

061 - 427



HI-Q Pump Manual



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ISSUE 5

HI-Q Pump Manual

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Section 1 - Introduction

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Section 1

Read this manual before you operate, or carry out any maintenance on, the High-Pressure Pump. Important safety information is highlighted as **WARNING** and **CAUTION** instructions. You must obey these instructions. The use of warnings and cautions is defined below:



WARNING

Warnings are given where failure to observe the instruction could result in injury or death to persons.

CAUTION

Cautions are given where a failure to observe the instruction could result in damage to the pump or to associated equipment.

1.1 Scope of this manual

This manual provides operation and maintenance instructions for the HI Q Pump as supplied for use in water jetting applications.

All specifications, descriptions and parts lists refer only to the pump type identified in section 2. While a large proportion of the information is common to all versions, great care must be taken if this manual is used with alternative versions.

Maintenance instructions included in this manual include:

- (1) Routine maintenance to be carried out at specific times.
- (2) Detailed maintenance and overhaul procedures. At certain times it will be necessary to replace seals and valve parts. The procedures to effect these replacements are explained in detail.

1.2 Composition of this Manual

This manual comprises the following further sections:

Section 2 Technical Data

This section contains a performance specification for the pump unit and a technical description of the most important features.

Section 3 Health & Safety

This section details health and safety considerations when using high pressure pumping equipment.

Section 4 Installation

Recommended installation procedure.

Section 5 Operation

This section describes the recommended operating procedures for the Pump Assembly.

Section 6 Routine Maintenance

This section details recommended routine maintenance requirements for the Pump Assembly.

Section 7 Fault Finding

Fault diagnosis tables for the Pump assembly

Section 8 HI Q Pump Maintenance

This section provides technical data for the high-pressure pump, detailed procedures for replacing the valves, and diaphragms, bearings and seals.

Section 9 Over Pressure Protection

Details of the available equipment.

Section 10 Spares Ordering & Recommended Kits

How to identify and order spares.

Recommended spares for routine and pump maintenance.

Section 11 Drawings & Parts Lists

Detailed drawings and parts lists for the pump, chassis, motor and drive assemblies.

Section 12 Accessories

Detailed drawings and parts lists for the Jump Jet Kit.

Flowplant Group Ltd have a policy of continual research and improvement and we reserve the right to make such modifications and design changes as are considered necessary in the light of experience, however, this copy of the manual will not be amended.

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Section 2 - Technical Description

SECTION 2

TECHNICAL DESCRIPTION

INTRODUCTION

- 2.1 The Harben Hi-Q Type high-pressure pump (Fig 1.1 to 1.3) is a radial piston diaphragm pump, which can be used for a number of industrial applications, including the following:
- (a) Water hydraulic systems
 - (b) Abrasive blasting and de-scaling
 - (c) Drain/sewer cleaning
 - (d) Tube de-scaling
 - (e) Desalination by reverse osmosis
 - (f) Pumping de-mineralised water
 - (g) Floor and surface cleaning
 - (h) Underwater cleaning
 - (i) Surface preparation
- 2.2 In addition to its reliability and long service intervals, the advantages of using this type of pump include:
- (b) Variable pressure and flow options without piston change
 - (c) Pumps can run dry without damage, as there are no piston seals
 - (d) Filtration up to 150 microns
 - (e) No modification is required to pump seawater
 - (f) Pump has multi-cylinders therefore reduced pulsation
- 2.3 The pump is designed to be directly coupled and flange-mounted, and can be supplied in either bare-shaft form, or skid mounted, trolley mounted, trailer mounted or truck mounted configurations. In addition, the pump can be mounted on an underwater ROV. Diesel drive, electrical drive and hydraulic drive options are available.

PUMP DESCRIPTION

- 2.4 The Hi-Q pump works on the radial piston design principle which uses one-way valves in conjunction with tubular diaphragms, fitted with an internal support or mandrel. The pumped fluid, which passes through this diaphragm, is enclosed by a cylindrical pressure chamber or barrel, in the ends of which are fitted inlet and delivery valves.
- 2.5 The pump crankcase, which contains the only mechanical moving parts, is filled with mineral hydraulic oil. This oil provides for the lubrication of all moving parts within the crankcase, and as a means of pressure to compress the diaphragm.
- 2.6 As the pump shaft rotates, the piston advances and its ports pass the end of the cylinder, sealing the chamber. Further advance of the piston causes the trapped oil

to compress the diaphragm around the mandrel, expelling the water in the diaphragm through the delivery valve and into the delivery manifold.

- 2.7 When the piston retreats, the diaphragm reverts to its tubular form and draws water through the inlet valve. Any oil slippage past the piston during the delivery stroke is made up through the piston ports as they open to the crankcase oil.
- 2.8 All mechanical parts, with the exception of the inlet and delivery valves, run in the oil-flooded crankcase and are therefore unaffected by contamination by the pump fluid, or by running dry.

Filtration

- 2.9 Standard filtration for the pump is normally 50 microns. This filter is usually fitted to the inlet of the supply tank or reservoir. This arrangement ensures that if the filter is neglected to the point of blockage, the tank will empty and the pump will run dry, thus enabling the dry-running qualities of the pump to be used as a filter maintenance indicator. Inlet conditions required are flooded suction; pressure feeding is not necessary.

IDENTITY

Manufacturer

- 2.11 The HI Q Pumps are manufactured by:

Flowplant Group Ltd
Gemini House, Brunel Road
Churchfields
Salisbury
Wiltshire SP2 7PU
ENGLAND

Tel: +44 (0) 1722 325424 Fax: +44 (0) 1722 411329

Pump Options/Identification

- 2.12 All barrels are given a letter code to indicate their position in the crankcase (refer to Section 8.12.45). This letter code can be found stamped on the face of adjacent to the inner cylinder. Each barrel of a different code is given its own part number.
- 2.14 A pump specification label is fitted on the pump crankcase, adjacent to the oil filler cap. This label will give the pump type, ie number of cylinders and piston/cylinder diameter.

For example: 4 - 33
 No. Of cyl piston/cyl dia

The label also gives the pump serial number, the type of oil to be used (Shell Tellus or equivalent), the maximum working pressure, the maximum working flow, and the pump's year of manufacture.

ASSOCIATED PUBLICATIONS

2.17 Associated with this manual are the following publications:

Operators guide - Part no 061-225
Code of practice - Part no 057-062

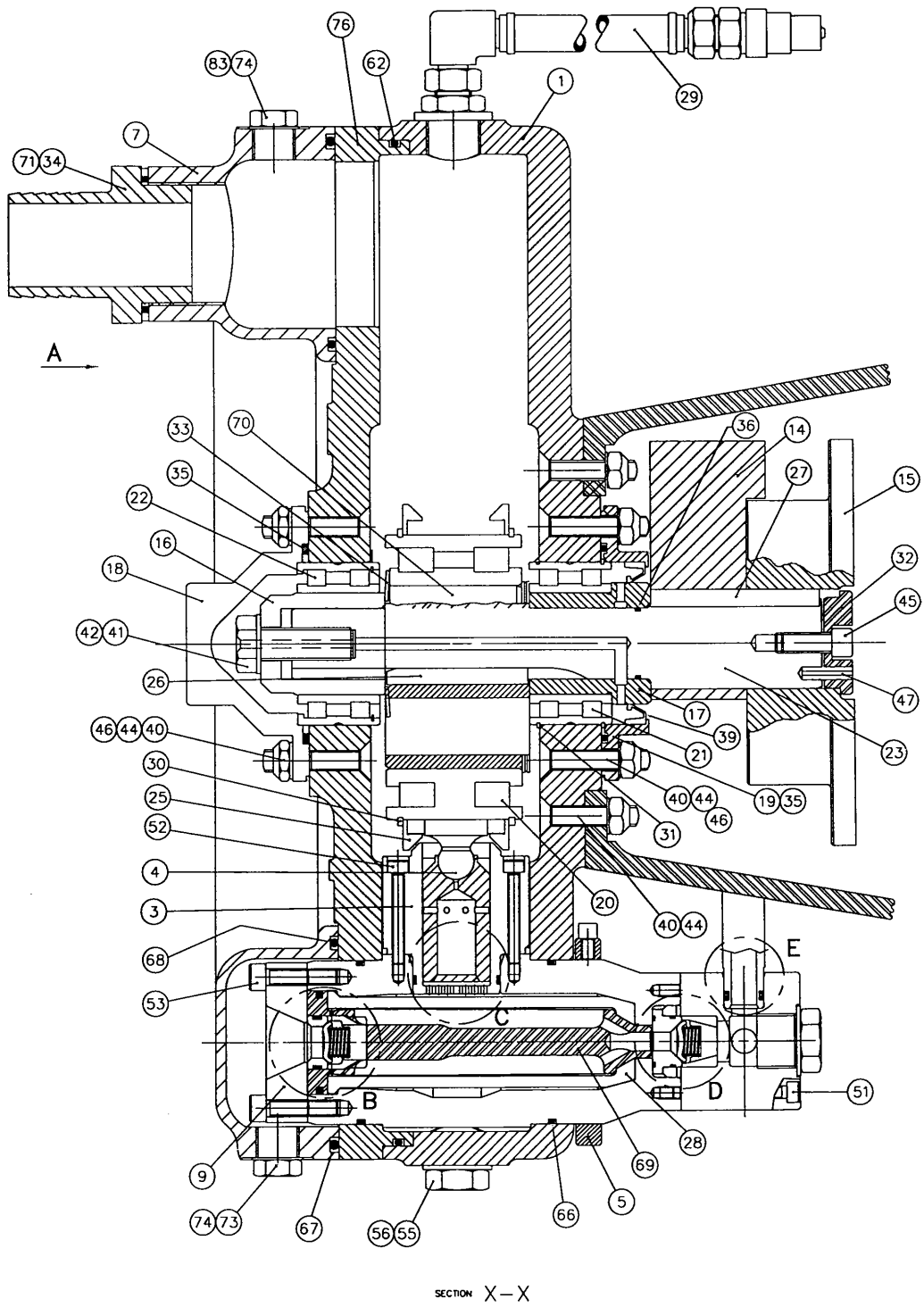
2.18 TECHNICAL DATA

Hi-Q Pump

Pump Type	Radial Diaphragm
Number of cylinders	4
Power rating	50 kW (67Hp)
Piston diameter	33 mm
Crankshaft Speed	1000 rpm
Maximum pressure	276 bar (4000 psi)
Flow rate	100 L/min
Crankcase lubrication	submerged
Crankcase oil capacity	11 Litres approx.
Recommended crankcase oil	Shell Tellus 100
Valves	Flowplant Group high response, low inertia Valves. Sized to suit pressure and flow rating.
Mounting	Via alternative Bell Housing

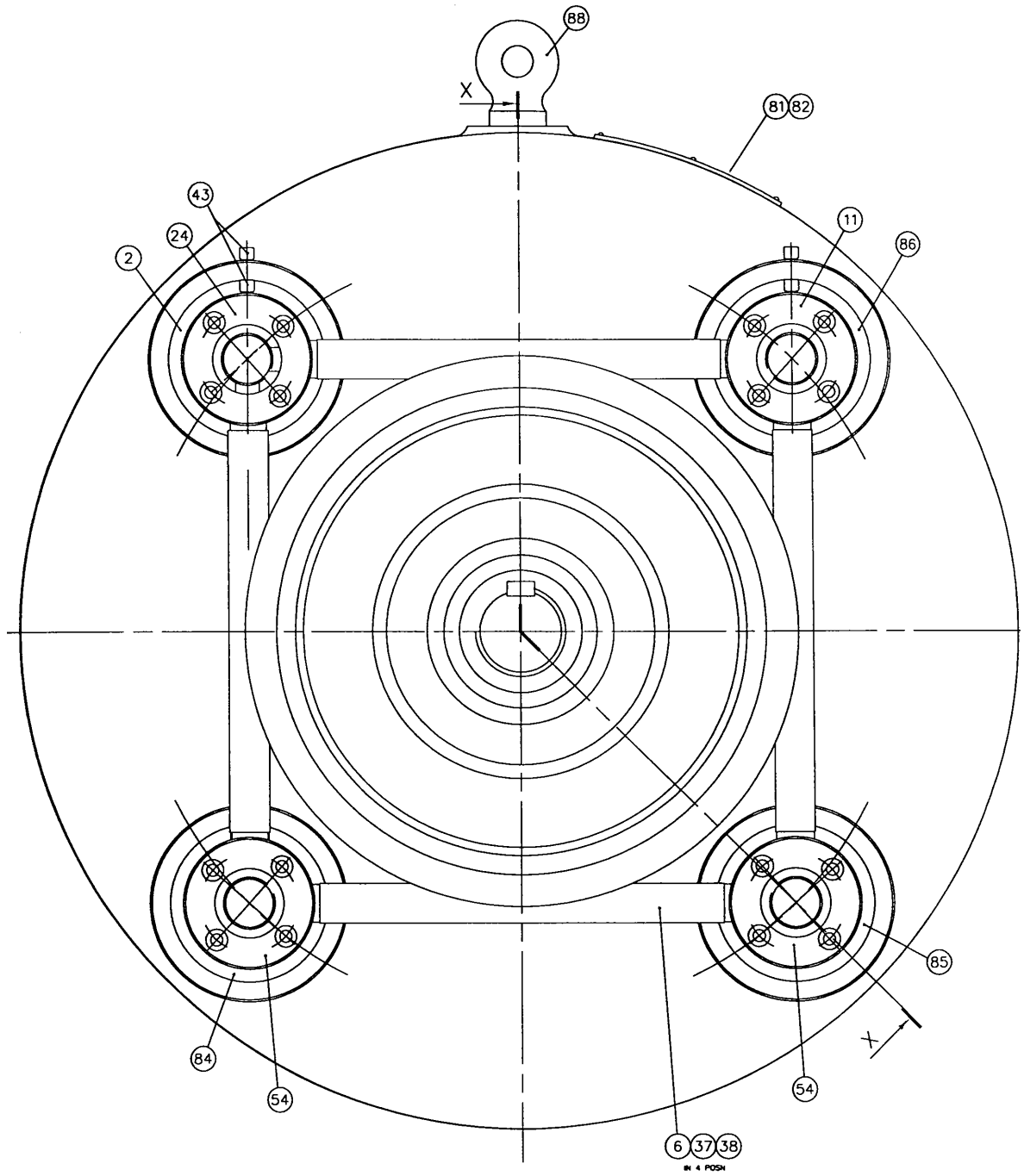
Dimensions & Weight

Length	0.52m max.
Width	0.5m
Height	0.5 m. approx.
Weight	100 Kg (estimated)



