Yellowpumps

ASSEMBLY, OPERATING & MAINTENANCE INSTRUCTIONS

TYPE ‘G’ GRAVEL PUMPS

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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 flow rate. 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 Yellowpump 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

1. OPERATION

MOTOR ROTATION CHECK

Remove all vee-belts or completely disconnect shaft coupling, as the case may be. **This is important!**

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

Warning: Rotation in direction opposite to the arrow on the pump will unscrew the impeller from the shaft causing serious damage to the pump.

PRIMING

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

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

NORMAL PUMP START UP

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

It is good practice whenever possible to start up pumps on water before introducing solids or slurry into the stream. On shutting down it is also desirable that pumps should be allowed to pump water only for a short period before shut down. Open intake valve (if any) and check that water is available at the inlet. Check drain valve (if any) is closed.

If a discharge valve is installed it is common practice to close it for start up. This is however mandatory only in some special cases where the motor could overload. Start pump and run up to speed, if pump is on suction lift execute priming procedure for facilities provided. When the pump is primed, isolate prime facilities (if any).

Open discharge valve. Check intake and discharge pressures (if gauges have been provided). Check flow rate by inspection of meters or pipe discharge.

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

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

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

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

It is preferable at start to have too much leakage than not enough. After the pump has run for 8-10 hours, gland bolts can be adjusted to give optimum leakage. If heating of gland persists, the packing should be removed and the gland repacked.

ABNORMAL START UP

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

Blocked intake pipe

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

Air entering gland

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

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

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

OPERATING FAULTS

Refer to the **fault finding chart** to determine the most likely cause of any problems. Some of the major faults that can occur are more fully detailed below.

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

Warning: pumps that are not fitted with a leak-off device must not be run for a long period against a closed discharge valve.

Low tank level

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

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

Blocked intake pipe

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

Blocked impeller

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

Safety warning: before applying manual torque to the pump shaft ensure that the intake and discharge lines are isolated and that the motor is disconnected.

Blocked discharge pipe

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

SHUTTING DOWN PROCEDURE

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

1. Close the discharge valve (if fitted) to reduce load on driving unit
2. Shut down the pump
3. Shut intake valve (if any)
4. If possible flush pump with clean water and let it discharge through the drain valve.
5. Gland sealing water (if any) must be left on during all subsequent operations, namely: Start up, running, shut down and run back.

Gland water may only then be turned off.

FAULT FINDING CHART

SYMPTOMS

FAULTS

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

Probable Faults

2. APPLICATION AND FEATURES OF TYPE 'G' GRAVEL PUMPS

These pumps are of heavy-duty construction, designed for continuous pumping of highly abrasive slurries containing large particles with high efficiencies, and low maintenance and ownership cost. They feature an unlined casing design, characterised by design simplicity, and minimum number of parts.

Important design features of this range of Yellowpump slurry pumps include:

- Cartridge type bearing assembly
- Casing attachment by quick-release clamps
- Heavy duty screw thread impeller attachment
- Through-bolt design throughout
- Easily replaceable shaft sleeve
- Replaceable casing components
- Minimum number of casing components

3. IDENTIFICATION OF PARTS

Each Yellowpump 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 Yellowpump 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. 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 FG108013 identifies the door to fit the casing of the 10/8 FG Yellowpump gravel pump. Refer to the component diagram of the appropriate size of Yellowpump for complete identification and description of component parts. Part names and basic part numbers are used in assembly instructions throughout this instruction manual. Yellowpump basic part numbers for all component parts of type 'G' pumps are listed in the appendix of this publication.

4. LUBRICATION – BEARINGS AND CENTRIFUGAL SEAL

It is recommended that grease used for lubricating both the rolling bearings (where applicable), and the 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
Work penetration 25°C A.S.T.M.	265 – 295

Recommended grease: **Good quality EP2 type grease**

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, based on mid-range pump size, 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 pump overhaul should be inspected to assess suitability for reuse, and identification of new parts should be 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 anti-seize compound 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. Exposure to direct and continuous sunlight will accelerate elastomer degradation.

5.1 FRAME ASSEMBLY

5.1.1 Fitting bearing assembly to base
Refer figs 1 and 8

(i) Insert **adjusting screw** (001) in **base** (003) from end face. Fix to base by fitting one nut and fully tighten. Fit two additional nuts separated by two flat washers. These nuts should be loose on adjusting screw and spaced well apart.

(ii) Apply anti-seize compound to semi-circular machined surfaces (bearing housing support cradle) in base.

(iii) Lower **bearing assembly** (005) into base. Approximately match machined surfaces of the bearing housing with those in base. Ensure that the bearing housing lug has fitted over the adjusting screw mounted in the base, and that it fits between the nuts and washers.

(iv) Fit **clamp bolts** (012) through base from below. Mount **clamp washer** (011) on each bolt (domed side up) and screw on nuts. Fully tighten clamp bolts on side 'A', i.e. on right hand side of base as viewed from the drive-end (refer figs 1 and 8). Clamp bolts on the other side (i.e. side 'B') should not be tightened at this stage. Leave finger tight only, to maintain alignment but allow axial movement of the bearing assembly.

(v) Apply anti-seize compound to **shaft** (073) protruding from **labyrinth** (062) at Impeller-end. This will assist fitting and removal of shaft components, and prevent damage to shaft surfaces by moisture.

(vi) Fit two pieces of timber, or an appropriate assembly cradle, to underside of base to prevent the pump from tipping forward during assembly of casing, as shown in fig 2. Ensure that the base is at a sufficient height above the floor to enable casing components to be assembled.

