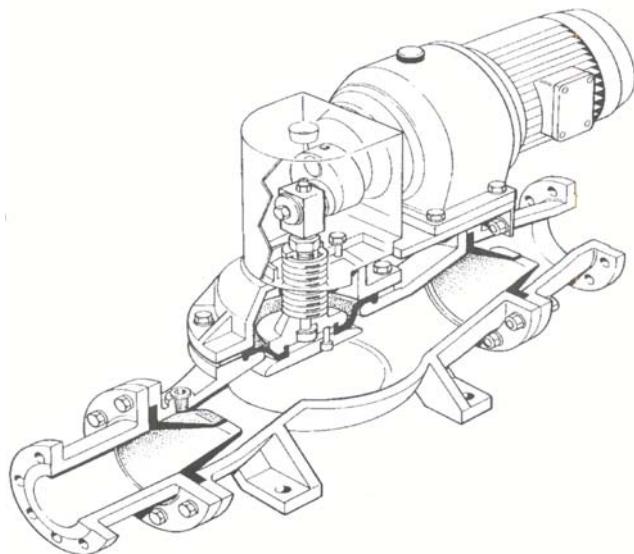




# Single Disc

Cast Iron Positive Displacement Mechanical Diaphragm Pumps

Operating Manual



# Alfa Laval

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## EC DECLARATION OF CONFORMITY

We hereby declare that the following machinery conforms to the machinery directive 89/392/EEC as amended by 91/368/EEC, 93/44/EEC and 93/68/EEC 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:

Machine Description Single Disc Pump - Motorised

Type/Size \_\_\_\_\_ Serial Number \_\_\_\_\_

Other Applicable Directives Electrical Equipment Low Voltage Directive 73/23/EEC

Electromagnetic Compatibility Directive 89/336/EEC

Applicable Standards/Specifications \_\_\_\_\_

**EN292 Parts 1 and 2 : 1991 Safety of Machinery - Basic concepts, general principles for design.**


**EN294 : 1992 Safety distances to prevent danger zones being reached by the upper limbs.**

**EN60204 Part 1 : 1993 Safety of Machinery - Electrical equipment of machines - specification for general requirements.**

**BS5304 : 1988 Code of Practice for Safety of Machinery.**

**ISO9001 : 2000 Quality Management System.**

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

Signed  Date \_\_\_\_\_  
(Authorised Person)

Name P.SWEET Position QUALITY MANAGER



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## **General**

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### **1.1 Pump Limits of Application or use**

This range of pumps has been designed for pumping a variety of sludge applications and has good tolerance of suspended solids and rag.

Pressures of up to 1.5 bar, speeds to 81rpm and temperatures to 70°C can be obtained on this range of pumps depending on pump model/size. The model type/size will be shown on the nameplate positioned on the pump.

It is important that the pump user confirms that the materials of construction are compatible with the pumping application.

For specific guidelines contact your supplier quoting :- pump model/size, serial number and system details (e.g. product, pressure, flow rate).

**Important :-** The pump is not designed for use with Agri foodstuffs or use underground.

### **1.2 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 for the pump. These details are stated on the original documentation and if not available may be obtained from your supplier quoting :- pump model and serial number.

### **1.3 Noise Levels**

Depending upon the pumping system and duty condition the pump noise levels may vary. The sound pressure level measurement stated is given for typical pumps/pump units at maximum pressures/speeds. The results being taken on water at ambient temperature:-

Recorded sound pressure level :- 85 dB(A):  
(Ref 20µPa).

**Note :-** Readings taken in accordance with ISO3746.

### **1.4 Utility Requirements**

#### **Electrical Supply :-**

This pump will require an electrical supply for operation.

# Operating Manual

## 1.5 Safety Requirements

All warnings in this manual are summarised on this page.

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

Personnel performing installation, operation and maintenance of the pump must have the relevant experience required.

## Warnings Signs:



General safety instructions are preceded by this symbol.



Electrical safety instructions are preceded by this symbol.



Take great care when using caustic agents.

### Installation



: **Always** observe the technical data.



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



: **Never** put your hands or fingers inside the port connections

### Operation



: **Always** observe the technical data.



: **Never** touch the pump or the pipelines when pumping hot liquids.



: **Never** stand on the pump or pipelines.



: **Never** run the pump with both the suction side and the pressure side blocked.



: **Always** handle toxic and acidic liquids with great care.



: **Never** put your hands or fingers inside the port connections.

### Maintenance



: **Always** observe the technical data.



: **Always** disconnect the pump from the power supply when servicing the pump.



: The pump must **never** be hot when servicing it.



: The pump and pipelines must **never** be pressurised when servicing the pump.



: **Never** put your hands or fingers inside the port connections.

**Study this manual carefully**

## 1.6 Health and Safety Information

### Potential Safety Hazards

The following section gives information on handling, storage and disposal of parts and materials used in the pumps which may be considered hazardous to health.

Please pass this information on to your Safety Officer, he may need it to comply with Health and Safety, and COSHH regulations.

Electric motors - the pumps have an electric motor fitted, so ensure that the relevant fire equipment is available.

The information contained here is brief.

### General First Aid

If potentially hazardous substances are accidentally inhaled, or skin or eyes contaminated, then the following basic precautions should be taken

Inhalation - Remove to fresh air

Skin - Wash with soap and water

Eyes - Flush with water, seek medical attention

In all cases, if symptoms persist, seek medical attention.

Material	Use	Major Hazard
Oil and Grease	Oil - Drive lubrication Grease - crank assembly	Skin and eye irritant.
Elastomeric compounds	Diaphragm and valve	Releases fumes when heated.
Paint	External pump surfaces.	Releases dust and fumes if machined. Treat as a hazard.

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## 2.0 Unpacking, Handling and Storage

To avoid any problems, on receipt of your pump always use the following procedure:-

### 2.1 Documents

1. Check the delivery note against the goods received.
2. If the pump has been delivered with an electric motor check that the motor instructions are available.

