

**OPERATION AND**  
**MAINTENANCE MANUAL**  
**GSD DIAPHRAGM PUMP**

**ISSUE 4**

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**SECTION 1**

**GENERAL DESCRIPTION**

## 1. GENERAL DESCRIPTION

### 1.1. GSD Diaphragm Pump

- 1.1.1. The GSD Diaphragm Pump is a fixed output single acting diaphragm pump. The pump consists of an electric motor driving a worm/worm wheel mesh gearbox with a crank/conrod mechanism. This reciprocates a diaphragm within a pump head assembly. Poppet type suction and delivery valves are fitted to the pump head. The absence of any gland offers zero leakage. The various engineering material options make the pump suitable for a wide range of chemicals. Typical applications are chemical injection, water treatment dosing, sampling or any other application where an economical positive liquid feed is required. The pump can be supplied stand alone or in a variety of custom built skid packages.
- 1.1.2. The standard pump maximum duty is 1000 l/h at 5 bar.
- 1.1.3. The standard 4 pole IP 55 electric motor is rated to 0.75 kW with a 415 VAC 3 phase 50 Hz supply. This gives a maximum stroke speed of 100 strokes/minute. Other motor options for hazardous environments or special projects are available on request.
- 1.1.3. The gearbox case is manufactured from cast iron. The standard construction of the pump head wetted parts is uPVC with a PTFE diaphragm. Other materials are available on request. The standard units are suitable upto 60°C.
- 1.1.4. The standard inlet and outlet port connections is 1" BSP for 1000 /h. Other port connections, i.e. NPT, flanges are available on request.
- 1.1.5. A full range of accessories including loading valves, relief valves and electrical starters are available from Grosvenor Pumps.

**SECTION 2**

**TECHNICAL DATA**

**2. TECHNICAL DATA**

**2.1. Pump Sizes**

|                   |          |   |
|-------------------|----------|---|
| GSD1000-5         |          | 1000 l/Hr @ 5 Bar G                           |
| Material          |          |   |
| Pump head         | Standard | uPVC  |
|                   | Option   | 316L stainless steel<br>PTFE 25% glass filled |
| Diaphragm         | Standard | PTFE  |
| Inlet Port        |          |   |
| GSD1000           |          | 1" BSP  |
| Discharge Port    |          |   |
| GSD1000           |          | 1" BSP  |
| Suction Condition |          | Flooded                                       |

