WEIR MINERALS EUROPE LIMITED

INSTALLATION, OPERATION & MAINTENANCE MANUAL

PUMP TYPE: 300LP T-SHG

Client:	**HERRENKNECHT AG**
Warman Ref:	**SAP195458/001**
Customer PO No.	**850703/B3/S-622/BU / WCG 4641**
Serial No/s:	**WP49925**
Tag No/s:	
Manual Ref:	**WP442KT**
Date:	**15/02/11**

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Original Instructions

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INSTALLATION AND MAINTENANCE MANUAL

WARMAN SUPER HEAVY GRAVEL PUMP

300 T-SHG

GLAND SEALED METAL LINED

NOTE:
This manual has been compiled to suit a particular range of pumps.
Additional copies are readily available, however, regrettably a nominal charge is made for the extra copies to cover printing and administrative costs. The policy of continuous improvement may mean that replacement parts may differ from original parts fitted. All information in this manual is based on the latest information available, but the right is reserved to introduce modifications which may affect this information.

PUMP IDENTIFICATION

To ensure long trouble free service from a Warman pump, the instructions contained in this manual must be carefully applied.

Every Warman pump has a nameplate attached to the base. 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	DIGITS	LETTERS	LETTERS
A	B	C	D
INTAKE DIAMETER	DISCHARGE DIAMETER	FRAME SIZE	WET END TYPE

(a) The intake diameter is given in inches.
It is expressed by a number such as 8.

(b) The discharge diameter is given in inches.
It is expressed by a number such as 6. The discharge diameter is usually smaller than the intake diameter; however, in some pumps the two are equal.

(c) The frame of the pump comprises the base and the bearing assembly. The frame size of the pump is identified by one or two letters such as E or EE.

(b) The wet end is identified by one or more letters. Some of these are:-
AH :Ultra heavy duty slurry pump
SC:Medium duty slurry pump
S:Solution pump
G:Gravel pump
D:Dredge pump

Examples:

8/6 EAH	8” 6” E AH	Intake diameter Discharge diameter Frame Size Ultra heavy duty slurry pump
8/6 EEAH	8” 6” EE AH	Intake Diameter Discharge diameter Frame size- High capacity bearings Ultra heavy duty slurry pump
8/8 FG	8” 8” F G	Intake Diameter Discharge Diameter Frame Size Gravel Pump

This manual highlights danger areas during assembly. These must also be observed during dismantling. Read the manual and for strict safety note the danger areas.

Emphasis is placed, in the manual, on the use of assembly aids. Each section is fully detailed with diagrams to show how to make use of the assembly aids. This emphasis is placed for two reasons, one for ease of maintenance, two for safety. The servicemen should always be aware of the size of the pump being dealt with. Some castings are heavy, in certain cases in excess of 1000Kg.

IMPORTANT:
Whilst the manual covers details of the installation, commissioning, fault finding and assembly of Warman pumps, dismantling of the pump is not described. The dismantling of the pump has never created any problems from a technical point of view, however certain items require consideration.

WARNINGS:
The following warnings provide important safety information and are relevant to all Warman pumps.
Some of the warnings are repeated in the text throughout the manual.

1. **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.**

2. **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.**

3. **DRIVER ROTATION MUST BE CHECKED BEFORE BELTS OR COUPLINGS ARE CONNECTED. PERSONAL INJURY AND DAMAGE TO EQUIPMENT COULD RESULT FROM OPERATING THE PUMP IN THE WRONG DIRECTION.**

4. **DO NOT OPERATE THE PUMP AT LOW OR ZERO FLOW CONDITIONS FOR PROLONGED PERIODS, OR UNDER ANY CIRCUMSTANCES WHICH COULD CAUSE THE PUMPING LIQUID TO VAPORISE. PERSONAL INJURY AND EQUIPMENT DAMAGE COULD RESULT FROM THE PRESSURE CREATED.**

5. **DO NOT APPLY HEAT TO IMPELLER BOSS OR NOSE FOR ANY REASON. PERSONAL INJURY AND EQUIPMENT DAMAGE COULD RESULT FROM THE IMPELLER SHATTERING OR EXPLODING WHEN HEAT IS APPLIED.**

6. **WHEN DISMANTLING THE PUMP ENSURE THAT THE VOLUTE IS CLAMPED WHILE THE COVER PLATE IS REMOVED.**

7. **SHOULD ANY DIFFICULTIES ARISE DURING DISMANTLING CONTACT WEIR MINERALS EUROPE LIMITED FOR ADVICE.**

INSTALLATION OF PUMP UNITS

Bedplates:
Before despatch from the factory the pump and its driving unit are erected on a common bedplate which in turn is supported on a level assembly bed. Pump and driving units which share the same bedplate have their driving and driven shafts aligned while the set is mounted on the assembly bed.

Uneven foundations on site such as concrete plinths can cause the bedplate to distort. To alleviate distortion, the foundation surface should be levelled as described in **'Levelling a Common Bedplate'.**

Foundations:
Efficient pump service can only be obtained by installing the pump on steel and concrete foundations designed to take all loads from the pump and motor and to absorb any vibrations.

During the preparation of the foundation block, holes should be cast into the concrete to accommodate the pump securing bolts. Refer to general arrangement drawing for foundation centres.

The top surface of the block should be left rough for keying the final grout.

Depth of foundations should be designed to suit nature of ground.

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 basic frame when the pump and pump base are installed.

Levelling a Common Bedplate:
Position the securing bolts through the holes in the bedplate and adjust the nuts to a full nut depth.

Mount the bedplate complete with pump and driving unit, onto the foundation block.

For large pump units i.e.; Pump, Gearbox, Variable speed Drive and Electric Motor it is strongly recommended that all items are removed from the bedplate prior to mounting.

Support with iron or steel packing pieces placed at frequent intervals between the underside of the bedplate and the top surface of the foundation block. Sufficient pieces must be used to support the bedplate without distortion. In addition at least one piece must be placed each side of each securing bolt. Check the bedplate level using an engineer's level and adjust to within 0.05mm in 254mm. This is achieved by shimming the gap with packing pieces. Ensure that each packing piece is supporting the bedplate.

When the bedplate is level, grout in the securing bolts.

When the grout has set, gently but firmly tighten the securing bolts. Care must be taken not to distort the bedplate or loosen the securing bolts in the grout by excessive tightening.

If previously removed mount all items onto the bedplate.

Check the alignment of the pump and its driving unit. See **Section WP2 'ALIGNMENT'.**

When both the bedplate level and the shaft alignment are satisfactory the final finishing grout can be run-in and the concrete plinth finished off.

ALIGNMENT AND TENSIONING - V BELT DRIVE

General:
When belt driven, the pump and motor shafts should be accurately aligned.

In belt drives, non-parallel shafts cause excessive belt wear.

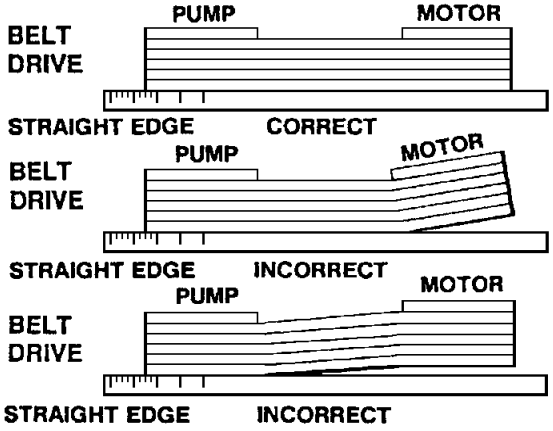


Fig. 1. BELT ALIGNMENT

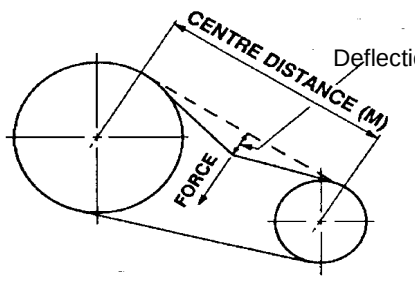
Alignment:
Before fitting the drive belt ensure the following details are adhered to.
Clean any oil or grease from the pulleys. Remove any rust or burrs from the grooves.
Reduce the centre distance by jacking the motor towards the pump using the jacking bolts supplied, until the drive belt can be put 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. Refer to Figure.1 Above.

Tensioning:
Proper tensioning of the belt drive ensures a longer life for both the belt and the roller bearings. Rotate the drive while tightening the belt in order to equalise the tension. The high performance required from a modern belt drive cannot be achieved without correct tensioning. To check the belt for correct tensioning refer to Fig. 2 below and proceed as follows: -

- Measure the centre distance (M)
- Apply a force at right angles to the belt at the mid point of the centre distance to deflect one belt by the required deflection.

  Deflection (mm) = Centre distance (m) x 16
- 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.



Deflection 16mm per one metre of centre distance

Fig. 2 BELT TENSIONING.

A new belt drive should be tensioned to the higher value stated (1.25 x setting forces) to allow for the normal drop in tension during the running in period.

After the drive has been running for thirty minutes, the tension should be rechecked and readjusted to the higher value.

Tensioning Forces:

Belt Section	Setting force to deflect belt 16mm per metre of span				
	Small Pulley Diameter (mm)	Basic setting forces Newtons (N)	Kilograms (kg)	1.25 x setting forces Newtons (N)	Kilograms (Kg)
SPZ	56 to 71	16	1.6	20	2.0
	75 to 90	18	1.8	22	2.2
	95 to 125	20	2.0	25	2.5
XPZ & QXPZ	over 125	22	2.2	28	2.8
SPA	80 to 100	22	2.2	28	2.8
	106 to 140	30	3.0	38	3.9
	150 to 200	36	3.7	45	4.6
XPA & QXPA	over 200	40	4.0	50	5.1
SPB	112 to 160	40	4.0	50	5.1
	170 to 224	50	5.1	62	6.3
	236 to 355	62	6.3	77	7.9
XPB & QXPB	over 355	65	6.6	81	8.3
SPC	224 to 250	70	7.1	87	8.9
	265 to 355	92	9.4	115	12.0
QXPC	over 375	115	12.0	144	15.0

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

Over Tensioning:
Over tensioning of the drive belt can shorten the drive belt life. Furthermore bearings will overheat due to excessive radial forces on the rolling elements and this will lead to premature bearing failure.

