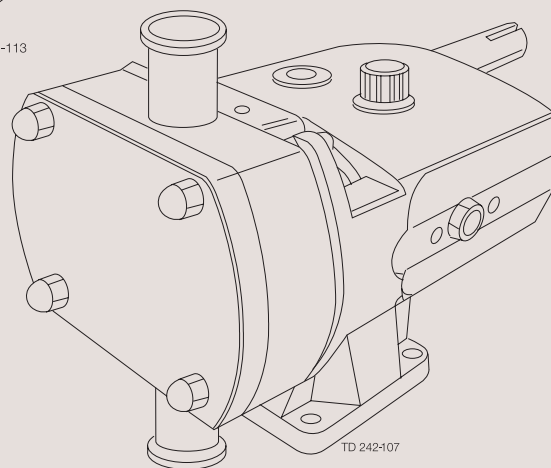
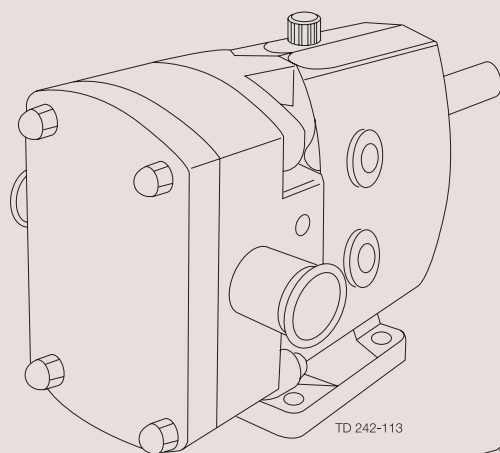




## Instruction Manual

### Rotary Lobe Pumps - SX Range





# EC Declaration of Incorporation

---

## The designating company

**Alfa Laval Eastbourne, Alfa Laval Ltd.**

Company Name

**Birch Road, Eastbourne, East Sussex BN23 6 PQ**

Address

**Phone: (01323) 412555 Fax: (01323) 412515**

Phone and Fax No

We hereby declare that the following machinery conforms to the machinery directive 98/37/EC and to the following other relevant directives. The machinery has been designed and manufactured in accordance with the transposed harmonised European standards; European and national standards as listed:

**We also hereby declare that the following machinery conforms to Regulation (EC) No 1935/2004 relating to materials and articles intended to come into contact with food.**

Machine Description: **Rotary Lobe Pump**

Type/Size:

Serial Number:

This machinery has been designed and manufactured in accordance with the following transposed harmonised European Standards:

**EN809: 1998 Pumps and pump units for liquids - common safety requirements.**

**ISO9001: 2000 Quality Management System.**

A technical construction file for this machinery is retained at the above address.

Signed



Date

Name

**P. Sweet**

Position

**Quality/H&S Manager**





# EC Declaration of Conformity

The designating company

**Alfa Laval Eastbourne, Alfa Laval Limited**

Company Name

**Birch Road, Eastbourne, East Sussex BN23 6 PQ**

Address

**Phone: (01323) 412555 Fax: (01323) 412515**

Phone and Fax No.

We hereby declare that the following machinery conforms to the machinery directive 98/37/EC and to the following other relevant directives.

The machinery has been designed and manufactured in accordance with the transposed harmonised European standards; European and national standards as listed;

We also hereby declare that the following machinery conforms to Regulation (EC) No 1935/2004 relating to materials and articles intended to come into contact with food.

Machine Description: **Rotary Lobe Pump - Motorised**

Type/Size:

Serial Numbers:

Date of manufacture:

Other Applicable Directives: **Electrical Equipment Low Voltage 73/23/EEC**

**Electrical Compatibility 89/336/EEC**

This machinery has been designed and manufactured in accordance with the following transposed harmonised European Standards:

**EN809:** **1998 Pumps and pump units for liquids - common safety requirements.**

**ISO9001:** **2000 Quality Management System.**

A technical construction file for this machinery is retained at the above address.

Signed



Date

Name

**P. Sweet**

Position

**Quality/H&S Manager**





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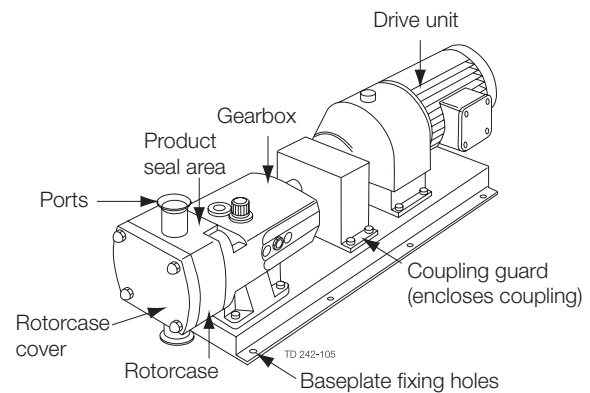
*The information contained herein is correct at the time of issue but may be subject to change without prior notice.*

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The SX pump is a positive displacement rotary lobe pump; it may be supplied with or without a drive unit (see drawing). The drawing shown indicates various parts of the pump unit.

The SX range has a universal gearbox design in series SX1 - 4. This enables the flexibility of mounting pumps with the inlet and outlet ports in either a vertical or horizontal plane. The port orientation, vertical or horizontal, may be changed by moving one of two available bolt-on feet on the gearbox. Port orientation should be specified when ordering, but the alternative foot design allows pumps that are already installed being changed should the need arise.

Series SX5, 6 and 7 pumps only have the inlet and outlet ports in the vertical plane by using dedicated gearbox castings.



### Pump Duty Conditions

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

### Noise Levels

Under certain operating conditions pumps and/or drives and/or the systems within which they are installed can produce sound pressure levels in excess of 85dB[A]. When necessary, protection against noise should be taken.

### External Cleaning

Use cleaning fluids below PH 8. Cleaning fluids above PH 8 may cause some paint discolouration.



---

*Unsafe practices and other important information are emphasized in this manual.  
Warnings are emphasized by means of special signs.*

---

**Always read the manual before using the pump!**

**WARNING!**

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

**CAUTION!**

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

**NOTE!**

Indicates important information to simplify or clarify practices.

---

General warning:



Dangerous electrical voltage:



Caustic agents:



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*All warnings in the manual are summarised on this page.*

*Pay special attention to the instructions below so that severe personal injury or damage to the pump are avoided.*

---

#### Installation

- **Always** observe the technical data (see chapter 5).
- **Never** start in the wrong direction of rotation with liquid in the pump.
- **Never** put your hands or fingers inside the port connections or anywhere close to rotating shafts.



The pump **must** be electrically connected by authorised personnel (see the motor instructions supplied with the drive unit).



#### Operation

- **Always** observe the technical data (see chapter 5).
- **Never** touch the pump or the pipelines when pumping hot liquids or when sterilising.
- **Never** stand on the pump or pipelines.
- **Never** run the pump with either the suction side or the pressure side blocked.
- **Never** put your hands or fingers inside the port connections or anywhere close to rotating shafts.



**Never** run the pump unless fully assembled i.e. pumphead must not be removed from gearcase.

Only handle toxic and acidic liquids in accordance with their manufacturers instructions and recommendations.



#### Maintenance

- **Always** observe the technical data (see chapter 5).
- The pump must **never** be serviced when hot.
- The pump and the pipelines must **never** be pressurised when the pump is being serviced.
- **Never** put your hands or fingers inside the port connections or anywhere close to rotating shafts.



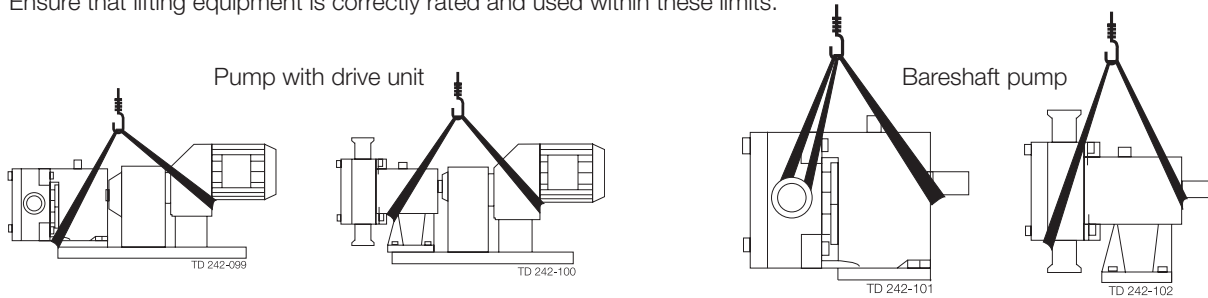
**Always** disconnect the power supply when the pump is being serviced.



**Step 1**

Refer to the pump weights guide (chapter 5) before selecting and using any lifting gear. The drawing show how the pump should be lifted.

Ensure that lifting equipment is correctly rated and used within these limits.

**Step 2****On receipt always:**

- Check the delivery note against the goods received.
- If motorised, check that the drive instructions are available.
- Inspect the packing for signs of damage in transit.
- Carefully remove the packing away from the pump.
- Inspect the pump for any visible signs of damage.
- Clean away the packing from the pump port connections.
- Be careful not to discard any manuals that may be enclosed with the packaging.
- Report any damage to the carrier.

**Step 3**

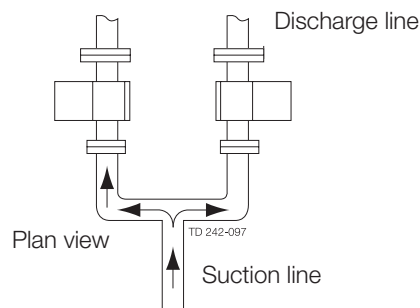
After receipt and inspection, if the pump is not to be installed immediately, the pump should be repacked and placed in suitable storage. The following points should be noted:

- Plastic or gasket type port covers should be left in place.
- Pumps received wrapped with corrosion inhibiting treatment material should have wrapping replaced.
- A clean, dry storage location free from vibration should be selected. If a moist or dusty atmosphere is used for storage, further protect the pump or unit with a suitable cover.
- Rotate the pump/pump unit by hand weekly, to prevent bearing damage.
- All associated ancillary equipment should be treated similarly.

