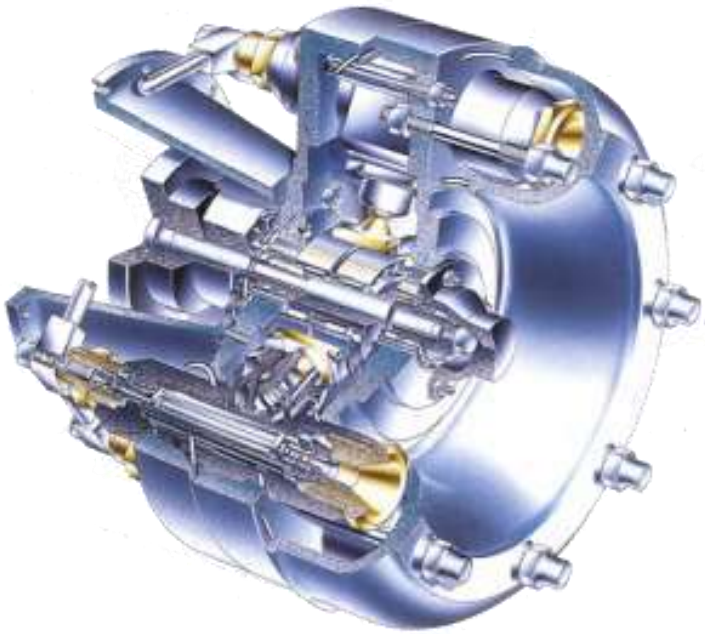
HARBEN

CENTURY PUMP

SERVICE MANUAL



This manual contains
IMPORTANT Safety Information

Flowplant Group Ltd.
Gemini House
Brunel Road
Churchfields Ind. Est.
Salisbury
Wiltshire, SP2 7PU
England

t:+44 (0)1722 325 424
f:+44 (0)1722 411 329

Harben Inc.
P.O.Box 2250
Cumming
GA 30028
USA.

t:+1 770 889 9535
f:+1 770 887 9411

CENTURY PUMP SERVICE MANUAL

AMENDMENTS

Change	Page(s) Amended	Date	Signature
5	Re-formatted	05/16	TWC
5.2	Warranty section amended	10/16	GHM
6	Re-formatted / Health & Safety section amended	28/11	AC
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HARBEN

CENTURY TYPE PUMP

SERVICE MANUAL

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FOREWORD

This manual is primarily concerned with the Harben Century Type Pump. In addition, general safety and operating information for the equipment into which the pump is installed is also included.

The conversion of pressurised water into a high velocity jet and its use as a cleaning and cutting tool is now familiar to, and used by, many people in a wide range of industries.

High pressure water can achieve remarkable results without the use of heat or chemicals and cost savings over conventional maintenance methods can in many cases show that a water jetting unit will pay for itself in hours rather than years.

Many companies have problems for which high pressure water offers a rapid solution, yet hesitate to consider this method because of the generally accepted high cost of such equipment. Backed by many years of design and manufacturing experience, Harben pumps are setting new standards of performance and reliability. The capital and operating costs are such that these offer and attractive return on investment that really makes sense.

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.

HEALTH AND SAFETY AT WORK

There are two main categories of risk. These are:

a) Injury from impact of water
b) Injury from environment.

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

INJURY FROM 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 an immediately accessible 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 PRESSURE UP TO 36750 LB/IN^2 (250 MPA, 2500 BAR, 2548 KG/CM^2) 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 such as are found in sewage. Bacterial swabs and blood cultures may therefore 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 any person, object or article is accidentally struck by the jet, this fact must be reported to the operator's representative.

INJURY FROM 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 must be worn.

b) Always clean scratches or cuts immediately. Disinfect and cover with a strip of gauze and impermeable plaster. SEEK MEDICAL HELP.

c) Avoid rubbing eyes, nose or mouth with 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.

SAFETY CODE OF PRACTICE

Full details of the Safety Code of Practice, when working with equipment containing a Harben pump, are given in Section 3 of this manual. The basic rules of this code are as follows:

1. ALWAYS WEAR THE CORRECT PROTECTIVE CLOTHING.
2. ALWAYS ENSURE 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 SWITCHED OFF.

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

POTENTIAL HAZARDS AND MISUSE OF HIGH PRESSURE EQUIPMENT

Failure to follow the instructions where this icon is shown can result in serious

- Never use a jetter that isn't regularly serviced according to the manufacturer's recommendations.

- When a jetter is used to clean drains & sewers that are contaminated with a hazardous substance it is possible these may be entrained in the resulting aerosol and inhaled by operators. Consider using respiratory protection.

- Do not spray flammable liquids – there is a risk of explosion.

- Ensure the correct fuel is used on all occasions or there is a risk of explosion.

- Never start the jetter when frozen. Operating a jetter whilst frozen could cause high speed ice bullets to be ejected from the jetter hose on machine start up.

- Never start jetting a drain, sewer or pipe unless the jet nozzle is safely inside the drain and pointing in the direction that you intend it to travel.

- When drain jetting a drain, sewer or pipe with an inside diameter that is not small enough to prevent the hose from turning back on itself, a drain jet extension (a piece of straight rigid tube equivalent to the pipe diameter) should be fitted between the end of the hose and the nozzle.

- Always use a safety leader hose at the beginning of the main jetting hose to alert operators when the jet nozzle is nearing the manhole entrance.

- Always consider the use of a tiger tail hose feed guide to protect the jetting hose from abrasion and prevent premature failure.

- Be aware that high pressure hoses can generate static electricity which may need to be controlled when working in hazardous areas.

- Never direct a high pressure water jet at electric power lines or electrical equipment as serious injury or death from electrocution could occur.

- When jetting drains or sewers if there is a danger to the general public from hoses laying across public walkways they must be covered in such a way as to protect against injury from hose failure and tripping hazards.

POTENTIAL HAZARDS AND MISUSE OF HIGH PRESSURE EQUIPMENT

Failure to follow the instructions where this icon is shown can result in serious injury

- Before starting work, check and ensure the drain jets have no blocked holes or nozzles as this may cause the pumping system to over pressurise which could result in burst disc failure or bursting the jetting hose.

- Never attempt to unblock a fully choked drain or pipe before considering the consequence of releasing the blockage and having a plan to deal with it. E.g. flooding, material ejection, drain nozzle ejection.

- Never attempt to clean drains or pipes in one pass because this could lead to debris build up behind the jet nozzle causing a pressure build up in the drainage system. Be aware that a pressure build up in the drain or pipe could cause the jet nozzle to be ejected at speed back towards the operator.

- Never enter the manhole to either place the jet nozzle into or extract it from the drain entrance unless the required confined space regulations have been met.

- Never work in a manhole with a radio remote control transmitter that is not classified for use in such areas.

- Never use the hydraulic hose reel facility as a winch to retract a jetting hose that has become stuck in the drain or pipe. Damage to the hose could be caused that will make subsequent hose failure more likely.

- Never allow jetting hoses to become kinked and always remove from service any jetting hose with an outer cover that has worn through to the reinforcing braid.

- Never use the high pressure jetting hose for any purpose other than sewer, drain or pipe cleaning, e.g. winching vehicles or other plant.

- Never use jetting nozzles and/or accessories that have not been calibrated for the jetting machine pump performance as this could cause rapid over pressurisation catching operators unaware.

- Never attempt to clean a drain or pipe with a nozzle that has more forward force than rear force. It could be ejected back toward the operator causing injury.

- Never attempt to clean a drain or pipe with a chain flail type jet that has unequal chain lengths as this could lead to severe vibration and high pressure hose failure.

POTENTIAL HAZARDS AND MISUSE OF HIGH PRESSURE EQUIPMENT

Failure to follow the instructions where this icon is shown can result in serious injury

- When using a venturi jet pump to remove fluid from a flooded manhole never place your fingers into the pump inlet as they could be trapped by the vacuum and cause injury.

- When using a venturi jet pump to remove fluid from a flooded manhole always secure the free end of the pump hose securely and ensure adequate drainage is in place to deal with high volumes of pumped water.

- Never use a dry shut type foot control valve on a jetter that does not have a pressure unloader valve as this could result in burst disc failure or bursting the jetting hose.

- When using a dry shut type system be aware that high pressure can be retained in the jetting hose even after the machine has been shut down. Always discharge pressure in a safe manner after machine shut down.

- When working with a gun always consider using a safety shroud to provide the operator with greater protection in the event of a hose burst.

- Never point the gun at anyone as injury from high pressure water will occur if the jet stream comes into contact with body parts.

- Never work on a slippery surface because the reaction force of the jetting gun could cause you to become unstable and lose your footing.

- Never work from a ladder as the reaction force of the jetting gun could cause the ladder to fall backwards from the working area causing possible injury.

- Never work from scaffolding unless it is designed, erected and managed by competent persons and it is adequately secured to prevent it being pushed over by jetting gun reaction forces.

- When using the jetting gun to clean hard surfaces be aware that splash back could contain hard debris travelling at speed.

- When using the jetting gun to clean contaminated surfaces be aware that splash back could contain dangerous contaminants.

- Never use the jetting gun to clean a surface that could be damage or penetrated by the water pressure unless that is the desired effect.

POTENTIAL HAZARDS AND MISUSE OF HIGH PRESSURE EQUIPMENT

Failure to follow the instructions where this icon is shown can result in serious injury

- Always ensure that an adequate area is cordoned off around the working zone so that flying debris and contamination cannot injure passers-by.

- Be aware that the use of water jetting guns fitted with oscillating or rotating heads tend to produce higher hand arm vibration levels than simple fixed head jets.

- When using a jetting gun or nozzle to clean at floor level wear suitable protective foot wear.

- Never use a high pressure jetting gun to clean down PPE whilst you or others are still wearing it as serious injury and death could result.

- Never use a high pressure jetting gun to wash or cool down livestock as serious injury and death could result.

- Drainage systems may carry bacteria and micro-organisms which can cause severe illness or death. Avoid exposing eyes, nose, mouth, ears, hands, cuts or abrasions to waste water or faecal matter during drain cleaning operations. After working around drainage systems help protect yourself by always washing hands.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

All persons using high pressure water jetting equipment should use all necessary PPE suitable for the task being carried out. This includes, but is not limited to:

- Ear protection
- Eye protection: a helmet with chin guard and visor is recommended
- Hand protection
- Waterproof clothing
- Safety boots with toe protection

Please note: A site specific Risk Assessment / Job Hazard Analysis must be completed to analyse which PPE must be worn.

Section 1

Pump Technical Data

Section 1

Technical Data

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1.1 INTRODUCTION

The Harben Century Type high pressure pump (Fig 1.1) is a radial piston diaphragm pump which can be used for a number of industrial applications, including the following:

(a) High pressure cutting of board, plastic and other materials
(b) Water hydraulic systems
(c) Abrasive blasting and de-scaling
(d) Drain/sewer cleaning
(e) Tube de-scaling
(f) Desalination by reverse osmosis
(g) Pumping demineralised water
(h) Floor and surface cleaning
(i) Underwater cleaning
(j) Surface preparation

In addition to its reliability and long service intervals, the advantages of using this type of pump include:

(a) Variable pressure and flow options without piston change
(b) Pumps can run dry without damage as there are no piston seals
(c) Filtration up to 150 microns
(d) No modification is required to pump sea water
(e) Pump has multi-cylinders therefore no pulsation

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.

1.2 PUMP DESCRIPTION

1.2.1 Functional

The following description of the Harben Century Type Pump applies equally to the 4 and 8 cylinder variants. Performance details of each type of pump are given later in this section.

The Century 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.

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.

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.

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.

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.

1.2.2 Filtration

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.

1.2.3 Fluid Flow

Arrangements are made on the pump for the incoming fluid to cool the crankcase oil. The use of standard diaphragm/barrel assemblies provides a choice of flows, depending upon the number of barrels fitted to a crankcase. The cylindrical form of these barrels is well suited to containing high pressures. Three piston diameters are available to suit a range of pressure up to 700 bar (10 000 psi).

1.3 IDENTITY

1.3.1 Manufacturer

The Harben Pumps are manufactured by:

Flowplant Group Ltd.,
Gemini House, Brunel Road,
Churchfields Industrial Estate, Salisbury,
Wiltshire, SP2 7PU, ENGLAND
Tel: +44 (0)1722 325 424
Fax: +44 (0)1722 411 329
www.flowplant.com
sales@flowplant.com

1.3.2 Pump Options/Identification

The Century Pump is available in either 4 or 8 cylinder options, with each having a choice of piston/cylinder diameter options of 22.5 mm, 25.0 mm or 27.5 mm.

All barrels are given a letter code to indicate their position in the crankcase (refer to Section 4, Fig 4.2). This letter code can be found stamped on the face adjacent the inner cylinder. Letters A to H are used. Each barrel of a different code is given its own part number.

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:

8	22.5
no. of cyl	piston 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.

1.4 DESIGN AND PERFORMANCE DATA

1.4.1 Physical Data

TABLE 1.1 PUMP PHYSICAL DATA

Pump diameter	560 mm
Pump length	451 mm
Inlet	2 in BSP/50 mm dia. hose tail
Outlet	1 /2 in BSP
Shaft diameter	45 mm
Shaft length	83 mm

Note: for full details of the pump physical data refer to Fig 1.1.

1.4.2 Performance Characteristics

For full details of the Century Series, Pump performance data, reference should be made to the appropriate information given in Tables 1.2 and 1.3a/b.

TABLE 1.2 PUMP PERFORMANCE DATA - MAXIMUM WORKING PRESSURES

Pump/Cylinder Diameter	1000 rpm (normal working speed)
22.5 mm	10 000 psi (700 bar)
25.0 mm	8000 psi (550 bar)
27.5mm	6000 psi (415 bar)

Notes:

i. As a rule, electrically-driven and diesel-driven pumps run at 1000 rpm, nominal.

ii. Quantity of cylinders does not, alter pump working pressure.

iii. Quantity of cylinders does alter flow rate.

1.5 EQUIPMENT DETAILS

Details relevant to the pump and associated equipment should be entered on the form shown in Table 1.3, at the rear of this section, for future reference.

1.6 ASSOCIATED PUBLICATIONS

Associated with this manual are the following publications:

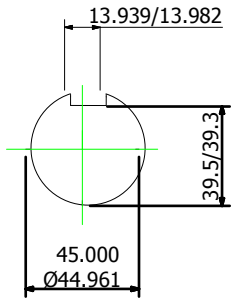
Operators guide - Part no. 061-225
Code of practice - Part no. 057-062

1) OIL FILLER
2) WATER INLET
3) WATER DRAIN
4) OIL DRAIN
5) FLENDER PART 4 B200
   COUPLING (CLAMPS COUNTER BALANCE)
6) OIL BLEED SCREW B.A.
7) WATER BLEED SCREWS B.A.
   FITTED TO TOP BARRELS ONLY
8) HIGH PRESSURE OUTLET G1/2"
9) VIEW EXCLUDING COUPLING AND COUNTER BALANCE
10) 6 STUDS M10x1.5 28mm LG

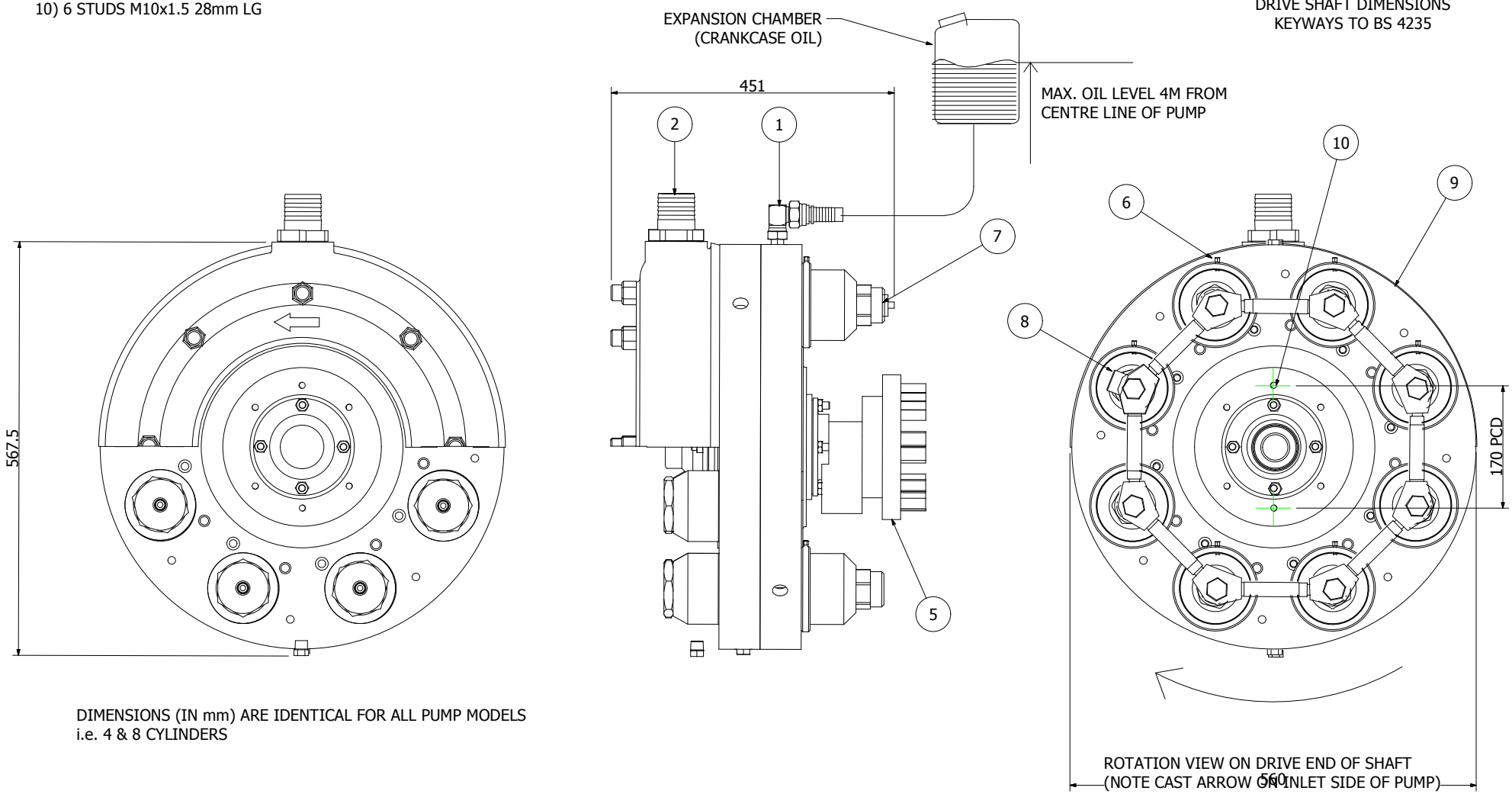
PUMP DIMENSIONS ARE SYMMETRICAL ABOUT CENTRE LINE
DIMENSIONS ARE IDENTICAL FOR ALL PUMPS