Adjustment:
After the drive has been running for thirty minutes, the tension should be rechecked and readjusted to the higher value. The drive should then be subsequently checked at regular maintenance intervals.

DRIVE ALIGNMENT AND TENSIONING OF POLY-V RIBBED BELTS

General

The correct installation, alignment and tensioning are critical to the life of the drive belts, pulleys and bearings. Pulley grooves should be in good condition, clean and free from sharp edges.

Alignment

- Isolate the power supply to the equipment before removing the drive guards to gain sufficient access to the drive.
- Mount the pulleys as close as possible to the bearings.
- The axial misalignment of the pulleys must not exceed 3mm per metre of centre distance.
- The angular misalignment of the driven and driver shafts must not exceed ½°.
- Laser alignment devices are available. Alternatively use a straight edge across both motor and pump pulley faces. Adjust the shafts and pulleys to obtain full contact between the straight edge and the pulley faces.

Initial Tensioning of a New Poly-V Ribbed Type "M" Belt

- Reduce the centre distance by moving the driving pulley towards the pump, using the jacking bolts supplied, until the drive belt can be put onto the pulley grooves without the use of force. Increase the centre distance to remove any initial belt slackness, but do not tighten.
- Draw two lines, one metre apart, perpendicularly across the outer surface of the belt. For centre distances less than one metre, reduce the separation to about 80% of the centre distance.
- Tension the belt using the jacking devices provided, rotating the drive slowly to equalise the tension, until the distance between the two lines has increased by 1% (10mm for lines initially 1m apart).
- The 1% elongation is only used for the first tensioning, to satisfy the initial stretching of the belt.
- Always maintain alignment during this operation.
- Run the drive under load and listen for a squealing noise emitting from the belt, particularly during start-up.

NOTE: A squealing noise will signify that the belt is slipping and requires more tension. A visual indication of low tension is that the 'slack side' of the belt will vibrate substantially more during start-up.

THE DRIVE MUST BE STOPPED IMMEDIATELY AND RE-TENSIONED.

- Re-start the drive and closely monitor the belt for signs of slippage during the first 60 minutes. It is during this period that the belt will stress relieve itself. Stop and re-tension if necessary.
- Re-start and run the drive for 24 hours, stopping and restarting after 5-6 hours, continually checking for sign of slippage as outlined above.

Re-tensioning a Poly-V Ribbed Type "M" Belt after Run-in Period

- After a 24 hour run-in period, the elongation of the belt should be reduced from the initial tension setting, to avoid overloading of motor and pump bearings. This method also applies to re-tensioning where necessary.
- First measure the distance between the lines on the belt. This should always be less than 1010mm.
- Remove the belt tension and remark two new lines 1m apart on the outer surface of the belt as above.
- Re-tension the belt using the jacking devices until the distance between the two lines has increased by 7mm.
- Always maintain alignment during this operation.

Re-start the unit and check visually the vibration on the 'slack side' of the belt; increase tension slightly if required.

ALIGNMENT - DIRECT COUPLED DRIVE

General:
In 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 Weir Minerals Europe Limited.

The following procedures outline the recommended practice given in BS 3170 1972 (Appendix) 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 0.04mm or better as measured on a Dial Test Indicator (DTI).

Couplings should be loosely coupled, each half must be free to move relative to the other or the resulting DTI 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 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: -
Isolate the driving unit from the power supply.

Refer to Fig. 3 and clamp two Dial Test indicators (DTI) at diametrically opposite points (180°) on one half coupling, with the plungers resting on the back of the other half coupling.

Rotate the couplings until the gauges are in line vertically, and set the gauges to read zero.

Rotate the couplings through a half (180°) revolution and record the reading on each DTI. The readings should be identical though not necessarily zero because of possible end float. Either positive or negative readings are acceptable provided that they are equally positive or negative. Refer to paragraphs headed 'Tolerances' for the maximum allowable tolerance and adjust the position of one of the units if necessary.
Rotate the couplings until the gauges are in line horizontally and reset the gauges to read zero.
Repeat operation and adjust the unit position until the correct tolerance is achieved and no further adjustment is necessary.

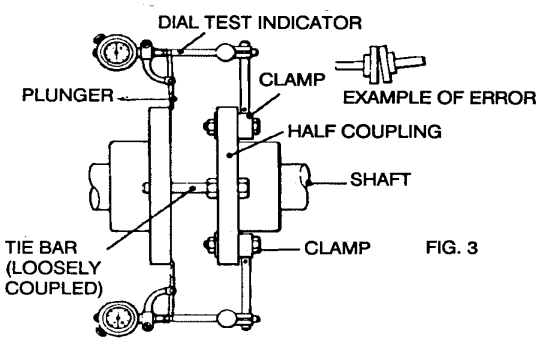
Radial Shaft Alignment
To ensure correct Radial Shaft Alignment proceed as follows: -

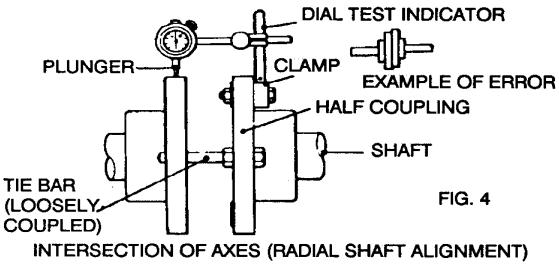
Isolate the driving unit from the power supply.
Refer to Fig. 4 and clamp one DTI on one half coupling, with the plunger resting on the rim of the other half coupling.

Set the gauge to read zero.

Rotate the couplings through a quarter (90°) revolution and record the reading on the DTI. Repeat for each quarter (90°) revolution. 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 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 and speed of units, but the following variations which can be tolerated when checking alignment, are suggested.

Semi Rigid Couplings

(a) Angular Alignment:
Couplings up to 300mm dia 0.05mm
Couplings more than 300mm dia 0.07mm

(b) Radial Alignment:
Not to exceed 0.1mm on micrometer dial gauge. (I.e. 0.05mm eccentricity).

Flexible Couplings
Consult Manufacturers Literature

INSTALLATION OF PIPEWORK

Pipework:
No strain should be imposed on the pump casing either by weight of pipes or by tightening badly fitted pipes. Experience has shown that such strain can seriously affect the alignment of the pumping unit.
All pipework attached to the pump must be the correct size and fully supported. The mating faces of the pipe flanges must abut squarely, with all bolt holes in line. In joining the pipework to the pump on no account should excessive force be used as this could result in damaged castings and flange damage.

A removable piece of pipe (preferably flexible on the intake side) should be fitted to the intake and discharge pipework. The removable intake/discharge pipes should be of sufficient length to allow removal of the casing for easy access when renewing worn parts.

IMPORTANT: WHEN USING DREDGE AND GRAVEL PUMPS ON FLOATING INSTALLATIONS BOTH INTAKE AND DISCHARGE FLANGES OF THE PUMP SHOULD BE CONNECTED TO FLEXIBLE PIPES. THIS ALLOWS FOR NATURAL MOVEMENT BETWEEN THE LONG LENGTHS OF FLOATING PIPEWORK AND THE FIXED PUMP FLANGES. FURTHERMORE VIBRATIONS NORMALLY TRANSMITTED TO THE PUMP WILL BE ABSORBED BY THE FLEXIBLE PIPEWORK.

Intake Conditions:
Suitable isolation should be fitted in the intake pipe as near to the pump as possible.

THE INTAKE PIPE MUST BE FULLY SUPPORTED.

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 of liquid must be of a larger bore than a short straight one passing the same quantity of liquid.

When the bore of 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 the formation of air pockets, the installation of intake pipework must be arranged under the following conditions:-

(a) With as few bends as possible

(b) Completely airtight

(c) Taper at the bottom (see Fig.5)

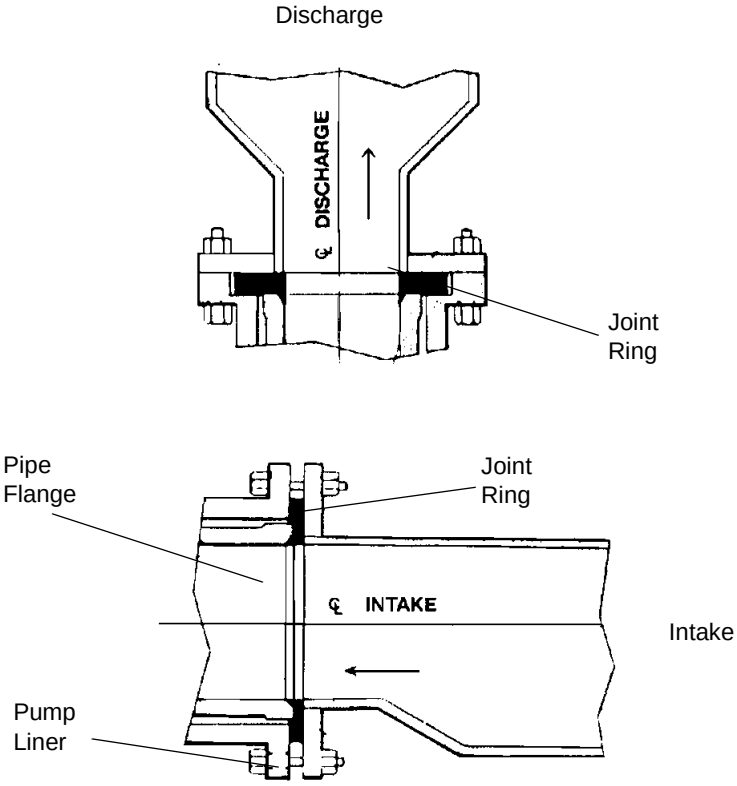
Delivery Conditions:
Suitable isolation should be fitted in the delivery pipe as near to the pump as possible.

THE DISCHARGE PIPE MUST BE FULLY SUPPORTED.

IMPORTANT: WHEN PIPING UP THE INTAKE AND DISCHARGE FLANGES OF THE PUMP IT IS IMPERATIVE THAT THE APPROPRIATE WEIR MINERALS JOINT RINGS BE USED. THE JOINT RINGS FORM AN EFFECTIVE SEAL BETWEEN PIPEWORK AND PUMP FLANGES.

IMPORTANT: CARE SHOULD BE TAKEN NOT TO OVERTIGHTEN THE FLANGE BOLTS THUS PREVENTING DAMAGE TO THE JOINT RINGS.

