SAFETY INFORMATION

The following safety information relating to pump operation and maintenance should be carefully observed, and correct procedures followed, to avoid injuries to personnel, and damage to equipment. All statutory requirements relating to this equipment must be complied with at all times.

DO NOT APPLY HEAT TO THE IMPELLER HUB OR INLET EYE TO ASSIST IMPELLER REMOVAL. APPLICATION OF HEAT MAY RESULT IN SHATTERING OF THE IMPELLER, RESULTING IN INJURY OR EQUIPMENT DAMAGE.

DO NOT OPERATE THE PUMP FOR AN EXTENDED TIME WITH ZERO OR VERY LOW FLOWRATE. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OVERHEATING OF THE PUMP, AND VAPORISATION OF THE PUMPED FLUID, WITH GENERATION OF VERY HIGH PRESSURES. SERIOUS INJURY TO PERSONNEL, OR DAMAGE TO EQUIPMENT MAY RESULT FROM SUCH ACTION.

CHECK DRIVE MOTOR ROTATION PRIOR TO FITTING OF DRIVE BELTS OR COUPLINGS. INCORRECT MOTOR ROTATION MAY CAUSE PERSONNEL INJURY OR EQUIPMENT DAMAGE.

DO NOT FEED VERY HOT OR VERY COLD FLUID INTO A PUMP AT AMBIENT TEMPERATURE. THERMAL SHOCK MAY RESULT IN FRACTURE OF PUMP WET-END PARTS.

A WARMAN PUMP MUST BE REGARDED AS BOTH AN ITEM OF ROTATING MACHINERY, AND A PRESSURE VESSEL. ALL RELEVANT SAFETY PRECAUTIONS AND PROCEDURES FOR SUCH EQUIPMENT SHOULD BE OBSERVED DURING PUMP INSTALLATION, OPERATION AND MAINTENANCE.

WHERE AUXILIARY EQUIPMENT IS ASSOCIATED WITH A PUMP (eg MOTORS, DRIVE BELTS, DRIVE COUPLINGS, SPEED REDUCERS, VARIABLE SPEED DRIVES, ETC), ALL RELEVANT INSTRUCTION MANUALS SHOULD BE CONSULTED, AND RECOMMENDED PROCEDURES IMPLEMENTED, DURING INSTALLATION, OPERATION AND MAINTENANCE OF THE PUMP SYSTEM.
# CONTENTS – PART 2N

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>2 - 1</td>
</tr>
<tr>
<td>2. APPLICATION AND FEATURES OF TYPE TC CYKLO VORTEX SLURRY PUMPS</td>
<td>2 - 1</td>
</tr>
<tr>
<td>3. IDENTIFICATION OF PARTS</td>
<td>2 - 1</td>
</tr>
<tr>
<td>4. LUBRICATION OF BEARING ASSEMBLY AND CENTRIFUGAL SEAL</td>
<td>2 - 2</td>
</tr>
<tr>
<td>4.1 Bearing Lubrication</td>
<td>2 - 2</td>
</tr>
<tr>
<td>4.2 Seal Lubrication</td>
<td>2 - 4</td>
</tr>
<tr>
<td>5. PUMP ASSEMBLY INSTRUCTIONS</td>
<td>2 - 6</td>
</tr>
<tr>
<td>5.1 Frame-Shaft Assembly</td>
<td>2 - 7</td>
</tr>
<tr>
<td>5.1.1 Fitting Bearing Cones to Shaft</td>
<td>2 - 7</td>
</tr>
<tr>
<td>5.1.2 Fitting Bearing Cup (Impeller-end) to Frame</td>
<td>2 - 8</td>
</tr>
<tr>
<td>5.1.3 Fitting Shaft to Frame</td>
<td>2 - 9</td>
</tr>
<tr>
<td>5.1.4 Determination of Shim Gap at Drive-End End Cover</td>
<td>2 - 10</td>
</tr>
<tr>
<td>5.1.5 Measurement and Adjustment of Bearing End-Play</td>
<td>2 - 13</td>
</tr>
<tr>
<td>5.1.6 Fitting Labyrinths, Piston Rings, Bearing Seal and Locknut</td>
<td>2 - 15</td>
</tr>
<tr>
<td>5.1.7 Testing of Frame-Shaft Assembly</td>
<td>2 - 15</td>
</tr>
<tr>
<td>5.2 Seal Assembly</td>
<td>2 - 16</td>
</tr>
<tr>
<td>5.2.1 Gland Seal Assembly</td>
<td>2 - 16</td>
</tr>
<tr>
<td>5.2.2 Centrifugal Seal Assembly</td>
<td>2 - 20</td>
</tr>
<tr>
<td>5.2.3 Dyna Seal Assembly</td>
<td>2 - 23</td>
</tr>
<tr>
<td>5.2.4 Mechanical Seal Assembly</td>
<td>2 - 24</td>
</tr>
<tr>
<td>5.3 Pump Casing Assembly</td>
<td>2 - 25</td>
</tr>
<tr>
<td>5.4 Miscellaneous Fittings</td>
<td>2 - 28</td>
</tr>
<tr>
<td>6. DISMANTLING PUMP AND REMOVAL OF IMPELLER</td>
<td>2 - 28</td>
</tr>
<tr>
<td>APPENDIX A - WARMAN BASIC PART NUMBERS</td>
<td>2 - 29</td>
</tr>
<tr>
<td>APPENDIX B - LUBRICATION DATA SHEET</td>
<td>2 - 31</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

This publication, Part 2N, forms part of a set which together comprise the Assembly, Operating, and Maintenance Instruction Manual for Warman Cyklo Slurry Pumps, Type ‘TC’. Other publications in the set comprise the following:

Part 1: Assembly, Operating and Maintenance Instructions – General Instructions for all Types of Warman Pumps.

2. APPLICATION AND FEATURES OF TYPE ‘TC’ CYKLO VORTEX SLURRY PUMPS

These pumps are of heavy-duty construction, designed for continuous pumping of moderately abrasive and corrosive slurries, where non-clog and gentle handling features are an additional requirement. They feature a recessed Impeller, with large casing clearances, which permit passage of single particles up to the size of the discharge pipe.

The pumps may be fitted with a water flushed packed gland seal, centrifugal expeller seal, or the Warman Dyna Seal. Third party mechanical seals may also be fitted where special sealing requirements favour this type of seal.

Important design features of this range of Warman Slurry Pumps include:

- Rugged, heavy duty, taper roller bearings
- Heavy duty screw thread Impeller attachment
- No axial adjustment of impeller required
- Choice of optional seal types
- Through-bolt design throughout
- Easily replaceable Shaft Sleeve
- Replaceable casing components
- Minimum number of casing parts

If problems are experienced during pump operation, reference should be made to the Fault Detection Chart in Part 1 of the Instruction Manual. If operating problems are not rectified by following instructions in the Chart, assistance should be sought from the nearest C.H. Warman Group office, or its local representative.

