Installation, Operation & Maintenance Manual

Sundyne Pumps

Model: LMV-801S

SA-07-11-92, Rev Orig
Oct 2015

Copyright

Warranty

Sundyne LLC warrants to Buyer for a period of twelve (12) months from the date of being placed in service (but not to exceed eighteen (18) months after the date of shipment) that the equipment at the time of shipment will be free from defects of design, material and workmanship. If any defects or malperformance occur during the warranty period, Sundyne's sole obligation shall be limited to alteration, repair or replacement at Sundyne's expense, F.O.B. Factory, of parts or equipment, which upon return to Sundyne and upon Sundyne's examination prove to be defective. Equipment and accessories not manufactured by Sundyne are warranted only to the extent of and by the original manufacturers' warranty. Sundyne shall not be liable for damage or wear to equipment caused by abnormal conditions, vibration, failure to properly prime or to operate equipment without flow or caused by corrosives, abrasives or foreign objects. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED OR IMPLIED INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. In no event shall Sundyne be liable for consequential or incidental damages

EUROPEAN UNION MACHINERY DIRECTIVE
(CE Mark System)
(where applicable)

This document incorporates information relevant to the Machinery Directive 2006/42/EC. It should be read prior to the use of any of our equipment. Individual maintenance manuals which also conform to the EU Directive should be read when dealing with specific models.

EUROPEAN UNION ATEX DIRECTIVE

This document incorporates information relevant to the ATEX Directive 94/9/EC (Directive on equipment and protective systems intended for use in potentially explosive atmospheres). It should be read prior to the use of any our equipment.

Compliance to the Directive is based on Atmospheres having pressures ranging from 0.8 to 1.1 bar and temperatures ranging from –20 °C to + 60 °C.

As indicated in the ATEX Directive 94/9/EC, It is the responsibility of the user of the pump to indicate to HMD Sealless Pumps the Zone and Corresponding group (Dust or Gas) that the pump is to be installed within.

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EC Declaration of Conformity

Manufacturer: HMD Pumps Ltd

Details of Equipment:

Model	Description	Harmonised Standards applied in order to verify compliance to the Directive
GTI GTA GSI GSA GS GSP GSP/A ZL GSPV GSPLF LMV-801S SPGSI SPGSA HPGSI HPGSA CS	Magnetic Drive Sealless Centrifugal Pumps	MACHINERY DIRECTIVE 2006/42/EC: BS EN ISO 12100:2010 Safety of Machinery - General principles for design – Risk assessment and risk reduction BS EN 809:1998+A1:2009 Pumps and pump units for liquids - Common Safety Requirements ATEX DIRECTIVE 94/9/EC: BS EN 13463-1:2009 Non-electrical equipment for use in potentially explosive atmospheres - Part 1: Basic method and requirements BS EN 13463-5:2011 Non-electrical equipment intended for use in potentially explosive atmospheres Protection by constructional safety 'c'.

Directives to which the above equipment complies to:

Machinery Directive
Directive relating to Machinery (2006/42/EC)
ATEX Directive
Directive on equipment and protective systems intended for use in potentially explosive atmospheres (94/9/EC)
Group II Categories 2 and 3 (gas)

Notified body:

Intertek Testing and Certification Ltd
Intertek House
Cleeve Road, Leatherhead
Surrey, KT22 7SB. UK

Certification Number: ITS03ATEX11179 and ITS03ATEX11179/1

ATEX Technical Construction File Number: ATEX-HMD-001

Year in which CE Mark was affixed: 1996

We certify that magnetically driven, bare shaft and separately mounted pumps manufactured by HMD Pumps Ltd meet the requirements of the above Directives, when installed, operated and maintained in accordance with our published Installation and Operating Manual. HMD magnetic drive pumps must not be put into service until all the conditions relating to safety noted in this manual have been met.

Authorised signatories on behalf of HMD Pumps Ltd:

Name: Steve Rose **Position:** Managing Director

Name: David Clark **Position:** Senior Engineering Manager

Date of issue: 8th September 2015 **Place of Issue:** United Kingdom

Revisions

October 2015	Original Release

Contents

INTRODUCTION

Sundyne Centrifugal Pumps

Sundyne API pumps provide high-energy performance and competitive efficiencies in a compact unit that is easy to maintain. Sundyne pumps are single stage and are closely coupled (OH4). Designed to increase the pressure of a continuous flow of fluid by applying centrifugal action, Sundyne pumps are most commonly used in HPI, CPI, and Boiler Feed applications. Commonly applied in refineries, petrochemical plants, and power generation plants, Sundyne pumps are used in high-head, low-to-medium flow processes.

This manual presents installation, servicing, troubleshooting, maintenance, and spare parts information for the latest Sundyne LMV 801S centrifugal pump. It is important that the manual is read thoroughly before installing and operating the pump. Images provided in this manual are based on typical configurations. Refer to the drawings provided with the order for the actual configuration. Questions regarding parts, service or operation should be directed to your Authorized Service Center or a listed Sundyne location.

***Note**: Parenthetical numbers included in the text correspond to item numbers on the illustrated figures. The item number serves as a location identifier and not a part number. The correct spare part can be ordered referencing the item and serial numbers. From there the correct part number can be obtained.*

Whilst every care is taken to ensure that the information is correct, no liability can be accepted by Sundyne or HMD Sealless Pumps for loss, damage or injury caused by errors in or omission from the information given.

Sundyne LLC RESERVES THE RIGHT TO CHANGE THEIR RECOMMENDATIONS WITHOUT PRIOR NOTICE OR CONSULTATION.

Text Symbols

In accordance with general safety and handling, OSHA 1910.145, BS EN 809 and other local directives, the following warning symbols and signs are used in this manual.

DANGER: Text accompanied by this symbol indicates failure to avoid hazards identified with this symbol will result in death.

WARNING: Text accompanied by this symbol indicates that failure to recognize these hazards could result in injury or even death.

ELECTRICAL HAZARD: Text accompanied by this symbol indicates that failure to follow directions could result in electrical damage to equipment or electrical shock.

RECOMMENDED: Text accompanied by this symbol indicates recommended usage.

REMINDER: Text accompanied by this symbol indicates a reminder to perform an action.

EQUIPMENT USE ALERT: Text accompanied by this symbol indicates that failure to follow directions could result in damage to equipment.

RECOMMENDED TOOL: Text accompanied by this symbol identifies the tool required for the operation.

Equivalent Terms

To assist in global understanding the following equivalent terminology is used: -

Used in this manual	**Also known as**
Alignment Pad	Support Gasket
Bush	Radial Bearing or Journal Bearing
Bearing Assembly	Power Frame
Containment Shell	Shroud
Gasket	Joint
Spanner	Wrench
Fit	Install
Grounding	Earthing
Check Valve	Non Return Valve

Units

Both Metric and equivalent US units are shown in this manual where appropriate.

Conversion factors between units are: -

°C	to	°F	multiply by 1.8 and add 32
mm	to	inches	divide by 25.4
Nm	to	lbf-ft	divide by 1.356
ml	to	US Fl.oz	divide by 29.6

Equipment and Safety Precautions

Sundyne LLC manufactures centrifugal pumps to exacting International Quality Management System Standards (ISO 9001) as certified and audited by Lloyd's Register Quality Assurance Limited. Genuine parts and accessories are specifically designed and tested for use with these products to ensure continued product quality and performance. Sundyne cannot test all parts and accessories sourced from other vendors; incorrect design and/or fabrication of such parts and accessories may adversely affect the performance and safety features of these products. Failure to properly select, install or use authorized Sundyne pump parts and accessories is considered misuse and damage or failure caused by misuse is not covered by Sundyne's warranty. Additionally, modification of Sundyne products or removal of original components may impair the safety of these products and their effective operation.

CHEMICAL HAZARD

Sundyne pumps may handle hazardous, flammable, and/or toxic fluids. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury and compliance must be ensured with COSHH, EPA or any applicable Health and Safety legislation. Pumpage must be handled and disposed of in accordance with applicable environmental regulations.

Safety procedures must be applied prior to any installation, maintenance, or repair of a Sundyne pump. Failure to follow safety precautions may lead to injury!

All pumps returned to Sundyne or HMD for servicing must have a decontamination certificate and the appropriate Health and Safety data sheets.

Wearing Personal Protective Equipment

To ensure safety, protective equipment must be worn at all times when installing, performing maintenance, or repairing equipment. The following safety recommendations must be adhered to for optimum safety:

- Safety glasses with side shields that meet ANSI Z87.1 standard for impact resistance must be worn at all times.
- Protective footwear (steel-toe shoes) meeting ASTM F2413-11 standard specification for performance requirement of protective footwear.
- Hearing protection is strongly recommended at all times when noise levels exceed 85 dB during an eight (8.0) hour period.

Chemical resistant gloves must be used if chemicals are utilized (refer to Using Chemicals for additional information).

A dust mask respirator must be worn if chemicals have warning labels regarding fumes, dust, or mists.

When using more than one piece of protective equipment, consider their compatibility. For example, safety glasses will not interfere with hearing protection equipment. Be sure to clean all pieces of personal protective equipment immediately after each use.

Refer to Section 8 of the chemical specific Safety Data Sheet for any additional PPE requirements.

Lifting

Attention must be given to the safe handling of all items. This applies to both installation and maintenance. Where pumps, pump units, or components weigh in excess of 35 lbs (16Kg) it is recommended that suitable lifting equipment should be used in the correct manner to ensure that personal injury or damage to pump components does not occur. Note that lifting eyes fitted to individual pieces such as pump and motor are designed to lift only this part and not the complete assembly

Using Forklifts

Any persons operating a forklift must have an active recognized operator license.

Before initializing forklift operation, verify that the lift is in a safe operating position.

Ensuring Electrical Safety

All electrical sources must be powered-off before installation, service, or repair of equipment occurs.

Sundyne recommends that a Lock-out/Tag-out program be followed prior to altering the equipment. Locks or tags must be provided to warn employees that equipment is temporarily unavailable.

Once all work has been completed, the person installing the lock or tag must remove it according to company procedure.

Testing Equipment

Prior to performing a test on newly installed, maintained, or repaired equipment; all personnel in the immediate area must be warned.

Follow company procedures prior to equipment testing at all times.

Magnets

Sundyne sealless pumps contain high strength magnets which may, in some circumstances, affect the operation of certain types of medical implants such as pacemakers. Wearers of these implants should take extreme caution when in proximity to a Sundyne sealless pump. The assembled pump presents no known problems, however internal components need to be treated with caution. Care should be exercised with wristwatches and other sensitive equipment from the strong magnetic field when working around and handling the Inner or Outer Magnet Rings.

Once all work has been completed, the person installing the lock or tag must remove it according to company procedure.

Using Chemicals

Any chemicals to be used must be accompanied by a relevant safety data sheet (SDS), in accordance with government legislation. If applicable, use chemical proof gloves.

An eye wash station (or equivalent) should be available in the event of injury. If any hazardous or flammable chemicals pass through the equipment, a complete decontamination of the equipment is required.

Protection from Falling

Fall protection and associated preventative measures are required when working on equipment located four feet or higher from the ground.

Follow company fall prevention procedures prior to working on equipment.

Preventative Machine Guards

Preventative guards must remain in place on all equipment.

Only remove the guards while performing maintenance or repair.

Replace the guards immediately after working on the equipment and prior to start up.

EXPLOSION/FIRE HAZARD

Never use an acetylene torch, open flame, or heat to attempt to remove parts that have seized together in Sundyne equipment. Any residual process gas or liquid that is flammable can result in an explosion or fire with potential for serious injury or death.

Pre-Commission Checklist

Familiarizing Yourself with the Pump

Before servicing and starting up the Sundyne pump, carefully review all information on the product, including:

- Specification sheets
- Outline drawings
- Performance curves
- Instruction and related manuals
- System P&ID/Process Flow Diagram (Clients equipment)
- Control system and operational philosophy/narrative (Client)

Familiarize yourself with the pump configuration before starting and operating the pump.

Driver Instructions

Carefully follow all installation and starting instructions provided by the driver manufacturer. This information is included in the final data package.

Verifying Auxiliaries

Before start up, verify that the following auxiliaries are met:

- Check the utility connections
- Verify that the auxiliary piping conforms to Sundyne standards, as indicated in the detailed specifications
- Verify all switch and instrument connections
- Verify that all switch and instrument settings are set to normal operating standards
- Calibrate all measurement equipment, such as flow meters, ampere meters, and pressure meters, etc.

Checking Driver Rotation

Verify that the direction of the driver rotates in the same direction as the arrow stamped or cast on the pump casing.

Do not run pump dry

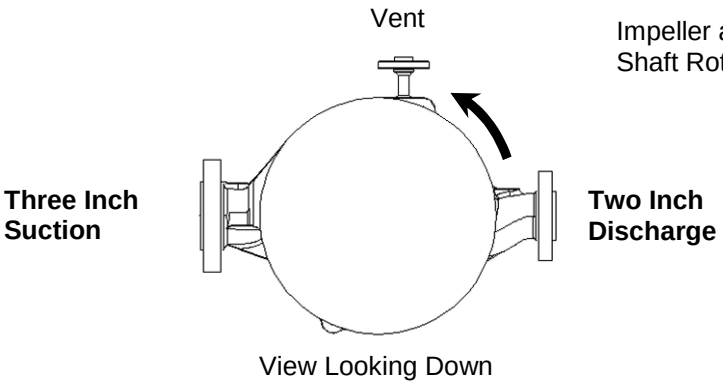
Piping Connections

Verify that the following bolted or threaded connections are tight:

- Pump flange bolts
- Is a check valve in the discharge line?
- Note: A start-up bypass line upstream of the check valve is recommended whenever feasible

Looking down→

Rotation of the driver must be counter-clockwise.