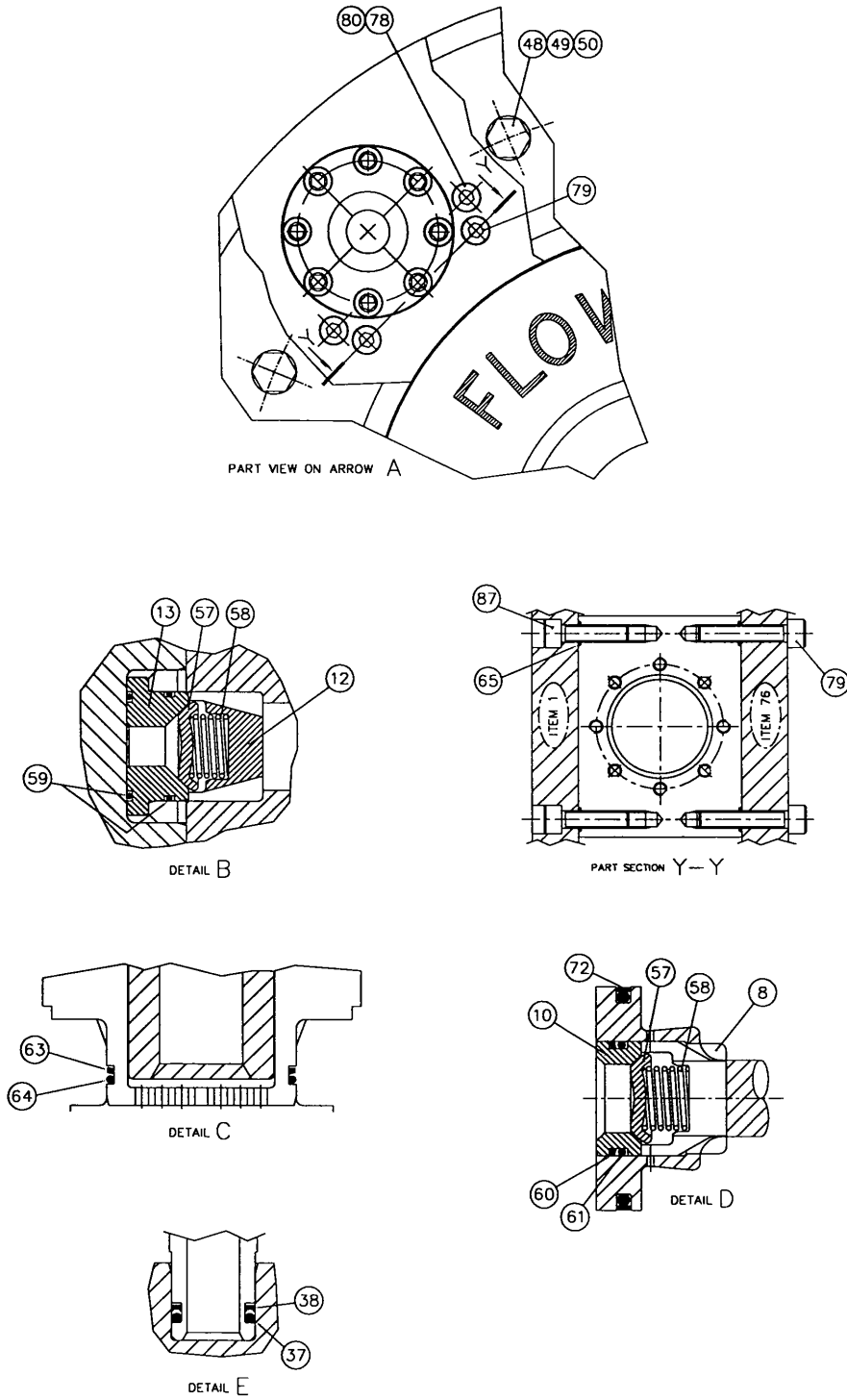
HI Q PUMP ASSEMBLY

FIG 1.1



HI Q PUMP ASSEMBLY

FIG 1.2



HI Q PUMP ASSEMBLY

FIG 1.3

DD NOT SCALE
IF IN DOUBT ASK!

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PUMP INTERFACE
DRIVE SHAFT END

SHAFT: $\phi 15$ (F7)
KEY: 14 WIDE (P9)

6 x M10 STUD
AS SHOWN ON 170 PCD

MALE SPIGOT LOCATION
 $\phi 144.986/144.946$

50.0°
TYP

MANUFACTURERS UNABLE TO COMPLY MAY
SUBMIT ALTERNATIVES WHEN QUOTING

ALL DRAWINGS NOT TO THE LATEST
ISSUE ARE TO BE DESTROYED.

PARTS LIST

ITEM	PART NO.	DRG. NO.	QTY	DESCRIPTION	REMARKS

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ON THE EXPRESS CONDITION THAT IT IS NOT
COPIED OR COMMUNICATED TO OTHER PERSONS
OR COMPANIES WITHOUT WRITTEN PERMISSION
FROM FLOWPLANT GROUP LTD.

WEIGHT OF UNIT 108kg (DRY)

OIL FILL/LIFTING FEATURE G 3/4"

WATER/AIR BLEED

WATER/AIR BLEED

WATER INLET G 2"

WATER OUTLET G 3/4" (4 OPTIONS)

WATER DRAIN PLUG

OIL DRAIN PLUG

210

110

40

DIM 'A'

276.5

276.5

NO OF HOLES 'D' x HOLES SIZE 'E'
EQUI-SPACED ON 'DIM F' PCD

DRWN	DCW	DATE	70/7/90
APPROVED		DATE	
CHECKED		DATE	23/11/06
SCALE	1:5	CALC	
WEIGHT	KG	TEST	
PROTECTION			

ISSUE	DATE	DRN	CHK	STATUS
3	22/11/00	DCW	DC	DIM Z10 ADDED (231100/A)
2	13/09/00	DCW		TABLE ADDED
1	20/1/00	DCW		NEW DRG

TOLERANCES TO BE AS SPECIFIED BELOW UNLESS OTHERWISE STATED

OVER	0	30	100	300	1000	2000
UP TO AND INCLUDING	30	100	300	1000	2000	
± FINE	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8
± FRACTION	± 0.3	± 0.5	± 0.7	± 1.0	± 1.5	± 2.0
± DECIMAL	± 0.5	± 1.0	± 1.5	± 2.0	± 3.0	± 3.0

ALL DIMENSIONS IN THE PRTS ARE UNLESS OTHERWISE STATED TO BE IN MM
DIMENSIONS TO BE WITHIN ± 0.15
DIMENSIONS TO BE WITHIN ± 0.25
DIMENSIONS TO BE WITHIN ± 0.30
DIMENSIONS TO BE WITHIN ± 0.50
DIMENSIONS TO BE WITHIN ± 0.75
DIMENSIONS TO BE WITHIN ± 1.00
DIMENSIONS TO BE WITHIN ± 1.50
DIMENSIONS TO BE WITHIN ± 2.00
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ALL DIMENSIONS IN THE PRTS ARE UNLESS OTHERWISE STATED TO BE IN MM
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DIMENSIONS TO BE WITHIN ± 0.50
DIMENSIONS TO BE WITHIN ± 0.75
DIMENSIONS TO BE WITHIN ± 1.00
DIMENSIONS TO BE WITHIN ± 1.50
DIMENSIONS TO BE WITHIN ± 2.00
DIMENSIONS TO BE WITHIN ± 3.00

FLOWPLANT GROUP
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Tel: (01722) 325424 Fax: 01722 411329 Tlx: 477183

SUPERVISOR/ SUPERSEDER BY

INSTALLATION ASSEMBLY
HI Q PUMP
SHEET 2 OF 2

DRG NO. 020-050/2.3
PART NO. 020050

Section 3 - Health & Safety

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Section 3

HEALTH AND SAFETY AT WORK

There are two main categories of risk. These are:

- (a) Injury from the impact of water
- (b) Injury from the environment

All persons involved in water jetting should be made aware of the risks.

3.1 INJURY FROM THE IMPACT OF WATER

In the event that a person is injured by the impact of a water jet, the injury caused may appear insignificant and give little indication of the extent of the injury beneath the skin and the damage to deeper tissues. Large quantities of water may have punctured the skin, flesh and organs through a very small hole that may not even bleed.

Immediate hospital attention is required and medical staff must be informed of the cause of the injury. To ensure that this is not overlooked, all operators engaged on jetting should carry a waterproof card, which outlines the possible nature of the injury and bears the following text which has been endorsed by the Employment Medical Advisory Service (EMAS) of the Health and Safety Executive:

THIS MAN HAS BEEN INVOLVED WITH HIGH PRESSURE WATER JETTING AT A PRESSURE UP TO 36750 LB/IN² (250 MPA, 2500 BAR KG/CM²) WITH A JET VELOCITY OF 1536 MILES (2458 KM) PER HOUR.

Please take this into account when making your diagnosis. Unusual infections with micro-aerophilic organisms occurring at lower temperatures have been reported. These may have gram negative pathogens like those found in sewage. Bacterial swabs and blood cultures therefore may be helpful.

A letter containing this and other relevant information should be sent to the doctor of each operator.

Where surgical examination is not immediately possible in remote situations, first aid measures should be confined to dressing the wound and observing the patient closely until a medical examination has been arranged.

If the jet accidentally strikes any person, object or article, this fact must be reported to the operator's representative.

3.2 INJURY FROM THE ENVIRONMENT

Work should only be carried out if it is safe to do so. A thorough examination of the site should be carried out before work is started. Refer to the Warnings and Cautions.

Special care should be taken where there is a danger of infection. There are many situations where infection can take place. As a guide to avoiding infection, the following points should be considered:

- (a) Full protective clothing
- (b) Always clean scratches or cuts immediately. Disinfect and cover with a strip of gauze and impermeable plaster. SEEK MEDICAL HELP.
- (c) Avoid rubbing the eyes, nose or mouth with your hands during working.
- (d) All contaminated clothing, vehicles and equipment should be thoroughly cleaned.
- (e) Operators should wash thoroughly after work and before eating, drinking or smoking.

3.3 SAFETY CODE OF PRACTICE

3.3.1 This section gives general information of safety and protective clothing to be used by the operators.

BASIC RULES

- 1. Always wear the correct protective clothing
- 2. Always ensure that all equipment is in a first class condition
- 3. Never work from a ladder
- 4. Never use the gun with the trigger locked on
- 5. Never point the gun at anyone, even if it is switched off.

3.3.2 This Code of Practice is intended to provide guidance on the safe operation of high-pressure water jetting equipment.

3.3.3 The term 'high-pressure water jetting' covers all water jetting, including the use of additives and abrasives, where there is an energy input to increase the pressure of the water.

3.3.4 This code applies to the high-pressure water jetting as defined above where there is a foreseeable risk of injury.

3.3.5 General

- (1) Only a responsible person who has received instruction in the operation of high-pressure water jetting equipment should be allowed to operate the equipment.

- (2) Barriers should be erected around the cleaning bay or where the work is being done 'in-situ', round the section of the plant concerned. Access within 10 meters by persons other than the jetting team, is strictly prohibited.
- (3) A warning notice '**NO UNAUTHORISED ENTRY High-Pressure Water Jetting in Progress**' should be displayed on each side of the bay, or the plant, where the work is being done.
- (4) Each member of the team should be provided with suitable waterproof clothing, wellington boots with internal steel toecaps, safety helmet with visor and earmuffs and gloves. Refer to paragraph 3.3.4 for details of protective clothing available.
- (5) Never attempt to change the jets or accessories whilst the pump is operating, even if the flow control selector valve is in recycle (dump) position.

3.3.6 Safety Gun

- (1) Never point the gun at anyone, even if it is switched off.
- (2) When using the 'deadmans handle' safety gun, the required jet should be fitted to the high-pressure barrel (as the low-pressure barrel is fitted with a diffuser) and tightened correctly before starting the unit. All other hose connections etc. must be checked before attempting to start the unit.
- (3) Water jetting guns should be properly maintained and care should be taken not to damage the delicate components of the trigger mechanism.

3.3.7 Drain / Sewer and Pipe Cleaning

- (1) In addition to the protective clothing listed in paragraph 3.3.5 section 3.3.4, the other equipment should be used when entering confined spaces, such as safety harness and rescue line, atmospheric testing equipment, escape breathing apparatus and hand lamps (intrinsically safe where appropriate).
- (2) To prevent snaking or reverse travel of a flexible hose inside the tube being cleaned, a section of steel pipe, slightly longer than the diameter of the tube to be cleaned, should be connected between the flexible hose and the nozzle (drain jet extension).
- (3) During drain cleaning operations it is advisable to use a coloured leader hose to act as a warning to the operator that the hose recovery is almost complete.
- (4) Where drain or pipe jetting operations are to be carried out remote from the high-pressure pump unit, i.e. where communication between the person controlling the pump and the equipment operator is not possible. It is essential that a remote control kit or foot control valve is used at the work point.

3.3.8 Hoses

- (1) Care should be taken to ensure that all hoses are maintained in good condition and are of the correct specification for the pressure being used.
- (2) Never loop the hose into an excessively tight radius, particularly adjacent to couplings.
- (3) When fitting re-usable couplings, always ensure that the current type of couplings is being used in relation to the hose specification.

NOTE:

The equipment that is detailed in paragraphs 3.3.9, 3.3.10, 3.3.11 and 3.3.12 are for specialist applications.

3.3.9 Underwater recoil-less safety gun

- (1) The Harben underwater recoil-less safety gun is designed for use underwater only. Extreme care should be taken to avoid rear facing balance jets when testing the equipment above the water.
- (2) If working in shallow water, where there is a possibility of the diver surfacing inadvertently during water blasting, care should be to ensure that the recoil balance jet protection tube is sufficiently long to prevent the diver directing it at himself.