3. IDENTIFICATION OF PARTS

Each Warman pump part has a unique name and a three-digit Basic Part Number. Parts with the same name have the same Basic Part Number, regardless of pump size. For example, the Expeller of every Warman pump has the Basic Part Number 028.

Additional letters and numbers are added before and after the Basic Part Number to further define a component part of a particular pump, as described in Part 1 of the Assembly, Operating, and Maintenance Instruction Manual. This expanded marking is identified as the Part Number, and represents a unique identification for each component part.
The Part Number is normally cast or otherwise prominently marked on each part. For example, Part Number TC4041 identifies the Back Liner to fit the casing of the 4/4TC, 6/4TC and 8/4TC Warman Cyklo Vortex Pumps. Refer to the Component Diagram of the appropriate size of Warman Pump for complete identification and description of component parts. Part names and Basic Part Numbers are used in assembly instructions throughout this instruction manual. Warman Basic Part Numbers for all component parts of Type ‘TC’ pumps are listed in the Appendix of this publication.

In all communications with the C.H. Warman Group, or its representatives, and particularly when ordering spare parts, it is recommended that the correct component names and Part Numbers be used at all times to avoid supply of incorrect parts. The pump serial number should also be quoted if any doubt exists as to part identification.

4. LUBRICATION OF BEARING ASSEMBLY AND CENTRIFUGAL SEAL

4.1 BEARING LUBRICATION

It is recommended that grease used for lubricating the rolling bearings, labyrinth seals, and packed gland of the centrifugal seal, should have the following characteristics:

Lithium soap base grease with EP additives and oxidation inhibitors.

N.L.G.I. Consistency No: 2
Drop Point > 170° C

RECOMMENDED GREASE: SHELL ALVANIA EP GREASE 2,
CASTROL EPL2, or equivalent.

Use only clean, recommended grease at all times.

Warman bearing assemblies that are correctly assembled and greased will have a long and trouble-free life, provided that they are adequately maintained, and protected against contamination by water and other foreign matter. Careful attention should be paid to labyrinth purging on a regular basis to maximise bearing life. Reduction of contaminant entry to bearing assemblies, by regular labyrinth grease application, will result in increased bearing life and reduced maintenance costs.

Maintenance personnel should determine the appropriate intervals (not to exceed 12 months) to dismantle bearing assemblies for inspection of bearings, re-greasing, and determining the time for the next scheduled inspection.

The frequency and amount of grease to be applied to bearings depends on a number of factors, including bearing size, pump speed, duration and extent of pump operation, ambient and operating bearing temperatures, and extent and nature of splash affecting the labyrinth seal region of the bearing assembly.
If regular grease application is considered appropriate by maintenance personnel, the plugs on the bearing assembly should be replaced with grease nipples. It is important that grease nipples are regularly cleaned prior to use to prevent entry of contaminants to the bearing cavity with periodic grease application. Grease should be applied often and sparingly, rather than in large quantities at long intervals. **DO NOT OVER-GREASE BEARINGS.**

**Excess Grease Application** - Over-lubrication of bearings will result in overheating due to churning of the grease. If bearings overheat after grease addition, or change, this is likely to be caused by excess grease. Under no circumstances should additional grease be applied to rectify the condition.

Most pumps operate well below maximum recommended bearing speeds, however over-lubrication is a common cause of bearing overheating, particularly with smaller bearing sizes. Experience and judgement should be applied in determining the most appropriate lubrication procedures for a particular pump. New pump installations should be monitored closely in the initial stages of operation, with particular attention being paid to bearing temperature and cleanliness.

**Initial Grease Application** - Recommended quantities of grease to be applied to each bearing for the range of pump sizes are shown in the Lubrication Data Sheet, located in the Appendix. New or re-conditioned pumps or Bearing Assemblies, which are supplied by the C.H. Warman Group, are normally supplied with grease applied in accordance with these specifications. Additional grease should only be applied according to recommendations for ongoing lubrication.

### TABLE 1

**TYPICAL LUBRICATION INTERVALS FOR PUMP BEARINGS**

<table>
<thead>
<tr>
<th>Pump Size</th>
<th>Bearing Part No</th>
<th>Grease Addition per Brg - gms</th>
<th>Lubrication Interval - hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>500 rpm</td>
</tr>
<tr>
<td>2/2 TC</td>
<td>B009</td>
<td>10</td>
<td>2500</td>
</tr>
<tr>
<td>3/3 TC</td>
<td>C009</td>
<td>15</td>
<td>2000</td>
</tr>
<tr>
<td>4/4 TC, 6/4 TC, 8/4 TC</td>
<td>D009</td>
<td>25</td>
<td>3500</td>
</tr>
<tr>
<td>6/6TC, 8/6TC, 10/6TC</td>
<td>D009</td>
<td>25</td>
<td>3500</td>
</tr>
<tr>
<td>8/8 TC, 10/8 TC</td>
<td>D009</td>
<td>25</td>
<td>3500</td>
</tr>
</tbody>
</table>

**Periodic Grease Application** - The above tabulation of lubrication intervals, as a function of pump speed, may be used as a guide for average pump conditions.
These lubrication intervals are based on average pump operating conditions as listed below.

- Ambient temperature in range 10 - 35° C
- Clean environment
- Pumps enclosed for protection from extreme weather conditions
- Operating conditions below maximum rating for the pump
- Absence of splash from excessive gland leakage or hose cleaning application
- Lubrication intervals assume bearing temperatures measured at the outer bearing ring do not exceed 70° C. Where this temperature is exceeded, intervals should be halved for each 15° C increment above 70°C. Maximum recommended grease operating temperature should not be exceeded under any circumstances

If any of these conditions are exceeded, in particular, if pumps operate in an excessively damp or dirty environment, lubrication intervals should be reduced accordingly.

4.2 SEAL LUBRICATION

Grease is applied to bearing seals and to the centrifugal seal assembly to purge contaminants from bearing cavities, and to lubricate the shaft seal.

(a) LABYRINTH SEAL LUBRICATION

A grease purged Labyrinth seal is provided at each end of the bearing cavity to ensure effective protection against water and grit entry to the bearings. This results in longer life of bearings, and contributes to reduced pump operating cost, hence careful attention to Labyrinth grease purging is an important maintenance requirement. The grease purged Labyrinth seal is shown in Fig 1. Grease is injected from a grease nipple or automatic grease feeder point, in the End Cover of each seal, to a point between two Piston Rings on the rotating Labyrinth, to form a pressurised grease barrier between the Piston Rings. Grease passing the inner Piston Rings enters the bearing cavities, and contributes to Bearing lubrication. Grease passing the outer Piston Rings purges water and grit from the seal entry regions, and provides continuous protection of the Bearings from entry of contaminants. V-Ring seals (where provided), and large diameter Labyrinth-flingers, are also important components of the seal assembly to provide additional protection against entry of contaminants. The effectiveness of bearing sealing is maximised by fitting automatic grease feeders, in lieu of grease nipples, for supply of regular shots of grease to the Labyrinth seals, in particular to the wet-end End Cover. Grease capacities of typically three months are recommended for automatic grease feeders.

