricant to be added periodically depends upon a number of factors and a combination of them, including speed and size of bearing, duration and extent of on-off operation, and the usual environmental conditions such as ambient and operating temperatures, splash and the presence of contaminants.

If a regular addition of grease is judged necessary, or for unusual circumstances where extreme conditions warrant additional lubricant to be supplied, the plugs on the bearing assembly maybe replaced with grease nipples although this practice is not highly recommended. Grease nipples must be cleaned prior to use, to prevent ingress of dirt into the bearings whilst greasing. It is preferrable to lubricate often and sparingly, than to add large amounts at long intervals. Bearings must never be overgreased.

Excess Grease: The immediate effect of an excess of grease within a bearing is overheating due to the churning of the grease. This particularly is to be avoided. If bearings run too hot after a change of grease, the trouble is likely to be due to overgreasing. Under no circumstances add more lubricant to correct the overheating.

Most pump bearings operate in the lower speed ranges but there is still the risk of damage due to over-lubricating especially in the case of the smaller sized bearings. Such cautionary measures to avoid over-lubrication, however, do not warrant neglecting the bearings completely. Therefore, judgement and experience should be the final determining factors in establishing routine lubrication procedures. Consequently it is advisable to observe the bearing frequently at the outset of operations taking careful note of any unusual conditions regarding temperature and cleanliness.

Use only recommended clean grease.

For ordinary conditions of continuous operation where bearing operating temperatures do not exceed the temperature where the grease loses its ability to seal, the guidelines tabulated below can be used.

SUGGESTED LUBRICATION INTERVAL FOR BOTH PUMP AND DRIVE END BEARINGS (Hours)

FRAME	BEARING	ADD g PER BRG	PUMP SPEED										
			200	300	400	600	800	1000	1200	1500	2000	2500	3000
A	A009	5	-	-	-	-	-	-	2100	1700	1300	1000	800
B	B009	10	-	-	-	-	-	2200	1800	1400	1050	800	650
C	C009	15	-	-	-	-	2200	1750	1400	1200	800	580	-
D	D009	25	-	-	-	2500	1750	1450	1100	850	-	-	-
E	E009	40	-	-	3300	2050	1500	1100	850	650	-	-	-
F	F009	65	-	3900	2900	1700	1200	850	-	-	-	-	-
G	G009	120	5000	3100	2300	1400	850	-	-	-	-	-	-
H	H009	325	4000	2400	1600	-	-	-	-	-	-	-	-
	H009D	155	20000	13000	8500	-	-	-	-	-	-	-	-

QUALIFICATION

The above table is based on normal operating conditions and intended to be a guideline. Normal operating conditions would include:

- Clean enviroment.
- Pumps under cover or protected from the weather (rain, snow, ice, dust etc.)
- Normal ambient temperatures (10 to 35°C).
- No spray from either badly maintained gland or from heavy washing down.
- Normal operating conditions-below full rating.
- Tabulated figures are based on bearing temperatures of 70°C measured at the outer ring. Intervals should be halved for every 15°C increase above 70°C, but the maximum permissable operating temperature for the grease should obviously not be exceeded.

Very dirty or damp atmospheric conditions or conditions that varied from those listed above would require that the recommendations be stepped up to a level that prevents contaminants from entering the bearings.

INITIAL GREASE FILL

The recommended initial quantities of grease to be used for each bearing is given on the attached Basic Bearing Assemblies information sheet.

4 LABYRINTH GREASE PURGING

Less contaminants entering the Bearing Assembly will result in longer Bearing life and ultimately a cost saving. Therefore careful attention paid to Labyrinth grease purging is an essential maintenance requirement.

RECOMMENDED INTERVALS FOR LABYRINTH GREASE PURGING

	Continuous (24h) Operation	16h Operation Per Day	8h Operation Per Day
Pump End Labyrinth	4 shots every 12 hours *	4 shots daily	2 shots daily
Drive End Labyrinth	4 shots every 120 hours	4 shots weekly	2 shots weekly

* Shots are from a standard hand operated grease gun.

Type '-10' Bearing Assembly Sealing Arrangement

Type '-10' is Warman standard Bearing Sealing Arrangement and is patented worldwide. The design uses an additional V-ring Seal and larger Flinger-Labyrinth arrangement as further protection against grit and moisture penetrating the bearing. To improve the sealing of the pump and drive ends of Bearing Assemblies, a radially drilled hole in the End Covers allows grease to be fed into the space between the Piston Rings rather than directly into the Labyrinth. The grease forms a pressurised barrier between the two Piston Rings. The small

amount of grease that enters the bearings will assist in their lubrication and the grease that escapes outwards together with the centrifuging effect when the pump is running will keep the labyrinth purged of grit and moisture. To improve the purging, particularly on the pump end of the bearing assembly the standard labyrinth grease purging nipple can be replaced with an automatic grease feeder (say three months capacity on smaller frames and one month capacity on the larger frames).

The type of grease used for Labyrinth sealing should be the same as that used for lubricating the bearings.

If an automatic grease feeder is used it will only be necessary to check at regular intervals that it has not fully discharged. If grease nipples are utilised, the guidelines as tabulated above should be followed.

Note: '-10' End Covers are supplied as standard and are available as Retrofit Kits.

5 ASSEMBLY INSTRUCTIONS

When Bearing Assemblies have been dismantled for complete overhaul, all parts should be closely inspected and new parts checked for correct identification.

Used parts being replaced should be thoroughly cleaned and repainted where required. Mating faces and spigots should be free of rust, dirt and burrs and given a coat of grease before they are fitted together to assist future overhaul.

It is preferrable to renew small bolts and set screws during overhaul and all threads should be coated with graphite grease before assembly. It is also recommended that all rubber seals should be replaced during major overhauls as rubber tends to harden and seals lose their effectiveness.

5.1 BEARING ASSEMBLY: FRAMES A, B, C, D, E, F & G

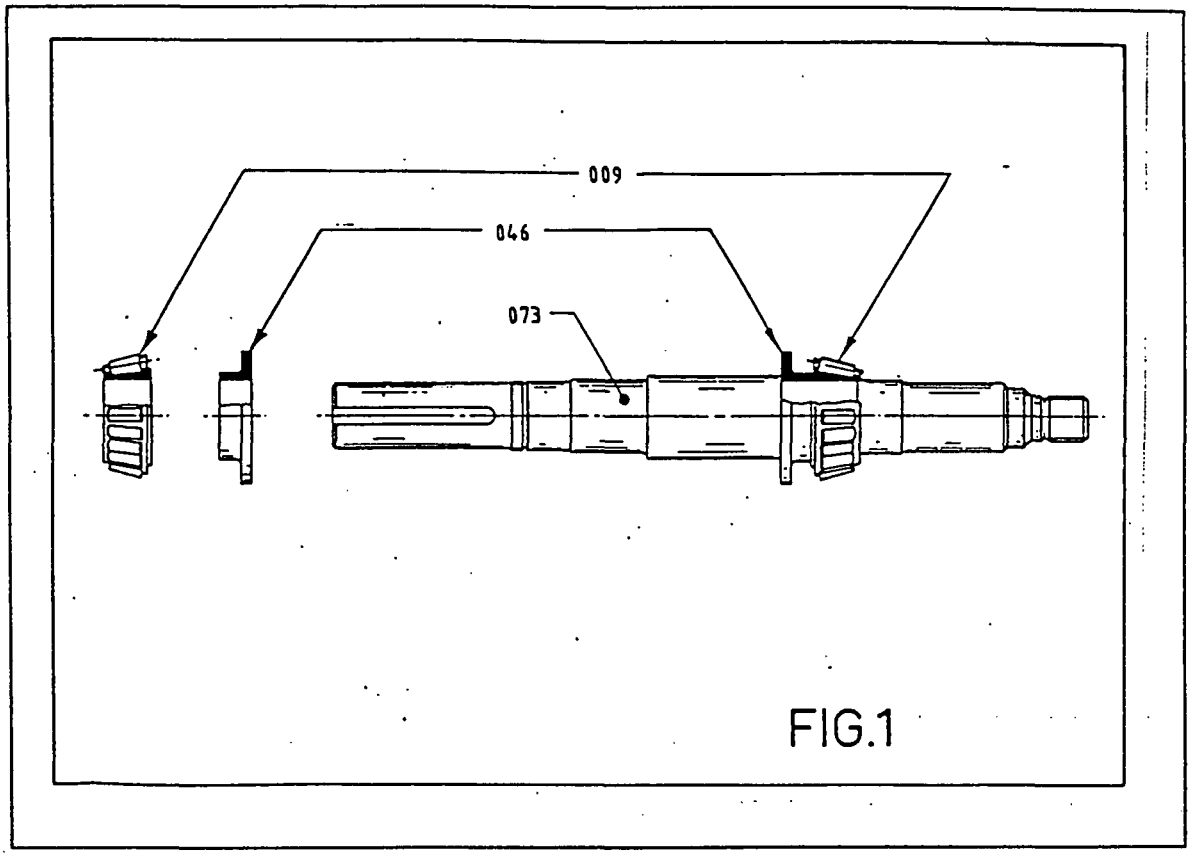


FIG.1

5.1.1 BEARING ASSEMBLY: Fitting Bearing Cones to Shaft
See Fig 1

1. Apply oil or light grease to bearing lands on SHAFT (073).

2. Slide on one GREASE RETAINER (046) with flange against shaft shoulder.

3. Fit cone of BEARING (009) to shaft with large diameter against retainer. It is advisable to preheat the Bearing Cone. We suggest a proprietry bearing induction heater is used following the manufacturers recommendations. The induction heating method is simple, quick, safe and economical.
With shaft in vertical position, heated Cone can be slipped on and pressed or tapped up to Grease Retainer.

4. Fit other GREASE RETAINER and BEARING CONE as above. It is important that both Grease Retainers be located hard against shoulders and Bearings in turn, hard against Grease Retainers. This should be further checked after Bearings cool.

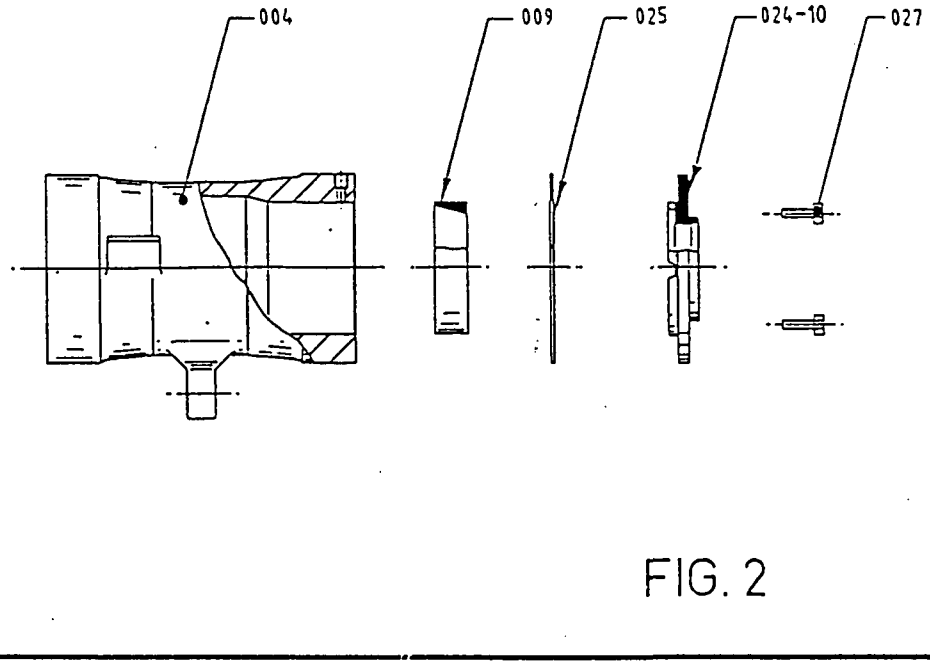


FIG. 2

5.1.2 BEARING ASSEMBLY: Fitting Impeller End Bearing Cup to Housing
See Fig 2

1. Apply oil or light grease to bore at each end of BEARING HOUSING (004).

2. Press, or tap carefully with mallet, cup of BEARING (009) into one end of Bearing Housing until cup is slightly below end face of Housing. The Bearing Housing is symmetrical and Bearing Cup can be fitted to either end. Small diameter of cup to face out. Assembly will be facilitated if housing is supported in vertical position.

3. Place END COVER (024) with one SHIM (025) in Housing and insert END COVER SET SCREWS (027). Use one thick shim only for sealing purposes (usually 0.4 or 0.5 mm).

4. Tighten Set Screws evenly. End Cover will now push Bearing Cup into correct position.

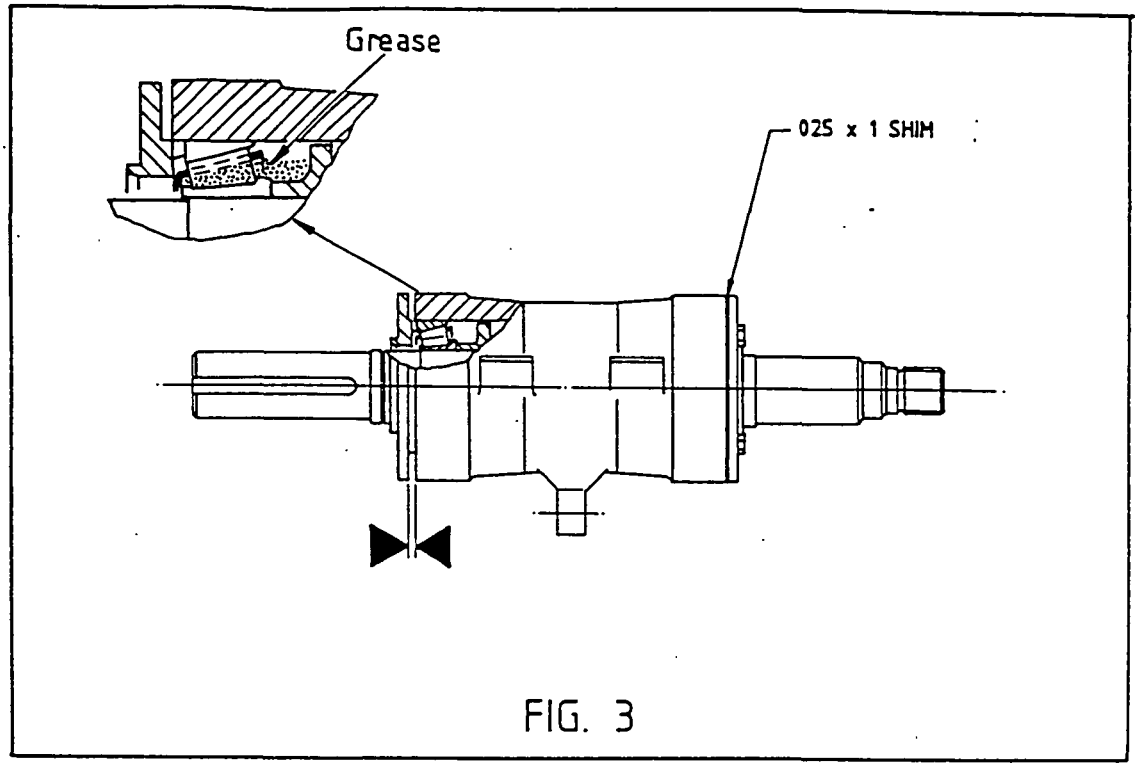


FIG. 3

5.1.3 BEARING ASSEMBLY: Fitting Shaft to Bearing Housing
See Fig 3

1. Obtain recommended type and quantity of grease per Bearing (refer to section 3).

2. Work this grease with a grease gun into Bearing on Shaft to fill space between cone, rollers and roller cage. Spread remainder of grease between Bearing and Grease Retainer.

3. Repeat with other Bearing.

4. Fit Shaft with threaded end into Housing.

5. Press remaining cup into Housing.

6. Place END COVER (024) into Housing and insert END COVER SET SCREWS (027). Do not use Shims at this stage, they will be used later (See Fig 4).

7. While rotating Shaft slowly by hand, gradually tighten Set Screws until Bearing Cup has been pushed right up to Bearing Cone, whereby shaft barely rotates and bearings have virtually no end play.

CAUTION: Do not overtighten Set Screws. Observe gap between End Cover and Housing face.

NOTE: For assemblies A, B and C frames, the above procedure can be carried out with Housing in horizontal position. For larger sizes, it is advisable to assemble in the vertical position so that Bearings will fit up concentrically.

5.1.4 BEARING ASSEMBLY: Gap Measurement (at power end) - See Fig 4

TABLE 1 - REGULAR END PLAY (Grease Lubricated Assembly)

FRAME	END PLAY - Cold - (mm)
A	0.03 - 0.05
B	0.05 - 0.10
C	0.10 - 0.15
D	0.13 - 0.18
E	0.18 - 0.23
F	0.25 - 0.30
G	0.36 - 0.41

5.1.4.1 Setting End Play - Method 1

Note 1 : Any method of determining required thickness of Shims may be used provided the final true end play between the Bearings is obtained. Refer to Table 1 above.

Note 2 : For assemblies with A, B and C frames all procedures can be carried out with Housing in horizontal position. For larger sizes, it is advisable to asssemble in the vertical position so that Bearings will fit up concentrically. This applies to all methods.

1. Fit Shaft with threaded end into BEARING HOUSING (004).
2. Press remaining cup into Housing, until it is slightly below the Housing face.
3. Fill recessed area of END COVER (024-10) with Grease as per Fig 2.
4. Place End Cover with remaining SHIMS (025) and insert END COVER SET SCREWS (027)
5. Evenly tighten End Cover Set Screws.
6. Press Shaft from both ends of Bearing Assembly, to ensure Bearing Cups are hard up against End Covers. Take care not to damage Shaft.
7. Proceed to Section 5.1.5 'End Play Measurement' and obtain the measured end play. The end play should be in excess of the values in Table 1.

8. Calculate the amount of shims to be removed to give end play according to Table 1.

9. Remove End Cover and excess Shims.

10. Replace End Cover with required SHIMS (025) and insert END COVER SET SCREWS (027).

11. Evenly tighten End Cover Set Screws.

12. Press Shaft from both ends of Bearing Assembly, to ensure Bearing Cups are hard up against End Covers. Take care not to damage Shaft.