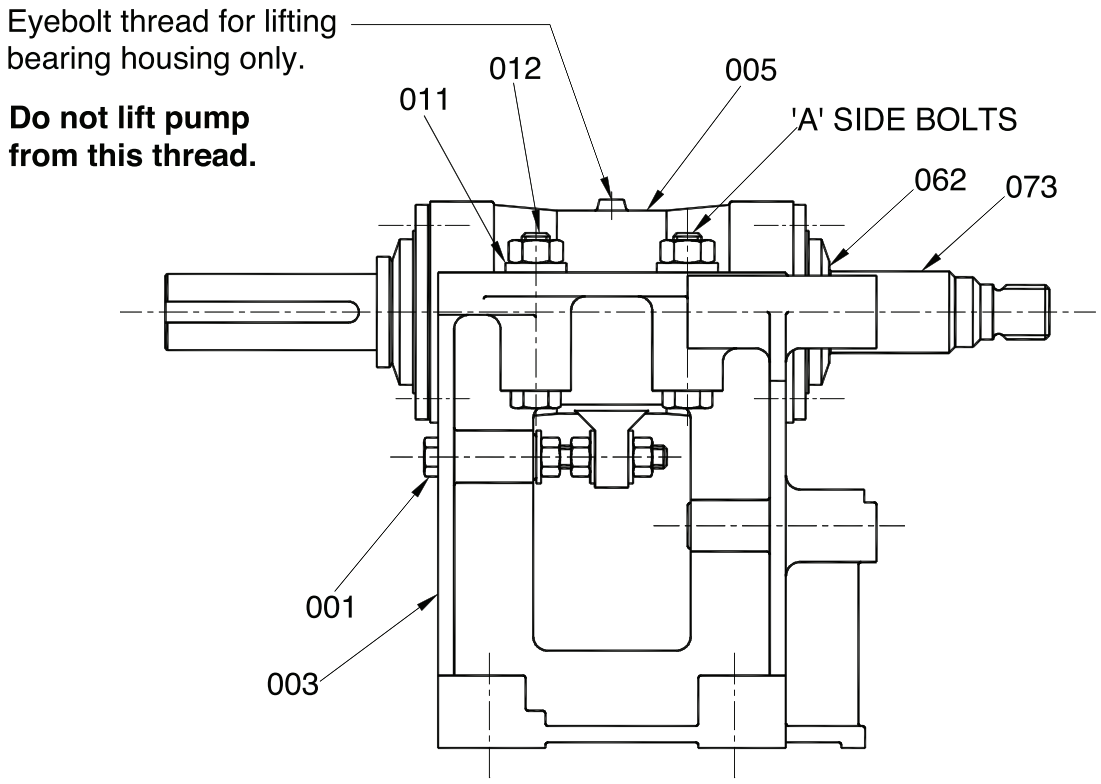


Fig 1. Frame assembly

5.1.2 Fitting adaptor plate
Refer fig 2

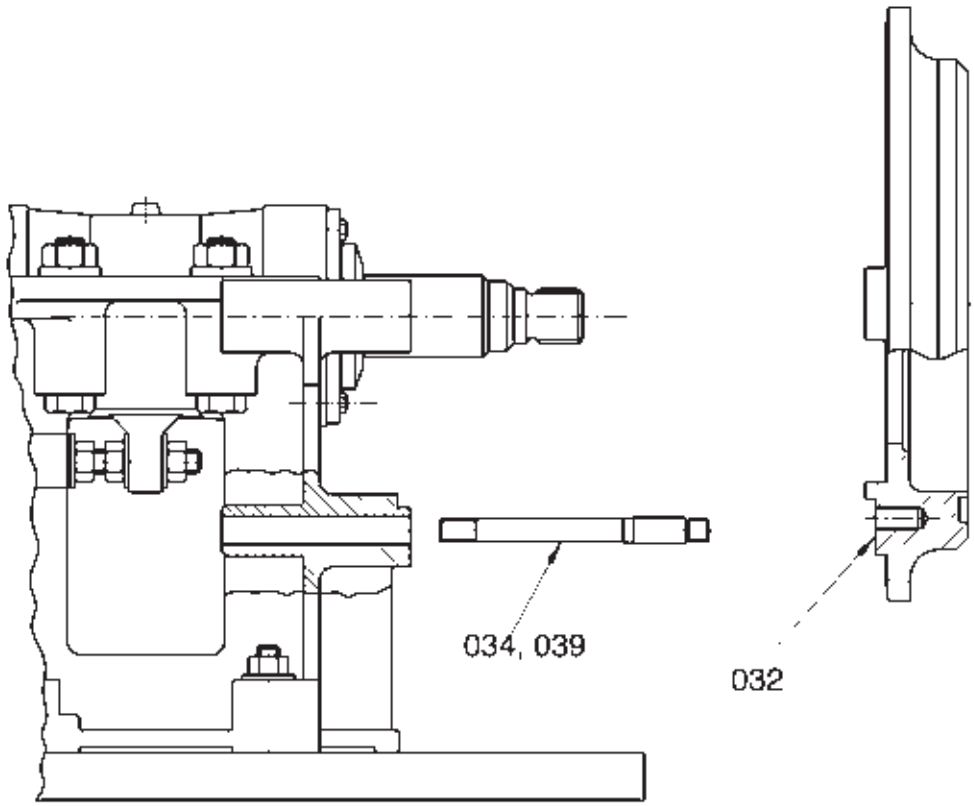


Fig 2. Fitting adaptor plate

(i) Screw **adaptor plate studs** (034 or 039) to tapped holes in **adaptor plate** (032), where applicable, and fully tighten.

(ii) Lift adaptor plate, and fit to base, engaging studs in corresponding holes in base, where applicable, and ensuring that the adaptor plate locating spigot engages with the corresponding base recess. Before fitting adaptor plate, apply anti-seize compound to the recess to assist future dismantling. Fit nuts to studs and fully tighten.

For pumps in which adaptor plates have clearance holes for bolts, fit **adaptor plate bolts**(034) to holes in adaptor plate, and engage corresponding holes in Base. Fit nuts to bolts and fully tighten.

5.2 SEAL ASSEMBLY

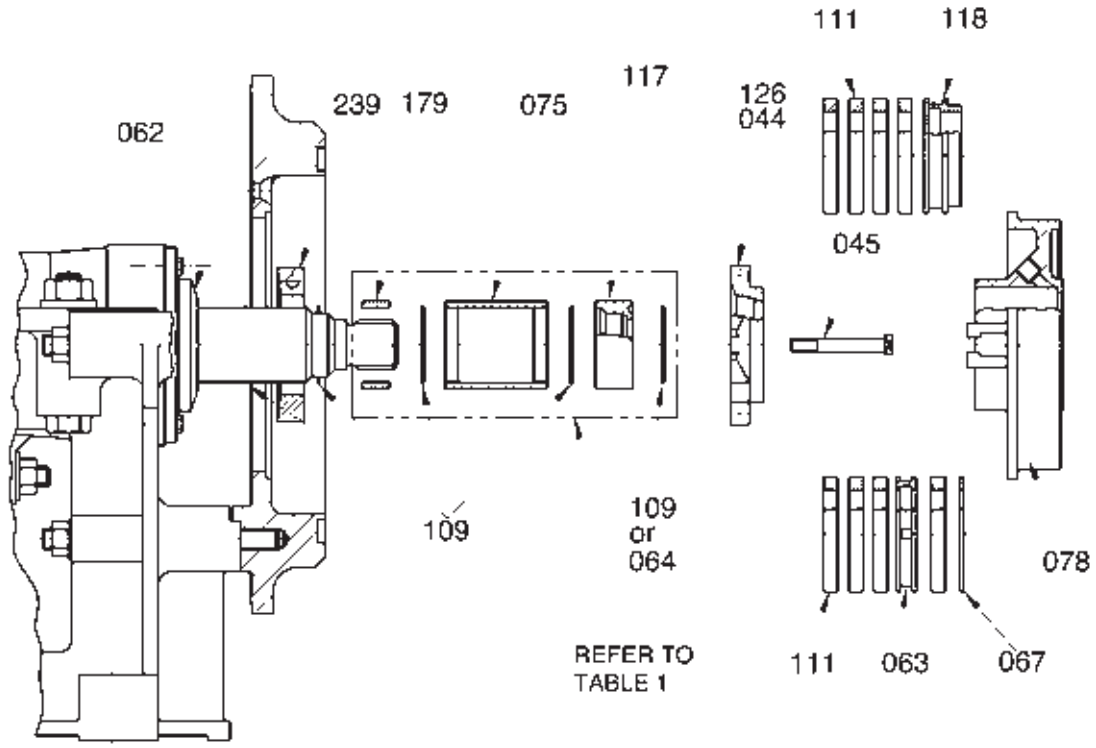


Fig 3. Gland seal assembly

5.2.1 GLAND SEAL ASSEMBLY

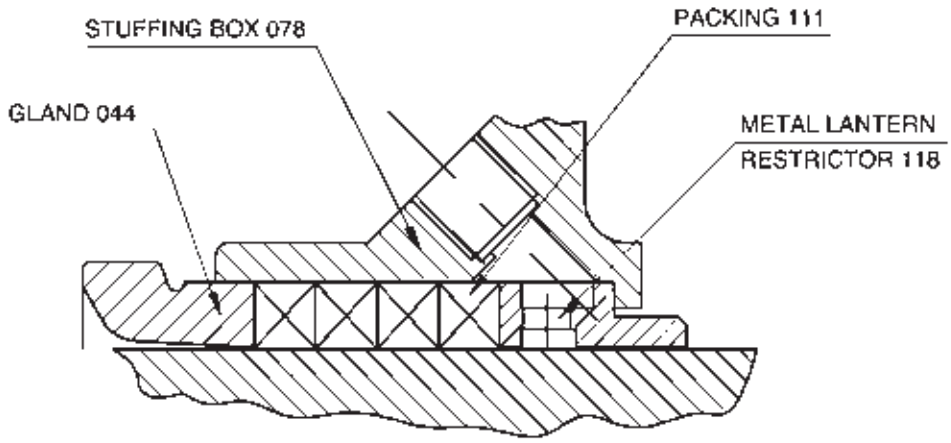
Fitting stuffing box, lantern restrictor, (or neck and lantern rings), packing, gland, shaft sleeve, shaft spacer, and shaft sleeve O-Rings
Refer figs 3, 4 and 6

Alternative stuffing box assemblies, which may be used depending on the particular pump application, are shown in fig 4. Gland sealing water flowrate may be minimized by using a non-metallic **lantern restrictor** (118-1), as shown in fig 4b.

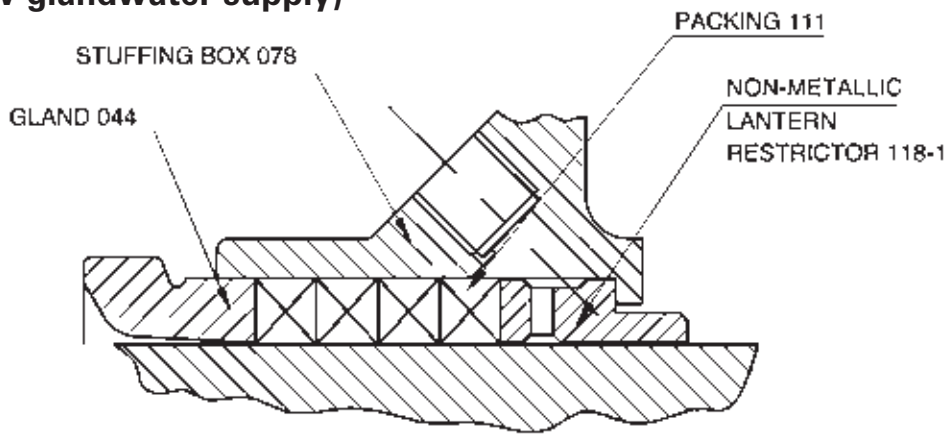
Different procedures are described below for assembling the seal components, depending on whether the pump frame size is larger than F or S. Either method may be used according to individual preference.

Figure 3 shows the relative position of impeller release collar, 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 1 lists the components assembled onto the shaft, in the order in which they are fitted, commencing at the **labyrinth** (062) at the Impeller-end of the bearing assembly. Pumps having similar arrangements of parts are grouped together in the table. (Generally, pumps having modified basic frames (CC, DD, etc) will have the same shaft components as those having basic frames (C, D, E, etc).)

