OPERATION & MAINTENANCE MANUAL

PYGME DIAPHRAGM PUMP MK 3

ISSUE 1

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SECTION 1

GENERAL DESCRIPTION

1. GENERAL DESCRIPTION

1.1. Pygme Diaphragm Pump Mk 3

1.1.1. The Pygme Diaphragm Pump MK 3 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. Ball or 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. Standard pump maximum duties are 30 l/h, 70 l/hr, 100 l/h, 200 l/h and 350 l/h at pressures upto 10 bar.

1.1.3. The standard 2 pole IP 55 electric motor is rated up to 0.37kW with a 415 VAC 3 phase 50 Hz supply. This gives a stroke speed of 60 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 up to 60^{o}C.

1.1.4. The standard inlet and outlet port connections are available in 1/2" BSP for flow ranges upto 200 l/h and 3/4" BSP for the 400 l/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

4" x 5/16"	30 l/Hr @ 10 Bar G
4" x ½"	70 l/Hr@ 10 Bar G
6" x 5/16"	100 l/Hr @ 8 Bar G
6" x ½"	200 l/Hr @ 6 Bar G
6" x 1"	350 l/Hr @ 5 Bar G

Material

Pump head	Standard	uPVC
	Option	316L stainless steel
		PTFE 25% glass filled
Diaphragm	Standard	PTFE

Inlet Port

Up to 200 l/Hr	1/2" BSP
350 l/Hr	3/4" BSP

Discharge Port

Up to 200 l/Hr	1/2" BSP
350 l/Hr	3/4" BSP

Suction Condition: Flooded

2.2. Motor - Standard

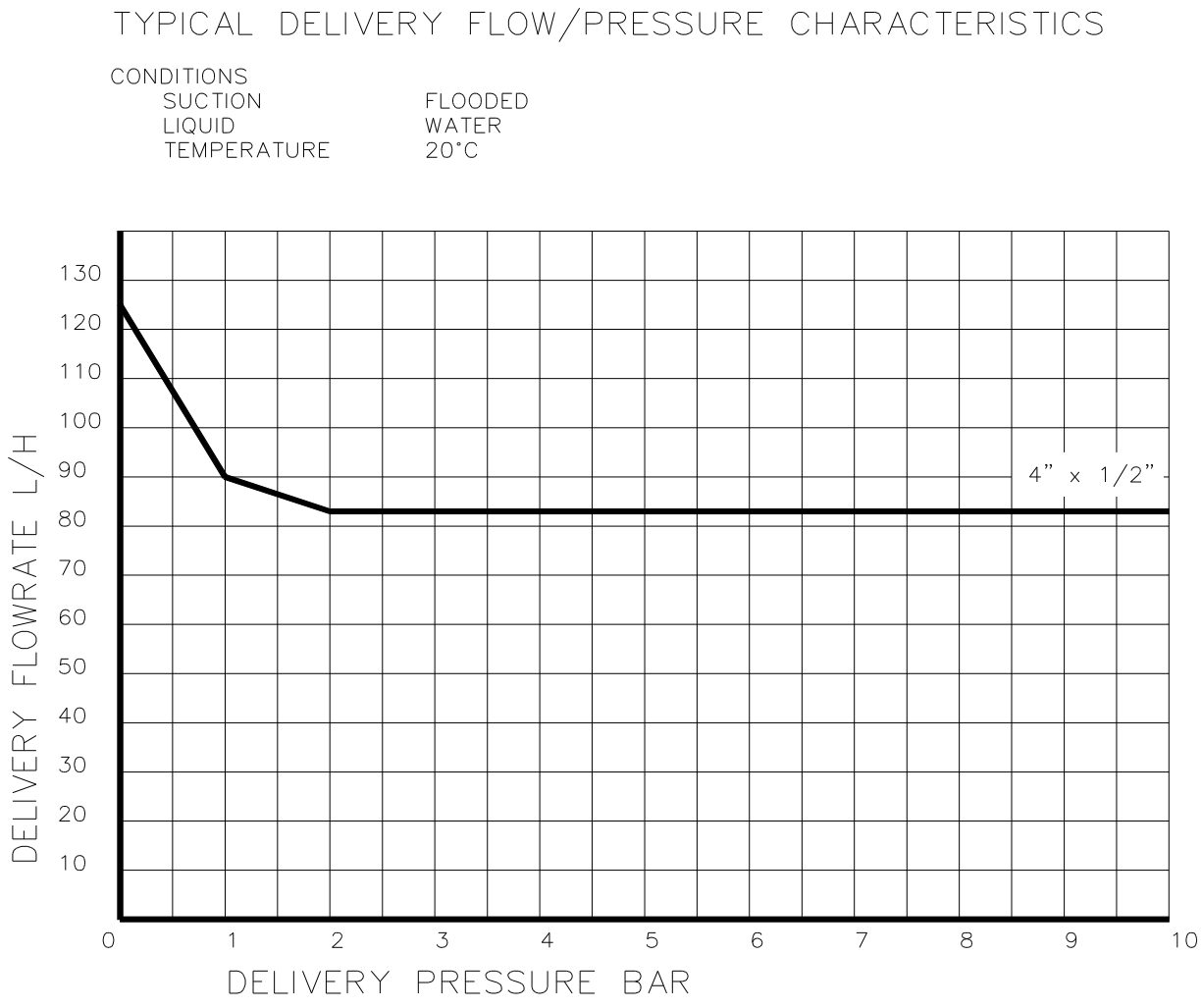
Type	IP 55 2 pole
Power	0.37 kW
Speed	1400 rev/min
Supply	
Standard	415 VAC/3 ph/50 Hz (star)
	240 VAC/3 ph/50 Hz (delta)
Optional	240 VAC/1 ph/50 Hz
Operation	Continuous