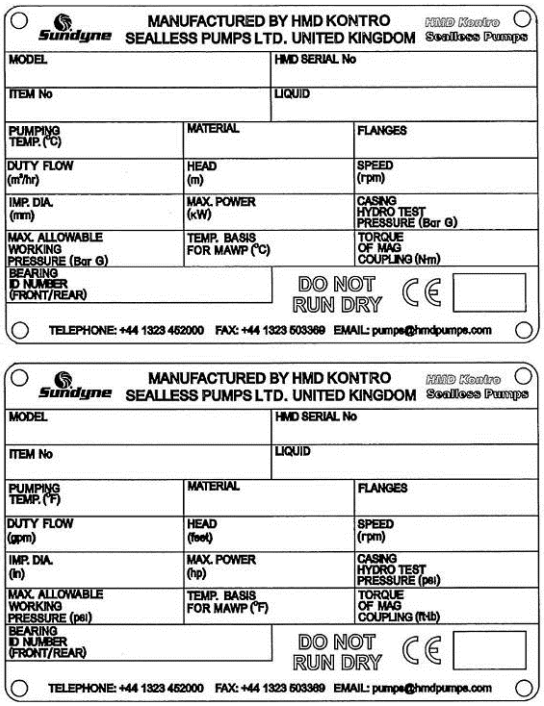
View Looking Down

General

Application or Use

Each pump is designed for operation at the conditions stated on the pump label (Fig 1). Should the need arise to operate the pump outside of the conditions indicated on the pump label, Sundyne should be contacted to check and confirm that the pump can be operated safely at the revised operating conditions.

Fig 1



Temperature Classification - (ATEX Directive 94/9/EC)

The maximum surface temperature of a metallic magnetic drive pump is the highest temperature ascertained from any one of the following conditions:

1. The temperature of the pumped liquid, plus 20°C (68°F).
   or
2. The ambient temperature plus 20°C (68°F).
   or
3. The ambient temperature plus 39°C (102°F) (only in the case of separately mounted pumps with oil lubricated bearing assemblies).
   or
4. The temperature of the heating medium being used in the heating jacket (if fitted).

The actual classification is calculated by obtaining the maximum surface temperature and then using the following table to obtain the relevant Temperature Class:

Table 1

Temperature Class	Maximum Surface Temperature (°C)	Maximum Surface Temperature (°F)
T1	450	842
T2	300	572
T3	200	392
T4	135	275
T5	100	212
T6	85	185

Example:
The pump is pumping a liquid with a temperature of 120°C (248ºF). The pump is close coupled and therefore does not have an external oil lubricated bearings. The maximum ambient temperature in which the pump may operate is 30°C (86ºF)

Condition 1 equates to 120°C + 20°C = 140°C (284ºF).
Condition 2 equates to 30°C + 20°C = 50°C (122ºF).
Condition 3 does not apply.
Condition 4 does not apply.

Thus the maximum surface temperature of the pump is 140°C which equates to a temperature classification of T3.

The maximum surface temperature of a plastic lined non-metallic magnetic drive pump or a ZeroLoss shell pump is the highest temperature ascertained from any one of the following conditions:

1. The temperature of the pumped liquid, plus 10°C (50ºF).
   or
2. The ambient temperature plus 10°C (50ºF).
   or
3. The ambient temperature plus 39°C (102ºF)(only in the case of separately mounted pumps with oil lubricated bearing assemblies).

INSTALLATION

Inspection

Inspect the shipping container for any damage sustained during shipment. If damage is found, note the nature and extent before unpacking. A photograph is helpful in any claims to be made against the shipper; also, inform Sundyne or the local authorized distributor. Check the nameplate data against the shipping papers and against your purchase order to ensure that the correct pump is supplied.

After unpacking check to see that the suction and discharge flanges are sealed. If the seals have come loose, examine the pump to ensure no packing material or dirt is in the casing. It may be necessary to remove the pump casing to check. Refer to the Dismantling Instructions if required.

Inspect the suction and discharge flanges to be certain that they are free from scratches or nicks and that they are clean. The gasket seating surfaces in particular should be cleaned carefully.

Ensure that a copy of this manual is in the hands of the installation personnel and that they have read it thoroughly before proceeding further.

The input shaft on the pump should turn freely on the pump, however it should not be turned excessively when the pump is dry. Excessive rotation of the shaft when the pump is dry may result in damage to the bearings. If the input shaft does turn freely, and if rotation is "not smooth," damage may have occurred during shipping.

Storing Your Pump Short-Term

If your Sundyne pump is not to be installed immediately but within the next 6 months, protect it from exposure to moisture and dust. The pump should be left undisturbed in its transportation packaging and stored in a dry area and not subjected to vibration.
If removal from the packaging is necessary, the pump should be stored covered in a clean, dry area protected from physical damage and vibration. All flanged and threaded connections should remain capped.

***Note**: Observe the storage instructions provided by the driver manufacturer.*

Storing Your Pump Long-Term

In addition to the precautions in the short-term section above, additional precautions are required for long-term storage.

If your Sundyne pump will not be operated for a period of time exceeding six months from the date of shipment, long-term storage conditions must be met. Sundyne should be informed at the time of order that long term storage is anticipated so that special packaging arrangements can be made. These will consist of:

- The pump will be packed in a wooden crate.
- The pump will be packed with bags of silica gel and covered with tar paper.

- All machined surfaces will be greased (if appropriate).
- All flanges and threaded connections will be capped.

Recommended Long-Term Storage Procedures

It is recommended that the pump should be left in its transportation packaging and stored in a dry area and not subjected to any vibration, which may cause brinelling of the electrical motor and pump bearings. At suitable intervals, during a period of storage, the pump rotor should be turned by hand.
After long term storage, when the pump is installed, the grease and oil lubricated assemblies should have the lubricants cleaned out and replaced. Refer to the section 7.2.1 for further details. This precaution is necessary because lubricants can deteriorate after a period of time.
Prior to installation it is recommended that the pump is inspected by a Sundyne engineer and that the commissioning is similarly supervised.

***Note**: Sundyne does not accept liability for equipment damaged during the storage period. Sundyne does not guarantee the quality of equipment during and after the storage period.*

***Note**: Any inspection fees are the sole responsibility of the purchaser.*

Installation Guidelines

Location

Centrifugal pumps should be installed as close as is practical to the source of liquid supply and preferably below the liquid level in the supply vessel.

Pumps installed on systems requiring suction lifts need special consideration and Sundyne should be consulted.

Pump units must be installed to ensure that adequate space is available for access and maintenance.

Sundyne supplies certified drawings showing foundation details and the space necessary to carry out routine inspection and maintenance with every pump; extra drawings are available at a moderate cost on request.

Foundations

Foundations may consist of any structure heavy enough to afford permanent rigid support to the full area of the pump base and to absorb any normal strains or shock. Concrete foundations built up from solid ground are the most satisfactory.

The pump base in the case of close coupled, or the base plate in the case of separately mounted pumps should be bolted securely in position with suitable foundation bolts.

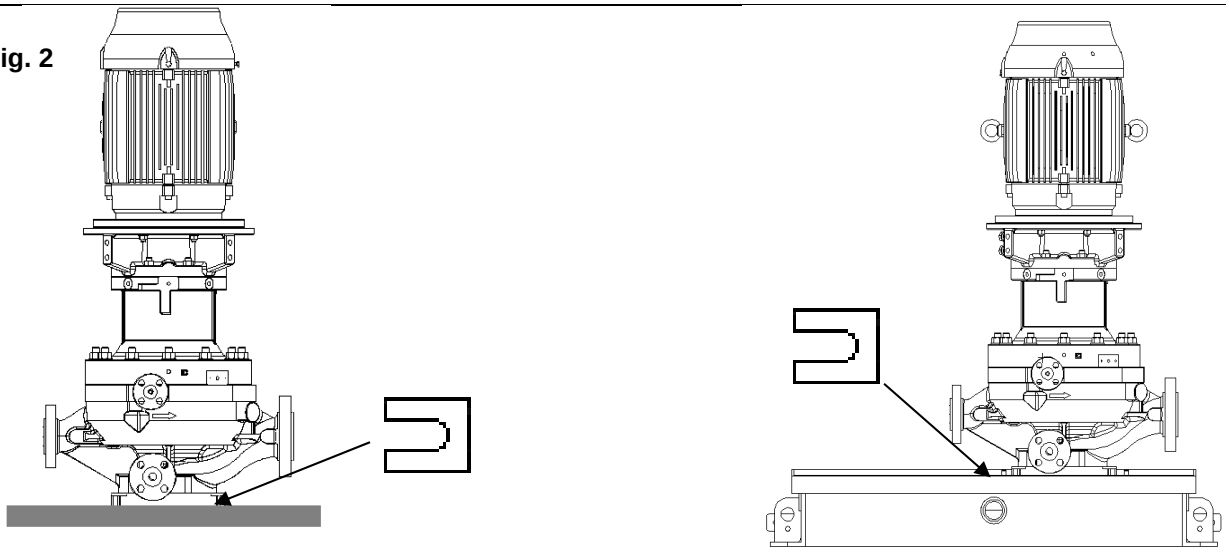
When a pump unit is mounted on steelwork or other such structures, care must be taken to ensure that the baseplate is not subject to distortion or vibration.

Where possible the pump units should be mounted over or as near as possible to main supporting members.

It may be necessary to mount pump units resiliently if there is the possibility of excess vibration. If in doubt, contact Sundyne or the authorized distributor.

Misalignment should be corrected by shims. Grouting may be necessary to prevent movement of the pump and stop the accumulation of chemical or hydrocarbon under the pump base. The pump should be leveled by shimming under the base prior to grouting the channels that are to be filled with grout through the access holes. The nuts on the foundation bolts should not be tightened until the grout has set for at least 48 hours. Fig. 2.

Fig. 2



Electrical Installation & Grounding

Electrical connection of the pump motor, to a suitably rated power supply shall be carried out by electrically skilled persons or staff. Care should be taken to ensure that the motor electrical connection will not overload the power supply. Provision shall be made to enable electrical isolation of the equipment.

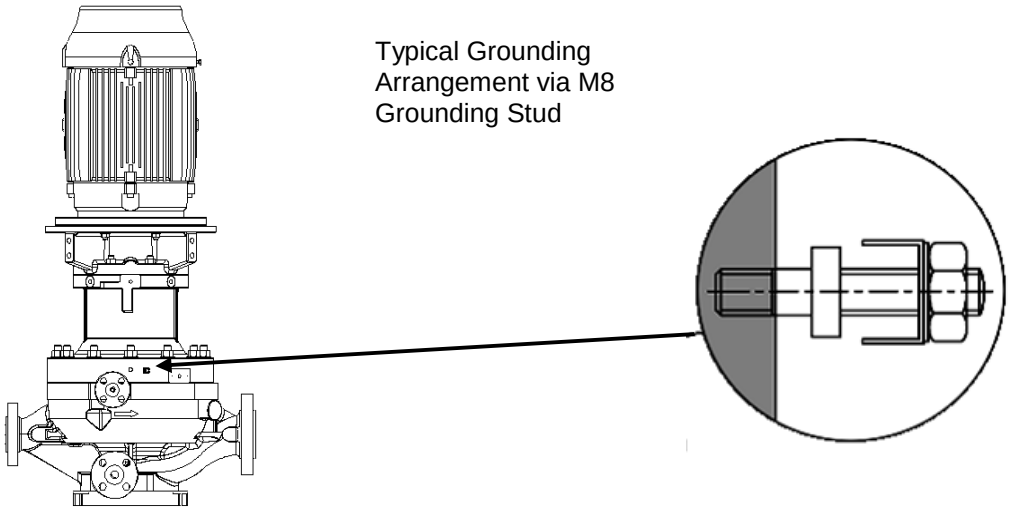
Pumps that have been supplied in accordance to the ATEX Directive (94/9/EC) will be identified by a label with the following symbol on it:

Such units are supplied with an M8 grounding stud, saddle washer, shake-proof washer and locking nut located on the Coupling Housing (Item 43.43). Once the unit has been installed and levelled, this shall be wired to ground with a suitable grounding cable, Fig 3, by electrically skilled persons or staff.

To further protect the integrity of the unit, an additional grounding connection can be made to the motor.

Fig. 3

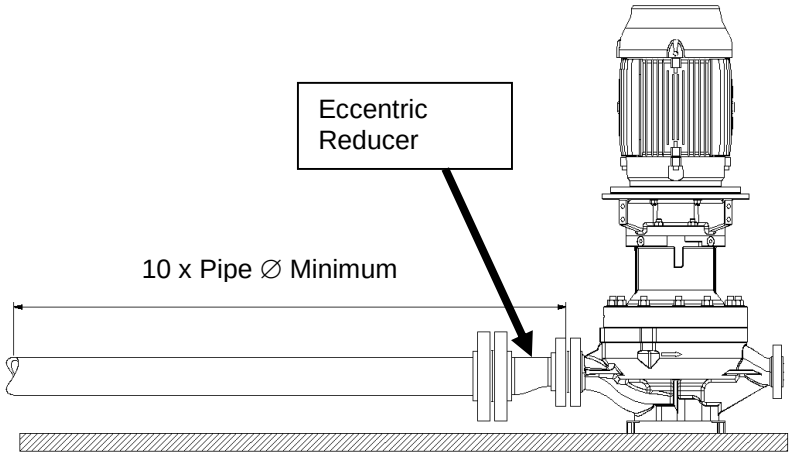
Typical Grounding Arrangement via M8 Grounding Stud



Suction and Discharge Piping

Good practice dictates that there should be a minimum straight length of pipe on the suction flange of the pump equal to ten times the suction pipe diameter. This is to allow the liquid to flow into the pump casing without turbulence. (Fig. 4)

Fig. 4

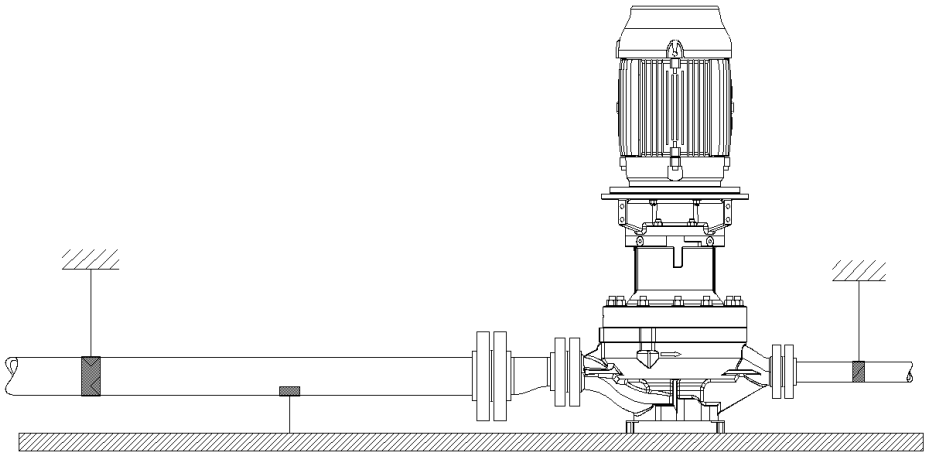


In addition, it is also good practice to use suction pipeline at least one to two sizes larger than the pump nozzle and reduce the pipe diameter at the pump flange. When doing so, insure the eccentric reducer is installed as shown with sloped side facing down (Fig. 4).