Where automatic grease feeders are used, reservoir levels should be checked on a regular basis, and re-filled when required. Where End Covers are fitted with grease nipples, for manual grease application, the recommendations for maintenance frequency shown in Table 2 are provided to ensure effective seal operation.
As noted in Section 4.1, the same grease should be used for Bearing lubrication, Labyrinth seal purging, and lubrication of the packed gland of the centrifugal seal.

**TABLE 2**

**SUGGESTED FREQUENCY FOR LABYRINTH SEAL GREASE APPLICATION**

<table>
<thead>
<tr>
<th>Labyrinth Seal</th>
<th>24hr Operation per day</th>
<th>16hr Operation per day</th>
<th>8hr Operation per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impeller-end</td>
<td>4 shots* each 12 hours</td>
<td>4 shots per day</td>
<td>2 shots per day</td>
</tr>
<tr>
<td>Drive-end</td>
<td>4 shots each 120 hours</td>
<td>4 shots per week</td>
<td>2 shots per week</td>
</tr>
</tbody>
</table>

* Shots from a standard manual grease gun.
(b) CENTRIFUGAL SEAL LUBRICATION

It is recommended that grease used for lubricating the rolling bearings, Labyrinth seals, and the packed gland of the centrifugal seal, should have characteristics as defined in Section 4.1.

The static seal chamber of centrifugally sealed pumps should be lubricated sparingly but regularly by means of the grease nipple fitted to the Expeller Ring. Several shots from a grease gun per 12 hours running time are recommended to form an adequate seal at the packing rings.

5. PUMP ASSEMBLY INSTRUCTIONS

Reference to a Component Diagram for the particular pump being assembled will be of assistance in following the instructions outlined in the following sections.

All parts dismantled during Bearing Assembly overhaul should be closely inspected to assess suitability for re-use, and identification of new parts checked. Parts suitable for re-use should be cleaned and painted. Matching faces should be free of rust, dirt, and burrs, and have a coating of grease applied prior to assembly.

Small fasteners should preferably be replaced, and all threads coated with graphite grease before assembly.

Replacement of all elastomer seals is recommended at major overhauls, as these materials tend to deteriorate with use.
5.1 FRAME-SHAFT ASSEMBLY

5.1.1 Fitting Bearing Cones to Shaft
- Refer Fig 2

(i) Apply oil or anti-seize compound to bearing lands on SHAFT (073).

(ii) Fit one GREASE RETAINER (046) with flange against Shaft shoulder.

(iii) Fit cone of BEARING (009) to Shaft with large diameter against Retainer, preferably preheating the Bearing cone before fitting. It is recommended that a proprietary bearing induction heater be used for this purpose. An alternative method is to immerse parts in a heated bath of a suitable heating oil. With Shaft in a vertical position, the heated Bearing cone should be slipped on, and pressed or tapped up to the Grease Retainer.

(iv) Fit the other Grease Retainer and Bearing cone as described above. It is important that both Grease Retainers are located hard against the Shaft shoulders, and Bearings are hard against the Grease Retainers. Check that these conditions are satisfied when the bearings have cooled to room temperature.
5.1.2 Fitting Bearing Cup (Impeller-end) to Frame  
- Refer Fig 3

This assembly operation is best carried out with the Frame supported in a vertical-axis orientation.

(i) Apply oil or anti-seize compound to bore at each end of FRAME (188).

(ii) Press (or tap carefully with mallet) cup of BEARING (009) into Impeller-end of Frame until cup is slightly below end face of Frame, with small diameter of cup facing out.

(iii) Fit END COVER (024) with one SHIM (025) to Frame, and insert END COVER SET SCREWS (027). Use one thick Shim only (typically 0.5 mm) to provide effective sealing.

(iv) Tighten Set Screws uniformly. This will adjust the Bearing cup to its correct position.
5.1.3 Fitting Shaft to Frame
- Refer Fig 4

The following procedure should be carried out with the Frame supported in a horizontal-axis orientation for pump sizes up to 3/3 TC. With larger pump sizes it is recommended that the Frame be supported in a vertical axis orientation, with drive-end uppermost, so that Bearings will fit up concentrically.

(i) Dispense quantities of grease for both Bearings corresponding with the type as specified in Section 4.1, and amounts as indicated in the Bearing Lubrication Data Sheet, located in Appendix B.

(ii) Distribute grease from a grease gun into Bearing mounted on Shaft, to fill spaces between cone, rollers, and cage. Discharge remainder of grease to space between Bearing and Grease Retainer.

(iii) Repeat item (ii) for other Bearing.

(iv) Fit Shaft through drive-end of Frame bearing cavity, with threaded end emerging through Impeller-end End Cover.

(v) Press remaining Bearing cup into drive-end of Frame bearing cavity (small diameter outwards) until it is slightly below the Frame end face.

Fig. 4
The remaining steps in this procedure depend on the method used to measure and set the Shim gap, and will be described in Section 5.1.4.

5.1.4 Determination of Shim Gap at Drive-end End Cover
- Refer Figs 5 and 6

Any one of several available methods may be used to determine the required thickness of Shims between the Frame, and End Cover faces, provided that the correct value of end-play between the Bearings is obtained, as indicated in Table 3. Two alternative methods will be described here in detail.

### TABLE 3
RECOMMENDED BEARING END-PLAY

<table>
<thead>
<tr>
<th>Pump Size</th>
<th>End Play - Cold (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/2 TC</td>
<td>0.05 - 0.10</td>
</tr>
<tr>
<td>3/3 TC</td>
<td>0.10 - 0.15</td>
</tr>
<tr>
<td>4/4 TC, 6/4 TC, 8/4 TC</td>
<td>0.13 - 0.18</td>
</tr>
<tr>
<td>6/6 TC, 8/6 TC, 10/6 TC</td>
<td>0.13 - 0.18</td>
</tr>
<tr>
<td>8/8 TC, 10/8 TC</td>
<td>0.13 - 0.18</td>
</tr>
</tbody>
</table>

Procedures for adjusting Bearing end-play should be carried out with the Frame supported in a horizontal-axis orientation for pump sizes up to 3/3 TC. With larger pump sizes, it is recommended that the Frame be supported with a vertical-axis orientation, so that Bearings will fit up concentrically.

(a) Setting Bearing End-Play - Method 1

Proceed from Section 5.1.3 (v), as described below.