From Fig 5 it can be seen that the Weir Minerals Joint Rings are compressed between the pump liner and the pipe flange. Therefore it is essential to manufacture intake and discharge pipe flanges with the bore the same as the pump.



JOINT RING (TYPICAL ARRANGEMENT) FIG. 5

COMMISSIONING CHECKS

Before any pump is brought into service during initial commissioning or re-commissioning after overhaul, all pipework associated with the pump should be flushed through. The following set procedure should then be carried out:-

Motor Rotation Check:
REMOVE ALL BELTS
DISCONNECT SHAFT COUPLING

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

Start motor, check rotation and correct if necessary to produce pump shaft rotation indicated by arrow on pump casing or bearing cartridge.
Refit belts. When tensioning belts maintain shaft alignment. See Section WP2 'ALIGNMENT'.
Reconnect shaft coupling.

Shaft Rotation:
The shaft should be rotated by hand to ensure that the impeller turns freely within the pump.
At any indication of fouling, the impeller must be adjusted. See Section WP6 'FRONT IMPELLER ADJUSTMENT'.

SEAL OPTIONS

1. Shaft Seal Check: Gland Seal
Full Flow: Restricted Flow: Low Flow

See Section WP6 'PUMP ASSEMBLY'
Check gland seal water is available and that it is of sufficient quantity and at the correct pressure.
In solids handling pumps, gland water pressure should be approximately 5 p.s.i. (0.35 kg/cm²) above pump discharge pressure. The following flow rate should be provided at the tapping in the stuffing box.

FLOW RATE

FRAME	Full (Litre/Second)	Restricted (Litre/Second)	Low (Litre/Minute)
A	0.15	0.07	0.8
B, N, NP	0.25	0.10	1.0
C, P	0.35	0.12	1.5
D, Q	0.55	0.15	2
E, R	0.70	0.20	4
F, SHH	1.00	0.26	6
G, FAH, FAM, ST, S, T	1.67	0.43	9
H, GAH, GAM, TU	2.00	0.57	11
U	3.08	-	17

Slacken off gland and adjust it so that a small flow is obtained along the shaft. Note that pumps supplied by Weir Factories usually have tight glands to minimise shaft vibration during transport. It is therefore necessary to slacken off gland bolts prior to starting the pump.

Gland sealing water must be left on during all operations. Including pump start up, and running.

NOTE: With the aging and deterioration of a pump gland, the required GSW Flowrate can be up to three times (3x) higher than listed above. Any design of a GSW supply system should take this higher flowrate into account.

2. Shaft Seal Check: Centrifugal Seal
See Section WP6 'PUMP ASSEMBLY'

Centrifugally sealed pumps fitted with metal expeller ring, lubricate the static seal chamber.
Two complete turns of the grease cup is recommended.

3. Shaft Seal Check: Mechanical Seal

For mechanically sealed pumps refer to seal manufacturers instructions.

Priming Procedure - Caution
A centrifugal pump is not self priming and must always be primed before operating. If it fails to generate its rated delivery head on starting. It must be stopped immediately, the fault rectified, and the pump re-primed before re-starting.

Pumps Operating on Positive Inlet Head:
To prime the pump, fully open the inlet isolating valve.

Pumps Operating on Negative Inlet Head:
A priming device must be used.

STARTING PROCEDURE

Normal practice whenever possible is to allow pumps to operate on water only for a short period before introducing solids or slurry into the system.

Before attempting to start up the pump carry out the check list below:-

Test and make available any alarm signals, interlock systems, and any other protective devices incorporated in the pumping system.

Open all ancillary inlet and outlet isolating valves to cooling systems.

Ensure that the shaft seal is serviceable.

Ensure that sufficient fluid is available at the inlet pipe to satisfactorily prime the pump.

Ensure that the inlet isolating valve is fully open.

Shaft Seal Check: Mechanical Seal

For mechanically sealed pumps refer to seal manufacturers instructions.

WARNING: PUMPS FITTED WITH MECHANICAL SEALS MUST HAVE THE SEAL CHAMBER VENTED TO ENSURE AIR IS NOT TRAPPED IN THE VICINITY OF THE SEAL FACES.

Ensure that the delivery valve is approximately 10% open. This reduces the load on the shaft seal.

PUMP START UP
When all foregoing procedure checks are satisfactory, depress the appropriate **'START PUMP'** push button on the control panel and run the pump up to its rated speed.

OPERATIONAL CHECKS

Running:
When the pump has attained its full operating speed the Following checks must be made:-

That the pump is rotating in the correct direction as Indicated by the directional arrow.

That the pump is generating not less than its rated Delivery head.

If the pump fails to generate at least its rated delivery head It must be stopped immediately, the cause ascertained, the fault rectified and the pump re-primed before re-starting. See Section WP3 'FAULT FINDING CHART'.

If the foregoing checks are proved to be satisfactory, open the delivery valve slowly and bring the pump gradually up to load.

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

CHECK THAT THE DRIVING UNIT IS NOT BEING OVERLOADED.

Overloading may 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.

1. Gland Leakage Check: Gland Sealed
If leakage is excessive tighten gland nuts until flow is Reduced to required level. If leakage is insufficient and gland shows signs of heating then loosen the 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 may be loosened to such an extent that the gland follower is allowed to disengage from the stuffing box.

At low pressure (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.

At high pressure (multi-stage operation) allow sufficient leakage to keep the glands cool.
A trickle of water should be sufficient.

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.

It is not essential to stop a pump because of gland heating unless steam or smoke is produced.

When initial heat up of the gland is encountered it is usually only necessary to stop the pump for a short time and allow the gland to cool. This may have to be carried out several times before the packing beds in correctly.

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

During the first 8 hours running, gland bolts should be adjusted to give optimum leakage.

High pressure operation may require a longer period of time before optimum leakage is achieved.
It is recommended that the gland follower nuts are tightened by a 1/4 TURN each hour to achieve optimum and maximum packing life.

2. Gland Leakage Check: Centrifugal Seal
During operation no gland leakage should occur to a centrifugally sealed pump. If leakage is occurring and persistent, consult Weir Minerals Europe Limited. A slight drip will occur from the gland during normal shutdown. Should the leakage be excessive during the shutdown period, first lubricate the gland by rotation of the grease cup. Two complete turns is recommended. If the gland still leaks adjust the gland nuts to the required tightness. If the gland leakage still persists repack the complete stuffing box.

Weir Minerals Europe Limited can supply all recommended packings in individual blocked rings, cut to length and moulded to the correct size for each type of pump.

3. Shaft Seal Check: Mechanical Seal
For mechanically sealed pumps refer to seal manufacturers instructions.

OPERATIONAL FAULTS

START UP

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

Blocked Intake Pipe:
When the pump has been inoperative for some time it is possible for slurry to settle in or around the intake pipe. This prevents the liquid rising to the pump impeller.

Faulty Inlet Valve:
Check valve is fully open.

Air Entering Gland:
Air may be induced into the pump through the gland for one or more of the following reasons listed below. This may prevent the pump 'picking up' its prime or cause it to lose its prime during operation.

(a) Sealing water pressure low.

(b) Sealing water quantity low.

(c) Gland sealing water connection into stuffing box is blocked.

(d) Packing is excessively worn.

(e) Shaft sleeve is excessively worn.

RUNNING

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

CHECK THAT THE DRIVING UNIT IS NOT BEING OVERLOADED.

Overloading may 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.

Blocked Intake Pipe:
It is possible during operations for foreign matter to be drawn across the bottom of the intake pipe thereby causing 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 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 certain size particles.
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 motor current and a drop in both discharge pressure and suction vacuum readings. Pump vibration may 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 to low to adequately transport the solids. Such a blockage will be shown up by a rise in discharge pressure, and a drop in both motor current and suction vacuum readings.

SHUT DOWN PROCEDURE

Normal practice whenever possible is to allow pumps to operate on water only for a short period to ensure the system is clear before shut down.

SHUT DOWN
Close the delivery valve to reduce the load on the driving unit.

Depress the appropriate 'STOP PUMP' push button on the control panel.

Gland sealing water must be left on during all operations, including shutdown and run back.

Close ancillary inlet and outlet isolating valves to cooling systems.

When all ancillary supplies have been isolated it is advisable to close the inlet isolating valve.

EMERGENCY SHUT DOWN
Depress 'STOP PUMP' push button.

MAINTENANCE PROCEDURES

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. However, regular observation checks by the operator can minimise the risk of costly stoppages.

Shaft Seal Care

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

Maintenance personnel should inspect gland packings at regular intervals, not longer than six months (1800 hours) to determine when packings need to be changed.

Weir Minerals Europe Limited can supply all recommended packings in individual blocked rings, cut to length and moulded to the correct size for each type of pump.

2. Centrifugally sealed pumps:
Fitted with metal expeller ring, lubricate the static seal chamber. Two complete turns of the grease cup per 12 hours running time is recommended.

Maintenance personnel should inspect gland packings at regular intervals, not longer than six months (1800 hours) to determine when packings need to be changed.

Weir Minerals Europe Limited can supply all recommended packings in individual blocked rings, cut to length and moulded to the correct size for each type of pump.

3. Mechanically Sealed Pump

For mechanically sealed pumps refer to seal manufacturers instructions.

Front Impeller Clearance

Warman pump performance is inversely proportional to the clearance between the impeller and the intake liner. This is more pronounced with an open impeller.

With wear, the clearance increases and pump efficiency drops. For best performance it is necessary, therefore to stop the pump occasionally and adjust the forward impeller clearance. See section WP6 'FRONT IMPELLER CLEARANCE ADJUSTMENT'.

This adjustment can be carried out without any dismantling of the pump.

Before restarting, check that impeller turns freely and that bearing housing clamp bolts are tight.

Bearings

Maintenance personnel should open bearing housings at regular intervals (not longer that twelve months) to inspect bearings, lubricant and to determine each time the course of action and the period for the next inspection.

Wearing Parts Replacement

The wear rate of a solids handling pump is dependant on 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.

Wearing parts must be replaced when the performance of a given pump no longer satisfies the requirements of a particular installation. 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 see appropriate sections of this manual.

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 a week. In this way all the bearing rollers in turn are made to carry static loads and external vibrations. Alternatively run all pumps at weekly intervals.