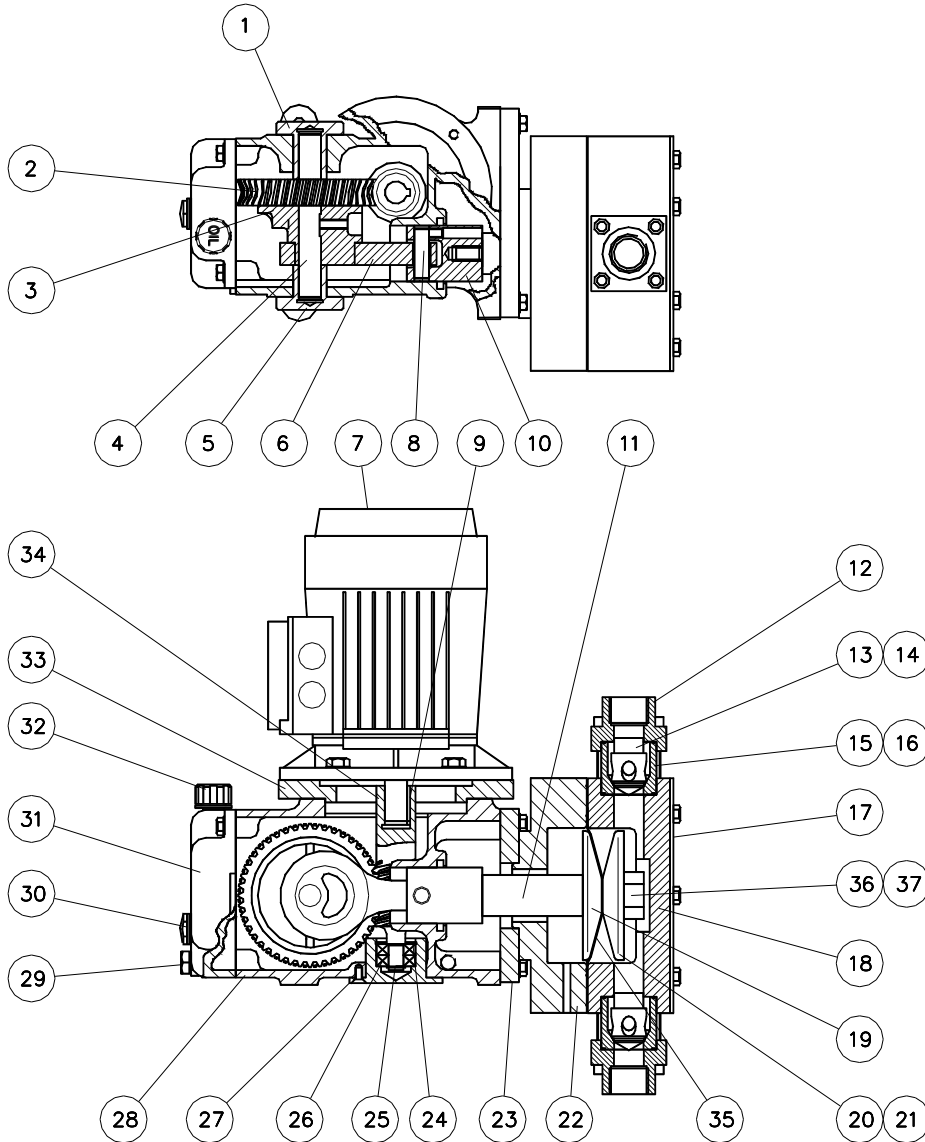
**2.2. Motor - Standard**

|           |  |   |
|-----------|--|---|
| Type      |  | IP 55 4 pole  |
| Power     |  | 0.75 kW   |
| Speed     |  | 1500 rev/min  |
| Supply    |  |   |
| Standard  |  | 415 VAC/3 ph/50 Hz (star)<br>240 VAC/3 ph/50 Hz (delta) |
| Optional  |  | 240 VAC/1 ph/50 Hz                                      |
| Operation |  | Continuous  |

**2.3. Dimensions**

|                |            |
|----------------|------------|
| Weight         | 50 kg nett |
| Overall Length | 364 mm     |
| Overall Height | 501 mm     |
| Overall Width  | 229 mm     |