ADAPTORS ARE AVAILABLE FOR A RANGE OF ELECTRIC
MOTORS AND DIESEL ENGINES: CONSULT MANUFACTURER

NOTE: FOR CIRCUIT DIAGRAM SEE DRG D3
AFTER JULY 1982 2" BSP WATER INLET IS STANDARD
FOUR 1 1/4" BSP INLETS ON REQUEST



DRIVE SHAFT DIMENSIONS
KEYWAYS TO BS 4235



DIMENSIONS (IN mm) ARE IDENTICAL FOR ALL PUMP MODELS
i.e. 4 & 8 CYLINDERS

Fig 1.1 Harben Century Type High Pressure Pump

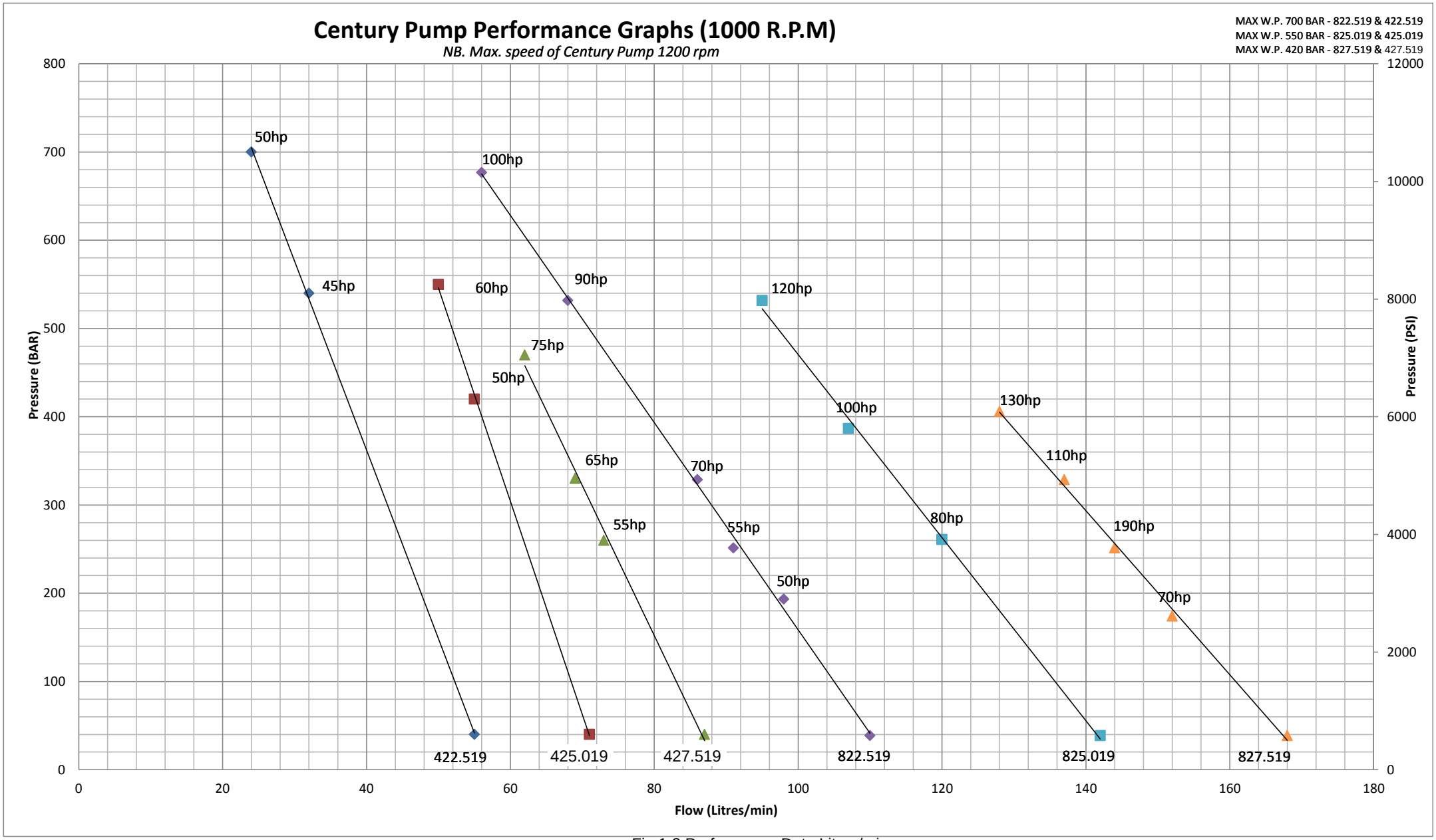


Fig 1.2 Performance Data Litres/min

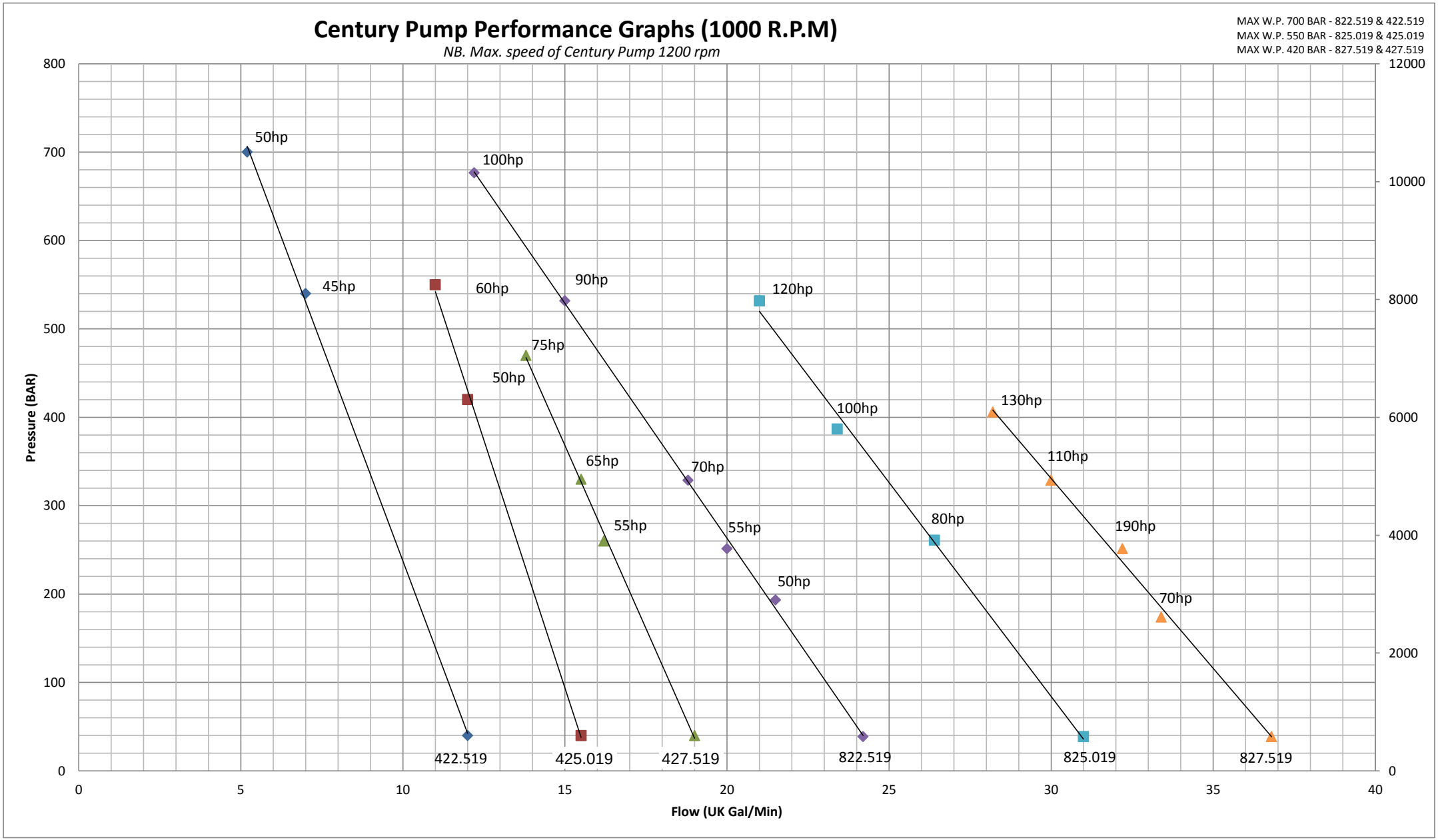


Fig. 1.3 Performance Data UK Gal/min

Pump Type_____ Pump Serial No(s)_____

Engine Type_____ Engine Serial No_____

Gearbox Type_____ Gearbox Serial No_____

Motor Frame / kW_____ Motor Serial No_____

Max. Working Pressure of Pump_____

Max. Flow at Above Pressure_____

Single Gun HV Jet Size_____

Single Gun 15 Deg. Fan Jet_____

Twin Gun HV Jet Size_____

Twin 15 Deg. Fan Jet Size_____

Twin Gun Choke Size_____

Type of Safety Gun Supplied_____

High Efficiency Drain jets

3Rear HE drain jet_____

6Rear HE drain jet_____

3Rear 1Forward HE drain Jet_____

Bomb/Ram Jet_____ HV_____ Fan_____

Turbo/Dia 38mm Screama Jet_____ Dia 16mm Screama Jet_____

Jet Leader_____

Plough Jet_____

Jet Pump_____ Type_____ Jet Sizes_____

Rotoblast_____

Hovervac_____

This pump unit and all the accessories listed above have been tested at:

_____BAR _____PSI

Section 2

Pump Installation

Section 2

Pump Installation

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2.1 INTRODUCTION

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 approval. Refer to Section 1 for technical data and a description of the pump. Section 1, Fig 1.1 should be referred to for further technical details and installation data.

The illustration given in Fig 2.1 Century Series pump.

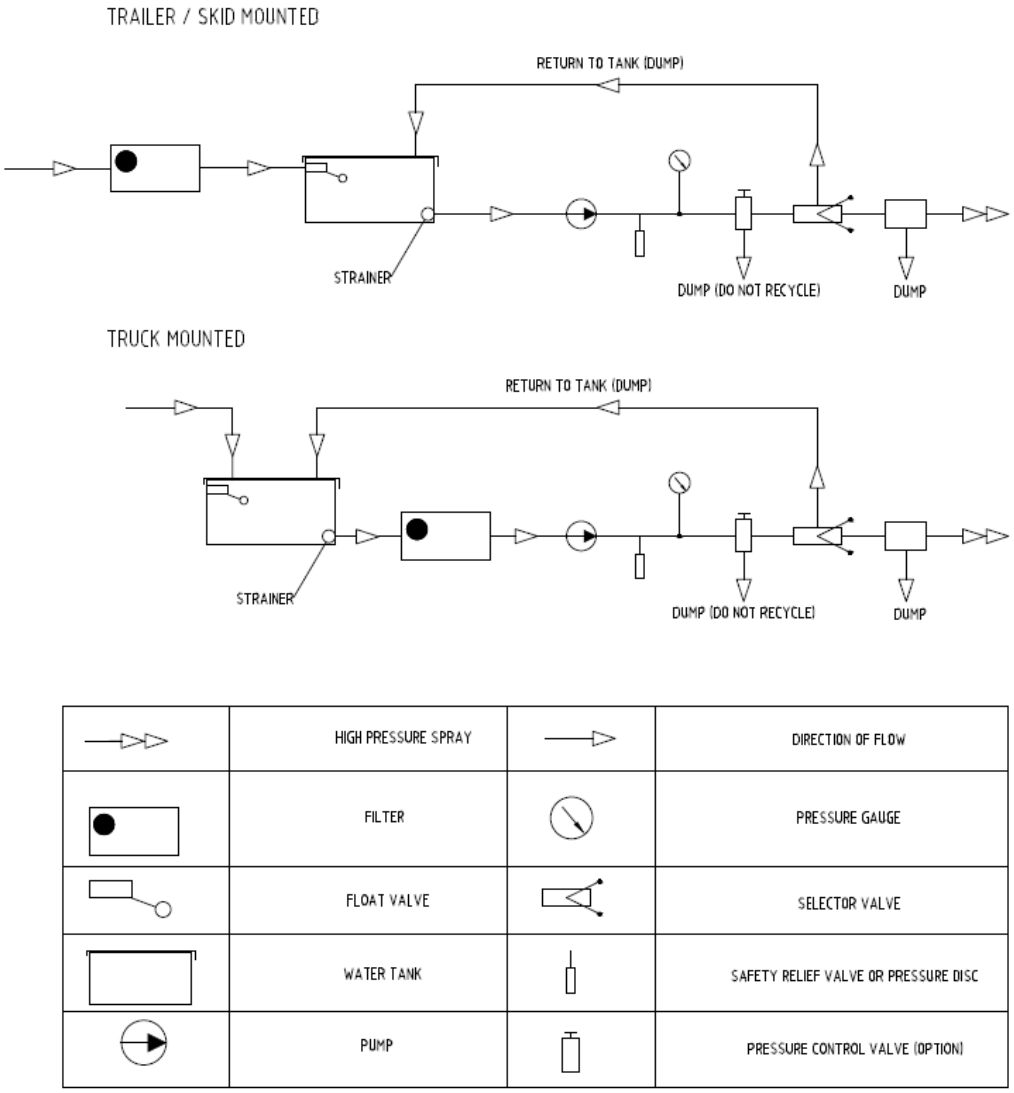

Fig 2.1 Pump Installation – Water Circuit Layout

2.2 PUMP MOUNTING

2.2.1 General Details

The Century Series pumps are designed for direct drive and flange mounting. The normal operating speed is 1000 rpm, nominal. Maximum operating speed is 1200 rpm. The pump must rotate anticlockwise, looking at the front of the pump ('arrow' cast into crank- case). 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.

The pump can be inclined between horizontal and 45 degrees (delivery end uppermost). If further inclination is required, between 45 degrees and vertical, Flowplant Group Ltd should be contacted at the address given in Section 1.

The weight of a pump with oil in the crankcase, drive coupling fitted and bell housing, depends on the number of cylinders fitted, as follows:

4 cyl - 160 kg
8 cyl - 205 kg

The engineer should ensure that all couplings are fitted with a 3 mm 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. Refer to Para 9 for further details of coupling arrangements.

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.

2.2.2 Pump Fitting

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. When Flender B200 couplings are used, sight/gauge holes are drilled in the bell housing for this purpose.

(b) It depends on the particular installation whether the pump head is removed to a workshop for maintenance, e.g. 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.

2.2.3 Coupling Arrangements

Arrangements are made on the pump for the incoming fluid to cool the crankcase oil. The use of standard diaphragm/barrel assemblies provides a choice of flows, depending upon the number of barrels fitted to a crankcase. The cylindrical form of these barrels is well suited to containing high pressures. Three piston diameters are available to suit a range of pressure up to 700 bar (10 000 psi).

For details of the prime mover/gearbox/pump coupling arrangements for diesel-driven and electrically-driven pumps, refer to Fig 2.2 and Tables 2.1 to 2.5.

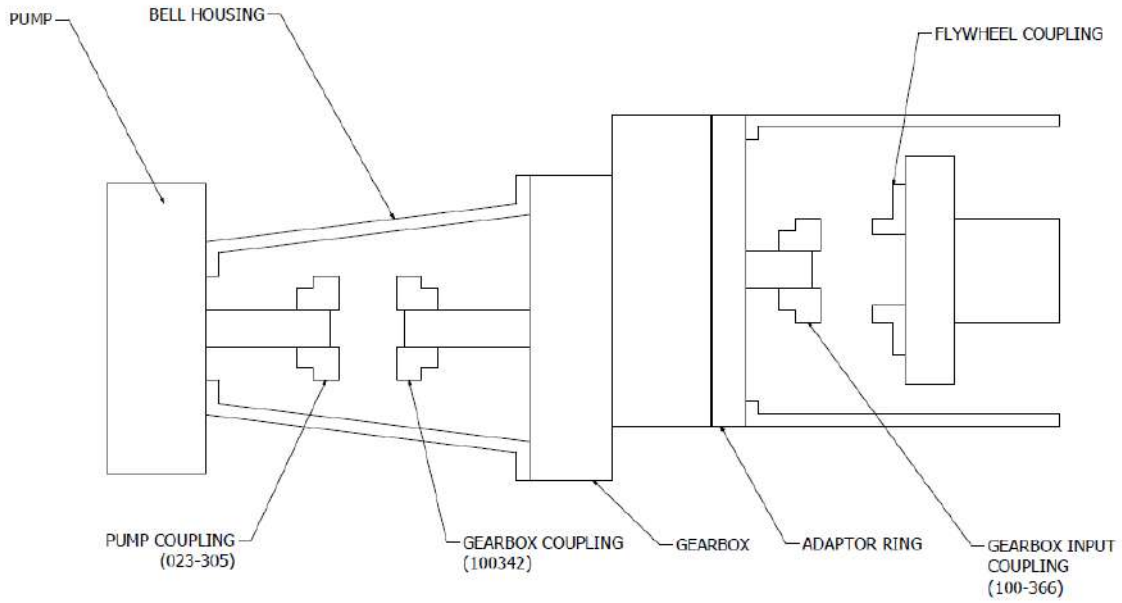

Fig 2.2 Pump Installation – Prime Movers/Gearbox/Pump Coupling Arrangements

TABLE 2.1 CENTURY GEARBOXES

PART NO	DESCRIPTION
105-119	2.7:1 Gearbox Bare Shaft Century
105-120	2.25:1 Gearbox Bare Shaft Century
105-121	2.0:1 Gearbox Bare Shaft Century
105-125	1.86:1 Gearbox Bare Shaft Century

TABLE 2.2 COUPLING FOR CENTURY GEARBOXES

PART NO	DESCRIPTION
100-342	Output Coupling B200 Pt 1, Flex Bore 57 mm, Key 16 mm
100-366	Input Coupling B180 Pt 1, Flex Bore 45 mm, Key 14 mm Perkins 1000 Series
023-594	Input Coupling M200 - Iveco 7000 Series

TABLE 2.3 FLYWHEEL COUPLINGS PERKINS/FORD

PART NO	DESCRIPTION
100-633	Coupling PT10 E180 CF - Perkins T6354.4/1006TG
100-367	Coupling PT10 E180 CF - Ford 2726T
023-593	Coupling PT10 E200 - Iveco 7675Si

TABLE 2.4 MOTOR HALF COUPLINGS FOR ELECTRIC MOTORS
(Metric Frame - Non-hazardous Types)

PART NO	DESCRIPTION
100-487	37 kW/50 HP Motor Coupling B200 Pt 1
100-487	45 KW/60 HP Motor Coupling B200 Pt 1
023-304	55 KW/75 HP Motor Coupling B200 Pt 1
023-304	75 KW/100 HP Motor Coupling B200 Pt 1
023-304	95 kW/125 HP Motor Coupling B200 Pt 1
023-304	111 kW/150 HP Motor Coupling B200 Pt 1

TABLE 2.5 BELL HOUSINGS

PART NO	DESCRIPTION
100-084	Diesel, Century Bell Housing
100-082	Bell Housing 37 kW - 111IkW, Electric
100-329	Adaptor Ring - must be used on 75 - 111kW electric motors
012-186	Adaptor Ring - must be used on diesel engines

2.3 INLET WATER

2.3.1 General

It is recommended that inlet water is filtered to 50 microns. Filtration to 150 microns is also possible. Refer to Flowplant Group for advice. Flowplant offer types of filter suitable for most applications.