2.3. Dimensions

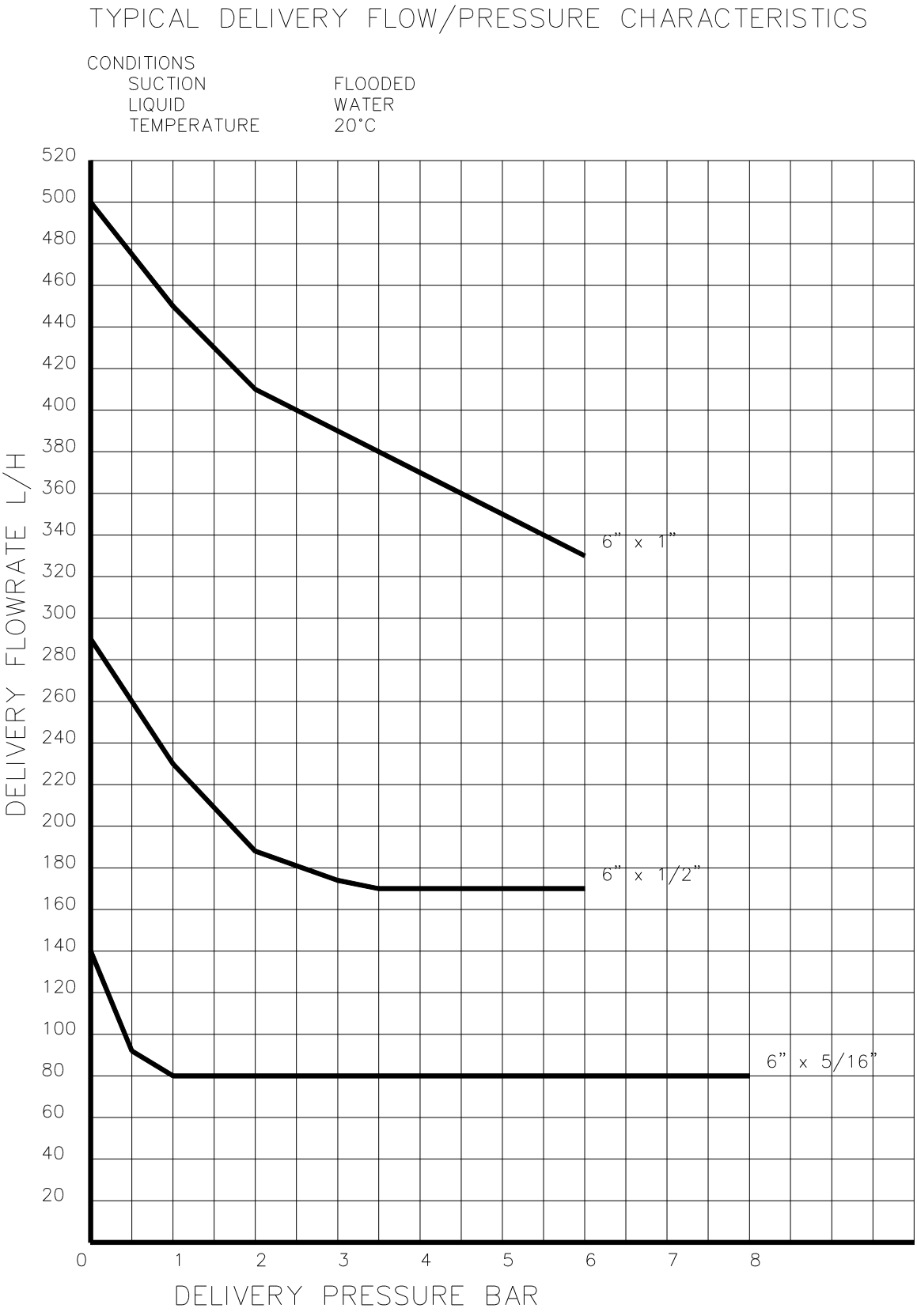
Weight	31 kg nett
Overall Length	345 mm
Overall Height	434 mm
Overall Width	230 mm