2.4. GSD Diaphragm Pump - Diagram of Parts

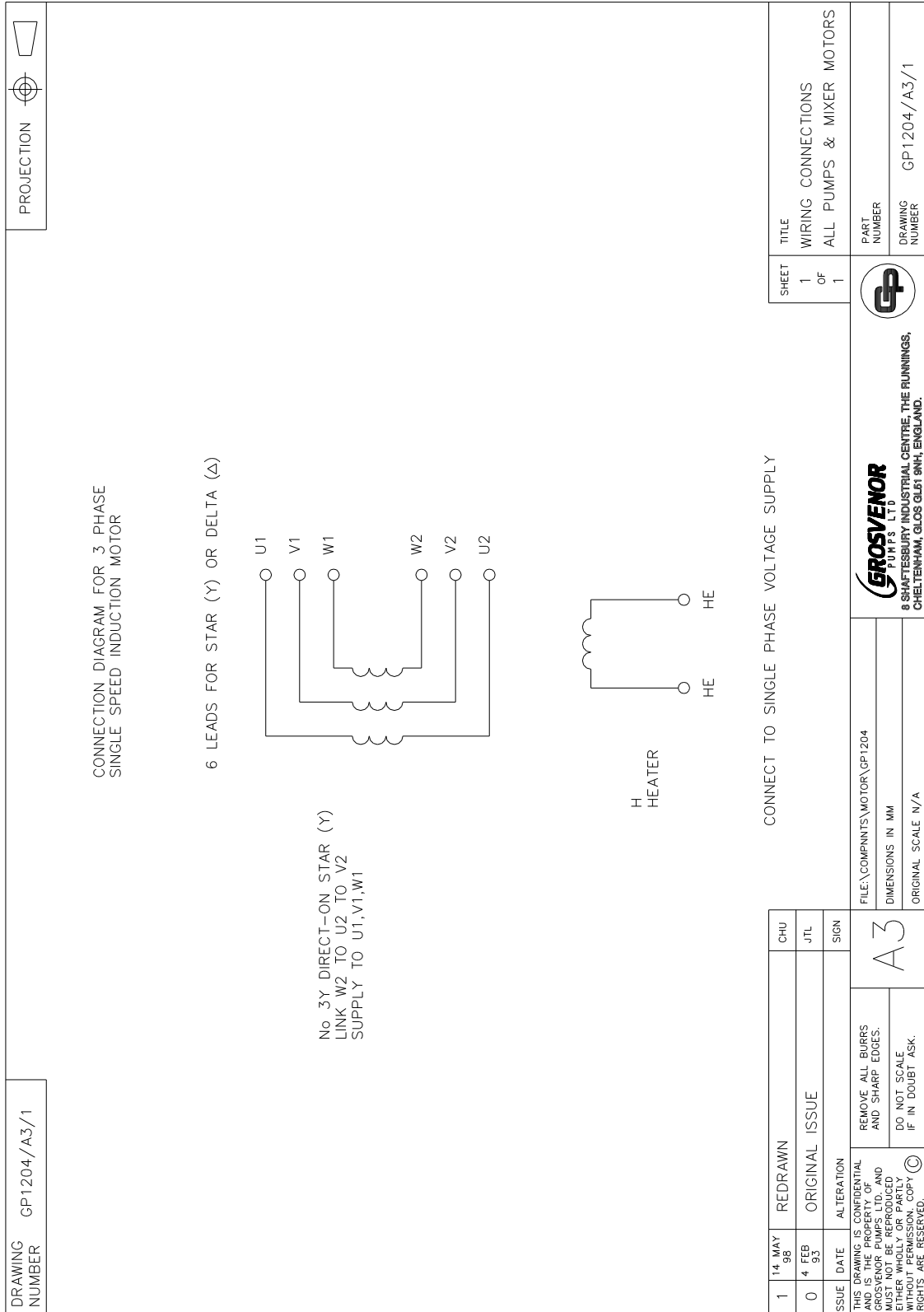


|    |                     |      |    |                            |      |
|----|---------------------|------|----|----------------------------|------|
| 1  | MAIN BEARING LONG   | 245  | 19 | DIAPHRAGM SUPPORT – REAR   | 2204 |
| 2  | WORM WHEEL          | 336  | 20 | DIAPHRAGM SUPPORT –FRONT   | 2203 |
| 3  | ECCENTRIC           | 334  | 21 | O-RING – DIAPHRAGM SUPPORT | 1709 |
| 4  | MAIN SHAFT          | 244  | 22 | BACK PLATE                 | 2208 |
| 5  | MAIN BEARING SHORT  | 246  | 23 | PUMP HEAD ADAPTOR PLATE    | 932  |
| 6  | CON ROD             | 193  | 24 | CIRCLIP $\phi 1-5/16"$     | 206  |
| 7  | MOTOR               | 639  | 25 | CIRCLIP $\phi 1/2"$        | 31   |
| 8  | CON ROD PIN         | 22   | 26 | BEARING                    | 208  |
| 9  | KEY                 | 1083 | 27 | BEARING HOUSING – TWIN     | 270  |
| 10 | CROSSHEAD           | 76   | 28 | GEARBOX                    | 218  |
| 11 | PUSH ROD            | 2201 | 29 | DRAIN PLUG                 | 25   |
| 12 | VALVE TOP           | 2205 | 30 | OIL LEVEL INDICATOR        | 71   |
| 13 | POPPET              | 2207 | 31 | CRANK CASE COVER           | 185  |
| 14 | O-RING – POPPET     | 2210 | 32 | BREATHER                   | 83   |
| 15 | VALVE BODY          | 2206 | 33 | MOTOR ADAPTOR PLATE        | 347  |
| 16 | O-RING – VALVE BODY | 2211 | 34 | WORM                       | 355  |
| 17 | PUMP HEAD PLATE     | 2202 | 35 | DIAPHRAGM                  | 2200 |
| 18 | PUMP HEAD           | 2209 | 36 | SUPPORT CAP                | 2224 |
|    |                     |      | 37 | O-RING – SUPPORT CAP       | 2212 |