LUBRICANTS

(a) Bearings
The recommended initial quantity of grease to be used for Each bearing is as follows:

Pump Frame	Grams / Bearing	
	DRIVE END	**WET END**
N / NP	**40**	**65**
CC / P / PQ	**80**	**100**
DD / Q / QR	**160**	**250**
EE / R / RS	**350**	**500**
FF / S / ST	**550**	**600**
GG / T / TU	**800**	**1600**
U / UV	**1300**	**3000**

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

A lithium-based soap in mineral oil with oxidation inhibitor, rust preventative and E.P. Chemical agent.

N.L.G.I. Constancy No	-	2
Drop point, °C ISO 2176	-	177 min
Worked penetration, 1/10 MM, ISO 2137	-	265-295

PRE-PACKED BEFORE DESPATCH WITH:-
FUCHS RENOLIT EP2

(b) Centrifugal Seal (where applicable)

It is recommended that the lubricating grease used in the centrifugal seal chamber should have the following characteristics:

A calcium-based soap in mineral oil with oxidation inhibitor and rust preventative.

N.L.G.I. Constancy No	-	4
Drop point,°C, ISO 2176	-	90.5
Worked penetration,1/10 MM, ISO 2137	-	175-205

PRE-PACKED BEFORE DESPATCH WITH:-
FUCHS CENTAURUS 4

EXAMPLES OF PROPRIETARY BRANDS OF LUBRICANTS RECOMMENDED BY WEIR MINERALS EUROPE LIMITED

THE ORDER OF MENTION HAS NO PREFERENTIAL CONNECTION
(The correct amount of lubricant detailed above is pre-packed in the bearing assembly prior to despatch from the factory)

SUPPLIER	GREASE (BEARINGS)	GREASE (CENTRIFUGAL SEAL)
Burmah Oil (Castrol)	Castrol Spheerol EPL2	Castrol Spheerol LG
Esso Petroleum Co Ltd	Beacon EP2	R111
Mobil Companies	Mobilux EP2	Mobilgrease Graphited No. 3 or Mobil-plex special
British Petroleum	Energrease LS EP2	Energrease C3-G
Texaco Ltd	Multifak EP2	Cup Grease 3
Shell UK Ltd	Shell Alvania EP2	Shell Barbatia 4 or Shell Alvania R3
Century Oil	Regulus A2 EP	Centaurus 4

It is recommended that before one of the above lubricants is used as an alternative, the associated housing should be flushed out prior to packing with new grease.

PERIODIC LUBRICATION

Shaft Seal Lubrication (Centrifugal Seal) - where applicable
A correctly packed gland will have a long, trouble free life, provided it is adequately maintained.

Check grease Staufer daily and top up as necessary.

Lubricate the static seal chamber. Two complete turns of the grease cup per 12 hours running time is recommended to enable the grease to form an adequate seal at the packing rings.

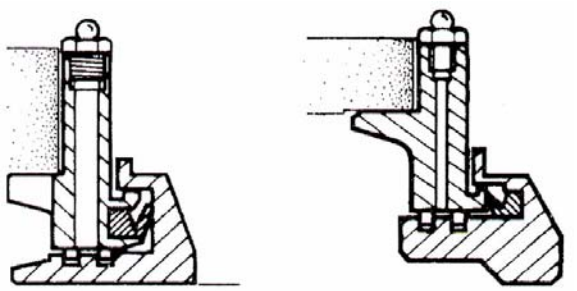
Use only recommended clean lubricant. See Section WP3 'LUBRICANTS'.

Bearing Lubrication
A correctly assembled and lubricated 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.

Maintenance personnel should open bearing housings at regular intervals (not longer than twelve months) to inspect bearings, lubricant and to determine each time the course of action and the period for the next inspection.

Labyrinth Seal Purging

The figure on the right shows the
principle of labyrinth seal assembly with grease purge.



To improve the sealing properties of the labyrinth at both the wet end and the drive end of the bearing assembly, a grease nipple and radially drilled hole in the end cover allows grease to be forced into the space between the piston rings.

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.

Less contaminants entering the bearing assembly will result in longer bearing life and ultimately considerable cost saving. Therefore careful attention to labyrinth purging is an essential maintenance requirement.

In order to maintain labyrinth sealing, grease should be injected into each grease nipple on the end cover.

Use only recommended clean lubricant. See Section WP3 'LUBRICANTS'.

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

Principle of labyrinth seal assembly with grease purge.

Suggested intervals based on normal conditions for grease purging of the labyrinth are tabulated below and intended as a guide. Very dirty or damp atmospheric conditions would require that the recommendations be stepped up to a level that prevents contaminants from entering the bearing assembly. The colour and condition of the purged grease may be used as a guide to varying the intervals.

RECOMMENDED INTERVALS FOR LABYRINTH GREASE PURGING

	Continuous (24h) operation	**16h Operation per day**	**8h Operation per day**
DRIVE END LABYRINTH	4 shots every	4 shots weekly	2 shots weekly
	120 hours		

* Shots are from a standard hand operated grease gun.

The end cover grease nipple can be replaced with an automatic grease feeder of: -
1 months capacity.

If an automatic grease feeder is used it must be regularly inspected so that it can be replaced before it is fully discharged.

SectionWP3
Fault Finding Chart

FAULTS	SYMPTOMS	Discharge failure	Reduced discharge delivery	Insufficient pressure	Pump loses prime	Excessive horsepower required	Leakage from stuffing box	Packing has short life	Vibration and noise from pump	Short life of bearings	Overheating or seizure of pump	Hopper Overflows
INTAKE FAULTS	Pump not primed.	■									■	■
	Pump or intake pipe not completely filled with liquid.	■	■		■				■			
	Suction lift too high.	■	■		■				■			
	Insufficient margin between intake pressure and vapour pressure.	■	■						■		■	
	Excessive amount of air or gas in liquid.		■	■	■							■
	Air pocket in intake line.	■	■		■							
	Air leaks into intake line.		■		■							
	Air leaks into pump through stuffing box.		■		■							
	Foot valve to small.		■						■			
	Foot valve partially clogged.		■						■			
	Intake pipe insufficiently submerged.	■	■		■				■			■
	Blocked intake.	■	■		■							■
	Intake pipe diameter too small or length of intake too long.	■	■		■							■
SYSTEM FAULTS	Speed to low.	■	■	■								■
	Speed to high.		■			■						
	Wrong direction of rotation.	■	■	■		■						■
	Total head of system higher than design head.	■	■	■		■						■
	Total head of system lower than design head.					■						
	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.	■	■	■	■				■			■
MECHANICAL FAULTS	Misalignment.					■	■	■	■	■	■	
	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 to 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 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 FAULT**

BEARINGS

Bearings and shaft should be kept clean at all times. Mild steel drifts only should be used when tapping bearings into position. Brass or copper drifts should NOT be used.

Check that shaft and shoulders are clean and free from burrs.

Before fitting bearings apply a smear of light lubricating oil to the bearing landings on the shaft.

Weir Minerals Europe Limited and related companies recommended the use of an induction heater to shrink bearings on to the shaft. The temperature for the heater should be 100°C.

For companies without an induction heater the following process should be used.

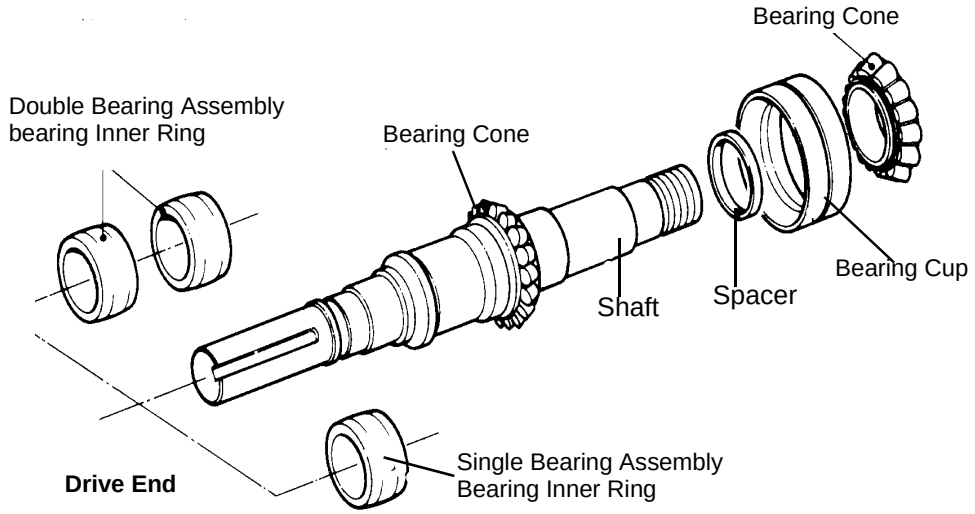
Pre-heat both bearings by immersion in clean oil at a temperature of approximately 100°C. Ensure that the bearings do not touch the bottom of the container.

NOTE: The bearing fitted at the impeller end is provided with spacers and as such is a pre-set assembly. The spacers are finished to size for each bearing assembly and component parts from one assembly are NOT interchangeable with those of a similar assembly. Because the component parts of both large and small bearing assemblies are matched to each other, they cannot be interchanged with similar components from other assemblies and should be kept in sets and assembled as received. Large bearing assemblies have an identifying serial number marked on each cup, cone and spacer.

Replacement of Impeller End Bearing Cone
Remove assembled bearing from packaging, separate into individual components and heat both cones using either of the methods described opposite. After heating, shrink one cone onto the shaft together with a spacer and the cup. Repeat the procedure and shrink the second cone onto the shaft. It is important that the cones and the spacer are located firmly against each other and that the complete assembly is hard against the shaft shoulder. When the assembly is cool tap it with a mild steel drift to ensure that it is tight against the shoulder.

Replacement of Drive End Single Bearing
After heating, shrink the inner ring bearing onto the shaft and tight against the shaft shoulder. Use the mild steel drift to drive the bearing ring against the shaft shoulder.

Replacement of Drive End Double Bearing
After heating, shrink both inner ring bearings onto the shaft and tight against the shaft shoulder. Use the mild steel drift to drive the bearing rings against the shaft shoulder.



BEARINGS

Inspect the bore of the bearing housing for radial score marks and cleanliness.

Apply clean lubricating oil to the bore at each end of the bearing housing.