(i) Distribute grease in recessed area of END COVER (024), facing Bearing.

(ii) Fit End Cover, with remaining SHIMS (025), and insert END COVER SET SCREWS (027).

(iii) Tighten End Cover Set Screws uniformly.

(iv) Press Shaft from both ends of Frame, preferably using hydraulic loading equipment, to ensure Bearing cups are firmly against End Covers, taking care to avoid damage to Shaft. Refer Fig 6.

(v) Proceed to Section 5.1.5 “Measurement and Adjustment of Bearing End-Play”, and determine the measured end-play. This should be in excess of the value indicated in Table 3.
(vi) Calculate the amount of Shims to be removed to give the recommended end-play, from Table 3.

(vii) Remove End Cover and excess Shims from the drive-end of the Frame.

(viii) Replace End Cover with required Shim thickness, and fit End Cover Set Screws.

(ix) Tighten End Cover Set Screws uniformly.

(x) Press Shaft from both ends of Frame to ensure Bearing cups are firmly against End Covers, taking care to avoid damage to Shaft.

(xi) Proceed to Section 5.1.5 to re-check Bearing end-play. If this value is outside the range indicated in Table 3, continue from item (vii) above. Otherwise, proceed to Section 5.1.6.

(b) Setting Bearing End-Play - Method 2

Proceed from Section 5.1.3 (v), as described below.

(i) Fit drive-end END COVER (024) into Frame, insert END COVER SET SCREWS (027), and screw in by hand. Do not fit SHIMS (025) at this stage. Refer to Fig 5.
(ii) While rotating shaft slowly by hand, gradually tighten Set Screws until the Bearing cup has been pushed right up to the Bearing cone, whereby the Shaft barely rotates, and the Bearings have almost no end play.

(iii) Measure gap between adjacent faces of End Cover and Frame, using feeler gauges, as shown in Fig 5. Providing Set Screws have been tightened uniformly, this method usually yields reliable values. Alternatively, the End Cover should be removed, and the following measurements taken with a depth micrometer:

(1) Depth of Bearing cup below end face of Frame.

(2) Length of End Cover spigot.

The “gap” thickness is then determined by subtracting (1) from (2).

(iv) Select Shim set having a thickness equal to the “gap” (refer item (iii) above) PLUS recommended end-play as indicated in Table 3.

(v) Remove drive-end End Cover, and distribute grease in recessed area of End Cover, facing Bearing.
(vi) Fit Shims, replace End Cover, and insert End Cover Set Screws. Adjust Set Screws to within about 3 mms of fully tightened position.
Note - With Shims inserted (refer Fig 5), the drive-end Bearing cup must now be displaced slightly to contact the End Cover spigot face, and provide increased Bearing end-play, as shown in Fig 6.

(vii) Apply force at Impeller-end of Shaft, or gently tap, to ensure that Bearing cup at drive-end is in contact with the loosely fitted End Cover. Care should be taken to avoid damage to Shaft thread.

(viii) Tighten End Cover Set Screws uniformly at drive-end to ensure even contact between End Cover and Bearing cup. Both Bearing cups should now be firmly in contact with the adjacent End Covers, and Bearing end-play set to the required value.

(ix) Follow procedure in Section 5.1.5 to measure the current value for Bearing end-play. If this value is outside the range indicated in Table 3, remove drive-end End Cover, adjust Shim thickness by the required amount, and proceed from item (v) above. Otherwise, proceed to Section 5.1.6.

5.1.5 Measurement and Adjustment of Bearing End-Play
- Refer Fig 7

The Bearing cups are now firmly in contact with the adjacent End Covers, and Set Screws fully tightened. The following procedure should be followed to accurately measure the actual end-play in the Bearings.

(a) Pump Sizes 2/2 TC and 3/3 TC

(i) Set up Frame with Shaft horizontal, and Frame firmly supported. Hold in bench vice if possible.

(ii) Attach mounting bracket with dial indicator micrometer securely fixed to Frame by means of one SET SCREW (027), and position dial actuating pin against end of Shaft.

(iii) Oscillate Shaft, and push it firmly backwards and forwards by hand several times to establish a consistent dial reading, and note end-play value as indicated by the total movement.

(b) Pump Sizes 4/4 TC to 10/8 TC

(i) Support Frame with Shaft vertical, Impeller-end down. The whole Assembly must be located in a position where it is accessible by a hoist.

(ii) Attach mounting bracket, with dial indicator, as described in (a) (ii) above.
(iii) Fit BEARING ASSEMBLY LIFTING PLATE (307), with eyebolts up, to upper end of Shaft, and attach LABYRINTH LOCKNUT (061) temporarily to Shaft. Fit sling, suspended from a hoist, to eyebolts on Lifting Plate, as shown in Fig 7.

(iv) Move Shaft up and down by lifting the Frame off the support by means of the hoist, and then returning it to the support. Observe maximum and minimum readings on the dial indicator. Repeat several times until consistent values are obtained for measured total Shaft movement. Note end-play value as indicated by the total Shaft movement.

(c) All Pump Sizes

If measured Bearing end-play is outside the ranges indicated in Table 3, Shims must be added or removed, at the drive-end, as required.

(i) To reduce Shim thickness, remove drive-end End Cover, remove appropriate number of Shims, replace End Cover, and tighten End Cover Set Screws.

(ii) To increase Shim thickness, remove drive-end End Cover, and follow procedure for fitting Shims, and moving Bearing cup back to End Cover as described from Sections 5.1.4(a)(viii) and 5.1.4(b)(vi), indicated in Fig 6.
After re-adjustment of Bearing end-play by addition or removal of Shims, the actual end-play must again be measured with the dial indicator to confirm the correct value.

5.1.6 Fitting Labyrinths, Piston Rings, Bearing Seal and Locknut. - Refer Fig 1

(i) Smear PISTON RINGS (108) with bearing grease (refer Section 4.1), and fit two Rings to the grooves of each LABYRINTH (062). Position Ring gaps diametrally opposite.

NOTE: Some pump sizes have a marginally different type of Labyrinth and End Cover at the ends of the Frame bearing cavity to that shown in the figures, with no provision for separate Bearing Seals (089-10). Refer to the Component Diagram for the particular pump size for specific details. Disregard following references to Bearing Seal (089-10) for these pumps.

(ii) Fit BEARING SEAL (089-10) to groove in each Labyrinth, with Seal lip exposed, or to groove in End Cover (if appropriate), with Seal lip exposed. As noted above, some pump sizes are not equipped with Bearing Seals (089-10)

(iii) Slide each Labyrinth over Shaft, and push into End Cover until Piston Ring prevents further entry.

(iv) Rotate Piston Rings to position gaps diametrally opposite grease purge feed points in End Covers. Compress Piston Rings with RING COMPRESSOR (301), then push each Labyrinth right into and against Bearing cone.