2.6. Wiring Diagram GP1204 latest issue



**SECTION 3**

**SAFETY**

### 3. SAFETY

#### 3.1. Standard Precautions

- 3.1.1. To comply with normal safety standards, the following measures are to be taken:
- 3.1.2. A minimum issue of standard protective clothing to be available to all personnel involved in the handling of chemicals and operation of the dosing plant, consisting of:
- 3.1.3. Goggles - with wide-angle vision, contact the skin in complete seal around both eyes and adequately vented without allowing access to spillage.
- 3.1.4. Safety helmet - of metal or reinforced plastic to the relevant British Standard or equivalent.
- 3.1.5. Gloves - wrist length, of soft PVC or rubber permitting full flexure.
- 3.1.6. Overalls - to be worn in conjunction with the items above or a one-piece chemical suit.
- 3.1.7. Standard site safety provisions, safety precautions and first aid instructions, in condensed form shall be declared at site and in site vehicles. All employees shall be in possession of literature giving full details of safety precautions and first aid action.
- 3.1.8. Ensure that the nature and properties of the chemical being handled are known in advance.
- 3.1.9. Ensure that the correct precautions for the chemical being handled are observed. IF IN DOUBT ASK.
- 3.1.10. Treat all materials as harmful.
- 3.1.11. Do not touch chemicals or residues with bare hands.
- 3.1.12. Maintain personal cleanliness.
- 3.1.13. Wash contaminated clothing before re-use.
- 3.1.14. Wash thoroughly after handling chemicals. Do not eat drink or smoke unless decontaminated.
- 3.1.15. Erect WARNING barriers where necessary.
- 3.1.16. Follow specific process instruction carefully.
- 3.1.17. Mix chemicals in the order specified.
- 3.1.18. **CAUTION: CHEMICALS CAN BE HARMFUL. PLEASE OBSERVE MANUFACTURER'S HANDLING AND STORAGE GUIDELINES.**
- 3.1.19. Health Hazards - Harmful in contact with the skin and irritating to the eyes.
- 3.1.20. Handling - Avoid contact with the skin and eyes. Wear suitable protective clothing gloves and eye protection. Wash out empty container thoroughly with water and add solution to system being treated.
- 3.1.21. Storage - Keep container in a cool, well ventilated place. Keep away from source of ignition. NO SMOKING.
- 3.1.22. Spillage and Disposal - Shut off all sources of ignition. Absorb spillage in earth and sand, collect up and remove all contaminated clothing. Eye exposure; in case of contact with eyes, rinse immediately with copious quantities of water. Ingestion; remove patient to fresh air, rest and warm. Administer oxygen or artificial respiration as necessary.

**SECTION 4**

**INSTALLATION, COMMISSIONING & OPERATION**

## **4. INSTALLATION, COMMISSIONING & OPERATION**

### **4.1. Mounting**

- 4.1.1. For maximum operating life, the pump should be located in a clean cool dry environment. If the site is classified as a hazardous area ensure the pump meets the site requirements. Position the pump on a rigid base preferably as low as possible relative to the supply for the optimum suction condition. Fix the pump gearbox firmly to the base using four suitable floor bolts.
- 4.1.2. If the pump is to be installed in an aggressive, hot, dirty environment, it is advisable to provide some cover. However it is essential to leave adequate ventilation for motor cooling. Do not obstruct the motor fan cover.

### **4.2. Pipe Connections**

- 4.2.1. The suction pipe sizes should be larger than the port connection. The number of pipe bends should be kept to a minimum to reduce flow losses, pulsation and water hammer effects. Increase the pipe size if long pipe runs are unavoidable. If water hammer is present, fit a pulsation damper unit in the delivery pipe line as close to the pump as possible. For technical advice, please refer to Grosvenor Pumps.
- 4.2.2. The pump is designed to be self-priming. However, if difficulties are experienced with priming, loosen/remove the delivery valve sub-assembly, fill the pumping chamber with the pumped liquid and refit the valve. Appropriate care should be taken if the liquid is harmful.
- 4.2.3. Allow sufficient time to fill large diameter and/or long pipe lengths to build up hydraulic pressure. If the pressure does not increase, check:-
  - All joints are tight and fully sealed and any dump/flushing valves are shut.
  - The relief valve is adjusted to the correct pressure.
  - The suction and delivery lines are connected to the correct pump ports.
  - The liquid is free of large debris and contaminants. Large solids will reduce valve efficiency. Fit a suction strainer/filter.
  - Entrapped air pockets. Bleed the system.
- 4.2.4. If there is a high suction head present, a loading valve may be required to prevent syphoning.