13. Proceed to Section 5.1.5 to re-check End Play.

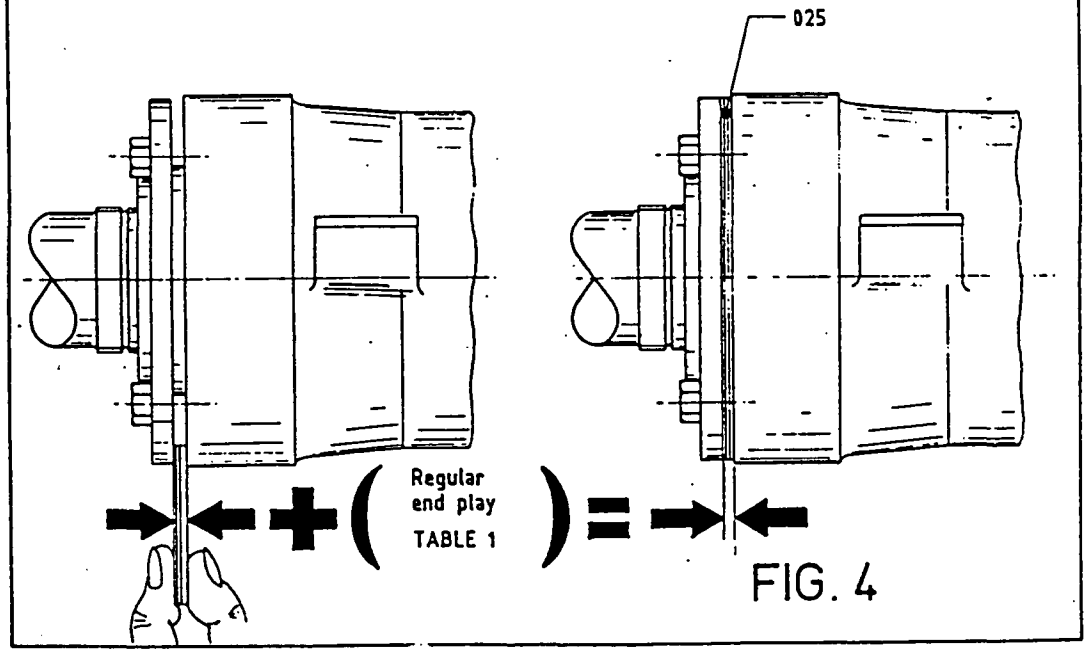


FIG. 4

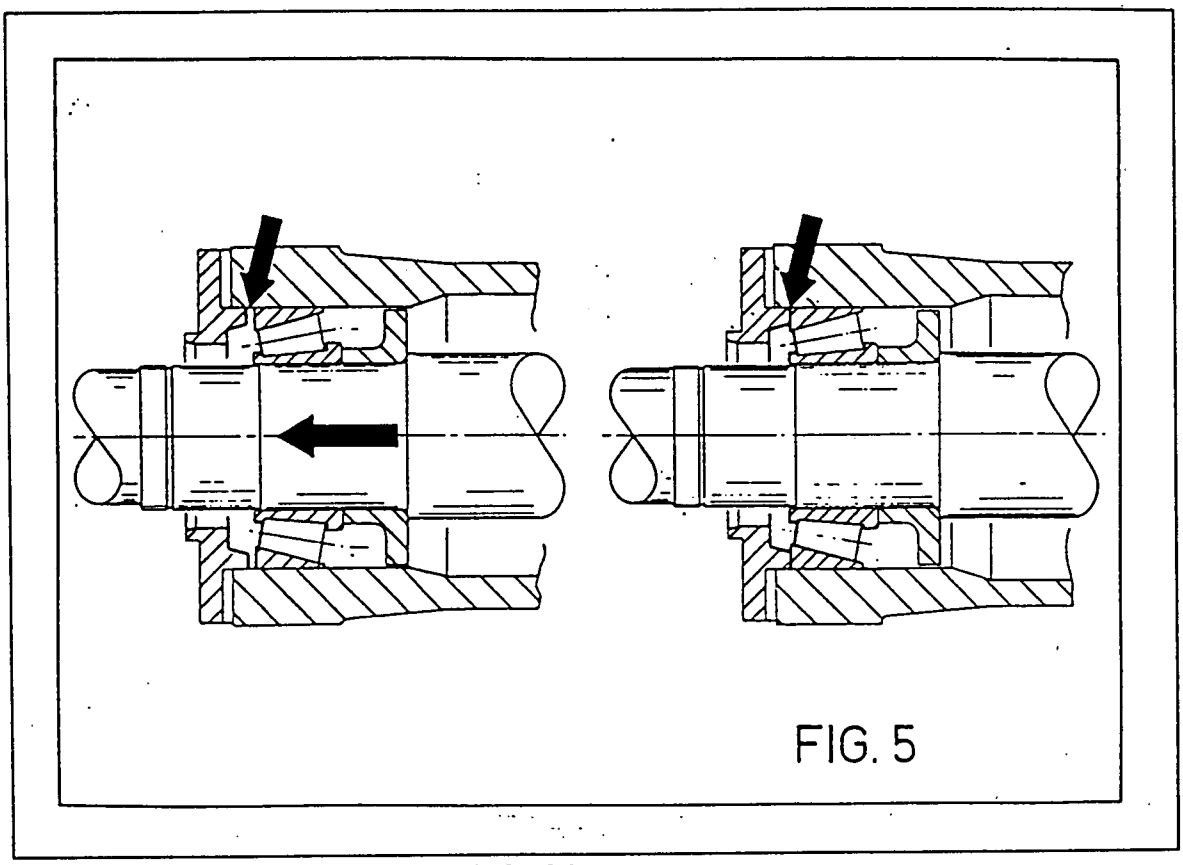


FIG. 5

5.1.4.2 Setting End Play - Method 2

1. Fit Shaft with threaded end into BEARING HOUSING (004).

2. Press remaining cup into Housing.

3. Place END COVER (024-10) into Housing and insert END COVER SET SCREWS (027). Tighten to finger tightness only. DO NOT use Shims at this stage, they will be used later (See Fig. 4)

4. While rotating Shaft slowly by hand, gradually tighten Set Screws until Bearing Cup has been pushed right up to Beaing Cone, whereby shaft barely rotates and bearings have virtually no end play.

5. Measure gap between End Cover flange and Housing face with feeler gauges. Providing Set Screws have been tightened evenly, this method is usually satisfactory. Alternatively, the End Cover may be removed and the following measurements taken with a micrometer:
   a) Depth of Bearing Cup below end face of Housing
   b) Length of End Cover spigot
   Gap is then obtained by subtracting a) from b).

6. Select SHIMS (025) of total thickness equal to gap (obtain above) plus regular end play (refer to Table 1)

7. Fit Shims, replace End Cover and insert End Cover Set Screws. Screw Set Screws temporarily to within approximately 3mm of fully tightened position. Note : With Shims inserted (refer to Fig 4), it is now necessary to move drive end Bearing Cup back to the End Cover to provide Bearing End Play.

8. Press or gently tap shaft at impeller end until Bearing Cup at opposite end has moved to the loosely fitted End Cover. Take care not to damage thread

9. Tighten Set Screws evenly to move Bearing cup into correct position. Both Bearing Cups should now be hard against their respectively End Covers and correct end play obtained.

10. Proceed to Section 5.1.5 for next instruction.

5.1.4.2 Setting End Play - Method 3

Acro-Set is a technique developed by the Timken Company for obtaining reliable tapered roller bearing end play settings. By torquing the End Cover Set Screws a preset amount, the required shim pack can be read off Table 2 after measuring the gaps between End Cover and Bearing Housing.

1. Fit Shaft with threaded end into BEAING HOUSING (004)

2. Press remaining cup into Housing.

3. Put on End Cover and two End Cover Set Screws.

4. While rotating Shaft slowly by hand, gradually tightened two Set Screws (180° apart) to preload torque specified in Table 2. The Shaft should be well seated and not rotate by hand.

5. Measure gap between End Cover flange and Housing face with taper gauge (preferred to feeler gauge)

6. Select Shims of total thickness equal to Shim pack as obtained from Table 2.

7. Fit Shims, replace End Cover and insert End Cover Set Screws. Screw Set Screws temporarily to within approximately 3mm of fully tightened position.

8. Press or gently tap shaft at impeller end until Bearing Cup at opposite end has moved to the loosely fitted End Cover. Take care not to damage thread

9. Tighten Set Screws evenly to move Bearing cup into correct position. Both Bearing Cups should now be hard against their respectively End Covers and correct end play obtained.

10. Proceed to Section 5.1.5 for net instruction.

Table 2: Qualifications

- Data for Table 2 has been compiled from measurements on sample batches of assemblies fitted with Timken Taper Roller Bearings.
- While Acro Set should give consistent results it is recommended that End Play is checked on each assembly (refer Section 5.1.5).
- While investigation of Acro Set method has also been carried out for D, E & F frames, results are not consistent enough to be included. Depending on results these frames maybe included at a later date.

Table 2

A-FRAME BRG ASSY End Cover Set Screw Torque:5.5 Nm End Play - Cold 0.030-0.050mm		B-FRAME BRG ASSY End Cover Set Screw Torque:8 Nm End Play - Cold 0.050-0.100mm		C-FRAME BRG ASSY End Cover Set Screw Torque:15 Nm End Play - Cold 0.100-0.150mm	
Gap Measured	Required Shim Pack	Gap Measured	Required Shim Pack	Gap Measured	Required Shim Pack
0.500	0.780	0.500	0.755	0.500	1.006
0.525	0.805	0.525	0.780	0.525	1.031
0.550	0.830	0.550	0.805	0.550	1.056
0.575	0.855	0.575	0.830	0.575	1.081
0.600	0.880	0.600	0.855	0.600	1.106
0.625	0.905	0.625	0.880	0.625	1.131
0.650	0.930	0.650	0.905	0.650	1.156
0.675	0.955	0.675	0.930	0.675	1.181
0.700	0.980	0.700	0.955	0.700	1.206
0.725	1.005	0.725	0.980	0.725	1.231
0.750	1.030	0.750	1.005	0.750	1.256
0.775	1.055	0.775	1.030	0.775	1.281
0.800	1.080	0.800	1.055	0.800	1.306
0.825	1.105	0.825	1.080	0.825	1.331
0.850	1.130	0.850	1.105	0.850	1.356
0.875	1.155	0.875	1.130	0.875	1.381
0.900	1.180	0.900	1.155	0.900	1.406
0.925	1.205	0.925	1.180	0.925	1.431
0.950	1.230	0.950	1.205	0.950	1.456
0.975	1.255	0.975	1.230	0.975	1.481
1.000	1.280	1.000	1.255	1.000	1.506
1.025	1.305	1.025	1.280	1.025	1.531
1.050	1.330	1.050	1.305	1.050	1.556
1.075	1.355	1.075	1.330	1.075	1.581
1.100	1.380	1.100	1.355	1.100	1.606
1.125	1.405	1.125	1.380	1.125	1.631
1.150	1.430	1.150	1.405	1.150	1.656
1.175	1.455	1.175	1.430	1.175	1.681
1.200	1.480	1.200	1.455	1.200	1.706
1.225	1.505	1.225	1.480	1.225	1.731
1.250	1.530	1.250	1.505	1.250	1.756
1.275	1.555	1.275	1.530	1.275	1.781
1.300	1.580	1.300	1.555	1.300	1.806
1.325	1.605	1.325	1.580	1.325	1.831
1.350	1.630	1.350	1.605	1.350	1.856
1.375	1.655	1.375	1.630	1.375	1.881
1.400	1.680	1.400	1.655	1.400	1.906
1.425	1.705	1.425	1.680	1.425	1.931
1.450	1.730	1.450	1.705	1.450	1.956
1.475	1.755	1.475	1.730	1.475	1.981
1.500	1.780	1.500	1.755	1.500	2.006
1.525	1.805	1.525	1.780	1.525	2.031
1.550	1.830	1.550	1.805	1.550	2.056
1.575	1.855	1.575	1.830	1.575	2.081
1.600	1.880	1.600	1.855	1.600	2.106
1.625	1.905	1.625	1.880	1.625	2.131
1.650	1.930	1.650	1.905	1.650	2.156
1.675	1.955	1.675	1.930	1.675	2.181
1.700	1.980	1.700	1.955	1.700	2.206
1.725	2.005	1.725	1.980	1.725	2.231
1.750	2.030	1.750	2.005	1.750	2.256
1.775	2.055	1.775	2.030	1.775	2.281
1.800	2.080	1.800	2.055	1.800	2.306
1.825	2.105	1.825	2.080	1.825	2.331
1.850	2.130	1.850	2.105	1.850	2.356
1.875	2.155	1.875	2.130	1.875	2.381
1.900	2.180	1.900	2.155	1.900	2.406
1.925	2.205	1.925	2.180	1.925	2.431
1.950	2.230	1.950	2.205	1.950	2.456
1.975	2.255	1.975	2.230	1.975	2.481
2.000	2.280	2.000	2.255	2.000	2.506

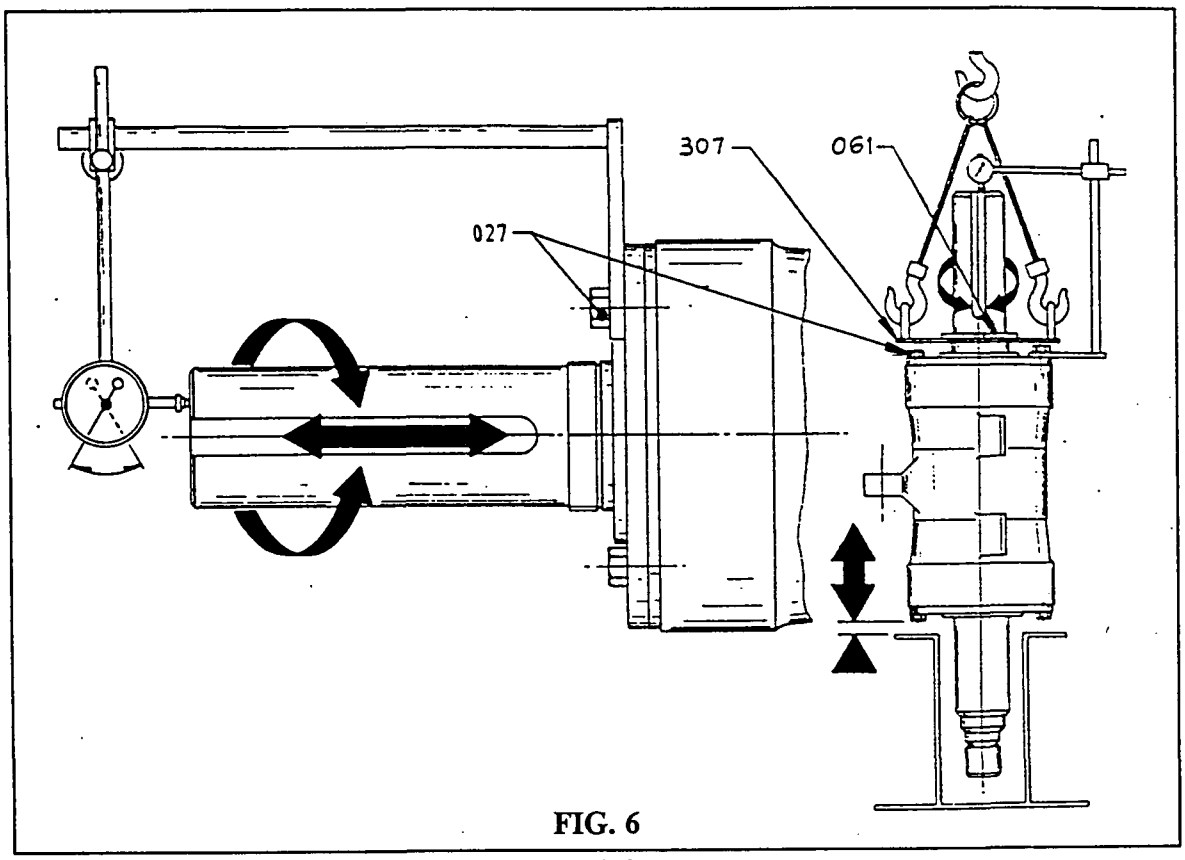


FIG. 6

5.1.5 BEARING ASSEMBLY: End Play Measurement

See Fig 6

Having moved the power end Bearing Cup back to the End Cover (refer to Figure 5) and finally tightened all Set Screws, it is now necessary to measure accurately end play in the Bearing Assembly.

FRAMES A, B & C:

1. Set up Bearing Assembly in horizontal position with Housing held firmly. Hold in bench vice if possible.

2. Attach mounting bracket with dial indicator micrometer securely to Housing by means of one Set Screw (027) and position dial actuating pin against end of Shaft.

3. Oscillate Shaft and push it hard backwards and forwards by hand several times to establish a consistent dial reading and note total movement.

FRAMES D, E, F & G:

1. Set up Bearing Assembly in vertical position, impeller end down. Support Assembly at lower End Cover with Shaft free. The whole Assembly must be located in a position where it can be reached by a hoist.

2. Attach mounting bracket with dial indicator as above.

3. Fit BEARING ASSEMBLY LIFTING PLATE (307) {eyebolts up} to upper end of Shaft, then screw LABYRINTH LOCKNUT (061) temporarily onto Shaft. Tie ends of a rope, suspended from a hoist, to the eyebolts on the Lifting Plate (refer to Figure 6).

4. Move Shaft up and down by lifting the whole Assembly off the support by means of the hoist and then lowering it back onto the same. Observe maximum and minimum readings on the dial indicator. Repeat several times until readings become consistent. Note total movement.

ALL FRAMES:
Should the end play be outside the regular limits (refer to table 1), Shims must be added or removed as required (at the power end).

a) If Shims have to be removed, reposition End Cover and tighten Screws after removal of Shims.

b) If Shims have to be added follow procedure for fitting Shims and moving Bearing Cup back to End Cover as described for FIGURE 5.

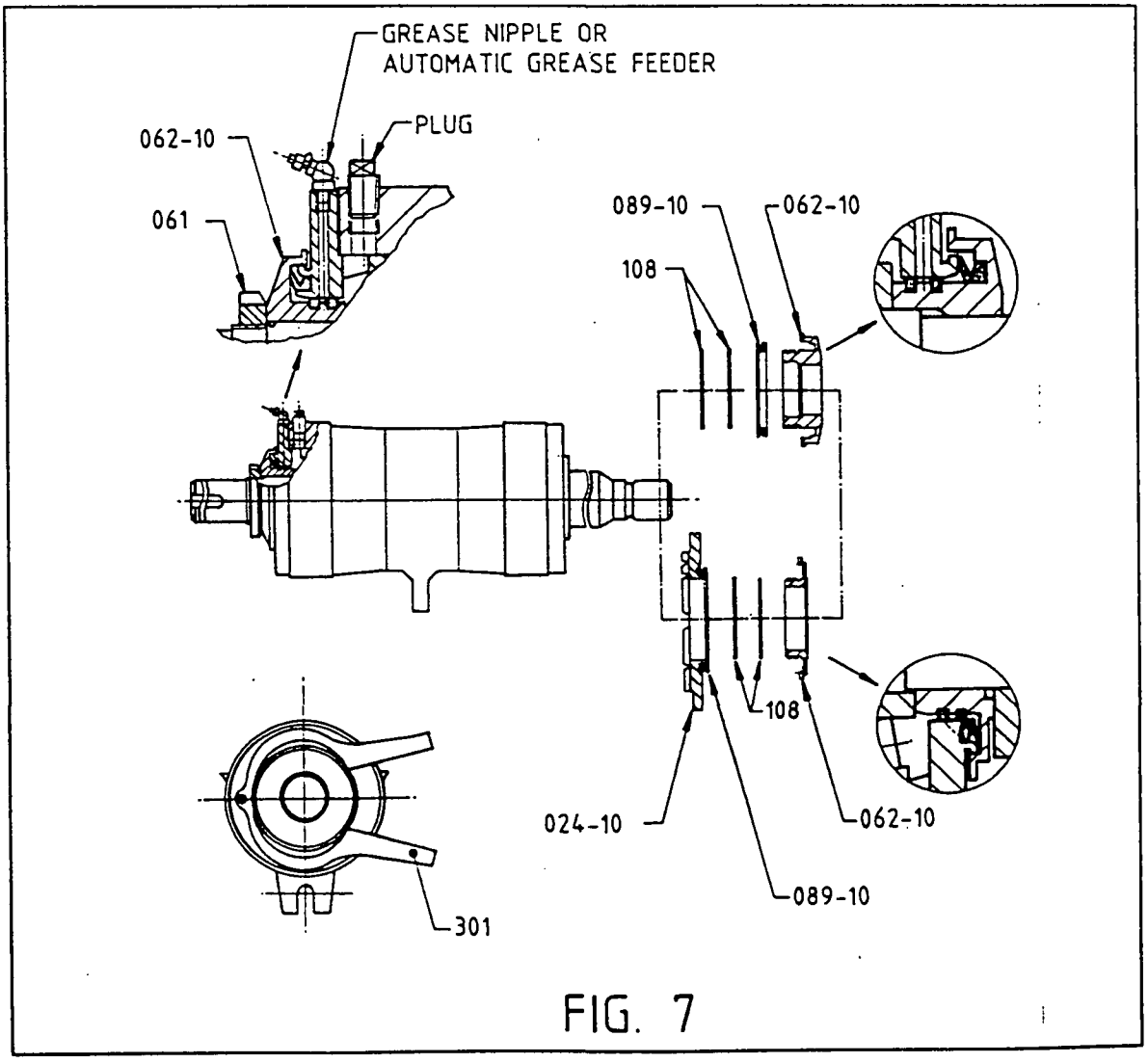


FIG. 7

After readjustment of end play with Shims, the actual play must again be measured with the dial indicator.

5.1.6 BEARING ASSEMBLY: Fitting Labyrinths, Piston Rings, Bearing Seal and Locknut - See Fig 7

1. Smear PISTON RINGS (108) with bearing grease (refer to section 3) and fit two rings to the grooves of each LABYRINTH (062). Position ring grooves diametrically opposite.

   NOTE: Some F and G Frames pumps have a different style of Labyrinth at the two ends of the Bearing Assembly. Check Components Diagrams.

2. For Frames C to G, fit Bearing Seal (089-10) into groove in End Cover with lip pointing INTO the bearing assembly. For Frame A and B, fit Bearing Seal to Labyrinth with lip pointing INTO the pump. (See Table 3 & Fig 7)

3. Slide Labyrinths over Shaft and push into End Cover until Piston Ring prevents further entry.

   NOTE: Position Piston Ring gaps away from main grease feed hole in End Cover.

4. Compress rings with RING COMPRESSOR (301), then push Labyrinths right into and against Bearing Cone.

5. Fit LABYRINTH LOCKNUT (061) and tighten with C-SPANNER (305).

6. Fit HEXAGONAL PLUGS (-) to Bearing Housing and GREASE NIPPLES (-) to End Covers.

7. Pump grease into each End Cover to flush Labyrinth.

   BEARING ASSEMBLY now takes Warman Basic Part Number (005) and should be ready for installation.