Ensure that the inside diameter of the suction pipe matches the nozzle openings as accurately as possible in order not to strain the pump casing. On no account lever the suction pipe flange to align it to the pump suction nozzle flange. The flange bolts should slip in to the aligned flange holes without straining the pipework.

Apply proper support to suction and discharge piping with proprietary pipe hangers or supports to keep the strain off the pump casing. (Fig. 5)

Fig. 5

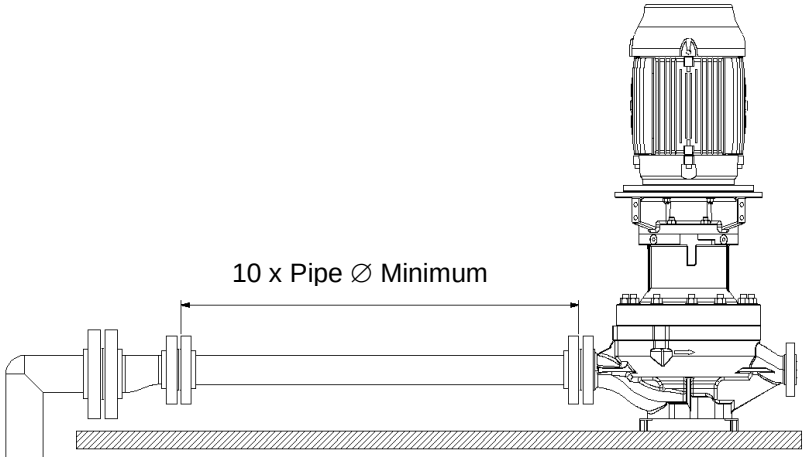


Ensure that all joints in the suction pipework are airtight.

Install suction piping, elbows, eccentric reducers (flat side up as in Fig 6) and all other fittings so that no air pockets can be created within the suction system.

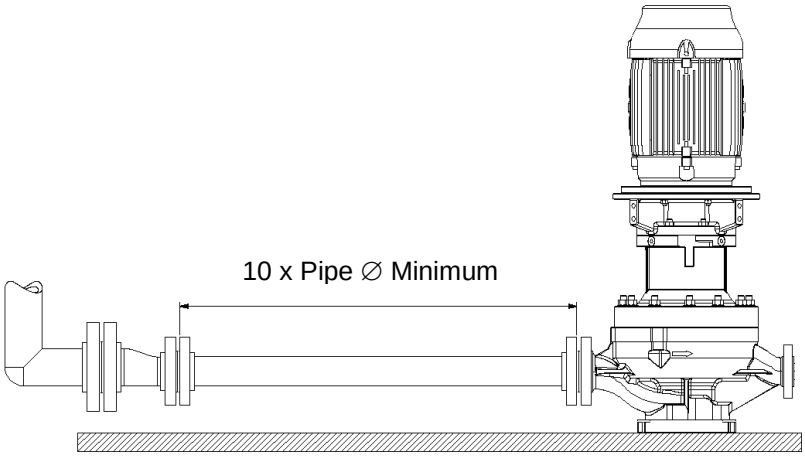
Position of eccentric reducer when liquid is below pump centerline. (Fig. 6)

Fig. 6



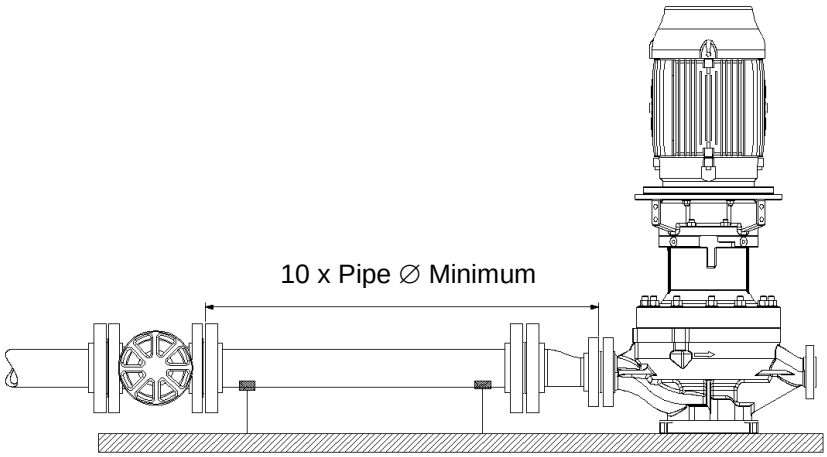
Position of eccentric reducer when liquid is above pump centerline. (Fig. 7)

Fig. 7



Mount valves from the suction pipework with the stems horizontal or vertically down to avoid air pockets. (Fig. 8)

Fig. 8



Pitfalls to Avoid On Suction Pipework

Avoid the use of valves that have high friction loss.

Avoid the use of in-line filters (with the exception of the commissioning period)

Avoid pipework layouts that promote vortices at the liquid level in the supply vessel.

Avoid the use of multiple spring type check valves.

Avoid flow meters.

Avoid at all costs a pipework system that may allow the pump to run dry.

Avoid using more than one pump feeding at the same time from a common suction pipeline.

Avoid any operating conditions that reduce the NET POSITIVE SUCTION HEAD (See section covering NPSH).

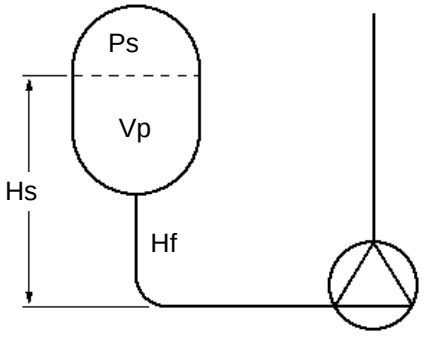
Net Positive Suction Head (NPSH)

Liquids cannot be towed or dragged down a pipe; liquids can only be pushed along a pipe. The push the liquid needs to flow in to the pump can only be supplied by some external energy source such as the absolute pressure in the surface of the liquid in the vessel and the head of the liquid over the center line of the pump.

A system that has insufficient NPSH available will cause the pump to cavitate. The general effects of cavitation are noise, erosion of metal surfaces and vibration of the system. The latter situation will result in the magnetic coupling overheating and the product-lubricated bearings will wear rapidly. Cavitation starts when the pressure at the pump suction falls near to the value of the vapor pressure of the pump liquid and this varies with temperature.

At the time the pump is selected, the NPSH available will have been calculated as per the following method: -

Fig. 9



NSPH available = Ps-Vp+Hs+Vs-Hf
Where:
Ps = Absolute pressure in suction vessel
Vp = Vapour pressure of liquid
Hs = Total static head
Hf = Friction losses in suction line
Vs = Velocity Head = $\frac{V^2}{2G}$

In the above equation, all parameters must be converted to meters head of liquid before the liquid calculation is carried out. The pump should be selected so that the NPSH available is a minimum of 0.5m (1.6 ft) greater than the NPSH required by the pump.

No subsequent alteration should be made to the pipework system without considering the effect that it will have on the NPSH available.

Discharge Pipework

The discharge pipework and its related equipment does not normally have as great an influence on pump performance as the suction pipework. There are, however, some points to watch with discharge pipework to ensure efficient pump operation.

In a manner similar to the suction pipework, provision must be made to support the discharge pipework and any other equipment.

The discharge pipework is normally more extensive than the suction system, so there are increased amounts of pipe strain being transferred to the pump and this must be avoided.

Where possible, there should be a straight length of pipe immediately on the discharge nozzle followed by a suitable valve and between the valve and the discharge flange there should be a pressure gauge to help monitor the pump's performance.

Should a check valve be fitted in the pump discharge line, provision should be made to vent the space between the pump and the check valve or the pump will not prime.

It cannot be stressed enough, how important it is to have pressure gauges on both the suction and the discharge sides of the pump.

Should a bypass be incorporated in the system, the bypass line should incorporate an orifice plate to ensure that the pump – in bypass mode - operates at the specified minimum safe flow (Fig. 10).

The bypass system should not be led back to the pump suction directly; it should be led back to the supply vessel to dissipate any heat built up during the bypass cycle.

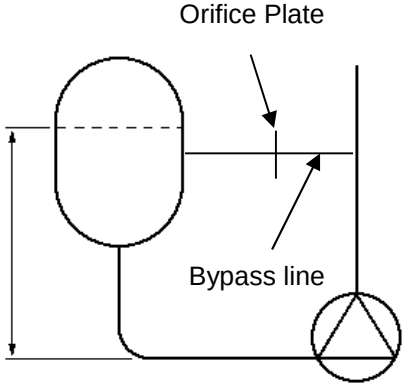
Motorized valves should be controlled such that they do not deadhead the pump whilst it is running.

It is also important that the system and its operation cannot permit the pump to lose differential head as any substantial loss of head could cause damage to the pump.

Never use force to position piping into place at the flanged suction and discharge connection locations. Failure to have piping properly aligned may impose excessive strains on the unit.

To ensure correct hydraulic performance, the orifice plate, when supplied must be installed, clamped on center between the pump discharge nozzle and the discharge pipe flange.

Fig. 10



Protection Systems

To minimize the effect of process or system malfunction the LMV 801S Sealless Pump can be provided with various fail safe devices to increase plant security.

The type of instrumentation or safety devices offered depends on the properties of the process liquid, the application and plant operating procedures.

It is rare, that all of the protection methods illustrated are needed and the number or type of protective device fitted is often a matter of client experience and preference.

Power Control Monitor (PCM)

Protects Against

- Dry Running
- Pump Seizure
- Cavitation
- Motor Faults
- Closed Valve

Motor power monitoring can provide good pump protection against low flow or dry running. Being remote from the pump head the power sensor is not affected by the liquid handled and is, therefore, more reliable than differential pressure or flow switches.

Temperature Sensor

Protects Against

- Dry Running
- Closed Head and Minimum Flow
- Internal/External Bearing Wear
- Pump Seizure
- Severe Cavitation
- Process Overheating

The containment shell provides pressure retention of the liquid cooling the pump bearings. The temperature sensor monitors the temperature of the outside diameter of the containment shell detecting temperature movements in response to operational change. The temperature sensing device, therefore, provides an optimum, inexpensive form of continuous pump protection. Normally an over temperature cut out and/or alarm is required, but low and high trips can be provided for liquids which can freeze at ambient air temperatures.

Differential Pressure Switches

Protects Against

- Dry running
- Minimum/Maximum Flow and Closed Head
- Severe Cavitation
- Pump Seizure

It is essential that sealless pumps are not run dry otherwise rapid bearing wear and heat buildup will occur. Differential pressure switches are reliable and economic forms of dry running protection. These failsafe devices are particularly suited to applications where the risk of suction starvation is high. The switch contacts are wired into the motor control circuit to provide a pump cut-out in the event of a drop in pump differential pressure.

Liquid Sensing Probe

Protects Against

- Internal Liquid Leakage
- Starting the pump dry

This instrumentation is usually installed in conjunction with a pressure tight coupling housing. An early warning of internal leakage is given before dangerous quantities of spillage can fill the housing. Another use for the liquid sensing probe is to ensure that the pump is primed with liquid before it can be started. When used for this, the liquid sensing probe is mounted at the pump discharge flange.

Secondary Containment or Control

Protects Against

- Leakage to Atmosphere
- Hazardous Emissions

Where a requirement for secondary containment or control exists, a sealed coupling housing is used to provide secondary pressure retention, to contain or control fluid leakage. The sealed coupling housing is pressure tested to the same hydraulic pressure rating as the pump liquid end. The drive shaft is fitted with a sealing system to suit.

The sealed coupling housing can be configured with optional flanged, top vent and drain vent ports to enable connection to different sensors and to enable the safe disposal and flushing of a system, in the unlikely event of a primary containment breach.
Although not always required, the pressure tight housing is desirable for very toxic or flammable chemicals.

The sealed coupling housing can be specified with a variety of sensors, varying in sensitivity from; the Liquid Sensing Probe (refer to previous section), a pressure switch or a gas or vapor detector. These sensors along with the shaft sealing system are configured to either prevent or limit any liquid or vapor escaping the primary pressure boundary from entering the power frame and its bearings.

If you require further information on secondary containment or control options, or pump protection devices please contact Sundyne/HMD or your local agent.

VapourView®

Protects Against

- Dry Running
- Gas or Vapour Related Process Upsets
- Gas in System or Vapourisation
- Pump Seizure

VapourView® is a patent protected instrument that sits outside the primary pressure boundary and uses ultrasonic technology to monitor the presence of gas or vapour in the containment shell. In addition to protecting the operation of the magnetic drive pump the VapourView® instrument provides vital information to an end-user on the condition of the process liquid.

It is strongly recommended, that as a minimum, power sensing protection with a Power Control Monitor is used to ensure long and safe operation of your sealless pump. This is particularly relevant to pumps being used in potentially explosive atmospheres.