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:

1) If water is filtered before the tank, then the tank must be sealed and vented to avoid contamination.
2) A pressure/flow check at the inlet to the pump is recommended. The maximum inlet water pressure for the pump is 0.5 bar (5.0 metre head) and the minimum recommended 0.05 bar (0.5 metre head).
3) Maximum recommended inlet water velocity 0.5 metres / second.
4) Recommended vortex stopper in tank outlet / pump inlet.
5) Flowplant recommend return line to be on opposite side of tank to tank outlet / pump inlet.
6) Flowplant recommend that tank should be of sufficient size so that at full flow, cannot be drained in under 4 minutes.

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.

Hose and pipe bores between the break water 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.

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.

(c) Refer to circuit layout for mounting angle of pump.

(d) If water inlet temperature is over 30°C, consult Flowplant.

Section 3

General Operating Information

Section 3

General Operating Information

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3.1 INTRODUCTION

This section gives general information on safety, protective clothing to be used by operators, and general starting and stopping procedures when the pump is incorporated in a machine. It should be remembered that the operating procedures given are to be used as a guide only, and the equipment handbook operating procedures should be used where applicable.

3.2 SAFETY CODE OF PRACTICE

BASIC RULES

1. **ALWAYS WEAR THE CORRECT PROTECTIVE CLOTHING.**
2. **ALWAYS ENSURE ALL EQUIPMENT IS IN A FIRST CLASS CONDITION.**
3. **NEVER WORK FROM A LADDER.**
4. **NEVER USE THE GUN WITH THE TRIGGER LOCKED ON.**

NEVER POINT THE GUN AT ANYONE, EVEN IF SWITCHED OFF.

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

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 water.

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

3.2.1 General

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

Barriers should be erected around the cleaning bay or where the work is being done 'in-situ', round the section of plant concerned. Access within 10 metres by persons other than the jetting team, is strictly prohibited.

A warning notice 'NO UNAUTHORISED ENTRY High Pressure Water Jetting in Progress' should be displayed on each side of the bay, or on the plant, where the work is to be done.

Each member of the team should be provided with suitable waterproof clothing, wellington boots with internal steel toe caps, safety helmet with visor and ear defenders, and gloves. Refer to Para 14 for details of protective clothing available.

Never attempt to change jets or accessories whilst the pump is operating, even if the flow control selector valve is in the recycle (dump) position.

3.2.2 Safety Gun

Never point the safety gun at anyone, even if it is switched off.

When using the 'dead-mans handle' safety gun, the required jet should befitted to the high pressure barrel (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.

Water jetting guns should be properly maintained and care should be taken not to damage the delicate components of the trigger mechanism.

3.2.3 Drain/Sewer

In addition to the protective clothing listed in Para 5(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).

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).

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.

In addition to 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.

3.2.4 Hoses

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.

Never loop the hose into an excessively tight radius, particularly adjacent to couplings.

When fitting re-usable couplings, always ensure that the current type of couplings are being used in relation to the hose specification.

3.2.5 Underwater Recoil-less Safety Gun

The Harben Underwater Recoil-less Safety Gun is designed for use under-water only. Extreme care should be taken to avoid rear-facing balance jets when testing the equipment above water.

If working in shallow water, where there is a possibility of the diver surfacing inadvertently during water blasting, care should be taken to ensure that the recoil balance jet protection tube is sufficiently long to prevent the diver directing it at himself.

3.2.6 Tube Cleaning

Where tube cleaning is to be done by means of a lance, the charge hand who 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 man, or men, controlling the lance, a clearly understood system of signals and instructions must be agreed upon.

A barrier should be placed at the far end of the tube being cleaned for protection against flying debris.

A shield fitted to the lance to protect the operator from debris ejected by backward pointing jets should be used for certain operations.

3.2.7 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.

3.2.8 Abrasive Injection Equipment

Because water/abrasive jetting can give rise to dangerous splash back, ensure all protective clothing, detailed in 3.2.1, is used. Some abrasives are known to produce residues which may be serious to health and should not be used for blasting, such as sand containing free silica.

3.2.9 Accidents

In the event of a person being 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/

Operators should carry a 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.

3.2.10 Protective Equipment

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

PART NO.	DESCRIPTION
061037	Waterproof Coverall Suit - size small
061025	Waterproof Coverall Suit - size medium
061026	Waterproof Coverall Suit - size large
061020	Waterproof Coverall Suit - size extra large
065076	Metatarsal Safety Boots – size 6
065061	Metatarsal Safety Boots – size 7
065060	Metatarsal Safety Boots – size 8
065057	Metatarsal Safety Boots – size 9
065058	Metatarsal Safety Boots – size 10
065066	Metatarsal Safety Boots – size 11
065065	Metatarsal Safety Boots – size 12
065062	Gauntlet Gloves
065013	Complete Helmet Set
061054	'No Unauthorized Entry – High Pressure Jetting In Progress' Safety Sign
061225	Operators Safety Guide
057062	Safety Code of Practice
061445	Code of Practice (Sewer Drain Jetting)
061259	Guide Do and Don't Booklet

3.3 GENERAL OPERATING INSTRUCTIONS

3.3.1 Introduction

The following operating instructions are of a general nature with reference being made to the appropriate manufacturer's handbook for the machine.

3.3.2 Starting

To start the unit, carry out the following instructions:

i. Prior to starting the unit, carry out the following pre-checks:

a) Set the high pressure selector to the recycle (dump) position.
b) Ensure the unit is on level ground.
c) Check that the water supply is connected and the header tank is full.
d) Check that all guns and nozzles are connected. Ensure correct fitting and correct size for the pressure required.

ii. 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 3.3.4, 3.3.5 respectively), familiarise yourself with the units controls and the stopping instructions (3.3.3).

iii. Move the selector to the High Pressure position.

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

3.3.3 Stopping

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

i. Reduce engine revs to tick-over speed.

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

iii. Switch off the prime mover by following the instructions given in the manufacturers and book for the engine/electric motor.

iv. If there is the risk of freezing, follow the instructions given the frost precautions (anti-freeze procedures, (3.3.6, 3.3.8).

v. 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.

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

3.3.4 To Oil Bleed the Pump

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 4, Table 4.2 for details of pump oil types and capacities.

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

ii. 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).

iii. 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.

iv. Repeat the procedure detailed in *iii.* for each barrel, starting from the lower barrels first.

v. 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.

vi. If the delivery line vibrates or the pump does not run smoothly, stop the unit and carry out a water bleed *(3.3.5)* and then repeat the oil bleed.

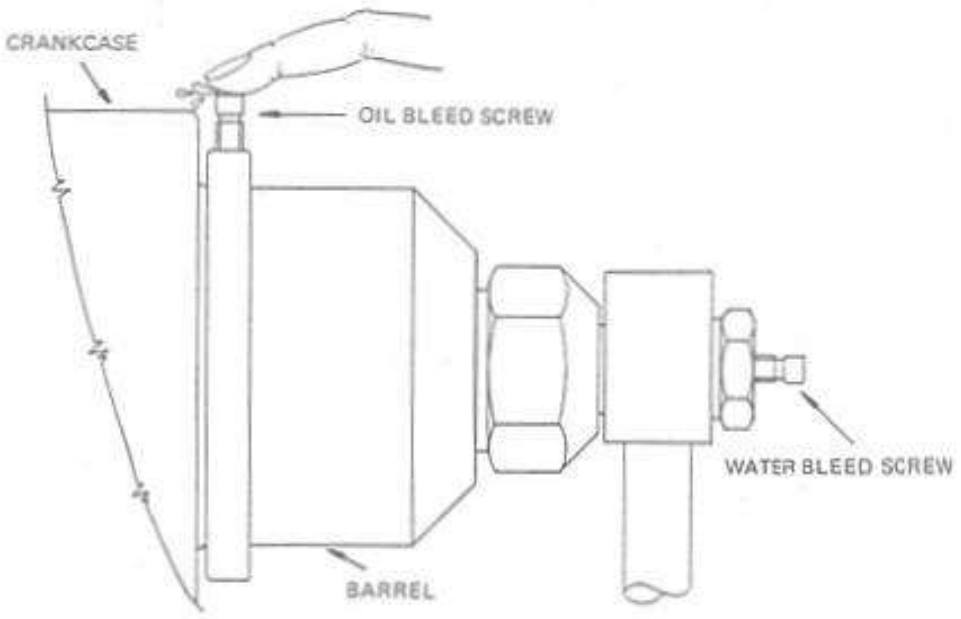

Fig 3.1 Bleeding the pump

3.3.5 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:

i. 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).

ii. 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 detailed in *i*. To identify the bleed nipples, refer to Fig 3.1.

iii. 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 detailed in i .

3.3.6 To Antifreeze a Unit Without an Antifreeze Tank

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

ii. Drain the water tanks.

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

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

v. Ensure the high pressure selector lever is in the dump (or off) position. Start the engine and allow to run for 1 minute.

vi. 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.

vii. Stop the engine. The unit is now anti-freezed.

3.3.7 To Remove Antifreeze from a Unit Without an Antifreeze Tank

Note: During this procedure, carry out the air bleed procedure detailed in Para 19, if necessary.

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

ii. Fill break tanks with water.

iii. Place the outlet of the high pressure hose into the container.

iv. Place the selector lever in the high pressure position, and whilst holding the high pressure hose, start the engine.

v. 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.

3.3.8 To Antifreeze a Unit with an Antifreeze Tank Fitted

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

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

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

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

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

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

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

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

3.3.9 To Remove Antifreeze from a Unit with an Antifreeze Tank Fitted

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

ii. Fill the water tanks.

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

iv. Place the selector lever in the high pressure position.

v. 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.

3.4 FAULT FINDING

3.4.1 General

It is essential when fault finding on the pump that due regard is taken of the likely equipment faults. Therefore Table 3.1 includes likely equipment faults, whilst Table 3.2 gives likely pump faults. For details of engine faults refer to the appropriate manufacturer's handbook. When investigating a pump diaphragm for possible failure, refer to Fig 3.2.

TABLE 3.1 EQUIPMENT FAULT FINDING

Problem	Cause	Action
Low System Pressure	1. Worn or incorrect size of cutting nozzle.	Replace nozzle.
	2. Engine speed slow.	Adjust to correct speed.
	3. Leaks from hose,pipes and connections.	Check connections for tightness. Replace as necessary.
	4. Blocked inlet filter.	Clean or replace element.
	5. Inlet hose too long.	Shorten hose length.
	6. Loss of water through dump line of selector valve or gun when high pressure selected.	Check seats and seals.
	7. Loss of water through dump line of remote control kit, if fitted.	Check seats and seals.
High System Pressure	1. Blocked nozzle, selector valve or gun.	Clean nozzle, selector valve or gun and flush out delivery line.
	2. Nozzle size too small.	Replace nozzle.
	3. Hose bore size too small.	Replace hose.
	4. Engine speed high.	Adjust to correct speed.
	5. Crushed delivery hose.	Replace if necessary.
	6. Two gun choke left in gun when operating as single gun unit.	Replace with STD choke.

Problem	Cause	Action
Low Water Level	1. Blocked or dirty pre-filters.	Clean or replace elements.
	2. Faulty ball valve assembly.	Replace if necessary.
	3. Wrong seat in float valve assembly.	Replace if necessary.
	4. Low inlet pressure.	Increase pressure.
Pump Not Running Evenly (also refer to Pump faults).	1. Air in water.	Water bleed pump (Para 19).
	2. Air in crankcase oil.	Oil bleed pump (Para 18).
	3. Worn Coupling.	Replace flexible elements and examine coupling.
	4. Faulty inlet or delivery valve.	Check valve condition.
	5. Diaphragm protection valve.	Re-seat protection valve and check delivery valves for ware/damage
Burst Disc Failure or Safety Relief Valve Operating (also refer to high system pressure problem).	1. Incorrect burst disc.	Replace with correct disc.
	2. Incorrect valve setting.	Check certificate/setting.
	3. Faulty valve.	Repair or replace, as necessary.
	4. Faulty or fatigued burst disc.	Replace with new disc.

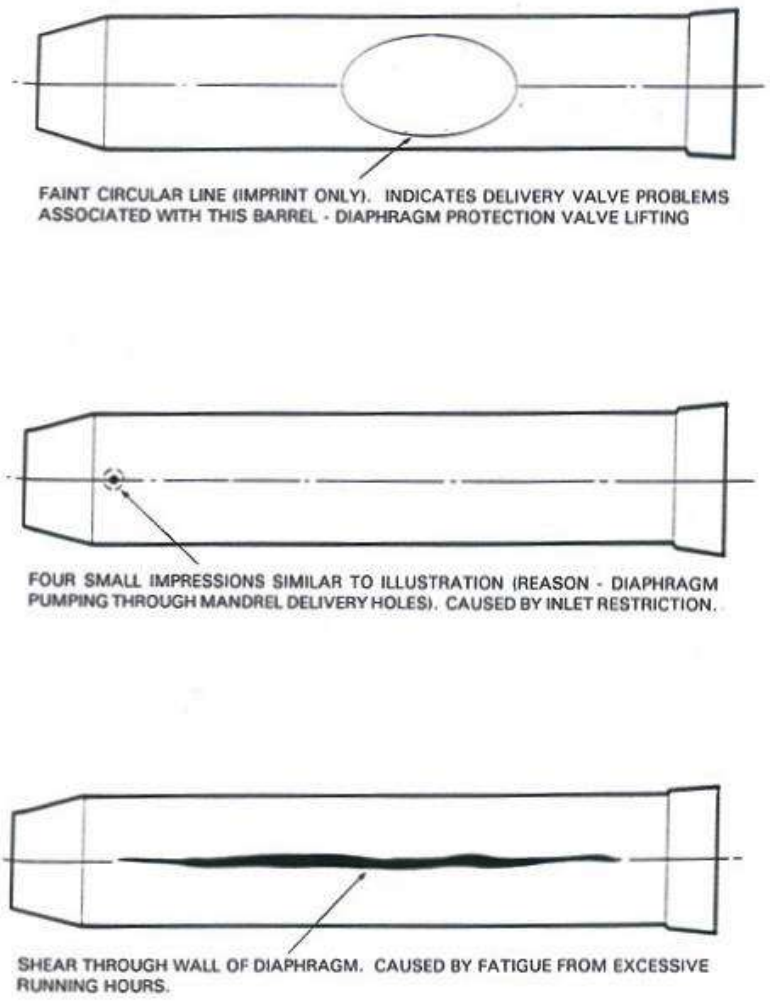

Fig 3.2 Pump Fault Finding – Diaphragm Failure and Indication of Other Problems

Section 4

Pump Maintenance and Overhaul Procedures

Section 4

Pump Maintenance & Overhaul Procedures

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4.1 ROUTINE MAINTENANCE

4.1.1 Introduction

The Maintenance Schedule (Table 4.1) gives details of pump maintenance only. For details of equipment maintenance, refer to the appropriate handbook. Details of pump oil capacities and recommended oil types are given in the Lubrication Chart (Table 4.2). Refer to the manufacturer's handbook for diesel engine oil.

Whilst specific periods for routine (preventive) maintenance of the pump are given, due regard should be taken of local regulations concerning the vehicle or machine. Ensure the machine is operating within those regulations.

TABLE 4.1 PUMP MAINTENANCE SCHEDULE

CHECKLIST	TO USE/DAILY/AFTER 8 HOURS RUNNING
Crankcase oil	Check for level, fill if necessary (refer to Section 3, Para 18(1) for procedure and Table 4. 2 for oil types).
Pipes, hoses and fittings	Check wear, damage, correct rating and size.
Pump working pressure	Check correct.
General	Check pump for smooth running, overheating, leaks, and security of components.
	SIX MONTHLY/300 HOURS
Inlet/delivery valves	Check for wear and damage. Torque inlet nuts to 6001bft/82.9kgm/814Nm at 250 hours
Diaphragms	Check for wear and damage.
	YEARLY/500 HOURS
Crankcase oil	Drain and renew.
Inlet/delivery valves	Check for wear and damage.
Pipes, hoses and fittings	Carry out detailed inspection
	TWO YEARLY/1000 HOURS
Inlet/delivery valves	Replace
Diaphragms	Replace

TABLE 4.2 PUMP LUBRICATION CHART

Manufacturer	Type
ESSO	Nuto H150
GULF	LP 150
MOBIL	DTE Extra Heavy
ROC	Kiron 150
TEXACO	Rando HD 150
BP	Energol HLP 150
AGIP	OSO 105
SHELL	Tellus 150
CENTURY OIL	PWLM
PETROFINA	Hydran 51
CASTROL	Hyspin AWS 150

Oil Capacity (litres)	
Number of Cylinders	
4-cyl	8-cyl
13.0	11.0

4.2 PUMP SERVICE INFORMATION

4.2.1 General

The following paragraphs give details of recommended service tools, torque settings, and service kits to be used when carrying out pump overhaul procedures.