3.3.10 Tube Cleaning

- (1) Where tube cleaning is to be done by means of a lance, the charge-hand that operates the remote control valve should first insert the lance into the tube, leaving the other end of the lance supported by one man. Once the tube has been inserted, the other men required to support the control lance should take up their places, and only then should the charge-hand operate the valve.

NOTE:

When the person operating the remote control valve is unable to speak directly to the men, controlling the lance, a clearly understood system of signals and instructions must be agreed upon.

- (2) A barrier should be placed at the far end of the tube being cleaned for protection against flying debris.
- (3) A shield fitted to the lance to protect the operator from debris ejected by backward pointing jets should be used for certain operations.

3.3.11 Hoverclean

The angle of the jet holders determine the rotational speed of the spray bar; this is set and locked in position at the works, and on no account must this angle be altered.

3.3.12 Abrasive Injection Equipment

Because water / abrasive jetting can give rise to dangerous splash back, ensure all protective clothing detailed in paragraph 3.3.5 section 3.3.4 is used. Some abrasives are known to produce residues, which may be a serious health risk and should not be used for blasting e.g. sand containing free silica.

3.3.13 Accidents

- (1) In the event that a person is injured by the impact of a water jet, the injury caused may appear insignificant and give little indication of the extent of the injury beneath the skin and the damage to deeper tissues. Large quantities

of water may have punctured the skin, flesh and organs through a very small hole that may not even bleed.

- (2) Operators should carry a waterproof card which explains to medical staff the possible nature of the injury, both relating to the high-pressure water and any unusual infections that may be found in sewage, such as leptospirosis, better known as Weil's Disease.

3.3.14 Protective Equipment

A range of top quality protective equipment is available from Flowplant Group Ltd, as follows:

PART NO.	DESCRIPTION	BRITISH STANDARD
061 - 037	Orange Waterproof Suit (small)	BS 4170
061 - 025	Orange Waterproof Suit (medium)	BS 4170
061 - 026	Orange Waterproof Suit (large)	BS 4170
061 - 020	Orange Waterproof Suit (extra large)	BS 4170
065 - 029	Wellington Boots (size 7)	BS 1870
065 - 016	Wellington Boots (size 8)	BS 1870
065 - 017	Wellington Boots (size 9)	BS 1870
065 - 018	Wellington Boots (size 10)	BS 1870
065 - 019	Wellington Boots (size 11)	BS 1870
065 - 002	Wellington Boots (size 12)	BS 1870
065 - 004	Gloves	BS 1651
065 - 027	Helmet	BS 5240
065 - 006	Visor	BS 2092
065 - 005	Visor and Chin Guard	BS 2092
065 - 029	Ear Defenders	BS 5108
065 - 013	White Helmet	BS 5240
	Visor and Chin Guard	BS 2092
	Ear Defenders	BS 5108
065 - 021	Safety / Rescue Harness	BS 1397
065 - 025	Warning Sign ' WATER JETTING'	
065 - 059	Safety Warning Sign (adhesive)	
065 - 028	Traffic Cone (450 mm)	
065 - 023	Gas Detector	BASEEFA Approved
065 - 022	Torch	BASEEFA Approved
065 - 024	Breathing Apparatus (15 minute escape set)	
061 - 257	Operators Safety Guide	
057 - 062	Safety Code of Practice	

3.4

FROSTY CONDITIONS

If frost has occurred there may be frozen water in the hose or pump, which will cause a dangerous blockage.



**WARNING
DO NOT START A FROZEN PUMP**

If frost has occurred do not start the pump until the complete pump assembly and associated hoses are completely thawed

SO YOU FORGOT TO TAKE PRECAUTIONS!



WARNING

THE PUMP MUST NOT BE STARTED IF IT IS FROZEN

If the equipment has been inadvertently allowed to freeze, it is essential that the whole system is first thoroughly thawed out, then cautiously flushed without any nozzle or other restriction to the high-pressure hose.

Ice which may have been retained in the system can be ejected from the hose at high speed as the pump is started. These 'bullets' of ice can travel up to 20 to 30 metres, with possible lethal consequences.

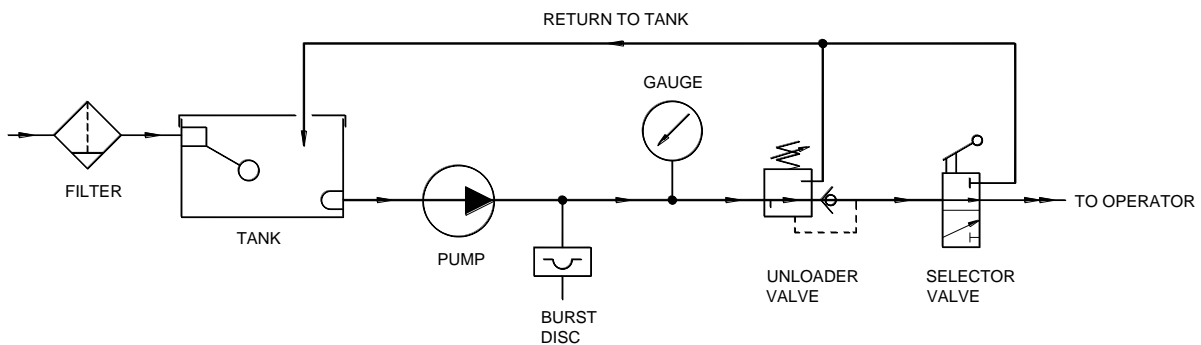
SEE SECTIONS 8.17 & 8.18

Section 4 – Installation & Commissioning

SECTION 4

PUMP INSTALLATION

- 4.1 It may be the case that the pump has not been purchased as part of a trailer or skid. The information given in this section is intended to enable customers to install the pump package in a frame of their design. It will enable engineers to carry out preliminary design work before submitting the design for Flowplant Group Ltd. approval. Refer to Section 2 for technical data and a description of the pump. Section 2 should be referred to for further technical details and installation data.
- 4.2 The illustration given in Fig 2.1 shows a typical circuit layout when using a HI Q pump.



TYPICAL INSTALLATION FIG 2.1

PUMP MOUNTING

General Details

- 4.3 The HI Q pumps are designed for direct drive and flange mounting. The normal operating speed is 1000 rpm, nominal that should not be exceeded. The pump must rotate anticlockwise, looking at the front of the pump ('arrow' cast into crankcase). The maximum inlet water pressure for the pump is 0.5 bar (5.0 metre head), whilst the maximum oil pressure for the pump is 4.0 metre head to centre line of pump.
- 4.4 The pump can be inclined between horizontal and 45 degrees (delivery end uppermost).

- 4.5 The engineer should ensure that all couplings are fitted with a 3mm clearance. Where a bell housing pump mounting and coupling shaft and cover cannot be fitted due to a difference in spigot or bolt locations, an adaptor ring may be fitted.
- 4.6 It is recommended that a detailed layout be drawn and the following points considered:
- (a) Selection of bell housing most suitable for adaptor ring. Additional machining to the bell housing may be required.
 - (b) Sufficient coupling engagement on the shaft whilst maintaining the recommended clearance.
 - (c) Clearance between shafts; careful design can eliminate the shortening of motor/engine shaft.

Pump Fitting

- 4.7 When the pump is to be fitted in position, the following points should be noted:
- (a) When the pump is first married up to the prime mover, access is required to check coupling clearance.
 - (b) It depends on the particular installation whether the pump head is removed to a workshop for maintenance, eg diaphragm or valve replacement or whether work is carried out in-situ.
 - (c) Where a pump 'strip-down' is required, the pump should be removed to the workshop. The use of an assembly stand (part no 100-279) is recommended.

Coupling Arrangements

- 4.8 For details of the prime mover/gearbox/pump coupling arrangements for diesel-driven and electrically driven pumps, refer to Fig 2.2.

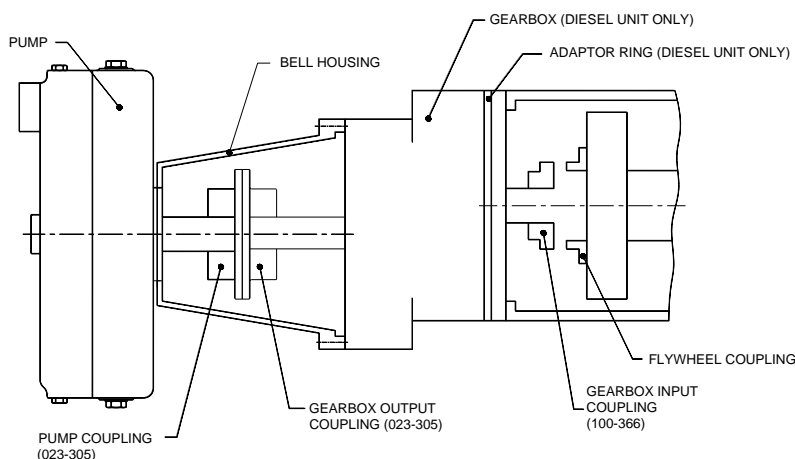


FIG 2.2

Fig 2.2 Pump Installation – Prime Mover/Gearbox/Pump Coupling Arrangements

INLET WATER

General

- 4.9 It is recommended that inlet water is filtered to 50 microns. Filtration to 150 microns is also acceptable, however finer filtration results in improved component life.
- 4.10 Turbulent water will cause the pump to run unevenly and cause excessive wear due to cavitation. For this reason, water must first pass through a break water or header tank controlled by a ball valve or float device. Water leaving the tank should have lamina flow characteristics and be air free.

NOTES

- a) If water is filtered before the tank, then the tank must be sealed and vented to avoid contamination.
- b) The maximum inlet water pressure for the pump is 0.5 bar (5.0 metre head).
- 4.11 A pH value of 5 to 9 is recommended. Although liquids outside this range may occasionally be pumped, it is advisable to contact Flowplant Group, at the address given in Section 1, for their advice.
- 4.12 Hose and pipe bores between the break tank and pump should be a minimum of 50 mm (2 in) and up to a length of 1 metre. If a longer length of hose/pipe is required, refer to Flowplant Group Ltd.
- 4.13 Other points to be considered concerning inlet water are:
- (a) Avoid long hose or pipe runs.
- (b) Avoid hose or pipe runs that cause air pockets or contain sharp bends.
- (c) Refer to circuit layout for mounting angle of pump.
- (d) If water inlet temperature is over 30°C, consult Flowplant Group Ltd.

DO NOT SCALE
IF IN DOUBT ASK

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PUMP INTERFACE
DRIVE SHAFT END

SHAFT 45 (F7)
KEY 14 WIDE (P9)

6 x M10 STUDS
ON 170 PCD

MALE SPIGOT LOCATION
144.986/144.946

50.0" TYP

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MANUFACTURERS UNABLE TO COMPLY MAY
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ALL DRAWINGS NOT TO THE LATEST
ISSUE ARE TO BE DESTROYED.

PARTS LIST

ITEM	PART NO.	DRG. NO.	QTY	DESCRIPTION	REMARKS	
BELL HOUSING	DIM A	DIM B	DIM C	DIM D	DIM E	DIM F
SAE 5	505	315.5	16	16	16	333.4 PCD
FRAME SIZE 250	521	450.155	8	8	8	500 PCD
PART NO. 100084		450.020				

WEIGHT OF UNIT 108kg (DRY)

NO OF HOLES D' x HOLES SIZE E'
EQUI-SPACED ON DIM F' PCD

ISSUE	DATE	DRN	CHK	STATUS
3	22/11/00	DGW	DL	DIM 210 ADDED (22100/A)
2	13/9/00	DGW		TABLE ADDED
1	20/1/00	DGW		NEW DRG

TOLERANCES TO BE AS SPECIFIED BELOW UNLESS OTHERWISE STATED (IN ML)

OVER	0	50	100	300	1000	2000
UP TO AND INCLUDING	± 0.15	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8
* FINE FINISHING	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8
* DELETE ONE	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8
FINISHING	± 0.3	± 0.5	± 0.7	± 1.0	± 1.5	± 2.0
FABRICATION (FINISHED)	± 0.5	± 1.0	± 1.5	± 2.0	± 3.0	± 3.0

ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED ARE IN MILLIMETERS.
GEOMETRICAL TOLERANCES TO BS 1878.
SURFACE FINISH TO BE AS SPECIFIED IN DRAWING.
MATERIALS TO BE AS SPECIFIED IN DRAWING.
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DRWN: DGW DATE: 20/1/00

APPROVED: [Signature]

CHECKED: DL DATE: 22/11/00

SCALE: 1:5

HEIGHT: Kg TEST

PROTECTION: [Blank]

TITLE: INSTALLATION ASSEMBLY

HI Q PUMP

SHEET 2 OF 2

DRG NO. 020-050/2.3

PART NO. 020050

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Section 5 - Operation

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Section 5

OPERATION

5.1 Scope of this Section

This section details the recommended general operating procedure for starting and stopping the HI-Q Pump.

Procedures for use of the high-pressure fluid derived from the pump are not included, as the customer's precise application is unknown.

5.2 Pre-start checks

5.2.1 Before the pump is switched on, ensure that a water supply with a pressure of not greater than 0.5 bar (5 metres head) is available. The water temperature should not be greater than 30°C.

Ensure any isolation valve in the inlet line to the pumpset is open.

If the pump has not been used for some considerable time, it is recommended that the pump is purged of air. See section 5.6.

5.2.2 Check the oil level in the pump. It should be completely full at all times.

5.2.3 Ensure delivery pipes/hoses are unrestricted.

5.2.4 Check that all guns and nozzles are connected. Ensure correct fitting and correct size for the pressure required.

5.3 Operating the pump-set

5.3.1 Set the high-pressure selector to the recycle (dump) position.

5.3.2 Start the unit. Refer to the manufacturer's handbook for information concerning engine/electric motor starting procedure.

NOTE: Before starting the unit and carrying out water and/or oil bleed operations (refer to paragraphs 5.6 and 5.5, respectively), familiarise yourself with the unit's controls and the stopping instructions (paragraph 5.4).