TABLE 3: FITTING OF BEARING SEAL

FRAME	To LABYRINTH	To END COVER
A	✓	
B	✓	
C		✓
D		✓
E		✓
F		✓
G		✓

5.2 BEARING ASSEMBLY - FRAME H

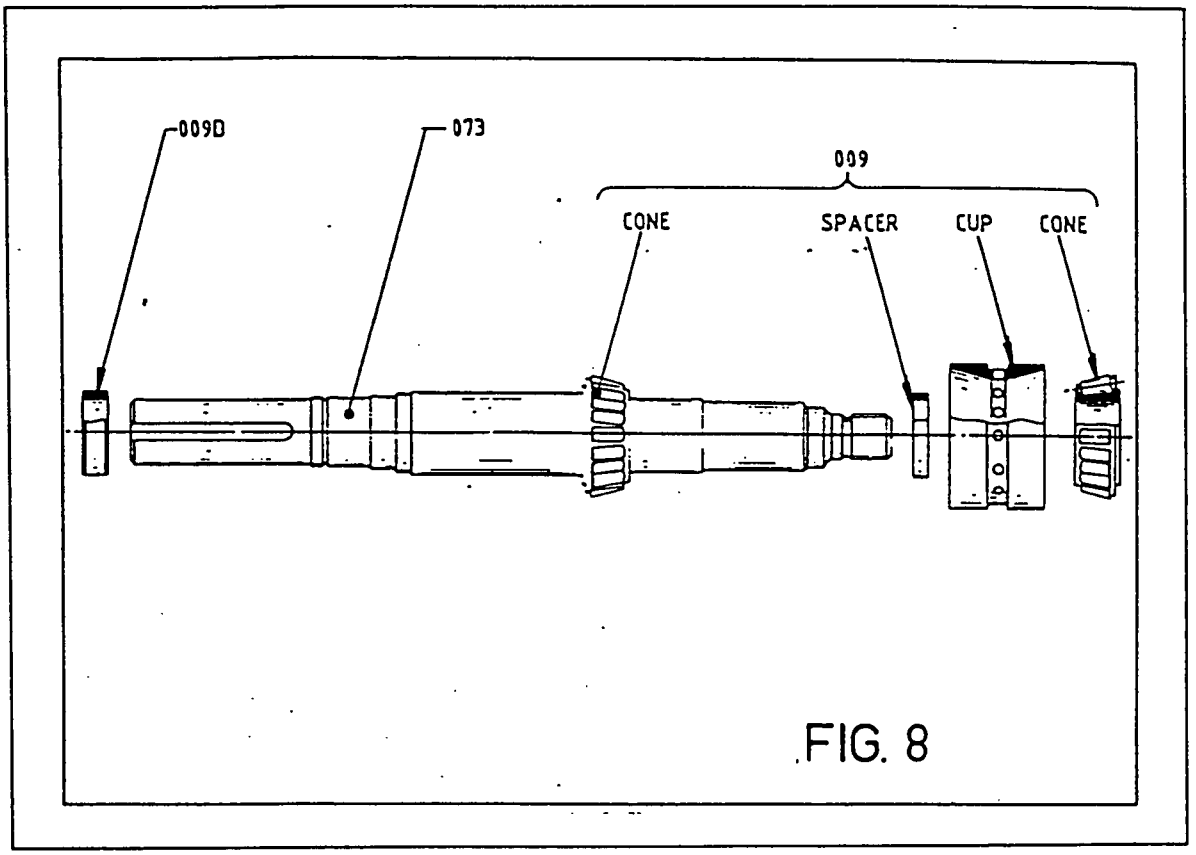


FIG. 8

5.2.1 BEARING ASSEMBLY: Fitting of Drive End Inner Bearing and Pump End bearing - See Fig 8

1. Apply light oil of grease to bearing journals of SHAFT (073).

2. Fit inner ring of BEARING (009D) to drive end of Shaft against shoulder. It is advisable to preheat the bearing cone. It is suggested a proprietry bearing induction heater is used following the manufacturers recommendations. The induction heating method is simple, quick, safe and economical. With shaft in vertical position, heated inner ring or cones can be slipped on and pressed or tapped up to grease shoulder.

3. Turn Shaft end to end (impeller end up), fit one Cone of BEARING (009) with large diameter against Shaft shoulder.

4. Fit Cone Spacer of BEARING (009) on Shaft against smaller end of cone and slide Cup against Cone.

5. Fit second Cone of BEARING (009) on Shaft with smaller end against Cone Spacer. It is important that Cones and Spacer are located against one another and in turn against Shaft shoulder. This sould be further checked after the Bearing cools.

NOTE: BEARINGS (009) are provided with Spacers and as such are pre-set assemblies. The Spacers are finished to size for each Bearing Assembly and component parts from one assembly are NOT INTER-CHANGEABLE with those from a similiar assembly. In some large Bearing Assemblies, to aid you so that these parts do not become mixed before use, an identifying "serial number" is marked on each cup, cone and spacer. ALL PARTS WITH THE SAME SERIAL NUMBER SHOULD BE KEPT TOGETHER. Some small pre-set assemblies are not marked with a serial number, but they are STILL NOT INTER-CHANGEABLE and component parts should be assembled as received. Further component parts must be assembled such that markings 'A', 'B', 'C' etc on cups, cones or spaces are matched.

6. Work recommended grease by grease gun into Bearing from both sides until grease appears through holes in cup. Remaining grease to be distributed evenly in Housing and End cover - refer to Information Sheet included in this manual.

5.2.2 BEARING ASSEMBLY: Fitting of Drive End Outer Ring Bearing to Bearing Housing - See Fig 9

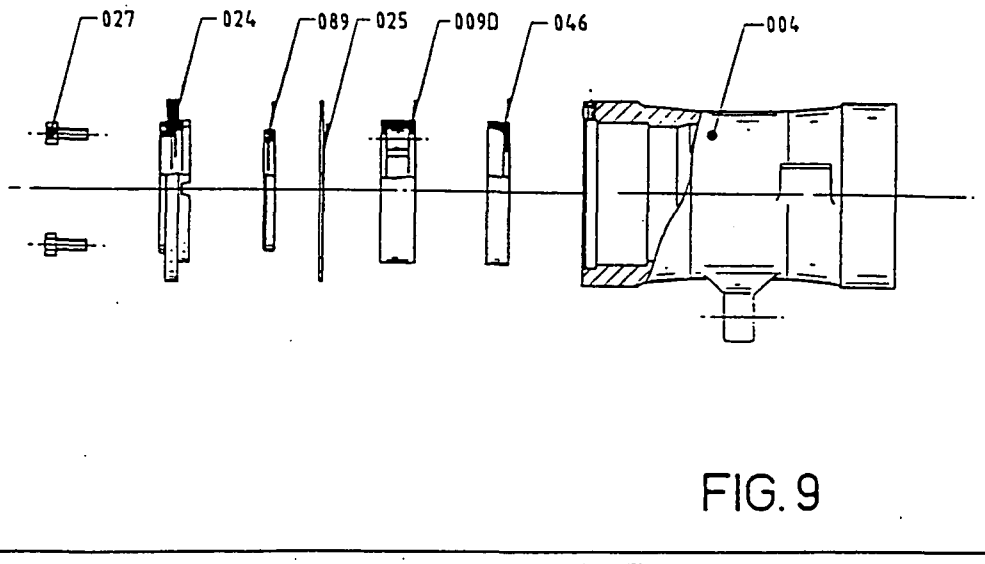


FIG. 9

1. Apply light grease or oil to drive end bore (marked DRIVE END) of BEARING HOUSING (004).

2. Stand Housing with drive end up and fit GREASE RETAINER (046)-{flat side down}.

3. Fit outer BEARING (009D) and evenly tap it with a soft hammer against grease retainer.

4. Work recommended bearing grease (refer to section 3) into Bearing in Housing and apply a liberal amount inside Housing. Leave space between Grease Retainer and Bearing half full. Remaining grease to be distributed in End Cover - refer to Information Sheet included in this manual.

5. Place on bench END COVER (024)- flat side up- and lightly grease inside recess.

6. Fit into End Cover recess BEARING SEAL (089) - lip down and tap it against recess shoulder.

7. Place End Cover with END COVER GASKET (025) in Housing, insert END COVER SET SCREWS (027) and tighten evenly.

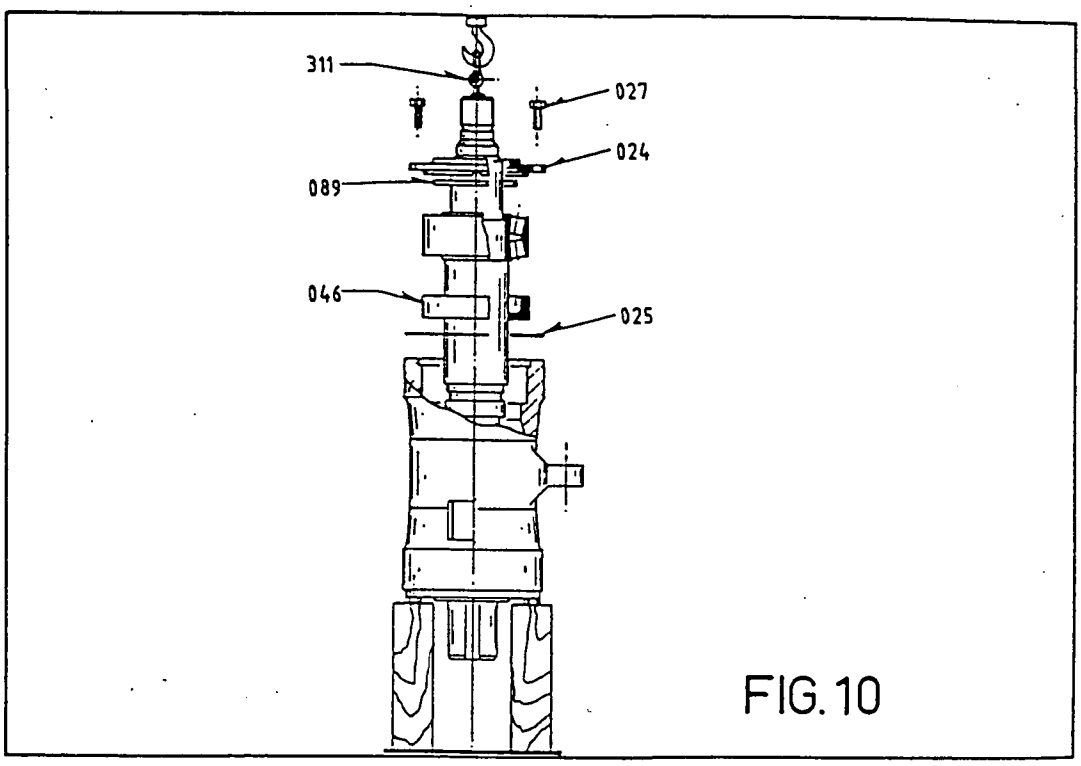


FIG. 10

5.2.3 BEARING ASSEMBLY: Fitting Shaft to Bearing Housing
See Fig 10

1. Place Bearing Housing on two wooden blocks with fitted End Cover down. Clean and lightly grease bearing bore.

2. Fit GREASE RETAINER (046) - Flat side down.

3. Screw standard EYE BOLT into impeller end of Shaft and by means of a hoist lift Shaft carefully into Housing. Tap Bearing until it rests against Grease Retainer.

4. Place second END COVER (024) - recess up - on bench and lightly grease recess.

5. Fit BEARING SEAL (089) - lip down - into End Cover recess and tap it against recess shoulder.

6. Place END COVER GASKET (024) on End Cover, turn End Cover assembly over and fit onto BEARING HOUSING. Insert END COVER SET SCREWS (027) and tighten evenly.

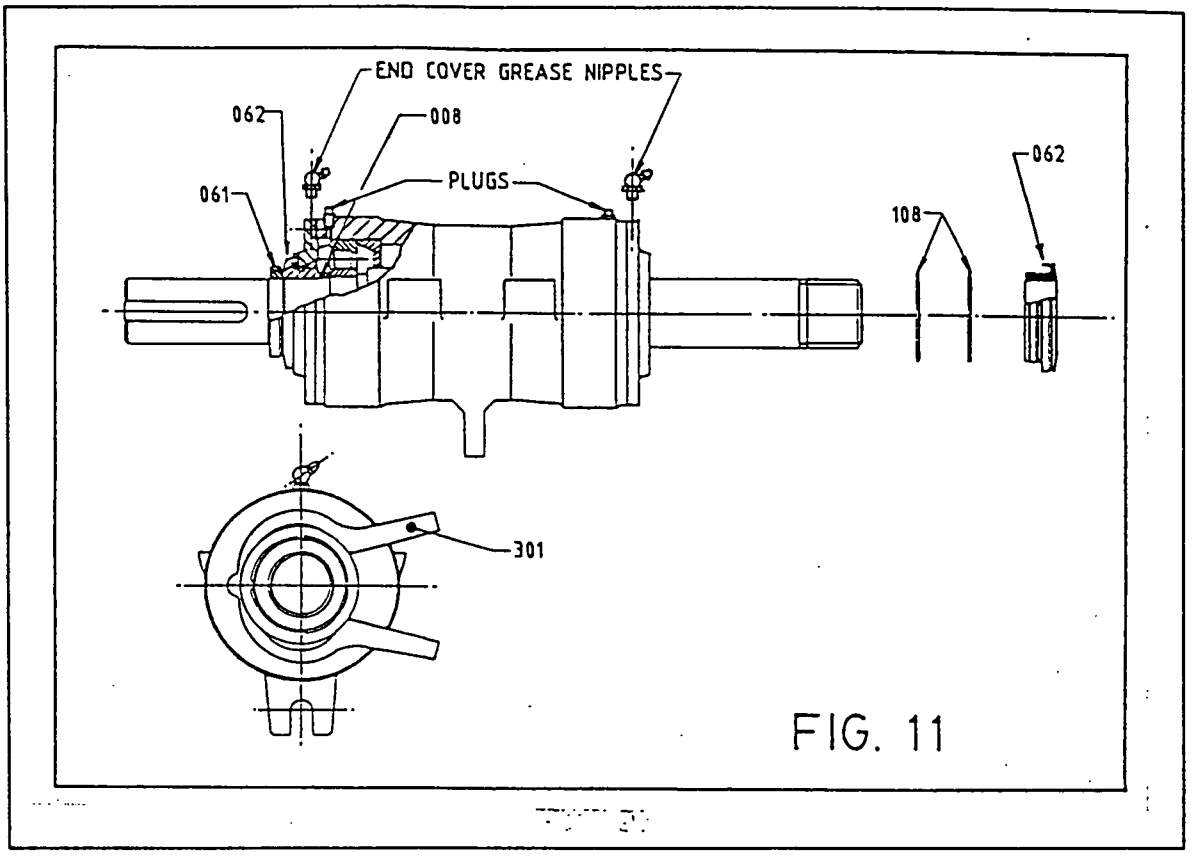


FIG. 11

5.2.4 BEARING ASSEMBLY: Fitting Labyrinths, Piston Rings and Locknut See Fig 11

1. Fit PISTON RINGS (108) with grease and fit two rings to the grooves of each LABYRINTH (062). Position ring gaps diametrically opposite.

2. Slide BEARING SLEEVE (008) over drive end of Shaft and push it against Bearing.

3. slide Labyrinths over Shaft, push into End Cover until Piston ring prevents further entry.

4. Compress Rings with RING COMPRESSOR (301), then push Labyrinths right into End Covers.

5. Fit LABYRINTH LOCKNUT (061) and tighten with C-SPANNER (305).

6. Fit HEXAGONAL PLUGS (-) to Bearing Housing and GREASE NIPPLES (-) to End Covers.

7. Pump grease into each End Cover to flush Labyrinth.

BEARING ASSEMBLY now takes Warman Basic Part Number (005) and should be ready for installation.

5.2.5 BEARING ASSEMBLY: Checking Fitted End Play

Although Bearing Assemblies are fitted together and require no adjustment, it is suggested the fitted end play is checked. The end play should be in the range 0.178 - 0.310 mm for the H frame.

Before measuring the fitted end play it is necessary to have pressure against the Labyrinth (pump end) whilst testing. The Bearing cones (pump end) remain in their correct position on the shaft and the end play, whatever it may be, will remain constant. Before proceeding further - refer to section 6 regarding fitting of the Impeller Release Collar. Note that the Impeller Release Collar must be fitted otherwise the angled bearing surface on the Labyrinth may be damaged. Slip a piece of tube over the Shaft, against the Release Collar, and hold tightly using a plate bolted to the end of the Shaft into the tapped hole in the end of the Shaft.

To measure the fitted end play of the Bearing Assembly, proceed as follows:

a) Stand assembly, impeller end up, on two wooden blocks. The whole assembly must be located in a position it can be reached by a hoist.

b) Attach a dial indicator to the assembly so the relative axial movement between Shaft and Housing can be measured. It is suggested that a dial indicator with a magnetic base is used. The base can be clamped to the End Cover and the stem of the dial indicator positioned on top of the SHAFT LIFTING NUT (311).

c) Move the Shaft up and down by lifting the whole assembly off the support by means of the hoist then lowering it back onto the support. Observe maximum and minimum readings on dial indicator. Repeat several times and check it is within range given. If outside these limits review assembly procedure.

6. FITTING IMPELLER RELEASE COLLAR

All WARMAN pumps utilise a thread to fasten the Impeller to the pump Shaft. The larger frames (FAM, G & H) incorporate an IMPELLER RELEASE COLLAR (239) to facilitate Impeller removal. The Impeller Release Collar fits against the impeller end Labyrinth.

For full details on installation and maintenance refer to SUPPLEMENT 'M2'.

NOTE: Before fitting Impeller Release Collar, fit SHAFT SLEEVE 'O' RING (109) into groove in Labyrinth.

7. TESTING

In some instances, the operator may wish to test run the assembly before placing the unit in service or store.

This operation can be carried out by mounting the assembly on a test rig or on a pump BASE (003). To obtain the required speed , connect Shaft to small motor either through a coupling or with pulleys.

Due to the Bearing configuration, it is necessary to have pressure against the Labyrinth (pump end) whilst testing. for frames fitted with an IMPELLER RELEASE COLLAR (239) this should be fitted to the Bearing Assembly before proceeding further - refer to section 6. Note that the release Collar must be fitted otherwise the angled bearing surface on the Labyrinth may be damaged. Slip a piece of tube over the Shaft, against the Release Collar, and hold tightly by screwing the SHAFT LIFTING NUT (311) on the impeller thread. The Bearing cones (impeller end) thereby remain in their correct position on the Shaft and the end play, whatever it may be, will remain constant.

Testing for one hour should be ample. One of two things will happen:

a) If the end play is correct and the amount of grease used are correct and all components in good order, there should be little or no heating after this period.

b) Should one or both Bearings heat quickly and excessively, the test should be stopped and the assembly allowed to cool. Excess heating occurs when it becomes impossible to hold a hand on the Bearing Housing for more than a few seconds.

Often a short heat up time is caused by an excessive amount of grease in the Bearings.
Allow to cool and then restart the test. If it heats up again, stop.
If heating persists, stop, disassemble and inspect all components. Watch for foreign matter in the grease and in component parts.

8. MAINTENANCE: STAND-BY PUMPS

Where stand-by pumps are standing idle for long periods, it is advisable to turn their Shafts a quarter of a turn by hand once per week. In this way, all rollers in turn are made to carry static loads and external vibrations.