A. Suitable for low lift & positive head applications



B. Suitable for high lift applications (Low flow glandwater supply)



C. Suitable for high lift applications (Very low flow gland water supply)

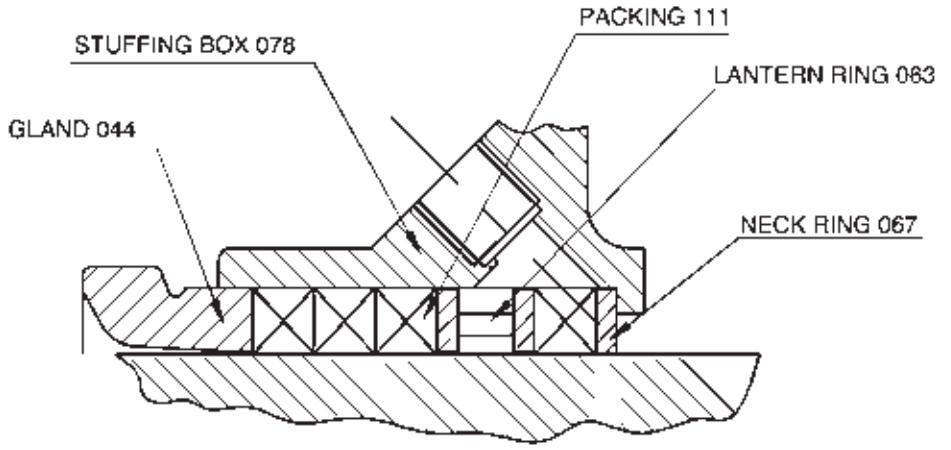


Fig. 4 Alternative gland arrangements for stuffing boxes

TABLE 1
GLAND SEAL – ORDER OF ASSEMBLY OF COMPONENTS ON SHAFT

FRAME	PUMP	SHAFT COMPONENTS (in order from end of impeller-end Labyrinth to Impeller)
D, F,	6/4D-G 8/8F-G 10/8F-G	109 Shaft O-Ring 075 Shaft Sleeve 109 Shaft O-Ring 117 Shaft Spacer 109 Shaft O-Ring
E, F,	6/6E-G 8/6E-G	109 Shaft O-Ring 075 Shaft Sleeve 109 Shaft O-Ring 117 Shaft Spacer 064 Impeller O-Ring
F	10/10F-G 12/10F-G	109 Shaft O-Ring 179 Shaft Sleeve Spacer 109 Shaft O-Ring 075 Shaft Sleeve 109 Shaft O-Ring 117 Shaft Spacer 109 Shaft O-Ring
G	14/12G-G 12/10G-G 12/12G-G	109 Shaft O-Ring 239 Impeller Release Collar 109 Shaft O-Ring 075 Shaft Sleeve 109 Shaft O-Ring 117 Shaft Spacer 109 Shaft O-Ring

(A) Frame Sizes: D, E, F, FF

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 4c.

(iii) Stand **shaft sleeve** (075) on end, and slide through lantern restrictor.

(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) Determine which components fit between the **labyrinth** (062) and the **shaft sleeve** (075 or 076), from the pump components diagram, or from table 1, for the particular pump being assembled. Fit these components to the shaft. Refer to part 4A of the instruction manual for details of fitting the **impeller release collar** (239), if required.

(vii) Apply anti-seize compound to stuffing box location recess in adaptor plate to assist future removal of stuffing box. Fit assembled stuffing box to adaptor plate, engaging shaft sleeve bore with shaft, and tapping stuffing box into position with a mallet. Locate stuffing box with gland seal water connection at the top. If 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 1.

NOTE:

(a) Apply heavy grease to the O-Ring groove in the shaft spacer to assist in holding the O-Ring which seals against the back face of the 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.

(B) Frame Size: G

Assemble components for gland seal assembly as described below.

(i) Determine which components fit between **labyrinth** (062) and **impeller**, from the pump components diagram, or from table 1, for the particular pump being assembled, and fit these components to the shaft. Refer to part 4A of the instruction manual for details of fitting the **impeller release collar** (239), if required.

NOTE:

(a) Apply heavy grease to the O-Ring groove to assist in holding the O-Ring which seals against the back face of the impeller.

(b) All O-Rings will be compressed and fully contained within their respective grooves when the impeller is screwed on to the shaft.

(ii) Place **lantern restrictor** (118) (small diameter towards Impeller end) over shaft sleeve, and move along sleeve to contact labyrinth (or impeller release collar, if applicable). In some applications, a **neck ring** (067), and **lantern ring** (063) are fitted in place of lantern restrictor, as shown in Fig 4c.

(iii) Attach **lifting plate** (310) to **stuffing box** (078), using the 3 jacking screws provided, and ensure that the gland seal water connection in stuffing box is in line with the lifting beam (see Fig 6).

(iv) Lift stuffing box with lifting plate, using a hoist, and insert stuffing box in adaptor plate, tapping into position with a mallet.

(v) Assemble all gland parts in stuffing box in the following manner, after all other parts of pump have been assembled.

(a) Slide **lantern restrictor** (118) or **neck ring** (067) inside stuffing box against retaining lip.

(b) Fit first **packing ring** (111) of required length to fill the stuffing box annulus, and push against the neck ring or lantern restrictor.

(c) Slide **lantern ring** (063) and press to flatten first packing ring. When a lantern restrictor is used, the lantern ring is omitted.

(d) Fit remaining packing rings (stagger joints) to almost completely fill the stuffing box chamber. Flatten each one separately.

(e) Assemble **gland** (044) halves over shaft sleeve with gland spigot towards stuffing box, fit **gland clamp bolts** (126), and fully tighten. Fit gland into stuffing box, and push down to compress packing rings. Fit gland bolts (045) and tighten sufficiently to remove slack (final adjustment will be made when test running pump).

(vi) 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 figs 5 and 6

Different procedures are described below for assembling the seal components, depending on whether the pump frame size is larger than F. Either method may be used according to individual preference.

Fig 5 shows a typical assembly of shaft components, indicating the relative position of parts on the pump shaft, which varies according to pump size. Table 1 lists shaft components for a **gland sealed pump** in the order in which are fitted to the shaft, commencing at the end face of the **labyrinth** (062) on the pump end of the bearing assembly. Pumps with similar sets of shaft components are grouped together in the table. Generally, in **centrifugally sealed pumps**, the same sets of component parts apply as for **gland sealed pumps**, except for substituting the **expeller** (028) for the **shaft spacer** (117). Exceptions to the general case are listed in table 2.

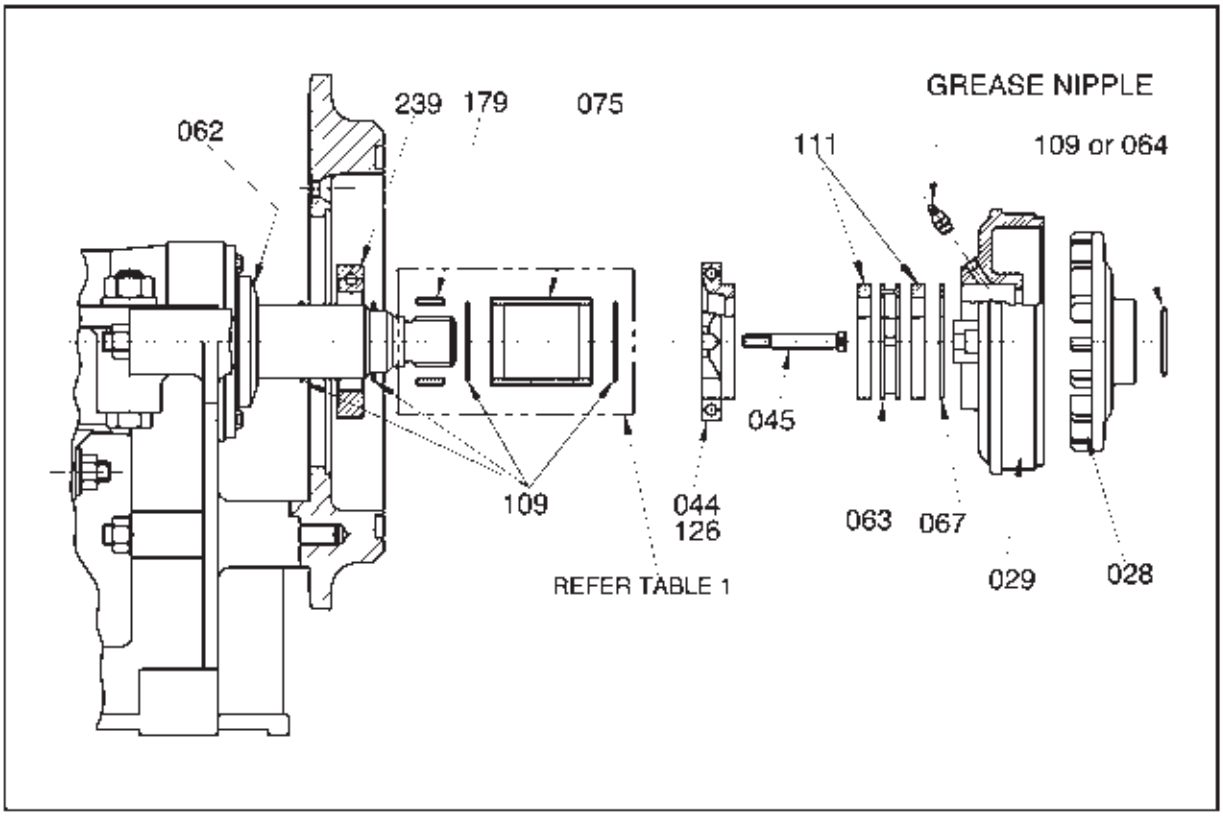


Fig.5 Centrifugal seal assembly

The following instructions describe the procedure to pack the gland of the expeller ring, which differs according to the pump frame size.