Replacement of Drive End Single Bearing
Insert the outer bearing race into the drive end of the bearing housing. Tap it with a mild steel drift to ensure that it is firmly located against the housing shoulder.

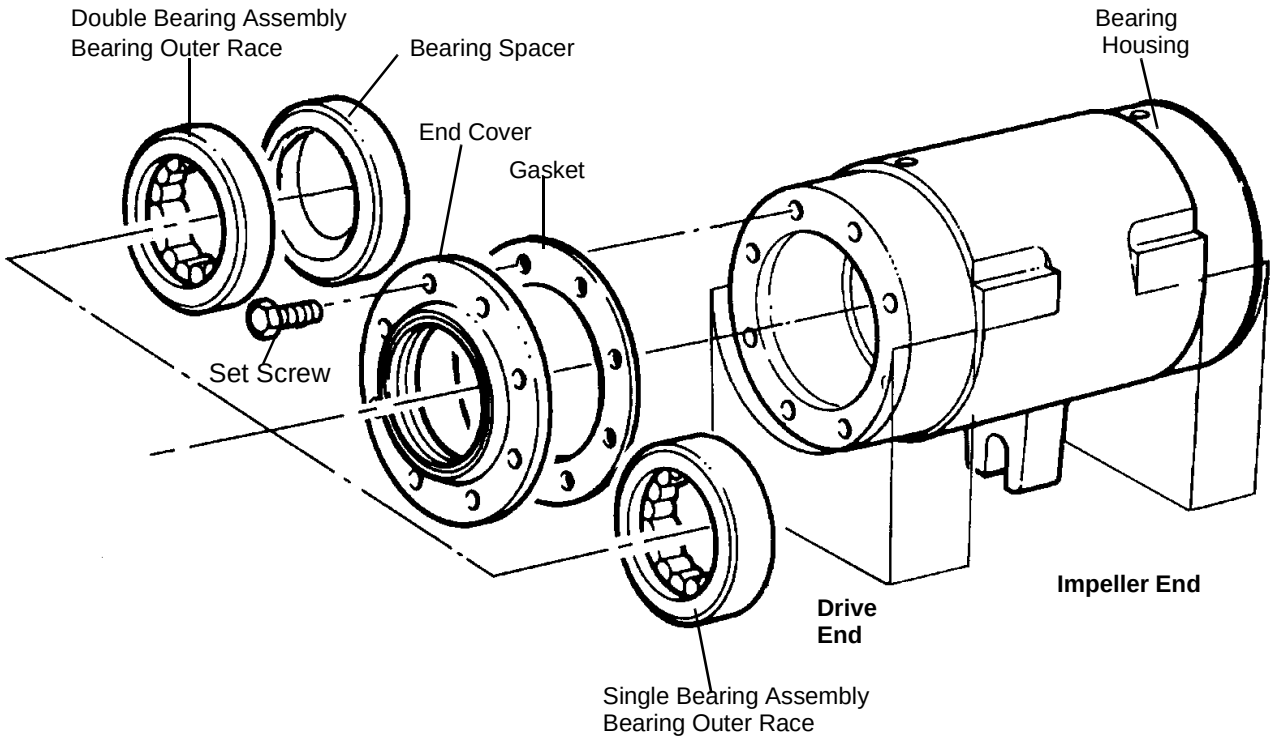
Position the end cover and gasket against the housing. Insert the end cover set screws and evenly tighten them to secure the end cover.

Replacement of Drive End Double Bearing Cup
Insert the outer bearing spacer and then the outer bearing race into the end of the bearing housing.
Tap them with a mild steel drift to ensure that both are firmly located against each other and against the housing shoulder.

Position the end cover and gasket against the housing. Insert the end cover set screws and evenly tighten them to secure the end cover.

Lubrication
See Section WP3 'LUBRICANTS' for recommended grease lubricant and initial quantity.

Work the grease by hand into the drive end bearing from both sides. Work any remaining grease into the space behind the end cover.



SHAFT AND BEARINGS IN HOUSING

Inspect the bore of the housing for radial score marks and cleanliness.

Lubrication
See Section WP3 'Lubricants' for recommended grease lubricant and initial quantity.

Work the grease by hand into the impeller end bearing from both sides until the grease appears through the holes in the cup.

Work any remaining grease into the space behind the end cover.
Insert the shaft assembly, drive end first, through the housing and locate the impeller end bearing against the bearing housing shoulder.

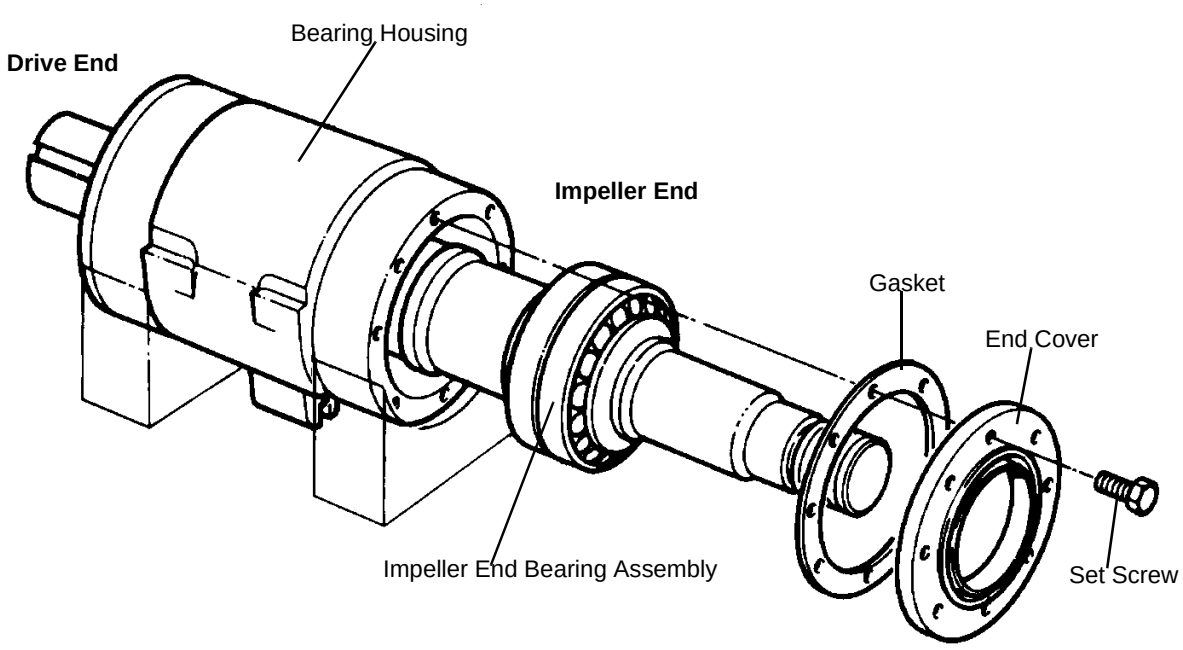
Whilst inserting the shaft continue to check the alignment of the drive end bearing.

Using a soft-faced hammer, gently tap the shaft into position.

When the bearing is in position, rotate the shaft to check alignment.

Position the end cover and gasket against the housing. Insert end cover set screws and evenly tighten them to secure the end cover.

Rotate the shaft several times to ensure no interference.



FITTING LABYRINTHS, PISTON RINGS, V RING SEALS AND LOCKSCREWS

Smear the shaft adjacent to the end covers with light grease.

Fit the V ring seal to each labyrinth, with the flat face towards the labyrinth. It will be necessary to stretch the seal to achieve this.

Ensure that the flat face of the seal is firmly against the labyrinth. See Section WP3 'LABYRINTH SEAL ASSEMBLY'.

Smear the piston rings with light grease and fit two rings to the grooves of each labyrinth, position ring gaps diametrically opposite.

Slide the impeller labyrinth over the shaft and push into the end cover until the piston rings prevent further entry.

Compress each piston ring in turn, push labyrinth fully into the end cover.

Slide the drive end labyrinth over the shaft and push into end cover until the piston rings prevent further entry.

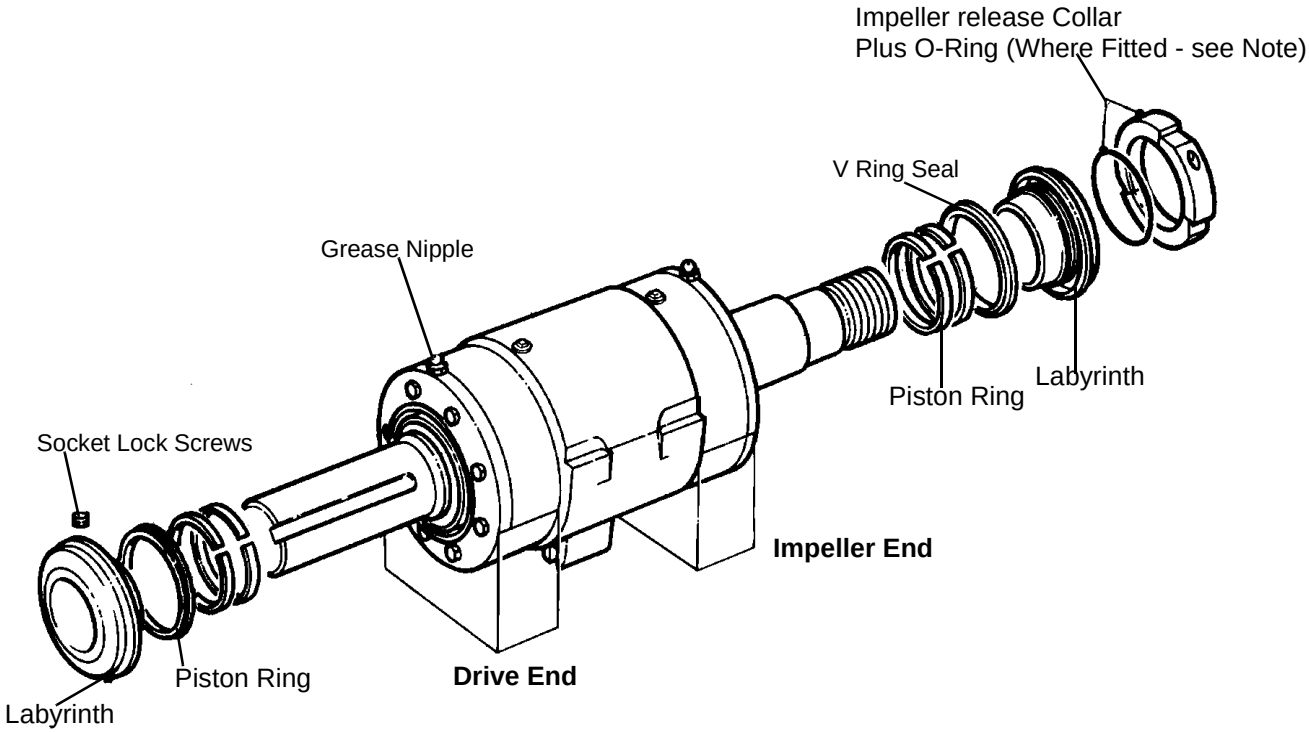
Compress each piston ring in turn, push labyrinth fully into the end cover.