### 2.2 Unpacking

Care must be taken when unpacking the pump, and the following stages must be completed:-

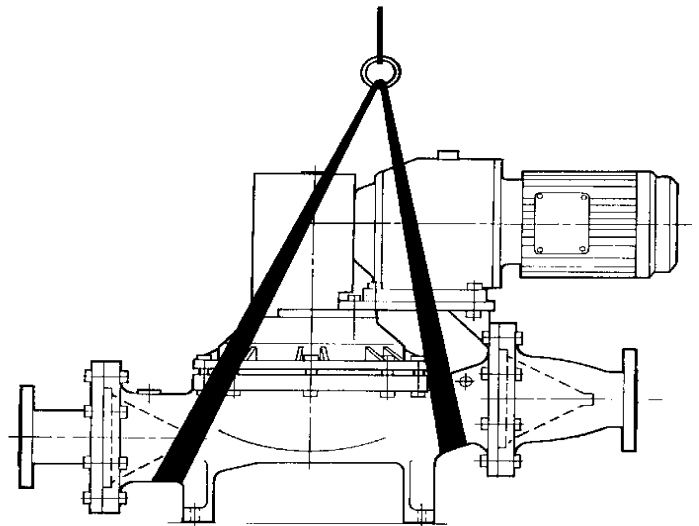
1. Inspect the packing for any possible signs of damage in transit.
2. Carefully remove the packing away from the pump.
3. Inspect the pump for any visible signs of damage.
4. Clean away the packing from the pump port connections.

### 2.3 Handling

Refer to the pump weights guide, prior to using any lifting gear. Use the correct lifting slings for the pump weight.

The pump should be lifted by wrapping the slings around the ports as shown below.

**Note :** To stop the slings slipping always cross the slings on the lifting hooks.





### 2.4 Pump Storage

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:-

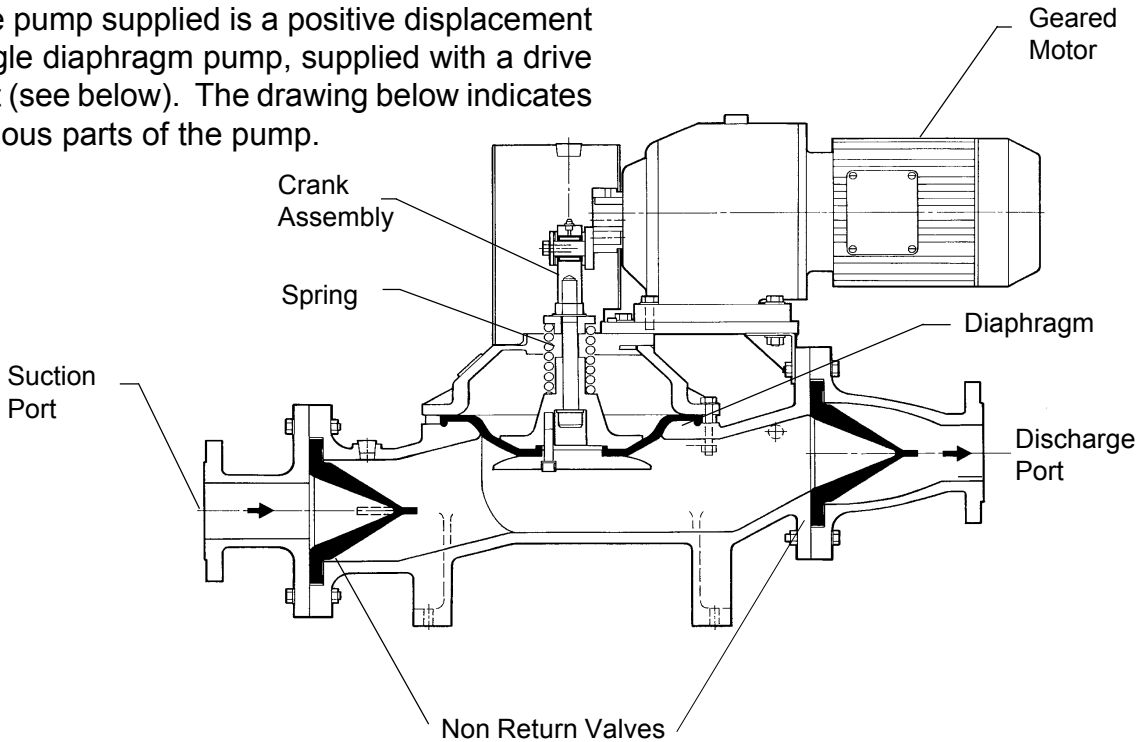
1. Plastic or gasket type port covers should be left in place.
2. Pumps received wrapped with corrosion inhibiting treatment material should be rewrapped.
3. A clean, dry storage free from vibration location should be selected. When a moist dusty atmosphere must be used for storage, further protect the pump or unit with a moisture repellent cover until it is to be installed.
4. All associated ancillary equipment should be treated similarly.
5. Rotate the drive unit by hand every 3 months.