4.2.2 Recommended Service Tools

The following tools should be available when servicing the pump:

Description	Part No.	Description	Part No.
Repair stand	100-279	Hammerlump,2 kg	206-010
Driftmandrel,	201-043	Spanner, adjustable, 6"	202-304
Separatormandrel,	201-082	Spanner, adjustable, 12"	202-302
Driftinlet valve guide,	201-044	Spanner, adjustable, 15"	202-301
Dolly, mandrel into diaphragm	201-012	Spanner, combination, 4 BA	202-150
Driftvalve removal,	061-045	Spanner, slogging, 50 mm	202-264
Puller coupling and C balance	201-081	Spanner, slogging, 70 mm	202-266
Dolly, bearing crankcase	201-011	Spanner, open ended, 13 mm x 17 mm	202-010
Dollyeccentric,	201-001	Spanner, open ended, 9/16" whit. x 5/8" whit.	202-048
Dollyoil seal in,	201-003	Spanner, plate, 61.3mm AF	201-151
Dollyoil seal out,	201-004	Socket, 3/4" square drive, 70 mm	203-283
Dollyseal stretcher	201-061	Socket, 3/4" square drive, 50 mm	203-282
Dollyseal pusher,	201-065	Socket, 1/2" square drive, 17 mm	203-170
Dollyseal shrinker,	201-066	Socket, 1/2" square drive, 27 mm	203-180
Press (small)	201-083	Socket, 1/2" square drive, 1116"	203-129
Wrench, hex 1/2" square drive, 8 x 100 mm	203-230	Socket, 1/2" square drive, 5/16"	203-204
Plierslong nose, 5",	205-021	Socket, converter, 1/2" F to 3/4" M	203-252
Torque wrench, Norbar No. 4	203-257	Socket, reversible ratchet, 1/2" square drive	203-242
Screwdriver,flat blade,10"	206-201	Socket, extension bar 250 mm, 1/2" square drive	203-247
Hammer, nylon. 1 3/4" dia.	206-001		

4.2.3 Torque Settings

The torque settings for selected components are:

	Drg Item No*	lbft	kgm	Nm
Inlet nut	43	600	82.9	814
Shaft bolt	92	100	13.8	135
Cylinder	25	500	69.1	680
Banjo bolt	57 and 58	120	16.6	160
Delivery nut	49 and 51	250	34.5	340
Banjo nut	107 and 106	200	27.6	270

*Refer to *4.3.1* and the drawings in this section to locate Item Number.

4.2.4 Service Kits

Service/overhaul kits are available when carrying out repair or overhaul of the pump. Details of kits for the Century type pumps/accessories are as follows:

Description	**Part No.**
Kit Overhaul, Valve and Diaphragm, 4 cyl Mk 4 Century	024-032
Kit Overhaul, Valve and Diaphragm, 8 cyl Mk 4 Century	024-033
Kit Seal, Mk 2 Century Selector	024-021
Kit Overhaul, Mk 2 Century Selector	024-022
Kit Overhaul, Mk 1Safety Relief Valve	024-023
Kit Overhaul, Mk 2 Safety Relief Valve	024-044
Kit Seal, Mk 9B Gun and FCV	024-035
Kit Overhaul, Mk 9B Gun and FCV	024-036
Kit Seal, Century Trigger Assembly	024-047
Kit Overhaul, Century Trigger Assembly	024-048
Kit Overhaul, High Speed Rotary Joint	024-030
Kit Seal, High Speed Rotary Joint	024-031
Kit Overhaul, Multi-selector	024-042

4.3 PUMP OVERHALL PROCEDURES

4.3.1 Introduction

During the pump overhaul procedures, reference should be made to the pump component and assembly drawings (Figs 4.1 to 4.6), which include associated parts lists, Also included are assembly drawings of the Mk 2 selector and safety relief valve (Figs 4.7 and 4.8).

In the following overhaul procedures, the item number that follows the description of a part refers to the assembly drawings (Figs 4.1 and 4.3 to 4.6).

4.3.2 Removal and Replacement of Pump Head

Note: Refer to 4.3.1 for drawing information.

Carry out a removal and replacement of the Pump Head, as follows:

i. Switch off and isolate the prime mover.

ii. Switch off or disconnect the water mains supply to the tank.

iii. Drain the water tank.

iv. Disconnect the water inlet hose to the pump.

v. Disconnect the small bleed hose at the top of the Inlet Manifold, if fitted.

vi. Disconnect the high pressure hose from the Delivery Manifold.

vii. Drain water from the Inlet Manifold.

viii. Disconnect the hose snap coupling from the top of the Crankcase to Oil Expansion Bottle.

ix. Remove the hose from the top of the Crankcase, and replace with a Lifting Eye (114).

x. Connect lifting tackle to the Lifting Eye. Do not take the weight of the pump, leave only slack cable.

xi. Remove the bolts from the bell housing, and pull off pump and bell housing.
Note: If an adaptor ring is fitted, it is usually best to leave it attached to the prime mover.

xii. Before replacing the pump, check the drive coupling stand-off distance.

xiii. Replace the pump, generally reversing the removal procedure.
Note: before operating the pump, it may be necessary to bleed the pump of air.

xiv. If the pump fitted is new or has been overhauled, carry out the running in procedure detailed from *4.3.7.*

4.3.3 Removal and Inspection of Delivery Valves – 4 Cylinder Pumps

Notes: *Oil need not be drained.*
Refer to 4.3.1 for drawing information.

Carry out removal and inspection of Delivery Valves, as follows:

i. Unscrew and remove the four Nuts (107 - not shown on drawings).Lift off Washers (91 - not shown on drawings).

ii. Delivery Tubes (19 - not shown on drawings) and Banjos (22 and 23) can now be pulled off.

iii. Unscrew and remove Delivery Nut (51) containing the Valve Assembly.

iv. Insert a flat blade screwdriver into the radial groove of Delivery Seat (45) and levering gently around, ease Seat from Delivery Nut (51)

v. Remove the Guide (48) and Ball (47) from Delivery Nut (51).

vi. Inspect the Ball (47) and Seat (45). If either is badly pitted, chipped or unevenly worn, it must be replaced.

vii. Inspect bore of Guide (48). Replace item if it is badly pitted, chipped or unevenly worn.

viii. Fit the Seat (45) into the Delivery Nut (51) using a small hand press. If a hand press is not available, tap the Seat in with a nylon mallet, making sure that it is tapped in squarely and no nylon from the mallet head goes into the Valve Assembly through the Seat hole.

ix. Grease the threads of the Delivery Nut (51) before assembly.

x. Re-fit the Valve Assembly to the unit reversing the removal procedure given in Sub-paras (4) to (1), in that order.

Note: Where possible, use a socket and torque wrench and torque the Delivery and Banjo Nuts to that specified in 4.2.3.

4.3.4 Removal and Inspection of Delivery Valves – 8 Cylinder Pumps

Notes: *Oil need not be drained.*
Refer to 4.3.1 for drawing information.

Carry out removal and inspection of Delivery Valves, as follows:

i. Unscrew and remove the Banjo Bolts (57 and 58) with Bonded Seal (65).

ii. Pull off Delivery Tubes (18) and Banjos (20 and 21). Recover the Bonded Seals (65) from between the Banjos and delivery Nuts.
NOTE Delivery Tubes are shown on Fig 1.1 (Section 1) linking each of the Barrels, via the Banjos.

iii. Unscrew and remove Delivery Nut (51) containing the Valve Assembly.

iv. Place a nylon drift (part no 061-045) through the female threaded end of the Delivery Nut until it touches the bottom of Guide (48), Tap the end of the Drift gently until the Guide pushes the Seat (45) out from the recess in the Delivery Nut

Note: If difficulty is experienced and the Valve Assembly is not completely removed, use a flat blade screwdriver in the radial groove of the Delivery Seat (45) and gently ease the Seat from the Delivery Nut. Guide (48) and Ball (47) can now be removed.

v. Inspect the Ball (47) and Seat (45). If either is badly pitted, chipped or unevenly worn, it must be replaced.

vi. Inspect bore of Guide (48). Replace item if it is badly pitted, chipped or unevenly worn.

vii. Fit the Seat (45) into the Delivery Nut (51) using a small hand press. If a hand press is not available, tap the Seat in with a nylon mallet, making sure that it is tapped in squarely and no nylon from the mallet head goes into the Valve Assembly through the Seat hole.

viii. Grease the threads of the Banjo Bolts (57 and 58) and Delivery Nut (49) before re-assembly.

ix. Re-fit the Valve Assembly to the unit reversing the removal procedure given in Sub-paras iii to i in that order.

Note: Where possible, use a socket and torque wrench and torque the Delivery and Banjo Nuts to that specified in 4.2.3.

4.3.5 Removal and Inspection of Delivery Valves – 8 Cylinder Pumps with Split Delivery Manifold

Notes: *Oil need not be drained.*
Refer to 4.3.1 for drawing information.

Carry out removal and inspection of Delivery Valves, as follows:

i. Unscrew and remove the four Nuts (106 - not shown on drawings).

ii. Lift off Washers (90 - not shown on drawings)

iii. Delivery Tubes (19 - not shown on drawings) and Banjos (22 and 23) can now be pulled off.

iv. Unscrew and remove the four Nuts (107 - not shown on drawings).

v. Lift off Washers (91- not shown on drawings).

vi. The second set of Delivery Tubes and Banjos can now be pulled off.

vii. Unscrew and remove Delivery Nuts (50 and 51) containing the Valve Assembly.

viii. Insert a flat blade screwdriver into the radial groove of Delivery Seat (45) and levering gently around, ease Seat from Delivery Nut (50 and 51)

ix. Remove the Guide (48) and Ball (47) from Delivery Nut (50 and 51).

x. Inspect the Ball (47) and Seat (45). If either is badly pitted, chipped or unevenly worn, it must be replaced.

xi. Inspect bore of Guide (48). Replace item if it is badly pitted, chipped or unevenly worn.

xii. Fit the Seat (45) into the Delivery Nut (50 and 51) using a small hand press. If a hand press is not available, tap the Seat in with a nylon mallet, making sure that it is tapped in squarely and no nylon from the mallet head goes into the Valve Assembly through the Seat hole.

xiii. Grease the threads of the Delivery Nuts (50 and 51) before assembly.

xiv. Re-fit the Valve Assembly to the unit reversing the removal procedure given in Sub-paras (7) to (1), in that order.

Note: Where possible, use a socket and torque wrench and torque the Delivery and Banjo Nuts to that specified in 4.2.3.

4.3.6 Removal and Inspection of Inlet Valve Assembly and Diaphragm

Notes: It is reccomended that oil is drained from the pump before commencing the following procedure.
Refer to 4.3.1 for drawing information.

The initial dismantling procedure depends upon the type of pump, as follows:

i. If 4-cylinder pump, carry out the procedure detailed in *4.3.3, i to iv*.

ii. If 8-cylinder pump, carry out the procedure detailed in *4.3.4, i to iii.*

iii. If 8-cylinder pump with split delivery manifold, carry out the procedure detailed in *4.3.5, i to vii.*

With the appropriate initial dismantling procedure completed, carry out removal and inspection of the Inlet Valve Assembly and Diaphragm, as follows:

i. Unscrew and remove Nuts (105).

ii. Pull the Inlet Manifold (16) off its Studs (101).

iii. Unscrew Inlet Nuts (43) using a 70 mm slogging spanner (part no 202-266), taking care not to damage Studs (101).

iv. Insert a Drift (part no 201-043) into the end of the Mandrel, from delivery end. Tap the end of the Drift to remove Collar (42), Inlet Seat (41), Spring (36), Valve 40, Mandrel Assembly (38) and Diaphragm (37) from the inlet end of the Barrel.

v. Pull the Inlet Seat (41) from the Mandrel Assembly (38). Remove Valve (40) and Spring (36).

vi. Using Extractor (part no 201-082), remove Diaphragm (37) from Mandrel Assembly (38). Inspect the Diaphragm for splits or holes, replace if necessary.

vii. Inspect Spring (36), replace if necessary.

viii. Inspect the seating faces of the Valve (40) and Seat (41). If either is badly pitted, chipped or unevenly worn, it must be replaced.

ix. Inspect the bore of Bush (114).. It should be noted that if the bore is worn it will prevent Valve (40) from shutting smoothly and squarely onto the Seat(41) and must be replaced if necessary. The procedure for replacing the Bush is as follows:

a. Remove the Pin (115).

b. Screw an M12 tap into the Bush (114) until it bottoms.

c. Hold end of tap in a vice and gently tap the face of Mandrel (116) with a nylon mallet, until the Bush is removed.

d. Carefully press a new Bush into the Mandrel using a drift (part no 201-044).

e. Using a 1.9 mm diameter bit, drill through 6 holes in Mandrel through wall of Bush (see Fig 4.1 - holes A).

f. Using a 1.9 mm diameter bit, drill through hole in Mandrel, right through Bush (see Fig 4.1 - holes B).

g. Using a flat punch, refit Pin (115) through Mandrel and Bush.

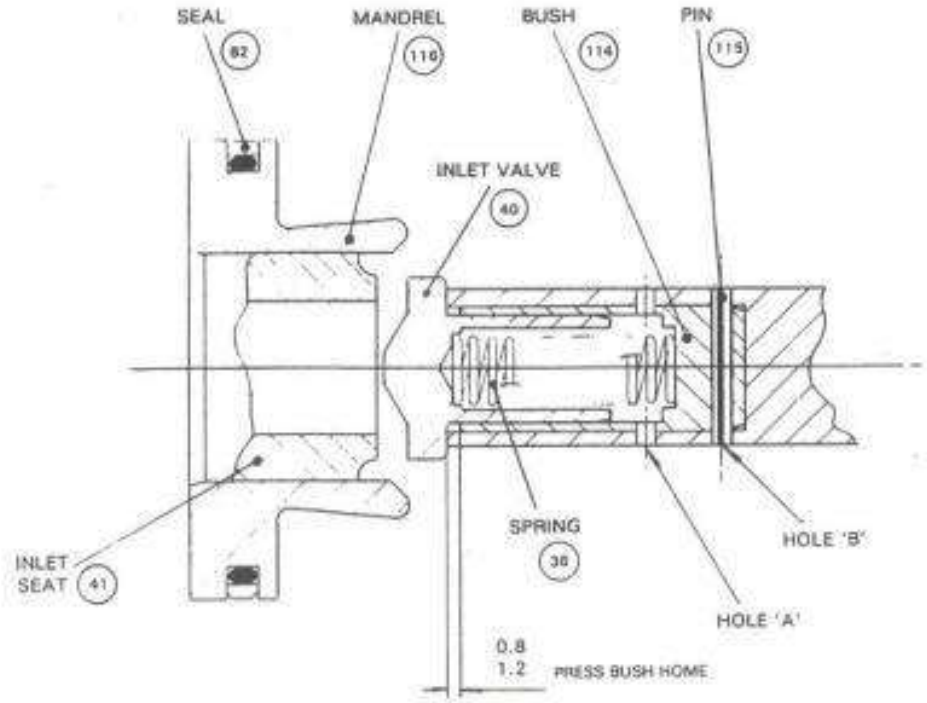


Fig 4.1 Mandrel Assembly

x. To assemble Mandrel assembly (38) and Diaphragm (37), smear a light film of pump oil along the lobes of the Mandrel then push it into the Diaphragm, ensuring there is no gap between Mandrel and Diaphragm at inlet end.

Note: It may be easier to hold the Diaphragm with the Mandrel almost pushed home in one hand, and hit the flat face of a nylon dolly (part no 201-012) with a nylon mallet.

xi. Inspect Seal (82 - Fig 4.1). If it is damaged, replace as follows:

a. Remove and discard old Seal.

b. Insert Dolly (part no 201-061) into the end of the Mandrel.

c. Fit '0' ring part of Seal into the groove of the Mandrel.

d. Push the hard plastic part of Seal over the Dolly, using Pusher (part no 201-065), and locate it in the groove on top of the '0' ring part of the Seal.

e. Using Shrinker (part no 201-066), shrink the Seal enough to fit into the Barrel without damage.

xii. Place Valve (40) and Spring (36) into Bush (114).

xiii. With reference to Fig 4.2, fit Back Up Ring (78) and '0' ring (76) to Seat (41), and grease both. Ensure Back Up Ring is fitted as shown.

xiv. Push and turn Seat (41) anti-clockwise into the Mandrel Assembly

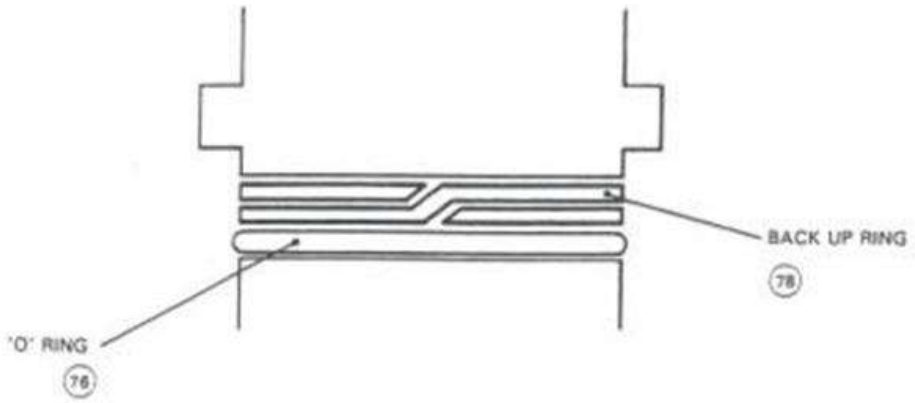


Fig 4.2 Inlet Valve Seat – Back Up Ring and 'O' Ring Fitting

xv. Grease (part no 054-041) the Seal (82), including the seal locating position in the Barrel (83), and push the complete assembly into the Barrel from the inlet end, as far as it will go by hand.

xvi. Grease both faces of the Collar (42) and fit it over the end of the Mandrel (116) and Seat (41).

xvii. Grease the Inlet Nut (43) threads and screw it into the Barrel. Torque the Inlet Nut to that specified in *4.2.3*.

xviii. Apply a thin even coat of grease over the end of the Barrel, which protrudes into the Inlet Manifold.

xix. Check '0' rings (68 and 69) are not damaged and are in place.

xx. Locate the Inlet Manifold (16) on to Studs (101) and fit Nuts (105) and Washers (85).

xxi. Fill the pump with oil (see Table 4.2 for oil types), and bleed each individual cylinder using Bleed Screws (93).

xxii. Depending upon the type of pump, carry out a reversal of the initial dismantling procedure detailed in *4.3.6.*

xxiii. The pump may now require further oil bleeding in accordance with the procedure detailed in Section *3.3.4.*

4.3.7 Separating Crankcase Halves

To inspect/overhaul components within the Crankcase, the two halves of the Crankcase have to be separated. Although this operation can be achieved on the power unit, it is recommended that the pump is removed from the unit and placed in a Century Pump Stand (part no 100-279).