9. WARMAN BASIC PART NUMBERS AND PARTS LIST:

WARMAN BASIC N°	PART NAME	REFER PAGE	REFER FIGURE
003	Base	23	---
004	Bearing Housing	6,10,11,19	2,9
005	Bearing Assembly	16,21	---
008	Bearing Sleeve	21	11
009	Bearing	5,6,17	1,2,8
009D	Bearing-Drive End	17,19	8,9
024	End Cover	6,7,8,10,19	2,9,10
025	Shim / End Cover Gasket	6,9,10,19	2,3,4,9,10
027	End Cover Set Screw	6,7,8,10,14,19	2,6,9,10
046	Grease Retainer	5,19,20	1,9,10
061	Labyrinth Locknut	16,21	6,7,11
062	Labyrinth	21	7,11
073	Shaft	5,17	1,8
089	Bearing Seal	16,19,20	9,10
108	Piston Ring	17,21	7,11
239	Impeller Release Collar	22,23	---
301	Piston Ring Compressor	16,21	7,11
305	'C' Spanner	16,21	---
307	Lifting Plate	14	6
311	Shaft Lifting Nut / Eye Bolt	22,23	10
---	End Cover Grease Nipple	16,21	7,11
---	Hex Plug	16,21	7,11

BASIC BEARING ASSEMBLIES

RECOMMENDED BEARING GREASE

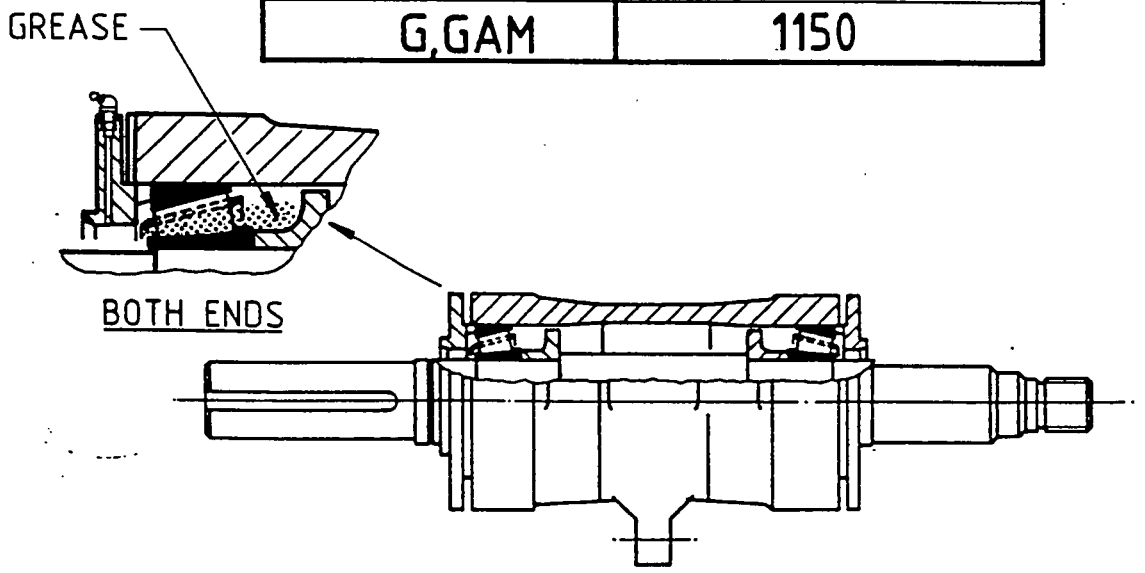
GREASE CHARACTERISTICS

A Lithium complex soap thickener grease with EP additives and oxidation inhibitors.

N.L.G.I. Consistency N°. 2
Drop point ..... ⩾ 260°C
Worked penetration 25°C A.S.T.M. 265-295

The recommended initial quantity of grease to be used for each bearing is as follows :

BEARING ASSEMBLY	GRAMS / BEARING
A	20
B	30
C	50
D	100
E	200
F,FAM	500
G,GAM	1150



Work initial quantity of grease by hand into bearing on shaft to fill space between cone , rollers and roller cage. Spread remainder of grease between bearing and grease retainer .

GREASE BRAND TYPE

MOBIL HP or equivalent.

WARMAN INTERNATIONAL LTD

WARMAN PUMPS

ASSEMBLY AND MAINTENANCE INSTRUCTIONS

SUPPLEMENT 'P1'

SERIES 'A' SLURRY PUMPS
TYPE 'A-SC'

MANUAL SUPPLEMENT 'P1'

WARMAN PUMPS - ASSEMBLY AND MAINTENANCE INSTRUCTION MANUALS AND SUPPLEMENTS IMPORTANT SAFETY INFORMATION

WARNING

The **WARMAN PUMP** is both a **PRESSURE VESSEL** and a piece of **ROTATING EQUIPMENT.** All standard safety precautions for such equipment should be followed before and during installation, operation and maintenance.

For **AUXILIARY EQUIPMENT** (motors, belt drives, couplings, gear reducers, variable speed drives, etc.) standard safety precautions should be followed and appropriate instruction manuals consulted before and during installation, operation and maintenance.

WARNING

DRIVER ROTATION MUST BE CHECKED before belts or couplings are connected. Personnel injury and damage could result from operating the pump in the wrong direction.

WARNING

DO NOT OPERATE THE PUMP AT LOW OR ZERO FLOW CONDITIONS FOR PROLONGED PERIODS, OR UNDER ANY CIRCUMSTANCES THAT COULD CAUSE THE PUMPING LIQUID TO VAPORIZE. Personnel injury and equipment damage could result from the pressure created.

WARNING

DO NOT APPLY HEAT TO IMPELLER BOSS OR NOSE in an effort to loosen the impeller thread prior to impeller removal. Personnel injury and equipment damage could result from the impeller shattering or exploding when the heat is applied.

WARNING

DO NOT FEED VERY HOT OR VERY COLD LIQUID into a pump which is at ambient temperature. Thermal shock may cause the pump casing to crack.

WARNING

FOR THE SAFETY OF OPERATING PERSONNEL, please note that the information supplied in this Manual only applies to the fitting of genuine Warman parts and Warman recommended bearings to Warman pumps.

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WARMAN PUMPS
ASSEMBLY AND MAINTENANCE INSTRUCTIONS
SUPPLEMENT 'P1'
SERIES 'A' SLURRY PUMPS
TYPE 'A-SC'

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1. INTRODUCTION:

Supplement 'P1' should be read in conjunction with the following Warman Assembly and Maintenance Instruction Supplements:

M1- General Instructions applicable to ALL TYPES of Warman Pumps
M4- Warman Mechanical Seals
BA2 or BA3 - One of these depending on whether Basic or Modified Basic Bearing Assemblies are used respectively.

2. ADVANTAGES AND USES OF TYPE 'A-SC' SLURRY PUMPS

Designed for the continuous pumping of fine, moderate and/or corrosive slurries up to heads of approximately 30 m. These pumps feature a choice of replaceable hard metal or pressure moulded elastomer liners and impellers and are all interchangeable within the same casing.

The Warman centrifugal shaft seal is commonly used, but an interchangeable packed gland seal is also available for every pump. Special mechanical seals for slurry service are being developed.

Ease of maintenance features include:

- Through bolt design
- Minimum number of casing bolts
- Slip fit replaceable Shaft sleeve
- Cartridge type Bearing Assembly
- Cast in Impeller thread

3. BEARING ASSEMBLY - MAINTENANCE AND ASSEMBLY INSTRUCTIONS:

The Bearing Assembly is assembled and maintained according to the instructions contained in the respective Warman Supplement 'BA2' or 'BA3' according to the TYPE of Bearing Assembly utilised.

4. CENTRIFUGAL SEALING - LUBRICATION:

In Centrifugally sealed pumps, lubricate the static seal chamber sparingly but regularly, by means of the Grease Cup.

The grease for the centrifugally sealed pump static seal chamber should have the following specifications:

A lithium complex soap thickener grease with EP additives and oxidation inhibitors.

N.L.G.I.Consistency No 2
Drop Point ..... ≥ 260 °C
Work penetration 25°C A.S.T.M. .... 265 - 295

RECOMMENDED GREASE :

MOBIL HP or equivalent.

5. PARTS IDENTIFICATION:

The comments in Warman Bearing Assembly Supplements regarding Warman Basic Numbers incorporated in Warman Part Numbers applies in the same manner to Warman Pump component parts.

For full description and part number identification, refer to the appropriate Warman Components Diagram. Names and Basic Numbers are used in assembly instructions in this manual. The relevant Warman Basic Numbers are listed at the end of this supplement (Section 8).

In all correspondence with WARMAN INTERNATIONAL LTD., or their representatives, and especially when ordering spare parts, it is advisable to use correct names as well as full part numbers to prevent misunderstandings or wrong deliveries. When in doubt, the pump serial number should be quoted as well.

6. ASSEMBLY INSTRUCTIONS:

A Components Diagram of the particular pump being assembled will assist in following the pump assembly instruction steps as detailed in the following sections.

When pumps have been dismantled for complete overhaul, all parts should be closely inspected and new parts checked for correct identification.

Used parts being replaced should be thoroughly cleaned and repainted where required. Mating faces and spigots should be free of rust, dirt and burrs and given a coat of grease before they are fitted together to assist future overhaul.

It is preferrable to renew small bolts and set screws during overhaul and all threads should be coated with graphite grease before assembly. It is also recommended that all rubber seals should be replaced during major overhauls as rubber tends to harden and seals lose their effectiveness.

6.1 FRAME ASSEMBLY:

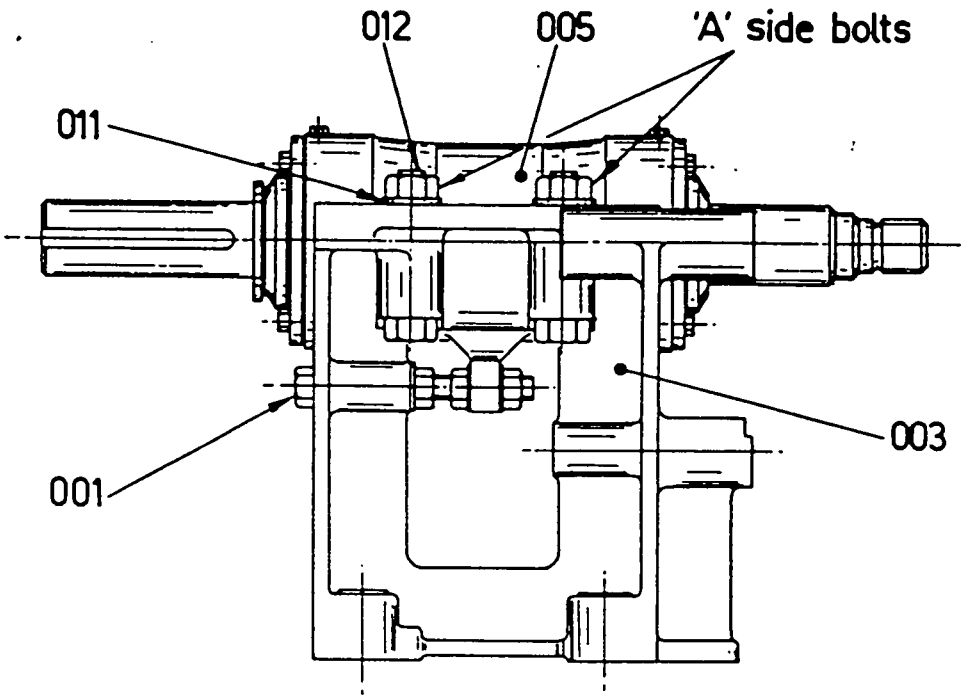


FIG. 1

6.1.1 FRAME ASSEMBLY: Fitting Bearing Assembly to Base - See Fig 1 & 9

1. Insert ADJUSTING SCREW (001) in BASE (003) from outside. Screw on one Nut and fully tighten. Screw on two additional Nuts with two flat Washers in between. These nuts to be left loose and maximum distance apart.

   In A-Frame pumps the Adjusting Screw is replaced by an ADJUSTING CAM (001) and it is fitted with CLAMP BOLT (012).

2. Apply grease to machined surfaces (Bearing Housing support cradle) in Base.

3. Lower BEARING ASSEMBLY (005) into Base. Approximately match machined surfaces of the housing with surfaces in the base.
Check that the Bearing Housing lug has fitted over the Adjusting Screw in the Base and is also between the nuts and washers.

4. Fit CLAMP BOLTS (012) through Base from underneath. Drop CLAMP WASHER (011) over each bolt (domed side up) and screw on nuts.
Fully tighten Clamp Bolts on side 'A', ie. on left hand side of Base when looking from Impeller end (Refer to Fig 1 & 9). The bolts on the opposite side 'B' should not be tightened for the time being. Leave snug only, to maintain alignment but allow axial movement.

5. Grease SHAFT (073) protruding from LABYRINTH (062) at Impeller end. This application of grease will assist fitting and removal of shaft components and prevent damage by moisture to the Shaft.

6. Fit two pieces of timber to underside of Base or appropriate Assembly Cradle to prevent the Pump from tipping forward during assembly of the wet end.
Check that the Base is at a sufficient height from the floor to allow assembly of the wet end components.

TABLE 1 - COVER PLATE BOLT TORQUES

PUMP	MAXIMUM TORQUE (Nm)
1/.75 SC	20
3/2 SC	40
4/3 SC	70
6/4 SC	70
8/6 SC	160
10/8 SC	325

6.2 PUMP ASSEMBLY:

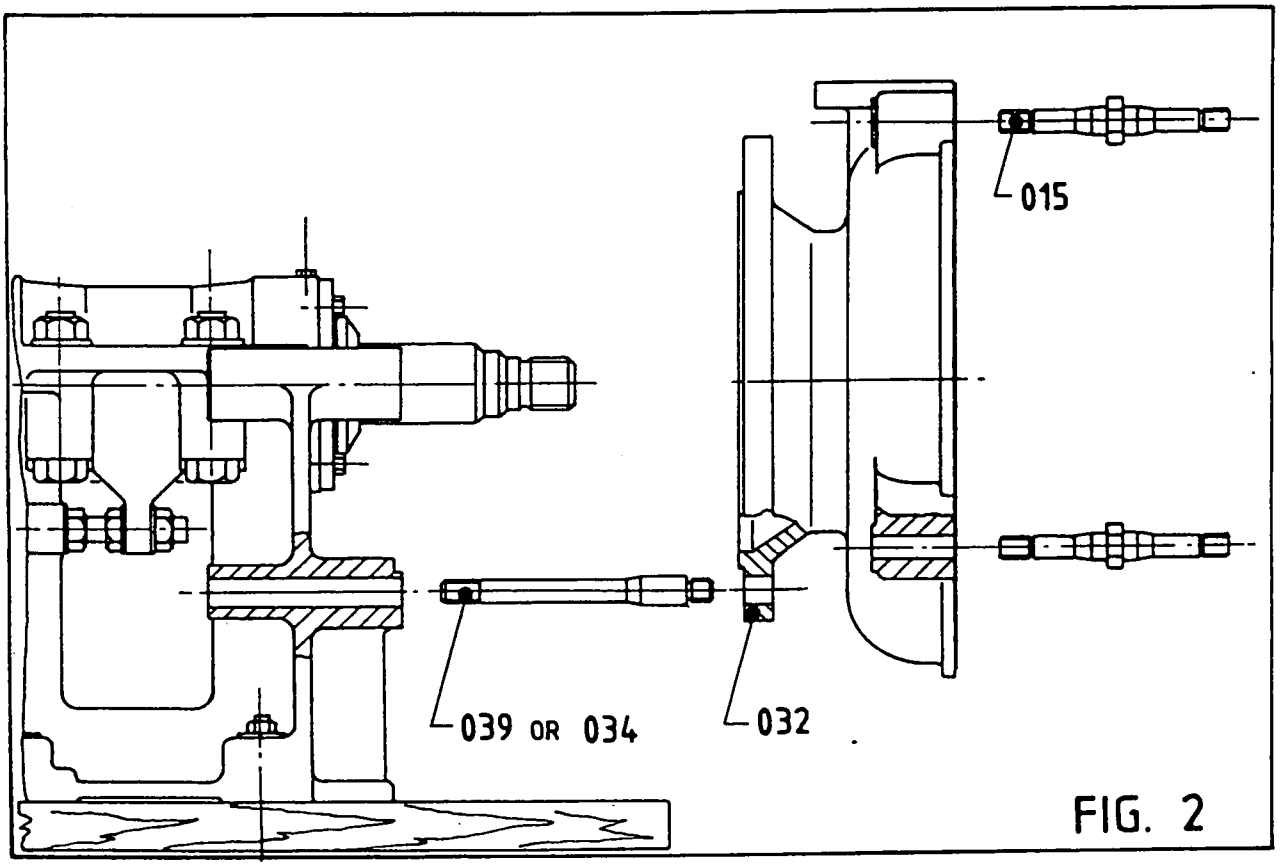


FIG. 2

6.2.1 PUMP ASSEMBLY: Fitting Frame Plate and Cover Plate Bolts - See Fig 2

1. Fit FRAME PLATE (032) to Base, making certain that the Frame Plate spigot has engaged with the corresponding base recess. Grease the recess to assist in future removal.
   With large pumps, Frame Plates are provided with radially tapped holes for EYE BOLTS (-) to facilitate lifting.

2. Insert FRAME PLATE STUDS (039) or FRAME PLATE BOLTS (034), depending on the pump. Fit Nuts and fully tighten.
   In most pumps the Frame Plate is bolted externally (studs are used) while the 1/.75 SC pump, bolts are used.
   The Frame Plate can be rotated to provide eight alternate discharge positions.

   Fit COVER PLATE BOLTS (015) through Frame Plate lugs, screw on Nuts, and torque evenly all bolts to value given in Table 1.

6.3 SEAL ASSEMBLY:

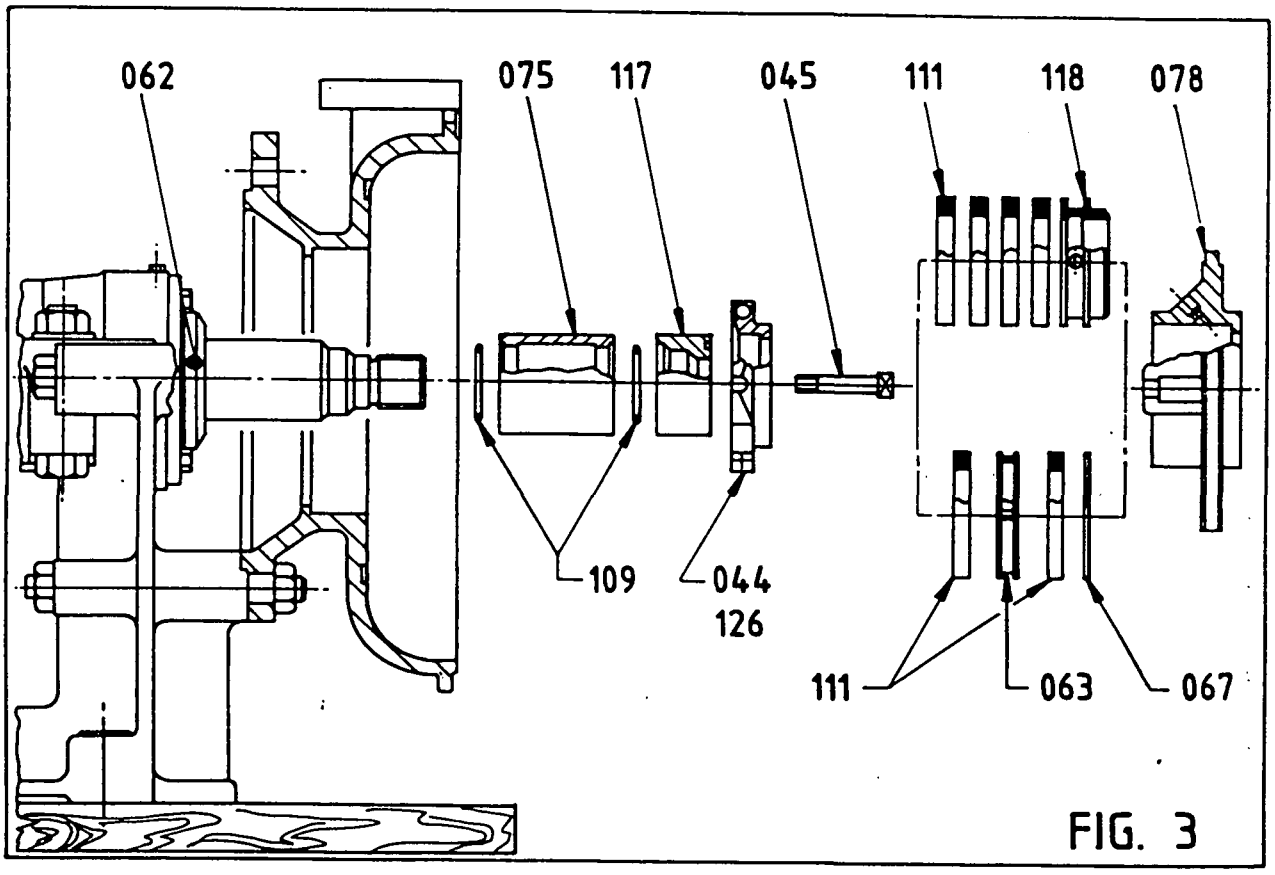


FIG. 3

6.3.1 GLAND ASSEMBLY: Fitting Stuffing Box, Lantern Restrictor, (or Neck and Lantern Rings), Packing, Gland, Shaft Sleeve, Shaft Spacer and Shaft Sleeve O-Rings - See Fig 3

Gland arrangements for Stuffing Boxes are shown on Warman Drawing A4-110-0-115795 attached. Select the arrangement that best suits the pump application. Non-metallic LANTERN RESTRICTORS (118-1) offer the advantage of minimising the Gland Sealing Water requirements.