# Operating Manual

## 3.0 Description of Pump or Pump Unit

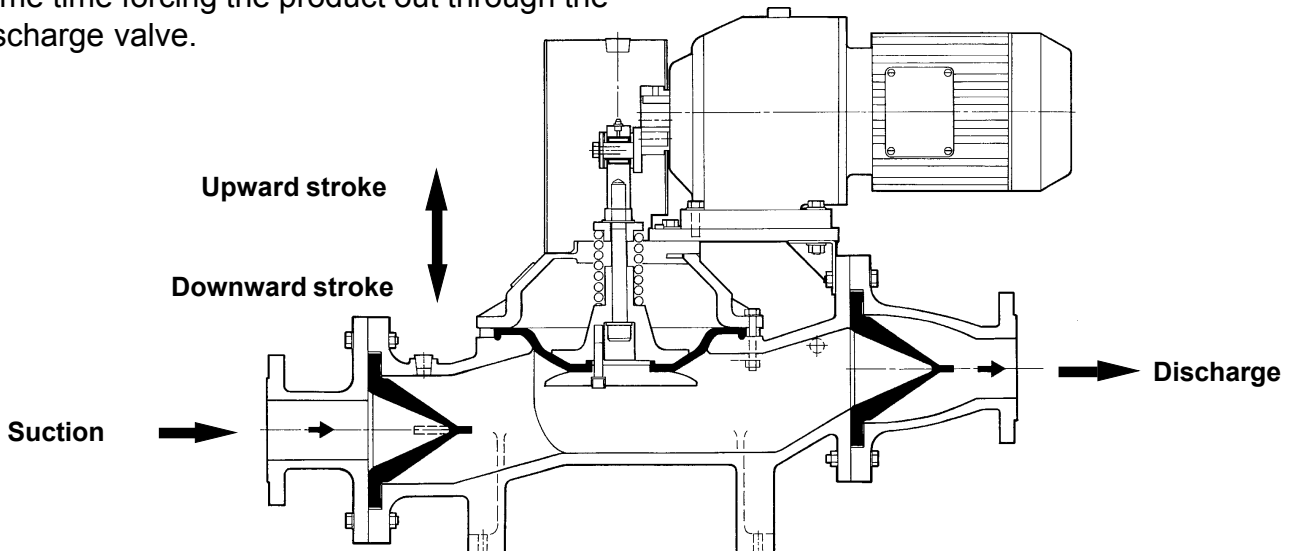
### 3.1 General Pump Unit

The pump supplied is a positive displacement single diaphragm pump, supplied with a drive unit (see below). The drawing below indicates various parts of the pump.

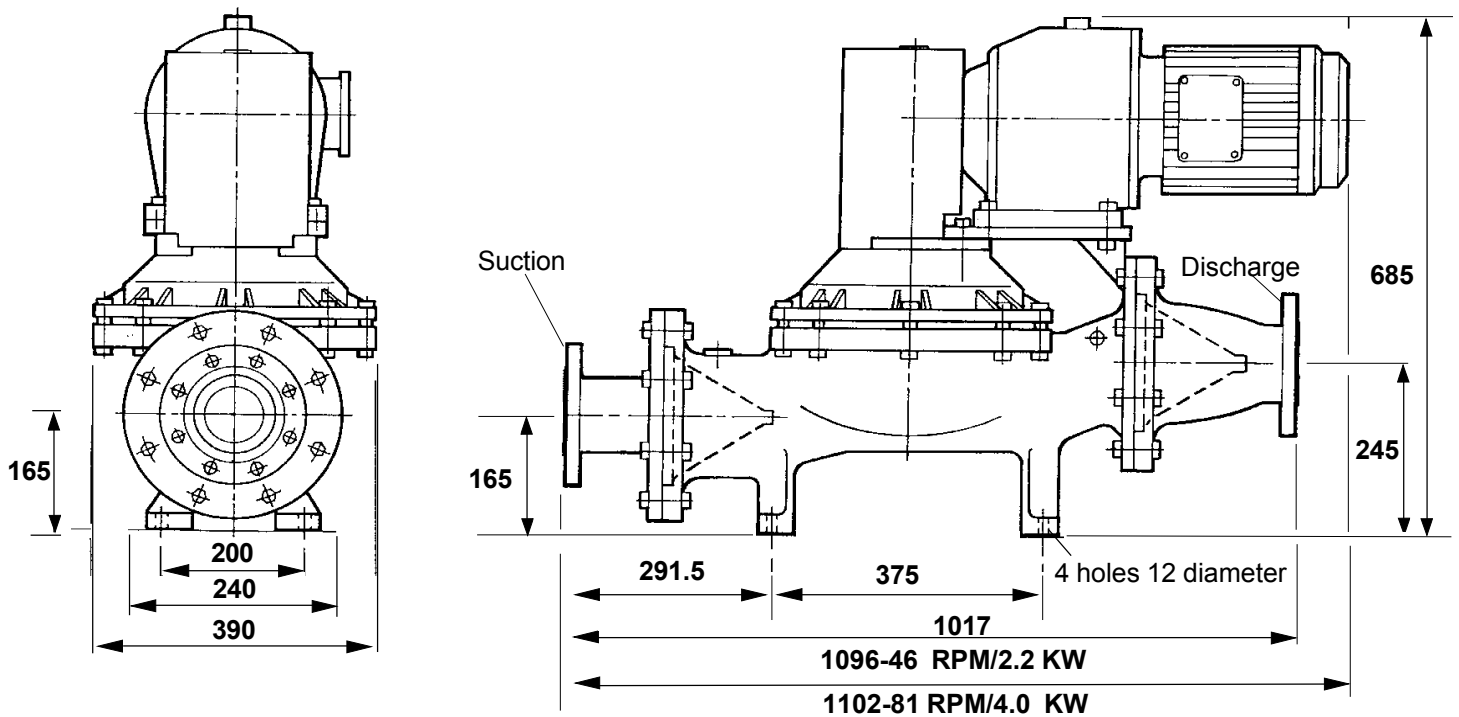


### 3.2 Principle of Operation

The pump operates by rotation of the gearbox drive shaft turning the crank assembly and thus providing the reciprocating pumping action of the diaphragm, as shown below. On the upward stroke the product is pulled through the suction valve into the pump body. The downward stroke shuts the suction valve whilst at the same time forcing the product out through the discharge valve.



## 3.3 Pump Dimensions and Weights



**NOTE :** Suction and discharge connections finished :-  
3" (80mm) BS4504 (DIN2533) or BS1560 ASA/ANSI 150

Weights - 2.2kw/46rpm = 200kg  
4.0kw/81rpm = 209kg

## 3.4 Pump Displacement and Capacities

The following table details the maximum pump capacity and displacement for the pump. The figures given below are for 1.5 bar discharge pressure and will vary depending upon the pump speed, crank stroke, pressure, viscosity and suction lift.

Displacement litres/rev	Maximum speed (rpm)	Maximum stroke (mm)	Maximum capacity at maximum speed m <sup>3</sup> /hr
4.9	81	70	22

# Operating Manual

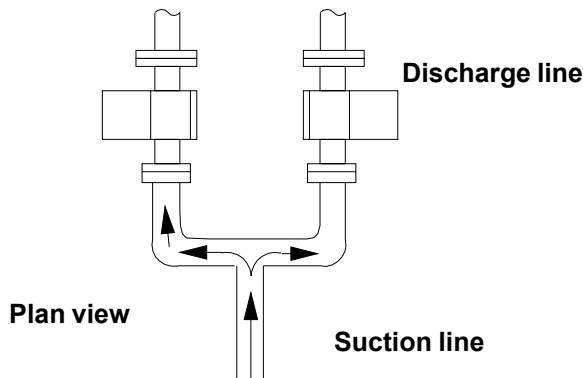
## 4.0 System Design and Information

### 4.1 System Design Advice

When designing the pumping system :-

**Do** - confirm that the pumping system has not altered since the pump was ordered.

**Do** - avoid high suction lifts and manifold/common suction lines for two pumps running in parallel, as this may cause vibration.