For guidance on the availability of protection systems for a specific pump range, please refer to Fig. 11 and Table 2.

If you have a specific requirement, contact Sundyne/HMD to discuss the available options in more detail.

Fig. 11: Protection Systems (Typical)

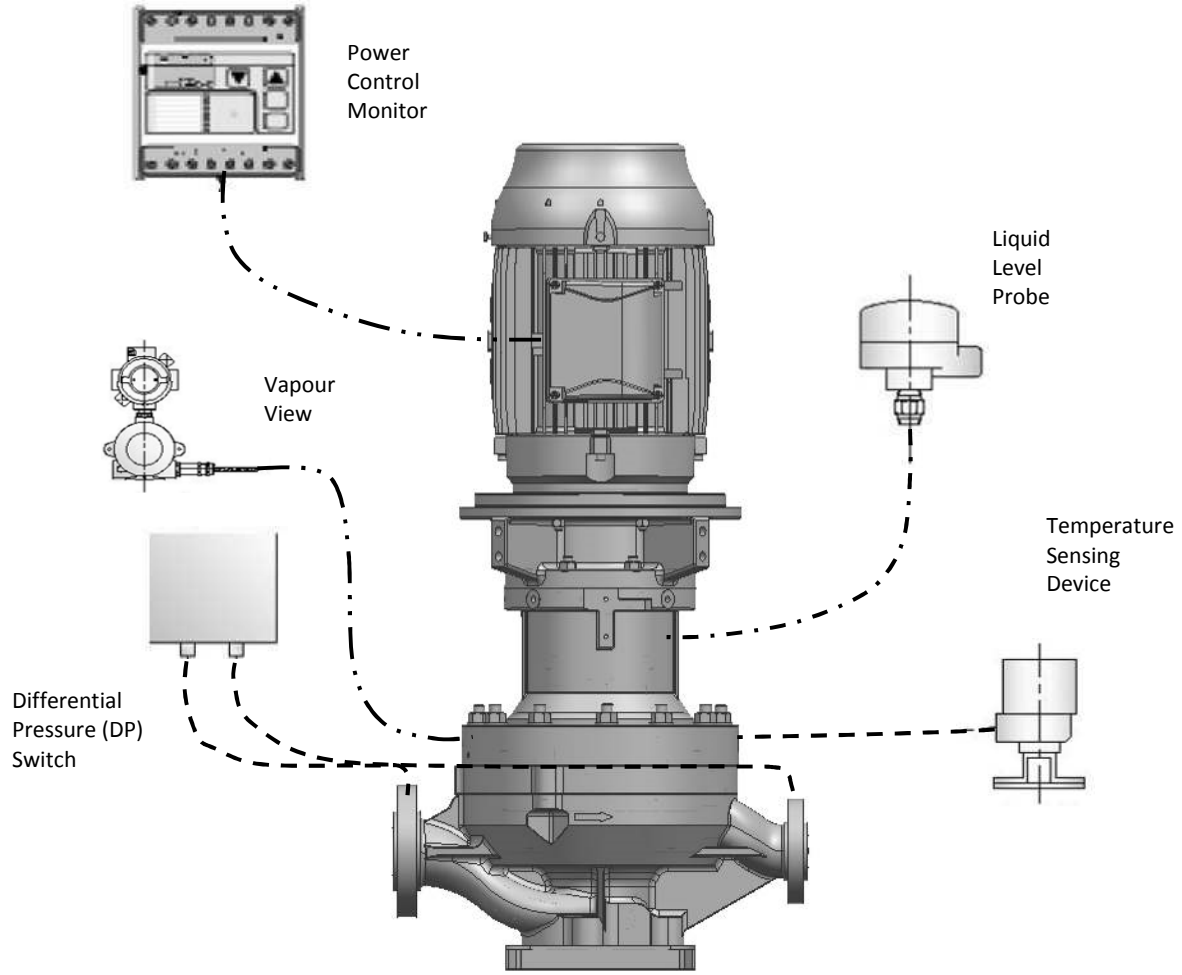


Table 2: Availability of Instrumentation

Model Prefix	Power Control Monitor	Temperature Sensing Device	Differential Pressure Switches[1]	Pressure Tight Coupling Housing	Liquid Sensing Probe	Secondary Containment or Control	Vapour View
LMV 801S	✓	✓	✓	✓	✓	✓	✓

Note: Any instrumentation installed in a Potentially Explosive Atmosphere should be ATEX certified.

[1] In some cases the connection of DP switch is made into suction and discharge piping and not the pump casing.

Precautions

Installation Considerations

A significant proportion of all pump problems occur during the commissioning period. There are a number of reasons for these problems and usually they are not as a result of poor materials, bad workmanship or design of the pump.

Normally, the problems encountered during commissioning are due to:

- Debris left in the system during the construction period
- Unexpected system characteristics
- Incorrect pump selection

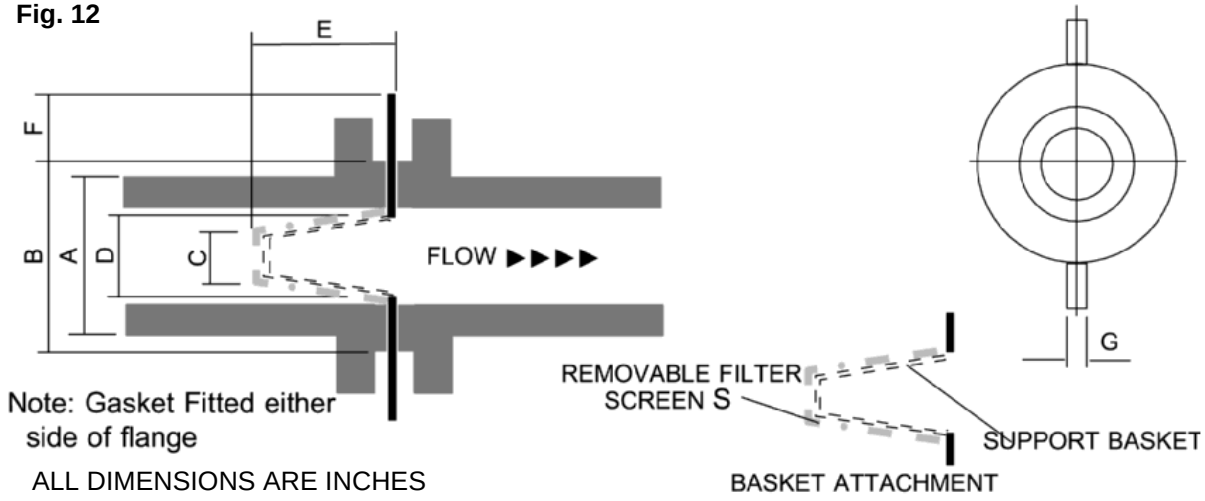
Every effort should be made to ensure that debris is removed from the pipework and related equipment prior to installing the pump.

The pump should not be installed until all pipework has been flushed to remove washers, nuts, welding slag, welding rod, studs, pieces of gasket material, pieces of rag, shot etc.

When the system has been cleared, the pump can be installed but provision should be made to install a temporary filter in the suction pipework close to the pump.

The recommended filter size and the method and position of it installation are shown in Fig. 12 and Fig. 13.

Fig. 12



A	B	C	D	E	F	G	S	Pipe Flow Area SCH 40	Pipe Flow Area SCH 80	Strainer Flow Area
3	5	1.75	2.69	6.5	3.5	1.5	40 X 40 Mesh	7.39	6.6	28.4

Note: Basket made from 16 SWG compatible with pump liquid

The filter consists of a 16 SWG metal basket (metal to be compatible with commissioning liquid) and a 40x40 mesh wire screen cloth.

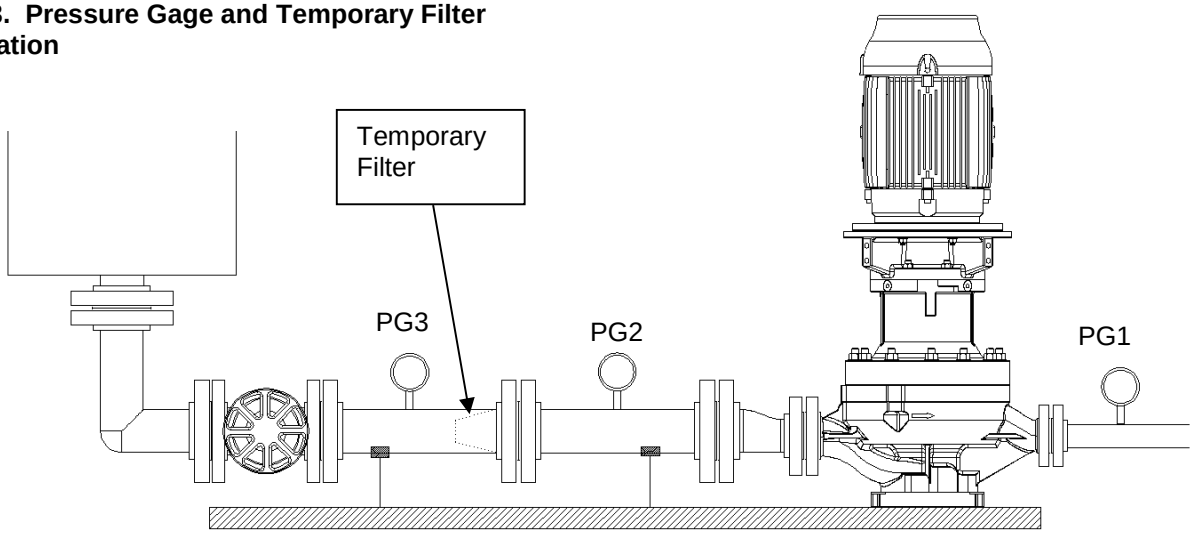
The table in Fig 12 shows the relationship between pipe diameter, its flow area and the strainer flow area.

Do not use a flat spade type screen in the system, the flow area will be less than the pipe flow area and this may create problems due to rapid blockage.

Fig. 13 shows how the temporary filter is installed in the system. It is important that all the gauges (PG1, PG2 and PG3) are installed; PG2 and PG3 will indicate if the filter is blocking and PG2 and PG1 will monitor the differential head across the pump to check that the pump is achieving duty.

After commissioning, gauges PG1 and PG2 should be installed permanently as they afford excellent continuing checks on the pump's performance.

Fig. 13. Pressure Gage and Temporary Filter Installation



The gauges should be calibrated in the same units and measure absolute pressure.

All pipework and related equipment should be checked to ensure it is installed correctly and is leak free.

Commissioning

General

The LMV-801S pump is a vertical in-line type pumps and is normally close coupled to the drive motor. Prior to initial start-up, special attention must be given to both checking the direction of rotation and to venting any trapped air from the pumps.

The LMV-801S pump must never be run against a closed discharge valve.

Venting

Purpose

Internal rotating parts are supported by plain bearings that are lubricated with the liquid being pumped. It is imperative that all internal bearings are immersed in the pumped liquid before the pump is run for the first time after installation or maintenance. Proper venting of the pump will ensure all bearings are flooded and ready for start-up.

Method

The following method for venting can be used for the LMV-801S pumps.

- Open both suction and discharge lines to flood pump
- Wait 5 minutes
- Open the vent line to purge air, close vent line
- Wait 5 minutes
- Open vent line a second time to purge remaining air, close vent line

Pump is now ready for direction of rotation check.

On pump startup, check that discharge head is within expected operating range. If discharge head is lower than expected, vent pump once more.

Direction of Rotation

Ensure pump is full of liquid prior to checking direction of rotation – Never run the pump dry, even briefly to check rotation.

- Fill pump with liquid and vent as above
- Connect motor terminals to power supply
- Remove motor cowl to observe motor fan
- Check direction of rotation labelling on pump
- Briefly energize motor to check direction is correct
- If direction is wrong, swap over two phases on the terminal block
- Re-check direction
- Replace motor cowl

Pump is now ready for start-up providing the proper venting procedure has been carried out. Refer to section for Pump Operation.

START UP

Start-Up Procedures

Run-In

If the pump is to be run under conditions which are considerably different from those conditions listed on the spec sheet (such as a change in specific gravity, suction pressure, flow rate, etc.) the factory should be consulted to ensure that the run-in conditions are compatible with the pump.

Start Up

Close all drains; open the suction and discharge valves fully and allow the pump to fill with liquid. Open the vent line and allow gas to vent appropriately, prior to starting the pump. Allow pump to vent until all gas has escaped and only liquid flows. Refer to the section *Venting* for the recommended procedure.

Do not energize the motor until the pump has been completely filled with liquid.

Check that the motor rotates in the same direction as the indicating arrow.

!! WARNING !! Under NO circumstances should the pump be run in the reverse direction!!

Close down the discharge valve so that it is about one quarter open. This is done to prevent excessive loading of the pump or driver when starting.

The LMV-801S pump must never be run against a closed discharge valve.

Fix your attention on the discharge pressure gauge (PG1 – see Fig. 13) and start the motor. The pressure should rise quickly and remain steady. If it hesitates and drops back to a lower level, even momentarily, stop the pump. The erratic pressure behavior is a sign that air and/or vapors are being purged from the pump.

Wait ten to fifteen seconds and the repeat step above. You may have to repeat this sequence several times before the discharge pressure goes to the correct reading and remains steady. At that time, the pump is fully primed.

With the pump running fully-primed, you should listen for any unusual noises. Metallic scraping sounds would be obvious signals to shut down the pump. Refer to section Operating Guidelines to locate the source of these noises.

If the pump emits a rumbling noise from the casing end, the problem is cavitation. Cavitation is the formation of vapor bubbles in the eye of the impeller and their subsequent collapse within the pump. Cavitation is usually due to inadequate NPSH available. Stop the pump and check there are no obstructions in the suction pipework system. Recheck the NPSH available and ensure that this is at least 0.5 meters (1.6 feet) greater than the pump requires.

Do not continue to run the pump under cavitating conditions.