Move the selector to the High-Pressure position.

Increase engine rpm (if diesel) to achieve desired pressure.

5.4 Stopping the pump

To shut down the unit, carry out the following instructions:

5.4.1 Reduce engine revs to tick-over speed.

5.4.2 Move the high-pressure selector to the recycle (dump) position.

5.4.3 Switch off the prime mover by following the instructions given in the manufacturer's handbook for the engine/electric motor.

5.4.4 If there is the risk of freezing, follow the instructions given for frost precautions (anti-freeze procedures, paragraphs 5.7 or 5.9).

5.4.5 If the unit is to be stored for more than 7 days without running, an inhibitor should be run through the system. **Do not** drain prior to storage; always leave full of fresh water or inhibitor.

5.4.6 Refer to the manufacturer's handbook for information concerning engine/electric motor protection/storage.

5.5 To Oil Bleed the Pump



CAUTION: ON NO ACCOUNT OPEN THE OIL BLEED SCREWS WHEN THE PUMP IS OPERATING UNDER PRESSURE

As delivered from the factory, the pump would have already been oil bled (except pump heads supplied separately). If necessary, oil bleed the pump as follows:

NOTE: Refer to the lubrication chart given in Section 8.14 for details of pump oil types and capacities.

5.5.1 Fill the pump to the top of the crankcase with the correct oil (or ensure oil is in the expansion bottle, if fitted).

5.5.2 Set the selector valve to the recycle (dump) position and start the engine/motor. Run at 750 rpm tick-over to prime, or inch electric motor (on/off).

NOTE: If the unit is fitted with a shut-down protection device, hold in the override button for 10 seconds (this allows the engine oil pressure to build up).

5.5.3 With reference to Fig 3.1, put a finger on top of an oil bleed screw on a lower barrel and open the screw slowly using a suitable spanner. When air-free oil flows, tighten the bleed screw firmly.

NOTE: Top up oil in the pump crankcase after each barrel has been bled.

5.5.4 Repeat the procedure detailed in 5.5.3 for each barrel, starting from the lower barrels first.

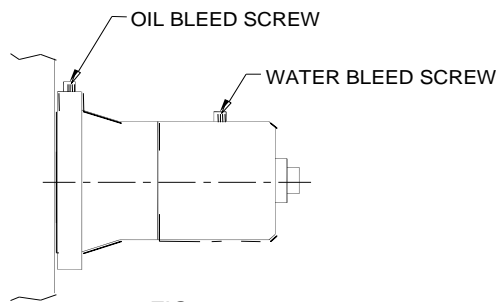


FIG 3.1

Fig 3.1 Bleeding the Pump

5.5.5 When the operator has taken up a working position, move the selector lever to the High-Pressure position and increase engine speed to reach working pressure.

5.5.6 If the delivery line vibrates or the pump does not run smoothly, stop the unit and carry out a water bleed (5.6) and then repeat the oil bleed.

5.6 To Water Bleed the Pump



CAUTION ON NO ACCOUNT OPEN THE WATER BLEED SCREWS WHEN THE PUMP IS OPERATING UNDER PRESSURE.

Whenever the unit is started after being allowed to run dry, the following procedure must be followed:

5.6.1 Set the selector valve to the recycle (dump) position and start the engine/motor. Run at 750 rpm tick-over to prime, or inch electric motor (on/off).

NOTE: If the unit is fitted with a shut-down protection device, hold in the override button for 10 seconds (allows engine oil pressure to build up).

5.6.2 The pump is self-priming. If, however, any difficulty is experienced, stop engine, loosen the upper bleed nipples and allow water to flow from each nipple (ensure that the header tank remains full). Tighten nipples and repeat the procedure details in 5.6.1. To identify the bleed nipples, refer to Fig 3.1.

5.6.3 When the operator has taken up a working position, move the selector lever to the High Pressure position and increase engine speed to reach working pressure.

NOTE: If the delivery line vibrates this indicates that air is still in the system. Stop the unit and repeat the procedure from 5.6.1.

5.7 To Anti-Freeze a Unit Without an Anti-Freeze Tank

5.7.1 Prepare 5 gallons (or larger quantity if required) of 30% to 50% anti-freeze solution.

5.7.2 Drain the water tanks.

5.7.3 Pour the anti-freeze solution into the break tanks.

5.7.4 Remove any jet or accessory from the end of the high-pressure hose.

5.7.5 Ensure the high-pressure selector lever is in the dump position. Start the engine and allow to run for 1 minute.

5.7.6 Holding the outlet end of the hose, move the selector to high-pressure position and allow the engine to run until the anti-freeze solution can be seen coming from the high-pressure hose.

5.7.7 Stop the engine. The unit is now anti-frozen.

5.8 To Remove Anti-Freeze From a Unit Without an Anti-Freeze Tank

NOTE: During this procedure, carry out the air bleed procedure detailed in paragraph 5.6, if necessary.

5.8.1 Drain any anti-freeze solution from break tanks into a container.

5.8.2 Fill break tanks with water.

5.8.3 Place the outlet of the high-pressure hose into the container.

5.8.4 Please the selector lever in the high-pressure position, and whilst holding the high pressure hose, start the engine.

5.8.5 Run the engine until all solution is returned to the container and clean water is seen flowing from the hose. The unit is now ready to use.

5.9 To Anti-Freeze a Unit With an Anti-Freeze Tank Fitted

5.9.1 Ensure the anti-freeze tank is full of 30% to 50% anti-freeze solution.

5.9.2 Turn the 3-port valve to the anti-freeze position and open valve on the anti-freeze tank (if fitted).

5.9.3 Remove any jet or accessory from the end of the high-pressure hose.

5.9.4 Move the selector lever to the high pressure (or on) position.

5.9.5 Holding the end of the hose, start the engine.

5.9.6 Allow engine to run on tick-over until the anti-freeze solution can be seen coming from the high-pressure hose.

5.9.7 Move the selector to the recycle (dump) position for 5 seconds (this allows the dump hose to be anti-freezed).

5.9.8 If Jump Jet or Remote Control kits are fitted, ensure they are anti-freezed. The unit is now anti-freezed.

5.10 To Remove Anti-Freeze From a Unit With an Anti-Freeze Tank Fitted

5.10.1 Move the 3-port valve to the water position.

5.10.2 Fill the water tanks.

5.10.3 Place the outlet of the high-pressure hose into the anti-freeze tank.

5.10.4 Place the selector level in the high-pressure position.

5.10.5 Start the engine. Allow it to run at tick-over and pump anti-freeze solution into the anti-freeze tank. Stop the engine when clear water is seen flowing out of the high-pressure hose. The unit is now ready to use.

Section 6 - Routine Maintenance

Section 6

PUMP MAINTENANCE

AFTER 8 HOURS RUNNING	Check the pipes, hoses and fittings for wear, damage, correct rating and size. Check the pump working pressure is correct. Generally check pump for smooth running, overheating, leaks, and security of components.
SIX MONTHLY / 300 HOURS	Check for wear and damage on inlet and delivery valves. Check for wear and damage on the diaphragms.
YEARLY / 500 HOURS	Drain and then renew the crankcase oil. Check for wear and damage on inlet and delivery valves. Check pipes, hoses and fittings for wear and damage.
TWO YEARLY / 1000 HOURS	Replace inlet and delivery valves.
THREE YEARS / 2000 HOURS	Replace diaphragms.

SECTION 8

Pump Maintenance

Contents

Section 8.0	Introduction
Section 8.1	Preparation for pump service and repair
Section 8.2	Return to service
Section 8.3	Pump running in procedures
Section 8.4	Removal inspection & re-assembly of delivery valves
Section 8.5	Removal inspection & re-assembly of inlet valves
Section 8.6	Removal inspection & re-assembly of diaphragm
Section 8.7	Separating lid from crankcase & the removal of the internal components
Section 8.8	Removal & re-fitting of drive bearing 100-054 item (21)
Section 8.9	Removal & re-fitting of non-drive bearing 100-056 item (22)
Section 8.10	Removal & re-fitting of main bearing 100-520 item (20)
Section 8.11	Removal & re-fitting of inner cylinder
Section 8.12	Assembly instructions for pump after a complete strip down
Section 8.13	Oil bleeding the pump
Section 8.14	Pump lubrication
Section 8.15	Water bleeding the pump
Section 8.16	Useful screw torque settings
Section 8.17	To anti-freeze unit without an anti-freeze tank
Section 8.18	To anti-freeze a unit with an anti-freeze tank

Section 8.0

INTRODUCTION TO PUMP MAINTENANCE

8.0.1 Introduction

Maintenance of the pump's water section should be undertaken whenever there are indications of wear in the valves, plungers or seals. Typical indications of wear are loss of pump performance or leakage of fluid. These are detailed in the Fault Finding Chart in Section 7.

The extent of wear will depend on the duty cycle of the pump and the quality of the fluid being pumped. When an average wear rate has been established, some users may prefer to carry out regular replacement of valves etc. as part of a preventative maintenance programme.

This section includes information to enable the customer to carry out maintenance on the pump providing competent personnel are available.

It is recommended that any maintenance within the pump casing should be carried out by Flowplant Group Limited or an accredited agent.

The following general points should be noted:-

8.0.2 Torque Setting Figures

Throughout re-assembly procedures in this section, specific torque figures are given for the important nuts, bolts and capscrews. These should be adhered to at all times.

8.0.3 Lifting equipment

Suitable lifting equipment may be required if it decided to remove the complete pump. However, it is possible (with care) to access the components within the water section without removal of the pump.

8.0.4 Special items

Some special tools will be required these are detailed below:

Note if carrying out the work listed below in sections 8.7, 8.8, 8.9, 8.10, 8.11 and 8.12 it is recommended that the HI Q Pump is returned to Flowplant Group Ltd.

- (a) To carry out work in section 8.4 use 201-114 delivery removal drift.
- (b) To carry out work in section 8.5 use 201-113 inlet valve seat remover.
- (c) To carry out work in section 8.6 use 201-113 inlet valve seat remover, 201-082 mandrel from diaphragm separator, 201-111 mandrel into diaphragm dolly, 201-115 seal stretcher, 201-065 seal pusher, 201-066 seal shrinker and 201-043 mandrel from barrel removal drift.
- (d) To carry out work in sections 8.7, 8.8, 8.9, 8.10, 8.11 and 8.12 use the list above and 201-011 bearing dolly, 201-081 puller, 100-279 pump repair stand.

8.0.5 Assembly Drawings

Drawings are provided with the item numbers to match the text within this section. However for identification of spare parts, refer to the drawings and parts list in section 11.

8.0.6 Procedures

Inspection and repairs procedures are detailed for all likely faults.

Whatever inspection and repair procedure(s) you intend to follow, **you must always prepare the pump as detailed in sub-section 8.1** as this contains important safety considerations.

Whatever inspection and repair procedure(s) you have carried out, you should always prepare the pump for return to service as detailed in sub-section 8.2.

Section 8.1

PREPARATION FOR PUMP INSPECTION AND REPAIR



WARNING

LETHAL VOLTAGE

Application of electrical power to the pump during the following procedure will cause catastrophic damage to the pump and could cause serious personal injury. Ensure the pump is completely isolated from the electrical supply in such a manner that it cannot be inadvertently switched on. Either physically disconnect the power cable or remove and retain appropriate fuses placing a notice on the fuse box as to why the fuses have been removed. If in doubt, refer to site safety procedures or the site safety officer.



WARNING

LETHAL HIGH PRESSURE

Before releasing any pump fitting, ensure the pump has been completely de-pressurised (i.e. zero reading on the pressure gauge). If necessary, let down any residual pressure by opening a valve in the delivery line.

To prepare the pump for inspection:-

- (1) Isolate services:-
Isolate the electrical supply to the motor.
Isolate the water supply.
- (2) Let down:-
Check for zero pressure on the pressure gauge. If necessary, let down any residual pressure by opening a valve in the delivery line.
- (3) Drain HI Q Pump Manifold:
Drain water from the inlet manifold by unscrewing and removing drain plug (73). Once drained refit and tighten drain plug (73).
- (4) Disconnect pipework & hoses:-
Disconnect the inlet hose at the inlet manifold. Disconnect all hoses from the outlet manifold.

Section 8.2

RETURN TO SERVICE

To prepare the pump for return to service proceed as follows:

- 8.2.1 Ensure all re-assembly procedures relating to particular work carried out on pump head have been followed. In particular ensure all screws have been torqued correctly
- 8.2.2 After filling pump unit with oil (section 8.13) connect oil expansion bottle and ensure this is approximately $\frac{1}{2}$ full.
- 8.2.3 Re-establish the electrical supply to starter box, or check engine is fuelled, oiled and watered and start.
- 8.2.4 Oil bleed the pump see section 8.13.
- 8.2.5 Connect inlet hose to pump manifold.
- 8.2.6 Connect high-pressure hose to delivery manifold, as well as any other equipment e.g. gauge, relief valve etc.
- 8.2.7 Re-connect the water supply and fill break tank.
- 8.2.8 Water bleed the pump see section 8.15.
- 8.2.9 Check for leaks and the smooth running of the pump.
- 8.2.10 Check again for leaks when pump is loaded at normal working pressure.

REMOVAL AND REPLACEMENT OF PUMP FROM DRIVER

- 8.2.11 Switch off and isolate the prime mover.
- 8.2.12 Switch off or disconnect the water mains supply and drain the water tank.
- 8.2.13 Disconnect the water inlet hose to the pump.
- 8.2.14 Disconnect the small bleed hose at the top of the inlet manifold, if fitted.
- 8.2.15 Disconnect the high-pressure hose from the delivery manifold.
- 8.2.16 Drain water from the inlet manifold.
- 8.2.17 Disconnect the hose snap coupling from the top of the crankcase to oil expansion bottle.
- 8.2.18 Remove the hose from the top of the crankcase and replace with a lifting eye.
- 8.2.19 Connect lifting tackle to the lifting eye. Do not take the full weight of the pump, leave tackle just slightly slack.
- 8.2.20 Remove the bolts from the bell housing, and pull off pump and bell housing.
- 8.2.21 Note: if an adapter ring is fitted, it is usually best to leave it attached to the prime mover.
- 8.2.22 Before replacing the pump, check the drive-coupling stand off distance.
- 8.2.23 Replace the pump, generally reversing the removal procedure.
- 8.2.24 If the pump fitted is new or has been overhauled, carry out the running in procedure.