*To ensure optimum operation it is important that any pump unit is installed correctly. When designing a pumping system the following should be taken into consideration.*

#### Design:

- Confirm the Net Positive Suction Head (NPSH) available from the system exceeds the NPSH required by the pump, as this is crucial for ensuring the smooth operation of the pump and preventing cavitation.
- Avoid suction lifts and manifold/common suction lines for two pumps running in parallel, as this may cause vibration or cavitation.
- Protect the pump against blockage from hard solid objects e.g. nuts, bolts welding slag etc. Also protect the pump from accidental operation against a closed valve by using relief valves, pressure switches or current limiting devices.
- Fit suction and discharge monitor points for diagnostic purposes.
- Fit valves, if two pumps are to be used on manifold/common discharge lines.
- Make the necessary piping arrangements if flushing is required for the seal or if a media is required for heating/cooling jackets and saddles.
- Allow at least 1 m for pump access/maintenance all around the pump.
- Do not subject rotary lobe pumps to rapid temperature changes, as pump seizure can result from thermal shock.



#### Pipework:

All pipework must be supported. The pump must not be allowed to support any of the pipework weight beyond the limits set in the following table.

#### Remember:

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

#### Always:

- Design short straight suction lines to reduce friction losses in the pipework thereby improving the NPSH available from the system.
- Avoid bends, tees and any restrictions close to either suction or discharge side of pump. Use long radius bends wherever possible.
- Provide isolating valves on each side of the pump to isolate the pump when necessary.
- Keep pipework horizontal where applicable to reduce air locks. Include eccentric reducers on suction lines.

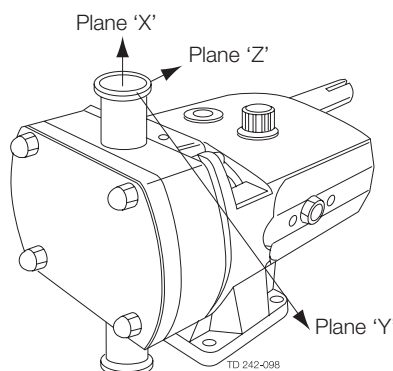
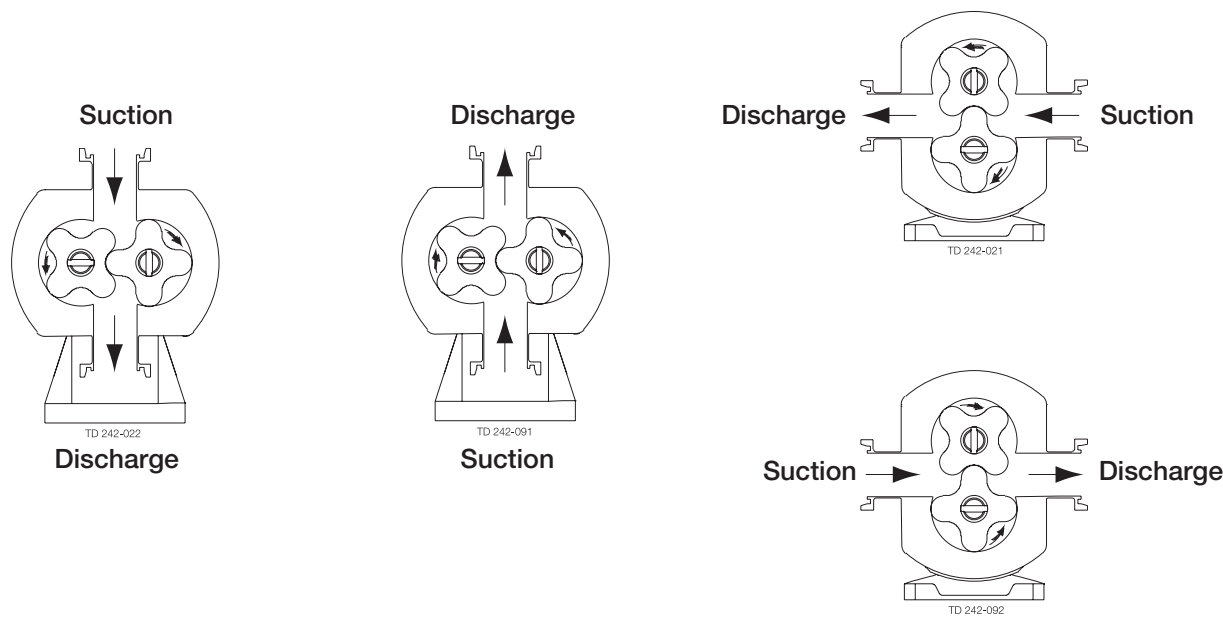


Table of Maximum Forces and Moments

Pump Model			Forces				Moments			
			FZ	FY	FX	EF	MZ	MY	MX	EM
SX1	Forces	N	80	60	70	120				
		lbf	18	13	16	27				
	Moments	Nm					30	30	30	50
		lbft					22	22	22	37
SX2	Forces	N	125	100	110	190				
		lbf	28	22	25	43				
	Moments	Nm					60	70	75	115
		lbft					44	52	55	85
SX3/4	Forces	N	165	135	150	260				
		lbf	37	30	34	58				
	Moments	Nm					100	115	140	205
		lbft					74	85	103	151
SX5/6	Forces	N	300	250	250	460				
		lbf	67	56	56	103				
	Moments	Nm					125	145	175	260
		lbft					92	107	129	192
SX7	Forces	N	380	320	320	590				
		lbf	85	72	72	133				
	Moments	Nm					165	190	230	340
		lbft					122	140	170	251

Direction of rotation

The direction of flow is dictated by the direction of rotation of the drive shaft. Reversing the direction of rotation will reverse the flow direction.



**Pump Lubrication:**

The pump will not be supplied pre-filled with oil therefore this table must be used to select recommended oil.

Oil changing: Oil level must be checked with the pump static.

First change: After 150 hours of operation, thereafter every 3000 hours of operation.

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

**NOTE!**

On horizontally ported pumps the sight glass must be fitted to the upper hole on the side of the gearcase.

Refer to technical data (chapter 5) for oil approximate quantities required.

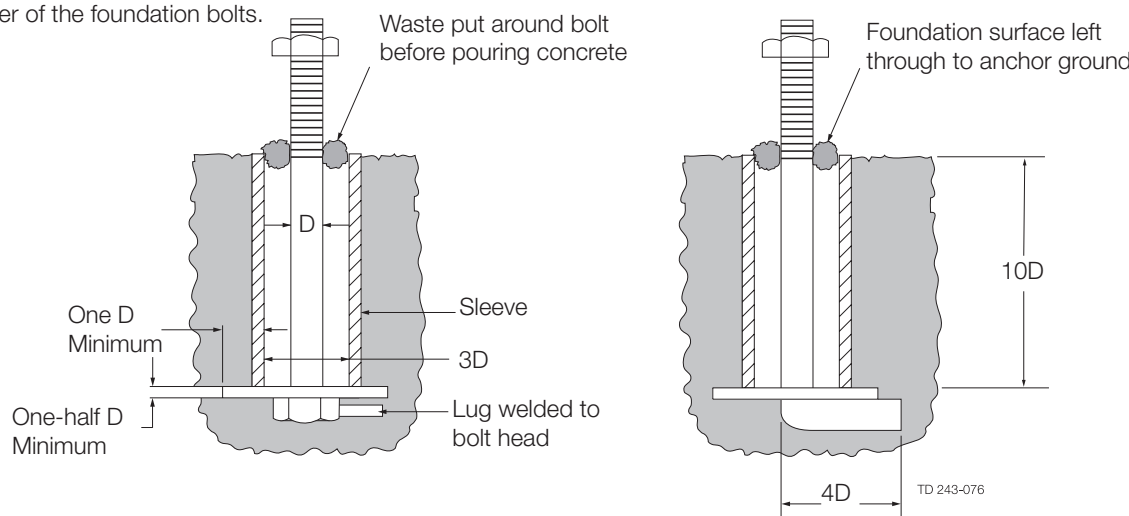
Recommended Oils		
Pump Operating Temperature		Food grade oils (USDA H1)
-20°C to +130°C (-4°F to +266°F)	+130°C to 200°C (+266°F to 392°F)	-20°C to +130°C (-4°F to +266°F)
BP Energol GR - XP150	BP Energol SG150	Bel-Ray No-Tox gear oil ISO grade 150, product # 6243.
Castrol Alpha SP150	Castrol Alphasyn PG150	Mobil DTE FM 150
Mobil Gear 629	Mobil Glygoyle 30	Optimol Optileb GT 150
Shell Omala 150	Shell Tivela S150	Castrol Vitalube GS 150.food grade
Texaco Meropa 150	Texaco Synlube CLP220	
Esso Spartan EP150	Mobil Glygoyle 22	

For ATEX applications refer to ATEX addendum manual.

**Baseplate Foundations**

Pumps when supplied with a drive unit are normally mounted on a baseplate. Our standard baseplates have pre-drilled fixing holes to accept base retaining bolts. To provide a permanent rigid support for securing the pump unit, a foundation is required which will also absorb vibration, strain or shock on the pumping unit. Methods of anchoring the baseplate to the foundation are varied, they can be studs embedded in the concrete either at the pouring stage as shown below, or by use of epoxy type grouts. Alternatively mechanical fixings can be used.

The foundation should be approx. 150 mm longer and wider than the baseplate. The depth of the foundation should be proportional to the size of the complete pump unit. For example, a large pump unit foundation depth should be at least 20 times the diameter of the foundation bolts.

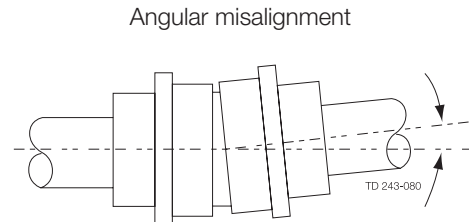
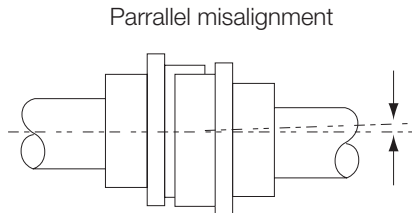


The drawing above shows two typical methods for foundation bolt retaining. The sleeve allows for "slight" lateral movement of the bolts after the foundation is poured. Rag or waste paper can be used to prevent the concrete from entering the sleeve while the foundation is poured. A minimum of 14 days is normally required to allow the curing of the concrete prior to pump unit installation.

---

**Coupling alignment:**

Before the pump unit is installed it is important to ensure that the mounting surface is flat to avoid distortion of the baseplate, which may cause pump/motor shaft misalignment and pump/motor unit damage.