Separate the Crankcase halves as follows:

Note: Refer to 4.3.1 for drawing information.

i. Remove the pump as detailed in *4.3.2* (removal and replacement of pump head).

ii. Unscrew the Capscrew (102). If necessary hold the Coupling (5) to stop the Shaft (17) rotating.

iii. Lift the Cap (56) out of the recess in the end of the Coupling (5).

iv. Remove Coupling (5) and Counter Balance (4) from the Shaft (17). This operation is made easier using a Puller (part no 201-081).

v. Unscrew and remove Nuts (86) and Washers (103).

vi. Remove the Bell Housing (84).

vii. Remove Key (30) from the Shaft (17).

viii. Place the pump in the repair stand.

ix. Drain the oil from the pump into a suitable container.

x. Depending on the type of pump, carry out one of the following operations:

a. If unit contains a 4-cylinder pump, carry out the procedure detailed in *4.3.3. I to iii*.

b. If unit contains an 8-cylinder pump, carry out the procedure detailed in *4.3.4 I to iii.*

c. If unit contains an 8-cylinder pump with split delivery manifold, carry out the procedure detailed in *4.3.5 I to vi.*

xi. Unscrew and remove Nuts (105).

xii. Pull Inlet Manifold (16) off of Studs (101).

Note: Depending on the nature of the repair or investigation, either complete the appropriate operation for the pump detailed in 4.3.3, .4 or .5, or continue this procedure from 4.3.7 xiii.

xiii. Unscrew and remove the Bleed Screws (93) and pull the Bleed Ring (44) off the Barrel.

xiv. Unscrew Barrel retaining Capscrew (95) one complete turn only.

Notes: (1) Only Capscrews adjacent to Barrels need be undone
(2) If a 4-cylinder pump, do not unscrew Capscrew (95).

xv. Unscrew and remove eight Nuts (111, 121) and Washers (103) from Bolt (99).

xvi. At the delivery side of the pump, unscrew Bolts (99) until end of Bolt is flush with the Inlet Crankcase (2).

xvii. Using a nylon mallet, tap the heads of Bolts (99), gently making the Inlet Crankcase (2) separate from the Delivery Crankcase (3). Ensure the Crankcase halves separate evenly. When the halves have almost separated, it may be necessary to unscrew Bolts (99) a couple more turns and tap them again to completely disengage the halves.

CAUTION
DO NOT UNSCREW BOLTS (99) MORE THAN IS NECESSARY. IF TOO FEW THREADS ARE BEING USED IN THE INLET CRANKCASE, THREADS MAY BE STRIPPED WHEN THE BOLTS ARE TAPPED.

xviii. When halves are apart, unscrew and remove Bolts (99).

xix. Lift Inlet Crankcase Remove Spacer Tube Assemblies (112).

xx. Remove spacer tube assemblies (112).

xxi. The pump is now prepared for Crankcase component repair or replacement.

4.3.8 Renewing Crankcase Components

Once the crankcase has been opened (Para 16) the following major repairs/replacements can be carried out:

a) Change Float Bearing (13) – *4.3.8.1*

b) Change Bearing (12) – *4.3.8.2*

c) Change Cylinder (25), Piston (26) and Slipper (27) – *4.3.8.3*

d) Change Bearing (11) – *4.3.8.4*

e) Change Oil Seal (81) – *4.3.8.5*

Note:The following procedures must be carried out sequentially. On completion of repairs/replacement of pump components, the pump should be re-assembled using the procedure detailed in Para 23.

4.3.8.1 Change float bearing (13)

i. Remove Nuts (86) and Washers (103) to remove Bearing Retainer (9).

ii. Using a press, remove the Float Bearing (13). The Bearing may be pressed out from either side.

iii. Fit a new Bearing (13). The Bearing may be pressed in from either side, but the Circlip in the Bearing must face the inside of the Crankcase.

Note: When fitting the Bearing (13), only press on to the outside race and not the inner race. Dolly(part no 201-011) is available for this purpose.

iv. Press in the Bearing so that 3 mm protrudes through the outside of the Crankcase.

v. Refit Bearing Retainer (9).

vi. Press Bearing fully home so that it locates up against the 'stop' in the Bearing Retainer (9).

4.3.8.2 Change Bearing (12)

i. Unscrew and remove the Shaft Bolt (92) and Washer (88).

ii. Slide Sleeve (7) off the Shaft (17).

iii. Remove Disc Springs (59), noting which way they were stacked and the quantity.

iv. Using circlip pliers, remove Circlip (54) from the groove in Bearing (11).

v. Lift off the Retaining Ring (28).

vi. Noting the position of each Barrel before removal, and dealing with one barrel at a time, unscrew the previously loosened Capscrew (95).

vii. Lift the Barrel (83) out of the Delivery Crankcase, gently tapping with a nylon mallet, if required. Take particular care that the Piston and Slipper Assembly (26 and 27) are not damaged as the Slipper is disengaged from the bottom of the Retaining Ring (28).

viii. Repeat the procedure detailed in sub-paras (6) and (7) for the remaining Cylinders.

ix. Lift off the Retaining Ring (28) and remove the Circlip (54) from the Bearing groove.

x. Pull vertically on the Bearing (11) and it and the Eccentric (6) will slide off the Shaft (17).

xi. Remove Key (29) from the Shaft keyway.

xii. Lift the Delivery Crankcase vertically. If the Drive End Sleeve stays in the Bearing (12), push it out from the inside.

xiii. Unscrew and remove four Nuts (86) and Washers (103). Remove Oil Seal Carrier (10) and '0' ring (71).

xiv. Remove both Circlips and press the Bearing (12) out either way, being careful of the Setscrews ((97 and 98).

xv. Fit new Bearing (12), by fitting Circlip into Bearing groove and pressing from either side of the Crankcase until the Circlip rests against the Crankcase. A Dolly (part no 201-011) is available for this purpose.

Note: When fitting the Bearing, only press on the outer race and not the inner race.

xvi. Put the other Circlip (55) into the Bearing groove.

4.3.8.3 Change Cylinder (25), Piston (26) and Slipper (27)

i. Unscrew and remove Screw (100). Plug (39) may come out with the Screw or when the Cylinder is removed.

ii. Unscrew and remove the Cylinder (25).

Note: Although the previous operation is all that is necessary to change a Cylinder, it is well worth removing the Spring (35) and the Diaphragm Protection Valve (33) and cleaning them thoroughly. Always keep the Valve components in matched pairs at all times.

iii. Inspect the Seal (73) in Seat (34) and replace if necessary, and fit '0' ring (74) into greased groove.

iv. Gently push Valve (33) into Seat (34), taking care not to damage Seal (73) and ensuring the Valve touches down onto the Seat. Place complete assembly into the Barrel.

v. Place Spring (35) into the Valve.

vi. Fit '0' ring (74) in the greased groove of the Cylinder and place on top of the Spring (35).

vii. Screw Cylinder (25) down. Torque the Cylinder to that specified in Para 5.

viii. Insert Plug (39) and lock with Screw (100).

4.3.8.4 Change Bearing (11)

i. Using a press, move the Eccentric out of the Bearing (11), Ensuring that the lip on the Eccentric is furthest away from the press ram.

ii. Fit new Bearing (11).

4.3.8.5 Change Oil Seal

i. Remove old Oil Seal (81).

ii. Fit new Oil Seal (81), ensuring that the flat side of the Oil Seal is facing the outside of the pump, and taking care not to damage the lip of the Seal.

4.3.9 Re-Assemble Pump

After carrying out any repair/replacement procedures, re-assemble the pump as follows:

i. Place the Shaft (17) into the repair stand, ensuring that '0' ring (72) is fitted, and in good condition.

ii. Assemble Delivery Crankcase (3) with Oil Seal (81) and Carrier (10), and with '0' ring (71) fitted so that the inner race of the Bearing (12) is supported. Then, from the outside, slide the Sleeve (8) through the Bearing (widest diameter on the outside).

iii. Lubricate '0' ring (72) with pump oil to avoid damage. Slide the Crankcase, with Sleeve fitted, over the Shaft.

iv. Place Key (29) in the Shaft keyway.

v. Slide Bearing (11), with Eccentric (6) pressed in, over the Shaft until it rests on Bearing (12).

Note: Lip on Eccentric (6) should face Bearing (12).

vi. Fit Circlip (54) into the bottom Bearing groove, then fit the Retaining Ring (28) over the Bearing to rest against it.

vii. Inspect '0' rings (71) ensuring they are in good condition. Grease '0' rings (71) and Barrel bores of Crankcase.

Note: During the following part of the procedure, refer to Fig 4.3 for Barrel Code positioning.

viii. Starting with the Barrel marked 'A', place this in the Crankcase with the Piston and Slipper Assembly in the Cylinder. Locate the Slipper (27) into the Retaining Ring, making sure that the Shear Pin (31) locates in the Barrel.

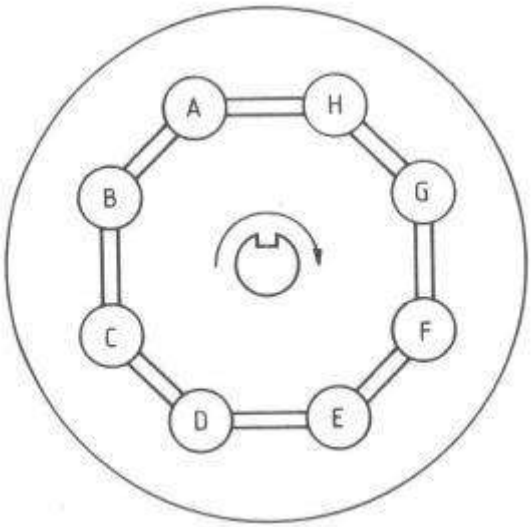


Fig 4.3 Barrel Code

ix. Continue replacing the Barrels in an alphabetical and clockwise order.

x. Place Retaining Ring (28) over Bearing and Slippers. Fit Circlip (54) into Bearing groove.

xi. Screw retaining Screw (95), with Bonded Seal (64), through Crankcase into the Barrel, leaving about one turn loose.

xii. Clean and check '0' ring (70) before placing it in greased groove of Delivery Crankcase (3).

xiii. Slide the Sleeve (7) over the Shaft (17), and place the Disc Springs (59) over the Sleeve so that they rest on the Eccentric (6).

xiv. Apply a small amount of retaining compound to the threads of the Shaft Bolt (92) and screw the Shaft Bolt, with Washer (88), into the end of the Shaft (17). Torque the Shaft Bolt to that specified in *4.2.3.*

xv. Turn the pump to the vertical position. Place Bolts (99) through the Delivery Crankcase, and slide the Spacer Assemblies (112) over them.

xvi. Grease '0' rings (71) and the Barrel bore of the Inlet Crankcase (2).

xvii. Place the Inlet Crankcase (2) in its correct position over the Shaft and Barrels (the oil filler should be at the top between Barrels 'A' and 'H').

xviii. Push the Inlet Crankcase (2) over the Barrels until the threads of Bolts (99) engage.

xix. Tighten Bolts (99) until the Crankcase halves are completely together. Care should be taken to tighten diagonally and a little at a time.

xx. Fully tighten Screw (95).

xxi. Fit Bearing Retainer (9) and '0' ring (71) using Nut (86) with Washers (103).

xxii. Place the Bleed Rings (44) and Bleed Screws (93) over the Barrels.

Note: If internal parts of the Barrels or Valves were removed, refer to the appropriate procedure and ensure they are re-assembled correctly.

xxiii. Fit Key (30) into the cleaned Shaft keyway.

xxiv. Clean the bore of Counter Balance (4) and Coupling (5). Check that both slide over the Shaft, but do not assemble.

xxv. Fit Bell Housing (84) using Nuts (86) with Washers (103).

xxvi. Grease the Shaft and the bores of the Counter Balance and Coupling.

xxvii. First push the Counter Balance on to the Shaft, then push the Coupling on to the Shaft.

xxviii. Fit Drive Cap (56) into the end of the Coupling, locating Pin (110) into the hole in the Shaft.

xxix. Put a small amount of retaining compound on Cap Screw (102) and tighten it into the Shaft.

xxx. Re-fit pump as detailed in Para 9 (Removal and Replacement of Pump Head.

4.3.10 Pump Running In

Prior to running in the pump after overhaul or major component replacement, the pump should be filled with oil to the correct level. Refer to Lubrication Chart (Table 4.2) for details of recommended oil types and pump oil capacities.

The pump should also be bled of air in accordance with the procedures given in *Sections 3.3.4, 3.3.5.*

Note: Check the direction of pump rotation when first switched on.

Run the pump at maximum pressure for the following periods, whilst checking for leaks, monitoring the flow and checking the results against pump performance data:

a. Off load - 30 minutes

b. 1 /2 max. pressure - 60 minutes

c. Max. pressure - 60 minutes.

The following points should be taken into account when determining maximum pressure to be used when running in the pump:

Piston Size	Maximum Pressure
22.5 mm	700 bar (10000 psi)
25.0 mm	550 bar (8000 psi)
27.5 mm	420 bar (6000 psi)

a. If the pump is being used on a system that has a lower working pressure than the maximum for the pump, then running in of the pump should be at the lower pressure.

b. Check the pump Identification Plate for the maximum working pressure of the pump before commencing the running in test. Some models of pumps have working pressures lower than stated, in which case running in should be carried out at the lower pressure.