2.4. Performance Graphs

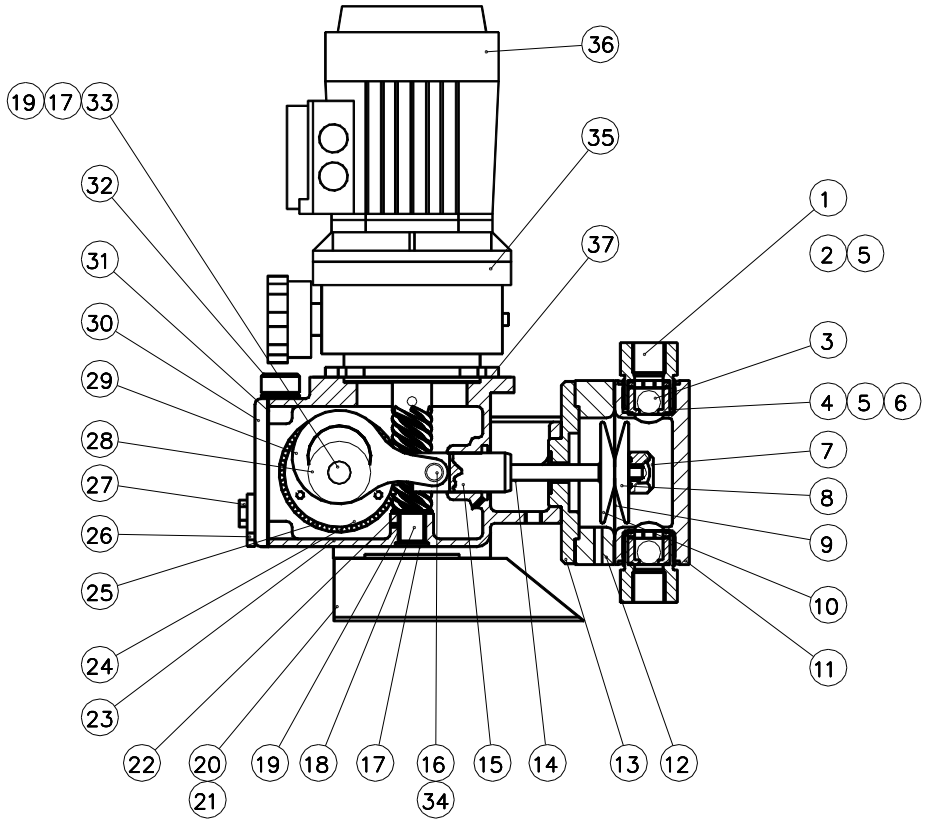
Pygme Diaphragm Pump 4" MK3



Pygme Diaphragm Pump 6" MK3



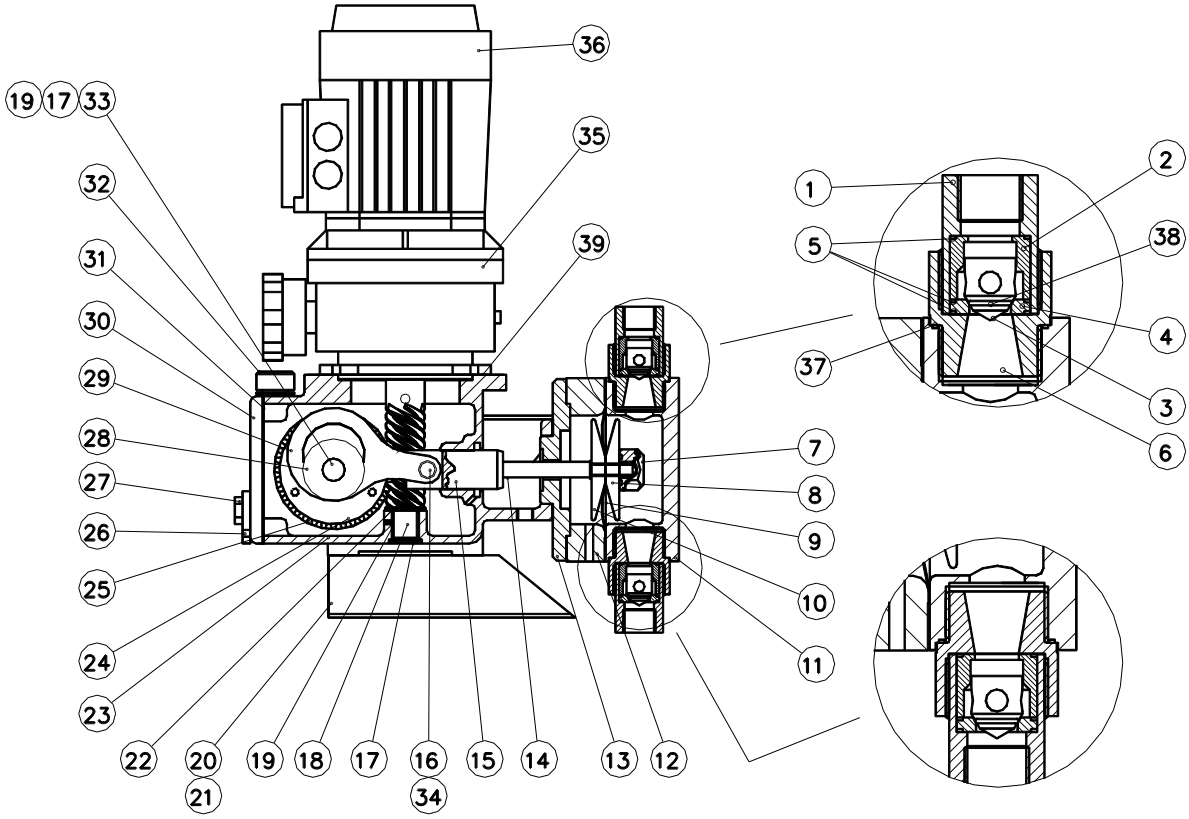
2.5. Pygme Diaphragm Pump Mk 3/4 - Ball Valves
Key To Diagram Of Parts