Once the baseplate has been secured, the pump shaft to motor shaft coupling alignment should be checked and adjusted as necessary. This is achieved by checking the maximum angular and parallel allowable misalignments for the couplings as stated by the coupling manufacturer.

---

This page is not applicable for ATEX applications.  
For ATEX application see ATEX addendum

### Step 1

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

It is important that:

- The flush is correctly connected (see below).
- A compatible flushing fluid is used and supplied at the correct pressure and flow rate (see step 5).
- The flush is turned on at the same time/prior to starting the pump, and turned off at the same time/after stopping the pump.

### Step 2

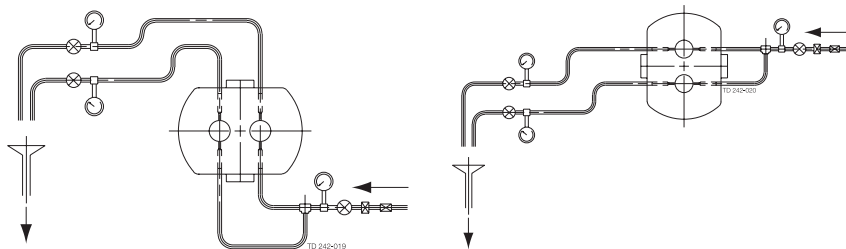
#### Connecting the flush

The following equipment is strongly recommended when using a flushing system:

- Control valve and pressure gauge, to enable the correct flushing pressure to be obtained and monitored.
- Isolation valve and check valve, so that the flush can be turned off, and to stop any unwanted substances flowing in the wrong direction.
- A method of visibly indicating flushing fluid flow.

### Step 3

#### Flushing arrangements in principle



### Step 4

#### Flushing fluid

The choice of flushing fluid is dependent upon the fluid being pumped and duty conditions i.e. pressure and temperature. Usually water is used for cooling or flushing water soluble products. For both single and flushed mechanical seal arrangements the temperature of flush media should never allowed to exceed the maximum temperature of the pumped media. For advice on selecting a suitable flushing fluid please contact pump supplier.

### Step 5

#### Flushing pressure and flow rate

Single flushed mechanical seal 0.5 bar (7 psi) maximum. Any further increase in pressure will result in lip seal failure. Double mechanical seal/flushed packed gland 1.0 bar (14 psi) higher pressure than the discharge of the pump. If the discharge pressure fluctuates set the pressure to suit maximum condition.

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

**Minimum flow rate required per shaft seal is 30 l/hr**

### Step 6

#### Pre-start up checks

- Check the pipework system has been purged to remove debris.
- Check all obstructions have been removed from pipework and pump.
- Check pump connections and pipework joints are tight.
- Check lubrication levels are correct.
- Check seal flushing is connected if applicable.
- Check all safety guards are in place.
- Check that inlet and outlet valves are open.



---

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

**Typical CIP procedure**

1. Flush through the system with cold water or bore water (6°) (43°F).
2. Run hot caustic soda (70-80°C) (158-176°F) at 2.5% dilution through the system for 20-30 minutes.
3. Final flush through with cold water again.

---

**Warnings**

- **Never** touch the pump or the pipelines as they will be extremely **hot**!
- **Do not** subject the pump to rapid temperature changes during CIP procedures, as pump seizure can result from thermal shock. A suitable by-pass is recommended.
- **Always** rinse well with clean water after using a cleaning agent.
- **Always** use rubber gloves and protective goggles when handling caustic agents.
- **Always** store/discharge cleaning agents in accordance with current rules/directives.



---

It is advisable to install pressure gauges on both sides of the pump so that any problems within the pump/pipework can be monitored.

**Maintenance schedule**

Your weekly schedule should include:

- Checking the oil level in the gearcase with the pump stationary.
- Checking the seals for leakage.
- Checking the oil seals for leakage.
- Check pumping pressures.

In certain operational circumstances the pump will pose a thermal hazard and as such should not be touched during operation. After shutdown the pump unit should be allowed time to cool.

Oil should be changed every 3000 hours of operation or a period of 2 years, whichever is the soonest.

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**Recommended Spare Parts**

The table shows recommended spare parts that should be retained within your maintenance schedule.

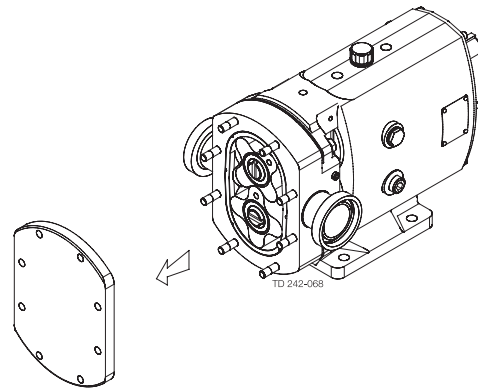
Part description	Quantity
Lip seal drive end	1
Compression joint rotorcase cover	1
Lip seal gland end	2
Cup seal, rotor retainers	2
Primary seals	2

**Step 1**

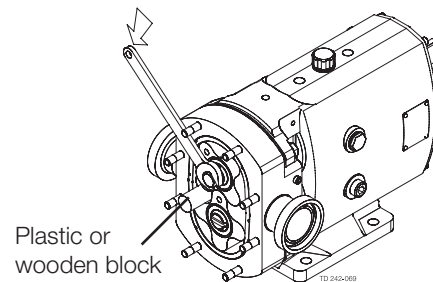
**Before disassembling the pump refer to safety precautions. See exploded view drawings (chapter 6).**

**Removing rotorcase cover.**

Remove rotorcase cover nuts (13) and cover (12).

**Step 2****Removing rotors**

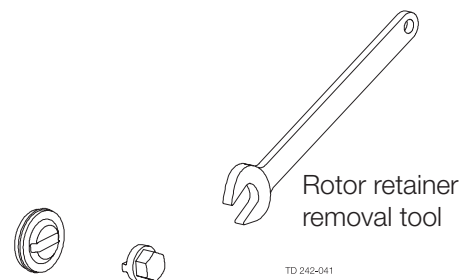
Insert a plastic/wooden block between the two rotors (17) to stop them turning.

**Step 3**

Remove rotor retainer (22) and rotors. A rotor retainer removal tool (supplied with all new pumps) is used for this purpose by sliding the tool into the rotor retainer slot and turning in an anti-clockwise direction.

Pump series 6 and 7 rotors are retained by torque locking assemblies, TLA's (19) and can be removed by:

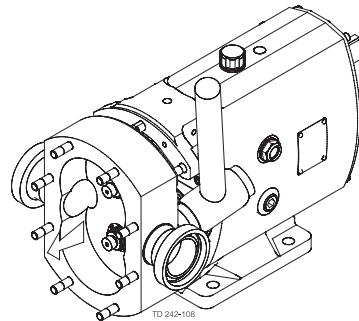
- loosen each TLA screw in several stages in a diametrically opposite sequence.
- use bolts to screw into two of the TLA holes (fitted with washers) and extract the TLA's.

**Step 4****Removing static seal components**

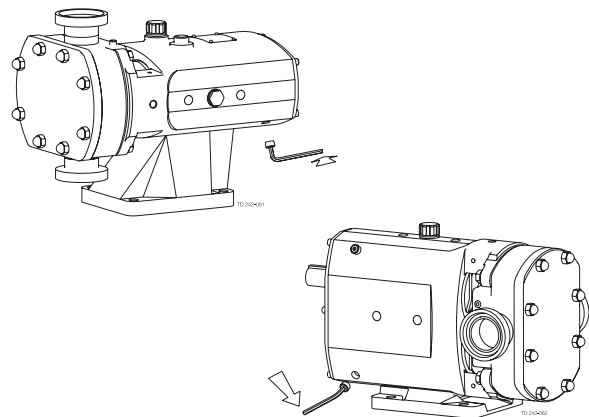
Please see section 4.5 for seal removal.

**Step 5****Removing rotorcase**

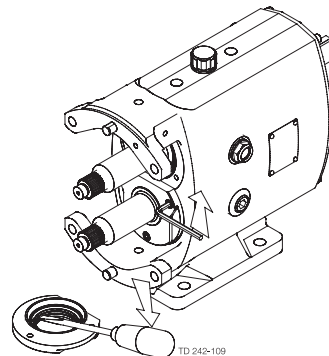
1. For flushed mechanical seal arrangements, remove the seal housing retaining nuts and ease the seal housing from the rotorcase.
2. Remove the rotorcase retaining nuts (4) and washers (4A).
3. Tap both sides of the rotorcase (9) with a soft mallet.
4. The rotorcase must not be allowed to drop onto the shafts (24 and 25) during the removal process.
5. Shims (8) should not be removed unless rotor clearances require resetting.

**Step 6****Draining pump lubrication**

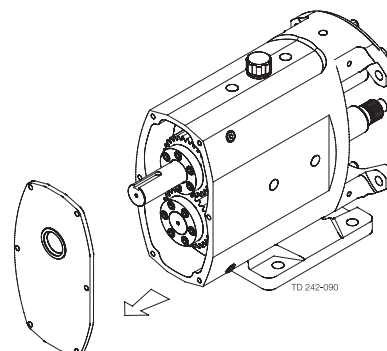
1. Place a tray under the gearcase to collect the waste lubricating oil.
2. Remove the lower drain plug (45) at the side of the gearcase (1).

**Step 7****Removing seal retainers**

1. Remove screws (15).
2. Then remove seal retainers (14) - as a liquid sealant has been used a lever may be required to remove retainers.
3. The lip seals (16) can be removed using a screwdriver/lever once the seal retainers are removed. It is essential to renew the lip seals and it is recommended that new gaskets or sealant be used prior to reassembly.

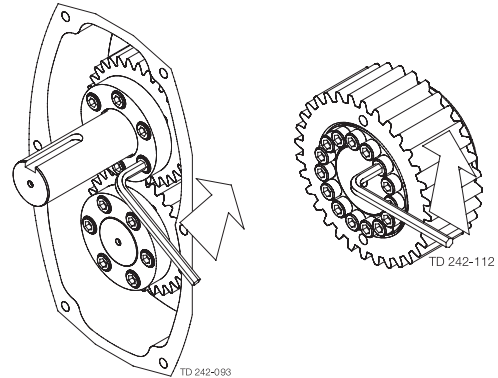
**Step 8****Removing Gearcase Cover**

1. Remove screws (6).
2. Remove gearcase cover (5) after breaking the gasket seal then press out the lip seal (7). It is essential to renew the lip seal prior to reassembly.