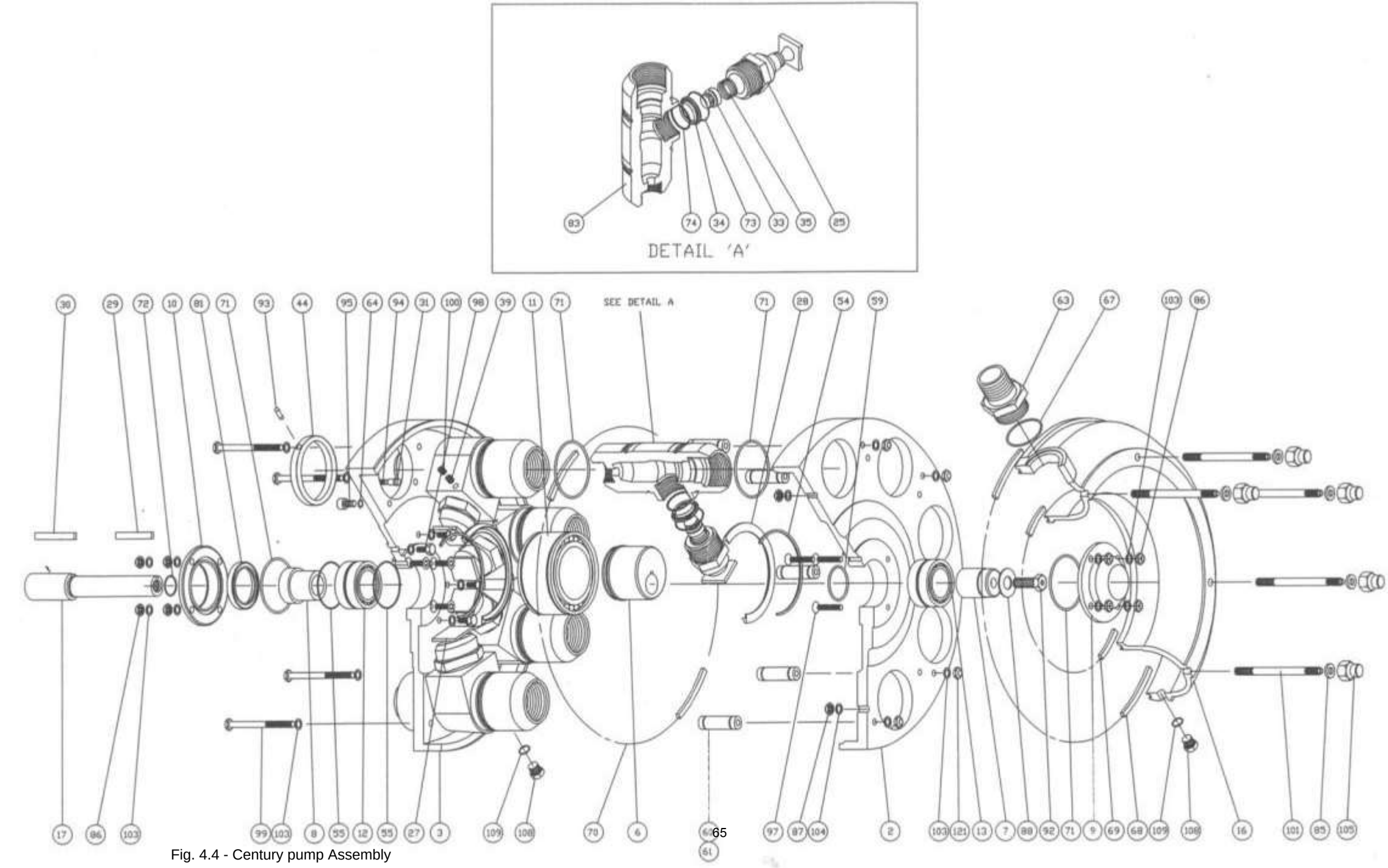
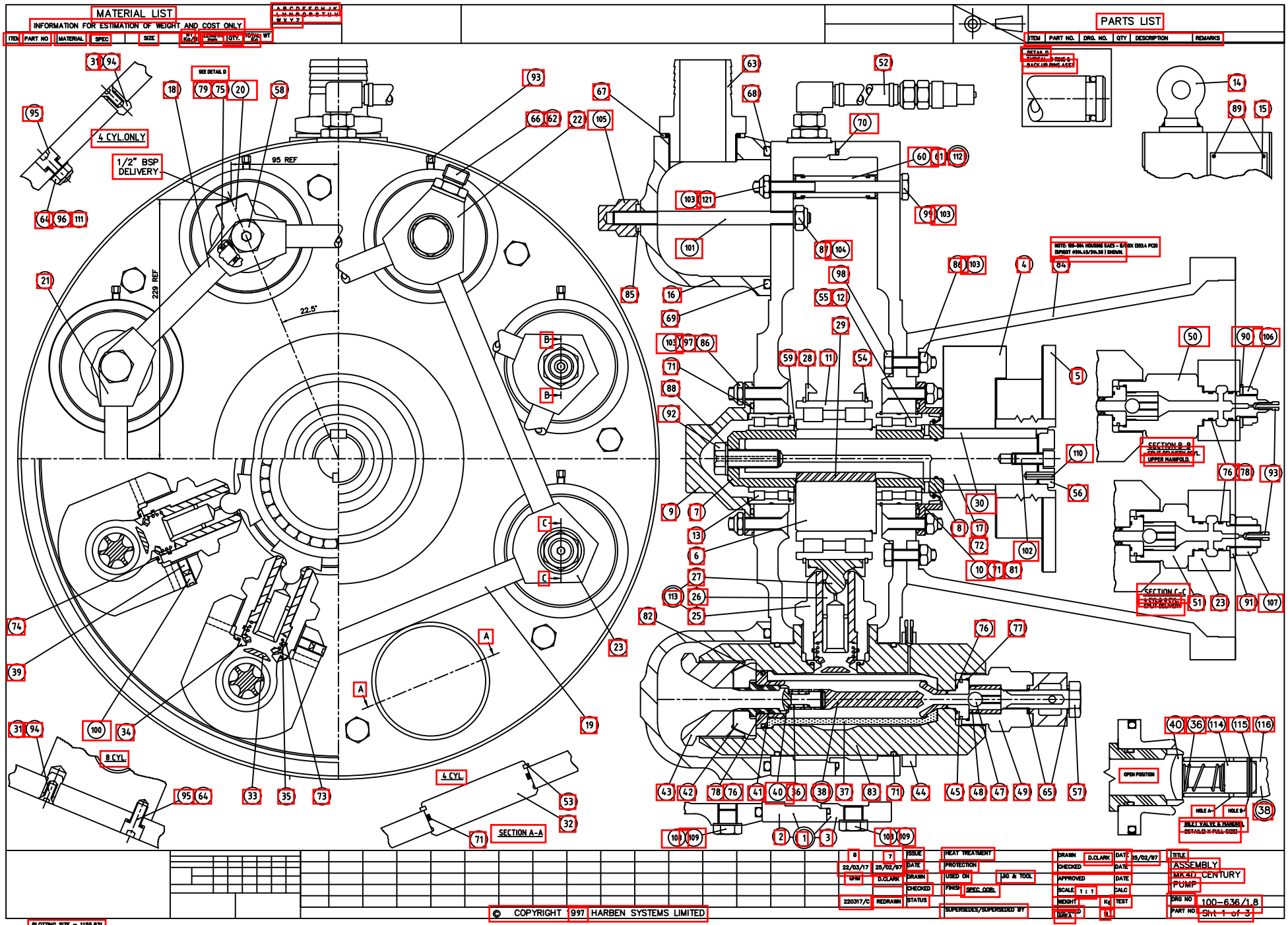


Fig. 4.4 - Century pump Assembly


MATERIAL LIST
INFORMATION FOR ESTIMATION OF WEIGHT AND COST ONLY
ITEM
PART NO
MATERIAL
SPEC
SIZE
QTY.
PARTS LIST
ITEM
PART NO.
DRG. NO.
QTY
DESCRIPTION
REMARKS
4 CYL.ONLY
1/2" BSP DELIVERY
95 REF
229 REF
22.5°
SEE DETAIL D
8 CYL.
4 CYL.
SECTION A-A
SECTION B-B
SECTION C-C
OPEN POSITION
ASSEMBLY
MK 81 CENTURY PUMP
DRG NO 100-636/1.8
PART NO Sht 1 of 3
DRAWN D.CLARK
CHECKED
APPROVED
SCALE 1 : 1
WEIGHT
DRG'A'D
HEAT TREATMENT
PROTECTION
USED ON
JIG & TOOL
FINISH
SPEC. CORL
SUPERSEDES/SUPERSEDED BY
ISSUE
DATE
DRAWN
CHECKED
STATUS
REDRAWN
220317/C
22/03/17
25/02/97
D.CLARK
© COPYRIGHT 997 HARBEN SYSTEMS LIMITED
PLOTTING SIZE = 1155,831

MATERIAL LIST

INFORMATION FOR ESTIMATION OF WEIGHT AND COST ONLY

ITEM	PART NO.	MATERIAL	SPEC	SIZE	WT Kg/M	LENGTH mm	QTY.	TOTAL WT Kg.

A B C D E F G H J K L M N P R S T U V W X Y Z

DO NOT SCALE
IF IN DOUBT ASK

MANUFACTURERS UNABLE TO COMPLY MAY SUBMIT ALTERNATIVES WHEN QUOTING.

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

Third angle projection

PARTS LIST

ITEM	PART No.	DRG. No	QTY	DESCRIPTION	REMARKS

			QUANTITY				
ITEM	PART NO	DRG NO	4 CYL	8 CYL	8 CYL SPLIT DEL	DESCRIPTION	REMARKS
1	100-347	100-334	1	1	1	CRANKCASE ASSEMBLY	
2	100-334	100-334	1	1	1	CRANKCASE INLET	
3	100-335	100-334	1	1	1	CRANKCASE DELIVERY	
4	100-517	100-517	1	1	1	COUNTER BALANCE	
5	023-305	023-305	1	1	1	COUPLING	
6	100-515	100-515	1	1	1	ECCENTRIC	
7	100-257	100-257	1	1	1	SLEEVE NON-DRIVE END	
8	100-652	100-652	1	1	1	SLEEVE DRIVE END OIL CIRCULATION	
9	100-336	100-336	1	1	1	BEARING RETAINER	
10	100-654	100-654	1	1	1	OIL SEAL CARRIER OIL CIRCULATION	
11	100-520	NONE	1	1	1	BEARING	
12	100-054	NONE	1	1	1	BEARING	
13	100-056	NONE	1	1	1	BEARING	
14	061-047	061-077	1	1	1	LIFTING EYE	
15	043-110	043-110	1	1	1	LABEL PUMP IDENTIFICATION	
16	100-456	100-456	1	1	1	MANIFOLD INLET	
17	100-655	100-655	1	1	1	SHAFT CENTURY OIL CIRCULATION	
18	100-315	100-315	0	8	0	TUBE DELIVERY	
19	100-380	100-315	4	0	8	TUBE DELIVERY	
20	100-316	100-316	0	2	0	BANJO 3-PORT	
21	100-317	100-317	0	6	0	BANJO 2-PORT	
22	100-379	100-379	2	0	4	BANJO 3-PORT	
23	100-378	100-378	2	0	4	BANJO 2-PORT	
24							
25	100-570	100-570	4	8	8	CYLINDER 22.5	
	100-571	100-570	4	8	8	CYLINDER 25.0	
	100-572	100-570	4	8	8	CYLINDER 27.5	
26	100-560	100-560	4	8	8	PISTON 22.5	
	100-561	100-561	4	8	8	PISTON 25.0	
	100-562	100-562	4	8	8	PISTON 27.5	
27	100-509	100-509	4	8	8	SLIPPER	
28	100-516	100-516	2	2	2	RETAINING RING	
29	100-063	100-063	1	1	1	KEY 8x10x69	
30	100-064	100-063	1	1	1	KEY 14x9x82	
31	100-337	100-337	8	8	8	SHEAR PIN	
32	100-375	100-375	8	0	0	PLUG	
33	100-449	100-449	4	8	8	VALVE DIAPHRAGM PROTECTION	
34	100-569	100-569	4	8	8	SEAT DIAPHRAGM PROTECTION	
35	037-008	037-008	4	8	8	SPRING DIAPHRAGM PROTECTION	
36	037-107	NONE	4	8	8	SPRING	
37	100-186	100-186	4	8	8	DIAPHRAGM	
38	100-678	100-678	4	8	8	MANDREL ASSY	
39	100-140	100-140	4	8	8	PLUG	
40	100-674	100-674	4	8	8	VALVE INLET	

			QUANTITY				
ITEM	PART NO	DRG NO	4 CYL	8 CYL	8CYL SPLIT DEL	DESCRIPTION	REMARKS
41	100-676	100-676	4	8	8	SEAT INLET	
42	100-498	100-498	4	8	8	COLLAR	
43	100-499	100-499	4	8	8	NUT INLET	
44	100-184	100-184	4	8	8	BLEED RING	
45	100-563	100-563	4	8	8	SEAT DELIVERY	
46							
47	013-037	013-037	4	8	8	VALVE DELIVERY	
48	100-484	100-484	4	8	8	GUIDE DELIVERY VALVE	
49	100-299	100-299	0	8	0	NUT DELIVERY	
50	100-494	100-494	4	0	4	NUT DELIVERY	
51	100-377	100-377	0	0	4	NUT DELIVERY	
52	100-442	100-442	1	1	1	OIL EXPANSION PIPE ASSY	
53	100-376	100-376	8	0	0	CIRCLIP	
54	100-521	NONE	2	2	2	CIRCLIP	
55	013-185	NONE	2	2	2	CIRCLIP	
56	100-234	100-234	1	1	1	DRIVE CAP	
57	100-333	100-333	0	6	0	BANJO BOLT	
58	100-176	100-333	0	2	0	BANJO BOLT	
59	100-071	NONE	1	1	1	DISC SPRING	
60	100-343	100-343	8	8	8	SPACER TUBE	
61	100-341	100-341	16	16	16	SEAL	
62	032-191	032-191	1	1	1	CON" 1/2"BSP x1/2"BSP ST/ST	
63	043-177	043-177	1	1	1	ADAPTOR	
64	033-049	NONE	8	8	8	SEAL BONDED 1/8"BSP	
65	015-097	NONE	0	16	0	SEAL BONDED 3/8"BSP	DOWTY 400-823-4490-73
66	015-098	NONE	1	1	2	SEAL BONDED 1/2"BSP	DOWTY 400-825-4490-73
67	015-010	NONE	1	1	1	SEAL BONDED 2"BSP	
68	013-202	NONE	1	1	1	'O'RING	
69	013-201	NONE	1	1	1	'O'RING	
70	013-206	NONE	1	1	1	'O'RING	
71	013-191	NONE	18	18	18	'O'RING	
72	013-001	NONE	1	1	1	'O'RING	
73	015-020	NONE	4	8	8	SEAL	
74	013-222	NONE	4	8	8	'O'RING	
75	013-302	NONE	8	16	16	'O'RING	
76	013-256	NONE	16	16	32	'O'RING	
77	013-279	NONE	4	8	8	'O'RING	
78	013-257	NONE	12	8	24	BACK UP RING	
79	013-328	NONE	8	16	16	BACK UP RING	
80							
81	100-058	NONE	1	1	1	OIL SEAL	
82	015-043	NONE	4	8	8	SEAL	
83	100-497	100-497	4	8	8	BARREL MK4	
84	100-		1	1	1	BELL HOUSING (REF)	

			QUANTITY				
ITEM	PART NO	DRG NO	4 CYL	8 CYL	8 CYL SPLIT DEL	DESCRIPTION	REMARKS
85	100-097	100-097	8	8	8	WASHER MANIFOLD	
86	013-304	NONE	14	14	14	NUT NYLOC M10 ST/ST	
87	013-109	NONE	8	8	8	NUT NYLOC M12	
88	013-116	NONE	1	1	1	WASHER PLAIN M16	
89	013-232	NONE	6	6	6	SCREW HAMMER DRIVE	
90	013-308	NONE	0	0	4	WASHER M20	
91	100-381	100-381	4	0	4	WASHER	
92	100-653	100-653	1	1	1	SCREW SHAFT OIL CIRCULATION	
93	100-345	100-345	8	10	16	BLEED SCREW	
94	013-081	NONE	8	8	8	SCREW SET CSK M8 x 16	
95	013-298	NONE	8	8	8	SCREW SET CAP HD M10x20	
96	013-029	NONE	6	6	6	WASHER PLAIN M10 FORM A	M/S Zn
97	013-181	NONE	8	8	8	SCREW SET CSK M10 x 50	
98	013-219	NONE	6	6	6	SCREW SET M10x40 LG	
99	013-303	NONE	8	8	8	BOLT M10x130 ST/ST	
100	013-067	NONE	4	8	8	SCREW SOCKET HD.M8x10	
101	100-465	100-465	8	8	8	STUD MANIFOLD	
102	013-218	NONE	1	1	1	SCREW SET CAP HD.M10x25	
103	013-305	NONE	30	30	30	WASHER ST/ST M10	
104	013-111	NONE	8	8	8	WASHER M12	
105	100-076	100-076	8	8	8	NUT MANIFOLD	
106	100-501	100-501	0	0	4	NUT SPLIT DELIVERY	
107	013-004	013-004	4	0	4	NUT NYLOC M20	
108	013-490	NONE	2	2	2	DRAIN PLUG	MAGNETIC
109	013-026	NONE	2	2	2	WASHER SEAL 3/8" BSP	
110	013-221	NONE	1	1	1	PIN	
111	013-030	NONE	12	8	8	NUT NYLOC M10	
112	100-094	100-094	8	8	8	SPACER ASSY	
113	100-573	100-573	4	8	8	PISTON,CYLINDER & SLIPPER ASSY 22.5	
	100-574	100-573	4	8	8	PISTON,CYLINDER & SLIPPER ASSY 25.0	
	100-575	100-573	4	8	8	PISTON,CYLINDER & SLIPPER ASSY 27.5	
114	100-675	100-675	4	8	8	STOP INLET VALVE	
115	100-348	NONE	4	8	8	PIN	
116	100-672	100-672	4	8	8	MANDREL	
117	100-401	100-334	1	1	1	CRANKCASE ASSY	
118	100-334	100-334	1	1	1	CRANKCASE INLET	CAST IRON OPTION
119	100-335	100-334	1	1	1	CRANKCASE DELIVERY	
120	100-417	100-334	1	1	1	CRANKCASE ASSY	AS ITEM 1 BUT ANODISED
121	013-723	NONE	8	8	8	NUT NYLOC M10	BRASS

FLOWPLANT
LEADERS IN CLEANING TECHNOLOGY

Flowplant Group Ltd.
Watt Road, Churchfields, Salisbury, Wiltshire. SP2 7UD
England.
Tel: (01722) 325424 Fax: 01722 411329 Tix: 477183

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	
* DELETE ONE RANGE	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8
	± 0.3	± 0.5	± 0.7	± 1.0	± 1.5	± 2.0
FABRICATION	± 0.5	± 1.0	± 1.5	± 2.0	± 3.0	± 3.0

ALL DIMENSIONS IN MILLIMETRES
GEOMETRICAL TOLERANCES TO BS 308
ANGULAR DIMS TO BE WITHIN--
MACHINED ± 0.5°, BENDING ± 2°
THREADS: BSP, TO MED. FIT. B.S. 2779
ISOMETRIC TO 6g / 6H

SURFACE ROUGHNESS: 1.6 MICRONS Ra
CONCENTRICITY TO WITHIN 0.2 T.I.R.
M/C RADII 1.5
DRILLED HOLES +0.15/-0.00
HOLE CENTRES TO BE ± 0.2
REMOVE ALL BURRS & SHARP EDGES.

8	7	ISSUE	
22/03/17	25/02/97	DATE	
GHM	DC	DRAWN	
		CHECKED	
220317/C	REDRAWN	STATUS	

HEAT TREATMENT
PROTECTION
USED ON JIG & TOOL
FINISH: N/A
SUPERSEDES/SUPERSEDED BY

DRAWN	D CLARK	DATE	25/02/97
CHECKED		DATE	
APPROVED		DATE	
SCALE	NTS	CALC	
WEIGHT	Kg	TEST	
EXPOSED AREA	N/A		

TITLE: ASSEMBLY PARTS LIST MK4D CENTURY PUMP
DRG NO: 100-636/1.8 sht 2 of 3
PART NO: AS ABOVE

DO NOT SCALE
IF IN DOUBT ASK !

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

ASSEMBLY PART NO.	NO. OF CYLINDERS			CYLINDER SIZE			MATL	REMARKS
	4	8	8 S/DEL	22.5	25	27.5		
100-680	1			1			AL	
100-681	1				1		AL	
100-682	1					1	AL	
100-683		1		1			AL	
100-684		1			1		AL	
100-685		1				1	AL	
100-686	1			1			AL	ANODIZED/HB
100-687	1				1		AL	ANODIZED/HB
100-688	1					1	AL	ANODIZED/HB
100-689		1		1			AL	ANODIZED/HB
100-690		1			1		AL	ANODIZED/HB
100-691		1				1	AL	ANODIZED/HB
100-692			1	1			AL	
100-693			1		1		AL	
100-694			1			1	AL	
100-695			1	1			AL	ANODIZED/HB
100-696			1		1		AL	ANODIZED/HB
100-697			1			1	AL	ANODIZED/HB

ISSUE	DATE	DRN	CHK	STATUS
8	22/03/17	GHM		220317/C
1	25/02/97	DC		NEW DRG

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LEADERS IN CLEANING TECHNOLOGY

Flowplant Group Ltd.
Watt Road, Churchfields, Salisbury, Wiltshire. SP2 7UD
England.
Tel: (01722) 325424 Fax: 01722 411329 Tix: 477183

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 MACHINING	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8
× MEDIUM MACHINING	± 0.3	± 0.5	± 0.7	± 1.0	± 1.5	± 2.0
FABRICATION / UNMACHINED	± 0.5	± 1.0	± 1.5	± 2.0	± 3.0	± 3.0

× DELETE ONE RANGE

ALL DIMENSIONS IN MILLIMETRES
GEOMETRICAL TOLERANCES TO BS 308
ANGULAR DIMS TO BE WITHIN:-
MACHINED ± 0.5° BENDING ± 2°
THREADS: BSP, TO MED. FIT. B.S. 2779
ISOMETRIC TO 6g / 6H

SURFACE ROUGHNESS: 1.6 MICRONS Ra
CONCENTRICITY TO WITHIN 0.2 T.I.R.
M/C RADII 1.5
DRILLED HOLES +0.13/-0.00
HOLE CENTRES TO BE ± 0.2
REMOVE ALL BURRS & SHARP EDGES.