(A) Frame Sizes: D, E, F, FF

(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:

(1) Fit first **packing ring** (111) of required length to fill the packing annulus.

(2) Fit **lantern ring** (063), and press down to flatten first packing ring.

(3) Fit remaining packing rings, staggering joints, to almost completely fill the packing chamber. Flatten each ring separately.

TABLE 2
CENTRIFUGAL SEAL – ORDER OF ASSEMBLY OF COMPONENTS ON SHAFT
(Special cases only – for other pumps refer to table 1, and replace 117 shaft spacer with 028 expeller)

FRAME	PUMP	SHAFT COMPONENTS (in order from end of impeller-end labyrinth to impeller)
D	6/4D-G	109 Shaft O-Ring 075 Shaft Sleeve 109 Shaft O-Ring 028 Expeller 064 Impeller O-Ring

(iv) 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).

(vi) Determine which components fit between **labyrinth** (062) and **shaft sleeve** (075), from the pump components diagram, or from tables 1 and 2 for the particular pump being assembled. Fit these components to the shaft. Refer to part 4A of the instruction manual for details of fitting the **impeller release collar** (239), if required.

(vii) Apply anti-seize compound to expeller ring location recess in adaptor plate to assist future removal of expeller ring. Fit the assembled expeller ring to the adaptor plate, and tap into position with a mallet. Locate expeller ring with the grease inlet connection at the top. **Lifting plate** (310) may be used in fitting the assembled expeller ring to the adaptor plate on the larger pump sizes, as shown in fig 6. 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) Assemble remaining O-Rings and shaft spacers, which fit between **shaft sleeve** (075) and **expeller** (028), as indicated in tables 1 and 2.

(ix) Fit **expeller** (028) to shaft, and compress assembled parts.

(x) Fit O-Ring (109 or 064) to groove in expeller.

NOTE:

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

(2) All O-Rings will be compressed and fully contained within their grooves when the impeller is screwed to the shaft.

(xi) Apply anti-seize compound liberally to shaft thread.

(xii) 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 grease nipple, as follows:

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. Re-fill grease cup with grease.

(B) Frame G

(i) Determine which components fit between **labyrinth** (062) and **expeller** (028), from the pump components diagram, or from table 1, for the particular pump being assembled. Fit these components to the shaft. Refer to part 4A of the instruction manual for details of fitting the **impeller release collar** (239), if required.

(ii) Assemble **lantern ring** (063) followed by **neck ring** (067) on shaft sleeve, and move along sleeve to contact labyrinth (or impeller release collar, if applicable)

(iii) Fit **expeller ring** (029) to **lifting plate** (310), using the three jacking screws, as shown in Fig 6. Ensure that grease inlet on expeller ring is in line with the lifting beam.

(iv) Apply anti-seize compound to expeller ring location recess in adaptor plate to assist future removal of expeller ring. Lift expeller ring, assembled to lifting beam, using a hoist, and fit to adaptor plate, tapping into position with a mallet.

(v) Assemble gland parts in expeller ring as described below, when all other pump assembly is complete.

(1) Slide **neck ring** (067) along shaft sleeve into expeller ring gland recess, to rest on retaining lip.

(2) Fit first **packing ring** (111) of required length to fill the packing annulus, and push against neck ring.

(3) Slide **lantern ring** (063) on shaft sleeve, and press down to flatten first packing ring.

(4) Fit remaining packing rings (stagger joints) to almost completely fill the packing chamber, flattening each ring separately.

(5) Assemble **gland** (044) halves over shaft sleeve, with gland spigot towards expeller ring, fit **gland clamp bolts** (126), and fully tighten. Engage gland in expeller ring seal annulus, 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).

(6) 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 grease nipple, as follows:

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. Re-fill grease cup with grease.

(vi) Assemble **shaft O-Ring** (109) between **shaft sleeve** (075) and **expeller** (028), as indicated in table 1.

(vii) Fit **expeller** (028) to shaft, and compress assembled parts.

(viii) Fit **O-Ring** (109 or 064) to groove in expeller.

NOTE:

(1) Apply heavy grease to the expeller O-Ring groove to hold the O-Ring which seals against the back face of the impeller.

(2) All O-Rings will be compressed and fully contained within their grooves when the impeller is screwed to the shaft.

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

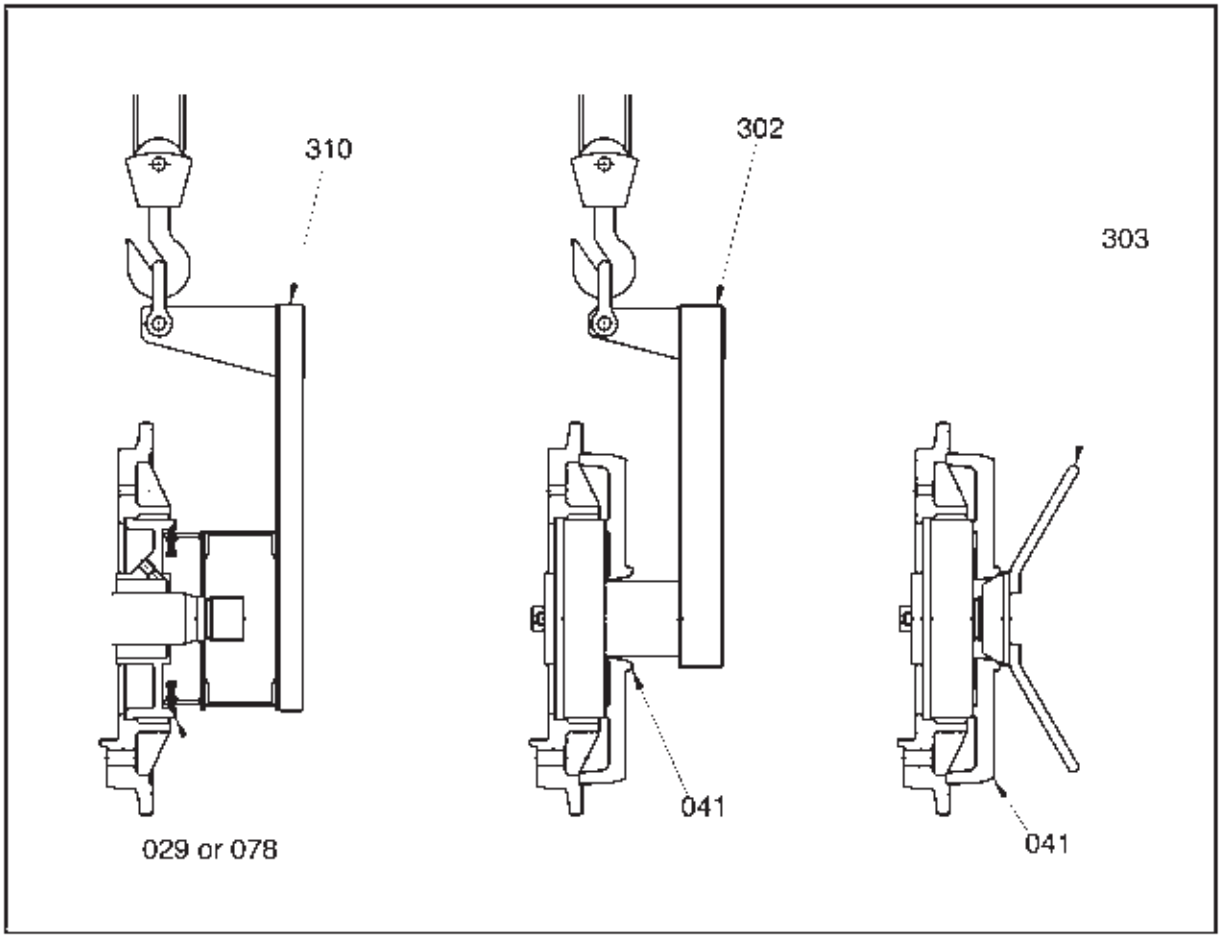


Fig.6 Pump assembly tools

5.3 PUMP CASING ASSEMBLY

The pump casing typically comprises a bowl, and casing end plates, viz the door and back liner. In the smaller pump sizes the door is integral with the bowl, whereas in all other pump sizes these are provided as separate parts.