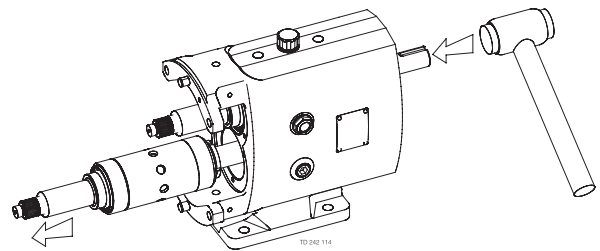


**Step 9****Removing timing gears**

1. Release clamp plate screws (40) on pump series 1, 2 and 3. For pump series 4, 5, 6 and 7 remove the torque locking assembly screw in several stages.
2. Remove gears (36) using the tapped extraction holes provided, or remove shaft assembly as shown in step 10 below.

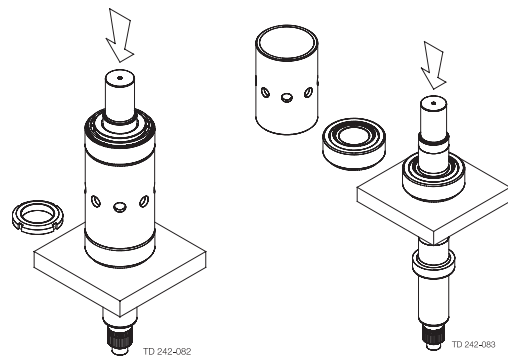
**Step 10****Shaft assembly removal**

1. Using a soft mallet gently tap the rear end of each shaft (24 and 25), to remove through the front of the gearcase (1).
2. Support each shaft during removal from the gearcase.
3. Remove the shaft abutment spacer (27):
  - For vertically ported pumps this is placed in the right hand bearing bore when viewed on the front face of the gearcase.
  - For horizontally ported pumps the shaft abutment spacer is placed in the top bearing bore.

**Step 11****Bearing removal**

1. Hold the shafts (24 and 25) in a vice using soft jaws to protect the areas where the seals will be located.
2. Remove the bearing nuts (30) with a 'sharp tap' on a 'C' spanner. The nuts may be tight all the way off as they are fitted with thread locking adhesive.
3. Mount the shaft vertically in a press with a tool positively located against the bearing inner as shown and apply pressure to the top of the shaft so that the shaft moves through the bearings (26 and 31).
4. Remove each bearing set (inner and outer). Good engineering practice suggests that if bearings are removed from the shafts they should be renewed.

**Clean and examine all components for wear or damage. Renew where necessary.**



#### 4.4.1 Fitting bearings to shafts

Take care not to damage shaft surfaces, in particular where the seals will be located.  
Ensure all fastenings are tightened to torque settings as shown in Technical Data (chapter 5).

On series 1, 2 and 3 pumps, bearings do not require heating. For series 4, 5, 6 and 7 pumps, heat the bearing inner cones to 110°C (230°F).

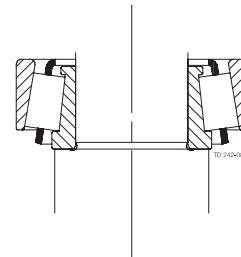
**Do not use any form of live flame when heating, as this will damage bearings.**

##### Step 1

Position shaft (24 and 25) vertically in a vice using soft jaws and apply anti-seize compound to the bearing diameters.

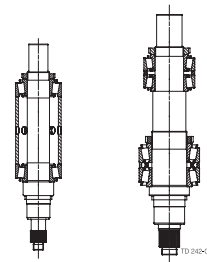
##### Step 2

Place the inner cone on the shaft ensuring a positive fit against the shaft shoulder.



##### Step 3

Locate outer cup, bearing spacer (32) and rear bearing cup.



##### Step 4

Allow bearings to cool (series 4, 5, 6 and 7 pumps only). Failure to do so will result in incorrectly set bearings.

1. Apply PermaBond Grade 145 or equivalent locking compound to the bearing nut thread.
2. Tighten the bearing nut (30), whilst at the same time rotating the bearings (26 and 31) and spacer (32). The bearings are correctly adjusted when the spacer can only be moved with a light tap of a mallet.
3. Repeat the above for double bearing assemblies.
4. Apply oil to the bearings.

#### 4.4.2 Fitting Shaft Assemblies

##### Step 1

Replace the shaft abutment spacer (27):

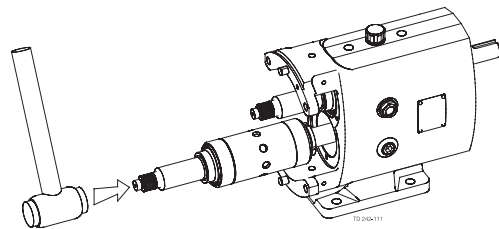
- For vertically ported pumps this is placed in the right hand bearing bore when viewed on the front face of the gearcase.
- For horizontally ported pumps the shaft abutment spacer is placed in the top bearing bore.

##### Step 2

Identify drive and auxillary shaft positions according to gearcase cover (5) orientation.

##### Step 3

1. Using a soft faced mallet tap the shafts (24 and 25) into the gearcase (1).
2. If the bearings have been replaced, a new abutment spacer will probably be needed. It is vital to ensure the rotor alignments is within the limits set in section 4.4.4.



#### 4.4.3 Fitting seal retainers

##### Step 1

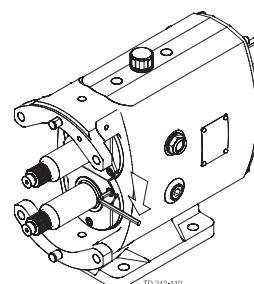
1. Clean the rear face of the seal retainers (14), fit in position and tighten.

##### Step 2

1. Check rotor alignment is correct by referring to the rotor abutment alignment in section 4.4.4.
2. When rotor alignment is correct remove seal retainers and press new lip seals (16) into seal retainers.
3. Apply liquid sealant onto the front of the gearcase (1) and push the seal retainers into position. Make sure lip seals are not damaged when sliding them onto the shafts.

##### Step 3

Replace and tighten the screws (15).



#### 4.4.4 Checking rotor abutment alignment

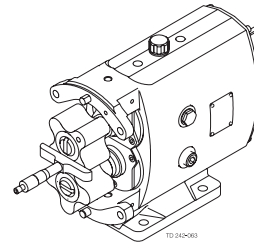
##### Step 1

Incorrect setting of rotor alignment will damage the pump.

Fit rotors onto shafts (24 and 25) and tighten rotor retainers (22).

##### Step 2

1. Using a depth micrometer ensure axial alignment is within tolerance of 0.012mm (0.0005 in).
2. If the alignment is incorrect, the shaft abutment spacer (27) must be replaced/machined.



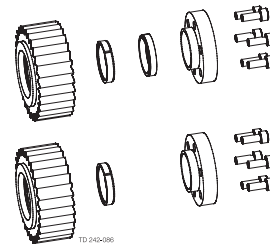
#### 4.4.5 Fitting timing gears

##### Step 1

Slide timing gears (36) onto shafts (24 and 25), realigning timing marks.

##### Step 2

1. Before fitting the torque locking devices (38) lubricate them with gear oil. Series 1, 2 and 3 have two sets of elements.
2. Series 4, 5, 6 and 7 pumps have torque locking assemblies.



##### Step 3

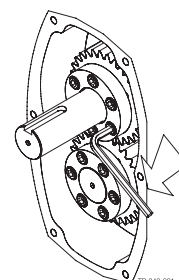
Fit timing gear clamp plates (39) - series 1, 2 and 3 only.

Fit torque locking assemblies (37) - series 4, 5, 6 and 7 only.

##### Step 4

Timing adjustment is now required:

Tighten one clamp plate/torque locking assembly only, allowing rotation of the shaft in the other gear for timing adjustment. See Adjusting Rotor Timing section 4.4.6.





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#### 4.4.6 Adjusting rotor timing

##### Step 1

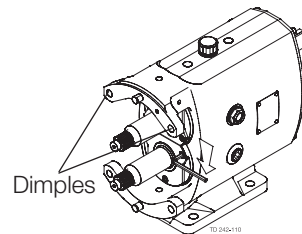
If the rotor timing requires adjustment (and assuming the pump has not yet been re-built), it is important to establish the cause for the rotors mistiming before proceeding.

To allow timing adjustment ensure that one shaft is able to rotate within the torque locking assembly/element. The other torque locking assembly/element should be tightened to the recommended torque.

---

##### Step 2

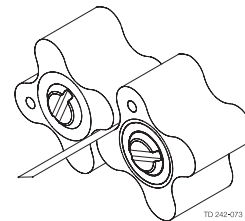
Locate one rotor (17) on to the drive shaft (24) with the dimple at the top. Turn the rotor through 45°. Fit the second rotor on to the auxillary shaft (25) with its dimple at the top as shown.



---

##### Step 3

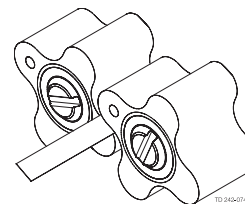
Turn the shaft so that the rotors are in the new positions as shown.



---

##### Step 4

Using feeler gauges measure between the points indicated, turning the shaft as required.



---

##### Step 5

If the measurement points are unequal tap the rotor which is on the free turning shaft until equal measurement through 8 points is achieved.

---

##### Step 6

Tighten the torque locking assemblies or clamp plate screws. Confirm timing is still correct. Remove the rotors.

---

#### 4.4.7 Fitting gearcase cover

##### Step 1

Clean the gearcase cover bore and remove all gasket material from the face. Press a new lip seal (7) into the cover (5).

---

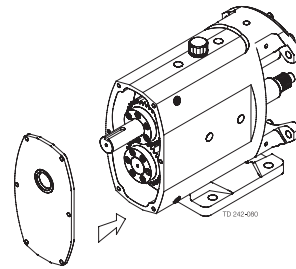
##### Step 2

Apply liquid gasket to the face of the cover where it mates with the gearcase.

---

##### Step 3

Smear oil on the inner lip of the lip seal and carefully slide the cover over the shaft ensuring the lip seal is centred and not cut or damaged. Tighten the screws (6).



---

#### 4.4.8 Fitting and shimming rotorcase

The rotorcase may require re-shimming if new components have been fitted. Back clearances must be checked before operating the pump.