(v) Fit LABYRINTH LOCKNUT (061) to drive-end of Shaft, and tighten with C-SPANNER (305).

(vi) Fit HEX PLUGS to tapped holes in Frame, adjacent Bearings, and GREASE NIPPLES to End Covers.

(vii) Pump grease into each End Cover Grease Nipple to flush Labyrinths.

The Shaft is now fully assembled for rotation in the Frame, and assembly of the remaining pump components may be completed.

5.1.7 Testing of Frame-Shaft Assembly

In some cases it may be standard practice to test run each Frame-Shaft assembly before placing the unit in service, or store.

This operation may be carried out by mounting the Frame-Shaft assembly on a test rig. The test speed may be obtained by connecting the Shaft to a small electric motor via a coupling or Vee-belt drive.
It is necessary to provide for axial loading of the Impeller-end Labyrinth, on all frame sizes, to prevent the adjacent Bearing moving on the Shaft during testing. This is achieved by fitting all Impeller-end Shaft components. The Impeller may be replaced by a suitable threaded sleeve to engage the Shaft thread.

Test running for one hour should be adequate. One of two outcomes will occur:

(i) If Bearing end-play and amount of grease are correct, and all components are in good order, little or no heating of the Frame in the region of the Bearings should be apparent.

(ii) If one or both Bearings heat quickly and excessively, the test should be stopped, and the Frame allowed to cool. Heating is excessive if the Frame surface, adjacent the Bearings, is too hot to touch for more than a few seconds.

Rapid heating may be caused by excessive grease in the Bearings. Allow to cool, and then re-start the test. If over-heating is repeated, stop the test.

If excessive heating persists, dismantle the Shaft assembly, and closely inspect all components. In particular, examine for foreign material in grease and on component parts.

It is normal practice for the C.H. Warman Group to seal the End Cover Set Screws at both ends of the Frame-Shaft Assembly, following satisfactory completion of test running, to protect the product Warranty on the Assembly. Holes should be drilled through the heads of at least four Set Screws, normal to the Set Screw axes. Plaited wire should be threaded through the drilled hole in each Set Screw, and the wire ends encapsulated in a date-stamped Quality Assurance lead seal.

5.2 SEAL ASSEMBLY

Seal assemblies fitted to the Type TC Cyklo Vortex pump normally comprise the Gland Seal, Centrifugal Expeller Seal, and Dyna Seal. Third party Mechanical Seals may also be fitted to this pump, and Adaptor Kits are available for fitting a number of these. Refer to Sections 5.2.1, 5.2.2, 5.2.3, or 5.2.4, depending on the type of seal fitted to the particular pump.

It should be noted that the ratio of Expeller to Impeller diameters in the Type ‘TC’ pump range is smaller than that of the corresponding Type ‘AH’ pump. A consequence of this is that Type ‘TC’ Pumps with Expeller seals have a lower threshold of maximum intake pressure before seal leakage occurs.

5.2.1 GLAND SEAL ASSEMBLY

- Fitting Stuffing Box, Lantern Restrictor, (or Neck and Lantern Rings), Packing, Gland, Shaft Sleeve, Shaft Spacer, and Shaft Sleeve O-Rings
- Refer Fig 8

Alternative Stuffing Box assemblies, which may be used depending on the particular pump application, are shown in Fig 9. Gland Sealing Water flowrate may be minimized by using a non-metallic LANTERN RESTRICTOR (118-1), as shown in Fig 9b, or the Stuffing Box assembly shown in Fig 9c.
Figure 8 shows the relative position of Shaft Spacer, Shaft Sleeve, O-Rings, etc, on the Shaft. The specific arrangement of these components on the Shaft may vary according to pump size. Table 4 lists the components assembled onto the Shaft, in the order in which they are fitted, commencing at the drive-end of SHAFT SLEEVE (075). Pumps having similar arrangements of parts are grouped together in the Table. Alternatively, the Component Diagram for the particular pump size may be referred to for details of the assembly of components on the Shaft.

Assemble components for Gland Seal Assembly as described below.

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

(ii) Place LANTERN RESTRICTOR (118) (large diameter up) in gland recess, to rest on retaining lip. A NECK RING (067) is fitted in place of the Lantern Restrictor in some applications, as shown in Fig 9c.

(iii) Stand SHAFT SLEEVE (075) on end, and slide through Lantern Restrictor.
Fig. 9  Alternative Gland arrangements for Stuffing Boxes

(a) SUITABLE FOR LOW LIFT & POSITIVE HEAD APPLICATIONS

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

(c) SUITABLE FOR HIGH LIFT APPLICATIONS
(VERY LOW FLOW GLAND WATER SUPPLY)
TABLE 4
GLAND SEAL – ORDER OF ASSEMBLY OF COMPONENTS ON SHAFT

<table>
<thead>
<tr>
<th>PUMP</th>
<th>SHAFT COMPONENTS (in order from drive-end of Shaft Sleeve to Impeller)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/2 TC</td>
<td>109 Shaft O-Ring, 075 Shaft Sleeve, 109 Shaft O-Ring, 117 Shaft Spacer, 109 Shaft O-Ring</td>
</tr>
<tr>
<td>3/3 TC</td>
<td>075 Shaft Sleeve, 109 Shaft O-Ring, 117 Shaft Spacer, 109 Shaft O-Ring</td>
</tr>
<tr>
<td>4/4 TC, 6/4 TC, 8/4 TC</td>
<td>109 Shaft O-Ring, 075 Shaft Sleeve, 109 Shaft O-Ring, 117 Shaft Spacer, 064 Impeller O-Ring</td>
</tr>
<tr>
<td>6/6 TC, 8/6 TC, 10/6 TC</td>
<td>109 Shaft O-Ring, 075 Shaft Sleeve, 109 Shaft O-Ring, 117 Shaft Spacer, 064 Impeller O-Ring</td>
</tr>
<tr>
<td>8/8 TC, 10/8 TC</td>
<td>109 Shaft O-Ring, 075 Shaft Sleeve, 109 Shaft O-Ring, 117 Shaft Spacer, 064 Impeller O-Ring</td>
</tr>
</tbody>
</table>

(iv) Fit the following items in turn:

(a) Fit first PACKING RING (111) of required length to fill the Stuffing Box annulus.

(b) Fit remaining Packing Rings (stagger joints) to almost completely fill the Stuffing Box chamber. Flatten each one separately.

Note – When a NECK RING (067) is used, fit LANTERN RING (063) after first Packing Ring, and press down to compress packing. Fit remaining Packing Rings, taking care to stagger joints.

(v) Assemble GLAND (044) halves, fit GLAND CLAMP BOLTS (126), and fully tighten. Place Gland in Stuffing Box, around Shaft Sleeve, and press down to compress Packing Rings. Fit GLAND BOLTS (045) and tighten just sufficiently to hold Shaft Sleeve (final adjustment will be made when test running pump). A cable tie may be used to secure bolts in position.