DRG. No.	DESCRIPTION	PART REF No.	DRG. No.	DESCRIPTION	PART REF No.
1	VALVE BODY	1751	26	DRAIN PLUG	25
2	VALVE GUIDE	1750	27	LEVEL PLUG	71
3	VALVE BALL	1217	28	MAIN THRUST WASHER	686
4	VALVE SEAT	1749	29	CONNECTING ROD	649
5	VALVE BODY O-RING	745	30	CRANKCASE COVER	647
6	VALVE SEAL	1795	31	CRANKCASE GASKET	699
7	DIAPHRAGM NUT	1205	32	OIL FILLER/BREATHER	1774
8	DIAPHRAGM SUPPORT (FRONT)	1204D	33	MAIN SPINDLE	650
9	DIAPHRAGM	1206	34	CROSSHEAD PIN BUSH	656
10	DIAPHRAGM SUPPORT (BACK)	1204A	35	VARIATOR	2123
11	PUMP HEAD	1768	36	MOTOR	
12	BACK RING	1243	37	MOTOR GASKET	2155
13	BACK PLATE	1242			
14	DIAPHRAGM ROD	1295			
15	CROSSHEAD	701			
16	CROSSHEAD PIN	655			
17	CORE PLUG	654			
18	WORM 5/8" BORE	1097			
19	BEARING BUSH	653S			
20	STAND RHS	885			
21	STAND LHS	885			
22	WORM THRUST WASHER	687			
23	GEARBOX CASE	717			
24	ECCENTRIC	822			
25	WORM WHEEL	1093			

Note: - Part 35 does not apply to Mk3

2.6. Pygme Variflow Diaphragm Pump Mk 3/4 - Poppet Valves
Key To Diagram Of Parts



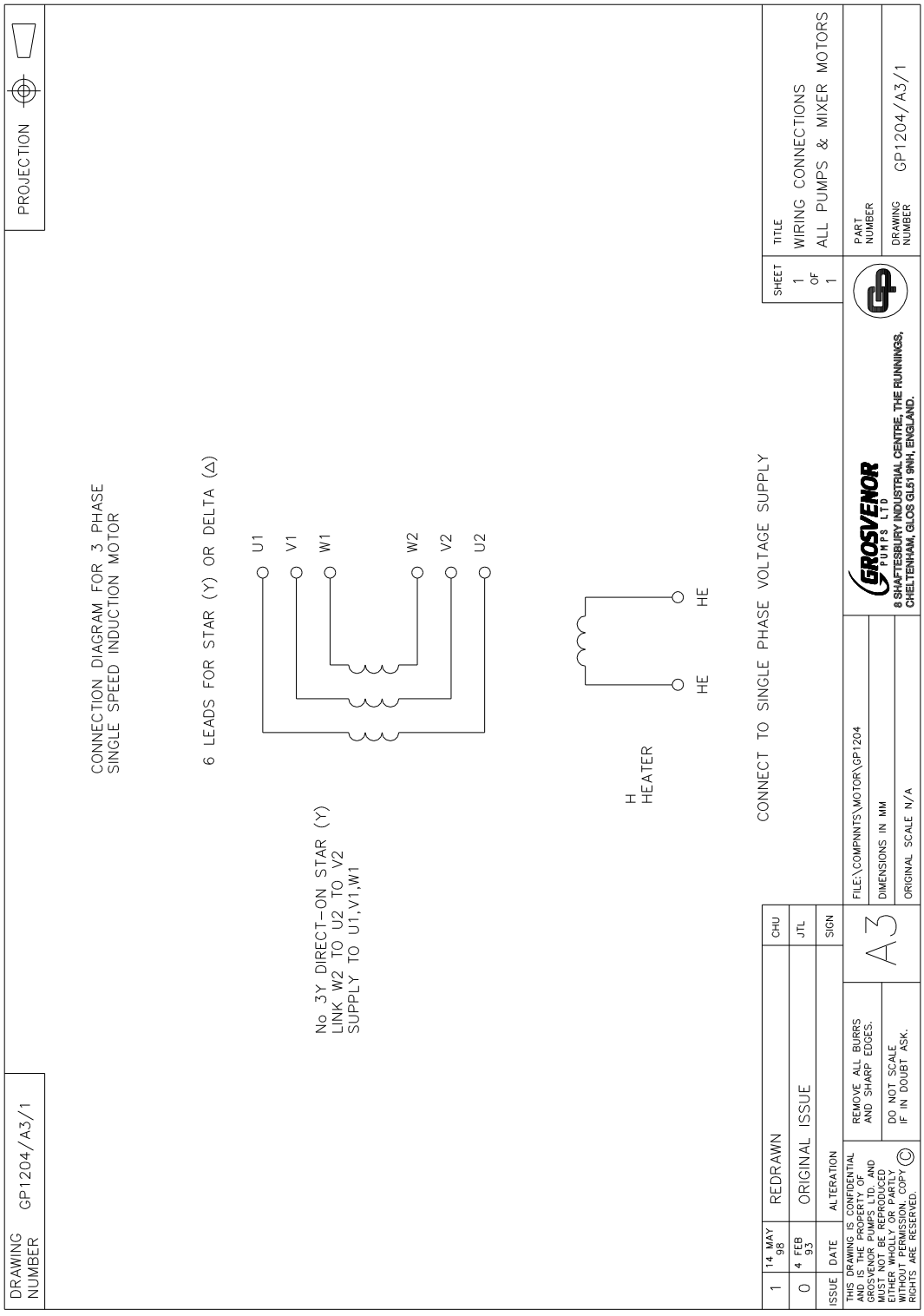
DRG. No.	DESCRIPTION	PART REF No.
1	VALVE BODY	2133
2	VALVE GUIDE	2130
3	VALVE POPPET	2127
4	VALVE SEAT	2136
5	VALVE BODY O-RING	2150
6	VALVE ADAPTOR	2124
7	DIAPHRAGM NUT	1205
8	DIAPHRAGM SUPPORT (FRONT)	1373
9	DIAPHRAGM	1419
10	DIAPHRAGM SUPPORT (BACK)	1392
11	PUMP HEAD	1768
12	BACK RING	1243
13	BACK PLATE	1241
14	DIAPHRAGM ROD	1295
15	CROSSHEAD	701
16	CROSSHEAD PIN	655
17	CORE PLUG	654
18	WORM	1095
19	BEARING BUSH	693
20	STAND RHS	858
21	STAND LHS	859
22	WORM THRUST WASHER	687
23	GEARBOX CASE	717FM
24	ECCENTRIC	822
25	WORM WHEEL	1093