Section 8.3

PUMP RUNNING IN PROCEDURE ITEM NUMBERS IN BRACKETS BEFORE DESCRIPTION RELATE TO ASSEMBLY DIAGRAM 020 - 050

Note: This procedure must be followed if any of the following components have been renewed:

- (3) Cylinder
- (4) Piston / slipper assembly
- (20) Main bearing
- (21) Drive bearing
- (22) Non-drive bearing

Whilst running pump, monitor the pressure, flow and temperature and check for oil and water leaks.

- 8.3.1 Run the pump off load for 30 minutes.
- 8.3.2 Then at half maximum working pressure for 60 minutes.
- 8.3.3 Finally run at maximum working pressure for another 60 minutes.
- 8.3.4 If the pump is being used on a system that has a lower working pressure than the maximum working pressure of pump then running in of the pump should be at the lower system pressure.

Section 8.4

REMOVAL, INSPECTION AND RE-ASSEMBLY OF DELIVERY VALVES

ITEM NUMBERS IN BRACKETS AFTER PART DESCRIPTION RELATE TO
ASSEMBLY DRAWING 020-050

Note: Pump oil need not be drained

- 8.4.1 Switch off and isolate prime mover.
- 8.4.2 Switch off or disconnect the water mains supply to the tank.
- 8.4.3 Drain the water tank.
- 8.4.4 Disconnect the high-pressure hose from the pump delivery manifold.
- 8.4.5 Unscrew and remove adapters and plugs (75&77) from outlet caps (11,24&54).
- 8.4.6 Unscrew and remove the sixteen cap-screws (51).
- 8.4.7 Pull delivery manifold assembly (6,24,11&54) away from barrels (2,84,85&86).
- 8.4.8 Once clear of barrels pull delivery tubes (6) from outlet caps (11,24&54).
- 8.4.9 Pass delivery valve removal drift (201-114) through tapped hole in outlet caps (11,24&54) and tap end of drift. Valve seat, valve head, spring and guide (12,13,57&58) will be removed.
- 8.4.10 Inspect the valve seat, and valve head (13&57). If either is badly pitted, chipped or unevenly worn, they must be replaced.
- 8.4.11 Inspect the bore of guide vanes (12). Replace if worn, pitted or chipped
- 8.4.12 Inspect spring (58) replace if damaged.
- 8.4.13 Check O-rings and back up ring (59,37&38) replace if damaged.
- 8.4.14 Refit the delivery-valve components, reversing the removal procedure.
- 8.4.15 Apply anti-seize paste to threads of capscrews (51) pass these through outlet caps (11,24&54) and screw into barrels. Tighten down very evenly, half a turn at a time until they are all down firm then torque to 16 Nm.
- 8.4.16 Refit adapters and plugs (75&77) into outlet caps (11,24&54).
- 8.4.17 Connect high-pressure hose to delivery manifold.
- 8.4.18 Fill water tank.

Section 8.5

REMOVAL INSPECTION & RE-ASSEMBLY OF INLET VALVES

ITEM NUMBERS IN BRACKETS AFTER PART DESCRIPTION RELATE TO
ASSEMBLY DRAWING 020-050

Note: Pump oil need not be drained

- 8.5.1 Switch off and isolate prime mover.
- 8.5.2 Switch off or disconnect the water mains supply to the tank.
- 8.5.3 Drain the water tank.
- 8.5.4 Remove inlet water hose fitted onto adapter (34), and remove drain plug (73).
- 8.5.5 Unscrew and remove eight nuts (48).
- 8.5.6 Remove eight-delrin washers (50).
- 8.5.7 Pull the inlet manifold (7) off studs (49).
- 8.5.8 Unscrew and remove eight screws (53)(8 per barrel).
- 8.5.9 Note: Support inlet cap (9), as this will be free to fall as soon as last screw (53) is removed.
- 8.5.10 Push inlet valve seat removal tool (201-113) through hole in seat (10) as far as it will go. Then screw knurled knob until tool expands and grips bore of seat. Gently pull and inlet seat (10) will be removed from mandrel (69).
- 8.5.11 Valve (57) and spring (58) can then be removed.
- 8.5.12 Using a 10mm bolt, screw it into inlet guide (8) and pull to remove guide from mandrel (69).
- 8.5.13 Inspect the valve seat and valve head (10&57) if either is pitted, chipped or unevenly worn they must be replaced.
- 8.5.14 Note: Inlet seat (10) is reversible.
- 8.5.15 Inspect the bore of guide vanes (8), replace if worn chipped or pitted.
- 8.5.16 Inspect spring (58) for damage and replace if necessary.
- 8.5.17 Check O-rings and back up rings for damage and replace if necessary.
- 8.5.18 Re-fit the inlet valve components reversing the removal procedure. Note: O-ring (61) fitted to seat (10) enters bore of mandrel before back up ring (60).
- 8.5.19 Apply anti-seize paste to the threads of screws (53) and pass these through inlet cap (9) and screw into barrel (2). It is very important to tighten these down very evenly, half a turn at a time, as inlet cap (9) is being used to push mandrel and diaphragm into their locations. When all are firm torque screws (53) again very evenly to 40nm.
- 8.5.20 Fit inlet manifold (7) over studs (49).
- 8.5.21 Fit eight-delrin washers (50) over studs (49) and up against inlet manifold.
- 8.5.22 Apply anti-seize paste to threads of studs (49) and screw on eight dome nuts (48) and torque them to 14 Nm.
- 8.5.23 Fit and tighten drain plug (73).
- 8.5.24 Connect inlet water hose to adapter (34).

Section 8.6

REMOVAL INSPECTION & RE-ASSEMBLY OF DIAPHRAGM 100-186 ITEM (28)

ITEM NUMBERS IN BRACKETS AFTER PART DESCRIPTION RELATE TO ASSEMBLY DRAWING 020-050

Note: Pump oil must be drained

- 8.6.1 Switch off and isolate prime mover.
- 8.6.2 Switch off or disconnect the water mains supply to the tank.
- 8.6.3 Drain the water tank.
- 8.6.4 Disconnect the high-pressure hose from the pump delivery manifold
- 8.6.5 Unscrew and remove the cap-screws (51) (four per barrel).
- 8.6.6 Pull delivery manifold assembly (6,24,11&54) away from barrels (2,84,85&86).
- 8.6.7 Remove inlet water hose fitted on to adapter (34) and remove drain plug (73).
- 8.6.8 Unscrew and remove eight nuts (48).
- 8.6.9 Remove eight-delrin washers (50).
- 8.6.10 Pull the inlet manifold (7) off the studs (49).
- 8.6.11 Unscrew and remove eight screws (53)(8 per barrel).
- 8.6.12 Note: Support inlet cap (9), as this will be free to fall as soon as last screw (53) is removed.
- 8.6.13 Fit mandrel removal tool (201-043) through hole delivery end of barrel, and locate it in end of mandrel, and then tap end of tool with mallet. The mandrel (69) diaphragm (28) and complete inlet valve assembly will be removed from barrel.
- 8.6.14 Note: As mandrel and diaphragm start to protrude from barrel, support it, as once clear of barrel it will be free to fall.
- 8.6.15 Push inlet valve seat removal tool (201-113) through hole in seat (10) as far as it will go. Then screw knurled knob until tool expands and grips bore of seat. Gently pull and inlet seat (10) will be removed from mandrel (69).
- 8.6.16 Valve (57) and spring (58) can then be removed.
- 8.6.17 Using a 10mm bolt, screw it into inlet guide (8) and pull to remove guide from mandrel (69).
- 8.6.18 Using tool (201-082) separate diaphragm from mandrel and then check diaphragm for any splits cuts or any visible damage and replace if necessary.
- 8.6.19 Inspect glydring seal (72) fitted in mandrel for damage, and replace if necessary, as follows:
 - A) Fit seal stretcher (201-115) in end of mandrel and push inner part of seal (72) (O-ring) up seal stretcher incline and into groove in mandrel (69).
 - B) Place outer part of seal on seal stretcher incline and using seal pusher (201-065) push it up stretcher all the way until it goes into mandrel groove on top of P-ring.
 - C) Finally remove seal stretcher from mandrel and push fitted glydring through seal shrinker (201-066).

Assemble as follows:

- 8.6.20 Fit dolly (201-111) into the inlet end of mandrel.
- 8.6.21 Lightly oil the tops of the six lobes on mandrel and the inside bore of diaphragm and push diaphragm onto mandrel as far as possible by hand.
- 8.6.22 Holding the diaphragm in one hand use a nylon mallet to hit dolly until fully home. There should be no gap left between mandrel and diaphragm. Dolly can now be removed.
- 8.6.23 Fit inlet guide (8) into mandrel (69) followed by spring and valve head (57&58).
- 8.6.24 Inlet seat (10) can now be pushed into mandrel (69), with O-ring entering bore before back up ring.
- 8.6.25 Oil outside of diaphragm (28) and glydring (72) and push into barrel as far as possible.
- 8.6.26 Apply anti-seize paste to threads of screws (53) pass them through inlet cap (9) and screw them into barrels. It is very important to tighten these down very evenly, half a turn at a time, as inlet cap (9) is being used to push mandrel and diaphragm into their locations. Once all are firm torque screws (53) again very evenly to 40 Nm.
- 8.6.27 Fit inlet manifold (7) over studs (49).
- 8.6.28 Fit eight-delrin washers (50) over studs and up against inlet manifold.
- 8.6.29 Apply anti-seize paste to threads of studs (49) and screw on eight dome nuts (48) and torque them to 14 Nm.
- 8.6.30 Fit and tighten drain plug (73).
- 8.6.31 Refit delivery manifold assembly (6,24,11&54).
- 8.6.32 Apply anti-seize paste to threads of capscrews (51) pass these through outlet caps (11,24&54) and screw into barrels. Tighten down very evenly, half a turn at a time until they are all down firm. Then torque to 16 Nm.
- 8.6.33 Connect inlet water hose to adapter (34).
- 8.6.34 Connect high-pressure hose to pump delivery manifold.
- 8.6.35 Fill with oil and bleed pump see relevant section.

Section 8.7

SEPARATING LID FROM CRANKCASE AND THE REMOVAL OF INTERNAL COMPONENTS

ITEM NUMBERS IN BRACKETS AFTER PART DESCRIPTION RELATE TO ASSEMBLY DRAWING 020-050

Note: It is recommended that pump repair stand (100-279) is used.

- 8.7.1 Remove drain plug (55) and drain oil into a suitable container.
- 8.7.2 Carry out instructions (1) to (11) in Section 1 Removal and Replacement of Pump Head.
- 8.7.3 Unscrew and remove capscrew (45). It may be necessary to hold the coupling (15) to stop it from rotating.
- 8.7.4 Lift the cap (32) out of recess in the end of the coupling (15).
- 8.7.5 Pull coupling and counter balance (14&15) off of the shaft (23).
- 8.7.6 Note: This operation can be made easier using special pulley (201-081).
- 8.7.7 Unscrew and remove nuts (40) and washers (46).
- 8.7.8 Remove the bell housing.
- 8.7.9 Remove key (27) from shaft (23). The end of key is bevelled so a screwdriver can be used between key and shaft if needed.
- 8.7.10 Place pump in repair stand (100-279) and lock shaft (23) to stand with a 10mm bolt through hole provided.
- 8.7.11 Unscrew and remove nuts (48) and delrin washers (50) and pull inlet manifold (7) off studs (49).
- 8.7.12 Unscrew and remove adapters and plugs (75&77) from outlet caps (11,24&54).
- 8.7.13 Unscrew and remove sixteen cap screws (51).
- 8.7.14 Pull delivery manifold assembly (6,11,24&54) away from barrels, then pull delivery tubes (6) from outlet caps.
- 8.7.15 Unscrew and remove eight screws (78) (two per barrel) on the inlet side of barrel only.
- 8.7.16 Unscrew and remove eight screws (79) (two per barrel) and screw these into threads that screws (78) were removed from (see instruction 15) stopping when you feel them stop against barrel face.
- 8.7.17 Unscrew and remove four nuts and washers (40&46) and lift off bearing retainer and O-ring (18&35).
- 8.7.18 Unscrew bolt (42) just enough to allow washer (41) to be turned around by hand.
- 8.7.19 Very slowly start screwing in eight screws (79), no more than half a turn each, and lid (76) will be jacked away from crankcase (1).
- 8.7.20 When lid (1) is free of barrels and crankcase lift off.
- 8.7.21 Unscrew bleed screws (43) from bleed rings (5) and remove bleed rings from barrels.
- 8.7.22 Unscrew and remove eight screws (87) (two per barrel) from delivery side of barrels.
- 8.7.23 Remove top circlip (30) from groove in main bearing (20), and lift off top retaining ring (25).

- 8.7.24 Each barrel can now be lifted out of crankcase, but you may need to gently tap delivery end of barrel with a nylon mallet. Care must be taken to support piston / slipper assembly (4) as it will be free to fall from cylinder (3) when it is clear of main bearing (20).
- 8.7.25 When all four barrels have been removed from crankcase remove bolt (42) that was loosened earlier and washer (41).
- 8.7.26 Remove disc spring (33).
- 8.7.27 Sleeve non-drive end (16) can now be pulled off shaft (23).
- 8.7.28 Pull bearing / eccentric assembly (20&70) off shaft, it will come complete with bottom retaining ring and circlip (25&30).
- 8.7.29 Crankcase (1) can now be lifted off shaft.
- 8.7.30 If sleeve drive end (17) has stayed with bearing (21) carefully push out from inside of crankcase, if sleeve is left on the shaft, pull off.
- 8.7.31 Unscrew and remove four nuts and washers (40&46) and lift off oil seal carrier, complete with oil seal and O-ring (19,35&39).
- 8.7.32 Depending on work being carried out go to that section.