### **4.3. Gearbox Oil**

- 4.3.1. Note the pump gearbox is supplied without lubrication oil. Unscrew the breather unit and fill the gearbox with a sufficient quantity of suitable oil (refer to Section 5 - Maintenance for approved lubricants). The level should be no higher than the oil level plug.

### **4.4. Electrical**

- 4.4.1. Before beginning any electrical work, isolate the supply at the mains.
- 4.4.2. Open the motor terminal box. Connect a suitably rated power supply to the motor. Use suitable power multi-core power cable with a cable gland nut. Fasten the power leads firmly to the terminal points. Always connect the supply earth lead.

- 4.4.3. Three phase motors can be controlled by a direct on-line starter or a frequency inverter. The standard motors can be wired in star or delta with a corresponding voltage variation e.g. either 415 VAC or 240 VAC. Therefore check the power supply.
- 4.4.4. The motor rotation should be anti-clockwise when viewed from the fan side. For three phase supply, if the rotation is clockwise, change any two of the three supply phases over. The direction for single phase motors has been factory set to be anti-clockwise. However, if the rotation is clockwise interchange the blue and yellow leads on terminals 2 and 3.
- 4.4.5. As the pump will operate upto the motor stalling point, it is recommended that an electrical overload trip device is fitted and/or a hydraulic relief valve fitted in the delivery line. To allow for start-up current surge, current trips should be 6 to 7 times the full load motor current. If the supply is from a frequency inverter, the motor should be specified with a thermistor which is compatible with the frequency inverter. Unless a blower is fitted to the motor, turndown must be limited to 3:1 with an inverter.

#### **4.5. Commissioning**

- 4.5.1. After pipe and electrical installation has been completed run the pump between 30 and 60 minutes at minimum hydraulic load and flow. Examine the entire hydraulic system including the pump for any leakages. Check the pump for unusual noises and vibration. For the first 14 days operation, expect the pump gearbox to run at a temperature of 65-70°C. This will in no way affect the overall pump performance.
- 4.5.2. If difficulties are experienced with priming, remove the delivery valve, fill the pumping chamber with the pumped liquid and refit the valve. Appropriate care should be taken if the liquid is harmful.
- 4.5.3. Allow sufficient time to fill large diameter and/or long pipe lengths to build up hydraulic pressure. If the pressure does not increase, check:-
- (i). All joints are tight and fully sealed and any dump/flushing valves are shut.
  - (ii). The relief valve is adjusted to the correct pressure.
  - (iii). The suction and delivery lines are connected to the correct pump ports.
  - (iv). The liquid is free of large debris and contaminants. Large solids will reduce valve efficiency. Fit a suction strainer/filter.
  - (v). Entrapped air pockets. Bleed the system.
- 4.5.4. If there is a high suction head present, a loading valve may be required to prevent syphoning.

#### **4.6. General Operation**

- 4.6.1. After successfully commissioning as detailed in Section 5, the pump can commence full operational duty. Before switching on the pump check all isolating valve are opened. Likewise switch off the pump before closing an isolating valve.
- 4.6.2. It is not good practice to allow a pump to run dry.
- 4.6.3. Check the system for water and chemical leaks.

- 4.6.4. Check the pump for excessive noise, vibration and overheating.
- 4.6.5. Ensure that all associated instruments are functioning correctly and that their indications are accurate and meaningful.
- 4.6.6. Operate the pump within the duty specified in the original order. Please note that the performance data specified in section 2.1. is the maximum capable for each pump. To avoid damage, never exceed 5 bar.
- 4.6.7. Check the pump will operate satisfactorily if it is to be used for another duty, i.e. different liquid, pressure, environment, power supply.
- 4.6.8. Always handle the pump by gripping the gearbox case and not by the pump head, valves or any pipework attached to the pump head.