Screw two socket lock screws into the drive end labyrinth to secure it to the shaft.

NOTE: Several of the larger pumps have an impeller release collar fitted. Joint the split release collar with its socket head capscrews and tighten up securely. Fit release collar and O-ring up to the labyrinth (flat face outwards towards the impeller threads).

Fit grease nipples to end covers.

The bearing assembly is now complete and called 'BEARING CARTRIDGE ASSEMBLY', part no. 005.



Issued: Sep2003

WEIR WARMAN LIMITED

WARMAN PUMPS

ASSEMBLY AND MAINTENANCE INSTRUCTIONS

SUPPLEMENT ‘P73’ (UK)

SUPER HEAVY DUTY GRAVEL PUMPS
TYPE 'SHG’

WARNINGS

Personnel injury and damage could result from not observing

A 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.) all related safety precautions must be followed and appropriate instruction manuals consulted before and during installation, operation, adjustment and maintenance. All guards for rotating parts must be correctly fitted before operating the pump including guards removed temporarily for gland inspection and adjustment.

•

Driver rotation must be checked before belts or couplings are connected.

•

Pump must not be operated 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.

•

No heat must be applied to impeller boss or nose. Shattering or exploding of the impeller may occur.

•

Do not feed very **hot or very cold** liquid into a pump, which is at ambient temperature.

•

Tapped Holes (for EyeBolts) and Lugs (for Shackles) on Warman Parts are for lifting individual parts only. **Lifting devices** of adequate capacity must be used wherever they are required to be used. Sound, safe workshop practices should be applied during all assembly and maintenance work. Personnel must not work under suspended loads.

•

The pump must be **fully isolated** before any maintenance, inspection or troubleshooting involving work on sections which are potentially pressurised (e.g. casing, gland, connected pipework) or involving work on the mechanical drive system (e.g. shaft, bearing assembly, coupling). Power to the electric motor must be isolated and tagged out. It must be proven that the intake and discharge openings are totally isolated from all potentially pressurised connections and that they are and can only be exposed to atmospheric pressure.

•

Castings made from the materials listed are brittle and have low thermal shock resistance. Attempts to repair or rebuild by welding may cause catastrophic failure. Repairs of such casting using these methods must not be attempted. A03, A04, A05, A06, A07, A08, A09, A12, A14, A49, A51, A210, A211, A217, A218.

•

Impellers must be tight on the shaft before any start-up i.e. all components on the shaft between impeller and wet end bearing must butt metal to metal against each other without any gap. Note that gaps may form when the pump experiences duty conditions conductive to unscrewing the impeller, such as excessive runback, intake pressure, motor braking etc.

•

Pumps have to be used only within their **allowable limits** of pressure and speed. These limits are depending on pump type, pump configuration and materials used.

•

This manual applies only to genuine Warman parts and Warman recommended parts.

ISSUED: SEP2003
LAST ISSUE: -

WARMAN PUMPS
ASSEMBLY AND MAINTENANCE INSTRUCTIONS
SUPPLEMENT 'P73' (UK)
SUPER HEAVY DUTY SLURRY PUMPS
TYPE 'SHG'

CONTENT

1. INTRODUCTION

Supplement 'P73' should be read in conjunction with the Warman Assembly and Maintenance Instruction Supplements.

This supplement contains step by step illustrated instructions for complete and correct assembly of Warman Super Heavy Duty Gravel Pumps - Types 'SHG'

ADVANTAGES & USES OF TYPE 'SHG' SUPER HEAVE DUTY GRAVEL PUMPS

The Warman centrifugal shaft seal is commonly used, but an interchangeable packed gland seal is also available for every pump.

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
- Impeller release collar
- Lifting lugs on all major components

BEARING ASSEMBLY - MAINTENANCE & ASSEMBLY INSTRUCTIONS

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

CENTRIFUGAL SEALING - LUBRICATION

In centrifugal sealed pumps, lubricate the static seal chamber sparingly but regularly, by means of the grease cup.

FITMENT OF PACKING IN A STUFFING BOX

The packing should be placed around the shaft sleeve and the scarf ends should be brought together. The joint should then be pushed into the annulus between the stuffing box and shaft sleeve. The rest of the packing should then be pushed into the annulus by starting near the joint and working around to the opposite side of the ring. Once the packing ring is started, push evenly all the way around the packing and gently push to the bottom keeping the packing as a ring.

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. All relevant Warman Basic Numbers are listed at the end of this supplement.

In all correspondence with Weir Warman 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.

2. Impeller Release Collar

PURPOSE OF THE IMPELLER RELEASE COLLAR

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 as unscrewing the impeller can present difficulties. The impeller release collar consists essentially of three segments forming a ring fastened together with socket head cap screws. One face is square and the other is tapered. Removing the segments is similar in effect to withdrawing a wedge. It loosens the impeller thread at the end of the pump shaft, which consequently allows easy unscrewing of the impeller.

INSTALLATION

The recommended assembly procedure is as follows:

1. Thoroughly clean protective coating from the IMPELLER RELEASE COLLAR (239) components.

2. Check to ensure the segments have no burrs or protruding dents; particularly on the two side faces butting Labyrinth and Shaft Sleeve.

The segments are not interchangeable. For this reason one of the three joints is marked with a centre punch on either side.

3. Form a ring by joining the segments with their socket head Cap Screws. Secure the Cap Screws with 'LOCTITE 222 SCREWLOCK' fluid or similar product. Tighten to the specified torque ±10%.

IMPELLER RELEASE COLLAR PART No.	CAP SCREW SIZE	RECOMMENDED TORQUE (Nm)
F239-1, FAM239, FG239-1, FRS239, S239	M10	20
G239, GG239, GH239, GK239, T239	M12	50
H239, HT239	M16	95
U239	M20	165

REMOVAL

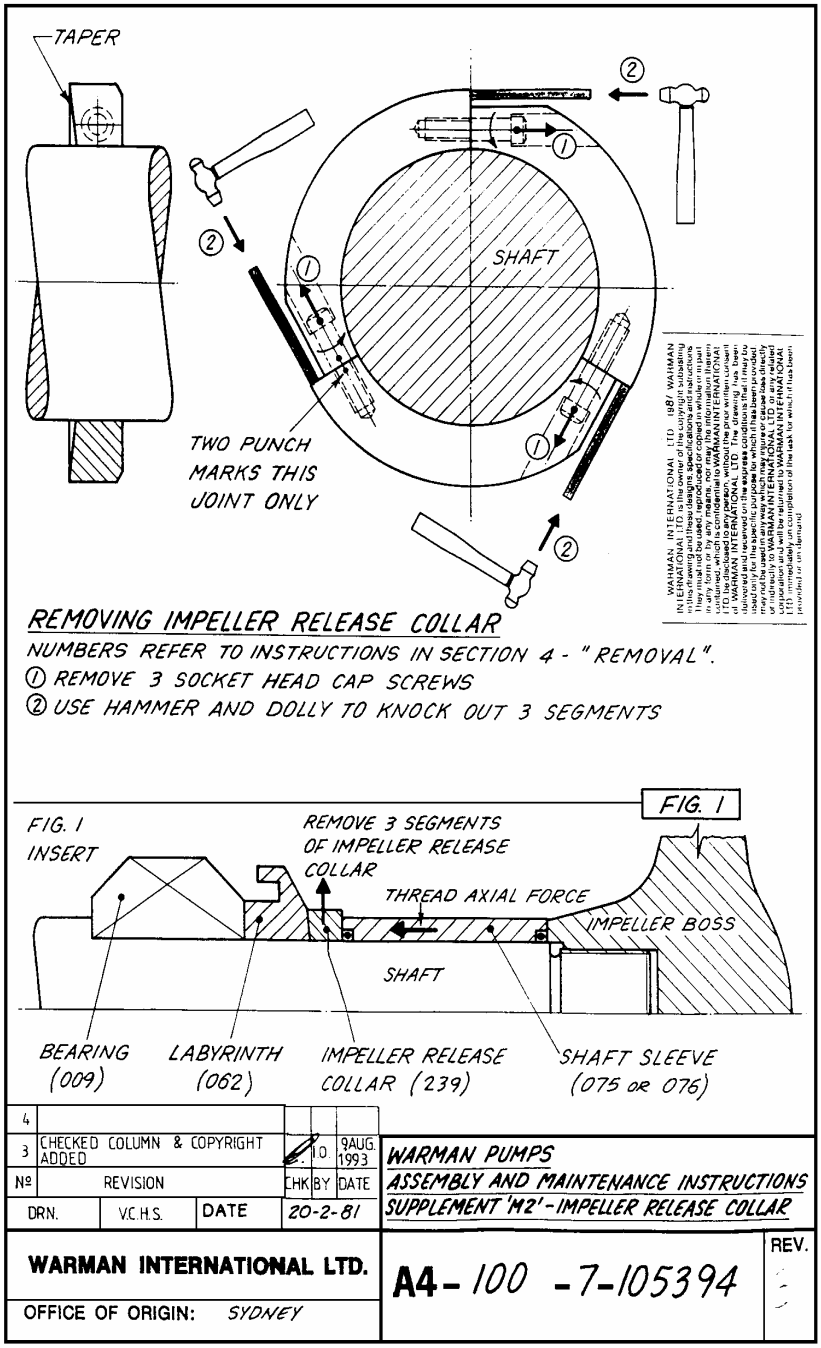
1. Remove the three socket head cap screws which hold the three segments together.

2. Using a dolly and hammer - apply blows to the end of each - refer to A4-100-7-105394.

Care should be exercised when hammering as excessively heavy blows may lead to brinelling of the bearings.