MATL
SPEC / PART NO.
SIZE
FINISH
HEAT TREATMENT
CALC

SUPERSEDES/
SUPERSEDED BY

DRAWN D CLARK DATE 25/02/97
APPROVED DATE
CHECKED DATE
SCALE NTS CALC
WEIGHT N/A Kg TEST
PROTECTION

TITLE
PUMP OPTIONS
MK4D CENTURY PUMP

DRG NO. 100-636/2.8 Sht 3of3
PART NO. 100636

MATERIAL LIST

INFORMATION FOR ESTIMATION OF WEIGHT AND COST ONLY

ITEM	PART NO.	MATERIAL	SPEC	SIZE	WT Kg/M	LENGTH mm	QTY.	TOTAL WT Kg

A B C D E F G H J K L M N P R S T U V W X Y Z

DO NOT SCALE IF IN DOUBT ASK !

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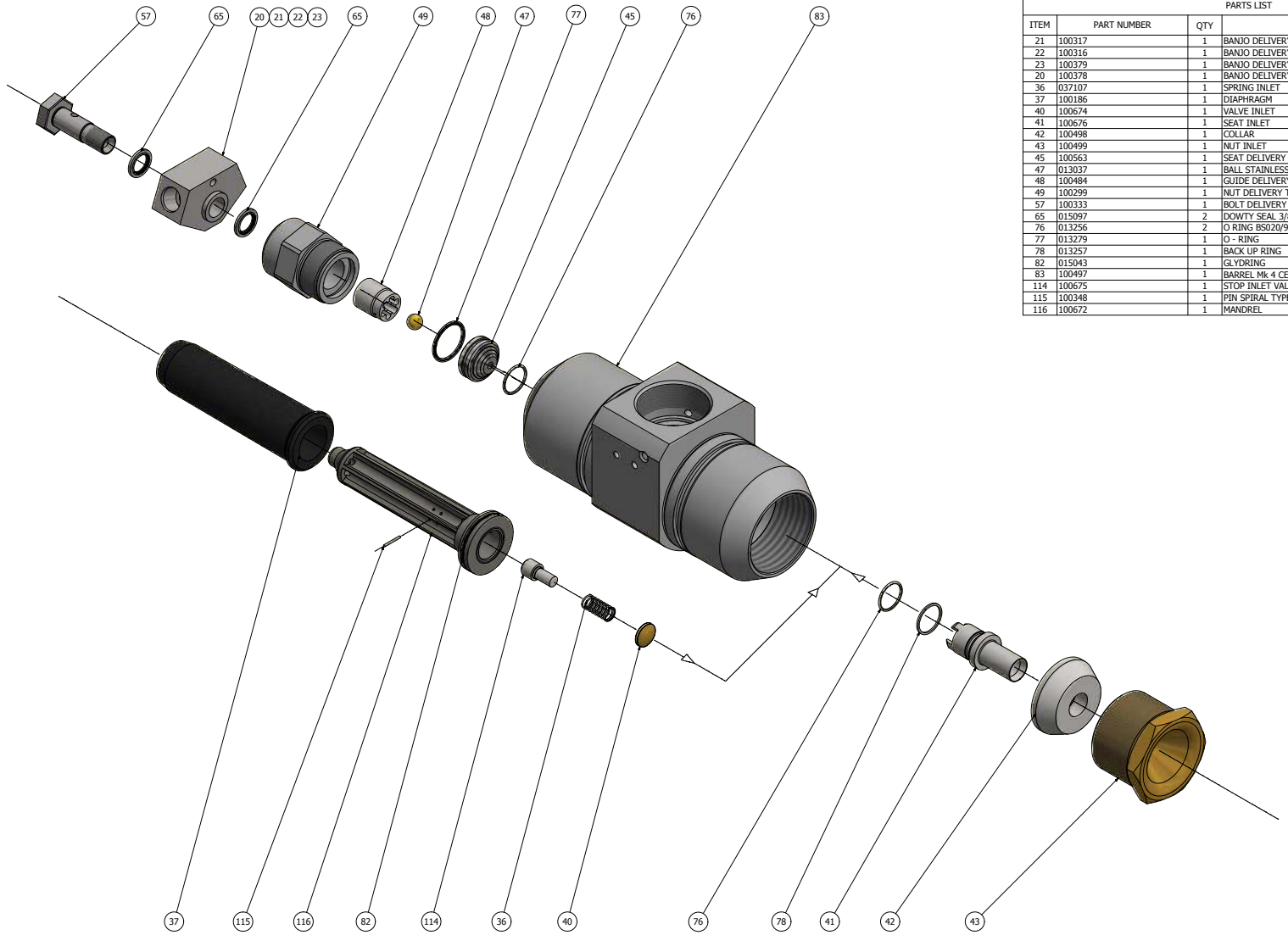
ALL DRAWINGS NOT TO THE LATEST ISSUE ARE TO BE DESTROYED.

Third angle projection

PARTS LIST

ITEM	PART No.	DRG. No	QTY	DESCRIPTION	REMARKS



PARTS LIST

ITEM	PART NUMBER	QTY	DESCRIPTION
21	100317	1	BANJO DELIVERY MANIFOLD 2 PORT
22	100316	1	BANJO DELIVERY MANIFOLD 3 PORT
23	100379	1	BANJO DELIVERY MANIFOLD 3 PORT
20	100378	1	BANJO DELIVERY MANIFOLD 2 PORT
36	037107	1	SPRING INLET
37	100186	1	DIAPHRAGM
40	100674	1	VALVE INLET
41	100676	1	SEAT INLET
42	100498	1	COLLAR
43	100499	1	NUT INLET
45	100563	1	SEAT DELIVERY
47	013037	1	BALL STAINLESS STEEL
48	100484	1	GUIDE DELIVERY VALVE
49	100299	1	NUT DELIVERY TUFTRIDED
57	100333	1	BOLT DELIVERY BANJO
65	015097	2	DOWTY SEAL 3/8"
76	013256	2	O RING BS020/90
77	013279	1	O - RING
78	013257	1	BACK UP RING
82	015043	1	GLYDRING
83	100497	1	BARREL Mk 4 CENTURY
114	100675	1	STOP INLET VALVE
115	100348	1	PIN SPIRAL TYPE 5/65" OD 5/8" LG
116	100672	1	MANDREL

FLOWPLANT

LEADERS IN CLEANING TECHNOLOGY

Flowplant Group Ltd.
Gemini House, Brunel Rd, Churchfields,
Salisbury, Wiltshire, England. SP2 7PU
Tel: (01722) 325424 Fax: 01722 411329

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	
* DELETE ONE RANGE	* FINE MACHINING	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8
	* MEDIUM MACHINING	± 0.3	± 0.5	± 0.7	± 1.0	± 1.5	± 2.0
FABRICATION / UNMACHINED		± 0.5	± 1.0	± 1.5	± 2.0	± 3.0	± 3.0

ALL DIMENSIONS IN MILLIMETRES
GEOMETRICAL TOLERANCES TO BS 308
ANGULAR DIMS TO BE WITHIN:- MACHINED ± 0.5°, BENDING ± 2°
THREADS: BSP, TO MED. FIT. B.S. 2779
ISOMETRIC TO 6g / 6H

SURFACE ROUGHNESS: 1.6 MICRONS Ra
CONCENTRICITY TO WITHIN 0.2 T.I.R.
M/C RADII 1.5
DRILLED HOLES +0.13/-0.00
HOLE CENTRES TO BE ± 0.2
REMOVE ALL BURRS & SHARP EDGES.

							2	1	ISSUE	HEAT TREATMENT	
							22/03/17	10/06/2014	DATE	PROTECTION	
							GHM	TWC	DRAWN	USED ON	JIG & TOOL
									CHECKED	FINISH:	
							220317/B	NEW DRG	STATUS		

SUPERSEDES/SUPERSEDED BY

DRAWN TWC	DATE 01/06/2014	TITLE	BARREL ASSEMBLY
CHECKED	DATE		
APPROVED	DATE		Mk 4 CENTURY
SCALE	CALC		
WEIGHT Kg	TEST	DRG NO	Q0768/3-2
EXPOSED AREA M²		PART NO	NONE

MATERIAL LIST

INFORMATION FOR ESTIMATION OF WEIGHT AND COST ONLY

ITEM	PART NO.	MATERIAL	SPEC	SIZE	WT Kg/M	LENGTH mm	QTY.	TOTAL WT Kg

A B C D E F G H J K L M N P R S T U V W X Y Z

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

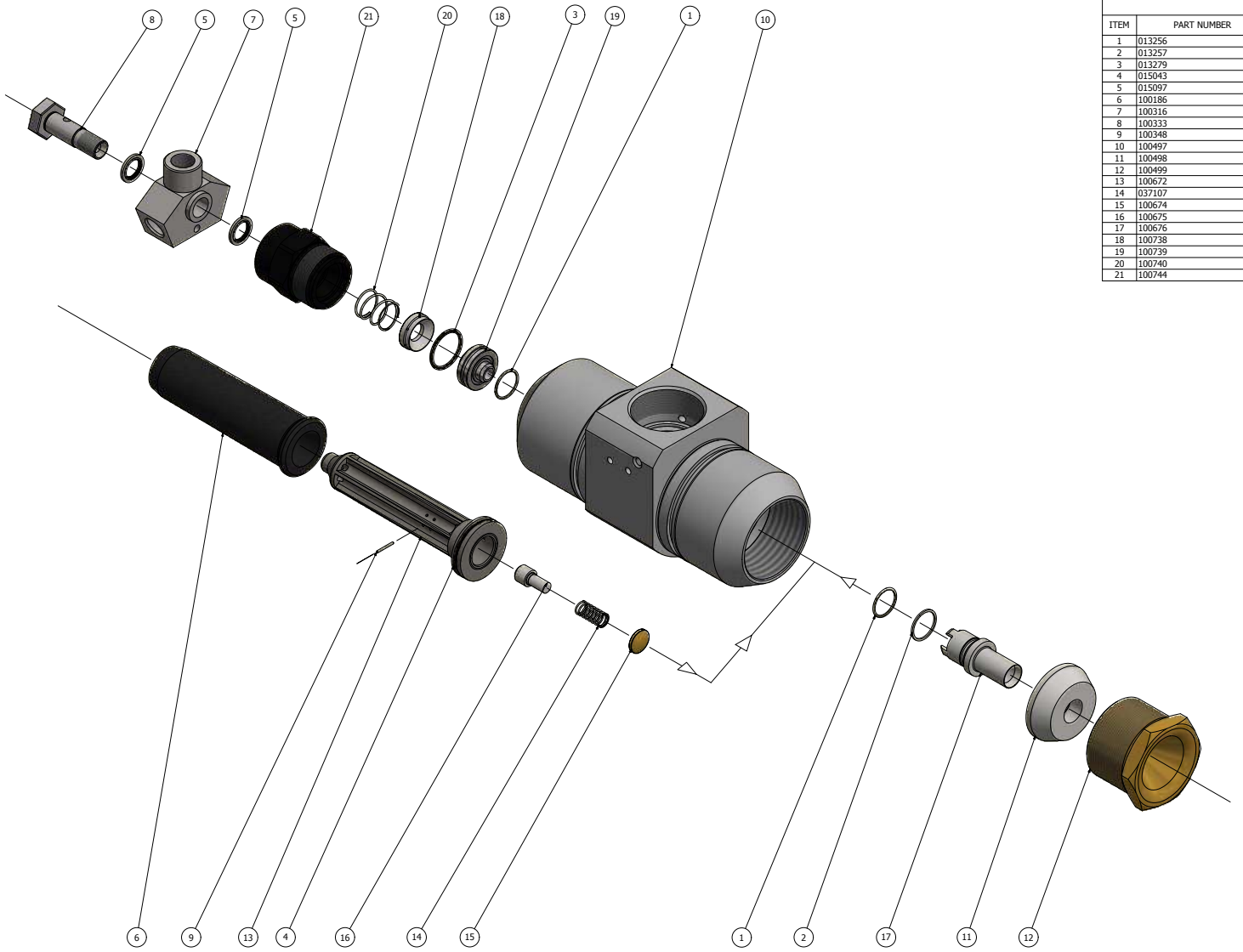
Third angle projection

PARTS LIST

ITEM	PART No.	DRG. No	QTY	DESCRIPTION	REMARKS

PARTS LIST

ITEM	PART NUMBER	QTY	DESCRIPTION
1	013256	2	O RING BS020/90
2	013257	1	BACK UP RING
3	013279	1	O - RING
4	015043	1	GLYDRING
5	015097	2	DOWTY SEAL 3/8"
6	100186	1	DIAPHRAGM
7	100316	1	BANJO DELIVERY BLOCK 3 PORT
8	100333	1	BOLT DELIVERY BANJO
9	100348	1	PIN SPIRAL TYPE 5/65" OD 5/8" LG
10	100497	1	BARREL Mk 4 CENTURY
11	100498	1	COLLAR
12	100499	1	NUT INLET
13	100672	1	MANDREL
14	037107	1	SPRING INLET
15	100674	1	VALVE INLET
16	100675	1	STOP INLET VALVE
17	100676	1	SEAT INLET
18	100738	1	SEAT HE DELIVERY VALVE
19	100739	1	RING HE DELIVERY VALVE
20	100740	1	SPRING HE DELIVERY VALVE
21	100744	1	NUT HE DELIVERY VALVE



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Flowplant Group Ltd.
Gemini House, Brunel Rd, Churchfields,
Salisbury, Wiltshire, England. SP2 7PU
Tel: (01722) 325424 Fax: 01722 411329

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	
* DELETE ONE RANGE	* FINE MACHINING	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8
	* MEDIUM MACHINING	± 0.3	± 0.5	± 0.7	± 1.0	± 1.5	± 2.0
FABRICATION / UNMACHINED		± 0.5	± 1.0	± 1.5	± 2.0	± 3.0	± 3.0

ALL DIMENSIONS IN MILLIMETRES
GEOMETRICAL TOLERANCES TO BS 308
ANGULAR DIMS TO BE WITHIN:-
MACHINED ± 0.5°, BENDING ± 2°
THREADS: BSP, TO MED. FIT. B.S. 2779
ISOMETRIC TO 6g / 6H

SURFACE ROUGHNESS: 1.6 MICRONS Ra
CONCENTRICITY TO WITHIN 0.2 T.I.R.
M/C RADII 1.5
DRILLED HOLES +0.13/-0.00
HOLE CENTRES TO BE ± 0.2
REMOVE ALL BURRS & SHARP EDGES.

2	1	ISSUE	
22/03/17	10/06/2014	DATE	
GHM	TWC	DRAWN	
		CHECKED	
220317/A	NEW DRG	STATUS	

HEAT TREATMENT
PROTECTION
USED ON JIG & TOOL
FINISH:
SUPERSEDES/SUPERSEDED BY

DRAWN TWC DATE 01/06/2014
CHECKED DATE
APPROVED DATE
SCALE CALC
WEIGHT Kg TEST
EXPOSED AREA M²

TITLE
BARREL ASSEMBLY
SPRING LOADED DELIVERY
Mk 4 CENTURY

DRG NO Q0769/3-2
PART NO NONE

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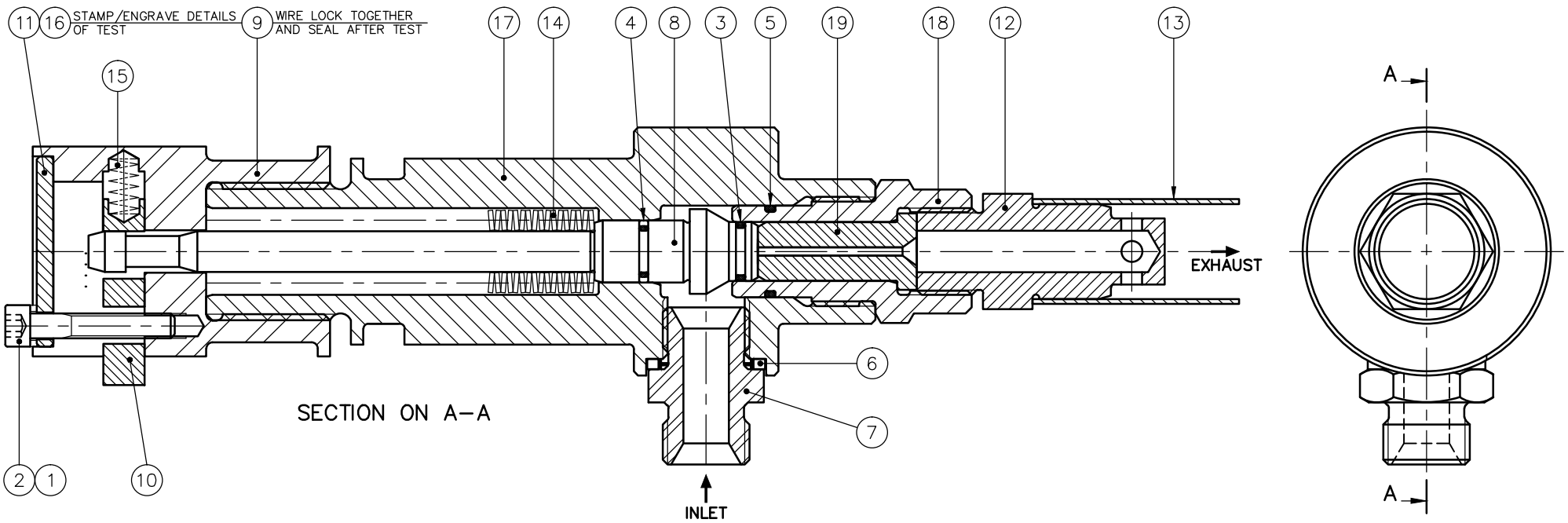
PARTS LIST

ITEM	PART NO.	DRG. NO.	QTY	DESCRIPTION	REMARKS



PART No.	SUITABLE FOR PUMP	RUNNING PRESSURE (bar)	RELIEF PRESSURE (bar)	SPRING PART No.	No OFF	CHOKE SIZE (PILOT)	CHOKE PART No.
035221	822519	700	770 – 800	036074	71	ø2	078594
035222		620	680 – 710	"	69	"	"
035223		550	600 – 630	"	67	"	"
035224	825019	480	530 – 550	"	66	"	"
035225		420	460 – 480	"	65	"	"
035226		350	380 – 400	"	64	"	"
035227		280	310 – 325	036075	75	"	"

2

IMPORTANT
REFER TO FLOW CALCULATION CHART
FOR SPECIFIC DRILL SIZE OF CHOKE

FLOWPLANT
LEADERS IN CLEANING TECHNOLOGY

Flowplant Manufacturing Ltd.
Gemini House, Brunel Road, Churchfields, Salisbury, Wilts.
SP2 7PU England. Tel: +44 (0) 1722 325424 F. 411329

OVER	0	30	100	300	1000	2000
UP TO AND INCLUDING	30	100	300	1000	2000	
* DELETE ONE RANGE * FINE MACHINING						
* MEDIUM MACHINING						
FABRICATION / UNMACHINED						

ALL DIMENSIONS IN MILLIMETRES
GEOMETRICAL TOLERANCES TO BS 308
ANGULAR DIMS TO BE WITHIN:-
MACHINED ± 0.5°, BENDING ± 2°
THREADS: BSP, TO MED. FIT. B.S. 2779
ISOMETRIC TO 6g / 6H

SURFACE ROUGHNESS: 1.6 MICRONS Ra
CONCENTRICITY TO WITHIN 0.2 T.I.R.
M/C RADII 1.5
DRILLED HOLES +0.13/-0.00
HOLE CENTRES TO BE ± 0.2
REMOVE ALL BURRS & SHARP EDGES.