(vi) Fit SHAFT O-RING (109) to the Shaft, as indicated in Table 4, corresponding with the drive-end of SHAFT SLEEVE (075).

(vii) Fit the assembled Stuffing Box to the FRAME (188) (with the Shaft Sleeve engaging the Shaft), and tap into position with a mallet. Locate Stuffing Box with Gland Seal Water connection at the top.

If the Shaft Sleeve remains forward of its correct position, it should be pushed back until it is firmly in contact with other items assembled on the Shaft. Ensure that any Shaft O-Rings are correctly positioned in grooves.
(viii) Fit remaining O-Rings and Shaft mounted items as indicated in Table 4.

Note:
(a) Apply heavy grease to the O-Ring groove in the Shaft Spacer to assist in holding the O-Ring which seals against back face of Impeller.
(b) All O-Rings will be compressed and fully contained within their respective grooves when the Impeller is screwed on to the Shaft.

(ix) Apply anti-seize compound liberally to Shaft thread.

5.2.2 CENTRIFUGAL SEAL ASSEMBLY
- Fitting Expeller Ring, Neck Ring, Lantern Ring, Packing, Shaft Sleeve, Shaft Sleeve O-Rings, and Expeller
- Refer Fig 10

Figs 10 shows a typical assembly of shaft components, indicating the relative position of parts on the pump Shaft up to the back face of the Impeller. Table 5 lists shaft components for all sizes of centrifugal expeller sealed pumps in the order in which are fitted to the Shaft, commencing at the drive-end of SHAFT SLEEVE (075), and terminating at the back face of the Impeller.
The following instructions describe the procedure to pack the gland of the Expeller Ring (metal or polyurethane lined), for all pump sizes.

(i) Place EXPELLER RING (029) flat on bench, gland side up.

(ii) Place NECK RING (067) in gland recess, to rest on retaining lip.

(iii) Stand SHAFT SLEEVE (075) on end, and slide through Neck Ring.

(iv) Assemble the following items in turn:

(a) Fit first PACKING RING (111) of required length to fill the packing annulus.

(b) Fit LANTERN RING (063), and press down to flatten first packing ring.

(c) Fit remaining Packing Rings, staggering joints, to almost completely fill the packing chamber. Flatten each ring separately.

### TABLE 5
CENTRIFUGAL SEAL – ORDER OF ASSEMBLY OF COMPONENTS ON SHAFT

<table>
<thead>
<tr>
<th>PUMP</th>
<th>SHAFT COMPONENTS (in order from drive-end of Shaft Sleeve to Impeller)</th>
</tr>
</thead>
</table>
| 2/2 TC | B109 Shaft O-Ring  
|       | TC2075 Shaft Sleeve  
|       | B109 Shaft O-Ring  
|       | TC2028 Expeller  
|       | B109 Shaft O-Ring |
| 3/3 TC | C109 Shaft O-Ring  
|       | TC3075 Shaft Sleeve  
|       | C109 Shaft O-Ring  
|       | A4-18666A Expeller  
|       | C109 Shaft O-Ring  
|       | A4-18665A Shaft Spacer  
|       | C109 Impeller O-Ring |
| 4/4 TC, 6/4 TC, 8/4 TC | D109 Shaft O-Ring  
| 6/6 TC, 8/6 TC, 10/6 TC | TC4075 Shaft Sleeve  
| 8/8 TC, 10/8 TC | D109 Shaft O-Ring  
|       | D028 Expeller  
|       | E064 Impeller O-Ring |
(v) Assemble GLAND (044) halves, fit GLAND CLAMP BOLTS (126), and fully tighten. Place Gland in Expeller Ring, around Shaft Sleeve, and push down to compress Packing Rings. Fit GLAND BOLTS (045) and tighten just sufficiently to hold Shaft Sleeve (final adjustment will be made when test running pump). A cable tie may be used to secure the bolts in position.

(vi) Fit SHAFT O-RING (109) to the Shaft, as indicated in Table 5, corresponding with the drive-end of SHAFT SLEEVE (075).

(vii) Apply anti-seize compound to Expeller Ring location recess in FRAME (188) to assist future removal of Expeller Ring. Fit the assembled Expeller Ring to the Frame (with the Shaft Sleeve engaging the Shaft), and tap into position with a mallet. Locate Expeller Ring with the grease inlet connection at the top. If the Shaft Sleeve remains forward of its correct position, it should be pushed back until it is firmly in contact with other items assembled on the Shaft. Ensure that any Shaft O-Rings are correctly positioned in grooves.

(viii) Fit SHAFT O-RING (109) to the Shaft, as indicated in Table 5, corresponding with the Impeller-end of SHAFT SLEEVE (075).

(ix) Fit EXPELLER (028) to Shaft, and compress assembled parts.

(x) For 3/3 TC Pump only:

(a) Fit SHAFT O-RING (109) to the Shaft, as indicated in Table 5, corresponding with the Impeller-end of EXPELLER (028).

(b) Fit SHAFT SPACER to Shaft, and compress assembled parts.

(xi) Fit O-RING (064 or 109) to groove in Expeller (or Shaft Spacer).

Note:

(a) Apply heavy grease to the O-Ring groove to hold the O-Ring which seals against the back face of the Impeller.

(b) All O-Rings will be compressed and fully contained within their grooves when the Impeller is screwed to the Shaft.

(xii) Apply anti-seize compound liberally to Shaft thread.

(xiii) Assemble gland lubricating parts, as follows, only when the pump assembly is otherwise complete. Fit Grease Nipple to Expeller Ring. Apply grease to Nipple with grease gun, to charge Lantern Ring cavity. If requested, an optional GREASE CUP may be fitted in lieu of the Grease Nipple. Fit GREASE CUP ADAPTOR (138) and GREASE CUP to Expeller Ring. Fill Grease Cup with recommended grease, and screw down to charge Lantern Ring cavity. Refill Grease Cup with grease.
5.2.3  DYNA SEAL ASSEMBLY
- Fitting Expeller Ring, Shaft Sleeve, Shaft Sleeve O-Rings, Dyna Seal and Expeller
- Refer Fig 11

Fig 11 shows a typical assembly of shaft components, indicating the relative position of parts on the pump Shaft, up to the back face of the Impeller. Table 5 lists shaft components for centrifugal expeller sealed pumps which are fitted to the Shaft in order of assembly, commencing at the end face of the Labyrinth (062) on the impeller-end of the Frame. In Dyna Sealed pumps, the same sets of component parts apply as for centrifugal expeller sealed pumps, except for substituting the Dyna Seal EXPELLER (028-20) for the EXPELLER (028).