##### NOTE!

Your supplier can advise the correct clearances from the pump serial number. Should they need adjustment follow steps below. Any incorrect setting of clearances is likely to damage the pump in operation. Plastic shims vary in colour for different thickness, and are grouped in equal packs at the top and bottom of the rotorcase held in place by shim retainers. For ATEX applications stainless steel shims are fitted. Shims can be stacked unequally providing the clearances are achieved.

---

##### Step 1

1. Remove the shim retainers (8A) and fit one of the thinnest shims (8) to top and bottom position.
2. Replace shim retainers and screws (8B).
3. Fit the rotorcase (9) to the gearcase (1), tighten the rotorcase retaining nuts (4) and fit the rotors (17).

---

##### Step 2

The back clearances can now be measured using feeler gauges. The additional shimming required to bring the clearances within tolerance can be determined, fit additional shims and re-check the clearances.

#### 4.4.9 Fitting primary seals

##### Step 1

Refer to section 4.5 for seal fitting instructions.

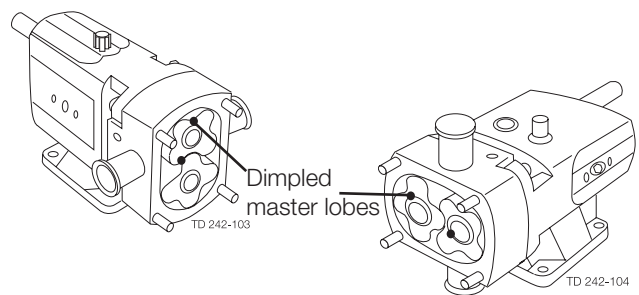
#### 4.4.10 Fitting rotors

##### Step 1

If fitted, carefully slide the O rings (18) over the shaft spline until they fit tightly against the shaft shoulder.

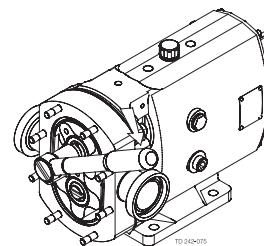
##### Step 2

Locate one rotor (17) on to the drive shaft (24) with the dimple at the top. Turn the rotor through 45°. Fit the second rotor on to the auxillary shaft (25) with its dimple at the top as shown. For series 6 and 7 pumps the rotors are retained by torque locking assemblies, TLA's. Slide the TLA assembly onto the shaft. Locate the clamp plate tool and tighten to the recommended torque figure. Tighten the TLA screws to the recommended torque figure. Unscrew the clamp plate tool and remove. Replace the rotor cap and tighten to the recommended torque figure.



##### Step 3

Fit new rotor retainer cup seals (20) to rotor retainers (22). Use a wooden/plastic block between the rotors to stop them turning whilst tightening the rotor retainers to the recommended torque settings shown in Technical Data (chapter 5).

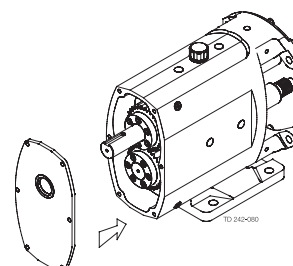


##### Step 4

To check rotors are correctly synchronised turn the drive shaft (24) by hand and check meshing clearances with feeler gauges to ensure that equal measurement through all eight points has been attained.

#### 4.4.11 Fitting rotorcase cover

1. Fit new rotorcase cover compression joint (11).
2. Fit rotorcase cover onto rotorcase (9) and tighten rotorcase cover nuts (13).
3. Refer to pump start up checks prior to operation.

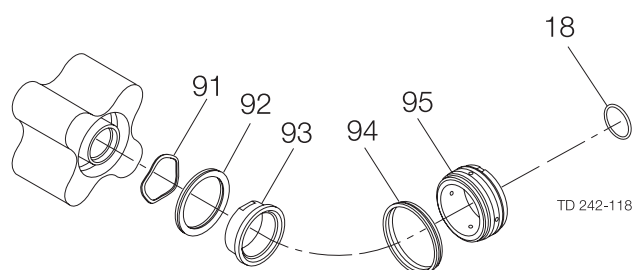


### 4.5.1 R00 Single mechanical seal

Mechanical seals are fragile. Take extreme care when handling. Clean components before fitting, checking there is no damage to sealing faces. New elastomeric parts should be fitted during assembly.

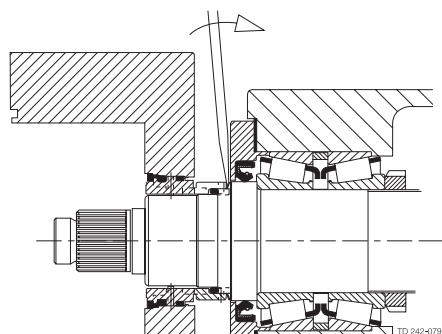
**The R00 mechanical seal is completely front loading without need of removing rotorcase for access or replacement. The seal setting distance is pre-set.**

Item	Description
91	Wave spring
92	Squad ring
93	Rotary seal ring
94	Cup seal
95	Stationary seal ring
18	Rotor sealing 'o' ring



#### Seal removal

1. Remove rotorcase cover, rotors and rotor sealing 'o' ring (18).
2. Extract the rotary seal ring (93), squad ring (92) and wave spring (91) from the rear of the rotors.
3. Gently ease the stationary seal ring (95) and cup seal (94) from the rotorcase using a suitable lever on the rear of the seal as illustrated.



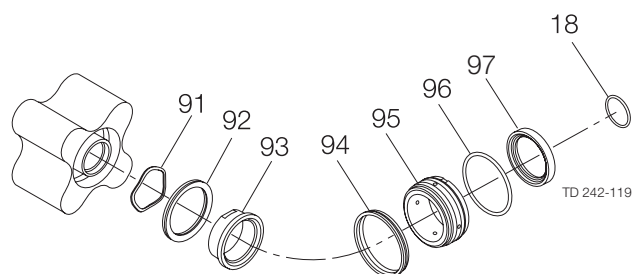
#### Seal fitting

1. Lightly lubricate cup seal (94) and fit to stationary seal ring (95).
2. Carefully aligning the slots in the stationary seal ring with the anti rotation dogs in the rotorcase, gently press the stationary seal ring assembly into the rotorcase bore until the stop is reached.
3. Fit wave spring (91) into the rear bore of the rotor.
4. Lightly lubricate squad ring (92) with appropriate grease and fit to rotary seal ring (93).
5. Align the two flats on the rotary seal ring with the drive flats in the rotor and gently push the rotary seal ring assembly into the rear bore of the rotor.
6. Wipe clean the sealing faces with solvent
7. Lightly lubricate rotor sealing 'o' ring (18) and slide onto shaft up to the shoulder.
8. Refit the rotors and rotorcase cover.

### 4.5.2 R00 Single flushed/quench mechanical seal

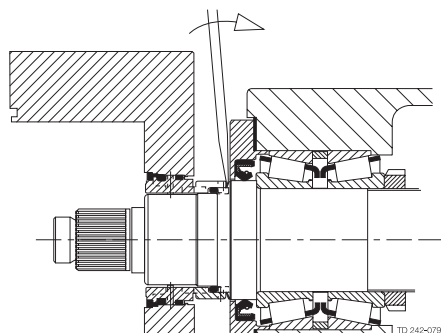
The R00 mechanical seal is completely front loading without need of removing rotorcase for access or replacement. The seal setting distance is pre-set.

Item	Description
91	Wave spring
92	Squad ring
93	Rotary seal ring
94	Cup seal
95	Stationary seal ring
96	Stationary seal ring o-ring
97	Lip seal
18	Rotor sealing 'o' ring



#### Seal removal

1. Isolate the flush media.
2. Remove rotorcase cover, rotors and rotor sealing 'o' ring (18).
3. Extract the rotary seal ring (93), wave spring (91) and squad ring (92) from the rear of the rotor.
4. Gently ease the lip seal (97), 'o' ring (96), stationary seal ring (95) and cup seal (94) from the rotorcase using a suitable lever on the rear of the seal as illustrated.



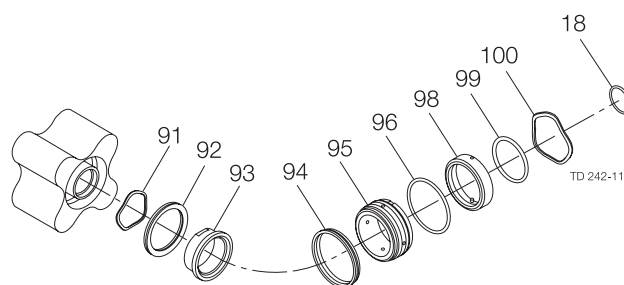
#### Seal fitting

1. Lightly lubricate cup seals (94) with appropriate grease and fit to stationary seal rings (95).
2. Fit cup seal and 'o' ring (96) to stationary seal assembly.
3. Fit lip seal (97) into stationary seal assembly.
4. Carefully aligning the slots of the stationary seal ring with the anti rotation dogs in the rotorcase, gently press the stationary seal ring assembly into the rotorcase bore until the stop is reached.
5. Fit wave spring (91) into the rear bore of the rotor.
6. Lightly lubricate squad rings (92) with appropriate grease and fit to rotary seal rings (93).
7. Align the two flats on the rotary seal ring with the drive flats in the rotor and gently push the rotary seal ring assembly into the rear bore of the rotor.
8. Wipe clean the sealing faces with solvent.
9. Lightly lubricate rotor sealing 'o' ring (18) and slide onto shaft up to shoulder.
10. Refit the rotors and rotorcase cover.

## 4.5.3 R00 Double flushed mechanical seal

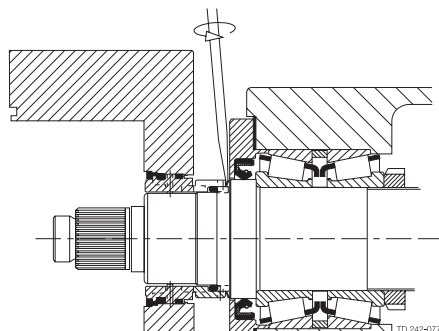
The R00 mechanical seal is completely front loading without need of removing rotorcase for access or replacement. The seal setting distance is pre-set.