Section 8.8

REMOVAL & REFITTING OF DRIVE BEARING 100-054 ITEM (21)

ITEM NUMBERS IN BRACKETS AFTER PART DESCRIPTION RELATE TO ASSEMBLY DRAWING 020-050

- 8.8.1 Carry out all instructions in section (8.7), separating lid from crankcase and the removal of internal components.
- 8.8.2 Remove both circlips (31) from grooves in bearing (21).
- 8.8.3 Using a press, remove bearing. It may be removed from either side, as long as crankcase is well supported as near to bearing as possible to prevent it from cracking.
- 8.8.4 Before fitting a new bearing, it is a good idea to have a dummy run as follows:
- 8.8.5 Make sure sleeve drive end (17) is in good condition. Because it is a very close fit inside the bearing and there can be no damage on outside diameter.
- 8.8.6 Lightly oil inside diameter of bearing and outside diameter of sleeve, very gently offer up sleeve to bearing bore, keeping it as square to the bearing bore as possible. Sleeve should be a very smooth, close, slide fit, NOT an interference fit, and must never be forced in, or out of the bearing. Once satisfied with the fit remove sleeve and put to one side.
- 8.8.7 Now carry out the following check on bearing (21). Hold inner race in bore of bearing one side of circlip, now try and turn the inner race the other side of circlip. Both should turn together. If one can turn independent of the other the bearing must be rejected.
- 8.8.8 Once satisfied with bearing fit a circlip (31) into bearing groove and lightly oil the outside diameter of the bearing.
- 8.8.9 The bearing is then pressed into crankcase (1), from either side, remembering to support case as close as possible to bearing, and using a dolly that will only press on outer race only, (201-011) is available for this purpose. Stop pressing when circlip (31) just touches crankcase face.
- 8.8.10 Fit remaining circlip (31) into bearing groove.

Section 8.9

REMOVAL & REFITTING OFF NON-DRIVE BEARING 100-056 ITEM (22)

ITEM NUMBERS IN BRACKETS AFTER PART DESCRIPTION RELATE TO ASSEMBLY DRAWING 020-050

- 8.9.1 Carry out all instructions in section (8.7), separating lid from crankcase and the removal of internal components.
- 8.9.2 Using a press, remove bearing (22). It may be removed from either side, as long as lid is well supported as near to bearing as possible to prevent it from cracking.
- 8.9.3 Before fitting a new bearing, it is a good idea to carry out the following check.
- 8.9.4 Make sure sleeve cap non-drive end (16) is in good condition. Because it is a very close fit in bearing there can be no damage on outside diameter.
- 8.9.5 Lightly oil inside diameter of bearing and outside diameter of sleeve, very gently offer up sleeve to bearing bore, keeping it as square to the bearing bore as possible. Sleeve should be a very smooth, close, slide fit, not an interference fit, and must never be forced in, or out of bearing. Once satisfied with the fit remove sleeve and put to one side.
- 8.9.6 The bearing can be pressed into lid from either side. As long as the internal circlip retaining the rollers faces the inside of pump, remembering to support lid as close as possible to bearing, and using a dolly that will press on outer race only, (201-011) is available for this purpose.
- 8.9.7 Stop pressing when 3mm of the bearing protrudes through the outside face of lid (76).
- 8.9.8 Fit bearing retainer (18), only two nuts (40) need to be used, one opposite the other.
- 8.9.9 Now carry on pressing bearing until it is fully down against bearing retainer (18) face.
- 8.9.10 Remove two nuts (40) and lift off bearing retainer.

Section 8.10

REMOVAL & REFITTING OF MAIN BEARING 100-520 ITEM (20)

NUMBERS IN BRACKETS AFTER PART DESCRIPTION RELATE TO
ITEM ASSEMBLY DRAWING 020-050

- 8.10.1 Carry out all instructions in section (8.7), separating lid from crankcase and the removal of internal components.
- 8.10.2 Press eccentric (70) out of the main bearing (20), ensuring that the lip on the eccentric is farthest away from the press ram.
- 8.10.3 Because of the interference fit of eccentric into bearing, it is recommended that a bearing induction heater is used to heat bearing prior to fitting it over eccentric, and not a press.

Section 8.11

REMOVAL & REFITTING OF INNER CYLINDER 078-152 ITEM (3)

ITEM NUMBERS AFTER PART DESCRIPTION RELATE TO ASSEMBLY DRAWING 020-050

- 8.11.1 Carry out all instructions in section (8.7), separating lid from crankcase and the removal of internal components.
- 8.11.2 Hold barrel (2,84,85or86) in bench vice fitted with soft jaws.
- 8.11.3 Unscrew and remove eight screws (52).
- 8.11.4 Two slots will be found on opposite sides of cylinder at the point of contact between cylinder and barrel, using two screwdrivers gently and evenly ease cylinder upwards.
- 8.11.5 If new o-ring and back up ring (63&64) are to be fitted, make sure o-ring is nearest the baffle end of cylinder.
- 8.11.6 Grease O-ring and back up ring (63&64) and the cylinder locating bore in barrel.
- 8.11.7 Carefully fit cylinders into barrels, making sure screwdriver extractor slots are facing the corners (one to face barrel letter code) and then line up clearance holes with taped holes.
- 8.11.8 Apply anti-seize paste to threads of screws (52), pass them through cylinder and screw into barrel and tighten until all are nipped down.
- 8.11.9 Finally torque screws (52) to 16 Nm.

Section 8.12

ASSEMBLY INSTRUCTIONS FOR PUMP AFTER A COMPLETE STRIP DOWN

ITEM NUMBERS IN BRACKETS AFTER PART DESCRIPTION RELATE TO
ASSEMBLY DRAWING 020-050

- 8.12.1 Clean and lay out all pump parts.
- 8.12.2 Check eccentric (70), counter balance (14) and coupling (15) slide freely on shaft (23) without keys (26&27) fitted.
- 8.12.3 Fit key (27) into shaft (23) and check counter balance and coupling (14&15) still slide freely on shaft. Then remove key.
- 8.12.4 Fit key (26) into shaft (23) and check eccentric (70) still slides freely on shaft. Then remove key.
- 8.12.5 Using a bearing induction heater fit main bearing (20) to eccentric (70) following induction heater manufacturer instructions.
- 8.12.6 Make sure sleeve drive end (17) is in good condition. Because it is a very close fit in bearing (21) there can be no damage on outside diameter.
- 8.12.7 Then carry out the following check, lightly oil inside diameter of bearing and outside diameter of sleeve, very gently offer up sleeve to bearing bore, keeping it as square to the bearing bore as possible. Sleeve should be a very smooth close slide fit, not an interference fit, and must never be forced in, or out of bearing. Once satisfied with the fit remove sleeve and put it to one side.
- 8.12.8 Now carry out the following check on bearing (21). Hold inner race of bearing one side of circlip, now try and turn the inner race the other side of circlip. Both should turn together. If one can turn independent of the other the bearing must be rejected.
- 8.12.9 Once satisfied with bearing, fit a circlip (31) into bearing groove and lightly oil the outside diameter of bearing.
- 8.12.10 The bearing is then pressed into crankcase (1), using a dolly that will only press on outer race only, (201-011) is available for this purpose. Press in from either side, but support case as near as possible to bore, to prevent crankcase from cracking. Stop pressing when circlip (31) just touches crankcase face.
- 8.12.11 Fit remaining circlip (31) into groove.
- 8.12.12 Lightly oil outside diameter of oil seal (39) and using a hand press, with a suitably sized dolly, fit it into carrier (19) until face of seal bottoms against carrier.
- 8.12.13 Lightly grease O-ring (35) and fit into groove of carrier (19).
- 8.12.14 Fit oil seal carrier, complete with oil seal, over threads of screw (44) followed by washers and nuts (40&46).
- 8.12.15 Lightly oil outside diameter of sleeve drive end and gently push it through oil seal (39) and into bearing bore (21) until face of sleeve bottoms against bearing.
- 8.12.16 Fit shaft (23) into pump repair stand (100-279), and lock shaft (23) to stand with a 10mm bolt through hole provided. Lightly grease o-ring (36) and fit

- over shaft and into O-ring groove. Take care to keep O-ring away from keyway while fitting as edges can damage O-ring.
- 8.12.17 Gently lower crankcase (1) over shaft.
 - 8.12.18 Fit key (26) into keyway of shaft (23) with chamfer towards shaft and uppermost.
 - 8.12.19 Fit eccentric, main bearing assembly (20&70) over shaft (23) and key (26).
Note: lip of eccentric (70) faces bearing (21).
 - 8.12.20 Fit a circlip (30) into groove nearest crankcase (1) on bearing (20).
 - 8.12.21 Fit a retaining ring (25) over bearing and up against circlip (30), with recess in ring (25) uppermost.
 - 8.12.22 Make sure sleeve cap non-drive end (16) is in good condition. Because it is a very close fit in bearing (22) there can be no damage on outside diameter.
 - 8.12.23 Then carry out the following check, lightly oil inside diameter of bearing and outside diameter of sleeve, very gently offer up sleeve to bearing bore, keeping it as square to the bearing bore as possible. Sleeve should be a very smooth close slide fit, not an interference fit, and must never be forced in or out of bearing. Once satisfied with the fit remove sleeve and put it to one side.
 - 8.12.24 The bearing is then pressed into the lid (76), using a dolly that will press on outer race only, (201-011) is available for this purpose. Press in from either side, as long as the internal circlip retaining the rollers faces the inside of pump, but support case as near as possible to bore to prevent lid from cracking. Stop pressing when 3mm of the bearing protrudes through the outside face of lid (76).
 - 8.12.25 Fit bearing retainer (18), only two nuts (40) need to be used, one opposite the other.
 - 8.12.26 Now carry on pressing bearing until it is fully down against bearing retainer (18) face.
 - 8.12.27 Remove two nuts (40) and lift off bearing retainer.
 - 8.12.28 Fit glydring seals (72) to grooves in mandrel, as follows:
 - (A) Fit seal stretcher (201-115) in end of mandrel and push inner part of seal (72) (O-ring) up seal stretcher incline and into groove in mandrel (69).
 - (B) Place outer part of seal on seal stretcher incline and using seal pusher (201-065) push it up stretcher all the way until it goes into mandrel groove on top of O-ring.
 - (C) Finally remove seal stretcher from mandrel and push fitted glydring through seal shrinker (201-066).
 - 8.12.29 Fit dolly (201-111) into the end of mandrel.
 - 8.12.30 Lightly oil the tops of the six lobes on mandrel and the inside bore of diaphragm and push diaphragm onto mandrel as far as possible by hand.
 - 8.12.31 Holding the diaphragm in one hand use a nylon mallet to hit dolly until fully home. There should be no gap left between mandrel and diaphragm. Dolly can now be removed.
 - 8.12.32 Fit inlet guide (8) into mandrel (69) followed by spring and valve head (57&58).
 - 8.12.33 Inlet seat (10) can now be pushed into mandrel (69), with O-ring entering bore before back up ring.
 - 8.12.34 Hold a barrel in a vice fitted with soft jaws.
 - 8.12.35 Oil outside of diaphragm (28) and glydring (72) and push into barrel as far as possible.

- 8.12.36 Apply anti-seize paste to threads of screws (53) pass them through inlet cap (9) and screw them into barrel. It is very important to tighten these down very evenly, half a turn at a time, as inlet cap is being used to push mandrel and diaphragm into their locations. Once all are firm torque screws (53) again very evenly to 40 Nm.
- 8.12.37 Fit and lightly grease anti-extrusion (63) and O-ring (64) into grooves in cylinder (3).
Note: O-ring will be nearest cylinder baffle.
- 8.12.38 Carefully fit cylinders into barrels, making sure screwdriver extractor slots are facing the corners (one to face barrel letter code) and then line up clearance holes with taped holes.
- 8.12.39 Apply anti-seize paste to threads of screw (53) and pass these through cylinders and screw into barrel and torque evenly down to 16 Nm.
- 8.12.40 Repeat instructions 28, through 39 for remaining barrels.
- 8.12.41 Oil O-rings (66) and fit them into grooves at delivery side of barrels (one per barrel).
- 8.12.42 Grease O-rings (65) (two per barrel) and fit into locations delivery side of barrel, making sure they stay located when barrel is turned upside down
- 8.12.43 Oil barrel locating bores in crankcase (1).
- 8.12.44 Gently fit an oiled piston/slipper assembly (4) into cylinders (3).
Note: Piston and cylinder are not matched sets when new, but if pump has already run and piston / slipper assemblies and cylinders are not being changed, then keep them in there running sets.
- 8.12.45 Before fitting barrel assemblies into crankcase you must identify which position in the case, barrel letter coded (A) will be fitted to. To do this decide which of the two $\frac{3}{4}$ " b.s.p tapped holes you will use as the oil fill hole.
Note: If original case is being used the pump specification plate will be located to one side of the oil fill hole anyway.
The barrel letter coded (A) will fit to the right of this point, and remaining barrels will be fitted alphabetically clockwise from this barrel (A, B, C & D).
- 8.12.46 Barrel letter coded can now be lowered delivery end first into crankcase. When barrel stops as O-ring begins to enter bore, fit barrel aligning tool (201-112) over shaft and hold it in place with bolt (42), which you leave half a turn from being tight. Then adjust barrel and paddle so that outside diameter of cylinder and edge of paddle lines up exactly. Then nip up bolt (42). Barrel can now be pushed down into crankcase, engaging slipper (41) into ring (25) at the same time.
- 8.12.47 Apply anti-seize paste to the threads of screw (87) (two per barrel) and screw into barrel after passing through crankcase. Tighten up, and then back off half a turn.
- 8.12.48 Repeat instructions 46&47, for barrels B, C & D.
- 8.12.49 Undo and remove bolt (42) and barrel aligning tool.
- 8.12.50 Fit sleeve non-drive end (16) over shaft.
- 8.12.51 Making sure washer (41) is over bolt (42) pass it through sleeve (16) and screw it into shaft and leave half a turn from being tight.
- 8.12.52 Put disc spring (33) over sleeve (16) and down onto eccentric (70).
Note: Disc spring is not flat so make sure when viewed from above it is the outside edge that is resting on the eccentric.
- 8.12.53 Fit top retaining ring (25) over bearing (20) making sure slipper (4) goes into recess of ring.
- 8.12.54 Fit circlip (30) into groove near the top edge of bearing (20).