The following instructions describe the procedure to assemble the Dyna Seal to all pump sizes for which it is available:

(i) Fit SHAFT O-RING (109), SHAFT SLEEVE (075), AND SHAFT O-RING (109) to the Shaft, as indicated in Table 5.

(ii) Apply anti-seize compound to Expeller Ring location recess in Frame to assist future removal of Expeller Ring. Fit EXPELLER RING (029-20) to Frame, and tap into position with a mallet.
(iii) Place EXPELLER (028-20) flat on bench, with vanes up. Place DYNA SEAL (425) loosely in centre of Expeller, with part number markings up. Apply liquid soap or rubber lubricant to lower sealing land surface of Dyna Seal. Adjust angular position of Dyna Seal so that drive lugs projecting from periphery of Seal fit between Expeller vanes. Apply downward pressure on Dyna Seal to expand lower sealing land over matching conical surface of Expeller, and engage sealing land in locating recess in Expeller. If necessary apply load unevenly, at one point on Seal periphery, to locally engage sealing land in recess, and progress around seal to complete engagement.

(iv) Ensure that the Shaft Sleeve O Ring at the end of the Shaft Sleeve is positioned in its locating groove.

(v) Apply liquid soap or rubber lubricant to inner conical sleeve surface of Expeller Ring. Place Expeller, with Dyna Seal fitted, on Shaft with Dyna Seal facing the drive-end. Carefully apply axial force to back face of Expeller to expand Dyna Seal lip over Expeller Ring sleeve as the Expeller moves along the Shaft into contact with the end of the Shaft Sleeve.

(vi) Fit O-RING (064 or 109) to groove in exposed face of Expeller.

Note:
(a) Apply heavy grease to O-Ring groove, in back face of Expeller, to hold O-Ring which seals against back face of the Impeller.

(b) All O-Rings will be compressed and fully contained within their grooves when the Impeller is screwed to the Shaft.

(vii) Apply anti-seize compound liberally to Shaft thread.

5.2.4 MECHANICAL SEAL ASSEMBLY

Adaptor kits are available for fitting a number of third party mechanical seals to Warman Pumps. When fitting these seals, reference should be made to supplementary instructions for the particular seal being installed. Further details of third party Mechanical Seals, for which adaptor kits are available, may be obtained from the C.H. Warman Group.
5.3 PUMP CASING ASSEMBLY
- Fitting Seal Rings, Back Liner, Impeller, Casing and Suction Cover
- Refer Figs 12 and 13

The pump casing typically comprises a Casing, and casing end plates, viz the Suction Cover and Back Liner. In small pumps the Casing and Suction Cover are combined in a single component, whereas in large pump sizes these are separate parts. Table 6 lists the type of pump casing configurations for the full range of pump sizes.

TABLE 6
PUMP CASING ASSEMBLY

<table>
<thead>
<tr>
<th>PUMP SIZE</th>
<th>CASING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TWO PART</td>
</tr>
<tr>
<td>2/2 TC</td>
<td>●</td>
</tr>
<tr>
<td>3/3 TC</td>
<td>●</td>
</tr>
<tr>
<td>4/4 TC, 6/4 TC, 8/4 TC</td>
<td>●</td>
</tr>
<tr>
<td>6/6 TC, 8/6 TC, 10/6 TC</td>
<td>●</td>
</tr>
<tr>
<td>8/8 TC, 10/8 TC</td>
<td>●</td>
</tr>
</tbody>
</table>

The pump casing assembly is described below.

(i) Fit ‘C’-or ‘L’ section SEAL RING (122) to periphery of STUFFING BOX (078) or EXPPELLER RING (029), preferably using contact cement adhesive. Apply adhesive to compression face of Seal Ring in about 4 to 6 points only to avoid undue restraint of Seal during compression.

(ii) Fit SHAFT KEY (070) (not shown) to Shaft keyway at drive-end, and bolt SHAFT WRENCH (306) (not shown) to Shaft, over key.

(iii) Fit BACK LINER (041) to FRAME (188) as follows:

(a) Apply anti-seize compound to cylindrical mating surfaces, comprising recess in Frame, and rear peripheral spigot of Back Liner, to assist dismantling.

(b) Place Back Liner in position, concentric with SHAFT (073), engaging rear peripheral spigot with recess in Frame if possible. If necessary, support Back Liner centrally in place using wedging pieces, and CASING BOLTS in holes on Frame around periphery of Back Liner.
(iv) Fit IMPELLER (191) to Shaft thread as follows:

(a) Ensure that the O Ring (064 or 109) at the end of the Expeller or Shaft Spacer is positioned in its locating groove, and that the Back Liner is supported centrally in place.

(b) Select Impeller, and apply anti-seize compound to thread. Lift Impeller, and screw to Shaft. While restraining Impeller, turn Shaft with Wrench to engage Impeller and Shaft threads. As back of Impeller engages Back Liner, ensure that peripheral spigot of Back Liner engages corresponding recess in Frame. Tighten Impeller on Shaft, restraining Impeller vane with pipe wrench or similar, by flogging Shaft Wrench.

(c) Ensure that the various O-Rings on the Shaft are not damaged, and are covered by adjacent parts.

(v) Fit CASING (092) as described below.

(a) Place CASING O-RING (124) over outer cylindrical surface of BACK LINER (041), and position against flange of FRAME (188).

(b) Lift Casing, using a hoist for larger pump sizes, and move axially to fit concentrically around Back Liner, engaging corresponding peripheral conical surfaces.
(c) Adjust angular orientation of Casing discharge to the required position, and align corresponding bolt holes in flanges of Casing and Frame.

(d) Fit CASING BOLTS and nuts to secure Casing to Frame. Tighten evenly and firmly until Casing flange uniformly contacts flange of Frame. If necessary adjust concentricity of Casing to ensure that Back Liner rear spigot engages corresponding recess in Frame.

(vi) For Three-Part Casings only (refer Table 6 and Fig 13)
- Fit SUCTION COVER (190) as described below.

(a) Place CASING O-RING (124) over outer cylindrical surface of Suction Cover, and position against flange.

(b) Lift Suction Cover, using a hoist, and move axially to fit into Casing, aligning bolt holes in matching flanges.

(c) Fit CASING BOLTS and nuts to matching holes in flanges of Casing and Suction Cover. Tighten evenly and firmly until faces of flanges are uniformly in contact.
5.4 MISCELLANEOUS FITTINGS

- Refer Fig 14

The pump assembly is now substantially complete, and requires only fitting of miscellaneous external components.

(i) Fit JOINT RINGS (060) to pump intake and discharge openings, and suitably secure in place.

(ii) Fit elastomer NUT COVERS (430) to all external nuts to prevent fouling of threads with slurry.

6. DISMANTLING PUMP AND REMOVAL OF IMPELLER

The procedure for dismantling the pump is generally the reverse of that described for pump assembly.