DRG. No.	DESCRIPTION	PART REF No.
26	DRAIN PLUG	1771
27	OIL LEVEL INDICATOR	1773
28	MAIN THRUST WASHER	686
29	CONNECTING ROD	649
30	CRANKCASE COVER	647
31	CRANKCASE GASKET	699
32	OIL FILLER/BREATHER	1774
33	MAIN SPINDLE	650
34	CROSSHEAD PIN BUSH	656
35	VARIATOR	2123
36	MOTOR	
37	O-RING	2157
38	VALVE POPPET O-RING	2070
39	MOTOR GASKET	2155

Note: - Part 35 does not apply to Mk3

2.7. Pygme Variflow Diaphragm Pump Mk 3 - Installation Details GP1773 latest issue

2.8. Wiring Connection Diagram - Motors
Drg. No. 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, 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 displayed 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. The following personal precautions are to be taken when handling chemicals:

3.1.9. Wear standard protective clothing and equipment as detailed above.

3.1.10. Ensure that the nature and properties of the chemical being handled are known in advance.

3.1.11. Ensure that the correct precautions for the chemical being handled are observed. IF IN DOUBT ASK.

3.1.12. Treat all materials as harmful.

3.1.13. Do not touch chemicals or residues with bare hands.

3.1.14. Wash away accidental contact immediately.

3.1.15. Keep self and clothes clean.

3.1.16. Wash contaminated clothing before re-use.

3.1.17. Wash thoroughly after handling chemicals. Do not eat drink or smoke unless decontaminated.

3.1.18. Erect WARNING barriers where necessary.

3.1.19. Follow specific process instruction carefully.

3.1.20. Mix chemicals in the order specified.

3.1.21. **CAUTION: CHEMICALS CAN BE HARMFUL. PLEASE OBSERVE MANUFACTURER'S HANDLING AND STORAGE GUIDELINES.**

3.1.22. Health Hazards - Harmful in contact with the skin and irritating to the eyes.

3.1.23. 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.

3.1.24. Storage - Keep container in a cool, well ventilated place. Keep away from source of ignition. NO SMOKING.

3.1.25. 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.

IN ALL CASES SEEK MEDICAL ADVICE AS SOON AS POSSIBLE.

SECTION 4

INSTALLATION & COMMISSIONING

4. INSTALLATION & COMMISSIONING

4.1. Mounting

4.1.1. For maximum operating life, the pump should ideally be located in a clean cool dry environment. If the site is classified as a hazardous area ensure the pump and motor meets the site requirements. Position the pump on a rigid base preferably as low as possible relative to the liquid supply for the optimum suction condition. Fix the pump gearbox firmly to the mounting base using four M8-1.25 screws or 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 size should be larger than the pump 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 line as close to the pump as possible. In severe hammer conditions, it may be essential to fit a pulsation damper in the suction line. If the suction head is higher than the delivery head a loading valve must be fitted to prevent syphoning while the pump is stationery. For technical advice, please refer to Grosvenor Pumps.