**Do** - protect the pump against blockage from hard solid objects e.g. nuts, bolts etc. Also protect the pump from accidental operation against a closed valve by using one of the following methods :- relief valves, pressure switch, current monitoring device.

**Do** - fit suction and discharge pressure gauges to monitor pressures for diagnostic purposes.

**Do** - install non-return valve to prevent syphoning when high pressures are applied to the pump whilst it is not in use. Valves are also recommended if two pumps are to be used on manifold/common discharge lines.

**Note:** It may be necessary to fit a pulsation damper in this situation.

**Do** - provide a hose cleaning facility to assist maintenance, ensuring the drive unit meets the specification for hose cleaning.

**Do not-** use the pump on high suction or high discharge static heads.

## 4.2 Pump and Base Foundations

To provide a permanent, rigid support for securing the pump unit a foundation is required, this will also absorb vibration, strain or shock on the pumping unit.

### Foundation Size

The foundation should be approximately 150mm longer and wider than the mounting base of the unit. The depth of the foundation should be approximately 150mm.

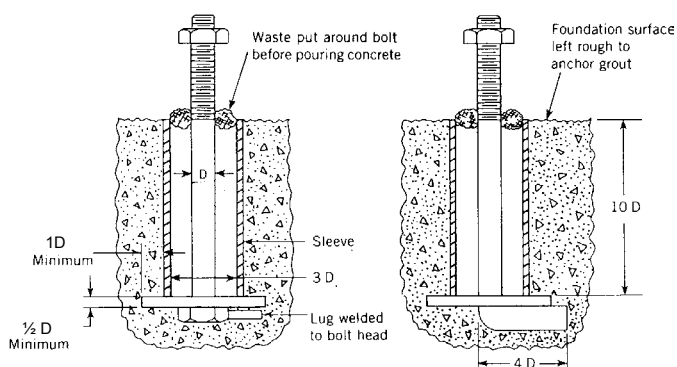
### Bolt Location Dimensions

The location and sizes of the relevant bolting down holes can be provided on a certified drawing from your supplier.

### Typical Foundation Bolts

The drawing below shows two methods for foundation bolt retaining. The sleeve allows for 'slight' lateral movement of the bolts after the foundation is poured. Use rag or paper to prevent the concrete from entering the sleeve while the foundation is poured. A minimum of 14 days is required to allow the curing of the concrete prior to operation.

D = Diameter of foundation bolts



## 4.3 Installation

Before the pump is installed it is advisable to consider the following:

- Always -** Ensure that the mounting surface is flat and always allow at least one metre for pump access/maintenance all around the pump.
- Weight -** Consider the weight of the pump and drive for lifting gear requirements.
- Electrical - Supply** Ensure that there is an adequate electrical supply close to the pump drive unit. This should be compatible with the electric motor selected.

# Operating Manual

## 4.4 Pipework

All pipework **must** be supported. The pump **must not** be allowed to support any of the pipework weight.

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

**Keep -** Pipework horizontal where applicable to reduce air locks. If required include eccentric reducers on suction lines.

**Always :-**

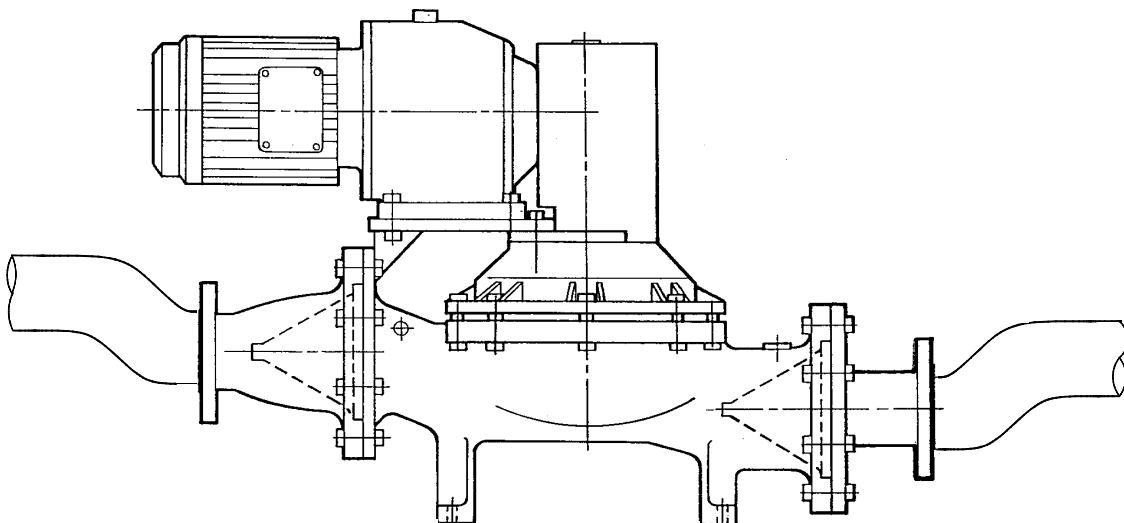
**Retain -** Liquid in the pump at all times. See below for pipework arrangement.

**Have -** Short straight suction lines to reduce friction losses in the pipework thereby improving the NPSH available.

**Avoid -** Bends, tees and any restraints close to either suction or discharge side of pump. Use long radius bends wherever possible.