5.3.1 TWO-PART CASING

Fitting seal rings, back liner, impeller, bowl, and clamp ring
Refer figs 6, 7 and 8

In two-part casings, a separate door is not provided, as it is integral with the bowl. This applies to pump size 6/4D-G. The pump casing assembly, with two-part casings, is described below.

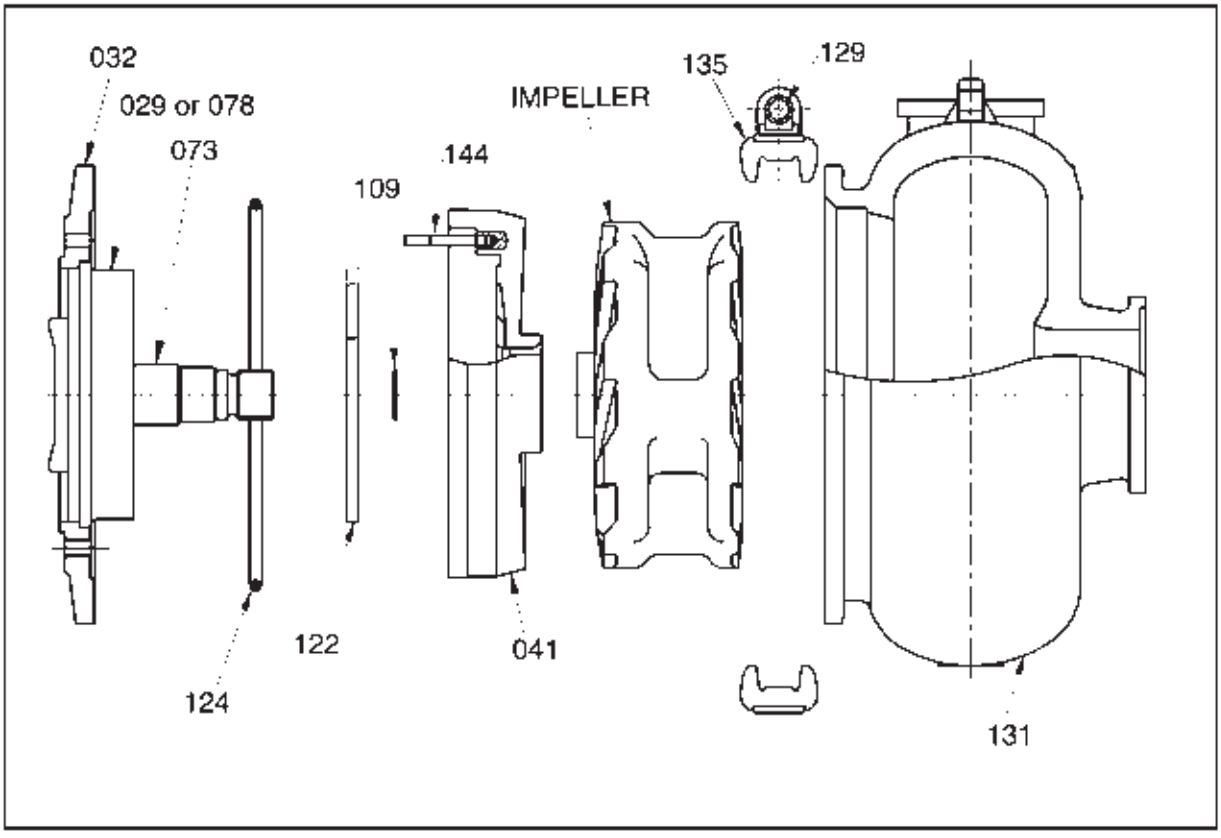


Fig. 7 Two-part casing assembly.

(i) Fit 'C'-section **seal ring** (122) to periphery of **stuffing box** (078) or **expeller 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.

(i) (ii) Fit **back liner** (041), as follows:

(a) Screw **back liner studs** (144) to tapped holes in back liner and fully tighten.

(b) Place back liner in position, concentric with **shaft** (073), engaging back liner studs with holes in **adaptor plate** (032). Fit washers and nuts to studs, and leave loose at this stage.

(c) Fit **shaft key** (070) in shaft keyway, and bolt **shaft wrench** (306) to shaft, over key. Ensure that **clamp bolts** (012) on side 'B' of base (refer fig 8) are sufficiently tight to hold bearing assembly horizontal, but not lock it. Restrain shaft with wrench, and fit **locating nut** (303) on shaft thread, as shown in fig 6. The conical face will locate the back liner in its correct radial position, and engage the peripheral spigot on the back liner with the corresponding recess in the adaptor plate. Fully tighten all back liner studs, and remove locating nut.

(d) Place **bowl seal** (124) over periphery of back liner, and move backwards until it is in contact with the adaptor plate.

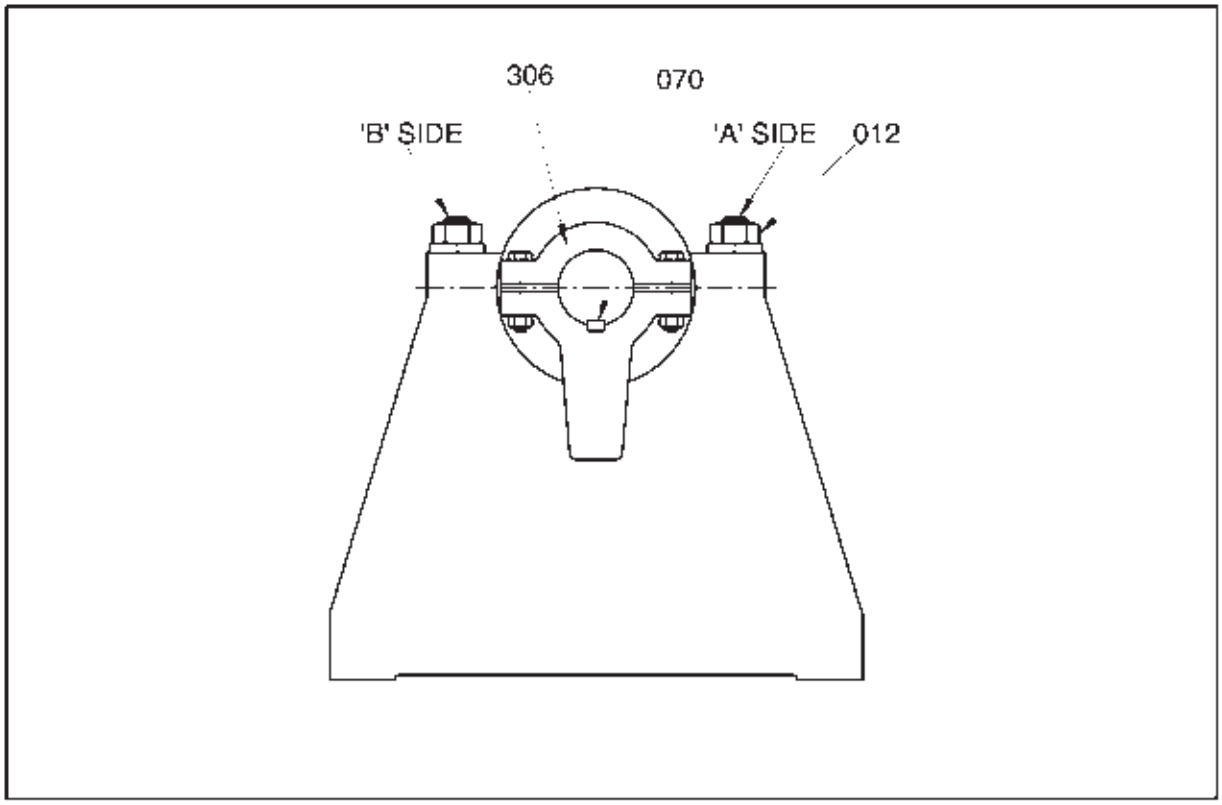


Fig. 8 View of base from drive-end.

(iii) Fit **impeller** to shaft thread as follows:

(a) Ensure that the O-Ring (109) at the end of the expeller or shaft spacer is positioned in its locating groove.

(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. Tighten impeller on shaft, with bar between between impeller vanes, and flogging shaft wrench.

(c) Move bearing assembly rearwards by adjustment of **adjusting screw** (001) until impeller contacts back liner.

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

(iv) Fit **bowl** (131), as described below. The bowl is secured to the adaptor plate by the clamp ring.

(a) Ensure that the **bowl seal** (124) is correctly positioned around the back liner, and against the adaptor plate.

(b) Lift bowl, using hoist, and position around back Liner. Push rearwards until it contacts the bowl seal.

(c) Adjust angular orientation of bowl discharge to the required position.

(v) Fit **clamp ring**(135), as described below. These rings are made up of four segments, joined together by four **clamp ring bolts** (129).