TOLERANCES TO BE AS SPECIFIED ABOVE UNLESS OTHERWISE STATED

MATL. –
SPEC/PT NO. –
SIZE. –
FINISH.
SPEC R:
– –
SUPERSEDES/ SUPERSEDED BY

	3	2	1
	19–09–14	13–02–05	22/11/04
	TWC	DC	DC
	190914/B	130205/E	NEW DRG

HEAT TREATMENT.

ISSUE	DRAWN	DATE
	D CLARK	22/11/04
DATE	APPROVED	DATE
DRN	CHECKED	DATE
CHK	SCALE 1 : 1	CALC
STATUS	WEIGHT N/A Kg	TEST
PROTECTION		
CALC:		

TITLE
SAFETY VALVE 2
ASSEMBLY

DRG NO. 035-221/3.3
PART NO. SEE TABLE

Fig. 4.7 - Safety Valve Assembly

Parts list

035221 – Safety Valve 2 Assembly

Item No.	Part No.	Description	Qty
1	013069	WASHER S/COIL SQR.SECTION M6 SPRING STEEL ZN	1
2	013525	SCREW SET SOCKET CAP HD M 6-1.0 6G 35 LG HT 8.8 ZN	1
3	015013	O RING BS013 PTFE	1
4	015014	SEAL GLYD RING 15MM DIA SHAFT	1
5	015033	O RING BS018/90	1
6	015098	SEAL BONDED 1/2" BSP 400-825-4490-73 761 BAR	1
7	032191	ADAPTOR 1/2" BSP M x 1/2" BSP M 1000 BAR ST/ST	1
8	078597	PLUNGER SAFETY RELIEF VALVE 2	1
9	036064	CATCH NUT SAFETY VALVE	1
10	036065	CATCH PLATE SAFETY VALVE MK2	1
11	036066	CAP SAFETY VALVE	1
12	036067	DISCHARGE ASSEMBLY SAFETY VALVE	1
14	036074	DISC SPRING 20x10.2x1.10 ZINC PLATED	71
15	036076	SPRING COMPRESSION SIR SPRINGMASTERS 459817	1
16	036077	LABEL SAFETY VALVE	1
17	078591	BODY SAFETY RELIEF VALVE	1
18	078592	NUT RELIEF VALVE	1
19	078594	CHOKE RELIEF 6.0	1
20	013354	SEAL SAFETY RELIEF VALVE	1

MATERIAL LIST								
INFORMATION FOR ESTIMATION OF WEIGHT AND COST ONLY								
ITEM	PART NO.	MATERIAL	SPEC	SIZE	WT Kg/M	LENGTH mm	QTY.	TOTAL WT Kg

A B C D E F G H J K L M N P R S T U V W X Y Z

DO NOT SCALE IF IN DOUBT ASK !

MANUFACTURERS UNABLE TO COMPLY MAY SUBMIT ALTERNATIVES WHEN QUOTING.

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

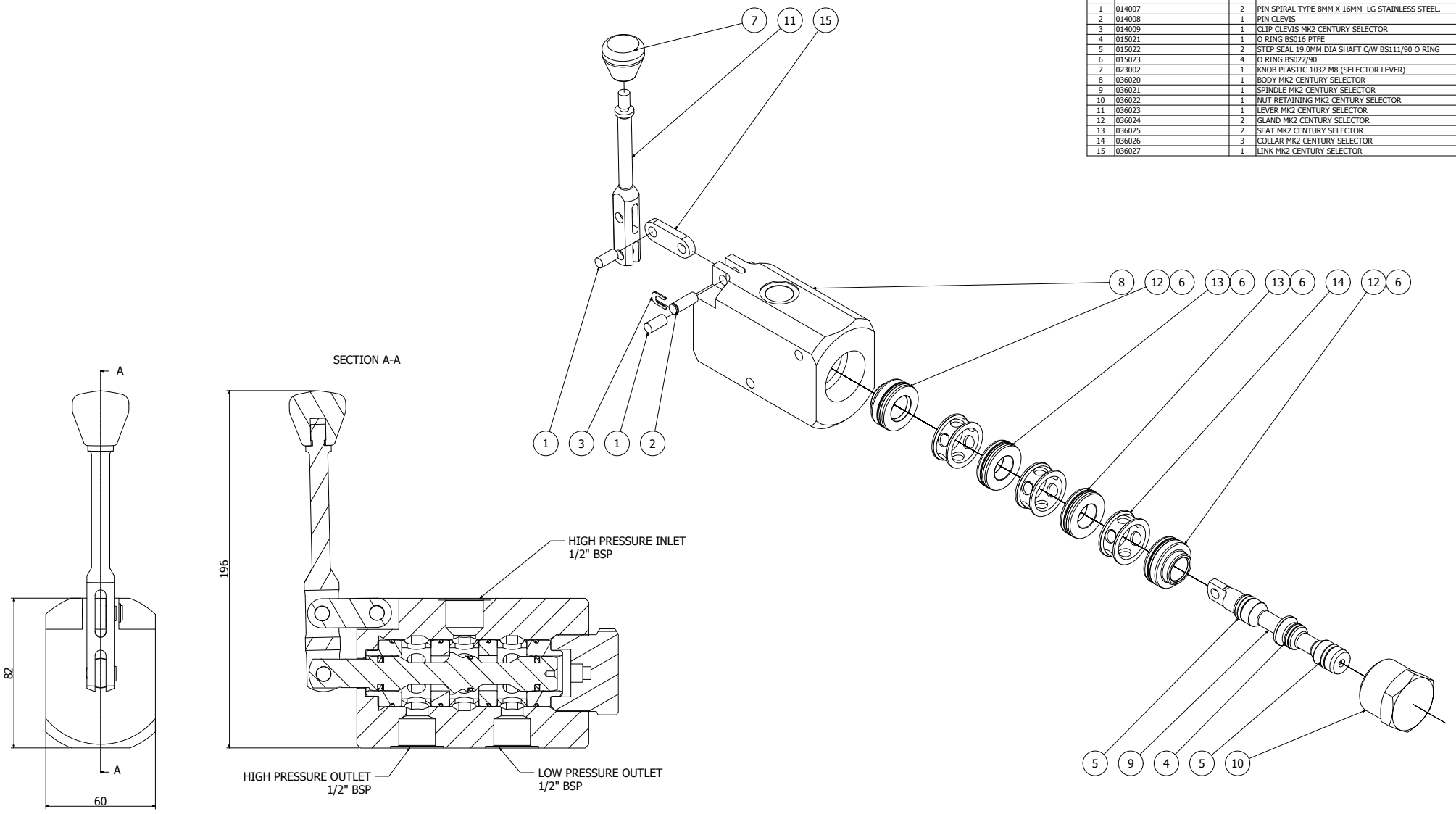
Third angle projection

PARTS LIST

ITEM	PART No.	DRG. No	QTY	DESCRIPTION	REMARKS

PARTS LIST

ITEM	PART NUMBER	QTY	DESCRIPTION
1	014007	2	PIN SPIRAL TYPE 8MM X 16MM LG STAINLESS STEEL.
2	014008	1	PIN CLEVIS
3	014009	1	CLIP CLEVIS MK2 CENTURY SELECTOR
4	015021	1	O RING BS016 PTFE
5	015022	2	STEP SEAL 19.0MM DIA SHAFT C/W BS111/90 O RING
6	015023	4	O RING BS027/90
7	023002	1	KNOB PLASTIC 1032 M8 (SELECTOR LEVER)
8	036020	1	BODY MK2 CENTURY SELECTOR
9	036021	1	SPINDLE MK2 CENTURY SELECTOR
10	036022	1	NUT RETAINING MK2 CENTURY SELECTOR
11	036023	1	LEVER MK2 CENTURY SELECTOR
12	036024	2	GLAND MK2 CENTURY SELECTOR
13	036025	2	SEAT MK2 CENTURY SELECTOR
14	036026	3	COLLAR MK2 CENTURY SELECTOR
15	036027	1	LINK MK2 CENTURY SELECTOR



FLOWPLANT
LEADERS IN CLEANING TECHNOLOGY

Flowplant Group Ltd.
Gemini House, Brunel Rd, Churchfields,
Salisbury, Wiltshire, England. SP2 7PU
Tel: (01722) 325424 Fax: 01722 411329

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	
* DELETE ONE RANGE	* FINE MACHINING	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	± 0.8
	* MEDIUM MACHINING	± 0.3	± 0.5	± 0.7	± 1.0	± 1.5	± 2.0
FABRICATION / UNMACHINED		± 0.5	± 1.0	± 1.5	± 2.0	± 3.0	± 3.0

ALL DIMENSIONS IN MILLIMETRES
GEOMETRICAL TOLERANCES TO BS 308
ANGULAR DIMS TO BE WITHIN:- MACHINED ± 0.5°, BENDING ± 2°
THREADS: BSP, TO MED. FIT. B.S. 2779
ISOMETRIC TO 6g / 6H

SURFACE ROUGHNESS: 1.6 MICRONS Ra
CONCENTRICITY TO WITHIN 0.2 T.I.R.
M/C RADII 1.5
DRILLED HOLES +0.13/-0.00
HOLE CENTRES TO BE ± 0.2
REMOVE ALL BURRS & SHARP EDGES.

ISSUE	5
DATE	24/06/14
DRAWN	TWC
CHECKED	
STATUS	240614/B
HEAT TREATMENT	
PROTECTION	
USED ON	JIG & TOOL
FINISH:	
SUPERSEDES/SUPERSEDED BY	
DRAWN	TWC
DATE	24/06/14
CHECKED	
DATE	
APPROVED	
DATE	
SCALE	
CALC	
WEIGHT Kg	
TEST	
EXPOSED AREA M²	
TITLE	SELECTOR Mk II CENTURY SERIES 700 BAR
DRG NO	036-028/3-5
PART NO	036028

Fig. 4.8 - Selector Mk2 - Century

Section 5

Warranty

Section 5

Warranty

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5.1 FLOWPLANT WARRANTY

Warranty of new products:
Equipment manufactured and supplied by Flowplant is warranted to be free from defects in materials and workmanship.

The warranty includes both parts and labour necessary to correct any such defects.

The warranty period for new products is 12 months from date of despatch from our factory or 2000 operating hours, whichever occurs soonest.

We shall repair or, at our option, replace free of charge any product, part(s) or component(s) manufactured by Flowplant which fail due to faulty manufacture or material within the warranty period.

Warranty of spare parts:
The warranty for new spare parts is 6 months from date of despatch on materials and workmanship or 250 operating hours, whichever occurs soonest.

The warranty for reconditioned spare parts is 90 days from date of despatch on materials and workmanship.

Provided always that

a) They are returned to Flowplant for inspection (carriage paid), along with a copy of the original part(s) sale invoice (where necessary); and

b) All terms agreed by Flowplant for payment of such goods have been complied with; and

c) If a defect/failure is discovered before the expiration of the warranty, notification must be given to the Flowplant service department immediately

d) Any claim hereunder is made within 30 days of the date of discovery of the defect/failure.

Provision of this warranty shall not apply to any Flowplant product which has been:

a) Used for a purpose for which it is not designed for; or

b) Applied to a use which has not been approved by Flowplant; or

c) Subject to misuse, negligence, lack of maintenance or accident; or

d) Repaired or altered in any way so as, in the judgment of Flowplant, to adversely affect its performance and reliability

5.2 LIMITATIONS OF THE WARRANTY

The new product and spare parts warranty is limited to defects in material or workmanship of the product. It does not cover loss of time, inconvenience, property damage or any consequential damages. Repair or replacement of the product is your exclusive remedy.

Our liability under this clause shall be in lieu and to this exclusion of any warranty or conditions implied or expressed by law as to the quality or fitness for purpose of any goods supplied hereunder PROVIDED THAT nothing in this clause shall operate so as to exclude liability for death or personal injury arising from the negligence of the company or its employees.

Our obligations as aforesaid shall constitute the full extent of our liability in respect of any loss or damage sustained by the purchaser whether caused by any breach of this contract or by our negligence or otherwise and we shall not be liable to make good or pay for loss of use of the goods, loss of revenue, loss of profit or goodwill or any direct or consequential losses howsoever caused and the purchaser undertakes to indemnify us against any such claims against us by third parties.

On order to comply with the provision of the Health and Safety at work etc., Act 1974 in respect of articles manufactured, supplied or installed for use at work we test all our products before they leave our factory and supply them with adequate instructions for their proper use. Further copies of these instructions are available from us upon request.

5.2.1 Non Warranty Items

The Warranty terms are a precise statement of Flowplant Group Ltd's intention to cover the replacement or repair cost, on a standardised and agreed basis, of any product failure resulting from defective material or sub-standard workmanship during the manufacturing process.

The following items are considered to be of a Maintenance nature and should not be subject of a claim.

Engine (Manufacturers Warranty Applies)

- Routine servicing of injector/fuel injection equipment.
- Heavy fuel consumption rectified by engine adjustment.
- Adjustment of fan belts/throttle and controls.
- Tightening of all sump and cover bolt/nuts water connections and exterior oilpipes and filter bolts.
- Filters and the cleaning of filters.
- Engine service components.
- Adjustments.

Brakes (Trailer)

- Brake shoe adjustment/bleeding and topping up of reservoir/draining of air systems where not due to a defective part.
- Brake squeal from brake linings.
- Replacement of linings due to fair wear and tear.
- Tightness of air lines/pipes.
- Filters and the cleaning of filters.
- Brake fluid.

Electrical (all products) Manufacturers Warranty Applies

- Cleaning of terminals.
- General maintenance of batteries, dynamo/alternator, starter etc.
- Adjustment to ignition system components.
- General adjustment to electrical control current settings.
- Brushes and other items due to fair wear and tear.
- Contactor tips and springs.
- Replacement of lamps, lenses and bulbs.

Steering/Running Gear

- Front wheel alignment, track adjustment.
- Steering adjustment.
- Hub bearing and float adjustment.
- Jockey wheels.

Hydraulics (all products)

- Tightening of hydraulic fittings and couplings.
- Filters and the cleaning of filters.
- Hydraulic fluid.

Chassis (self-propelled and trailer-mounted units)

- General rattles.
- Paint chips.
- Alignment and adjustment of panels etc.
- Deterioration of paint and external fittings due to neglect, exposure and fair
- wear and tear.
- Accidental damage.

Lubrication (all products)

- Complete or partial lubrication services.

Corrosion (all product)

- Damage caused by adverse weather/atmosphere conditions.

General (all products)

- Fair wear and tear.
- Any work carried out to improve the general finish of the machine above
- what is known to be the factory standard.
- Failure to maintain the equipment in accordance with the manufacturers reccomendations.

REMEMBER:

i. The replacement or repair of tyres is not covered by the Company's warranty terms.
ii. In the case of van and truck mounted equipment the warranty relating to the actual vehicle remains the responsibility of the vehicle manufacturer or supplier.

In order to comply with the provisions of the Health and Safety at Work Act 1974 in respect of articles manufactured, supplied or installed for use at work, we test all our products before they leave our factory and supply with them adequate instructions for their proper use. Further copies of these instructions are available from us on request.

We shall not be liable for loss, injury or damage of whatever nature caused by goods, design, technical information, suggestions, etc supplied by us where as the case maybe they have been structurally modified or misused or misapplied or have not been properly cared for and maintained, and the purchaser hereby agrees to indemnify us against all such claims and demands or by whomsoever they are brought.

5.2.2 Service and Spares

Flowplant provide service and spares cover in most parts of the world. When ordering spares, please quote:-

a) Your company name and address.
b) Destination of parts, if different.
c) Description and part number.
d) Quantity required.
e) Price and method of payment.
f) Delivery date.
g) Order number.
h) Confirmation of order.

When requesting service or repairs, please state:-

a) Your company name and address.
b) Location of machine/unit if different from above.
c) Type and model of machine/unit.
d) Pump serial number.
e) Problem(s) with machine/unit.
f) Availability of machine/unit for service or repairs.
g) Date of service and site contract.
h) Cost and method of payment.
i) Order number.
j) Confirmation of order.