Call the system designer to check the calculations.

When the cause of the cavitation is established and corrected, continue the commissioning.

The differential pressure should now be checked by subtracting the suction pressure gauge reading from the discharge pressure gauge reading and the answer is the differential pressure in absolute terms.

This pressure should then be converted to meters head of liquid taking into account the specific gravity of the liquid.

When the head has been calculated, it should be compared with that stamped on the pump nameplate. Any variation should be investigated.

All of these startup steps and checks can be made in a relatively short time. The only remaining requirement is to monitor for particles or debris content in the pumped liquid over a period of time. Some systems will only require twenty-four hours of monitoring whilst others may need much more. The actual time required depends on the pumped liquid & the process conditions.

Check the pressure drop across the start-up filter (PG3-PG2) continually. Under NO circumstances should PG2 be allowed to drop to the point where the NPSH available at the suction flange drops below required level. The danger pressure should be known before commissioning. (Fig. 13) is system related.

When the pressure drop (PG3-PG2) increases, the temporary screen is becoming clogged with particles and should be cleaned out. This will require closing down the discharge and suction valves to isolate the pump and screen. After the strainer has been cleaned and re-installed, the pump will have to be primed just as on initial start-up. (Fig. 13).

Examine the debris and/or particles removed from the strainer each time it is cleaned. The strainer contents should be foreign matter to the process and it will take longer and longer for the strainer to clog up. If no new debris shows up for a reasonable period of time then the temporary strainer and pressure gauge PG3 can be removed. (Fig. 13).

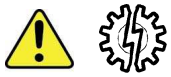
If the temporary strainer keeps clogging up at a relatively even pace and the clogging material is process-orientated particles, such as undissolved crystals, “high boiler” compounds or other entrained particles which are expected to continue forming in the pumped liquid, some permanent modification to the pumping system may be required.

If the temporary filter continues to become clogged, it is encouraged to review the problem with Sundyne/HMD. To be of greatest assistance to you at the time we would like to know: -

a) The chemical composition of the solids
b) The percentage weight concentration
c) The size of the largest particles involved
d) The relative hardness of these solids

The more we know about the problem, the better our chances of suggesting a permanent solution to the problem.

Operating Guidelines



Precautions

The simple precautions required under operating conditions are as follows: -

DO NOT RUN THE PUMP DRY
Dry running the pump will cause the pump shaft bearings to lose lubrication flow resulting in premature wear and failure, which can occur in minutes. To guard against this a Power Control Monitor (PCM) can be supplied by Sundyne/ HMD.

DO NOT RUN THE PUMP CONTINUOUSLY WITH THE DISCHARGE VALVE CLOSED
The power required by the impeller does not decrease to zero, as the flow reduces to zero. Consequently the power delivered to the impeller heats the pumped liquid which can overheat and vaporize. If the liquid vaporizes, then lubrication of the bearings will be lost causing premature wear and failure.

DO NOT ALLOW THE PUMP TO CAVITATE
Piping changes, process temperature, changes in the level of liquid in the suction supply tank can change the NPSH available resulting in cavitation. Cavitation will damage any pump severely in a short period of time.

PUMPS IN PARALLEL
Should two pumps be supplied to operate in parallel, to meet a specific duty. It is essential that extreme care be taken in controlling the flow rate of any one of the two pumps in the eventuality that the second pump is stopped. Without careful control of the flow rate of the operating pump, then this pump will experience a very low system resistance and as a result will operate at a significantly higher flow rate than that specified, leading to bearing failure and/or cavitation problems.

INSUFFICIENT AND EXCESSIVE FLOW
The pump should not be operated below its specified minimum safe flow rate due to excessive loads and increased heat input into the pumped liquid, leading to bearing failure.

The pump should not be operated at flow rates significantly in excess of those specified. This will lead to high bearing loads, low differential head and cavitation resulting in subsequent pump damage. Sundyne/HMD should be consulted for advice on maximum flow limits.

SUCTION TANK
It is essential that good practice be observed in the design of suction pipework and vessels to ensure sufficient submersion of the pipework is maintained and that air entrainment and vortices are not present.

OVER PRESSURE
It is essential that the pumping system is not over pressurized and that the discharge pressure of the pump does not exceed the design rating of the equipment.

HIGH TEMPERATURE
It is essential that the temperature of the system, to which the pump is connected, is monitored accurately and that the pump does not experience temperature excursions that exceed the rating of the equipment.

The continuous operating temperature for pumps with a ZeroLoss shell is 120°C.

THERMAL SHOCK
Pumps should not be subject to thermal shock unless specifically designed for this, because this may lead to premature failure of the internal bearings. In general pumps should not be heated or cooled at a rate greater than 10ºC per minute.

JACKETS
If the pump has been fitted with heating jackets or trace heating it is essential that this jacket be heated to its operating temperature and that the pump has been given sufficient time to increase the product temperature to the correct value prior to starting the pump.

LOW AMBIENT TEMPERATURE
Care should be taken when starting pumps after they have been subject to excessively low ambient temperature, due to the possibility of frost forming on the outer magnet ring and rolling element-bearing races. This could be sufficient to prevent the pump starting and leading to motor overload or magnet coupling disengagement & subsequent damage.

NON RETURN VALVES
Care should be exercised in the fitting of non-return valves to discharge pipework as this may prevent correct venting of the pump prior to start up.

STAND BY PUMPS
These should be primed fully then left with the line valves closed to prevent process debris accumulating and causing blockages.

APPLICATIONS
The equipment should only be used for the application(s) for which it was supplied. Use of this equipment on applications with a significantly different specific gravity, vapor pressure or specific heat could lead to pump failure.

MOTORS
The equipment should only be used with the motor specified at time of order. The motor frame size should not be changed without prior approval from Sundyne/HMD.

REMOVAL OF PROTECTION DEVICES
No protection device such as condition monitoring equipment, or guards supplied by Sundyne/HMD should be removed from the equipment without prior approval.

MODIFICATION TO PARTS
The user should, under no circumstances, modify parts or use parts other than those manufactured by Sundyne/HMD. Sundyne/HMD

employ rigorous design, Quality and inspection techniques and the use of unapproved components may invalidate warranty conditions and seriously compromise safety.

SOLIDS
It is essential that this pump is not operated with the solids greater than that specified at time of order as this could lead to blockage of internal flow passages and the wearing of components.

DEBRIS
Suction strainers should be used during commissioning of new plant to ensure that commissioning debris does not enter the suction of the pump.

FILTER SYSTEMS
If filter systems and cooling flow pipe valves are fitted it is essential that:

- The filter is cleaned regularly to ensure sufficient flow is present.
- All valves are open and no restrictions to flow are placed in the cooling loop.

VENTING
The pump and associated pipework should be fully vented prior to running to ensure no gas is present at the suction of the pump.

COMMISSIONING
Care should be exercised in commissioning a pump with a significantly higher specific gravity liquid (>20%) than that specified for the product. If in doubt consult Sundyne/HMD.

ROUTINE STARTING OF THE PUMP
This should be carried out with the pump primed fully, the suction line valve open fully and the discharge line valve approximately one quarter open.

MOUNTING
Pumps and base plates must be located in accordance with Sundyne/HMD's recommendations. It is essential that these components be securely mounted to prevent movement.

COUPLINGS
Care should be exercised in aligning the pump drive shaft coupling to ensure that runout is minimized with the pump at operating temperature.

DIRECTION
It is essential that the pump is only run in the direction specified by Sundyne/HMD. Failure to do this may result in excessive heating of the product and subsequent damage to the pump.

VIBRATION
Resonance of the pump assembly during operation should be avoided. Pump assembly resonance may result from structural piping vibrations or be due to the rotational frequency of the pump and motor (see also section Vibration Levels).

NOZZLE LOADS
Pumps should not be subject to excessive nozzle loads as this may lead to casing failures and misalignment of couplings. For the maximum allowable nozzle loads for a specific pump model contact Sundyne/HMD.

LUBRICATION
Pump lubrication shall use the correct grade of oil at the scheduled intervals. Care shall be taken to prevent contaminants and moisture from entering the oil and causing premature bearing failure.

PUMP DRIVE END BEARINGS
On separate motor units the bearings are either grease or oil lubricated as standard. Re-lubrication should be carried out every 1500/2000 hours with Shell Alvania RA Grease (Aeroshell 7 Grease for sub-zero service). Oil lubricated bearing assemblies, use Castrol Hyspin AWS 68 Oil, or approved equivalent, which should be changed every 4000 hours or more frequent intervals in hot conditions.

MOTOR BEARINGS
The motor bearings shall be greased in accordance with the bearing re-lubrication instructions issued by the motor manufacturer.

Controlling the Pump During Startup

To ensure control of the pump during start up, follow the start-up procedures for your desired configuration.

Single Operation

Start the pump with the suction valve open while throttling the discharge valve. This will ensure that the pump will reach the design flow operating point.

If the process fluid is near its vapor pressure, open the supply vessel seal cavity vent so that the pump can fill with liquid.

Parallel Operation

To prevent back-flow, place check valves in the discharge piping of each pump.

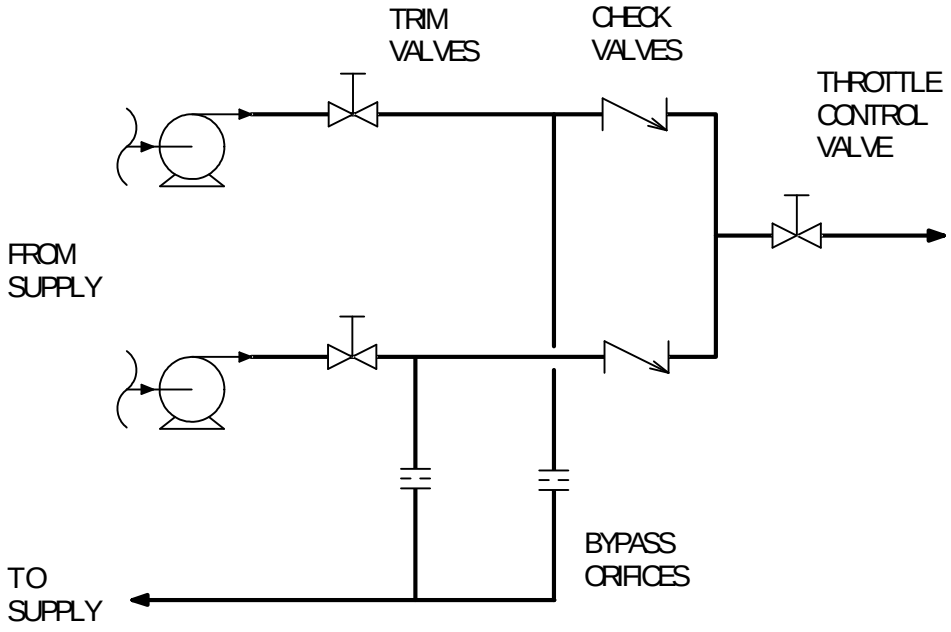
Note: *Sundyne recommends installing separate bypass loops around each pump for additional operational flexibility.*

1. Start the first unit as described in the Single Operation instructions.
2. Start the second unit with the bypass valve set to maintain the flow above minimum flow.
3. Open the discharge valve on the second unit so that the design flow of both units is maintained.

Note: *Do not operate the pumps at their peak head capability.*

Sundyne recommends that separate flow controls be used on each pump to provide a lower minimum flow range than is achieved by pressure control.

Figure 14. Bypass System Example for Parallel Pump Operation



OPERATION & CONTROL

Operation of Sundyne Pumps

Under normal operation, several factors must be taken into consideration to ensure successful pump operation. Experienced pump operators will be aware of jeopardizing factors and their effects.

Suction Conditions

Improper flow of liquid into the impeller is the most common operational abuse of centrifugal pumps. Two conditions must exist to prevent turbulence at the eye of the impeller.

- Proper suction piping, see suction piping section.
- Liquid reaching the impeller eye must have enough vapor pressure to prevent the fluid from flashing to a gas in the impeller. If this condition occurs, it will cause cavitation, which can damage the impeller and inducer. When centrifugal pumps cavitate the noise sounds like the pump is “pumping gravel”. In high speed, single stage pumps, this sound may not be discernable. Cavitation can be prevented by maintaining suction pressure at a high enough level and suction temperatures low enough to maintain Net Positive Suction Head ($NPSH_a$) available greater than Net Positive Suction Head ($NPSH_r$) required by the pumps.

Minimum Flow Conditions

Vibration and noise will occur during operation of centrifugal pumps if either of two conditions exist:

- Internal flow separations
- Recirculation at low flow conditions

If the operator is noticing excessive noise or vibration, operation must be suspended until the cause is determined and corrected. Continued use may cause damage to the pump. Resonance in the discharge line can accentuate noise, vibration, and damage to the pump, primarily when a control valve is located an excessive distance downstream from the pump.

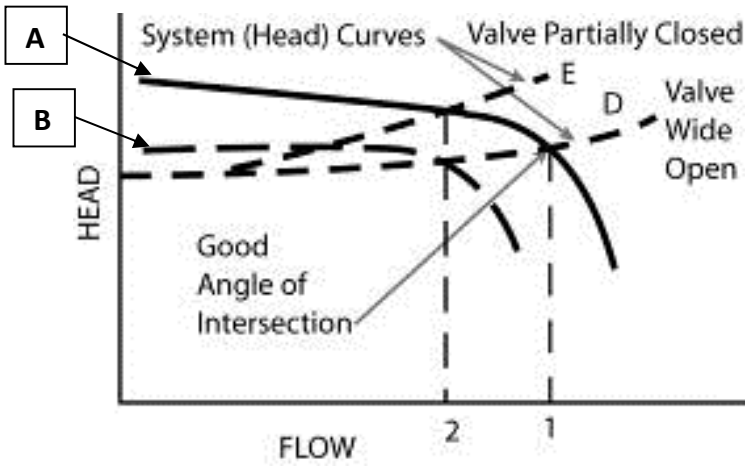
Entrained Gases

The head and capacity of centrifugal pumps will be reduced by gas that is drawn in with the liquid. Under normal operating conditions, centrifugal pumps can tolerate up to 2% of gas (by volume). Entrained gases can cause damage to mechanical seals with the exception of double seals. If you have entrained gas, contact Sundyne for further instruction.