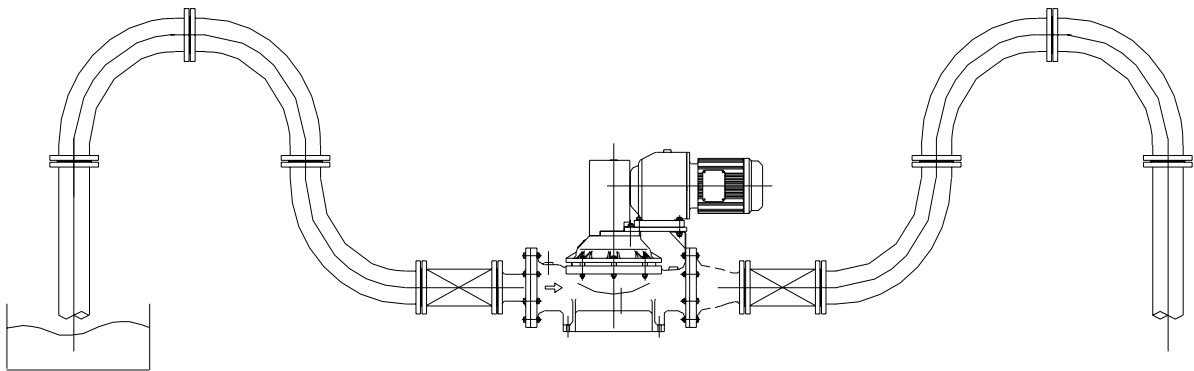
**Provide -** Isolating valves on each side of the pump to isolate the pump when necessary.

**Fit -** where possible, a pipe of a diameter which maintains a self cleaning velocity.



## 4.5 Priming Pipework

If this pump type is to be installed on an application where it is to perform a suction lift, we would recommend that priming pipework be fitted to the pump in-order to create a fluid trap around it, as shown in the diagram below.



### Suction Lift Application

Note: Always use long radius bends.

## 4.6 Priming

On initial installation or after pump maintenance, the pumps will require priming.

## 4.7 Maintenance

Consideration should be given when designing the installation that sufficient space is available for maintenance.

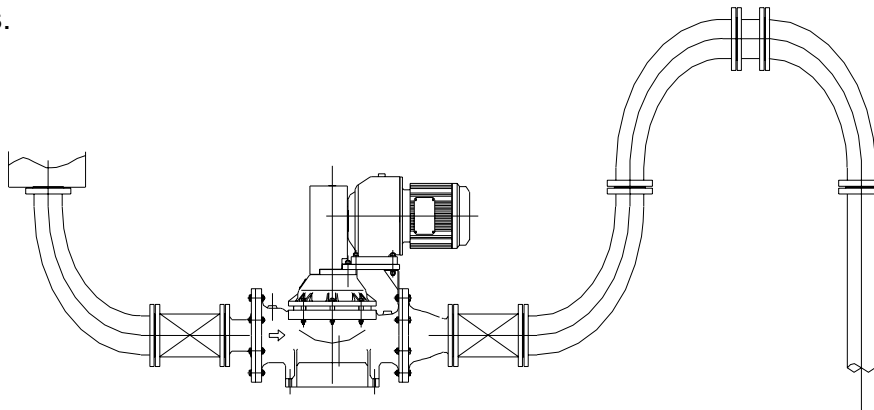
## 4.8 Self cleansing velocity

In situations where the pump is to be pumping down long discharge lines and is designed with rest periods of sufficient time to allow solids to settle, we would recommend that the lines be flushed through with clean water. This water should be pumped through the system at a self cleansing velocity to ensure that no solid matter is left in the lines.

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## 4.9 Syphoning

On installations where the top water level in the suction tank is above the discharge invert level there is a theoretical chance of the pumps syphoning this is particularly so on thin watery sludge's. Provision should be made on these types of installations to counter this effect by way of a siphon break or a motorised valve which comes in to operation when the pump stops.



**Syphon Break Application**

Note: Always use long radius bends

## 4.10 Re-priming

On installations where the pump is seeing a positive discharge head and has to be stripped/removed for maintenance, difficulty may be experienced in re-priming the pump. For this type of installation we would recommend that either the discharge line be emptied or a back pressure relief system be employed. This could be done by teeing into the discharge line local to the pump and returning it back to the suction tank.

## 4.11 Surge arrestors

Surge arrestors should be fitted to any pump working with either a high discharge head and long delivery pipework or long suction lifts. This is due to surge hammer which is the main cause of mechanical failure within the pump. There is also a significant improvement in sound power readings if surge arrestors are fitted.

## Float switch

When considering the installation of a single disc pump caution should be expressed over a suction condition which is flooded. This is due to a potential leak passage to atmosphere if the pump diaphragm fails. In such an installation it is important that a protection device such as our diaphragm float switch be employed to either send an alarm or isolate the pump automatically if this situation should arise.



## 5.0 Start Up and Shut Down

### 5.1 Pump Start-Up Check List

	YES	NO
1. Is the location of the 'stop' button clear?	<input type="checkbox"/>	<input type="checkbox"/>
2. Has the pipework system been flushed through to purge welding slag and any other hard solids?	<input type="checkbox"/>	<input type="checkbox"/>
3. Have all <b>obstructions</b> been removed from the pipework or pump?	<input type="checkbox"/>	<input type="checkbox"/>
4. Are the pump <b>connections</b> and pipework joints <b>tight</b> and <b>leak-free</b> ?	<input type="checkbox"/>	<input type="checkbox"/>
5. Is there <b>lubrication</b> in the <b>drive</b> unit?	<input type="checkbox"/>	<input type="checkbox"/>
6. To assist priming has the pump been filled with water via the plug on the suction side of the pump?	<input type="checkbox"/>	<input type="checkbox"/>
7. Are the pipework <b>valves open</b> ?	<input type="checkbox"/>	<input type="checkbox"/>
8. Are <b>all safety guards</b> in place?	<input type="checkbox"/>	<input type="checkbox"/>
9. Are the pump <b>speed/pressure</b> settings below the pump maximum limitations?	<input type="checkbox"/>	<input type="checkbox"/>

All answers should be 'yes' before proceeding.

If there are any pumping problems refer to the fault finding chart.