4.2.2. All pipe and fittings should be rated to the maximum pressure to be encountered. All pipe joints should be sealed with a suitable gasket, seal, or sealant.

4.2.3. Other recommended items are a suction strainer, relief valve, pressure gauge and isolating valves. For technical advice, please refer to Grosvenor Pumps.

4.3. Gearbox Oil

4.3.1. **THE PUMP GEARBOX IS SUPPLIED WITHOUT LUBRICATION OIL.** Unscrew the oil level plug and fill the gearbox with a sufficient quantity of suitable grade oil (Refer to para. 5.11 of Section 5 - Maintenance, for approved lubricants).

4.4. Electrical

4.4.1. Before beginning any electrical work, isolate the supply at the mains.

4.4.2. Open up the motor terminal box. Connect up a suitably rated power supply to the motor. Use suitable 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. Single and three phase motors should be controlled by a direct on-line starter. Three phase motors can be controlled by a frequency inverter. The standard motors can be wired in star or delta with a corresponding voltage variation e.g. either 415 VAC in star or 240 VAC in delta. 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.

4.4.5. As the pump will operate up to 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.

4.4.6. For high humidity applications, an anti-condensation heater should be fitted in the motor. A separate power supply will be required for the heater element.

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^{o}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.

SECTION 5

OPERATION

5. OPERATION

5.1. General

5.1.1. 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.

5.1.2. It is not good practice to allow a pump to run dry.

5.1.3. Check the system for water and chemical leaks.

5.1.4. Check the pump for excessive noise, vibration and overheating.

5.1.5. Ensure that all associated instruments are functioning correctly and that their indications are accurate and meaningful.

5.1.6. 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 the maximum pressures specified.

5.1.7. Check the pump will operate satisfactorily if it is to be used for another duty, i.e. different liquid, pressure, environment, power supply.

5.1.8. Always handle the pump by gripping the gearbox case and not by the pump head, valves or any pipework attached to the pump head.

SECTION 6

MAINTENANCE

6. MAINTENANCE

6.1. Safety

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

6.2. General Maintenance

6.2.1. 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. Special tool Bearing Bush mandrel - Grosvenor Part No. 1841 will be required. 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.

6.3. Motor

6.3.1. Isolate electric supply, disconnect wires from terminal box. The motor lifts off after removing the four M8 screws on the motor flange. The motor is non-serviceable. A replacement motor is available from Grosvenor Pumps.

6.3.2. To replace the motor, insert the motor shaft into top of the worm shaft, ensuring the key is not dislodged and the motor sits fully down. Tighten the four M8 flange screws.

6.3.3. Connect wiring to ensure rotation is anti-clockwise when viewing motor on fan end. (Refer to para. 4.4 of Section 4 Installation)

6.5. Pump Head Assembly

6.5.1. To remove the pump head assembly, first disconnect the suction and discharge piping at the pump valve connection.

6.5.2. Position the diaphragm rod (1295) at centre stroke.

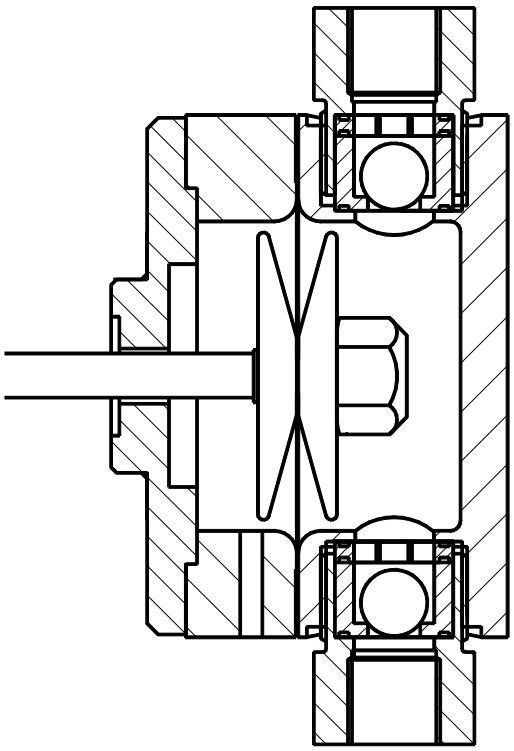
6.5.3. Remove the six capscrews securing the pump head (1768) to the backplate (1241). The pump head can be removed.

6.5.4. Unscrew the diaphragm nut (1205) whilst firmly holding still the diaphragm rod. The front diaphragm support (1373), diaphragm (1419), back diaphragm support (1392) and back ring (1243) can be removed.