System Head Curve

The point of intersection between the system curve and the pump characteristic curve determines the flow or operation for the centrifugal pump. For steady flow to occur, the system curve must intersect the pump characteristic curve at a significant angle. The following diagram gives examples of satisfactory and unsatisfactory angles of intersection.

Figure 15. Typical Operation



Note: *In Figure 15, the curve for pump A has a significant angle of intersection with system curves D and E. The system curve D could represent a system with the control valve wide open while curve E could represent the same system but with the throttle valve closed to reduce flow from flow 1 to flow 2. Pump curve B, on the other hand, will provide only flow 2, even with the control valve wide open (curve D). When the control valve is partially closed to create system curve E, the curve E and lower pump curve B are practically parallel. The lack of a significant angle of intersection means that the system is unstable, pump flow is likely to fluctuate erratically and not respond to control valve position.*

Parallel Operation

Maximizing control is critical when operating centrifugal pumps in parallel. One pump can overpower the other in regards to head at a lower total flow. If a simple, unrestricted manifold (Figure 16) connects two pumps at the discharge head, the discharge head of one pump is imposed on the other.

In Figure 17, two pumps operating in parallel will never have exactly the same performance curves. At the design point (Q1), with the valve open, both pumps are operating at the same flow and head. However, as the system curve changes with the valve positioning (Q2), pump A can produce a higher head than pump B. In this case pump B will stop flowing altogether, causing it to operate in an unstable minimum flow condition.

Since pump B would effectively be deadheaded, the fluid in it would heat up and boil. During internal boiling, it could encounter liquid slugging and probable damage to the pump. Proper selection of a control system can prevent this situation.

Figure 16. Parallel Units Common Valve

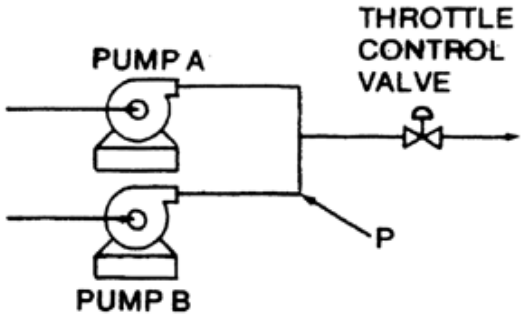
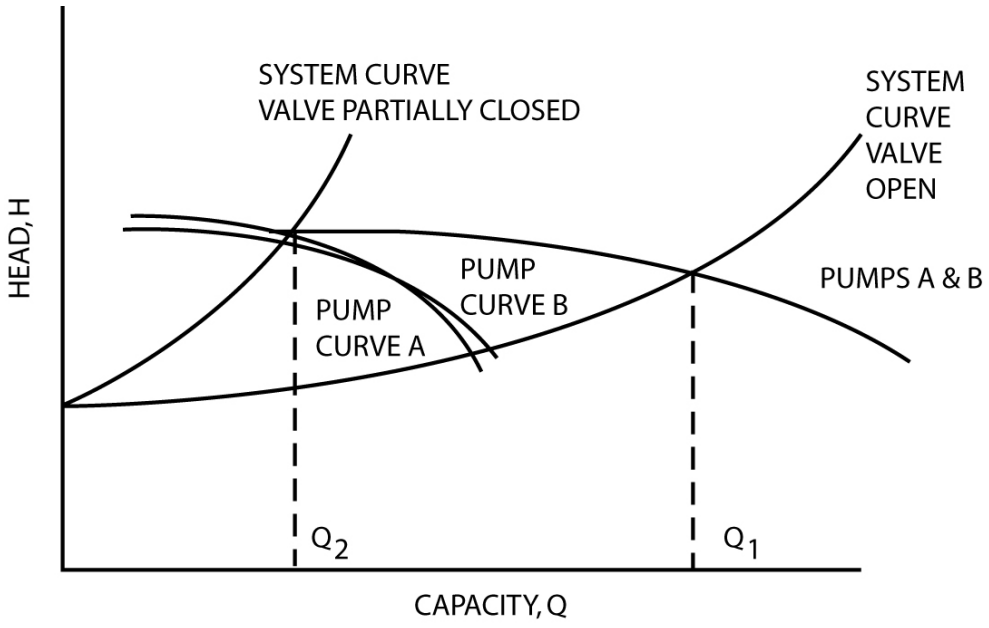


Figure 17. Parallel Operation



Servicing

Maintenance Schedule

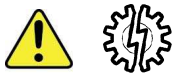
The timing for maintenance of the Sundyne/HMD Sealless pump is established primarily by the liquid end bearing bush system. The time span is longer than for a “canned motor” pump because it has over four times the bearing bush wear allowance. It will outlast mechanical seals because it is more tolerant of solids and because the pressure x surface velocity (PV) values of the bearing bush system are much lower than the PV values of seal faces in the mechanical seal. Despite these conservative design advantages, the bearing bush system can develop some wear over a period of time, depending on the application. It is possible to avoid the effects of excessive bearing bush wear by the use of planned maintenance based on experience on the particular application involved. This will avoid breakdown situations arising due to unmonitored wear causing pump failure by contact between other rotating and stationary parts of the pump liquid end. It is suggested that after initial commissioning, the pump should be inspected after six months to establish the future maintenance periods by comparison of the running clearances with the “as new” dimensions.

Vibration Levels

An indication as to the condition of pump can be ascertained by recording the vibration level of the pump and comparing them to level that would be expected when the unit is new. The following table indicates typical levels of vibration that can be expected during operation at the conditions indicated on the pump nameplate:-

Table 3

Pump Prefix	Magnet Coupling Size	4 Pole Speeds mm/sec [in/sec] - rms	2 Pole Speeds mm/sec [in/sec] - rms
LMV 801S	EA	2.8 [.110]	<3 [.118]



Dismantling

Before starting to dismantle a pump all relevant and appropriate safety precautions must be taken, particularly if the pumps have been handling hazardous or toxic liquids. Consult CoSHH and Material Safety Data Sheets (MSDS). IF YOU HAVE ANY DOUBTS, SEEK ADVICE FROM YOUR SAFETY OFFICER OR THE LIQUID MANUFACTURER.

Obey the following rules:
-

- Always wear adequate Personal Protective Equipment (PPE) when dismantling pumps that have been used to pump toxic or hazardous products. This should comprise clothing, eye and gloved hand protection as a minimum. Breathing apparatus may also be necessary.
- Always isolate the pump electrically before dismantling. Ensure that the electrical switch gear cannot be operated whilst any work is being carried out on the pump.
- Always drain the pump casing of product before removing the pump from its associated pipework.
- Flush out the pump casing and shroud with a compatible flushing liquid and drain away to a safe area.
- Check with your process engineers to see if any special decontamination procedures have to be followed before working on the pump.

- All pumps returned to HMD for factory servicing must be decontaminated and labelled in accordance with the Sundyne/HMD Return Material Authorization (RMA) procedure.

These safety precautions are to be taken in addition to any formal safety procedures specified by your Company and do not supersede, change or absolve you form your statutory duties under current Government legislation. Our recommendations are based on our current experience. If in doubt or you need to know our latest recommendations – you must contact Sundyne/HMD Sealless Pumps.

Fault Finding

Flowcharts

This section is intended to highlight possible pump problems caused by system design inadequacies or incorrect operation.

Because the sealless pump impeller is not coupled directly to the electric motor, it is inherently quiet so that any increase in noise is a good indication that there is a problem.

Should it be necessary to dismantle a pump, please read through the dismantling instructions carefully (see section Dismantling).

No special tools[1] are required to dismantle a Sundyne/HMD Sealless Pump and no special skills are required as the pump is simple in design and robust in construction.

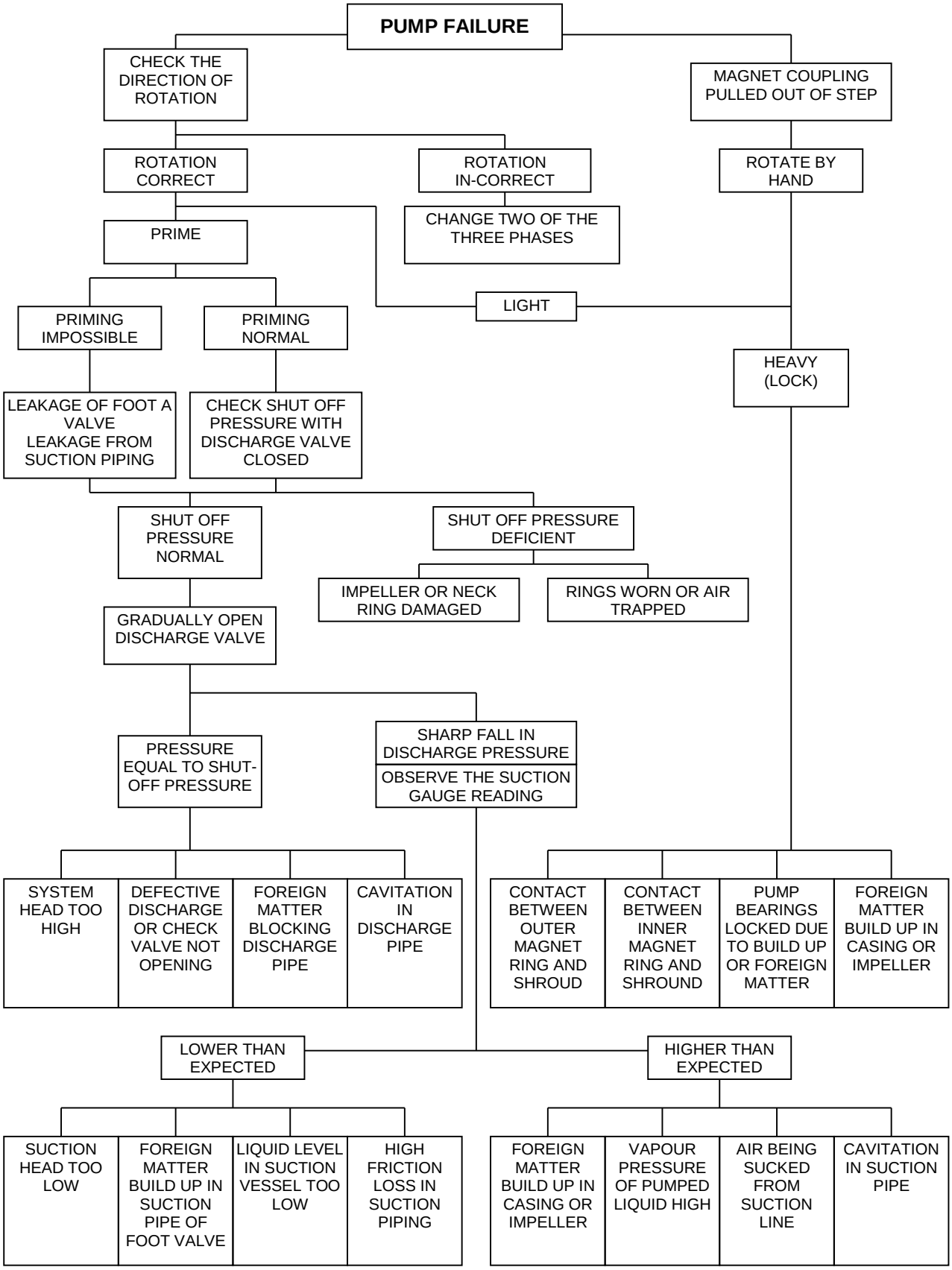
Refurbishing is by replacement and no attempt should be made to repair pump components by welding and re-machining.

Clearances between the rotating components in the pump are comparatively large, so care must be taken not to scrap components before checking that the clearances are excessive.

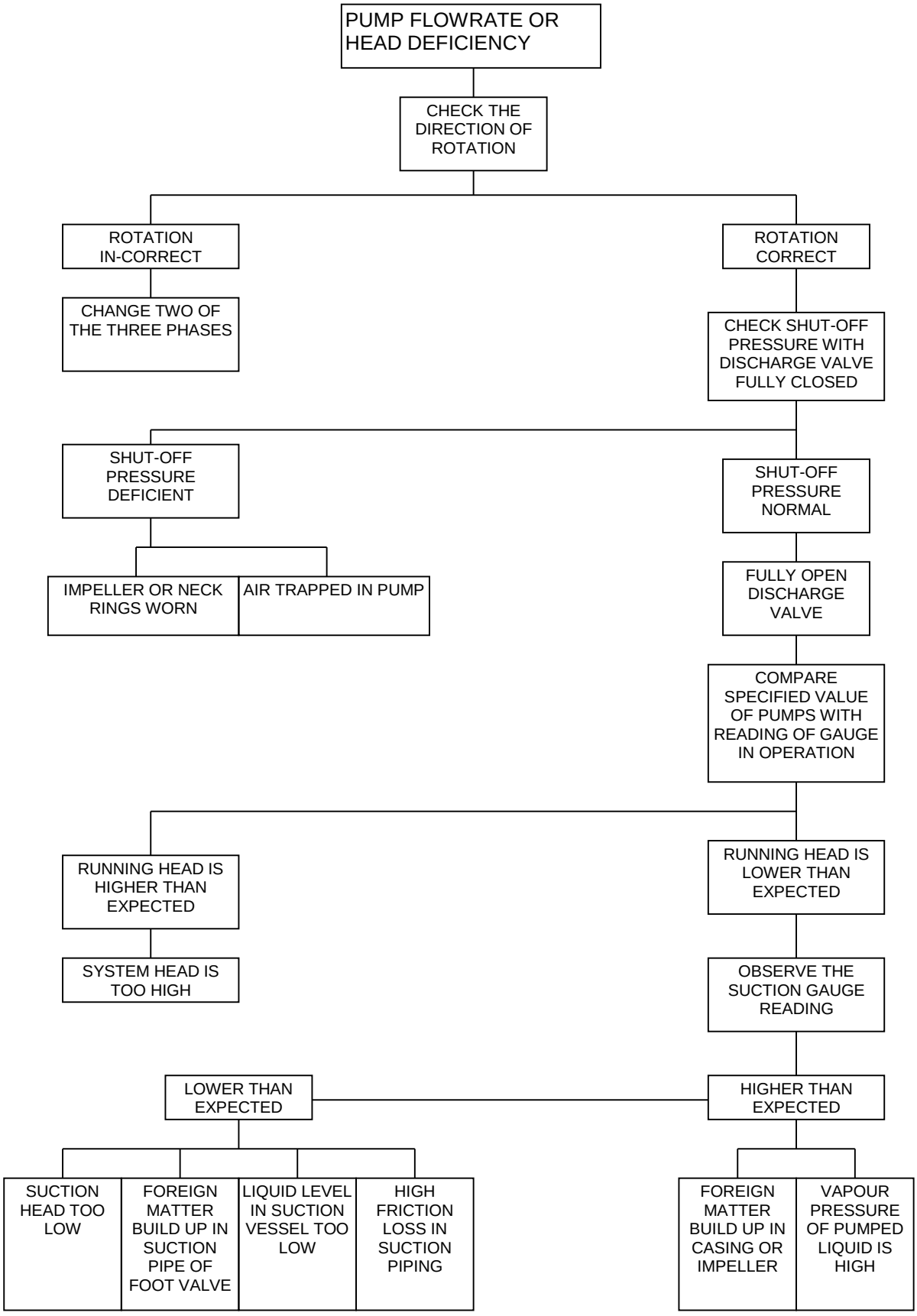
In the event that the magnetic coupling is pulled out of step, then **the motor must be stopped IMMEDIATELY** because continuation of running will damage the magnets.