- 8.12.55 Oil O-rings (66) (one per barrel) and fit into grooves at inlet end of barrels.
- 8.12.56 Grease O-rings (65) (two per barrel) and fit into there locations on inlet side of barrel.
- 8.12.57 At this point it is worth checking the following points before fitting the lid on:
- (A) That the disc spring (33) is in place and up the right way.
 - (B) Retaining rings (25) are free to move around and up and down.
 - (C) Port in piston is showing when it is at its highest point in cylinder (3).
 - (D) Turn pump to check for free running of all pump internals.
 - (E) Oil bleed holes in barrels are all facing the top of pump.
 - (F) O-rings (66) are in place on the inlet end of barrels.
 - (G) O-rings (65) are in place in the recesses in barrels.
- 8.12.58 Fit greased O-ring (62) into the groove in crankcase lid (76), and apply oil to barrel locating bores in crankcase lid.
- 8.12.59 Apply oil to sleeve (16) and to bore of bearing (22).
- 8.12.60 Gently offer crankcase lid (76) up to crankcase, engaging non-drive sleeve (16) into bearing bore (22) and barrels into their bores in crankcase lid. Then if needed lid can be gently tapped down evenly using a nylon mallet, but stop just before o-ring (62) in lid enters crankcase bore.
- 8.12.61 Apply anti-seize paste to eight-screw (79) and pass these through lid and screw into barrels. Then tighten these down very evenly, turning each a half turn at a time until lid is fully down. Then torque screws (79) to 20 Nm.
- 8.12.62 Turn pump through 90 degrees and then torque eight screws (87) that are holding delivery side of barrels into crankcase to 20 Nm.
- 8.12.63 Bolt (42) is now torqued to 135 Nm.
- 8.12.64 Grease O-ring (35) and fit into recess of bearing retainer (18), and then fit retainer over bearing (22).
- 8.12.65 Fit washers and nuts (44&46) onto screw (44) and tighten down to hold retainer in place.
- 8.12.66 Fit bonded seals (80) over eight screws (78) and apply anti-seize paste to threads and screw into tapped holes in crankcase lid (76),(two next to each barrel), and torque to 20 Nm.
- Note: These are blanking screws that were removed so that lid could be jacked off of crankcase.
- 8.12.67 Apply anti-seize paste to four-bleed screw (43) and screw them into bleed rings (5) and fit assembly over delivery end of barrels. Line up point of bleed screw with counter sunk hole in barrel and nip up.
- 8.12.68 Push outlet guide (12) into bore of outlet caps (11,24&54). The recess for spring should be facing you. You may need to use a delrin rod and nylon mallet to gently tap it in.
- 8.12.69 Fit spring (58) into guide recess.
- 8.12.70 Put valve head (57) onto spring (58) and push down to check that valve head moves freely in guide.
- 8.12.71 Grease four O-rings (59) and fit them into grooves around small diameter of outlet seats (13) and push into bore of outlet caps. You may need to use a delrin rod and nylon mallet to gently tap it in.
- 8.12.72 Grease remaining four O-rings (59) and fit them into grooves on face of outlet seats (13).
- 8.12.73 Fit O-rings and back up rings (37&38) into grooves in delivery tubes (6) and grease them.
- Note: O-ring will be nearest to the end of tube, with the concave side of back up ring facing the O-ring.

- 8.12.74 Fit the four delivery tubes (6) into greased locating bores of outlet caps (11,24&54) to form a square.
Note: Outlet caps (11&24) are tapped to take a bleed screw and these will be fitted to top two barrels a & d. Once assembled leave on bench.
- 8.12.75 Fit dowty seal (56) over threads of drain plug (55), screw into crankcase (1) and fully tighten.
- 8.12.76 Fit lifting eye (88) to oil filler hole in crankcase (1) and remove pump from assembly rig.
- 8.12.77 Fit key (27) into shaft (23) with removal chamfer facing towards the centre of shaft, and towards you. At this point check that counter balance and coupling (14&15) slide onto shaft and key, then remove both.
- 8.12.78 Apply anti-seize paste to sixteen-screw (51).
- 8.12.79 Keeping hold of two screws (51), and a 5mm allen key, offer up assembled outlet manifold to delivery end of barrels. Outlet caps (11&24) drilled and tapped to take bleed screws are fitted to barrels a & d. Two screws (51) can now be screwed into two opposite outlet caps, to hold it in place. Now remaining fourteen screws can be fitted and evenly torqued down to 16 Nm.
- 8.12.80 Apply a little anti-seize paste to the two bleed screws (43), and screw into outlet caps (11&24) and nip up.
- 8.12.81 Fit bonded seals (56) over blank plugs (75) and adapters (77) and apply anti-seize paste to the threads. Then screw these into outlet caps in the desired positions and fully tighten.
- 8.12.82 Grease O-rings (67&68) and fit into grooves in the inlet manifold (7).
- 8.12.83 Fit inlet manifold over studs (49), ensuring drain plughole is at the bottom.
- 8.12.84 Fit washers (50) over the threads of studs (49), and then apply anti-seize paste to stud threads.
- 8.12.85 Screw on nuts (48) and torque to 10 Nm.
- 8.12.86 Fit bonded seal (71) over threads of adapter (34) and apply grease to threads. Then screw into inlet manifold and tighten fully.
- 8.12.87 Fit bonded seal (74) over the threads of drain plug (73), and screw into inlet manifold and tighten fully.
- 8.12.88 Fit bonded seal (74) over threads of plug (83), and screw into the top of inlet manifold and tighten fully.
- 8.12.89 Fit bell housing, washers (46) and nuts (40) and fully tighten.
Note: Coupling clearance inspection hole in bell housing in bell housing must be positioned between a & d barrels
- 8.12.90 Grease shaft (23) and slide on counter balance and coupling (14&15).
- 8.12.91 Fit roll pin (47) into drive cap (32) and place cap onto the end of coupling (15) locating roll pin (47) into hole in shaft (23).
- 8.12.92 Apply a little anti-seize paste to the threads of screw (45) and screw into shaft, after passing through drive cap (32) and torque to 70 Nm.
Note you will have to wedge counter balance (14) against wall of bell housing to enable you to apply torque.
- 8.12.93 Fit pump back onto driver see section 8.2
- 8.12.94 Fill pump with oil and bleed see section 8.13 and 8.14

Section 8.13

OIL BLEEDING THE PUMP



CAUTION: ON NO ACCOUNT OPEN THE OIL BLEED SCREWS WHEN THE PUMP IS OPERATING UNDER PRESSURE

REFER TO THE LUBRICATION CHART GIVEN IN SECTION 8.14 FOR DETAILS OF PUMP OIL AND CAPACITIES

- 8.13.1 Fill the pump to the top of the crankcase, and then connect oil expansion bottle and hose, and fill bottle about half way.
- 8.13.2 Make sure all four oil bleed screws (43) are nipped up.
- 8.13.3 Set the selector valve to the recycle (dump) position and start the engine / motor, and run at approx. 750 r.p.m. , or inch electric motor (on/off).
- 8.13.4 Starting with one of the lower barrels put a finger of one hand on the top of bleed screw, while slowly opening bleed screw very slowly using a suitable spanner. When air-free oil flows, tighten the bleed screw firmly.
- 8.13.5 Whilst oil bleeding, check oil level in expansion bottle frequently and keep topped up so that air is not introduced into crankcase, and then into cylinders.
- 8.13.6 Repeat the procedure for the remaining three barrels.

Section 8.14

PUMP LUBRICATION

OIL CAPACITY FOR A HI Q PUMP IS APPROX. 11.0 LTS.

MANUFACTURER	TYPE
SHELL	TELLUS 100
ESSO	NUTO 100
GULF	LP 100
MOBIL	DTE 18
ROC	KIRON 100
TEXACO	RANDO HD 100
BP	ENERGOL HLP 100
AGIP	OSO 75
CENTURY OIL	PWLL
PETROFINA	HYDRAN 100
CASTROL	HYSPIIN AWS 100

Section 8.15

WATER BLEEDING THE PUMP



CAUTION: ON NO ACCOUNT OPEN THE WATER BLEED SCREWS WHEN THE PUMP IS OPERATING UNDER PRESSURE

- 8.15.1 Whenever the unit is started after being allowed to run dry, the following procedure must be followed.
- 8.15.2 Set the selector valve to the recycle (dump) position and start the engine / motor. Run at approx. 750 r.p.m to prime, or inch electric motor (on/off).
- 8.15.3 The pump is self-priming. If however any difficulty is experienced, stop engine, and loosen the two bleed screws (43) that are screwed into two outlet caps (11&24) fitted to top two barrels A & D. Allow the water to flow from each of them, (ensure that the header tank remains full) when water is air free tighten both bleed screws firmly.
- 8.15.4 Engine / motor can now be started with the selector in the recycle (dump) position.
- 8.15.5 When the operator has taken up a working position, move the selector lever to the high-pressure position and increase engine speed to reach working pressure.
- 8.15.6 If the delivery line vibrates this indicates that air may still be in the system. Stop the unit and repeat the procedure listed above again.

Section 8.16

USEFUL TORQUE SETTINGS

ITEM NUMBER	PART NUMBER	DESCRIPTION	TORQUE Nm
(40)	013-304	Nut NYLOC M10	54 Nm
(42)	100-653	Shaft Bolt	135 Nm
(45)	013-218	Screw M10X25	70 Nm
(48)	013-747	Nut Acorn M10	14 Nm
(51)	013-745	Screw M6X55	16 Nm
(53)	013-768	Screw M8X35	40 Nm
(78)	013-576	Screw M8X20	20 Nm
(79)	013-770	Screw M8X40	20 Nm
(52)	013-767	Screw M6X50	16 Nm
(87)	013-079	Screw M8X 30	20 Nm

Section 8.17

TO ANTI-FREEZE A UNIT WITHOUT AN ANTI-FREEZE TANK

- 8.17.1 Prepare 25lbs. (or larger quantity if required) of 30% to 50% anti-freeze solution.
- 8.17.2 Drain the water tanks
- 8.17.3 Pour the anti-freeze solution into the water break tanks.
- 8.17.4 Remove any jet or accessory from the end of the high-pressure hose.
- 8.17.5 Ensure the high-pressure selector lever is in the dump (or off) position. Start the engine and allow to run for 1 minute.
- 8.17.6 Holding the outlet end of the hose, move the selector to the high-pressure position and allow the engine to run until the anti-freeze solution can be seen coming from the high-pressure hose.
- 8.17.7 Stop the engine.
- 8.17.8 The unit is now anti-freezed.

To remove anti-freeze from a unit without an anti-freeze tank

- 8.17.9 Drain any anti-freeze solution from the break water
- 8.17.10 Tanks into a container.
- 8.17.11 Fill break water tanks with water.
- 8.17.12 Place the outlet of the high-pressure hose into the container.
- 8.17.13 Place the selector lever in the high-pressure position, and whilst holding the high pressure hose, start the engine.
- 8.17.14 Run the engine until all solution is returned to the container and clean water is seen flowing from the hose.
- 8.17.15 The unit is now ready to use.

Section 8.18

TO ANTI-FREEZE A UNIT WITH AN ANTI-FREEZE TANK

- 8.18.1 Ensure the anti-freeze tank is full of 30% to 50% anti-
- 8.18.2 Freeze solution.
- 8.18.3 turn the 3-port valve to the anti-freeze position and
- 8.18.4 open valve on the anti-freeze tank (if fitted).
- 8.18.5 remove any jet or accessory from the end of the high
- 8.18.6 pressure hose.
- 8.18.7 Move the selector lever to the high pressure (or on)
- 8.18.8 position.
- 8.18.9 Holding the end of the hose, start the engine.
- 8.18.10 Allow the engine to run on tick-over until the anti-freeze solution can be
- 8.18.11 seen coming from the high-pressure hose.
- 8.18.11 Move the selector to the re-cycle (dump) position for 5 seconds (this allows
- 8.18.12 the dump hose to be anti-frozen).
- 8.18.12 If jump jet or remote control kits are fitted, ensure they are anti-frozen.
- 8.18.13 The unit is now anti-frozen.

To remove anti-freeze from a unit with an anti-freeze tank fitted

- 8.18.14 Move the 3-port valve to the water position.
- 8.18.15 Fill the water tanks.
- 8.18.16 Place the outlet of the high-pressure hose into the anti-freeze tank.
- 8.18.17 Place the selector lever in the high-pressure position.
- 8.18.18 Start the engine. Allow it to run at tick-over and pump anti-freeze solution
- 8.18.19 into the anti-freeze tank. Stop the engine when clear water is seen flowing
- 8.18.19 out of the high-pressure hose.
- 8.18.19 The unit is now ready to use.

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Section 9 - Over Pressure Protection

Section 9

OVER PRESSURE PROTECTION

A HI Q Pump fitted into any system MUST always be protected from over pressure using a suitable device.

This device must not be able to be isolated from the pump in any way and must be treated as one of the most important pieces of equipment fitted.

Please refer to the Technical Department at Flowplant Group Ltd in Salisbury for suitable over pressure protection.