REUSE OF IMPELLER RELEASE COLLAR

Provided that the impeller release collar was not distorted or damaged - in particular the two side faces and tapped threads - then it may be cleaned and re-installed as described before.



3. 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 preferable 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.

FRAME ASSEMBLY

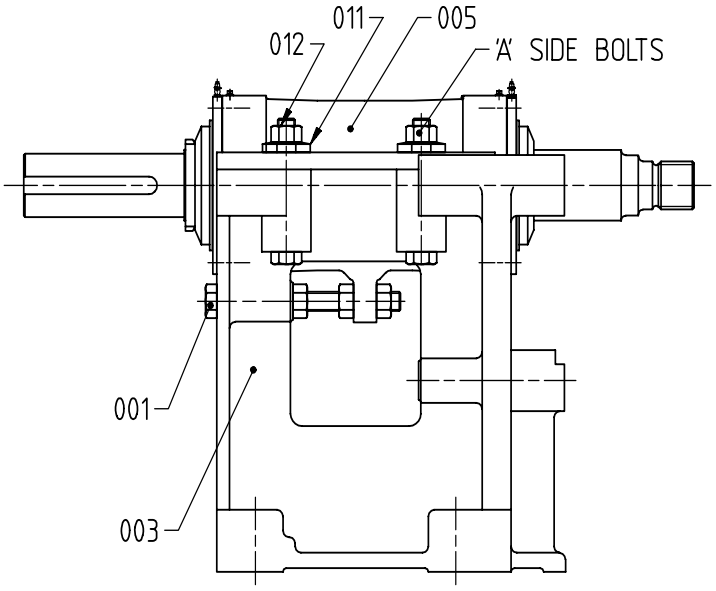


Figure 1

Fitting Bearing Assembly to Base

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.

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.

4. Check that the bearing housing lug has fitted over the adjusting screw in the base and is also between the nuts and washers.

5. Fit CLAMP BOLTS (012) through base from underneath. Drop CLAMP WASHER (011) the bolts (washers domed side up) and screw on nuts.

A-side of the pump: left hand side when looking from the intake of the pump
B-side of the pump: right hand side when looking from the intake of the pump

Fully tighten clamp bolts on A-side. The bolts on B-side should not be tightened for the time being. Leave snug only, to maintain alignment but allow axial movement.

6. 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.

7. 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.

WET END ASSEMBLY

Fitting Wet End Shaft Components

1. Mount and bolt the Base on wooden members or onto a suitable assembly cradle to allow assembly of wet end components and to prevent the pump tilting forward under its own weight.

2. Fit one SHAFT SLEEVE O-RING (109) onto Shaft against the Labyrinth.

3. Slide the assembled IMPELLER RELEASE COLLAR (239) onto Shaft. The *tapered* face of the Impeller Release Collar must butt the Labyrinth (which has a corresponding tapered face) while the square face faces the Shaft Sleeve.

For assembly of the release collar see chapter Impeller Release Collar.

4. Fit second Shaft Sleeve O-Ring (109) against Impeller Release Collar.

5. Slide SHAFT SLEEVE (076) over the Shaft. Let it rest against the Shaft Sleeve O-Ring. This way there is still a small gap between shaft sleeve and Shaft Spacer.

6. Place another SHAFT SLEEVE O-RING (-) into the receptive groove of Shaft Sleeve.

Fitting Adaptor Plate

Fit ADAPTOR PLATE (032) to Frame using FRAME PLATE STUDS (039).

GLAND SEAL ASSEMBLY AND FITTING

FRAMES: G, GG, ST, T, TU, H and U

1. From a components diagram (for the particular pump being assembled) ascertain the components which fit between the LABYRINTH (062) and IMPELLER (-). Fit these components to the shaft.

2. Fit LANTERN RESTRICTOR (118) (small diameter out) freely over shaft and push against Bearing housing. In some cases a LANTERN RING (063) followed by NECK RING (067) is used in place of the lantern restrictor.

3. Attach STUFFING BOX LIFTING PLATE (310) to STUFFING BOX (078) on opposite side of lugs using three jacking screws provided and ensure that water connection in the stuffing box is in line with the lifting beam (see Figure 7).

4. Fit STUFFING BOX (078) into Adaptor Plate and secure it with CLAMP BRACKET (022).

   Assembly of all gland parts in stuffing box should be carried out in the following manner after all other parts of the pump have been assembled.

5. Slide LANTERN RESTRICTOR (118) or NECK RING (067) inside stuffing box against retaining lip.

6. Fit first PACKING RING (111) of correct length to fill annulus and push against neck ring.

7. Slide LANTERN RING (063) and press to flatten first ring. When a lantern restrictor is used, the lantern ring is omitted.

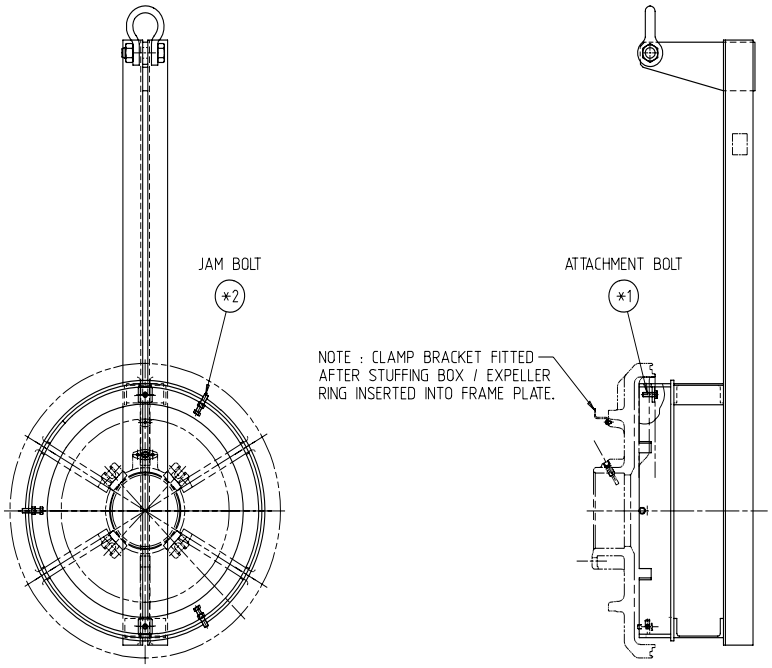
8. Fit packing rings to almost completely fill the annulus (stagger packing joints and flatten each ring).

9. Assemble GLAND (044) halves over shaft sleeve with gland spigot towards stuffing box, insert GLAND CLAMP BOLTS (126) and fully tighten. Push into stuffing box to compress packing rings. Insert GLAND BOLTS (045) and nip up. (Final adjustment will be made when testing the pump).

10. Liberally grease shaft thread.

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

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.



1. Fit SEAL O-RING (-) into the groove on the rim of the Stuffing Box.

2. Fit one VOLUTE LINER SEAL (124) into the recess in Adaptor Plate (flat face in).

3. Using LIFTING TUBE (302) fit FRAME PLATE LINER INSERT (041) and secure it with FRAME PLATE LINER INSERT STUDS (-)

Fitting Impeller

1. Attach IMPELLER LIFTING BEAM (313) to IMPELLER (-), lift into position and turn Shaft using the SHAFT WRENCH (306). Flog the Shaft Wrench to tighten the impeller. Confirm the gap between the Shaft Sleeve and the Labyrinth has now vanished.

During above action, the back of the Impeller may come in contact with the Frame plate liner insert. This is of no concern as long as the Bearing Assembly is free and able to slide.

2. By means of one Nut on the ADJUSTING SCREW (001) move the Bearing Assembly backwards to a position just clear of the Frame Plate Liner Insert. Confirm Shaft and Impeller are turning freely.

Fitting Bowl

1. Screw and tighten the BOWL STUDS (-) into tapped holes provided in Bowl (back liner side).

2. Lift BOWL (092) with hoist using one or two lugs to obtain discharge position required. Pass it over the impeller, line up studs with holes in adaptor plate and fit it over the taped rim of the Frame Plate Liner Insert.

3. Screw on and tighten the nuts.

4. Screw and tighten the remaining Bowl Studs into tapped holes provided in Bowl (Door side).

Fitting Door

1. Fit second VOLUTE LINER SEAL (124) into DOOR CLAMP PLATE (292).

2. Fit DOOR STUDS (-) into DOOR (013).

3. Lift the assembly with a hoist, line up studs with holes in Bowl and fit it into the tapered rim of the Bowl. Screw nuts on Door Studs and tighten.

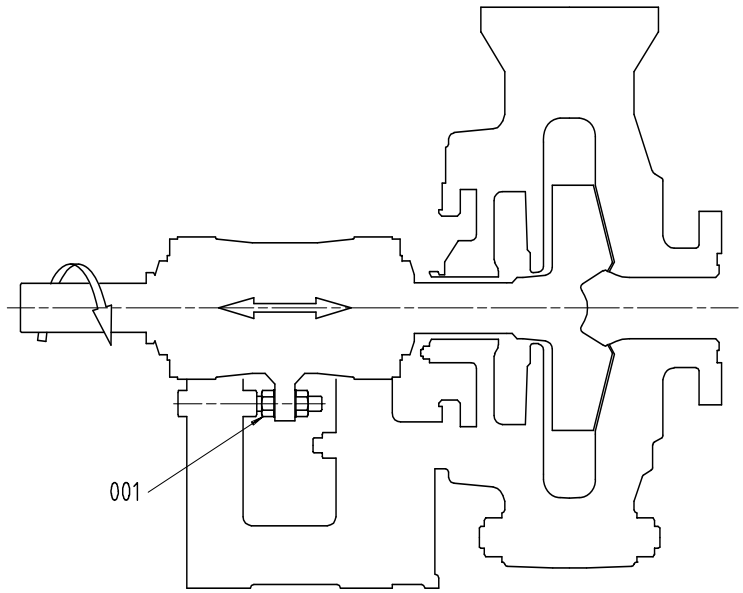
4. Fit INTAKE FLANGE (130) halves around intake neck of Door, clamp halves with bolts and fully tighten.