Item	Description
91	Wave spring
92	Squad ring
93	Rotary seal ring (inboard)
94	Cup seal
95	Stationary seal ring
96	Stationary seal ring o-ring
98	Rotary seal ring (outboard)
99	Rotary seal ring o-ring
100	Wave spring
18	Rotor sealing o-ring



## Seal removal

1. Isolate the flush Media.
2. Remove rotorcase cover, rotors and rotor sealing 'o' ring (18)
3. Extract the rotary seal ring (93), wave spring (91) and squad ring (92) from the rear of the rotor.
4. Gently ease all other seal components from the rotorcase using a suitable lever on the rear of the seal as illustrated.



## Seal fitting

1. Lightly lubricate cup seals (94) and stationary seal 'o' rings (96) with appropriate grease.
2. Fit cup seal (94) and 'o' ring (96) to stationary seal ring (95).
3. Lubricate and fit rotary seal ring 'o' ring (99) into outboard rotary seal ring (98).
4. Slide wave spring (100) along shaft through the rotorcase bore until located on the shaft shoulder. Wipe clean the sealing faces with solvent.
5. Fit outboard rotary seal assembly, ensuring the drive pins engage with slots in the shaft.
6. Carefully aligning the slots in the stationary seal rings with the anti rotation dogs in the rotorcase, gently press the stationary seal ring assembly into the rotorcase bore until the stop is reached.
7. Fit wave spring (91) into the rear bore of the rotor.
8. Lightly lubricate squad rings (92) with appropriate grease and fit to rotary seal rings (93).
9. Align the two flats on the rotary seal ring with the drive flats in the rotor and gently push the rotary seal ring assembly into the rear bore of the rotor. Wipe clean the sealing faces with solvent.
10. Lightly lubricate rotor sealing 'o' ring (18) and slide onto shaft up to the shoulder.
11. Refit the rotors and rotorcase cover.

**NOTE!**

If the flushing pressure is in excess of 5 bar above the discharge pressure an o-ring is specified in place of the squad ring.

Problem												Probable Causes	Solutions
No flow	Under capacity	Irregular discharge	Low discharge pressure	Pump will not prime	Prime lost after starting	Pump stalls when starting	Pump overheats	Motor overheats	Excessive power absorbed	Noise and vibration	Pump element wear		
✓				✓								Incorrect direction of rotation.	Reverse motor.
✓												Pump not primed.	Expel gas from suction line and pumping chamber and introduce fluid.
✓	✓	✓	✓	✓						✓		Insufficient NPSH available.	Increase suction line diameter. Increase suction head. Simplify suction line configuration and reduce length. Reduce pump speed.
	✓	✓	✓	✓						✓		Fluid vaporising in suction line.	Increase suction line diameter. Increase suction head. Simplify suction line configuration and reduce length. Reduce pump speed.
✓	✓	✓		✓	✓							✓	Air entering suction line. Remake pipework joints.
	✓	✓		✓	✓					✓			Strainer or filter blocked. Service fittings.
	✓			✓	✓	✓	✓	✓	✓	✓			Fluid viscosity above rated figure. Decrease pump speed. Check seal face viscosity limitations.
✓	✓	✓											Fluid viscosity below rated figure. Decrease fluid temperature. Increase pump speed.
						✓			✓	✓		✓	Fluid temp. above rated figure. Cool the pump casing. Reduce fluid temperature. Check seal face and elastomer temp. limitations.
						✓		✓	✓				Fluid temp. below rated figure. Heat the pump casing. Increase fluid temperature.
										✓	✓	✓	Unexpected solids in fluid. Clean the system. Fit strainer to suction line. If solids cannot be eliminated, consider fitting double mechanical seals.
✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	Discharge pressure above rated figure Check for obstructions i.e. closed valve. Service system and change to prevent problem recurring. Simplify discharge line to decrease pressure.
												✓	Seal flushing inadequate. Increase flush flow rate. Check that flush fluid flows freely into seal area.
	✓							✓	✓	✓			Pump speed above rated figure. Decrease pump speed.
✓	✓												Pump speed below rated figure. Increase pump speed.
	✓						✓	✓	✓	✓	✓	✓	Pump casing strained by pipework. Check alignment of pipes. Fit flexible pipes or expansion fittings. Support pipework.
							✓		✓	✓		✓	Flexible coupling misaligned. Check alignment and adjust mountings accordingly.
							✓	✓	✓	✓	✓	✓	Insecure pump driver mountings. Fit lock washers to slack fasteners and re-tighten.
						✓	✓	✓	✓	✓		✓	Shaft bearing wear or failure. Refer to pump maker for advice and replacement parts.
							✓	✓	✓	✓	✓	✓	Insufficient gearcase lubrication. Refer to pump maker's instructions.
✓	✓									✓	✓	✓	Metal to metal contact of pumping element. Check rated and duty pressures. Refer to pump maker.
✓		✓			✓								Worn pumping element. Fit new components.
✓					✓								Suction lift too high. Lower pump or raise liquid level.
												✓	Fluid pumped not compatible with materials used Use optional materials.
												✓	No barrier in system to prevent flow passing. Ensure discharge pipework higher than suction tank.
												✓	Pump allowed to run dry. Ensure system operation prevents this. Fit single or double flushed mechanical seals.
									✓	✓			Faulty motor. Check and replace motor bearings.
✓													Pumping element missing Fit pumping element.

## 5.1.1 Oil capacities

Pump model	Port orientation		Port orientation	
	Vertical litres	Horizontal litres	Vertical US pints	Horizontal US pints
SX1	0.30	0.40	0.60	0.80
SX2	0.60	0.70	1.20	1.40
SX3	1.10	1.50	2.20	3.10
SX4	1.50	2.00	3.20	4.20
SX5	5.00	-	10.60	-
SX6	8.50	-	18.00	-
SX7	12.50	-	26.40	-

## 5.1.2 Weights

Pump model	Bare Shaft Pump kg (lb) Port Orientation		Pump with drive unit kg (lb) Port Orientation	
	Horizontal	Vertical	Horizontal	Vertical
SX1/005	15 (33)	16 (35)	46 (101)	49 (108)
SX1/007	16 (35)	17 (37)	55 (121)	58 (128)
SX2/013	32 (71)	33 (73)	80 (176)	81 (179)
SX2/018	33 (73)	34 (75)	85 (187)	86 (190)
SX3/027	57 (126)	59 (130)	147 (324)	150 (331)
SX3/035	59 (130)	61 (134)	152 (335)	155 (342)
SX4/046	107 (236)	110 (243)	271 (597)	274 (604)
SX4/063	113 (249)	116 (256)	277 (611)	280 (617)
SX5/082	-	155 (342)	-	295 (650)
SX5/115	-	165 (364)	-	310 (683)
SX6/140	-	278 (613)	-	545 (1202)
SX6/190	-	290 (639)	-	570 (1257)
SX7/250	-	340 (750)	-	660 (1455)
SX7/380	-	362 (798)	-	685 (1510)



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

## 5.1.3 Tool requirements

Description	Tool required	Pump Model						
		SX1	SX2	SX3	SX4	SX5	SX6	SX7
Rotorcase cover nut (13)	Socket Size (mm)	13	17	17	17	17	19	19
	Torque Setting (Nm)	20	39	39	39	39	105	105
	Torque Setting (lbft)	14.8	28.8	28.8	28.8	28.8	77.4	77.4
Rotor retainer (22)	Socket Size (mm)	19	19	19	24	24	24	24
	Torque Setting (Nm)	20	60	80	120	160	160	160
	Torque Setting (lbft)	14.8	44.3	59.0	88.5	118.0	118.0	118.0
Rotor TLA (19)	Key Size (mm)	-	-	-	-	-	5	5
	Torque Setting (Nm)	-	-	-	-	-	14	14
	Torque Setting (lbft)	-	-	-	-	-	10.3	10.3
Rotorcase retaining nut (4)	Spanner Size (mm)	13	17	17	19	19	24	24
	Torque Setting (Nm)	20	40	40	64	64	175	175
	Torque Setting (lbft)	14.8	29.5	29.5	47.2	47.2	129.1	129.1
Seal retainer screw (15)	Key Size (mm)	5	5	5	6	6	6	8
	Torque Setting (Nm)	10	10	10	25	25	25	40
	Torque Setting (lbft)	7.4	7.4	7.4	18.4	18.4	18.4	29.5
Gearcase cover screw (6)	Key Size (mm)	5	5	5	6	6	6	6
	Torque Setting (Nm)	10	10	10	25	25	25	40
	Torque Setting (lbft)	7.4	7.4	7.4	18.4	18.4	18.4	29.5
TLA/Clamp plate screw (40)	Key Size (mm)	5	5	5	5	6	6	6
	Torque Setting (Nm)	12	17	12	14	35	35	35
	Torque Setting (lbft)	8.9	12.5	8.9	10.3	25.8	25.8	25.8
Drain plug (45)	Key Size (in)	¼	¼	¼	¼	½	½	½
Foot bolt (58)	Key Size (mm)	5	6	6	8	-	-	-
	Torque Setting (Nm)	15	30	30	60	-	-	-
	Torque Setting (lbft)	11.1	22.1	22.1	44.3	-	-	-



## 5.1.4 Pump Data Table

Model	Displacement			Suction & Discharge Connection Size                      Pressure				Differential Speed Max Speed		Maximum Capacity at 	Maximum 
	litres/rev 100 rev	Imp gal/ 100 rev	US gal/ Diameter	Nominal Bore (International Std)		Connection Size					
				mm	inches	mm	inches	bar	psi	rev/min	m3/hr
SX1/005	0,050	1,1	1,3	22	0,87	25	1,0	12	174	1200	4
SX1/007	0,070	1,5	1,8	35	1,38	40	1,5	7	101	1200	6
SX2/013	0,128	2,8	3,4	35	1,38	40	1,5	15	217	1000	8
SX2/018	0,181	4,0	4,8	47	1,85	50	2,0	7	101	1000	11
SX3/027	0,266	5,9	7,0	47	1,85	50	2,0	15	217	1000	16
SX3/035	0,350	7,7	9,2	62	2,44	65	2,5	7	101	1000	21
SX4/046	0,460	10,1	12,2	47	1,85	50	2,0	15	217	1000	28
SX4/063	0,630	13,9	16,6	62	2,44	65	2,5	10	145	1000	38
SX5/082	0,820	18,0	21,7	62	2,44	65	2,5	15	217	600	30
SX5/115	1,150	25,3	30,4	73	2,87	80	3,0	10	145	600	41
SX6/140	1,400	30,8	37,0	73	2,87	80	3,0	15	217	500	42
SX6/190	1,900	41,8	50,2	96	3,78	100	4,0	10	145	500	57
SX7/250	2,500	55,0	66,0	96	3,78	100	4,0	15	217	500	75
SX7/380	3.800	83,6	100,4	140	5,51	150	6,0	10	145	500	114