For further information on fault symptoms, causes and remedies consult the Fault Tree flowcharts in the following pages. (Section Fault Finding).

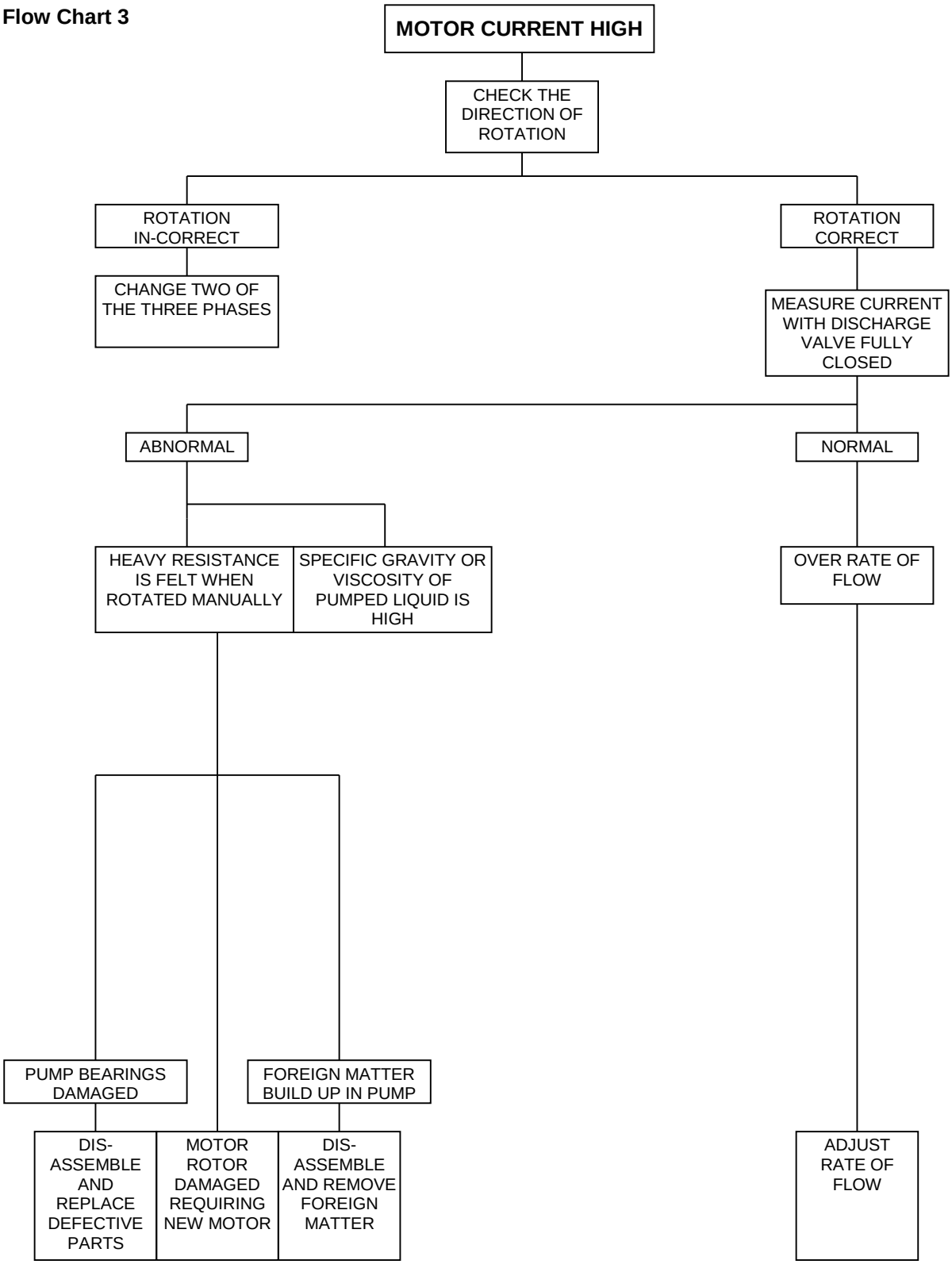
Flow Chart 1


PUMP FAILURE
CHECK THE DIRECTION OF ROTATION
MAGNET COUPLING PULLED OUT OF STEP
ROTATION CORRECT
ROTATION IN-CORRECT
ROTATE BY HAND
CHANGE TWO OF THE THREE PHASES
PRIME
LIGHT
PRIMING IMPOSSIBLE
PRIMING NORMAL
HEAVY (LOCK)
LEAKAGE OF FOOT A VALVE LEAKAGE FROM SUCTION PIPING
CHECK SHUT OFF PRESSURE WITH DISCHARGE VALVE CLOSED
SHUT OFF PRESSURE NORMAL
SHUT OFF PRESSURE DEFICIENT
IMPELLER OR NECK RING DAMAGED
RINGS WORN OR AIR TRAPPED
GRADUALLY OPEN DISCHARGE VALVE
PRESSURE EQUAL TO SHUT-OFF PRESSURE
SHARP FALL IN DISCHARGE PRESSURE
OBSERVE THE SUCTION GAUGE READING
SYSTEM HEAD TOO HIGH
DEFECTIVE DISCHARGE OR CHECK VALVE NOT OPENING
FOREIGN MATTER BLOCKING DISCHARGE PIPE
CAVITATION IN DISCHARGE PIPE
CONTACT BETWEEN OUTER MAGNET RING AND SHROUD
CONTACT BETWEEN INNER MAGNET RING AND SHROUND
PUMP BEARINGS LOCKED DUE TO BUILD UP OR FOREIGN MATTER
FOREIGN MATTER BUILD UP IN CASING OR IMPELLER
LOWER THAN EXPECTED
HIGHER THAN EXPECTED
SUCTION HEAD TOO LOW
FOREIGN MATTER BUILD UP IN SUCTION PIPE OF FOOT VALVE
LIQUID LEVEL IN SUCTION VESSEL TOO LOW
HIGH FRICTION LOSS IN SUCTION PIPING
FOREIGN MATTER BUILD UP IN CASING OR IMPELLER
VAPOUR PRESSURE OF PUMPED LIQUID HIGH
AIR BEING SUCKED FROM SUCTION LINE
CAVITATION IN SUCTION PIPE

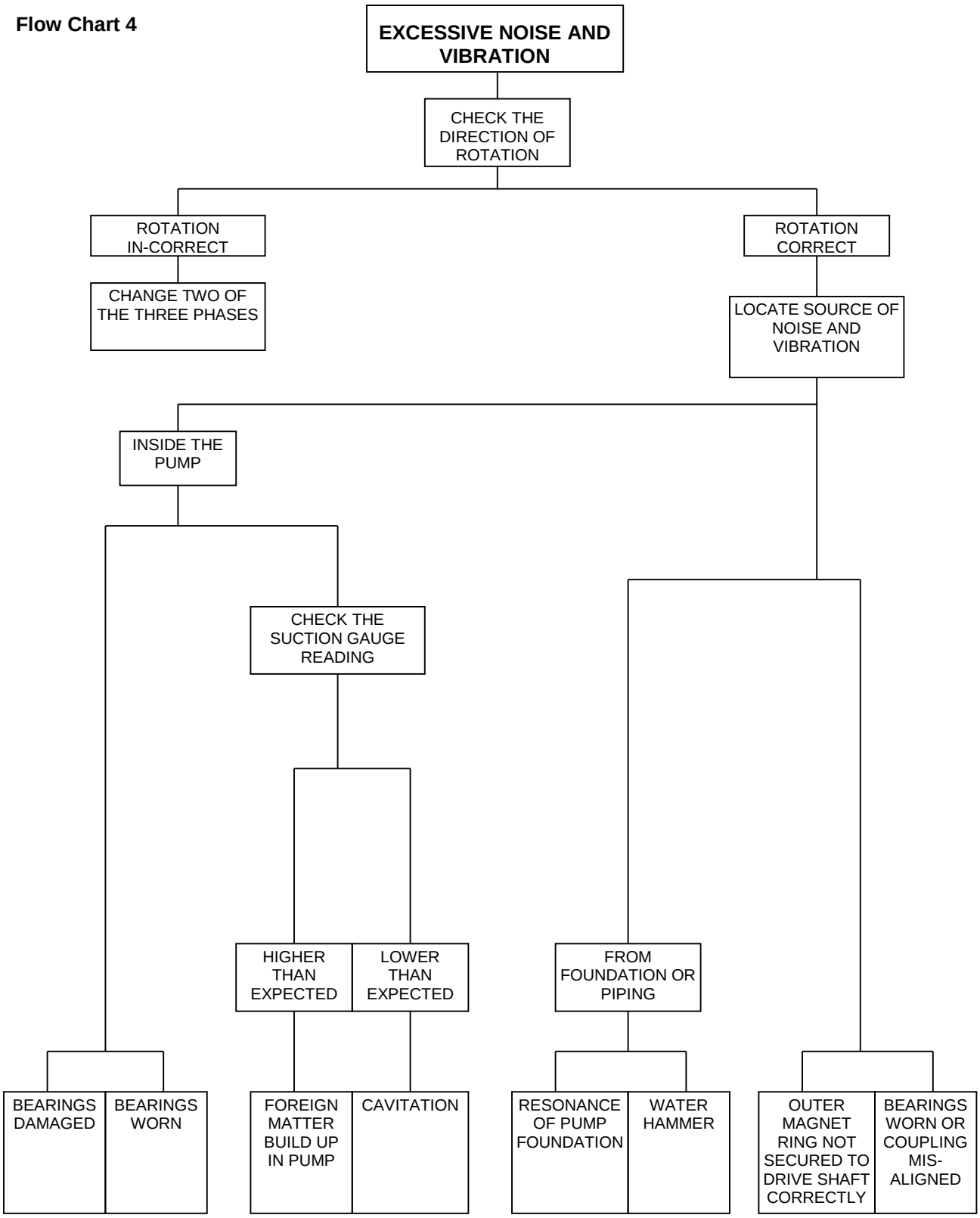
Flow Chart 2


PUMP FLOWRATE OR HEAD DEFICIENCY
CHECK THE DIRECTION OF ROTATION
ROTATION IN-CORRECT
CHANGE TWO OF THE THREE PHASES
ROTATION CORRECT
CHECK SHUT-OFF PRESSURE WITH DISCHARGE VALVE FULLY CLOSED
SHUT-OFF PRESSURE DEFICIENT
IMPELLER OR NECK RINGS WORN
AIR TRAPPED IN PUMP
SHUT-OFF PRESSURE NORMAL
FULLY OPEN DISCHARGE VALVE
COMPARE SPECIFIED VALUE OF PUMPS WITH READING OF GAUGE IN OPERATION
RUNNING HEAD IS HIGHER THAN EXPECTED
SYSTEM HEAD IS TOO HIGH
RUNNING HEAD IS LOWER THAN EXPECTED
OBSERVE THE SUCTION GAUGE READING
LOWER THAN EXPECTED
HIGHER THAN EXPECTED
SUCTION HEAD TOO LOW
FOREIGN MATTER BUILD UP IN SUCTION PIPE OF FOOT VALVE
LIQUID LEVEL IN SUCTION VESSEL TOO LOW
HIGH FRICTION LOSS IN SUCTION PIPING
FOREIGN MATTER BUILD UP IN CASING OR IMPELLER
VAPOUR PRESSURE OF PUMPED LIQUID IS HIGH

Flow Chart 3


MOTOR CURRENT HIGH
CHECK THE DIRECTION OF ROTATION
ROTATION IN-CORRECT
CHANGE TWO OF THE THREE PHASES
ROTATION CORRECT
MEASURE CURRENT WITH DISCHARGE VALVE FULLY CLOSED
ABNORMAL
NORMAL
HEAVY RESISTANCE IS FELT WHEN ROTATED MANUALLY
SPECIFIC GRAVITY OR VISCOSITY OF PUMPED LIQUID IS HIGH
OVER RATE OF FLOW
PUMP BEARINGS DAMAGED
FOREIGN MATTER BUILD UP IN PUMP
DIS-ASSEMBLE AND REPLACE DEFECTIVE PARTS
MOTOR ROTOR DAMAGED REQUIRING NEW MOTOR
DIS-ASSEMBLE AND REMOVE FOREIGN MATTER
ADJUST RATE OF FLOW