#### **4.7. Speed Variator and Flow Control**

- 4.7.1. The speed variator allows the flow to be varied by controlling the motor speed into the pump gearbox. The speed can be varied over a range of 17% to 100% which takes 9 turns of the handwheel. The number of rotations is shown on a gravity dial indicator set within the handwheel. Therefore at ZERO position, the dial indicator shows 17% of the maximum flow and at NINE position, shows 100%.
- 4.7.2. To INCREASE the flow, turn the hand wheel ANTI-CLOCKWISE. To REDUCE the flow, turn the hand wheel CLOCKWISE.
- 4.7.3. The orientation of the speed variator and the motor can be rotated in 90° increments to suit the individual application.

**SECTION 5**

**MAINTENANCE**



## **5. MAINTENANCE**

### **5.1. Safety**

- 5.1.1. **CAUTION: BEFORE STARTING ANY MAINTENANCE PROCEDURE, ENSURE THAT ALL SAFETY INSTRUCTIONS DETAILED IN THE CURRENT WORKS MANUAL AND STANDARD PROCEDURES HAVE BEEN COMPLIED WITH.**

### **5.2. General Maintenance**

- 5.2.1. General maintenance is an oil change every 6 months. If the pump is in continuous operation at maximum duty, a detailed inspection of parts will be required at 12 month intervals. The pump unit is best dismantled in a fully tooled workshop. Full spares and any special tools are available from Grosvenor Pumps. Full refurbishment can be carried out by Grosvenor Pumps engineers. Contact Sales Dept for a quotation.