(a) With the bowl supported in place around the back Liner, and fully rearwards against the adaptor plate clamp flange, fit one clamp ring segment on the upper vertical centreline to clamp the adaptor plate and bowl clamping flanges.

(b) Fit two clamp ring segments on the horizontal centreline, adjacent upper segment, and attach to upper segment with clamp ring bolts.

(c) Fit remaining clamp ring segment on lower vertical centreline, and attach clamp ring bolts.

(d) Tighten each clamp ring bolt in turn to lock bowl in position.

5.3.2 THREE-PART CASING

Fitting seal rings, back Liner, impeller, bowl, clamp rings, door, and door clamp plate

Refer figs 6, 8 and 9

In three part-casings, a separate door is provided, independent of the bowl. This applies to pump sizes larger than 6/4D-G. The pump casing assembly, with three-part casings, is described below.

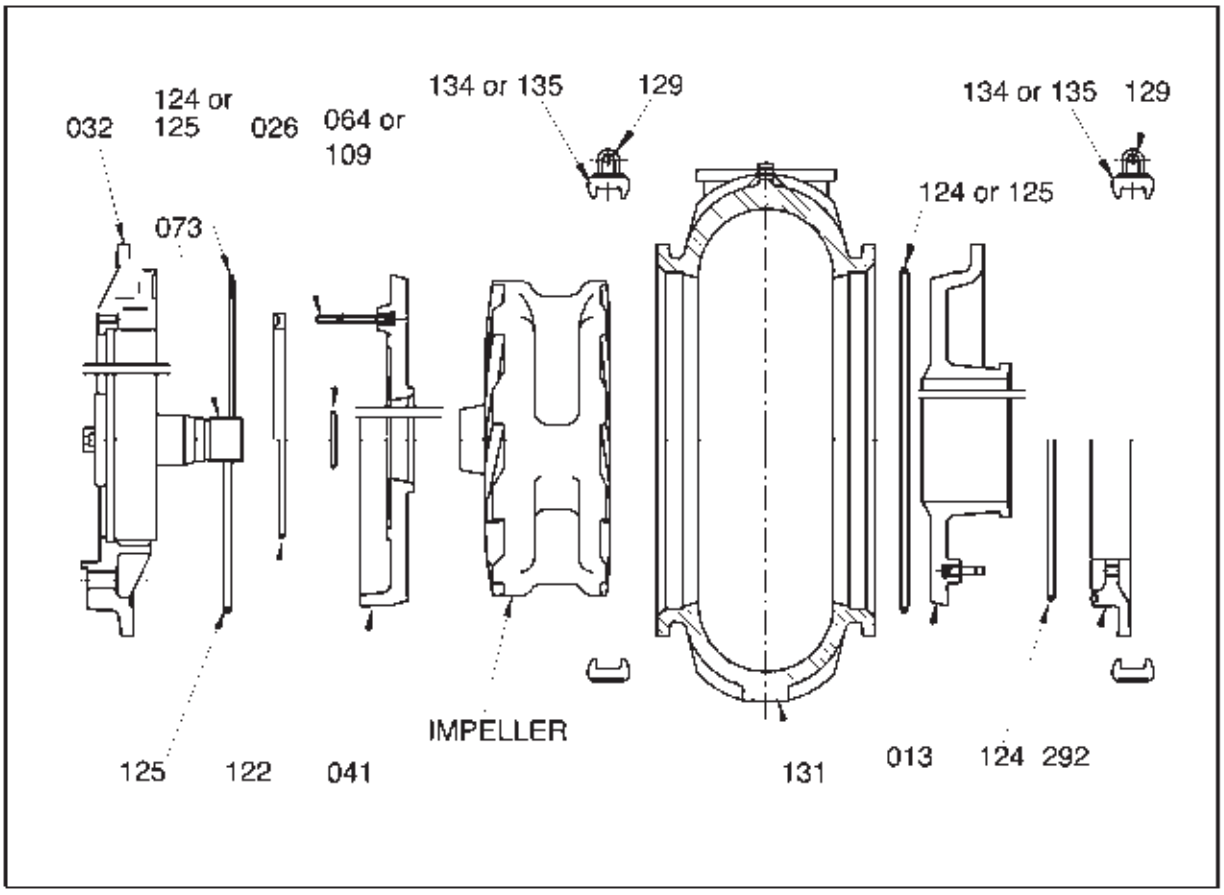


Fig. 9 Three-part casing assembly

(i) Fit 'C'-section, or O-Ring type, **seal ring** (122) to periphery of **stuffing box**(078) or **expeller 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) Where applicable, fit 'C'-section, pressure activated, **bowl ring** (124 or 125). Fit to groove in the adaptor plate, mounted flat face in, using contact cement adhesive if required. This seal configuration is shown above the centreline in fig 9.

NOTE: This instruction applies only to pump sizes in which the bowl seal (124, 125) between the back liner and adaptor plate is a 'C'-section pressure seal, eg, in the 6/6E-G pump. Where this seal is an O-Ring, eg, in the 6/4D-G pump, ignore this instruction.

(iii) Fit **back liner** (041), as follows:

(a) Screw **back liner studs** (026) to tapped holes in back liner and fully tighten.

(b) Suspend **lifting tube** (302) from hoist (refer Fig 6). Stand back liner on edge, and engage lifting tube in bore of liner. Lift tube, with liner attached, and slide tube over shaft thread. Align studs with holes in adaptor plate, and move back liner fully rearwards. Ensure that the seal rings have not been displaced. Fit washers and nuts to back liner studs, and leave loose at this stage. Remove lifting tube.

(c) Fit **sahft key** (070) in shaft keyway, and bolt **shaft wrench** (306) to shaft, over key. Ensure that **clamp bolts** (012) on side 'B' ofbase (refer Fig 8) are sufficiently tight to hold bearing assembly horizontal, but not lock it. Restrain shaft with wrench, and fit **locating nut** (303) on shaft thread, as shown in fig 6. The conical face will locate the back liner in its correct radial position, and engage the peripheral spigot on the back liner in the corresponding recess in the adaptor plate on some pump sizes (refer note below). Fully tighten all back liner studs, and remove locating nut.

NOTE: The spigot engagement applies only to pump sizes in which the bowl seal (124, 125) between the back liner and adaptor plate is an O-Ring, eg the 6/4D-G pump. Where this seal is a 'C'-section pressure seal, eg, the 6/6E-G pump, spigot engagement is not provided.

(d) Where applicable, place O-Ring type **bowl seal** (124 or 125) over periphery of back liner, and move rearwards until it is in contact with adaptor plate. This seal configuration is shown below the centreline in Fig 9.

NOTE: This instruction applies only to pump sizes in which the bowl seal (124, 125) between the back liner and adaptor plate is an O-Ring, eg in the 12/10F-G. pump. Where this seal is a 'C'-section pressure seal, eg, in the 6/6E-G pump, ignore this instruction.

(iv) Fit **impeller** 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.

(b) Select **impeller**, and apply anti-seize compound to thread. Lift impeller, using a hoist, and screw to shaft. While restraining impeller, turn shaft with wrench to engage impeller and shaft threads. Tighten impeller on shaft with bar between impeller vanes, and flogging shaft wrench.

(c) Move bearing assembly rearwards by adjustment of **adjusting screw** (001) until impeller contacts back liner.

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

(v) Fit **bowl** (131), as described below. The bowl is secured to the adaptor plate by means of the clamp ring.

(a) Ensure that the O-Ring type **bowl seal** (124 or 125) (where applicable) is correctly positioned around the Back Liner, and against the adaptor plate.

(b) Lift bowl from the lifting lug provided, using a hoist, and position around back liner. Push rearwards until it contacts the bowl seal.

(c) Adjust angular orientation of bowl discharge to the required position.

(vi) Fit first **clamp ring** (134), as described below. These rings are made up of four segments, joined together by four **clamp ring bolts** (129).

(a) With the bowl supported in place around the back liner, and fully rearwards against the adaptor plate clamp flange, fit one clamp ring segment on the upper vertical centreline to clamp the adaptor plate and bowl clamping flanges.

(b) Fit two clamp ring segments on the horizontal centreline, adjacent upper segment, and attach to upper segment with clamp ring bolts.

(c) Fit remaining clamp ring segment on lower vertical centreline, and attach clamp ring bolts.

(d) Tighten each clamp ring bolt in turn to lock bowl in position.

(vii) Fit **door** (013) as described below. Depending on pump size, they may be fitted with one of two door design configurations. In one door design, provided on some pump sizes, the peripheral clamp flange is integral with the door, and its assembly is described in 'procedure A'. In an alternative design configuration, the peripheral clamp flange is provided on a separate part, the **door clamp plate** (292), which is fastened to the door by multiple **door studs**. This type of door design is assembled as described in 'procedure B'.

(A) Procedure A – Applicable only to door with integral peripheral clamp flange.

This door configuration is shown above the centreline in fig 9.

(a) Place **bowl seal** (124 or 125) over outer cylindrical surface of door, and move forwards until it is in contact with the peripheral clamp flange.