ALL FRAMES

1. Place STUFFING BOX (078) flat on bench (gland side up).

2. Place a LANTERN RESTRICTOR (118) (small diameter down) in gland recess to rest on retaining lip.
   In some applications, a NECK RING (067) is used in place of the Lantern Restrictor.

3. Stand SHAFT SLEEVE (075) on end and slide through Lantern Restrictor.

4. Fit following items in turn:
   (a) First PACKING RING (111) of correct length to fill annulus;
   (b) Remaining Packing Rings (stagger packing joints) to almost completely fill the annulus. Flatten each one separately.
   Note: When a NECK RING is used, place LANTERN RING (063) on top of first ring of Packing and press down to flatten first Ring; then fit remaining Packing Rings (stagger Packing joints).

5. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126) and fully tighten. Place gland in Stuffing Box and push down to compress Packing Rings. Insert GLAND BOLTS (045) and just nip up Nuts sufficiently to hold Shaft Sleeve (final adjustment will be made when testing pump).

6. Fit SHAFT O-RING (109) on Shaft and slide up to Labyrinth.

7. Insert assembled Stuffing Box in Frame Plate and tap into position with a mallet. Locate Stuffing Box with water connection at top.
   The Shaft Sleeve will probably remain forward. It should be pushed back to the mating part on the Shaft. Check the O-Ring is correctly positioned in groove.

8. Fit second SHAFT O-RING (109) and push into recess in end face of Shaft Sleeve.

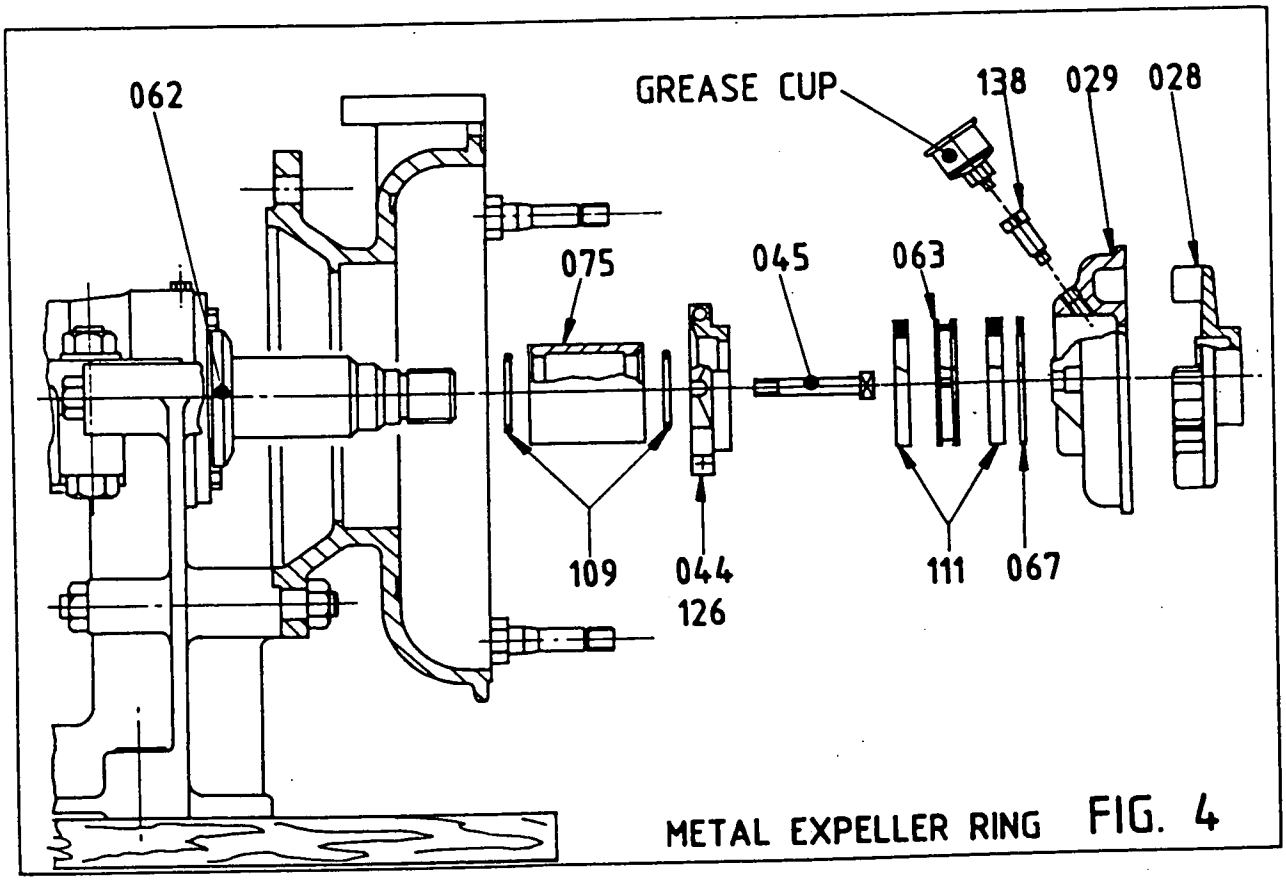
9. Place SHAFT SPACER (117) on Shaft and press up to Shaft Sleeve.

10. Fit IMPELLER O-RING (064 or109) to groove in Shaft Spacer.
    Note:
    a. To assist in holding the last O-Ring in position which seals against the Impeller, apply heavy grease to the O-Ring groove.

    b. All the O-Rings in their respective grooves will be compressed and fully covered by these metallic parts when the Impeller is screwed onto the Shaft.

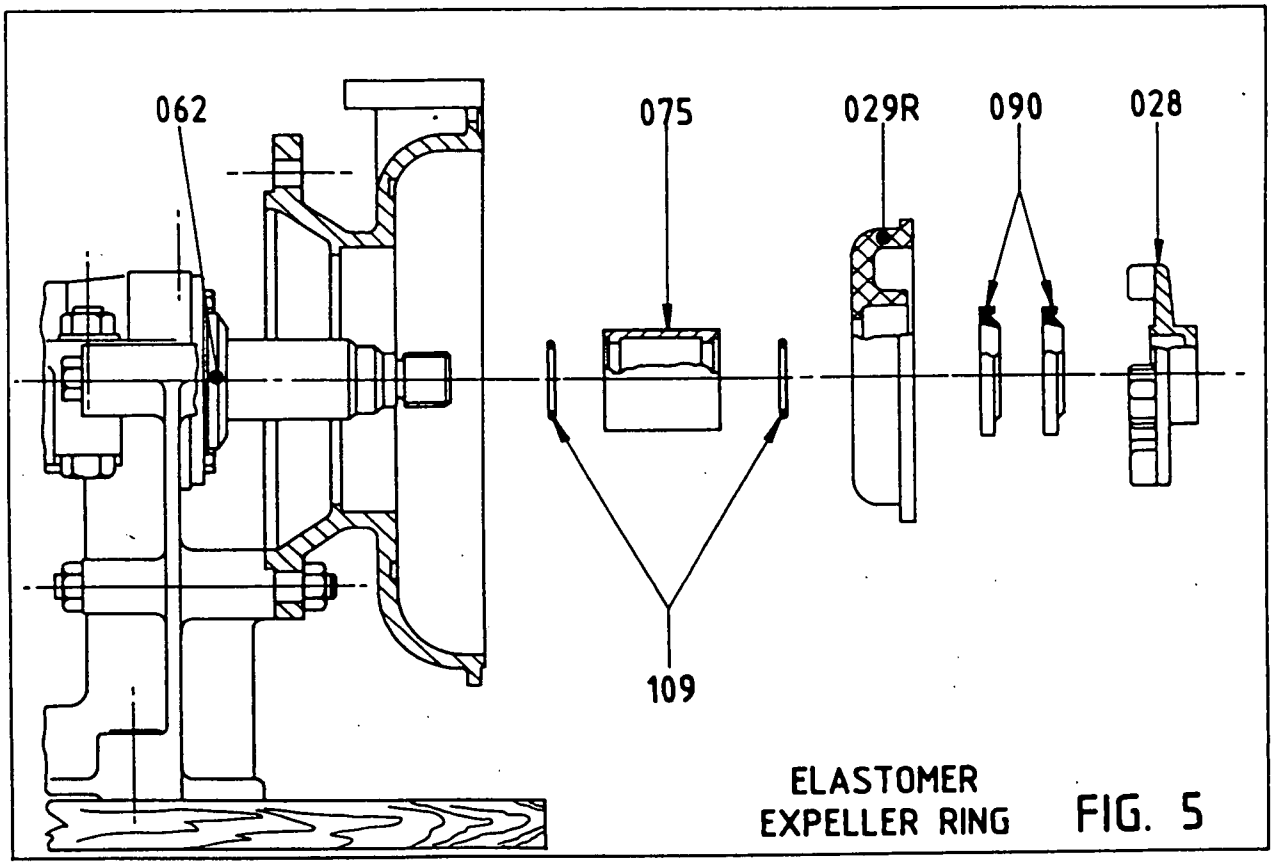
11. Liberally grease Shaft Thread.

6.3 SEAL ASSEMBLY:

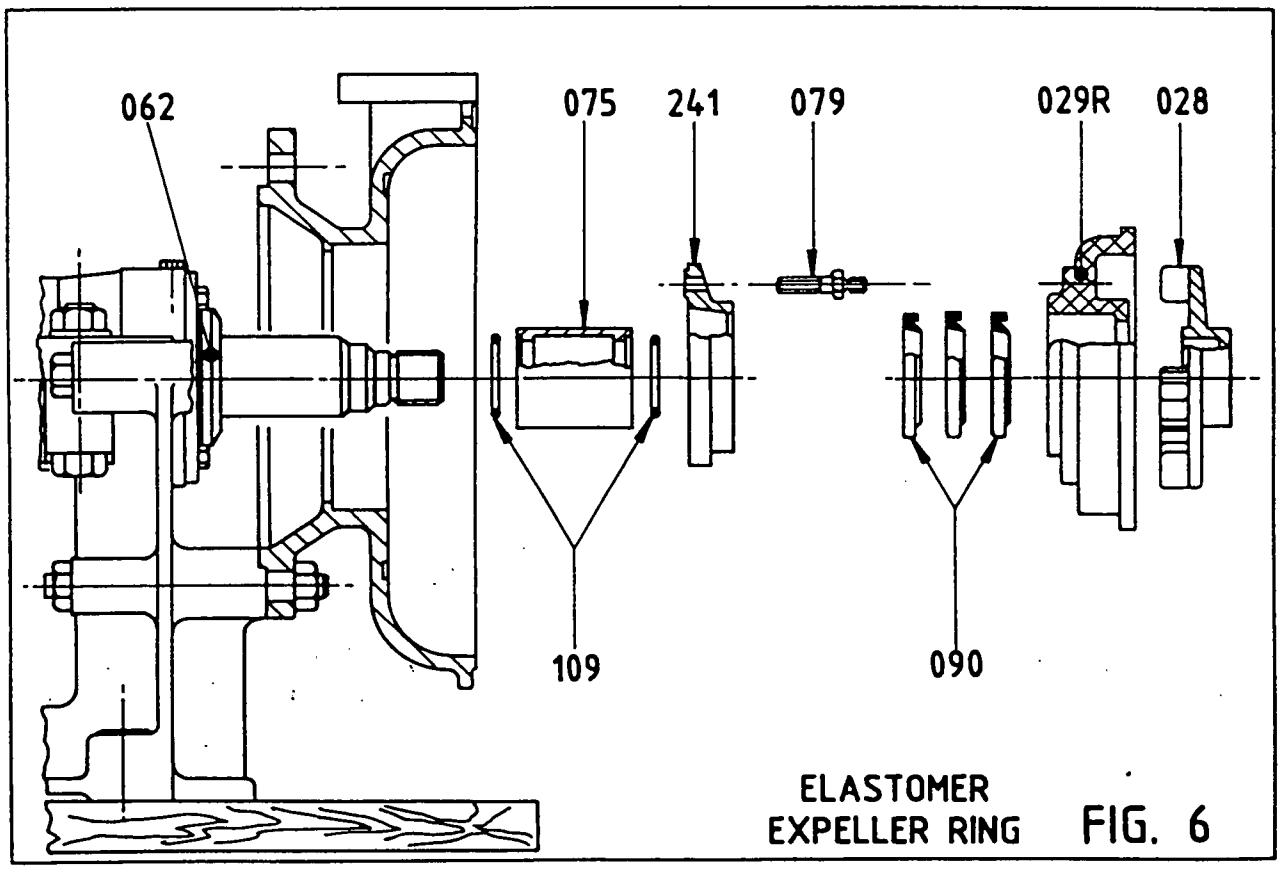


METAL EXPELLER RING FIG. 4

6.3 SEAL ASSEMBLY:



6.3.2 CENTRIFUGAL SEAL ASSEMBLY: Fitting Expeller Ring, Neck and Lantern Rings, Packing, (Lip Seals), Shaft Sleeve, Shaft Sleeve O-Rings and Expeller
- See Fig 4, 5 & 6



Two types of EXPELLER RING are available - Metal or Elastomer. **Metal Expeller Rings are fitted with PACKING.**
Elastomer Expeller Rings are recommended to be fitted with LIP SEALS ONLY as there is no provision for lubrication, and the elastomer cannot conduct heat away that would be generated by Packing.

In all cases, the EXPELLER (028) substitutes directly for the SHAFT SPACER (117) in the gland sealed arrangement. All other sleeves/O-Rings etc remain the same.

METAL EXPELLER RINGS - ALL PUMPS (FIG 4):
To fit PACKING (111) to a METAL EXPELLER RING proceed as follows:

1. Place EXPELLER RING (029) flat on bench (gland side up).
2. Drop NECK RING (067) into gland recess to rest on retaining lip.
3. Stand SHAFT SLEEVE (075) on end through Neck Ring.

4. Fit the following items in turn:

   (a) First PACKING RING (111) of correct length to fill annulus.
   (b) LANTERN RING (063) pressed down to flatten first ring.
   (c) Remaining Packing Rings (stagger Packing joints and flatten each Ring) to almost completely fill the annulus.

5. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126) and fully tighten. Place Gland in Expeller Ring and push down to compress Packing Rings. Insert GLAND BOLTS (045) and just nip up Nuts sufficiently to hold Shaft Sleeve.

6. Fit SHAFT O-RING (109) on Shaft and slide up to Labyrinth.

7. Insert assembled Expeller Ring in Frame Plate and tap into position with mallet. Locate Expeller Ring with grease inlet at top.

   The Shaft Sleeve will probably remain forward. It should be pushed back to the Labyrinth and O-Ring.

8. Fit second SHAFT O-RING (109) and push into recess in end face of Shaft Sleeve.

9. Place EXPELLER (028) on Shaft and press up to Shaft Sleeve.

10. Fit IMPELLER O-RING (064 or 109) to groove in Shaft Spacer.

    Note:

    a. To assist in holding the last O-Ring in position which seals against the Impeller, apply heavy grease to the O-Ring groove.

    b. All the O-Rings in their respective grooves will be compressed and fully covered by these metallic parts when the Impeller is screwed onto the Shaft.

11. Liberally grease Shaft thread.

12. Assembly of Gland lubricating parts will be done after all other parts of the pump have been assembled.

    Fit GREASE CUP ADAPTOR (138) and GREASE CUP (-) to the Expeller Ring. Fill Cup with recommended grease and screw down Cup to charge Lantern Ring. Top up Cup.

ELASTOMER EXPELLER RING (FIG 5 & 6):

To fit LIP SEALS to ELASTOMER EXPELLER RINGS proceed as follows:

1/.75 SC, 3/2 SC, & 4/3 SC PUMPS (FIG 5):

1. Place EXPELLER RING (029R) flat on bench (annular groove up).

2. Insert two LIP SEALS (090) {lip to point INTO pump so it is activated by internal pressure} in recess against retaining lip.
   To ease fitting smear outside diameter of seals with liquid soap or rubber lubricant.

3. Fit SHAFT SLEEVE O-RING (109) on Shaft and slide up to Labyrinth.

4. Slide SHAFT SLEEVE (075) on Shaft.

5. Fit second SHAFT O-RING (109) and push into recess in end face of Shaft Sleeve.

6. Insert assembled Expeller Ring over Shaft Sleeve into Frame Plate recess and tap into position with mallet.

7. Place EXPELLER (028) onto Shaft and press up to Shaft Sleeve.

8. Fit IMPELLER O-RING (064 or 109) to groove in Expeller Ring.
   Note:
   a. To assist in holding the last O-Ring in position which seals against the Impeller, apply heavy grease to the O-Ring groove.

   b. All the O-Rings in their respective grooves will be compressed and fully covered by these metallic parts when the Impeller is screwed onto the Shaft.

9. Liberally grease Shaft Thread.

FOR 6/4 SC, 8/6 SC and 10/8 SC PUMPS (FIG 6):

1. Place EXPELLER RING (029R) flat on bench (gland side up).

2. Fit two EXPELLER RING STUDS (079) in Expeller Ring tapped holes provided and fully tighten.

3. Insert two LIP SEALS (090) {lip to point INTO pump so it is activated by internal pressure} in recess against retaining lip.
   To ease fitting smear outside diameter of seals with liquid soap or rubber lubricant.

4. Place LIP SEAL GLAND (241) in Expeller Ring, fit Nuts on Studs and fully tighten. Note that Gland adjustment is not required.

5. Fit SHAFT O-RING (109) on Shaft and slide up to Labyrinth.

6. Slide SHAFT SLEEVE (075) on Shaft.

7. Fit second SHAFT O-RING (109) and push into recess in end face of Shaft Sleeve.

8. Insert assembled Expeller Ring over Shaft Sleeve into Frame Plate recess and tap into position with mallet.
Position Expeller Ring with Studs on horizontal plane.

9. Place EXPELLER (028) onto Shaft and press up to Shaft Sleeve.

10. Fit IMPELLER O-RING (064 or 109) to groove in Expeller Ring.
Note:
   a. To assist in holding the last O-Ring in position which seals against the Impeller, apply heavy grease to the O-Ring groove.

   b. All the O-Rings in their respective grooves will be compressed and fully covered by these metallic parts when the Impeller is screwed onto the Shaft.

11. Liberally grease Shaft Thread.

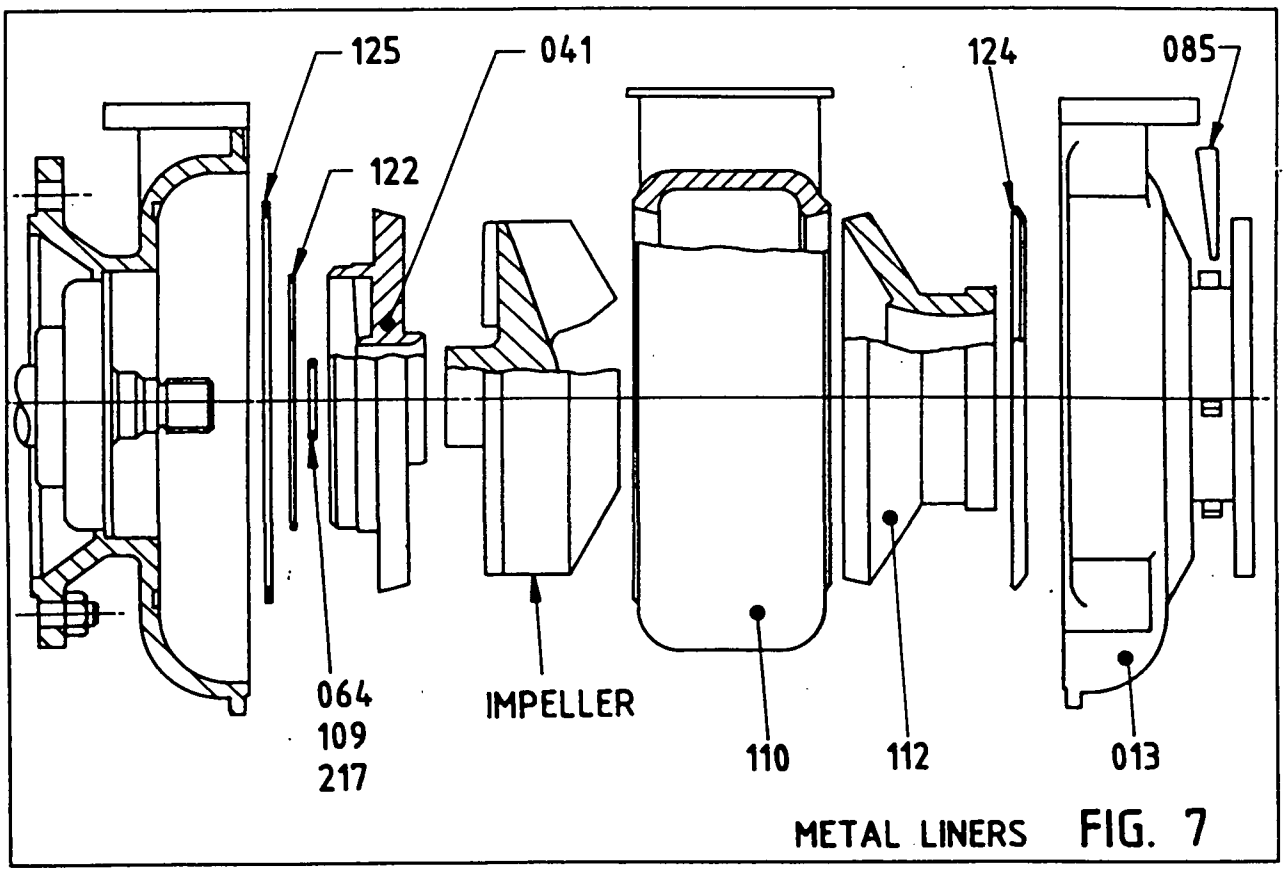
6.3.3 WARMAN MECHANICAL SEAL ASSEMBLY:

For pumps fitted with a Warman Mechanical Seal (Warman Basic Number '162-50') follow the assembly and maintenance instructions contained in Warman Supplement **'M4'**.