Section 10 – Recommended Spares

Section 10

RECOMMENDED SPARES

ITEM NUMBERS IN BRACKETS RELATE TO ASSEMBLY DRAWING
020-050

	PART NUMBERS	DESCRIPTION	QTY. PER PUMP	ITEM NO.
	078-157	Valve Guide Inlet	4	(8)
	078-159	Valve Seat Inlet	4	(10)
Inlet Valve Assembly	078-164	Valve Head	4	(57)
	015-127	O-Ring (Inlet Seat)	4	(61)
	015-128	Anti-Extrusion Ring (Inlet Seat)	4	(60)
	037-042	Spring (Inlet Valve)	4	(58)
	078-161	Valve Guide Outlet	4	(12)
	078-162	Valve Seat Outlet	4	(13)
Delivery Valve Assembly	078-164	Valve Head	4	(57)
	015-129	O-Ring (Delivery Seat)	4	(59)
	037-042	Spring (Delivery Valve)	4	(58)
	100-186	Diaphragm	4	(28)
	015-043	Seal Glydring (Mandrel)	4	(72)
	013-302	O-Ring (Delivery Valve)	8	(37)
	013-328	Back Up Ring (Delivery Tube)	8	(38)

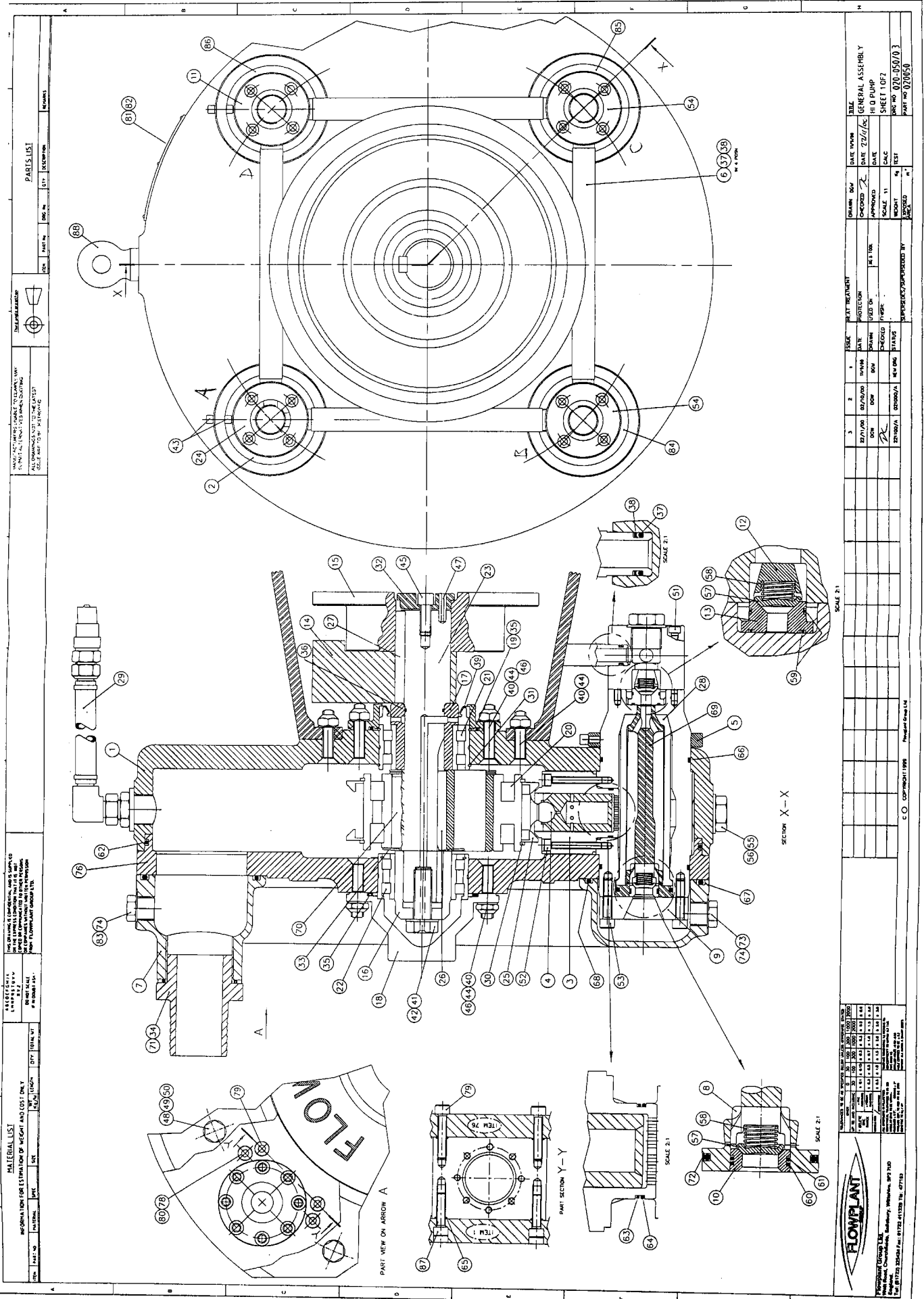
Section 11 – Drawings & Parts Lists

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Item:	Part No:	Part Description:	Qty:
1	074015	CRANKCASE HI Q PUMP 4 CYL	1
2	078151	BARREL 'A' HI Q PUMP	1
3	078152	CYLINDER HI Q PUMP	4
4	020051	PISTON & SLIPPER ASSY/33MM/HI-Q PUMP	4
5	078154	BLEED RING HI Q PUMP	4
6	078155	DELIVERY TUBE HI Q PUMP	4
7	078156	INLET MANIFOLD HI Q PUMP	1
8	078157	VALVE GUIDE INLET HIGH Q PUMP	4
9	078158	INLET CAP HI Q PUMP	4
10	078159	VALVE SEAT INLET HI Q PUMP	4
11	078160	OUTLET CAP HI Q PUMP	1
12	078161	VALVE GUIDE OUTLET HI Q PUMP	4
13	078162	VALVE SEAT OUTLET HI Q PUMP	4
14	078241	COUNTER BALANCE - HI Q PUMP	1
15	023305	COUPLING PART 4 B200 BORE 45MM KEY 14MM CENT. MALE	1
16	100257	SLEEVE CAP NON DRIVE END	1
17	100652	SLEEVE DRIVE END OIL CIRCULATION	1
18	100336	BEARING RETAINER MARK 2 CENTURY MACHINED	1
19	100654	OIL SEAL CARRIER OIL CIRCULATION	1
20	100520	BEARING MAIN MK4 CENTURY (SL04 5018)	1
21	100054	BEARING END CENTURY (SL04 5010 C3)	1
22	100056	BEARING END CENTURY FLOATING (SL18 5010 A C3)	1
23	100655	SHAFT CENTURY PUMP OIL CIRCULATION	1
24	078185	OUTLET CAP HI Q PUMP	1
25	100516	RETAINING RING MK4 CENTURY	2
26	100063	KEY 10 x 8 x 69MM CENTURY PUMP TO BS4235	1
27	100064	KEY 14 x 9 x 82MM CENTURY COUPLING TO BS4235	1
28	100186	DIAPHRAGM CENTURY "C" TYPE	4
29	100442	OIL EXPANSION PIPE ASSY	1
30	100521	CIRCLIP CENTURY BEARING INA WR140	2
31	013185	CIRCLIP WR80 (ANDERTON)	2
32	100234	DRIVE CAP	1
33	100071	DISC SPRING 67.5 X 50.5 X 0.70	1
34	043177	ADAPTOR [PLASTIC] 2" BSPM X 2" O/D	1
35	013191	O RING BS239/70	2
36	013001	O RING BS026/90	1
37	013302	O RING BS113/90	8
38	013328	BACK UP RING [PARKER PARBAK 8.113]	8
39	100058	SEAL OIL CB 60 x 80 x 8	1
40	013304	NUT NYLOC M10-1.5 6H S/S A2	14
41	013116	WASHER PLAIN M16 FORM A M/S ZN	1
42	100653	BOLT SHAFT OIL CIRCULATION	1
43	100345	BLEED SCREW STAINLESS STEEL	6
44	013181	SCREW SET CSK SOC HD M10-1.5 6G 50 LG HT 10.9 ZN	14
45	013218	SCREW SET CAP SOC HD M10-1.5 6G 25 LG HT 12.9 ZN	1
46	013305	WASHER PLAIN M10 FORM A S/S	14
47	013221	PIN ROLL TYPE 1/4" DIA X 3/4" LG 304 STAINLESS ST	1
48	013747	NUT ACORN M10 NICKEL PLATE	8
49	013746	STUD M10	8
50	013754	WASHER DELRIN	8
51	013745	SCREW CAPSCREW M6 X 55 GRD 12.9 NICKEL PLATE	16
52	013767	SCREW SET SOC CAP HD M6 X 50 LG SELF COLOUR	32

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53	013768	SCREW SET SOC CAP HD M8 X 35 HT 12.9 ENP	32
54	078186	OUTLET CAP HI Q PUMP	2
55	N01807	DRAIN PLUG 3/4 BSP MAGNETIC : TSCM/TYPE4	1
56	033014	SEAL BONDED 3/4" BSP 400-827-4490-41 420 BAR	5
57	078164	VALVE HEAD INLET/OUTLET HI Q PUMP	8
58	037042	SPRING INLET/OUTLET HI Q PUMP	8
59	015129	O RING 22.1 I/D 1.6 SECTION 90 SHORE SIZE 0221-16	8
60	015128	ANTI-EXTRUSION RING PTFE SPIRAL	4
61	015127	O RING 22 I/D 2 SECTION 90 SHORE	4
62	015126	O RING 484 I/D 4 SECTION 70 SHORE SIZE 204-584 (see notes)	1
63	015125	ANTI EXTRUSION RING 39 I/D 2 SECT PTFE SPIRAL	4
64	015124	O RING 39 I/D 2 SECTION 90 SHORE SIZE REF 204-039	4
65	078311	WASHER - HI Q PUMP	16
66	015130	O RING 70 SHORE 74.5MM I/D 3MM THK BS4518 0745-30	8
67	015122	O RING 489.3 I/D 5.7 SECTION 70 SHORE SIZE 202-892	1
68	015121	O RING 285 I/D 5 SECT 70 SHORE SIZE REF. 204-855	1
69	078170	MANDREL MODIFICATION HI Q PUMP	4
70	078163	ECCENTRIC 33MM THROW HI Q PUMP	1
71	015010	SEAL BONDED 2.0" BSP 400-836-4490-41 288 BAR C-TXT	1
72	015043	SEAL GLYDRING FOR MK4 CENTURY MANDREL	4
73	N01810	DRAIN PLUG 1/2 BSP MAGNETIC	1
74	033010	SEAL BONDED 1/2" BSP 400-825-4490-41 448 BAR	2
75	023369	PLUG BLANKING 3/4"BSP S/S	2
76	074016	CRANKCASE LID HI Q PUMP 4 CYL	1
77	023370	ADAPTOR 3/4"BSP M x 3/4"BSP M 550BAR ST/ST	1
78	013576	SCREW SET CAP SOC HD M8 X 1.25 X 20 LG ST/ST A2	8
79	013770	SCREW SET SOC CAP HD M8 X 40 LG ST/ST A2	8
80	033313	SEAL BONDED M8 400-866-4490-41 604 BAR	8
81	013232	SCREW HAMMER DRIVE NUMBER 2 X 3/16" BRASS	6
82	043110	LABEL PUMP IDENTIFICATION	1
83	023391	PLUG BLANKING 1/2" BSP ST/ST	1
84	078205	BARREL 'B' HI Q PUMP	1
85	078206	BARREL 'C' HI Q PUMP	1
86	078207	BARREL 'D' HI Q PUMP	1
87	013079	SCREW SET CAP SOC HD M8-1.25 6G 30 LG HT 8.8 ZN	8
88	061047	LIFTING EYE CENTURY 3/4"BSP	1
89	064024	PROTECTIVE CAP 50 ID X 25 LONG PVC	1
90	032193	ADAPTOR 3/4" BSP M x 1/2" BSP M 900 BAR ST/ST	1
91	013043	HOLDER FOR PRESSURE DISC	1
92	011046	PRESSURE DISC WHITE 4000 PSI	1
93	023822	PRESSURE DISC ADAPTOR 1/2" BSP 90 DEG M/F	1



<p>MATERIAL LIST INFORMATION FOR ESTIMATION OF WEIGHT AND COST ONLY QUANTITY IN BRACKETED PARTS LIST</p>		<p>PARTS LIST DATE: 22/11/99 DRAWN BY: [] CHECKED BY: [] APPROVED BY: []</p>	
ITEM	PART NO.	QTY	DESCRIPTION

<p>MANUFACTURING INSTRUCTIONS ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE TO BE CAST</p>		<p>DATE 22/11/99 SCALE 1:1 WGT [] TEST [] REWORK [] REWORKED BY []</p>	
NO.	REV.	DATE	DESCRIPTION

<p>GENERAL ASSEMBLY SHEET 1 OF 2 Dwg No. 070-050/0-3 Part No. 020/50</p>		<p>DATE 22/11/99 SCALE 1:1 WGT [] TEST [] REWORK [] REWORKED BY []</p>	
NO.	REV.	DATE	DESCRIPTION

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Section 12 - Accessories

How to fit Jump Jet Kit 026-064 to Hi-Q Pump

Item numbers in brackets after the description relate to general assembly drawing 026-064.

1. Before carrying out the following instructions decide which barrel (A,B,C or D) the Jump Jet will be fitted to. The proceed as follows:
2. Jump Jet Kits can be fitted to any outlet cap, as long as it is the valve assembly end of the Jump Jet that is fitted to either side of the chosen outlet cap.
3. Once assembled delivery “square”, made from the four outlet caps, two delivery tubes 078-155 and the two Jump Jet Kits, has been fitted to the pump and sixteen 6mm caphead bolts have been torqued to 16 Nm set up the Jump Jet as follows.
4. With nut (9J) fully backed off up against delivery tube shoulder (8J), apply a little Loctite Thread Lock to the exposed thread on the tube.
5. Using a spanner across flats on tube (8J) to stop it turning. screw nut (9J) towards washer (10J) and fully tighten. This will push delivery tube (8J), and valve seat adaptor (1J) apart, preventing the shuffling of the Jump Jet assembly back and forth when pump is running.
6. Plumb the Jump Jet circuit as shown in drawing Q0207.

Item:	Part No:	Part Description:	Qty:
1	078524	VALVE SEAT ADAPTOR JUMP JET KIT HI Q PUMP	2
2	7001567	PRESSURE DISC ASSEMBLY HI Q PUMP	1
3	078523	GUIDE FOR BALL JUMP JET HI Q	2
4	ABA10	STAINLESS STEEL BALL 10MM DIA	2
5	061633	Assembly Instructions Hi-Q Jump Jet Kit	1
6	013302	O RING BS113/90	6
7	013328	BACK UP RING [PARKER PARBAK 8.113]	6
8	078230	DELIVERY TUBE (SHORT) HI Q PUMP	2
9	078242	NUT M24	2
10	078243	WASHER - JUMP JET KIT	2