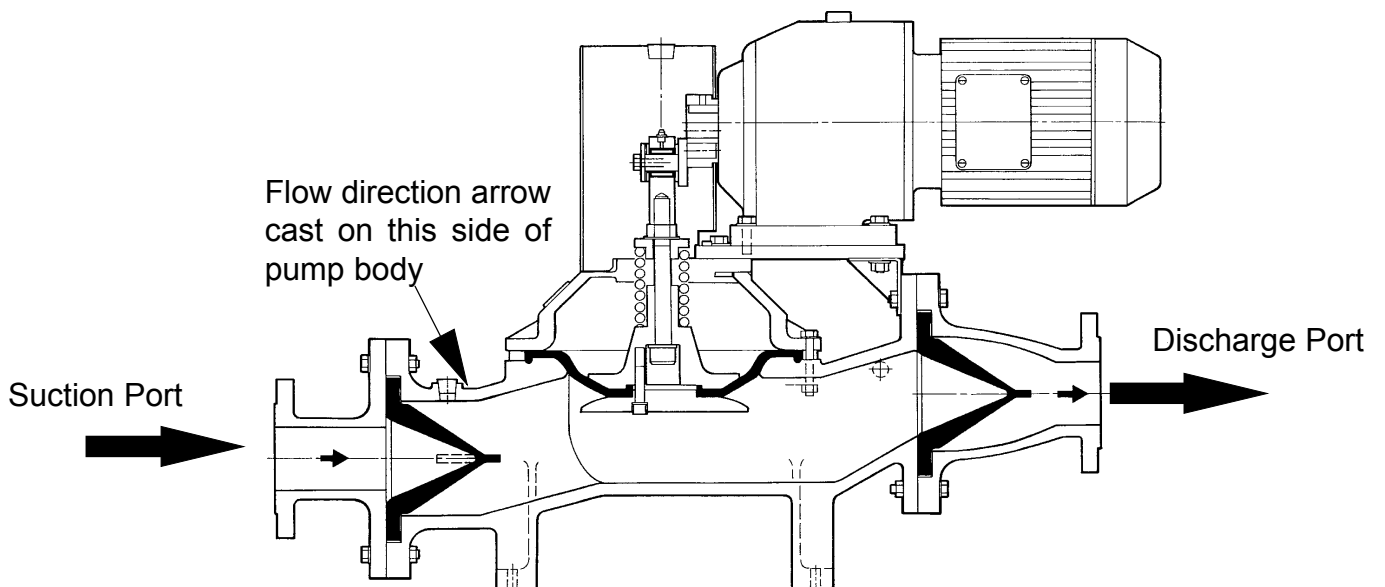
# Operating Manual

## 5.2 Pump Shut Down Procedure

1. Turn the pump off.
2. Isolate the pump/drive unit from all power and control supplies.
3. Close the pipework valves to isolate the pump.
4. If the pump is to be dismantled refer to the dismantling section.

## 5.3 Direction of Rotation

The direction of flow is dictated by the direction of the arrow cast into the pump body. The pump only has one direction of flow (see below).



## 6.0 Maintenance and Inspection

### 6.1 Maintenance Schedule

It is advisable to install pressure gauges on either side of the pump so that any problems within the pump/pipework will be highlighted.

Your monthly schedule should include:

- Checking the **oil level** in the drive unit.
- Greasing the **crank bearing** via the grease nipple. (Use Mobilplex 48 grease or equivalent).

### 6.2 Drive Unit Lubrication

The drive unit lubrication capacity is 2.0 litres. The following is a list of recommended oil grades for the drive unit :-

Make	Grade
Castrol	Alpha SP220
Shell	Omala 220
Esso	Spartan EP220
Texaco	Meropa 220
Mobil	Mobilgear 630/Mobilube GX90
Duckham	Fleetoid 90/Hypoid 90
BP	BP energol/GRXP220
Gulf EP	HD220

### 6.3 Recommended Spare Parts

The following table details the recommended spare parts which should be retained within your maintenance stock.

Part Description	Quantity
Diaphragm	1
Non Return Valve	2
Sealing Washers	3

## 7.0 Disassembly And Assembly

### 7.1 Before Dismantling the Pump

Before starting to dismantle the pump

**Always:-**



**Purge -**

the pump and system if any noxious/potentially explosive products have been pumped, and ensure the area is well ventilated.



**Isolate -**

pump/drive unit from all power and control supplies.



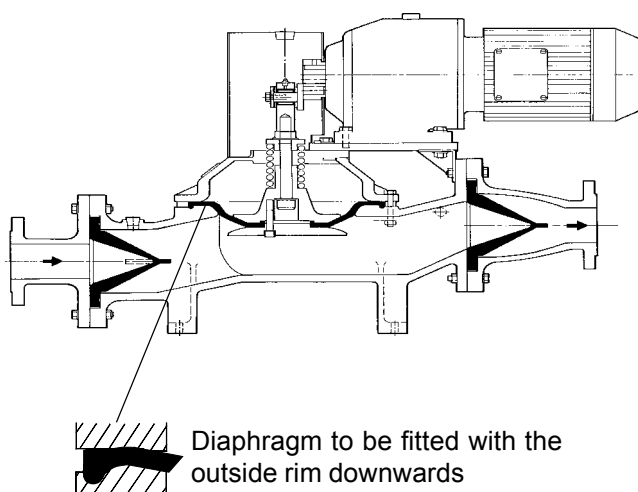
**Close -**

pipework valves to isolate the pump

**Read this section first  
before continuing to dismantle the pump.**

## 7.2 Replacing The Diaphragm

1. Remove the guard.
2. Remove the drive unit and support bracket bolts from the drive supports.
3. Release the socket set screw from the drive shaft crank assembly, and withdraw the crank/drive unit from the conrod.
4. Use lifting gear to remove the drive unit.
5. Carefully loosen the top housing retaining bolts and remove the top housing, ensuring the spacers are not misplaced.
6. Release the plunger retainer screws and plunger retainer.
7. Inspect and replace the diaphragm if necessary. Always replace the three sealing washers prior to reassembly.
8. Reassemble the pump in reverse order.