Access to the IMPELLER (191) requires removal of the SUCTION COVER (190) and CASING (092). These parts may be withdrawn after removal of the CASING BOLTS.

Impellers are normally fitted to Shafts with a right hand screw thread attachment on all Warman pumps, although left hand threads are an available option. Impeller removal generally involves applying an impulsive torque loading to the Impeller, while separately restraining the Shaft from rotation.
### APPENDIX A

#### WARMAN BASIC PART NUMBERS

<table>
<thead>
<tr>
<th>WARMAN BASIC PART No.</th>
<th>STANDARD WARMAN MATERIAL CODE</th>
<th>PART NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>009</td>
<td>-</td>
<td>Bearing</td>
</tr>
<tr>
<td>024</td>
<td>D20</td>
<td>End Cover</td>
</tr>
<tr>
<td>025</td>
<td>P30</td>
<td>Shim</td>
</tr>
<tr>
<td>027</td>
<td>E62</td>
<td>End Cover Set Screws</td>
</tr>
<tr>
<td>028</td>
<td>A05A</td>
<td>Expeller</td>
</tr>
<tr>
<td>028-20</td>
<td>A05A</td>
<td>Expeller (Dyna Seal)</td>
</tr>
<tr>
<td>029</td>
<td>A05A</td>
<td>Expeller Ring</td>
</tr>
<tr>
<td>029-20</td>
<td>A05A</td>
<td>Expeller Ring (Dyna Seal)</td>
</tr>
<tr>
<td>041</td>
<td>A05A</td>
<td>Back Liner</td>
</tr>
<tr>
<td>044</td>
<td>K24, C23</td>
<td>Gland</td>
</tr>
<tr>
<td>045</td>
<td>E62</td>
<td>Gland Bolt</td>
</tr>
<tr>
<td>046</td>
<td>G01</td>
<td>Grease Retainer</td>
</tr>
<tr>
<td>060</td>
<td>R08A</td>
<td>Joint Rings</td>
</tr>
<tr>
<td>061</td>
<td>E62</td>
<td>Labyrinth Lock Nut</td>
</tr>
<tr>
<td>062</td>
<td>D20</td>
<td>Labyrinth</td>
</tr>
<tr>
<td>063</td>
<td>K31, C23</td>
<td>Lantern Ring</td>
</tr>
<tr>
<td>064</td>
<td>S10</td>
<td>Impeller O-Ring</td>
</tr>
<tr>
<td>067</td>
<td>P50A, C23</td>
<td>Neck Ring</td>
</tr>
<tr>
<td>070</td>
<td>E05</td>
<td>Shaft Key</td>
</tr>
<tr>
<td>073</td>
<td>E05</td>
<td>Shaft</td>
</tr>
<tr>
<td>078</td>
<td>G01</td>
<td>Stuffing Box</td>
</tr>
<tr>
<td>089-10</td>
<td>S10</td>
<td>Bearing Seal</td>
</tr>
<tr>
<td>092</td>
<td>A05A</td>
<td>Casing</td>
</tr>
<tr>
<td>108</td>
<td>G02</td>
<td>Piston Ring</td>
</tr>
<tr>
<td>109</td>
<td>S10</td>
<td>Shaft O-Ring</td>
</tr>
<tr>
<td>111</td>
<td>Q05A</td>
<td>Packing</td>
</tr>
<tr>
<td>117</td>
<td>E62, C23</td>
<td>Shaft Spacer</td>
</tr>
<tr>
<td>118</td>
<td>K31, C23</td>
<td>Lantern Restrictor</td>
</tr>
<tr>
<td>118-1</td>
<td>P50A</td>
<td>Lantern Restrictor (Non-metal)</td>
</tr>
<tr>
<td>122</td>
<td>R11A</td>
<td>Expeller Ring/Stuffing Box Seal</td>
</tr>
<tr>
<td>124</td>
<td>R08A</td>
<td>Casing O-Ring</td>
</tr>
<tr>
<td>126</td>
<td>E62, C23</td>
<td>Gland Clamp Bolt</td>
</tr>
</tbody>
</table>
### APPENDIX A

**WARMAN BASIC PART NUMBERS (Cont.)**

<table>
<thead>
<tr>
<th>WARMAN BASIC PART No.</th>
<th>STANDARD WARMAN MATERIAL CODE</th>
<th>PART NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>138</td>
<td>E62</td>
<td>Grease Cup Adaptor</td>
</tr>
<tr>
<td>188</td>
<td>D20</td>
<td>Frame</td>
</tr>
<tr>
<td>190</td>
<td>A05A</td>
<td>Suction Cover</td>
</tr>
<tr>
<td>191</td>
<td>A05A</td>
<td>Impeller</td>
</tr>
<tr>
<td>305</td>
<td>E02</td>
<td>C-Spanner</td>
</tr>
<tr>
<td>306</td>
<td>E02</td>
<td>Shaft Wrench</td>
</tr>
<tr>
<td>307</td>
<td>E02</td>
<td>Bearing Assembly Lifting Plate</td>
</tr>
<tr>
<td>425</td>
<td>R08A</td>
<td>Dyna Seal</td>
</tr>
<tr>
<td>430</td>
<td>U14A</td>
<td>Nut Covers</td>
</tr>
<tr>
<td>-</td>
<td>E62</td>
<td>Casing Bolt</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Grease Cup</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Grease Nipple</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Hex Plug</td>
</tr>
<tr>
<td>A4-18665A</td>
<td>-</td>
<td>Shaft Spacer</td>
</tr>
<tr>
<td>A4-18666A</td>
<td>-</td>
<td>Expeller</td>
</tr>
</tbody>
</table>

**NOTE:** For details of specific Warman Material Codes, refer to Assembly, Operating and Maintenance Instructions, Part 1 – General Instructions for all Types of Warman Pumps, Appendix B.
APPENDIX B

LUBRICATION DATA SHEET

GREASE SPECIFICATION

Lithium soap base grease with EP additives and oxidation inhibitors.

N.L.G.I. Consistency No: 2
Drop Point > 170°C

RECOMMENDED GREASE: SHELL ALVANIA EP GREASE 2,
CASTROL EPL2, or equivalent

GREASE QUANTITY

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

<table>
<thead>
<tr>
<th>PUMP SIZE</th>
<th>GREASE QUANTITY - gms per Bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/2 TC</td>
<td>30</td>
</tr>
<tr>
<td>3/3 TC</td>
<td>50</td>
</tr>
<tr>
<td>4/4 TC, 6/4 TC, 8/4 TC</td>
<td>100</td>
</tr>
<tr>
<td>6/6 TC, 8/6 TC, 10/6 TC</td>
<td>100</td>
</tr>
<tr>
<td>8/8 TC, 10/8 TC</td>
<td>100</td>
</tr>
</tbody>
</table>

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.