(b) Lift door, using a hoist, and fit inside bowl. Ensure that bowl seal has not been displaced. Push door rearwards until it contacts the bowl clamp flange.

(c) Fit the second clamp ring, as described in (vi) above, to fix the door to the bowl.

(B) Procedure B – Applicable only to door with peripheral clamp flange on separate door clamp plate, which is bolted to door.

This door and seal configuration is shown below the centreline in Fig 9.

(a) Fit **door seal** (124 or 125) to groove in end face of **door clamp plate** (292), using contact cement adhesive if required. This seal may be alternatively a 'C'-section pressure seal, or an O-Ring seal (a shown in fig 9 below centreline), depending on the particular pump size. If of the 'C'-section pressure seal type, mount flat face in, against door clamp plate.

(b) Firmly fasten **studs** to tapped holes in door.

(c) Place door on a bench top, or floor, with studs upwards. Lift door clamp plate and position over door, with door seal downwards. Ensure that seal is not displaced. Engage studs with corresponding holes, and lower door clamp plate until it rests on door, with door seal in contact.

(d) Fit nuts to studs, and tighten uniformly.

(e) Where applicable, place O-Ring type **bowl seal**(124 or 125) over periphery of door, and move rearwards until it is in contact with clamp flange of door clamp plate.

NOTE: This instruction applies only to pump sizes in which the bowl seal (124, 125) between the door and door clamp plate is an O-Ring, eg, in the 14/12G-G pump.

(f) Fit the second clamp ring, as described in (vi) above, to fix door to bowl.

5.4 MISCELLANEOUS FITTINGS

Refer fig 10

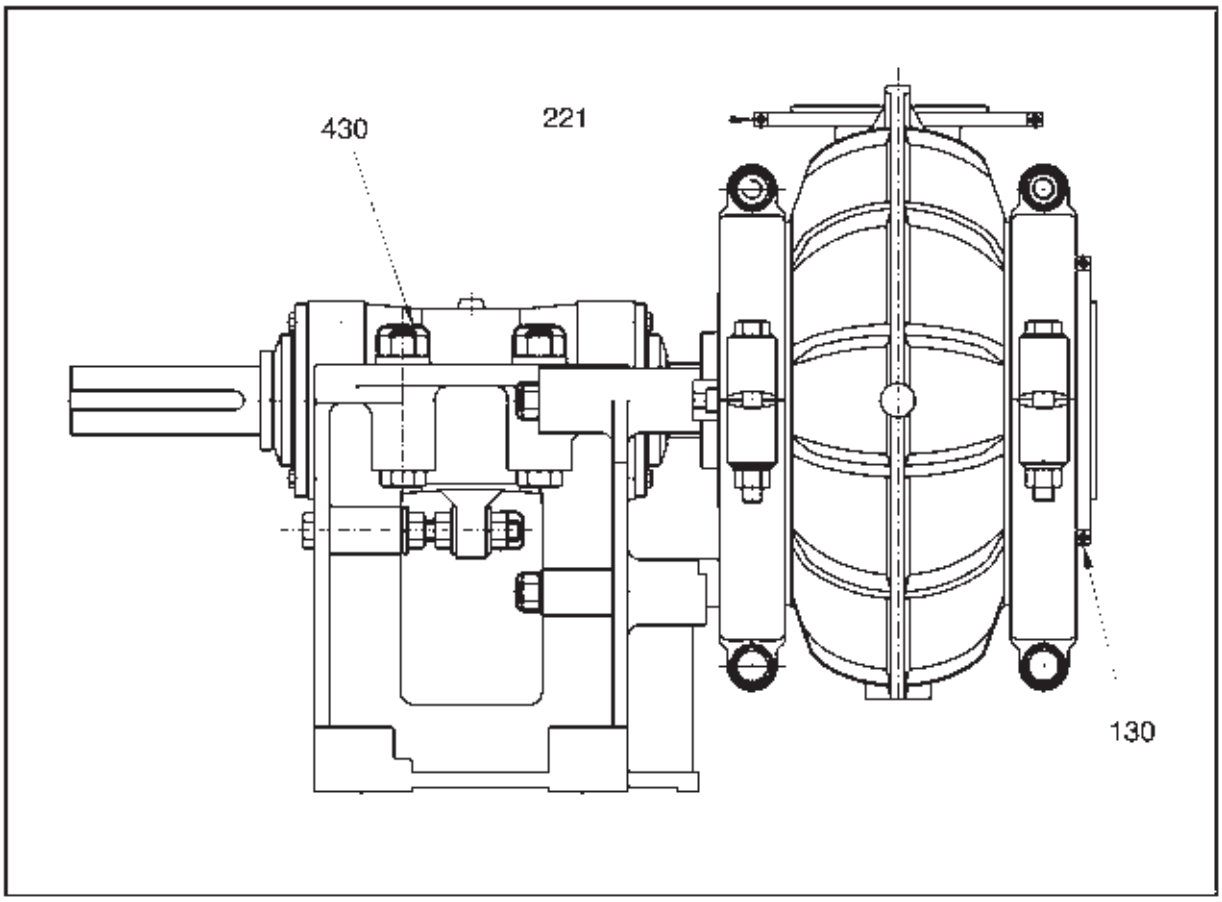


Fig. 10 Assembled pump

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

(i) Fit elastomer **nut covers** (430) to all external nuts to prevent fouling of threads with slurry.

(ii) Fit split **flanges** (130, 221) to intake and discharge openings. Screw clamp bolts to tapped holes in flange halves, and fully tighten to secure flanges.

(iii) The **intake joint ring** (060) and **discharge joint ring** (132) are supplied loose with pumps. Fit intake joint ring and discharge joint ring as shown in fig 10, using contact cement adhesive to provide support during fitting of intake and discharge pipework.

5.5 IMPELLER ADJUSTMENT

Refer figs 8 and 11.

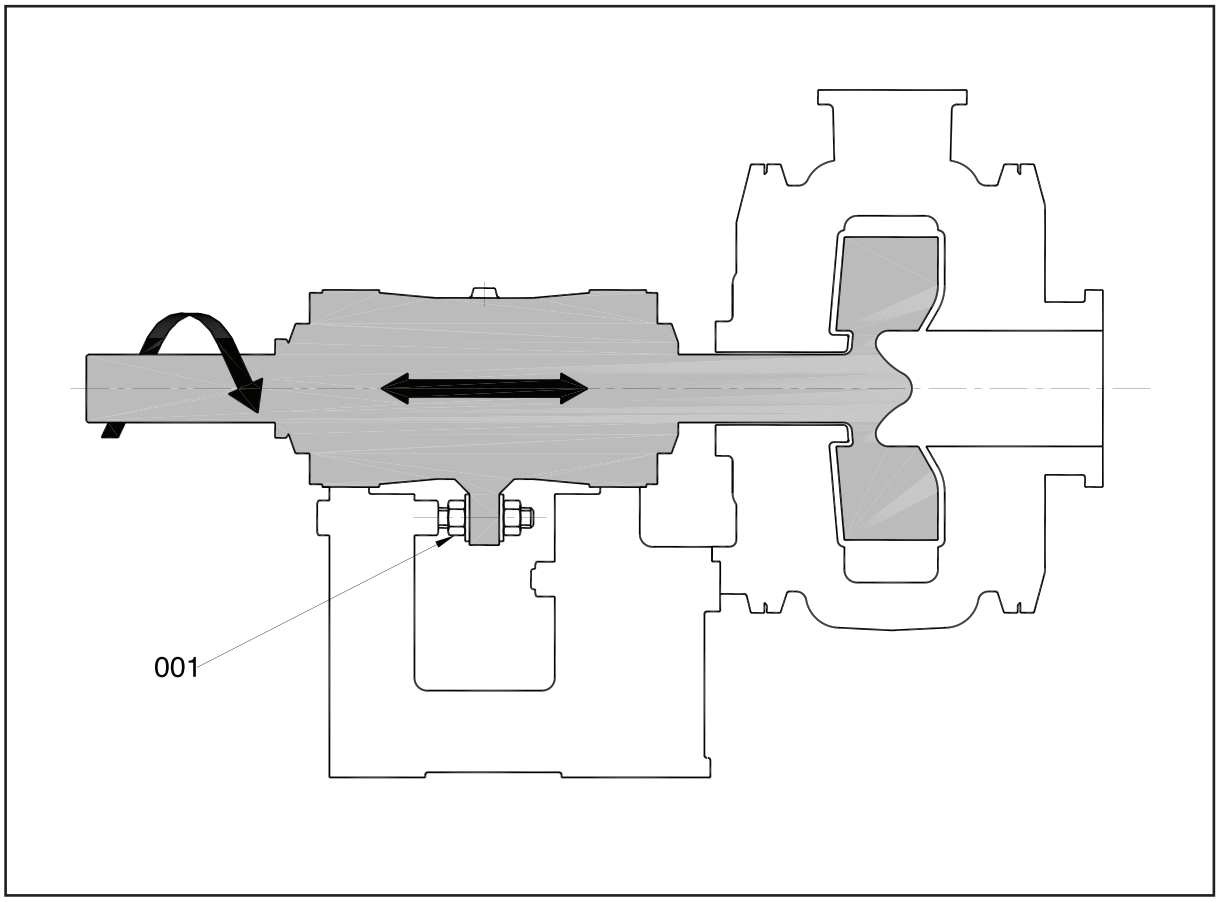


Fig. 11 Impeller adjustment

(a) Initial adjustment

With a gland seal fitted, the pump should be adjusted to operate with the impeller having minimum axial clearance with the intake-end casing surface. Adjustment of impeller front-end clearance is carried out as follows:

(i) Rotate the shaft clockwise (as viewed from the drive-end) by hand, and move the bearing assembly forward (towards the pump intake) by adjusting the rear nut on the **adjusting screw** (001) until the impeller contacts the casing surface.