The Warman Mechaical Seal is supplied as a cartridge seal ready to install in the pump. If the mechanical seal is in pieces, first assemble the components into a cartridge following the instructions in Warman Supplement 'M4'.

Note: When fitting Warman Mechanical Seals the Bearing Assembly (005) needs to be altered. Replace END COVER (024) at pump end of Bearing Assembly with END COVER (024-50) by following instruction contained in Warman Supplement 'M4'.

6.4 PUMP ASSEMBLY:



METAL LINERS FIG. 7

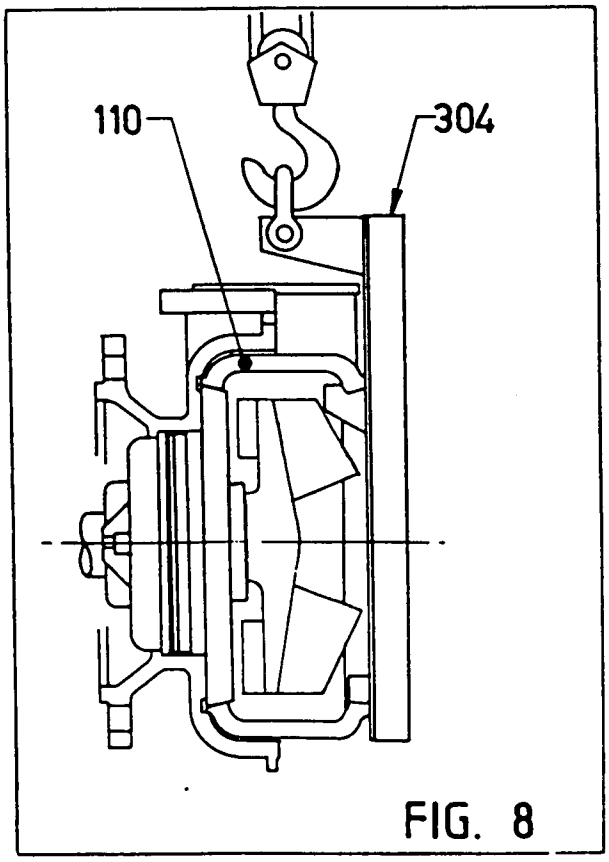


FIG. 8

6.4.1 METAL LINERS - TWO & THREE PIECE: Fitting Seal Ring, Frame Plate Liner Insert, Impeller, Volute Frame and Cover Seals, Volute Liner, and Cover Plate.
- See Fig 7, 8 & 9

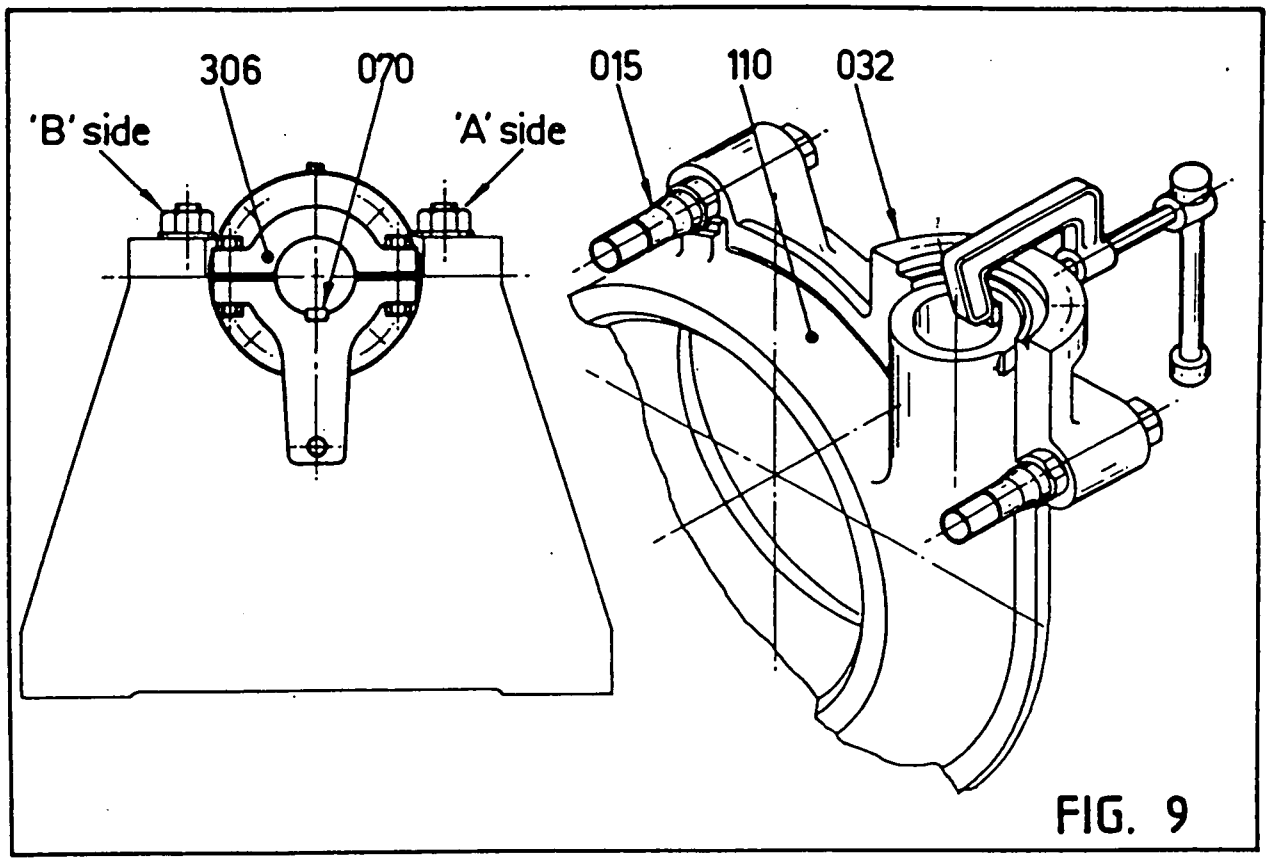


FIG. 9

1. The SEAL RING (122) is an O-RING. Fit it in Frame Plate recess against rim of the Stuffing Box or metal Expeller Ring. Use rubber contact cement to hold seal in position.

2. Fit VOLUTE FRAME SEAL (125):
The Seal is one of two types:

O-Ring: VOLUTE LINER SEAL (125): 1/.75 SC PUMP ONLY:
The Seal is an O-Ring - it is fitted at a later stage (refer to 3 (c) below)

FLAT SOLID SEAL: VOLUTE FRAME SEAL (125): ALL OTHER PUMPS.
The Seal is a flat rectangular section. Fit it to the groove in the back of the Frame Plate. Use rubber contact cement to hold the seal in position.

3. Fit FRAME PLATE LINER INSERT (041) and IMPELLER (-).

(a) Obtain correct type of IMPELLER (-) as specified for the particular application. Rest Impeller (boss up) on a flat surface. Apply grease to the Impeller thread.

Place FRAME PLATE LINER INSERT (041) over Impeller boss, then screw Impeller on Shaft. Observe that the various Seals have not shifted and that the spigot on the back of the Frame Plate Liner Insert engages fully with the spigot in the Frame Plate.

(b) Fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) on Shaft, over Key. Holding Shaft with Wrench and turning the Impeller with a bar between vanes, nip up Impeller on Shaft. Do not overtighten.
Check that Clamp Bolts (012) on Side 'B' of Base (refer to FIG 9) are nipped up just enough to hold the Bearing Assembly horizontal but not to lock it.
To hold the Frame Plate Liner Insert temporarily in its correct position, move the Bearing Assembly back by means of the Nut on the Adjusting Screw (001). The Insert may be centred by hand if rquired.

(c) **FOR 1/.75 SC PUMP ONLY:**
Fit VOLUTE LINER SEAL (125) - {O-Ring} over rim of Frame Plate Liner Insert and next to Frame Plate.

4. Fit VOLUTE LINER (110) as follows:

FOR 1/.75 SC, 3/2 SC and 4/3 SC PUMPS:

These pumps have a one piece front liner ie. the Cover Plate Liner Insert (112) is an integral part of the VOLUTE LINER (110).

(a) Lift VOLUTE LINER (110) over Impeller and push back into Frame Plate so that the taper of the Frame Plate Liner Insert engages with the corresponding taper in the Volute Liner. Check that the Volute Liner Seal (O-Ring) had not shifted.

To hold the Volute Liner temporarily in this position use a G-Clamp to clamp the Volute Liner discharge nozzle to half flange of the Frame Plate. Refer to FIG 9.
TO PREVENT INJURY IT IS VERY IMPORTANT THAT THE VOLUTE LINER BE HELD FIRMLY DURING THE FINAL STAGES OF ASSEMBLY.
Continue assembly from point 5 below.

FOR 6/4 SC, 8/6 SC and 10/8 SC PUMPS:

(a) Use VOLUTE LIFTING BEAM (304) and a hoist to lift VOLUTE LINER (110) off the floor (refer to FIG 8) pass it over the Impeller and fit it over the tapered rim of the Frame Plate Liner Insert. Check that the Volute Frame Seal has not shifted.

To hold the Volute Liner temporarily in this position use a G-Clamp to clamp the Volute Liner discharge nozzle to half flange of the Frame Plate. Refer to FIG 9.

TO PREVENT INJURY IT IS VERY IMPORTANT THAT THE VOLUTE LINER BE HELD FIRMLY DURING THE FINAL STAGES OF ASSEMBLY.

(b) Rest COVER PLATE (013) {Intake Flange down} on suitable supports to keep the flange approximately 25 mm above the floor.

(c) Fit VOLUTE COVER SEAL (124) in groove in Cover Plate using rubber contact cement to hold seal in position.

(e) Lower COVER PLATE LINER INSERT (112) into Cover Plate.

(f) Insert COTTERS (085) through slots in neck of Cover Plate and tap them carefully and evenly until the Throatbush is held firmly in the Cover Plate.

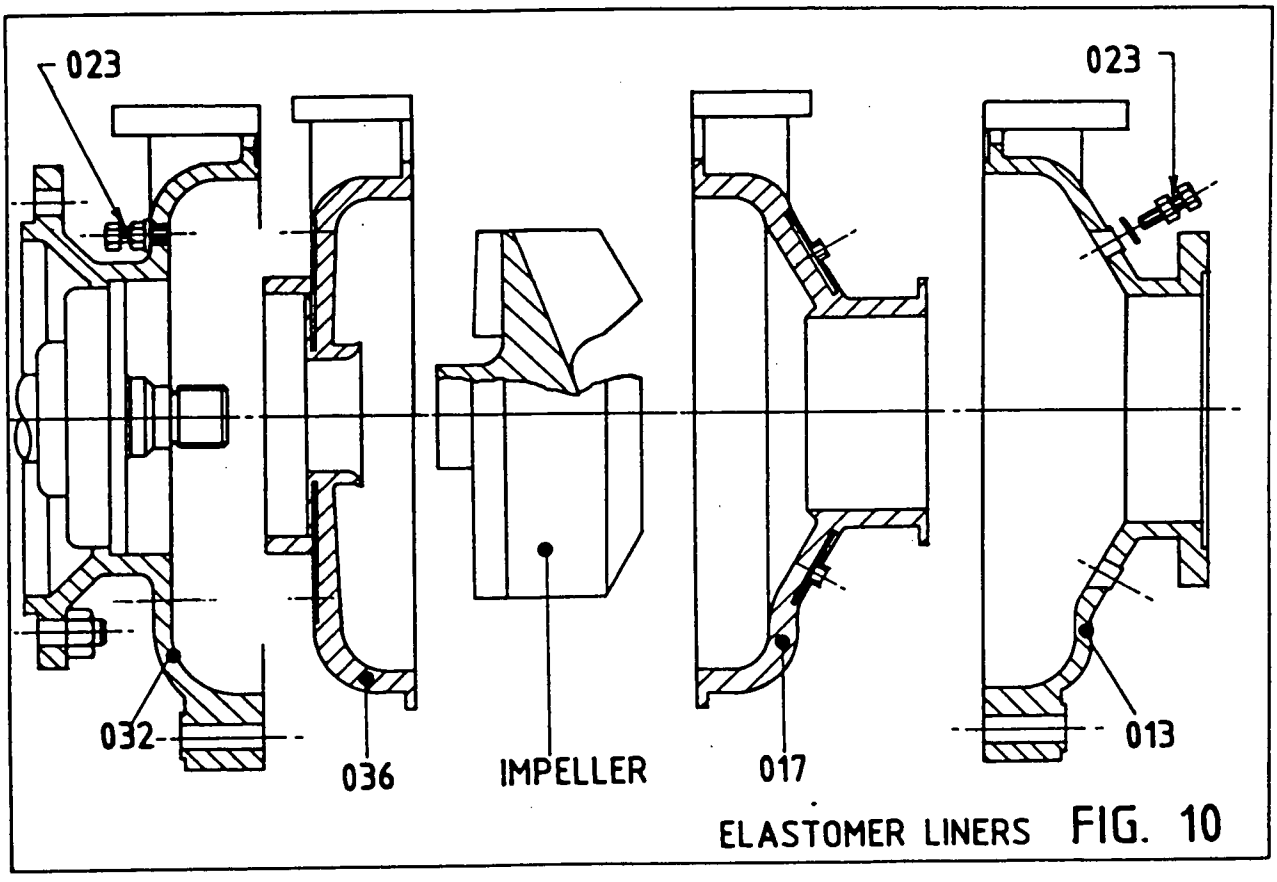
5. Fitting COVER PLATE (013) - proceed as follows:

Lift COVER PLATE (013) complete with Cover Plate Liner Insert, where applicable, over Volute Liner and line up holes with Cover Plate Bolts (015) already fitted in Frame Plate.
Large Cover Plates are provided with radially tapped holes for Eye Bolts to facilitate lifting.
Screw Nuts on Cover Plate Bolts. Do not tighten. Remove G-Clamp from Volute Liner then torque all Cover Plate Bolts evenly to the torque values given in Table 1.

6. Check Throatbush Cotters for tightness.

7. Pump is now ready for fitting of Joint Rings and Impeller Adjustment. Refer to sections 6.4.3 and 6.5 respectively.

6.4 PUMP ASSEMBLY:



ELASTOMER LINERS FIG. 10

6.4.2 ELASTOMER LINERS - TWO PIECE: Fitting Frame Plate Liner, Impeller, Cover Plate Liner & Cover Plate - See Fig 10

1. Fit FRAME PLATE LINER (036) as follows:
   Lift Liner into position, line up threaded bosses with holes and push into Frame Plate, screw on Nut and Washer onto each LINER SETSCREW (023) and position just under Setscrew head. Screw Setscrew into Liner through holes in Frame Plate and tighten. Tighten down the Nut on the Setscrews sufficiently to hold the Liner back in the correct positon in the Frame Plate.

2. Obtain correct type of IMPELLER (-) as specified for the particular pump application.

   (a) Rest Impeller (boss up) on a flat surface. Apply grease to threads then screw Impeller onto Shaft.
   (b) Fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto Shaft, over Key. Holding Shaft with Wrench and turning Impeller with bar between vanes, nip up Impeller on Shaft. Do not overtighten. Ensure that the various O-Rings on the Shaft are not damaged during assembly and that they are fully covered by the various parts.

3. Fit COVER PLATE LINER (017) and COVER PLATE (013) as follows.

   (a) Place Cover Plate Liner on the floor {intake flange up}. Apply a liberal amount of liquid soap or rubber lubricant on the intake flange and inside the intake neck of COVER PLATE (013).

   (b) Place Cover Plate over Cover Plate Liner, line up bosses with holes (where provided), and press Cover Plate down until Liner is hard against Cover Plate. Insert a small tire iron between intake neck and Liner and lift flange out.

   (c) Fit a Nut and Washer onto each LINER SETSCREW (023) and screw on and position just under Setscrew head. Screw Setscrew into Liner through holes in Cover Plate and tighten. Tighten down the Nut on the Setscrew sufficiently to hold the Liner back in the correct positon in the Cover Plate.

   (d) Lift Cover Plate complete with Liner and line up holes with Cover Plate Bolts (015) already in the Frame Plate.
   Screw Nuts on Cover Plate Bolts and tighten evenly to torque given in Table 1.

4. Pump is now ready for fitting of Joint Rings and Impeller Adjustment. Refer to sections 6.4.3 and 6.5 respectively.

6.4 PUMP ASSEMBLY:

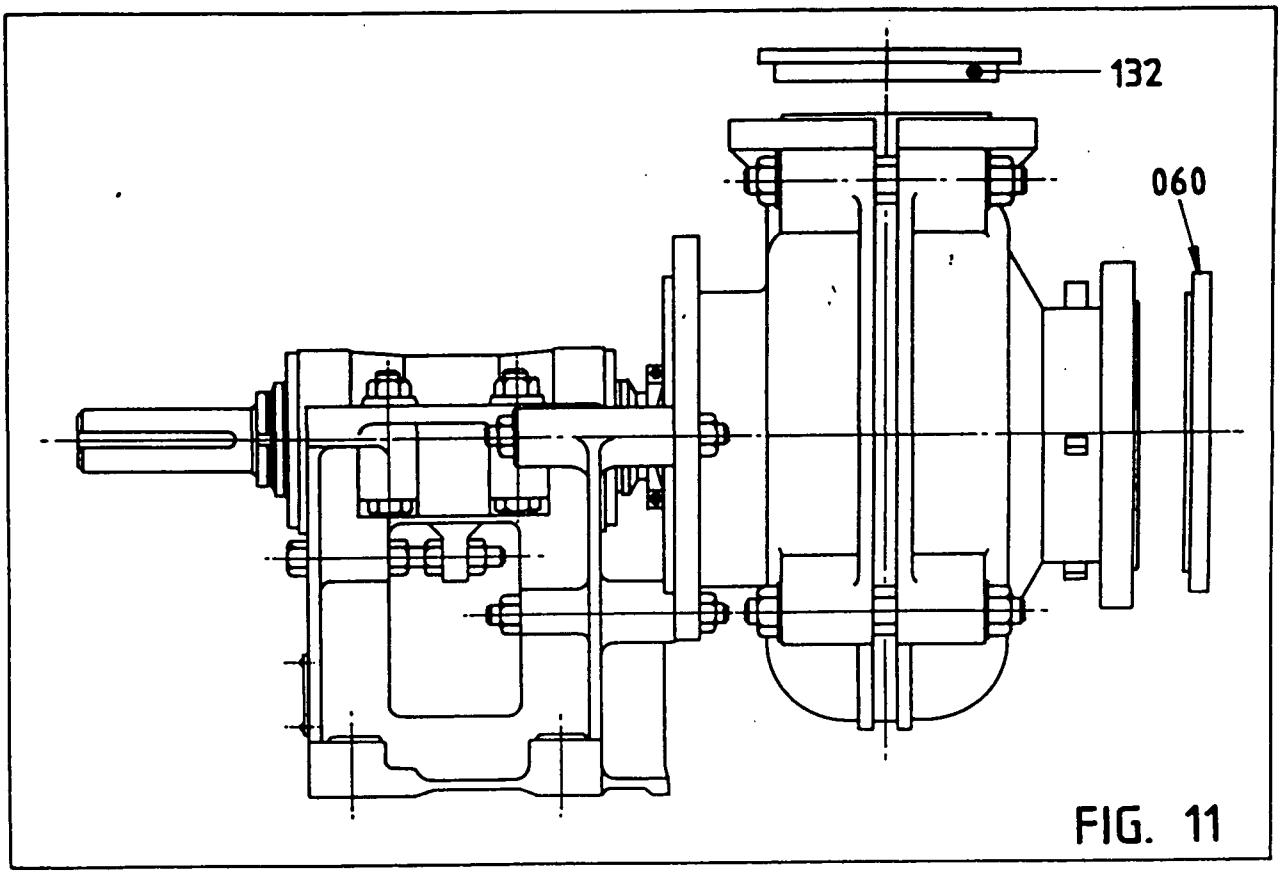


FIG. 11

6.4.3 ASSEMBLED PUMP: Fitting Joint Rings - See Fig 11

The Pump is now fully assembled.