5. Fit DISCHARGE FLANGE (221) halves around discharge neck of Bowl; clamp halves with bolts provided and fully tighten.

6. Perform Impeller Adjustment.

7. Before connecting to the pipework fit INTAKE JOINT RING (372) and DISCHARGE JOINT RING (372)

IMPELLER ADJUSTMENT



Pump performance changes depending on the clearance between the front of the impeller and the throatbush. With wear, the clearance increases, the pump efficiency is reduced and the pump wear increased. For good performance it is necessary, therefore, to stop the pump occasionally and move the impeller forward.
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.

Procedure

Principle:

The Impeller should 'just touch' the throatbush.

1. Make sure the Nuts on the Adjusting Screw are not hindering the movement of the Bearing Assembly. Make sure the B-side Clamp Bolt Nuts are loose.

2. Rotate the Shaft clockwise. By means of the rear Nut on the Adjusting Screw move the Bearing Assembly forward, ie. towards Door, until the Impeller starts to rub on the Door.

3. Release the rear Nut by one sixth of a turn ('one flat') to create a little space between the Nut and Lug of the Bearing Housing. Use the other Nut to move the Bearing Assembly back and clamp the lug firmly.

4. Tighten the Nuts on the B-side to the recommended torque.

5. Check the Impeller is free by rotating it clockwise a full turn.

6. Check the drive coupling clearance and if necessary adjust.

Bearing Housing Clamp Bolt Torque Table

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

4. WARMAN BASIC PART NUMBERS

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 by the user to ensure maximum use of the pump.

In major plants it is usual to stock an additional bearing assembly for every four pumps of the same size. This enables a quick exchange of the bearing assembly in any one of the pumps.

Often this operation is carried out when parts are being replaced. The removed bearing assembly can then be inspected in a workshop, overhauled if necessary and kept ready for the next pump.

Alternatively the bearing assembly can be returned to Weir Minerals Europe Limited for overhaul in their own workshops.

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

Pump Parts Identification:
Every Warman pump part has a name and a three digit basic number. Parts with the same name, irrespective of size or material, have the same basic number. Thus the SHAFT of every Warman pump has the basic number 073.

Additional letters and digits are added to a given basic number to identify a specific component part of a particular pump and the material in which it is manufactured.

Example: F10147A05

F - Frame size

10 - Discharge diameter

147 - Basic number for impeller

A05 - Material code for High Chrome

Some of the letters or digits are omitted in some pump parts where the information is not needed.

Example: D009

D - Frame Size

009 - Basic number for bearing

In all correspondence with Weir Minerals Europe Limited 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. This can be found on the nameplate located on the pump base. For a list of common basic numbers and material codes see sheet WP7.02, SERVICE

Weir Minerals Europe Limited is in a unique position to offer you the very best Warman pump servicing facilities that you can find at unbeatable prices.

It is our interest to offer the product and back up service that gives you the user the lowest possible ownership costs.

At our Todmorden manufacturing centre we can offer you the wealth of experience and skills born from over fifty years of slurry pump manufacture.

We offer four levels of service depending on your particular needs.

- 24 hour on site breakdown service
- Workshop overhaul
- Service exchange
- Contract maintenance

If necessary we will answer requests for assistance on a 24 hr basis, subject to the availability of spare parts we can have fully trained fitters on site within 24 hours.

However, the most popular level of service that our customers use is the workshop overhaul. Where better to send your Warman pumps to be refurbished than where they were originally manufactured. We have fully trained service fitters, all the necessary tools and equipment and genuine Warman spare parts. Ready to turn around your pump in the shortest possible time.

On a large number of the more standard sizes of pump we can offer service exchange units. However if you wish to use this service then you should discuss your particular pump requirements with our service department at Todmorden.

Contract maintenance has been established with a number of larger pump users where local maintenance staff are not available for routine work, again this should be discussed with our service department at Todmorden.

Using Weir Minerals Europe Limited's service facilities gives you the secure knowledge that your Warman pump is fully guaranteed and incorporates all the latest modifications.

For further details please contact:

Customer Service Department
Weir Minerals Europe Limited
Halifax Road
Todmorden
Lancs OL14 5RT
Telephone: +44 (0)1706 814251

BASIC NUMBERS

Every Warman pump part has a name and a three digit basic number. Parts with the same name, irrespective of size or material have the same basic number.

There are over three hundred different basic numbers, most of which do not refer to wearing parts. The following list gives the correct names and basic numbers of the parts most likely to be ordered as spare parts.

PART NAME	BASIC NUMBER
Bearing assembly	005
Bearing	009
Door	013
Cover plate liner	017
Cover plate	018
Impeller (2 vane chokeless)	021
Shim set	025
Expeller	028
Expeller Ring	029
Frame Plate Liner	036
Frame Plate Liner Insert	041
Frame Plate Liner (Half)	043
Gland	044
Impeller (3 vane open)	052
Intake Joint Ring	060
Labyrinth Locknut	061
Labyrinth	062
Lantern Ring	063
Impeller O-Ring	064
Neck Ring	067
Shaft	073
ShaftSleeve	075
Stuffing Box	078
Throatbush	083
Lip Seal	090
Casing	092
Piston Ring	108
Shaft O-Ring	109
Volute Liner	110
Packing	111
Cover Plate Liner Insert	112
Shaft Spacer	117
Lantern Restrictor	118
Seal Ring	122
Volute Liner Seal	124
Back Liner Seal	125
Impeller (5 vane open)	127
Bowl	131
Discharge Joint Ring	132
Impeller (5 vane open)	147
Back Liner	156
O-Ring	217
Casing	222
Release Collar	239
Shaft (Left hand)	254
Labyrinth (Right hand)	255

Note: Spare parts lists for specific Warman pumps showing the full Warman part number are available on request from Weir Minerals Europe Limited.

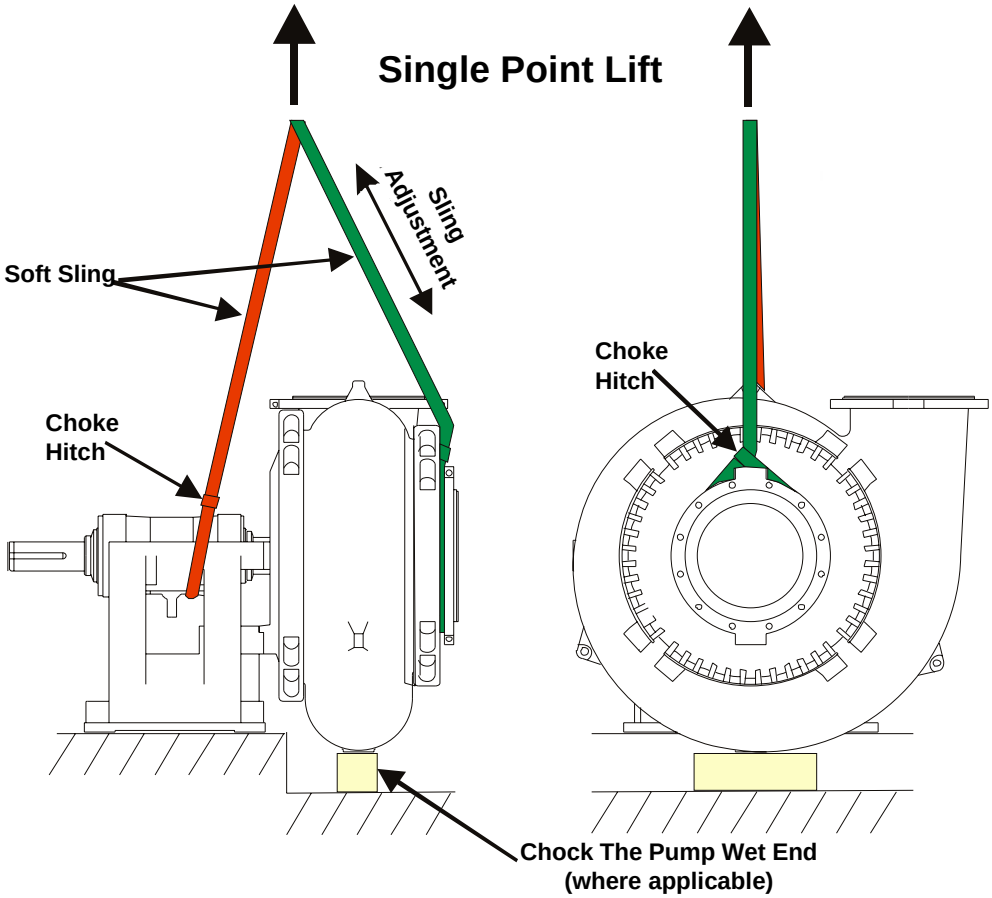
MATERIAL CODES

A material code is used on all parts, which are made from standard Warman materials and on parts, which can be supplied in a variety of materials.

All Warman material codes have one letter followed by two digits; some of the more common codes and their corresponding materials are as follows:

MATERIAL NAME	MATERIAL CODE
Nihard	A03
High Chrome	A05
Nihard Type 4	A06
Niresist	C02
EN56D Mild Steel	C21
316 Stainless Steel	C23
Ferralium	C55
SG Iron	D24
Cadmium Plated SG Iron	D70
Mild Steel	E05
Zinc coated Mild Steel	E62
Cast Iron	G02
Titanium	M01
Hastelloy C	L04
PTFE	P03
PVC	P30
Kevlar	Q21
Rubber	R26
Nordel	S01
Nitrile	S10
Butyl	S21
Hypalon	S31
Neoprene (liners & impellers)	S42
Neoprene (seals)	S43
Viton	S51
Ceramic coated EN56D	Z04

Lifting Diagram: Bareshaft Gravel Pump



Safety Instructions

1. The illustration above shows a safe method of lifting the pump. However, the lifting of the pump should be undertaken by a competent person who is familiar with slinging safety legislation and practices. This person must be able to select suitable lifting equipment and then apply it safely.

2. The mass of the pump is given on its nameplate

3. The estimated centre of gravity for the pump is shown in the operation manual, the position of which will vary due to manufacturing variations.

4. The sling length may require adjusting to get a level lift.

5. Use a Choke Hitch where indicated to prevent the pump rotating during the lift.

6. Where indicated a soft sling must be used to protect the pump from damage.

7. Pumps with the wet end lower or higher than the bottom of the base will require a chock putting under the wet end to prevent it tipping over prior to it being secured to its foundations.

8. Lifting points on the individual pump component parts are for lifting of that part only and are not designed to take the full weight of the pump.