(ii) Unscrew the rear nut by one sixth of a turn, and move the bearing assembly back by adjustment of the front nut on the adjusting screw until the lug on the bearing assembly contacts the rear nut. Fully tighten the front nut to secure the bearing assembly in position.

(iii) Ensure that the shaft can now rotate freely without contact of the impeller with the casing surface. If contact occurs, repeat step (ii).

NOTE: After the initial Impeller adjustment is completed, the **bearing housing clamp bolts** (012) must be tightened to torque values indicated in table 3, below. If a torque wrench, or equivalent device is not available, bolts should be tightened in accordance with the procedure as described in appendix B.

With a centrifugal seal assembly fitted, the pump should be adjusted to operate with the impeller having approximately equal axial clearance with the front and rear casing liners.

If leakage occurs from the centrifugal seal during pump operation, the impeller should be adjusted rearwards to minimise axial clearance between the impeller and rear casing liner. If seal leakage persists after impeller adjustment, this indicates that the intake pressure is excessive for the impeller fitted. Leakage may be prevented by fitting of an alternative impeller having improved intake pressure sealing characteristics. This may require fitting of a differential impeller.

(b) Periodic Adjustment

Periodic adjustment of impeller clearance over its operating life is an important factor in maximising wear life of both impeller and casing parts. Extensive field experience has shown that an increase in wear life of up to 50 percent can be achieved by regular impeller adjustment, compared with pumps not subject to initial or ongoing adjustment. Regular impeller adjustment has shown an increase in wear life of typically 20 percent compared with pumps subjected only to initial adjustment.

The recommended procedure for periodic Impeller adjustment is as follows:

(i) At initial pump assembly, adjust Impeller to “just clear” the casing intake end surface, as described in (a).

(ii) After 50 to 100 hours of pump operation, re-adjust impeller front-end clearance, as described in (a).

(iii) Re-adjust impeller front-end clearance a further two or three times at regular intervals over its wear life. This may coincide with regular pump maintenance intervals, typically 500 hours.

NOTE: After each Impeller adjustment is completed, the **bearing housing clamp bolts** (012) must be tightened to torque values indicated in table 3, below. If a torque wrench, or equivalent device is not available, bolts should be tightened in accordance with the procedure as described in appendix B.

TABLE 3
TIGHTENING TORQUE
FOR BEARING HOUSING CLAMP BOLTS

Frame Size	Minimum Torque (N m)
D & Q	45
E, F, R and S	185
G	325
T and TU	525
H and U	1500

7. 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** requires removal of the **door** (013), **clamp rings** (134, 135), and **bowl** (131). These parts may be withdrawn after removal of the clamp rings. Impellers are fitted to shafts with a right hand screw thread attachment on all Yellowpump pumps. Impeller removal generally involves applying an impulsive torque loading to the impeller, while separately restraining the shaft from rotation.

APPENDIX A

Yellowpumps basic part numbers

YELLOWPUMP BASIC PART No.	STANDARD YELLOWPUMP MATERIAL CODE	PART NAME
001	E62	Adjusting Screw
003	G01	Base
005	-	Bearing Assembly
011	E62, E63	Clamp Washer
012	E62	Clamp Bolt
013	D20	Door
026	E62	Frame Plate Liner /Insert Stud
028	A05A	Expeller
029	A05A	Expeller Ring
032	D20	Adaptor Plate
034	E62	Adaptor Plate Bolt
039	E63	Adaptor Plate Stud
041	A05A	Back Liner
044	K24, C02	Gland
045	E62	Gland Bolt
060	R08A	Intake Joint
062	D20	Labyrinth
063	K31, C02	Lantern Ring
064	S18	Impeller O-Ring
067	C23	Neck Ring
070	E05	Shaft Key
073	E05	Shaft
075	D20	Shaft Sleeve
076	D20	Shaft Sleeve (Long)
078	G01	Stuffing Box
109	S18	Shaft O-Ring
111	Q05A	Packing
117	E62, C23	Shaft Spacer
118	K31, C02	Lantern Restrictor
118-1	P50A	Lantern Restrictor (Non-metal)
122	R11A	Expeller Ring/Stuffing Box Seal

APPENDIX A

Yellowpumps basic part numbers (cont)

YELLOWPUMP BASIC PART No.	STANDARD YELLOWPUMP MATERIAL CODE	PART NAME
124	R08A	Bowl Seal, Door Seal
125	R08A	Bowl Seal, Door Seal
126	E62, C23	Gland Clamp Bolt
129	E62	Clamp Ring Bolt
130	E02	Flange
131	A05A	Bowl
132	R08A	Discharge Joint Ring
134	D20	Clamp Ring
138	E62	Grease Cup Adaptor
144	E62	Back Liner Stud
179	C23	Shaft Sleeve Spacer
221	E02	Discharge Flange
239	C23	Impeller Release Collar
292	D20	Door Clamp Plate
302	E02	Lifting Tube
303	E02	Locating Nut
306	E02	Shaft Wrench
310	E02	Stuffing Box/Expeller Ring
		Lifting Beam
430	U04A	Nut Covers
-	-	Grease Cup
-	-	Grease Nipple

APPENDIX B

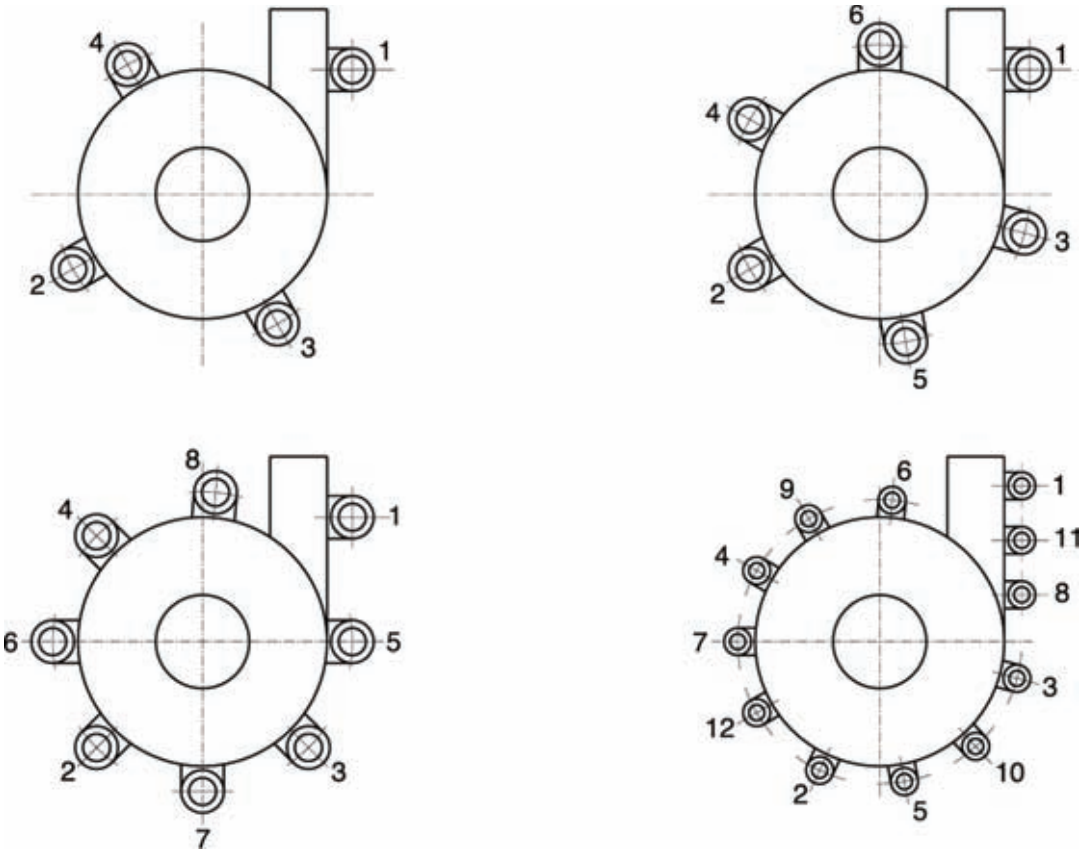


Fig B. Bolt tightening sequence

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