## 7.3 Replacing The Non Return Valves

**Both Non-Return Valves Are Identical.**

### Suction (inlet) Side

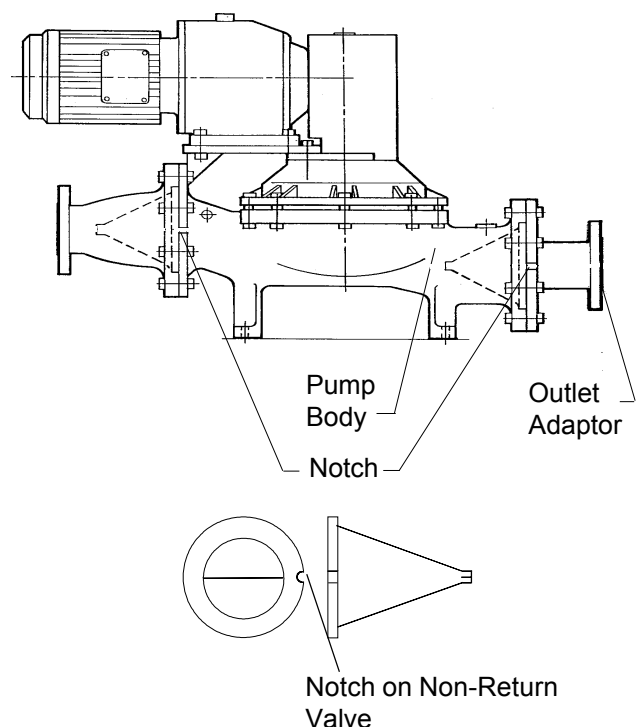
The suction side is denoted by the large arrow cast into the pump body. Access to the valve is achieved by releasing and removing the nuts and bolts which retain the inlet adaptor.

### Discharge (outlet) Side

The larger oval shape of the outlet adaptor houses the valve which is removed by releasing the nuts and bolts which retain the adaptor and bracket.

### Refitting the Non Return Valves

Before refitting always inspect the valves for signs of wear. A notch is provided on both the pump body and the outlet adaptor which must be used to line up with the mating notch on the non-return valve.

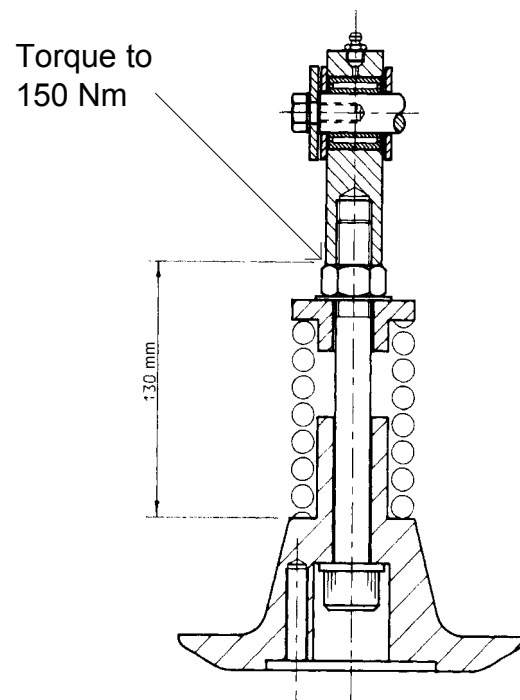


# Operating Manual

## 7.4 Replacing Connecting Block Assembly

1. Remove the guard.
2. Remove the drive unit and support bracket bolts from the drive supports.
3. Release the socket set screw from the drive shaft crank assembly and withdraw the crank/drive unit from the con rod.
4. Use lifting gear to remove the drive unit.
5. Carefully loosen the top housing retaining bolts and remove the top housing, ensuring the spacers are not misplaced.
6. Release the plunger retaining screws and plunger retainer (always replace three sealing washers prior to re-assembly).
7. Release diaphragm.
8. Remove con rod cap head.
9. Spring, plunger will now be loose. Replace if required.
10. Re - assemble in reverse order ensuring crank con rod nut is torqued to 150Nm and setting length for con rod spring is correct. NOTE : Setting length dimension is irrespective of crank size. See Fig 1.

Figure 1.



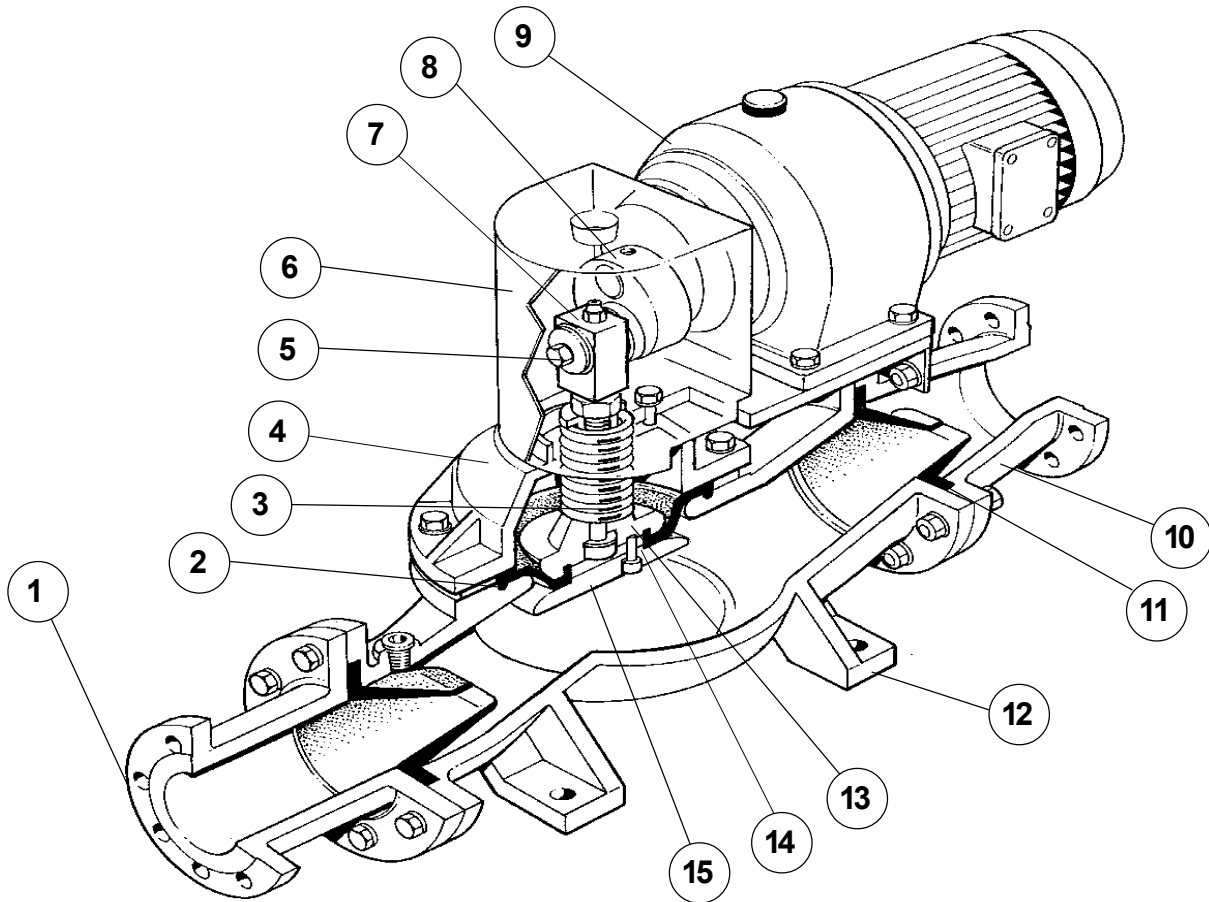
**Note:** Use PermaBond A130 or equivalent on all screws shown.