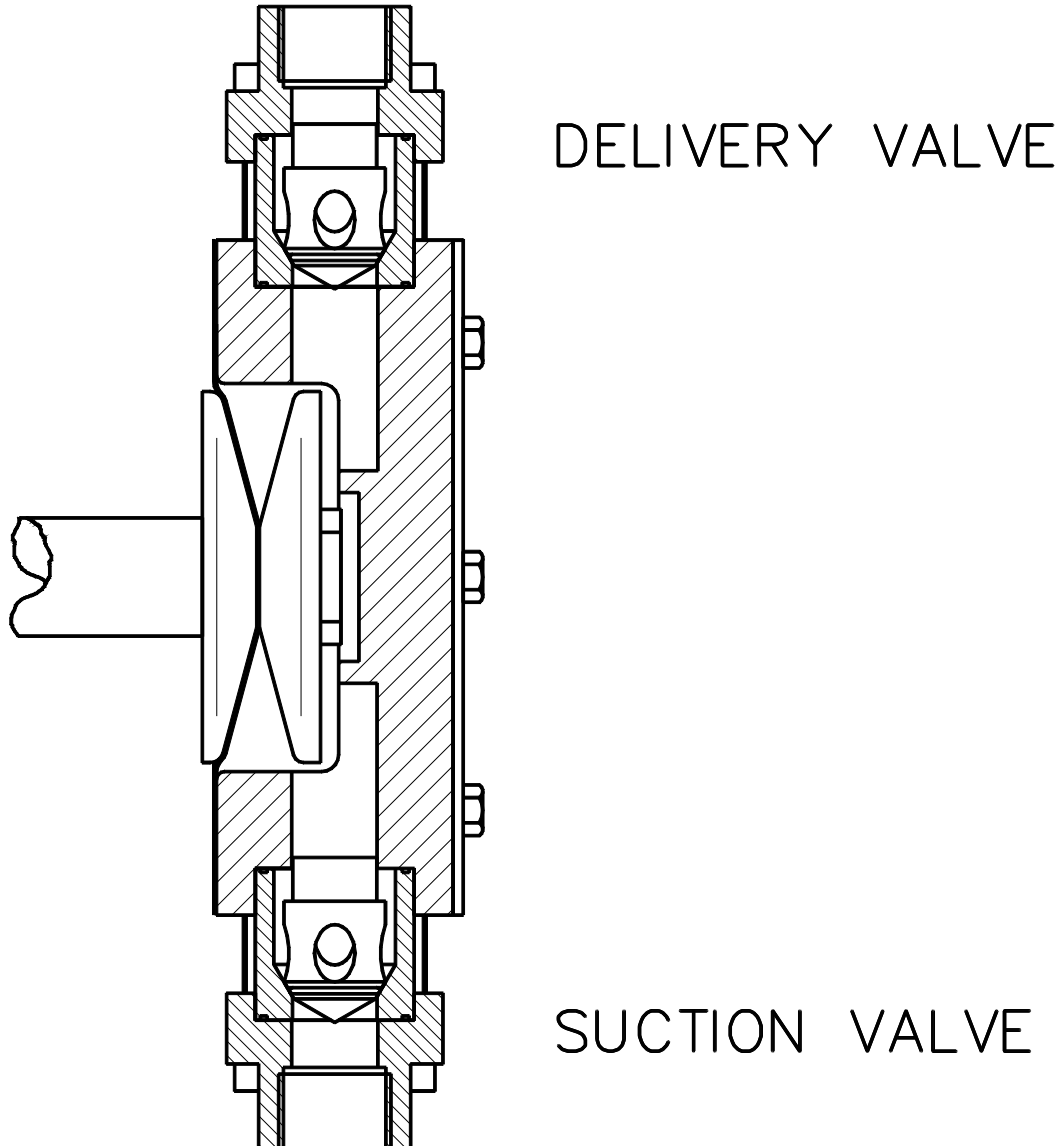
### **5.3. Motor**

- 5.3.1. Isolate electric supply, disconnect wires from terminal box. After removing the flange bolts, the motor lifts off the mounting flange. The motor shaft is located in the worm with a close tolerance fit and may require some considerable force to separate it from the gearbox. The motor is non-serviceable.
- 5.3.2. To refit the motor, insert the shaft into the worm, ensuring key (1083) is not displaced. Press the motor fully down onto the mounting flange. Retighten the motor flange bolts.
- 5.3.3. Reconnect the wiring to ensure rotation is anti-clockwise when viewing motor on the fan end.

### **5.4. Speed Variator (if fitted)**

- 5.4.1. The speed variator can be removed from the pump gearbox by unscrewing the four M8 screws. Normally the worm will lift off with the speed variator output shaft. It is a sliding fit but the worm can seize itself onto the variator output shaft. Use lever bars and releasing fluid to ease off the worm. Applying heat from a blow torch to the worm is permissible but care must be taken not to damage the speed variator aluminium body. Do not damage the worm teeth. The speed variator is non-serviceable.
- 5.4.2. To replace the speed variator, position the speed variator over the pump gearbox. Line up the speed variator output shaft key with the worm keyway and lower the speed variator onto the pump gearbox. Ensure the key is not displaced and the speed variator sits fully down on the gearbox flange before tightening the four M8 screws.
- 5.4.3. The speed variator is non-serviceable. A replacement speed variator is available from Grosvenor Pumps.

### 5.5. Suction and Delivery Valves Assemblies



- 5.5.1. Note the orientation of the parts which make up the suction and delivery valve assemblies. Unscrew the four M8-1 capscrews holding the valve top (2205) to the pump head (2209). Gently separate the valve body (2206) and poppet (2207). Examine all parts for wear and/or damage. Always renew the valve body O-rings (2211) and valve poppet O-rings (2210).
- 5.5.2. Check the poppets, valve seats and valve guides are replaced in the respective valve bodies in their correct suction or delivery orientation. When refitting the valve assemblies, ensure all valve body O-Rings are positioned in their seats before tightening. Tighten the four M8-1 capscrews holding the valve top to 15 Nm. With the PVC and PTFE threaded parts extreme care must be taken during reassembly.

### 5.6. Pump Head Assembly

- 5.6.1. To remove the pump head assembly, first disconnect the suction and discharge piping at the pump valve connection.
- 5.6.2. Position the diaphragm push rod (2201) at centre stroke.
- 5.6.3. Remove the six screws securing the pump head (2209) to the backplate (2208). The pump head can be removed with the pump head plate (2202).
- 5.6.4. Unscrew the front diaphragm support cap (2224) exposing the M10 nut. Unscrew the M10 nut to remove the diaphragm, front and rear diaphragm support.
- 5.6.5. To remove the backplate, unscrew the four M8-1 capscrews holding it to the pump head adaptor plate (932).
- 5.6.6. Reassembly is the reversal of para. 5.6.2 to para. 5.6.5.. Always replace the diaphragm regardless of its condition. During replacement, ensure the diaphragm push rod is at centre stroke and align the screw holes in the diaphragm to the backplate holes. Refit the front diaphragm support M10 nut using a suitable thread sealant i.e. Loctite 222. Retighten the M10 nut with a torque wrench to 10 Nm and screw on the support cap with O-ring. Refit the pump head and retighten the six screws to 20 Nm. The diaphragm must be fully stretched to its final shape before running the pump at full power. Turn the gearbox by hand for ten stroke cycles under no load.