6.5.5. Reassembly is the reversal of para. 6.7.2 to para. 6.7.4.. Always replace the diaphragm regardless of its condition. During replacement, ensure the diaphragm rod is at centre stroke align the screw holes in the diaphragm to the pump head holes. Refit the front diaphragm support. Use a suitable thread sealant i.e. Loctite 222 on the diaphragm nut threads. Retighten the diaphragm nut with a torque wrench to 20 Nm. Refit the pump head and retighten the six capscrews.
The diaphragm must be fully stretched to its final shape before running the pump at full power. Remove the motor fan cover and rotate the motor anti-clockwise (from top) by hand for at least 5 complete stroke cycles. Refit fan cover and run pump under power.

6.6. Suction and Delivery Valves Assemblies - Ball Type

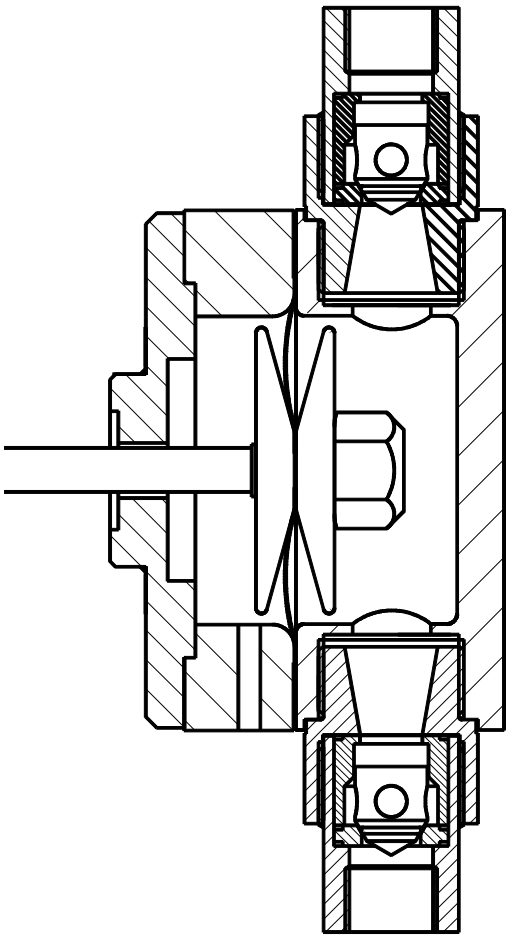
6.6.1. Unscrew the suction and delivery valve bodies (1751) from the Pump Head. Examine the valve balls (1217), valve body, valve seat (1749) and valve guide (1750) for wear and/or damage. Always renew the valve body O-Rings (745).



6.6.2. Check that the Valve Seats and Valve Guides are replaced in the respective Valve Bodies in the correct suction or delivery orientation. When refitting the valve assemblies, ensure the valve body O-Rings are positioned in their seats before tightening with a torque wrench to 25 Nm.

6.7. Suction and Delivery Valves Assemblies - Poppet Type

6.7.1. Unscrew the suction and delivery valve adaptors (2124) to remove the valve assemblies from the pump head. To access the individual valve parts, unscrew the valve body (2133) from the valve adaptor. Examine the valve poppet (2127), valve seat (2136) and valve guide (2130) for wear and/or damage. Always renew the valve body O-rings (2150), valve poppet O-rings (2070) and valve adaptor O-ring (2157).



6.7.2. When refitting the valve assemblies, ensure all valve body O-Rings are positioned in their seats before tightening. Tighten the valve body to 20 Nm. With the PVC and PTFE threaded parts extreme care must be taken during reassembly. Check the poppets, valve seats and valve guides are replaced in the respective valve bodies in their correct suction or delivery orientation. (refer to para 2.5. Key to Diagram of Parts in Section 2 - Technical Data).

6.8. Pump Gearbox

6.8.1. Special tool Bearing Bush mandrel - Grosvenor Part No. 1841

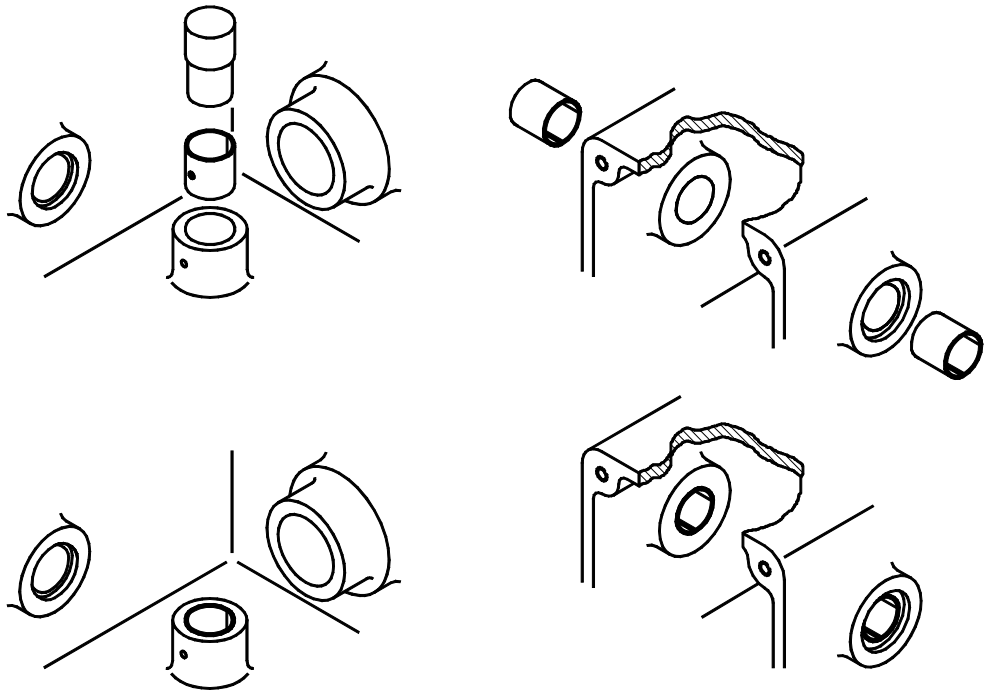
6.8.2. It is impractical to strip the Gearbox Assembly with the Pump still mounted in its installed environment. Remove the Motor, Speed Variator and Pump Head assembly.