## 8.0 Faults, Causes and Remedies

SYMPTOM	POSSIBLE CAUSE	REMEDIES
<b>NO PRIME OR SLOW PRIME</b>	<ol style="list-style-type: none"> <li>1. Suction line not air tight</li> <li>2. Valve (if fitted) not seating</li> <li>3. Strainer clogged</li> <li>4. Suction lift too high</li> <li>5. Diaphragm worn or damaged</li> <li>6. Diaphragm not seating properly due to solids accumulation</li> <li>7. On suction lifts needs liquid head retained in discharge pipework</li> <li>8. Blocked suction pipe</li> <li>9. Sludge density too high</li> </ol>	<ol style="list-style-type: none"> <li>1. Cure all air leaks</li> <li>2. Clean seating and check</li> <li>3. Clean strainer</li> <li>4. Lower pump or raise liquid level</li> <li>5. Check and replace diaphragm</li> <li>6. Clean out suction housing</li> <li>7. Ensure pump has liquid in discharge pipework</li> <li>8. Clean out suction pipe</li> <li>9. Desludge manually or recirculate until thinner</li> </ol>
<b>NOT ENOUGH LIQUID DELIVERED</b>	<ol style="list-style-type: none"> <li>1. Differential pressure too high</li> <li>2. Excessive suction lift</li> <li>3. Pump blocked/or pipe blocked</li> <li>4. Pump wear</li> <li>5. Pump speed/crank stroke too low</li> </ol>	<ol style="list-style-type: none"> <li>1. Reduce pressure or increase speed to compensate</li> <li>2. Lower pump or raise liquid level</li> <li>3. Clean out pump and suction pipe</li> <li>4. Renovate as necessary</li> <li>5. Increase pump speed</li> </ol>
<b>PUMP TAKES EXCESSIVE PRESSURE</b>	<ol style="list-style-type: none"> <li>1. Liquid too thick or specific gravity greater than in planned duty</li> <li>2. Total head too high</li> <li>3. Closed discharge valve</li> <li>4. Chocked pump or pipeline</li> </ol>	<ol style="list-style-type: none"> <li>1. Fit larger motor or reduce distance pumped</li> <li>2. Reduce total head</li> <li>3. Open valve</li> <li>4. Clean out pump and suction pipe</li> </ol>
<b>EXCESSIVE VIBRATION</b>	<ol style="list-style-type: none"> <li>1. Head too high</li> <li>2. Pump or pipeline blocked</li> <li>3. Liquid too thick</li> <li>4. Cavitation due to blocked suction</li> <li>5. Pump damaged</li> <li>6. Inadequately supported rigid pipework</li> <li>7. Pulsation dampers required</li> <li>8. Flow rate over specification</li> </ol>	<ol style="list-style-type: none"> <li>1. Reduce total head</li> <li>2. Clean lines</li> <li>3. Reduce viscosity or use alternative pump</li> <li>4. Clean out suction line</li> <li>5. Renovate as necessary</li> <li>6. Support pipework at closer intervals</li> <li>7. Fit dampers</li> <li>8. Reduce pump speed</li> </ol>
<b>POOR DRIVE LIFE</b>	<ol style="list-style-type: none"> <li>1. Misalignment between drive and crank assembly</li> <li>2. Blocked pipework</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and rectify alignment</li> <li>2. Flush pipelines</li> </ol>
<b>POOR DISC LIFE</b>	<ol style="list-style-type: none"> <li>1. Head persistently too high</li> <li>2. Medium attacking disc material</li> <li>3. Liquid temperature too high</li> </ol>	<ol style="list-style-type: none"> <li>1. Reduce total delivery head</li> <li>2. Use optional disc material</li> <li>3. Reduce product temperature</li> </ol>
<b>SYPHONING</b>	<ol style="list-style-type: none"> <li>1. No forward barrier to flow</li> </ol>	<ol style="list-style-type: none"> <li>1. Ensure discharge pipework higher than suction tank, syphon break may be required</li> </ol>

# Operating Manual

## 9.0 Pump Drawing And Parts List



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Inlet Adaptor	8	Crank Assembly
2	Diaphragm	9	Drive Unit
3	Spring	10	Outlet Adaptor
4	Top Housing	11	Non Return Valve
5	Connecting Block Screw	12	Pump Body
6	Guard	13	Plunger
7	Connecting Block	14	Retainer Spacers
		15	Retainer

## 9.1 Torque Specification Chart

DESCRIPTION	TORQUE		SPANNER/KEY SIZE
	Nm	lbft	
Inlet Adaptor Nuts	15	10	17
Outlet Adaptor Nuts	56	41	17
Plunger Retainer Screw	15	10	10
Top Housing Nuts	56	41	19
Drive Unit/Support Nuts	98	72	19