### 5.7. Gearbox Assembly

- 5.7.1. It is impractical to service the gearbox assembly with the pump is still mounted on the skid base frame. Work is carried out after removing the complete motor as in 5.3. and pumphead assembly 5.6..
- 5.7.2. Drain the gearbox oil by removing the drain plug (25). Remove the crankcase cover (185). If fitted, remove the motor plate (347). On the bottom face of the pump gearbox, unscrew the three countersunk head screws holding the bottom bearing housing (270). With a pair of internal circlip pliers remove the retaining circlip (31) holding the two worm bearings (208) in the bottom bearing housing. After separating the bottom bearing housing, remove the circlip (206) holding the two worm bearings to the worm (349). Remove the lock grub screw in the eccentric (334). Remove the long and short main bearings (245 & 246) and push the main shaft (244) out. Pull out the connecting rod (193) and crosshead (76). Remove the crosshead pin lock screw and push out the crosshead pin (22).
- 5.7.3. Examine all parts for severe wear or damage. Replace any parts as required.
- 5.7.4. Reassembly of gearbox is reverse of 5.7.2.. Replace all gaskets and seals.

### 5.8. Final Assembly

- 5.8.1. Fit the motor.
- 5.8.2. Fit Nameplate and crosshead guard
- 5.8.3. Connect wiring to give correct rotation.
- 5.8.4. Run-in for the Gearbox for 2 hours. Drain the gearbox and refill with fresh oil.

- 5.8.5. Replace pumphead and valve assemblies. The complete pump is ready for commissioning. Check the pump for unusual noises and vibration. For the first 14 days operation, expect the pump gearbox to run at a temperature of 65-70°C. This will in no way affect the overall pump performance.

### **5.9. Spare Parts**

- 5.9.1. Spare parts can be identified to drawing by part number. Always quote pump serial number which can be found on pump crankcase cover. Parts should be ordered from:-

**Grosvenor Pumps Limited,  
Trevoole, Praze,  
Camborne,  
Cornwall**

**Tel. 01209 831500**

**Fax. 01209 831939**

### **5.10. Lubrication**

- 5.10.1. The pump is empty when supplied, but should be filled before commissioning. Recommended grades are shown on pump nameplate for major oil companies. Equivalent grades for other oil companies are listed here. The oil level is determined by level plug and should be checked weekly. Change approximately every 6 months. All gearbox parts are lubricated by splash. Motor bearings are fully charged with grease for life by manufacturer.

**Oil capacity - 0.7 litres Approx.**

### **5.11. Approved Lubricants**

- 5.11.1. Oil grades based on ambient temperatures, suitable for normal applications. The recommendations are based on current information available and responsibility cannot be accepted for quality or suitability of oil supplied nor to any mechanical defect due to unsatisfactory lubrication.
- 5.11.2. Oils marked \* contain mild E.P. additives and should not be used for units operating above 80°C normal running temperatures.
- 5.11.3. In general these oils should not be used below -4°C. If intended for such use, Grosvenor Pumps can recommend suitable oils for lower temperatures. Oils marked # are usually obtainable at most garages and motor factors.

#### **SUPPLIER**

BP Oil Ltd.

Burmah - Castrol (UK) Ltd.

Esso Petroleum Ltd.

#### **OILS**

Energol HLP 320

Energol CS 320 \*

Hypogear 90 EP #

Alpha ZN 320

Castrol ST 90 #

Hypoy EP 90 #

Teresso 320

GX 85W/90

Mobil Oil Co. Ltd.

DTE AA

HD 140 #

GX 140 #

Shell

Vitrea 320 \*

Macoma R 320 \*

Tellus V320

HD 90/140#

Texaco Ltd.

Regal R & O 320