6.8.3. Undo the drain Plug (1771) and drain and discard the gearbox oil.

6.8.4. Lift out the Worm (727) (if not already out on the Motor Shaft). Examine the Worm journal for wear damage. Discard and replace if required.

6.8.5. Removing the Crankcase Cover (647) allows access to internal parts. To remove internals first loosen the locking grub screw in the Eccentric (648). Turn the Gearbox on its side and with a centre punch, hammer out the Core Plugs (654) from either side. Ease out the Main Shaft (650). Pull out the Worm Wheel/Eccentric sub-assembly (689/648), Side Thrust Washer (686), Connecting Rod (649) and the Crosshead (701). Remove the locking screw holding the Small End Pin (655) in the Crosshead and push out the Small End Pin. Examine all parts for wear damage. Discard and replace any parts as required.

6.8.6. Examine the two Main Shaft, the Worm journal bearing bushes for wear and/or damage. If required press them out with the mandrel and replace.



6.8.7. Refit the gearbox internals in reverse. To refit the bearing bushes, turn the Gearbox onto its side. Squirt some oil onto the bearing bushes and press in with the Bearing Bush mandrel with the split line upper most or nearest the pump head side.

6.8.8. Put the Worm Wheel/Eccentric sub-assembly, Side Thrust Washer, Connecting Rod and the Crosshead in the Gearbox in their relative order. Align the Main Shaft with the machined flat section facing the Eccentric locking Grubscrew and slide it through the Bearing Bush, Eccentric, Washer and the second Bearing Bush.

6.8.9. Coat waterproof sealant (Hermetite/liquid gasket) around the edge of a Core Plug and place it onto the gearbox bearing counterbore. Hammer the Core Plug firmly into place. Repeat for the remaining bearing bushes.

6.8.10. Refill with correct quantity and grade of oil,

6.8.11. Fit the Drain Plug, Oil Level Indicator and Filler Breather.

6.8.12. Fit the Worm with a Worm Thrust Washer into the Gearbox.

6.8.13. Pour in enough oil upto the Oil Level Indicator. Turn the Worm with the worm crank handle. Check for smoothness of operation.

6.8.14. Replace the speed variator and motor. Reconnect wiring to give correct rotation. Run the gearbox for one hour. Check for unusual noises and vibration. For the first 14 days operation, expect the pump gearbox to run at a temperature of 65-70^{o}C. This will in no way affect the overall pump performance

6.8.15. Replace pump head and valve assemblies to complete the pump assembly.

6.9. Spare Parts

6.9.1. Spare parts can be identified to drawing by part number. **ALWAYS QUOTE THE SERIAL NUMBER** which can be found on pump crankcase cover. Parts should be ordered from:-

Grosvenor Pumps Limited
Trevoole,
Praze, Camborne,
Cornwall. TR14 0PJ
Tel. 01209 831500
Fax. 01209 831939

6.10. Lubrication

6.10.1. **THE PUMP GEARBOX IS SUPPLIED WITHOUT LUBRICATION OIL.** It should be filled before starting. Recommended grades from major oil companies are shown on the pump nameplate. Equivalent grades for other oil companies are listed here. The oil level is determined by the 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 - Pumps - Approx. 0.3 litres**

6.11. Approved Lubricants

6.11.1. 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.

6.11.2. Oils marked * contain mild E.P. additives and should not be used for units operating above 80°C normal running temperatures.

6.11.3. 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.

6.11.4. Oils marked # are usually obtainable at garages and motor factors.

SUPPLIER	OILS
BP Oil Ltd.	Energol HLP 320
	Energol CS 320 *
	Hypogear 90 EP #
Burmah - Castrol (UK) Ltd.	Alpha ZN 320
	Castrol ST 90 #
	Hypoy EP 90 #
Esso Petroleum Ltd.	Teresso 320
	GX 85W/90
Gulf Oil (GB) Ltd.	Harmony 320
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
Total	Azolla ZS 320
	Silva 20W/50 #