**Please note:**

Maximum differential pressure capability of the pump does not apply to the pressure rating of the mechanical seals which is 15 bar, and the selected port connection as stated below:

SMS - 10 bar (all sizes)

RJT - 10 bar (all sizes)

DIN11851 - 40 bar (25-50mm), 25 bar (50-100mm), 16 bar (150mm)

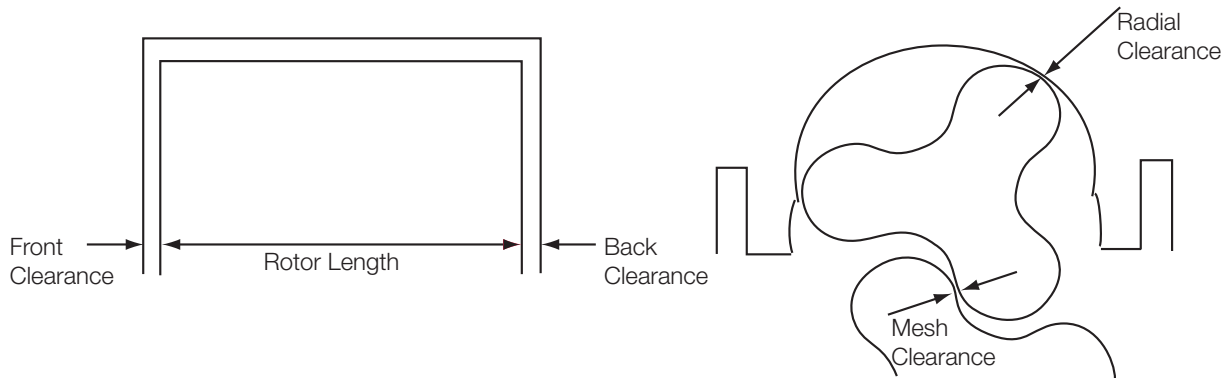
IDF/ISS - 16 bar (25-50mm), 10 bar (65-150mm) providing provision for support ring is to be made.

Tri-clamp (BS4825) - Pressure rating is dictated by the clamp band used. Refer to clamp band supplier.

For size 150mm on SX7/380 pumps, only DIN11851, SRJT or Tri-clamp connections are available.

**Ex Note:**

ATEX applications: Max. speed and Max. capacity are not applicable for ATEX applications.



All dimensions in mm							
Pump Model	Pressure bar	Rotor Length	Front Clearance Min.	Back Clearance Min.	Rotor Diameter Min.	Radial Clearance Min.	Mesh Clearance Min.
SX1/005	6	28.88 - 28.91	0,11	0,05	57,85	0,16	0,09
	12	28.80 - 28.83	0,16	0,08	57,75	0,21	0,17
SX1/007	7	41.74 - 41.77	0,19	0,11	57,65	0,23	0,21
SX2/013	5	38.30 - 38.33	0,10	0,05	80,34	0,10	0,09
	15	38.18 - 38.21	0,16	0,11	80,06	0,24	0,17
SX2/018	7	54.08 - 54.11	0,14	0,09	80,22	0,16	0,17
SX3/027	5	52.36 - 52.39	0,11	0,10	95,50	0,13	0,24
	15	52.22 - 52.25	0,21	0,14	95,14	0,28	0,24
SX3/035	7	68.81 - 68.84	0,19	0,11	95,20	0,28	0,24
SX4/046	5	51.96 - 51.99	0,08	0,05	124,91	0,11	0,22
	15	51.89 - 51.92	0,13	0,07	124,75	0,19	0,22
SX4/063	5	71.18 - 71.21	0,09	0,05	124,81	0,16	0,20
	10	71.06 - 71.09	0,16	0,10	124,73	0,20	0,28
SX5/082	15	67.25 - 67.30	0,20	0,15	150,04	0,23	0,28
SX5/115	10	94.55 - 94.60	0,20	0,15	150,04	0,23	0,28
SX6/140	15	79.55 - 79.60	0,20	0,15	177,22	0,24	0,38
SX6/190	10	107.82 - 107.87	0,25	0,15	177,22	0,24	0,38
SX7/250	15	104.64 - 104.69	0,33	0,28	205,78	0,56	0,50
SX7/380	10	158.89 - 158.94	0,38	0,30	205,78	0,56	0,50

Minimum mesh clearance at any mesh position.

All dimensions in millimeters



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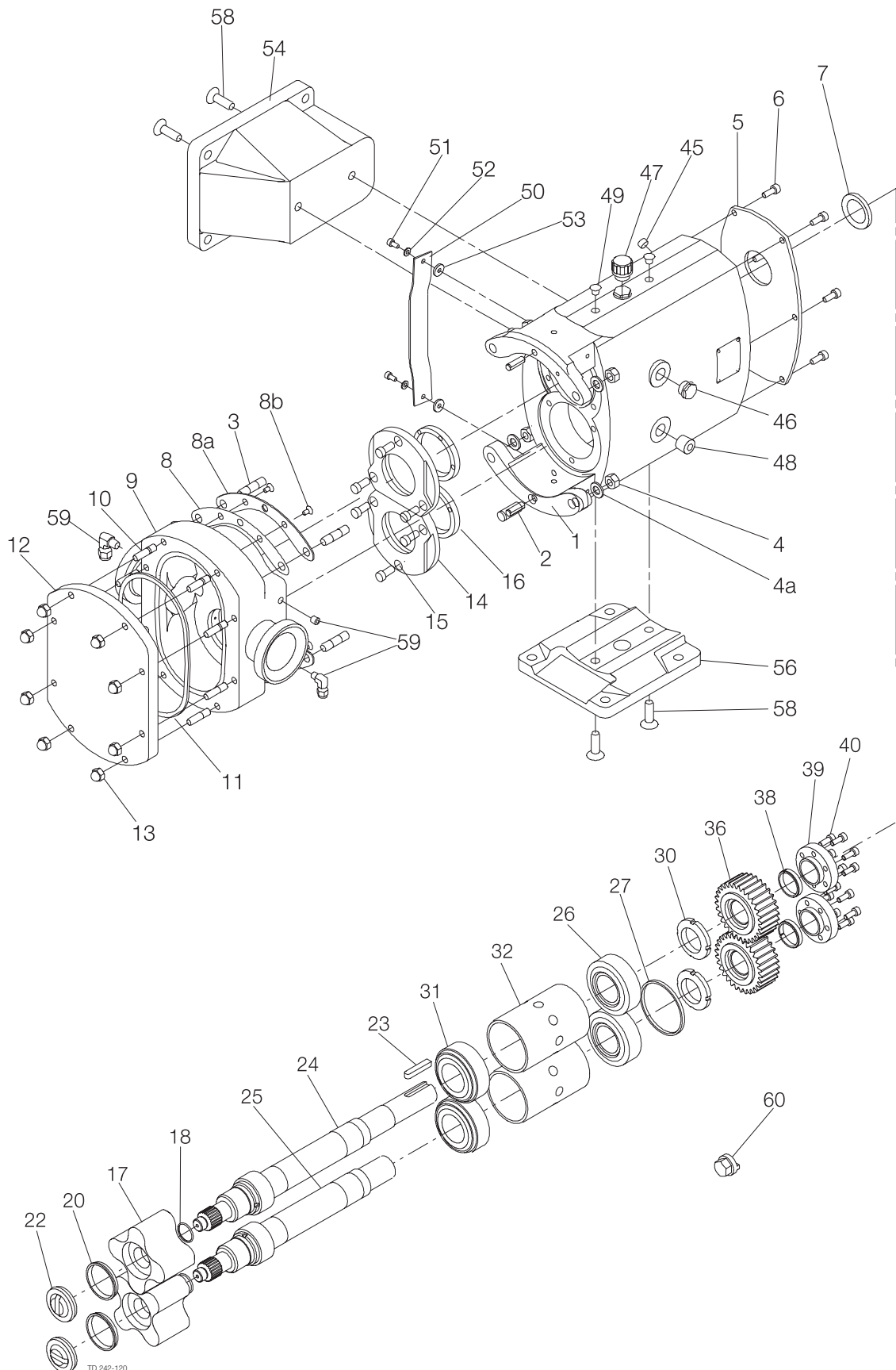
**Parts List**

Pos.	Denomination
1	Gearcase - universal mounting
2	Dowel
3	Stud, rotorcase retention
4	Nut, rotorcase retention
4A	Washer, rotorcase retention
5	Cover, gearcase
6	Screw, gearcase cover
7	Lip seal, drive end
8	Shim
8A	Shim retainer
8B	Shim retainer screws
9	Rotorcase
10	Stud, rotorcase/cover retention (not SX1/005)
11	Compression joint
12	Cover, rotorcase
13	Dome nut, rotorcase cover
14	Retainer, seal
15	Screw, seal retainer
16	Lip seal, gland end
17	Rotors
18	'O' Ring, rotor sealing shaft end
20	Cup seal, rotor retainer
22	Rotor retainer
23	Key
24	Shaft, drive
25	Shaft, auxiliary
26	Bearing, rear
27	Spacer, shaft abutment
30	Nut, bearing
31	Bearing, front
32	Spacer, bearing
36	Timing gear
38	Torque locking element
39	Clamp plate <sup>9</sup>
40	Screw, clamp plate
45	Drain plug
46	Sight glass
47	Filler plug
48	Plug
49	Blanking plug
50	Gland guard
51	Screw, gland guard
52	Washer, gland guard (only SX3)
53	Washer, gland guard
54	Foot, vertical port
56	Foot, horizontal port
58	Bolt, Foot
59	Plug/elbow for seal flushing (if required)
60	Rotor removal tool

This page shows an exploded drawing of the SX1 - 3.

The drawing includes all items of the pump.