For pumps requiring INTAKE JOINT RING (060) and DISCHARGE JOINT RING (132), they are supplied loose.

Fit the INTAKE JOINT RING (060) and the DISCHARGE JOINT RING (132) as shown in FIG 11. Use rubber cement to hold joints in position while connecting Intake and Discharge pipework.

Impeller clearance has now to be adjusted (refer to Section 6.5).

6.5 IMPELLER ADJUSTMENT:

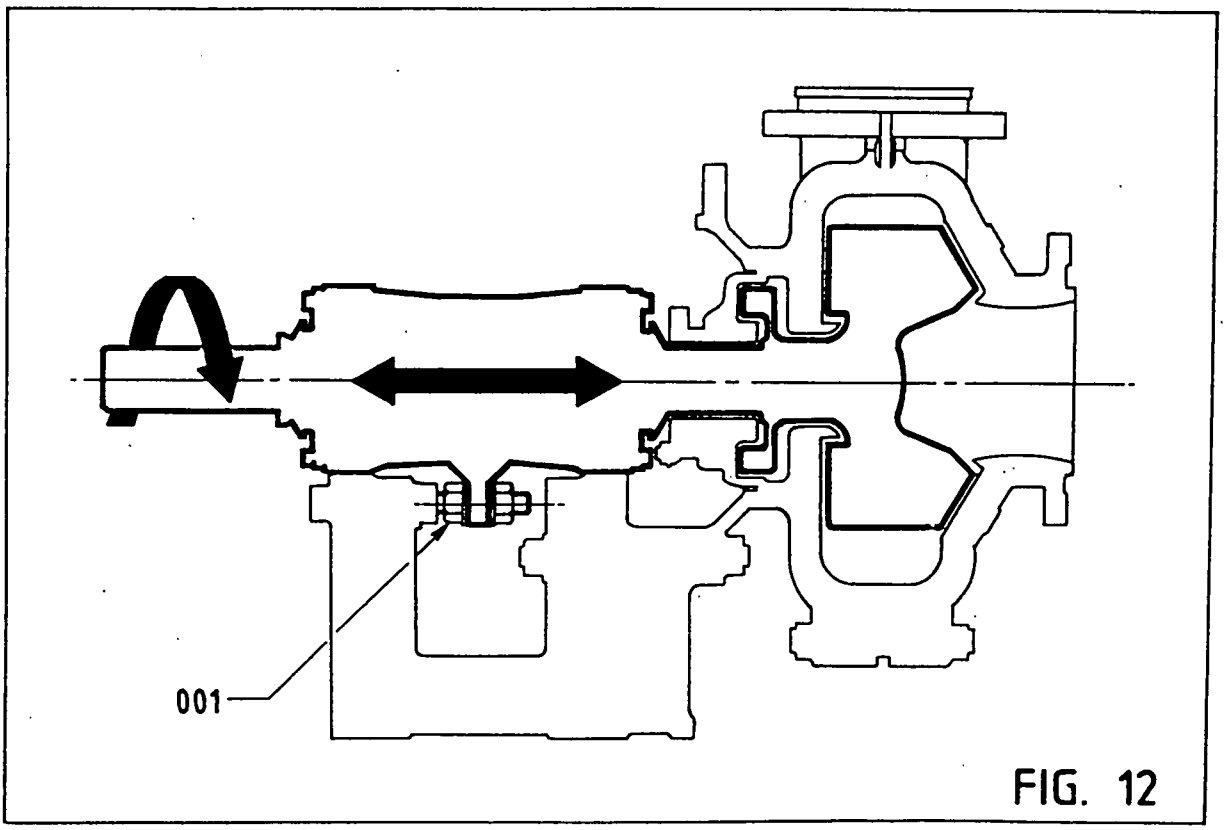


FIG. 12

6.5 IMPELLER ADJUSTMENT:
- See Fig 12 & 8

In both METAL and RUBBER LINED PUMPS the Impeller should just clear the front Liner (Throatbush).

1. Rotate Shaft clockwise by hand and move Bearing Assembly forward (towards front Liner) by tightening the rear Nut on the ADJUSTING SCREW (001) until the Impeller starts to rub on the front Liner.

2. Release the rear nut by one sixth of a turn, then move Bearing Assembly back by means of front Nut until Housing touches the rear lug.

NOTE

Impeller adjustment is a key element in extending the wear life. Field tests on certain pumps indicate if Impellers are adjusted right forward when fitted and again at regular intervals during the wear life, then an increase of 40-

–50% in life can be achieved over pumps which were not correctly adjusted forward at the initial fit-up. Further, pumps which were regularly adjusted over their life have shown a 20% increase over pumps which were only adjusted once at the initial fit up.

Recommended procedure:

i. On initial fit-up, adjust the Impeller so it "just touches" the Throatbush.
ii. Re-adjust the Impeller to "just touch" the Throatbush after 50–100 hours.
iii. Re-adjust a further two to three times at regular intervals during the wear life of the pump (this could coincide with the regular maintenance times – say 500 hours).
vi. After adjustment of the impeller, it is important to tighten the Bearing Housing Clamp Bolt to a torque value given in the following Table.

BEARING HOUSING CLAMP BOLT TORQUE TABLE

FRAME SIZE	MAXIMUM TORQUE (Nm)	FRAME SIZE	MAXIMUM TORQUE (Nm)
A	10		
B	10	N	25
C	45	P	45
D	45	Q	45
E	185	R	185
F	185	S	185
G	325	T	525
H	1500	U	1500

THE PUMP IS NOW COMPLETE AND READY FOR ASSEMBLY OF DRIVE COMPONENTS AND INSTALLATION.

PACKING WILL REQUIRE FINAL ADJUSTMENT DURING INITIAL START-UP.

7. PUMP DISMANTLING & IMPELLER REMOVAL:

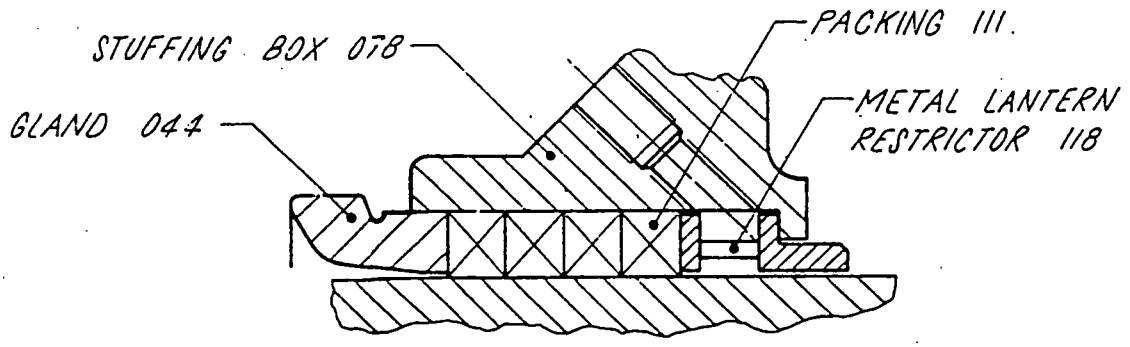
Dismantling the pump is the reverse of the instructions given for assembly purposes. To gain access to the IMPELLER (-) generally the Cover Plate complete with Liners or THROATBUSH (112) can be withdrawn from the pump by removing the Nuts on the COVER PLATE BOLTS (015) and for metal lined pumps the metal VOLUTE LINER (110).

8. WARMAN BASIC PART NUMBERS AND PARTS LIST:

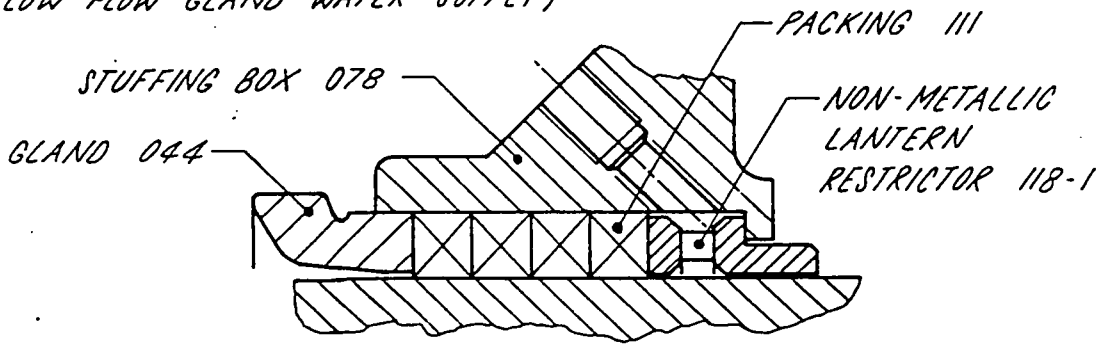
WARMAN BASIC N°		PART NAME PAGE	REFER FIGURE
001	Adjusting Screw or Cam	3,16,21	1,12
003	Base	3	1
005	Bearing Assembly	4,13	1
011	Clamp Washer	4	1
012	Clamp Bolt	4,16,21	1
013	Cover Plate	17,19	7,10
015	Cover Plate Bolt	5,17,19,22	
017	Cover Plate Liner	19	
023	Cover/Frame Plate Liner Stud	18,19	
024	End Cover (also 024-50)	13	---
028	Expeller	11,12,13	4,5,6
029	Expeller Ring	10	4
029R	Expeller Ring (rubber)	12	5,6
032	Frame Plate	5	2,9,10
034	Frame Plate Bolt	5	2
036	Frame Plate Liner	18	10
039	Frame Plate Stud	5	2
041	Frame Plate Liner Insert	16	7,8
044	Gland	7,11	3,4
045	Gland Bolt	8,11	3,4
060	Intake Joint	20	11
062	Labyrinth	4	3,4,5,6
063	Lantern Ring	7,11	3,4
064	Impeller O-Ring	7,11,12	7
067	Neck Ring	7,10	3,4
070	Shaft Key	16,18	9
073	Shaft	4	---
075	Shaft Sleeve	7,12,13	3,4,5,6
078	Stuffing Box	7	3
079	Expeller Ring Stud	12	6
085	Cotter	17	7
090	Lip Seal	12	5,6
109	Shaft O-Ring	7,11,12,13	3,4,5,6,7

WARMAN BASIC N°		PART NAME PAGE	REFER FIGURE
110	Volute Liner	11,16,22	7,8,9
111	Packing	7	3,4
112	Cover Plate LIner Insert	17,22	7
117	Shaft Spacer	10	3
118	Lantern Restrictor (also 118-1)	6	3
122	Seal Ring	15	7
124	Volute Cover Seal	15,17	7
125	Volute Frame Seal	15,16	7
126	Gland Clamp Bolt	7,11	3,4
132	Discharge Joint Ring	20	11
138	Grease Cup Adaptor	11	4
162-50	Warman Mechanical Seal	13	---
241	Lip Seal Gland	13	6
304	Volute Lifting Beam	16	8
306	Shaft Wrench	16,18,22	9
---	Eye Bolt	6	---
---	Grease Cup	11	4
---	Impeller	16,19,22	7

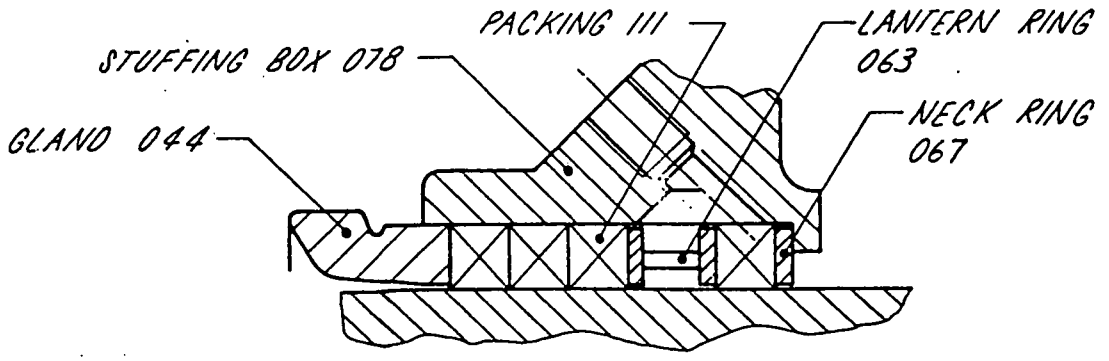
(1) SUITABLE FOR LOW LIFT & POSITIVE HEAD APPLICATIONS



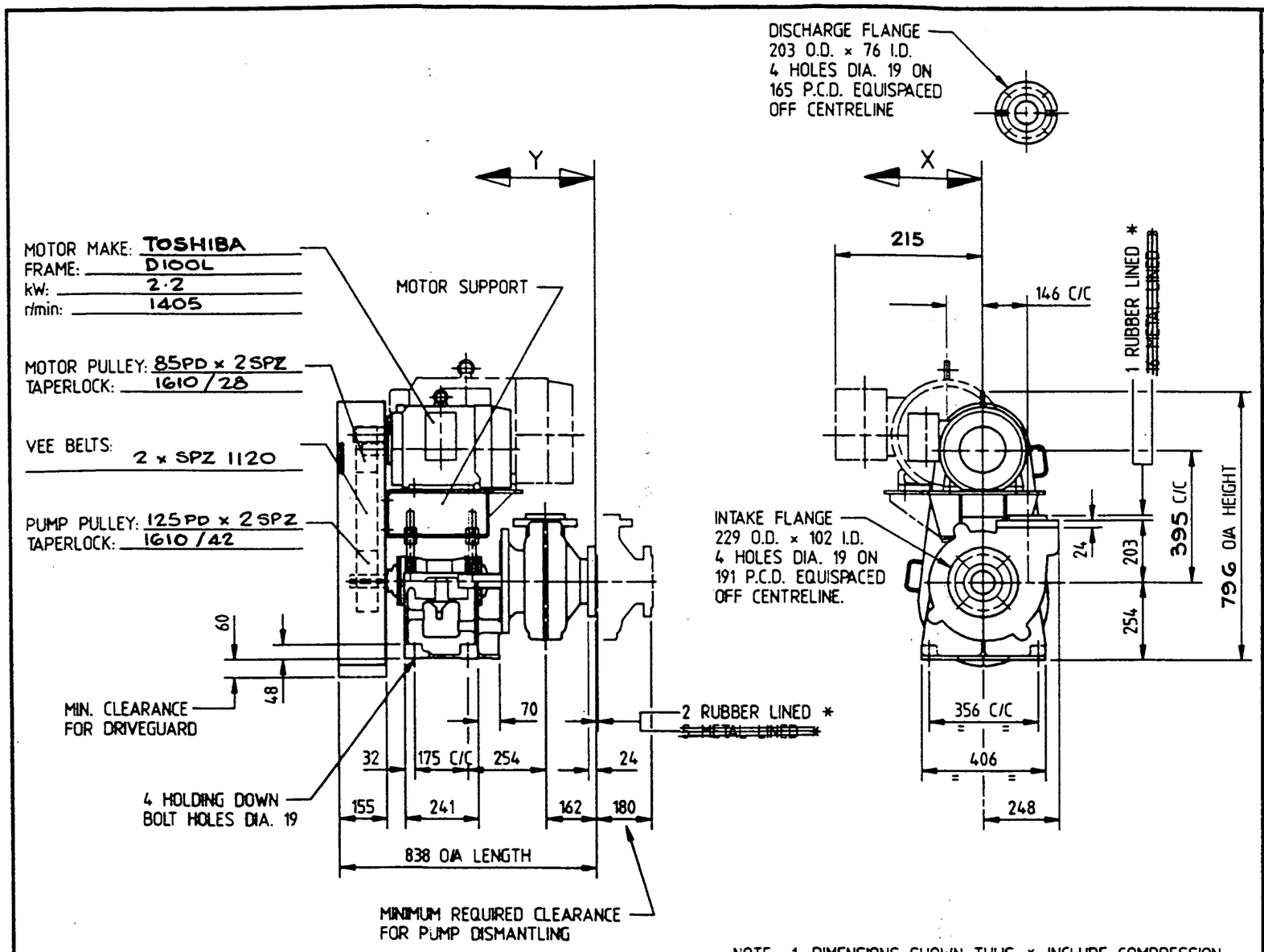
(2) SUITABLE FOR HIGH LIFT APPLICATIONS (LOW FLOW GLAND WATER SUPPLY)



(3) SUITABLE FOR HIGH LIFT APPLICATIONS



REV.	063 WAS 067 & 067 WAS 063 JA. 6-4-89		WARMAN PUMPS GLAND ARRANGEMENTS FOR STUFFING BOXES
DATE	21-9-84	DRN.	
SCALE	——		
WARMAN INTERNATIONAL LTD.		A4– 110 –0– 115795	REV. 1
OFFICE OF ORIGIN : SYDNEY			



NOTE: 1. DIMENSIONS SHOWN THUS * INCLUDE COMPRESSION OF WARMAN RUBBER JOINT.

~~2. FOR GLAND WATER CONNECTION REFER TO DRAWING A3-109613~~

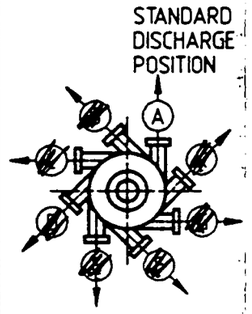
LOAD TABLE

ITEM	MASS (kg).	POSITION OF CENTROID (mm).			
MOTOR	32	X=	Y=		
PUMP	189	X= 0	Y= 310		
DRIVE COMPONENTS	80	X= 0	Y= 590		

AXIAL HYDRAULIC FORCE (N). ON ADJOINING PIPEWORK

	WITH FLEXIBLE JOINT(S).	WITH RIGID JOINT(S).
AT INTAKE		ZERO
AT DISCHARGE		ZERO

ALTERNATIVE POSITIONS OF DISCHARGE AS VIEWED FROM INTAKE FLANGE.



DISCHARGE POSITION B IS NOT POSSIBLE WITH MOTOR FRAMES LARGER THAN D132M.

POSITIONS B & C RECOMMENDED WHEN PUMPING FROTHY PULPS.

POSITIONS F & G RECOMMENDED WHERE COMPLETE DRAINAGE OF PUMP IS REQUIRED.

CLIENT	BRISBANE CITY COUNCIL
LOCATION	WYNNUM W. W. T. P.
EQUIPMENT No/S.	
No. OF ASSEMBLIES	TWO
SERIAL No/S.	SY 5G743 & 44
WORKS ORDER No/S.	P97/0144

No.	DESCRIPTION	BY	DATE	CHK
4				
3				
2				
1				

REVISIONS

APP.	LGG
CHECK	LAW
PREP.	CCV
DATE	4 FEB 97
SCALE	———

ARRANGEMENT OF WARMAN 4/3 C-SC PUMP WITH [D100L] MOTOR

CV DRIVE DISCHARGE FLANGE POSITION [A]

WARMAN INTERNATIONAL LTD.