### Exploded Drawing



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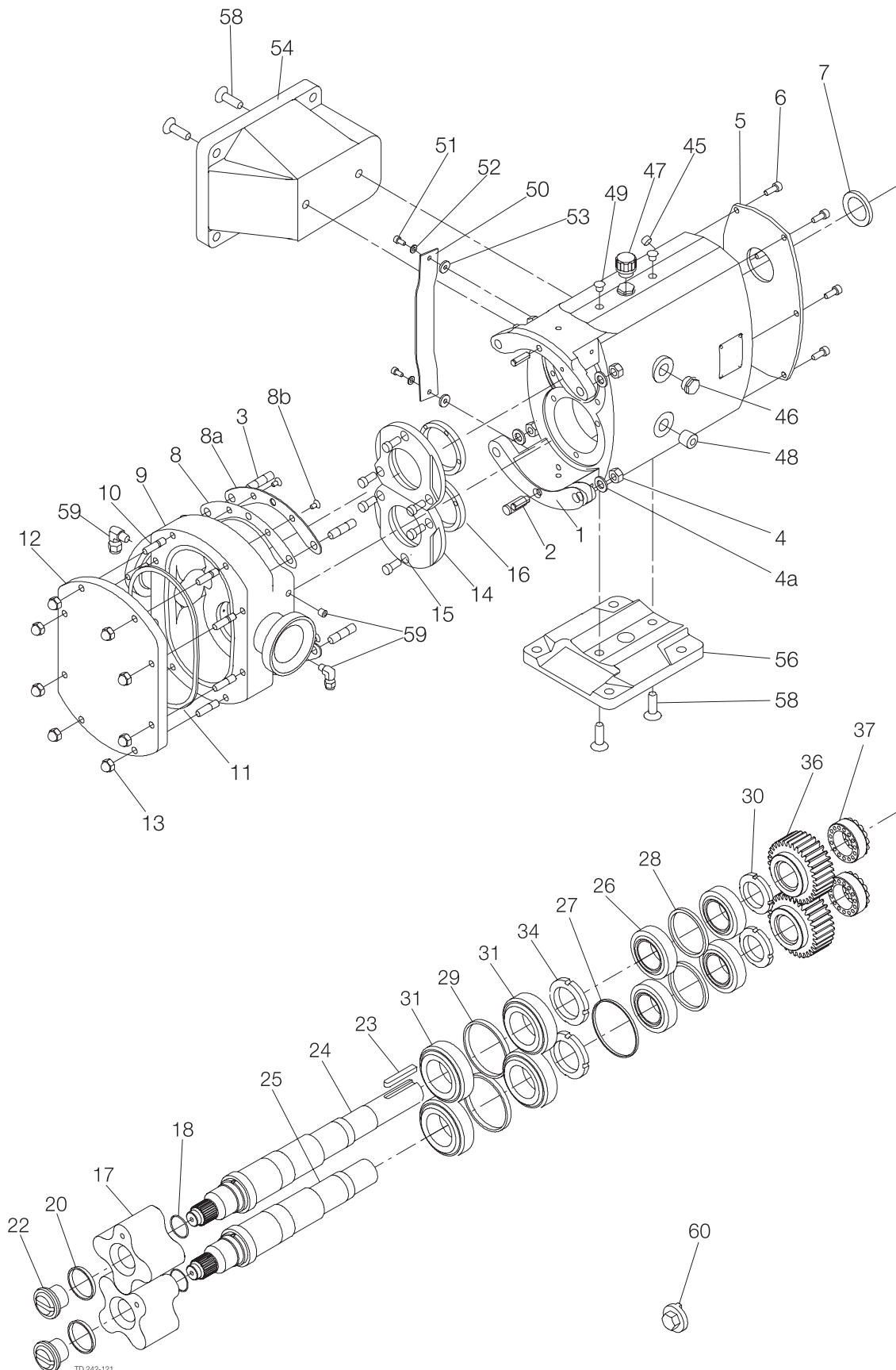
**Parts List**

Pos.	Denomination
1	Gearcase - universal mounting
2	Dowel
3	Stud, rotorcase retention
4	Nut, rotorcase retention
4A	Washer, rotorcase retention
5	Cover, gearcase
6	Screw, gearcase cover
7	Lip seal, drive end
8	Shim
8A	Shim retainer
8B	Shim retainer screws
9	Rotorcase
10	Stud, rotorcase/cover retention
11	Compression joint
12	Cover, rotorcase
13	Dome nut, rotorcase cover
14	Retainer, seal
15	Screw, seal retainer
16	Lip seal, gland end
17	Rotors
18	'O' Ring, rotor sealing shaft end
20	Cup seal, rotor retainer
22	Rotor retainer
23	Key
24	Shaft, drive
25	Shaft, auxiliary
26	Bearing, rear
27	Spacer, shaft abutment
28	Spacer, bearing drive end
29	Spacer, bearing gland end
30	Nut, bearing
31	Bearing, front
34	Nut, bearing front
36	Timing gear
37	Torque locking assembly
45	Drain plug
46	Sight glass
47	Filler plug
48	Plug
49	Blanking plug
50	Gland guard
51	Screw, gland guard
52	Washer, gland guard
53	Washer, gland guard
54	Foot, vertical port
56	Foot, horizontal port
58	Bolt, Foot
59	Plug/elbow for seal flushing (if required)
60	Rotor removal tool

This page shows an exploded drawing of the SX4.

The drawing includes all items of the pump.

### Exploded Drawing



TD 242-121

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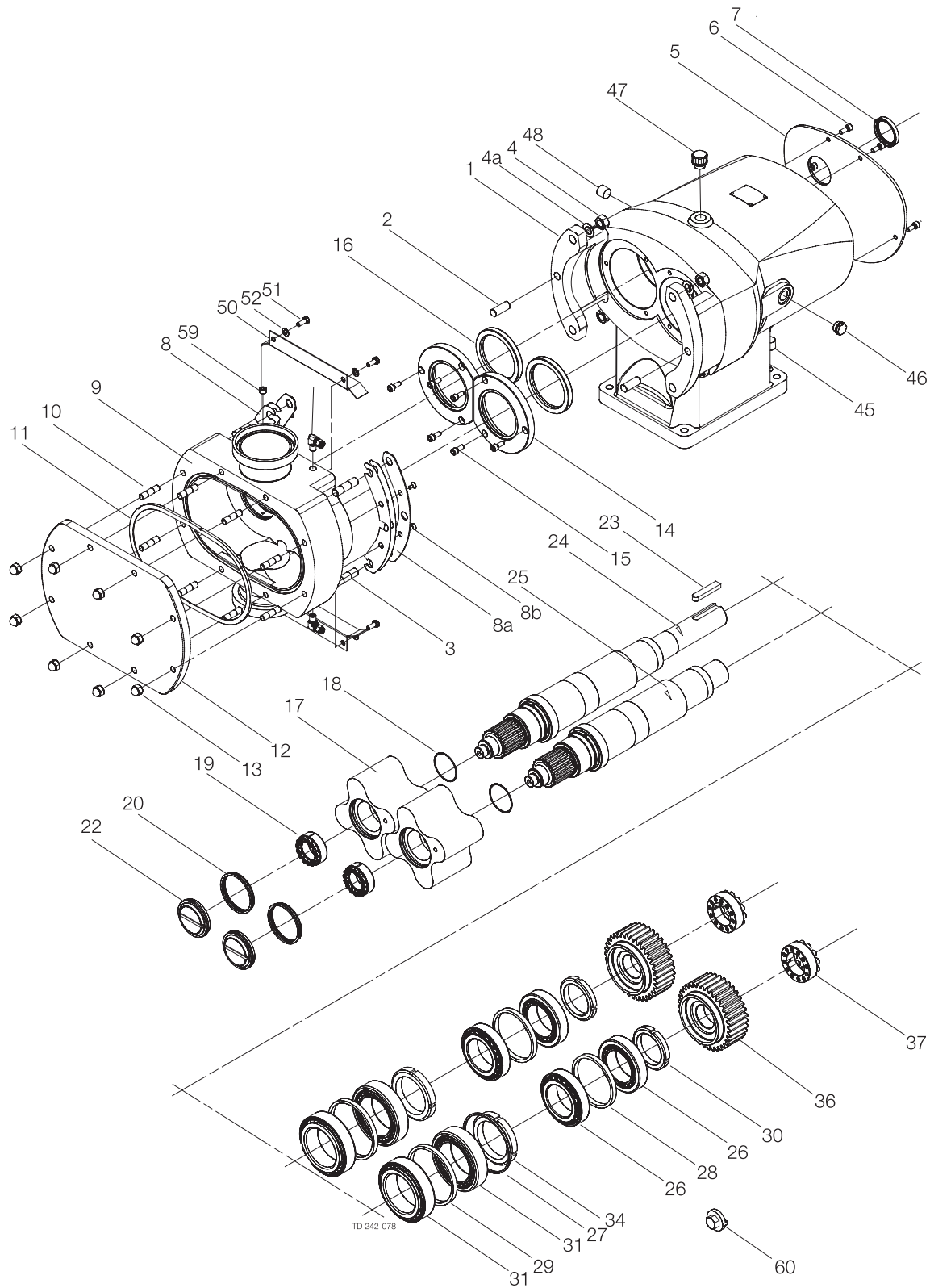
**Parts List**

Pos.	Denomination
1	Gearcase
2	Dowel
3	Stud, rotorcase retention
4	Nut, rotorcase retention
4A	Washer, rotorcase retention
5	Cover, gearcase
6	Screw, gearcase cover
7	Lip seal, drive end
8	Shim
8A	Shim retainer
8B	Shim retainer screws
9	Rotorcase
10	Stud, rotorcase/cover retention
11	Compression joint
12	Cover, rotorcase
13	Dome nut, rotorcase cover
14	Retainer, seal
15	Screw, seal retainer
16	Lip seal, gland end
17	Rotors
18	O-ring, rotor sealing shaft end
19	Torque locking assembly
20	Cup seal, rotor retainer
22	Rotor retainer
23	Key
24	Shaft, drive
25	Shaft, auxiliary
26	Bearing, rear
27	Spacer, shaft abutment
28	Spacer, bearing drive end
29	Spacer, bearing gland end
30	Nut, bearing rear
31	Bearing, front
34	Nut, bearing front
36	Timing gear
37	Torque locking assembly
45	Plug
46	Sight glass
47	Filler plug
48	Drain plug
50	Gland guard
51	Screw, gland guard
52	Washer, gland guard
59	Plug/elbow for seal flushing (if required)
60	Rotor removal tool



*This page shows an exploded drawing of the SX5 - 7 - vertically ported.*

*The drawing includes all items of the pump.*







**How to contact Alfa Laval**

Contact details for all countries are continually updated on our website.

Please visit [www.alfalaval.com](http://www.alfalaval.com) to access the information direct.