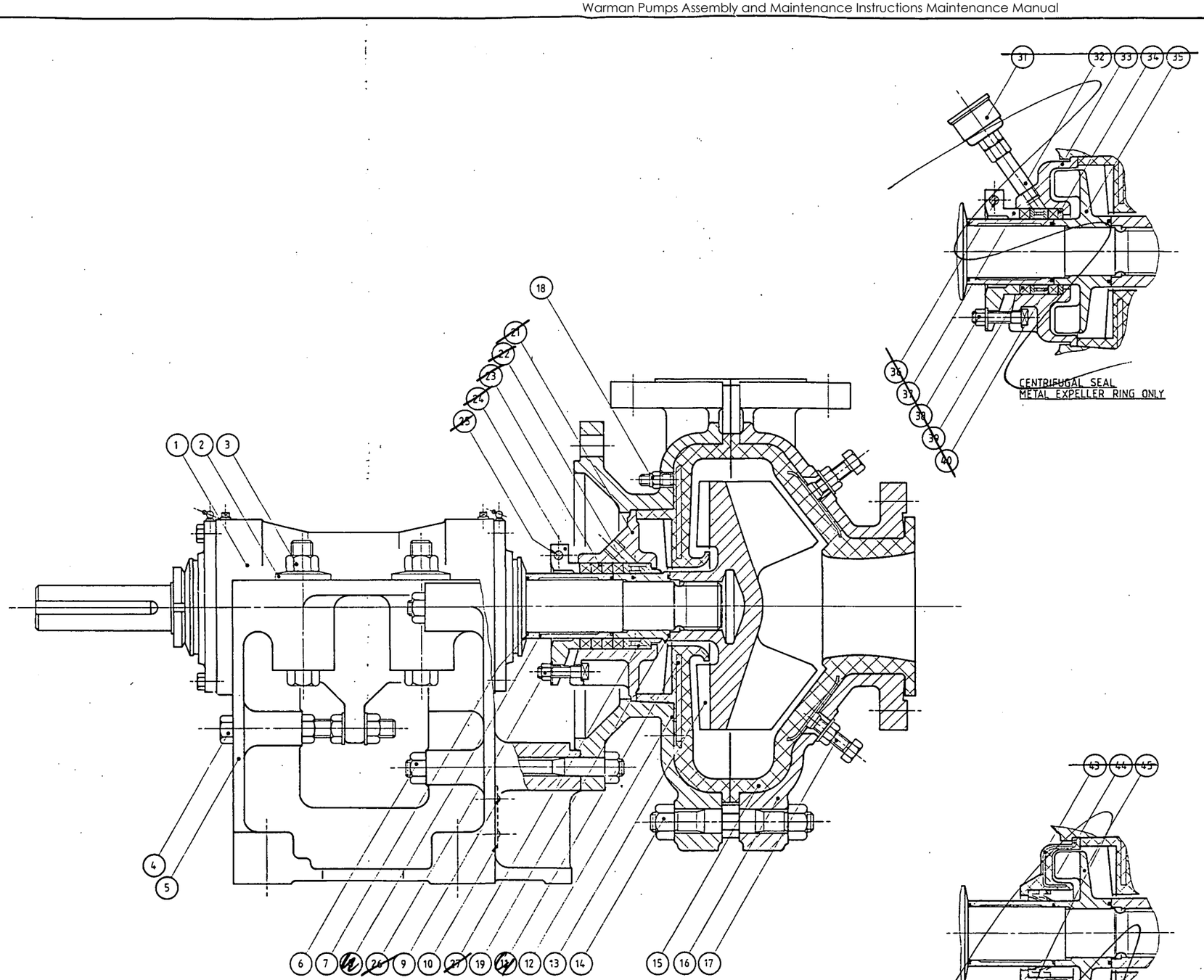
OFFICE OF ORIGIN : BRISBANE

Warman CAE-CAD-CAM

A3-S2-1-302114

REV.

MASTER DRG. A3-110486 | REV. 2 | REDRAWN DWN 155 & 60 DIAM. CLEARANCE FOR D/GUARD) ADDED | By. AAG | Date. 25.3.96 | Chk. | DRN.: AAG | CHECK: | APP.: | REV. : | DATE : MAR.25,1996



ITEM	QTY	DESCRIPTION			PART No.
1	1	BEARING ASSEMBLY (REF. DRG. A1-106009)			CAM005M
2	4	CLAMP WASHER			C011
3	4	CLAMP BOLT	M20H1-120ZN		C012M
4	1	ADJUSTING SCREW - 3 NUTS - 2 WASHERS			C001M
5	1	BASE			C003M
6	3	FRAME PLATE STUD - 2 NUTS			C039M
7	2	SHAFT O-RING	26T47N134		C109
~~8~~	~~1~~	~~SHAFT SLEEVE~~			~~C075~~
9	4	NAMEPLATE RIVET TLP/0424BS			——
10	1	NAMEPLATE - B6			——
~~11~~	~~1~~	~~FRAME PLATE LINER~~			~~43038~~
12	1	FRAME PLATE			CSC3032
13	1	IMPELLER (AS SELECTED)			
14	4	COVER PLATE BOLT - 2 NUTS			CSC015M
15	1	COVER PLATE LINER			43017
16	1	COVER PLATE			CSC3013
17	4	COVER PLATE LINER SETSCREW			W8H2-7ZC
18	2	FRAME PLATE LINER STUD	W6Z3-6ZL		43026
19	1	IMPELLER O-RING	26T50N136		CSC064
20					
		GLAND SEAL ONLY			
21	1	STUFFING BOX			CSC078
22	1	SHAFT SPACER			CSC117
23	4	PACKING			C111
24	1	GLAND (2 PIECE)			C044
25	2	GLAND CLAMP BOLT	M8H1-60SN		C126M
26	2	GLAND BOLT - 1 NUT - 1 WASHER			C045M
27	1	LANTERN RESTRICTOR			C118
28					
29					
30					
		CENTRIFUGAL SEAL METAL EXPELLER RING ONLY			
31	1	GREASE CUP			WP2L82-L
32	1	GREASE CUP ADAPTOR			B138
33	1	EXPELLER RING			CSC029
34	1	NECK RING			C067
35	1	EXPELLER			CSC028
36	2	GLAND CLAMP BOLT	M8H1-60SN		C126M
37	1	GLAND (2 PIECE)			C044
38	2	GLAND BOLT - 1 NUT - 1 WASHER			C045M
39	2	PACKING			C111
40	1	LANTERN RING			C063
41					
42					
		CENTRIFUGAL SEAL RUBBER EXPELLER RING ONLY			
43	1	EXPELLER RING			CSC029
44	2	LIP SEAL			C090
45	1	EXPELLER			CSC028
46					

SEE DRG A3-110-0-133177
FOR SEAL COMPONENTS.

SUPERSEDES DRG CSY 3495, CSY 3522, CSY 5346

NO	DESCRIPTION	BY	DATE
5			
4			
3			
2	ITEM 31 PART No WAS WP2L82-L ITEM 32 PART No WAS B138	GAG	7/05/1993
1	ITEM 43 PART No WAS CSC029P	GAG	7/05/1993

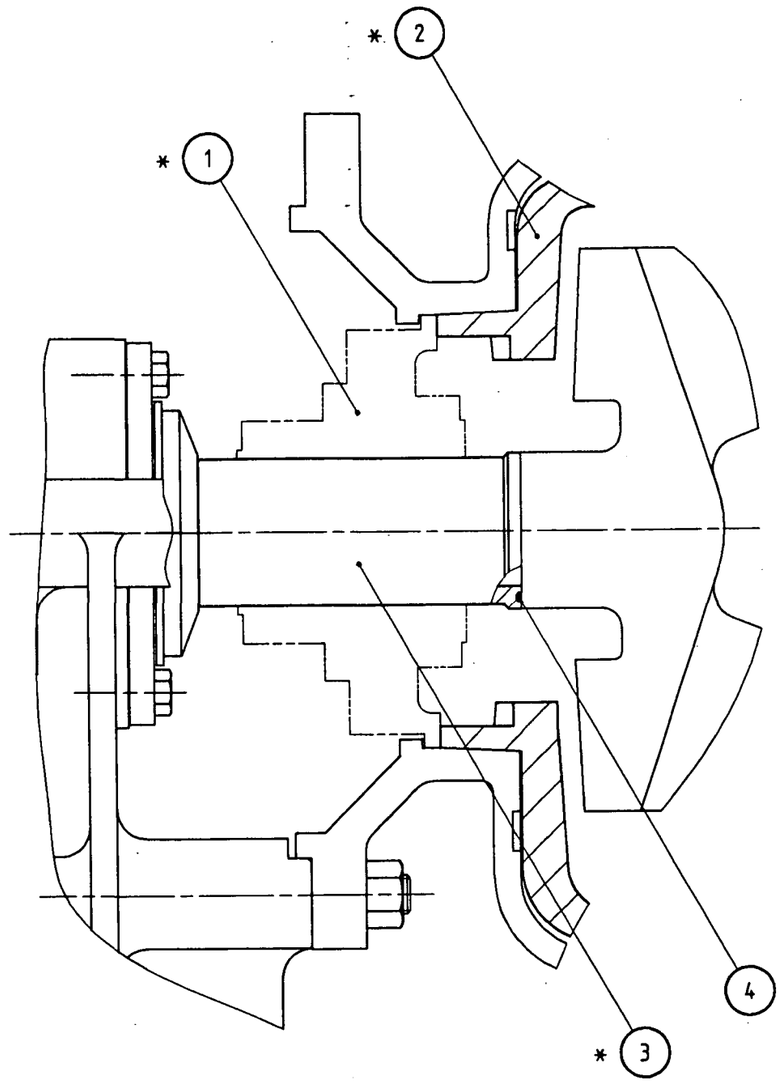
REVISIONS

APP	
CHECK	A J G
DRN	M D W
DATE	15-12-82
SCALE	

WARMAN PUMP
4/3C-SC RUBBER LINED
COMPONENTS DIAGRAM

WARMAN INTERNATIONAL LTD.
OFFICE OF ORIGIN SYDNEY

A1— 110 -0-110059 | REV. 2



ITEM	QTY	DESCRIPTION		PART No.
1	1	'BURGMANN' MECHANICAL SEAL (03-HR321/60-E2)		CSC162-27M
2	1	FRAME PLATE LINER		43036MS1
3	1	SHAFT SLEEVE		CSC424M
4	1	IMPELLER O-RING		CSC064

NOTE: 1. FOR ITEMS OTHER THAN THOSE SHOWN REFER TO 4/3 C-SC RUBBER LINED COMPONENTS DIAGRAM A1-110059.

2. ITEMS MARKED THUS * REPLACE THE SEAL COMPONENTS SPECIFIED ON A1-110059.

No.	DESCRIPTION	BY	DATE	CHK
4				
3				
2				
1				

REVISIONS

APP.	
CHECK	JA
DRN.	RMM
DATE	JAN.29,1997
SCALE	

WARMAN PUMP
4/3 C-SC RUBBER LINED
SEAL ARRANGEMENT WITH 'BURGMANN' MECHANICAL SEAL

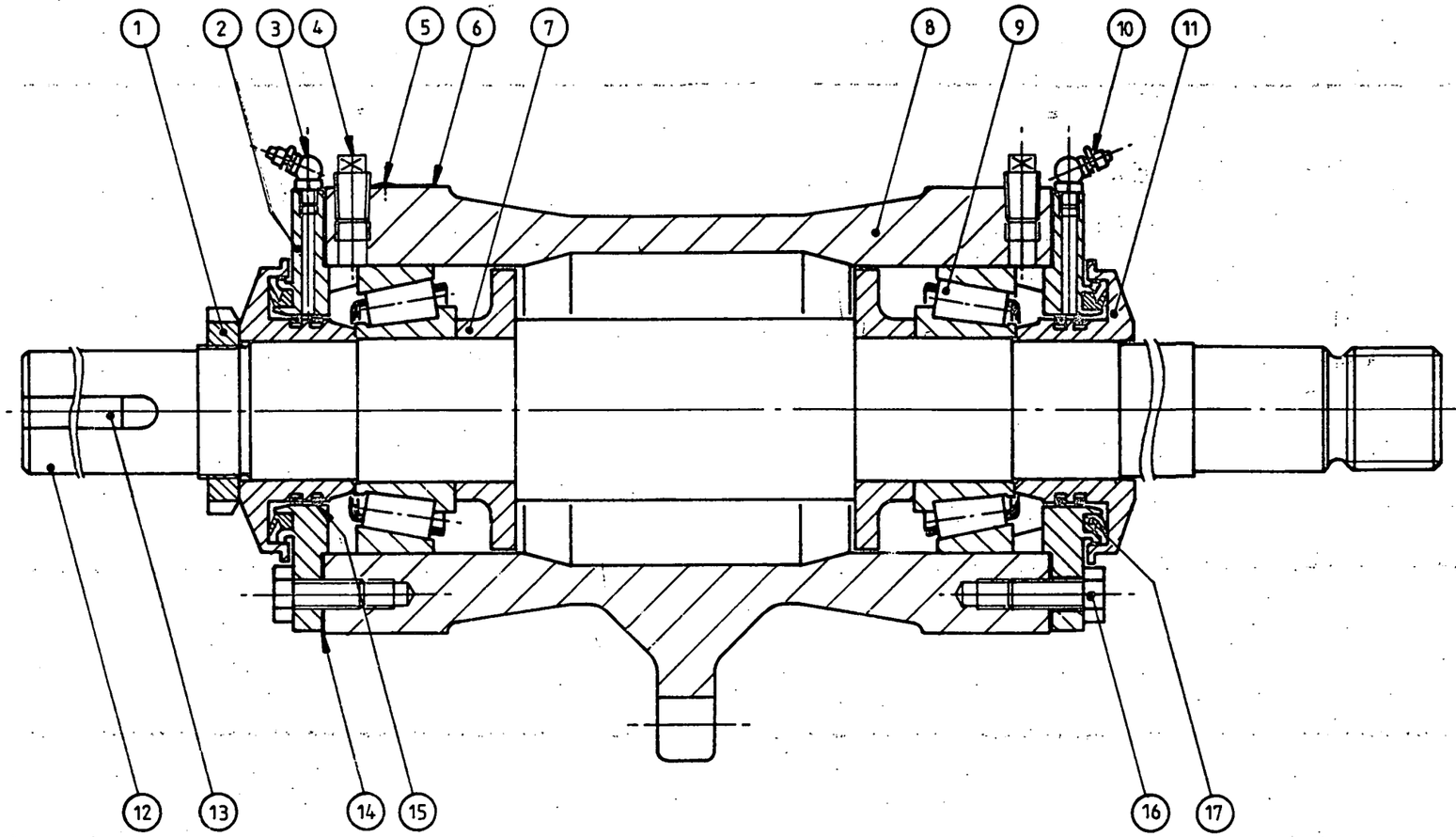
WARMAN INTERNATIONAL LTD.

OFFICE OF ORIGIN : SYDNEY

Warman CAE-CAD-CAM

A3– 110 –0–133177

REV.



ITEM	QTY	DESCRIPTION		PART No.
1	1	LABYRINTH LOCKNUT		C061
2	2	END COVER		C024-10
3	2	GREASE NIPPLE		UF4L73-Z
4	2	PLUG		WP4P1-E
5	2	NAMEPLATE RIVET TLP/D424BS		———
6	1	NAMEPLATE S32		———
7	2	GREASE RETAINER		C046
8	1	BEARING HOUSING		C004M
9	2	BEARING		C009
10	2	GREASE CAP		A365
11	2	LABYRINTH		C062-10
12	1	SHAFT		CAM073M
13	1	SHAFT KEY		C070M
14	1	SHIM SET		C025
15	4	PISTON RING		C108
16	8	END COVER SET SCREW M10H2-25Z		B027M
17	2	BEARING SEAL		C089-10

No.	DESCRIPTION	BY	DATE
6			
5			
4			
3	REDRAWN WITH C410-10 END COVER ASSEMBLY	BMcH	14.4.89

REVISIONS

APP.	Keb
CHECK	
DRN.	B/McH
DATE	14.4.89
SCALE	———

WARMAN PUMP
BEARING ASSEMBLY— CAM005M
COMPONENTS DIAGRAM

WARMAN INTERNATIONAL LTD.

OFFICE OF ORIGIN: SYDNEY

A3— 110 —0—106009

REV. 3

WARMAN INTERNATIONAL LTD

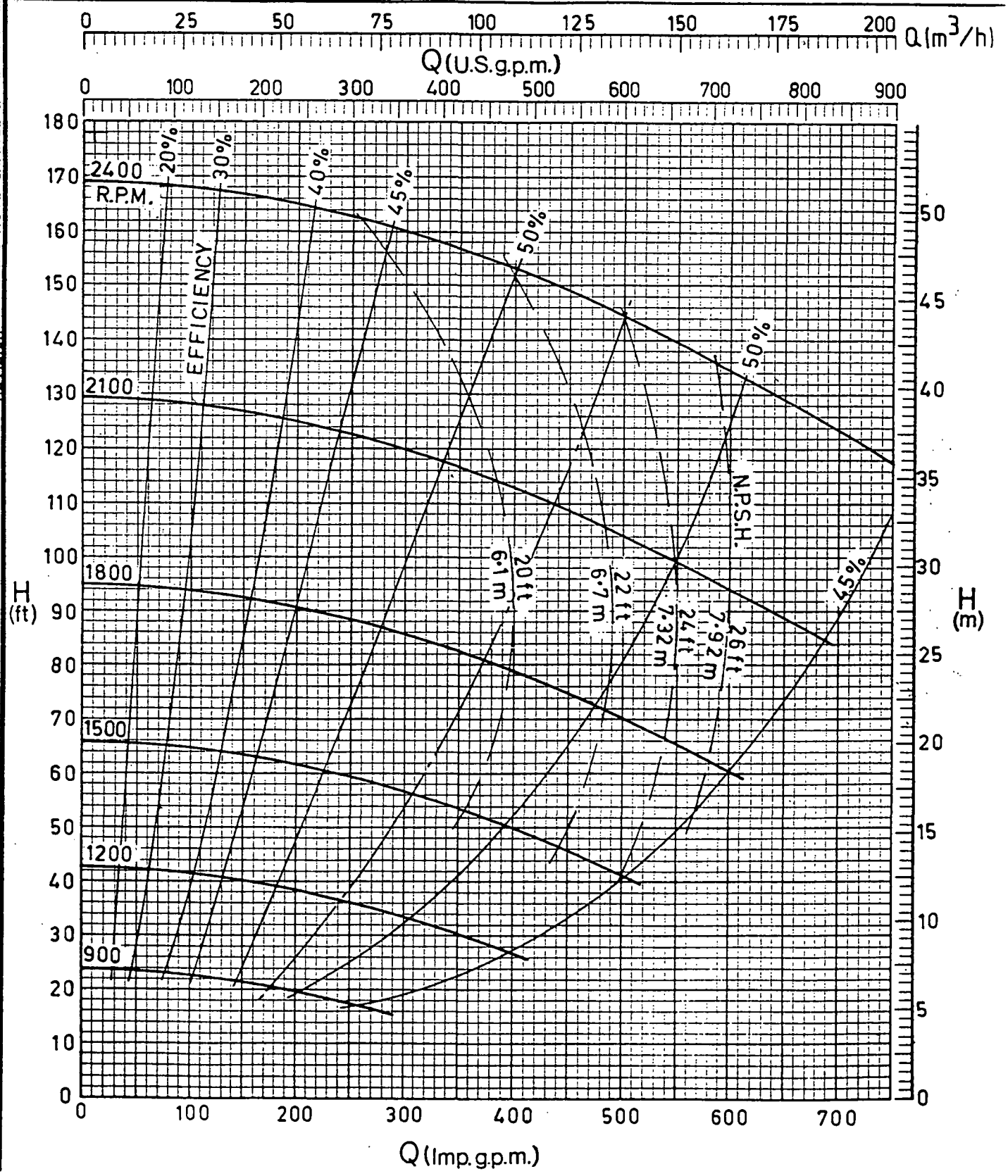
PERFORMANCE CURVES

PUMP			IMPELLER 43021				SHAFT SEAL	GLAND
SIZE	FRAME	TYPE	VANES	TYPE	MAT'L	VANE DIA.	LINER MAT'L	METAL
4/3	C	SC	2	OPEN CHOKELESS	METAL	9 ins. 229 mm	—	

WPA 43A67
EFFECTIVE FROM JUNE 1985

Frame suitability must be checked for each duty and drive arrangement.
CURVES SHOW APPROXIMATE PERFORMANCE FOR CLEAR WATER (To International Test Standard ISO2548 Class C) : For media other than water , corrections must be made For density , viscosity and/or other effects of solids.

NORM. MAX. SPEED	FRAME RATING	MIN. PASSAGE SIZE
n= 2400	H.P.= 40 kW= 30	40



GENERAL NOTES REVISED.
LAST ISSUE : MAY 1982
REVISION : SPHERE NOTE CHANGE & CENTRIFUGAL NOTE DELETED.

REF: ESY P 968 (TEST 38)