Flow Chart 4


EXCESSIVE NOISE AND VIBRATION
CHECK THE DIRECTION OF ROTATION
ROTATION IN-CORRECT
CHANGE TWO OF THE THREE PHASES
ROTATION CORRECT
LOCATE SOURCE OF NOISE AND VIBRATION
INSIDE THE PUMP
CHECK THE SUCTION GAUGE READING
HIGHER THAN EXPECTED
LOWER THAN EXPECTED
FROM FOUNDATION OR PIPING
BEARINGS DAMAGED
BEARINGS WORN
FOREIGN MATTER BUILD UP IN PUMP
CAVITATION
RESONANCE OF PUMP FOUNDATION
WATER HAMMER
OUTER MAGNET RING NOT SECURED TO DRIVE SHAFT CORRECTLY
BEARINGS WORN OR COUPLING MIS-ALIGNED

Pump Diagnostics

Several system factors may affect the performance of the pump. These factors are:

- Temperature
- Specific gravity
- Suction pressure
- Driver Speed
- Flow rate
- Control characteristics

These factors as well as internal problems must be considered when analyzing pump system performance. The following table gives diagnostic information that can be useful when analyzing gearbox and pump performance problems

Table 4. Pump Diagnostics

Situation/Symptom	Possible Cause	Investigative/Corrective Action
No flow, no pressure at start-up.	Pump not completely filled with liquid.	Bleed all vapor or air from vent. Allow more cool-down time if pumping low temperature fluid. Check suction line for air leak if suction pressure is lower than atmospheric.
	NPSH actually lower than NPSH requirement listed on specification sheet.	Suction line blocked – check suction screen and valve. Excessive pressure drop through suction piping. Flow restricted by vapor pockets in high points of suction line. Suction tank level or pressure too low. Entrained air or vapor in pumped fluid. NPSH reduced by presence of more volatile fluid in process fluid.
	Failure of drive component, such as interconnecting shaft or impeller key, or item missing from assembly.	Disassemble and inspect.
	Reverse direction of rotation.	Direction of driver shaft rotation must be as shown by arrow on pump casing. Note: Impeller and driver rotate in the same direction.
Insufficient total head.	Flow too high.	Check total head and flow rate against performance curve.
	Wrong direction of driver shaft rotation. (It is possible for the pump to develop greater than 50 percent design total head in this condition).	Direction of driver shaft rotation must be as shown by arrow on pump casing. Note: Impeller and driver rotate in the same direction.
	NPSH actually lower than NPSH requirement listed on specification sheet.	Refer to solutions listed under “No flow, no pressure at start-up”.
	Flow too low, causing overheating of fluid resulting in internal boiling and unstable pump operation.	Increase through-flow rate. Bypass part of pump discharge to supply tank.
	Diffuser discharge throat partially plugged or impeller damaged by passage of a solid particle.	Clean these areas of all obstructions and restore surfaces to a smooth polished finish free of all corrosion pitting. Edge of diffuser throat must be sharp.

Situation/Symptom	Possible Cause	Investigative/Corrective Action
Insufficient total head cont.	Corrosion and/or erosion of diffuser throat (may also be accompanied by corrosion/ erosion of diffuser and cover surface adjacent to impeller).	If edge of throat is no longer sharp and smooth or has opened in size, head-rise may be reduced. Opening of the inlet area of the throat will result in higher flow rate and horsepower consumption. Corrosion/erosion of diffuser and cover surfaces will result in a significant horsepower increase.
	Excessive recirculation from discharge to inlet.	Check flow through external plumbing. Pump o-ring (936C) damaged or missing. Integral centrifugal separator orifice worn.
	Process fluid specific gravity or viscosity different from values shown on specification sheet.	Check actual viscosity and specific gravity at operating temperature. Viscosity higher than five centipoise will cause reduced head and flow and increased power consumption.
	Driver speed too low.	Check speed against value listed on specification sheet.
	Pressure gauges or flow meters in error	Calibrate instrumentation.
Driver overloaded.	Fluid specific gravity or viscosity higher than values listed on specification sheet.	Check actual viscosity and specific gravity against value listed on specification sheet.
	Electrical failure in electric driver.	Check circuit breaker heater size and setting. Check voltage and voltage balance between phases. Current for each phase should be balanced within three percent.
	Mechanical failure in driver or pump.	Remove driver and check for freedom of rotation. Remove fluid end and search for any mechanical failure.
	Corrosion pitting on surface of diffuser cover or diffuser, adjacent to impeller blades. Head rise is also reduced by this condition.	Disassemble pump and inspect. Rough or pitted surfaces can cause friction losses which will significantly increase horsepower consumption. Clean these areas of all obstruction and restore surfaces to a smooth polished finish. Check diffuser throat area at the inlet; erosion or corrosion resulting in roughness or increased area will increase horsepower consumption. Note: A larger throat size than design will allow a higher flow and horsepower for a given head rise.
Excessive discharge pressure pulsations.	Flow rate too low.	Increase flow rate through pump. Add bypass to suction tank if necessary.
	Insufficient NPSH available.	Refer to solution for insufficient NPSH under “No flow, no pressure at startup,” above.
	Defective flow control valve.	Check control valve.

Maintenance

General Safety

Before disassembling a pump all relevant and appropriate safety precautions must be taken. **SEEK ADVICE FROM YOUR SAFETY REPRESENTATIVE OR THE MANUFACTURER IF YOU HAVE ANY DOUBTS.**

Care should be taken in assembling magnetic components due to their attraction with ferrous materials. Also particular care should be exercised when inserting or withdrawing the Inner Magnet Ring into or out of the Containment Shell contained within the Coupling Housing, due to the axial pull of the Outer Magnet Ring.

Tools Required

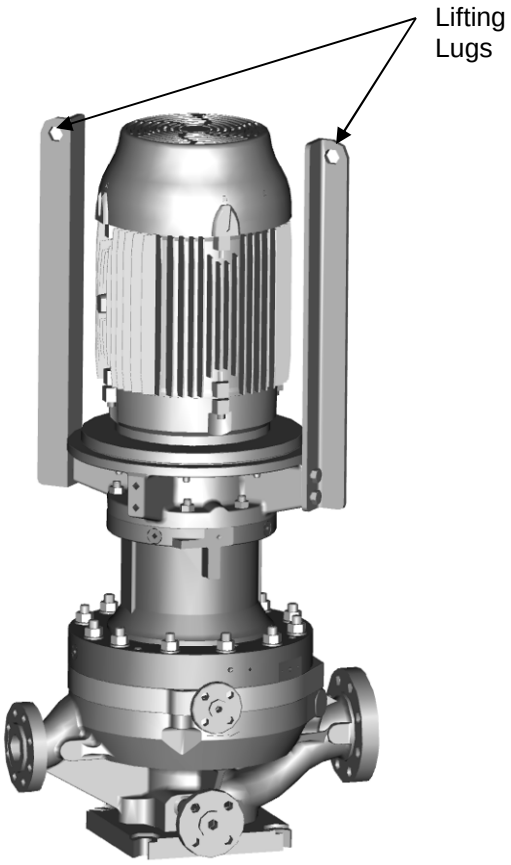
The table of tools shown below is fully comprehensive and allows for complete strip-down and re-build of pump.

Tool List	
Hexagon Bit Socket and / or Hexagon Key	3/16”
	7/32”
	¼”
	5/16”
	3/8”
	½”
	8 mm (IEC Motors)
Socket and / or Spanner	¾” (Deep)
	1-1/8” (Deep)
	1-1/4”
	50 mm
	17 AF (IEC 90 Motor)
	19 AF (IEC 100 to 132 Motor)
	24 AF (IEC 160 to 225 Motor)
Torque Wrenches	For torque settings from 25 Nm (18 lbf-ft) to 300Nm (220 lbf-ft)
General tools required	
Ratchet Extension bar Soft mallet Eye Bolts 5/16" x 3 Eye Bolt 1/2" UNC x 3 Eye Bolt 5/8” UNC x 2 Eye Bolt M16 x 2 (IEC Motors) Lifting Equipment x 2	Pry bar x 2 Dial Test Indicator complete with magnetic base Loctite 242 Threadlocker (or similar) Anti-seize compound Steel Discs Ø3.50 X 1.0 thick [Ø90mm X 25 mm thick] x 2 (for Replacement of Bushes and Thrust Pad)

Lifting Points

Lifting Lugs are intended to lift the entire pump assembly. Never use the lifting lugs to stand a pump up from a horizontal position. The lugs are intended for a vertical lifting direction only. Eye bolts attached to the motor are intended for lifting the motor only.

Quantity	Weight Capacity
2	Up to 1650 lbs (750 kg)
4	Over 1650 lbs (750 kg)



Sundyne recommends the use of swivel hoist rings for the handling of parts and assemblies as demonstrated in the following section. Use of other lifting devices may result in harm to the user or damage to equipment.

Quantity	Size
3	5/16-18
3	½-13 UNC
2	5/8-11 UNC

Swivel Hoist Ring

DISASSEMBLY OF PUMP

Before working on Pump ensure it is drained and decontaminated.

When disassembling Pump, it is recommended that each set of fasteners be individually bagged. Tie a tag to each bag with fastener Reference number (REF) written on tag. Reference numbers are taken from the Cross Sectional Drawing and Parts List, and are contained in brackets ( ) in this manual. This will aid rebuilding, particularly where fasteners for different components are of similar size. Work should be carried out in a clean area where possible.

For maintenance purposes the pump casing may be left in the pipework whilst the main part of the pump is back-pulled, OR the complete pump can be removed from the pipework.

Maintenance work should be carried out in a workshop or suitable work area.

The pump can be split into three discrete assemblies for maintenance purposes:

- Motor and Motor Support
- Magnet Drive Unit
- Casing and Diffuser

These will be considered at different stages in the instructions below.

If the complete pump is to be removed from the pipe work and taken to a working area, the pump case must be bolted down to a suitable base for stability before work on the pump can begin.

This is especially important for larger motors and pumps with a bearing box fitted.

The Inner Magnet Ring (37.37) and Outer Magnet Ring (51.51) contain strong magnets and care should be taken in the vicinity of ferrous materials.

For example, if workbench top is metal, ensure it has a covering of hardboard, plywood, or plastic sheeting. Also be careful when using tools around these components.

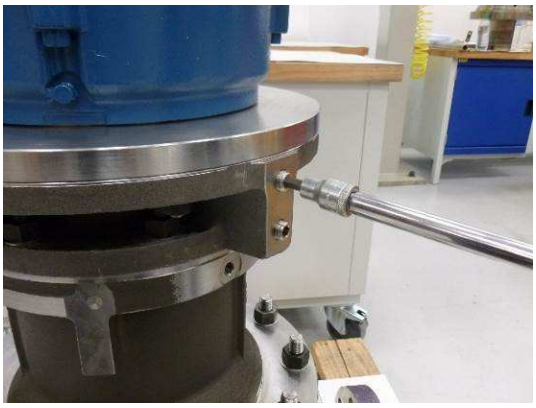
Note that two cranes or lifting devices will be required to maneuver the pump parts into position for maintenance.

Disassembly - Stage 1 -Removal of Pump from Pipe Work

1.01 Complete pump should be lifted with Lifting Lugs (98.98) that were originally supplied with the pump.

To fit Lifting Lugs first remove grub screws (45.S53) from webs of Motor Adaptor (45.45).

5/16” Hex



1.02 Fit Lifting Lugs (98.98) to Motor Adaptor (45.45) with **High Tensile** Retention Screws (98.S11) and Washers (98.W11).

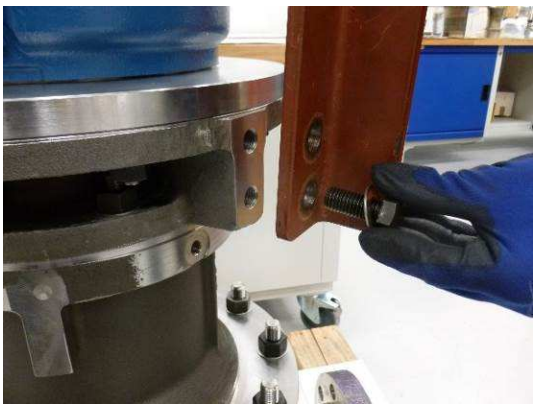
Each new pump is furnished with the above lifting equipment.

2 off Lifting Lugs for pumps up to 750 kg (1650 lbs).

4 off Lifting Lugs for pumps over 750 kg (1650 lbs).

15/16” AF for NEMA motors

24 mm AF for IEC motors



1.03 Fit suitable lifting gear to Lifting Lugs (98.98) and take up any slack to prevent toppling of pump.

Undo pipe work and fixing down screws.

Lift pump away from pipe work and move to suitable working area.

Securely fasten pump to suitable base during transport.

It is recommended that the pump base be securely fastened to a suitable surface during maintenance activities to prevent toppling of the pump.

This is especially important when large motors are fitted.

1.04 Remove Retention Screws (98.S11), Washers (98.W11) and Lifting Lugs (98.98) from Motor Adaptor (45.45).

15/16” AF for NEMA motors

24 mm AF for IEC motors

1.05 Image shows a complete pump ready for disassembly.

Disassembly - Stage 2 - Motor and Motor Support (Close Coupled)

2.01 Attach suitable lifting gear to lifting eyes either side Electric Motor

Ensure motor lifting eyes are capable of lifting the additional weight of Motor Adaptor (45.45), Drive Adaptor (52.52) and Outer Magnet Ring (51.51).

This extra weight is shown as Motor Adaptor weight on customer specific installation drawing.

DO NOT LIFT COMPLETE PUMP WITH LIFTING EYES OF ELECTRIC MOTOR.

2.02 Loosen and remove Nuts (43.N13) and Washers (43.W14) from Motor Adaptor (45.45).

2.03 Lift Motor together with Motor Adaptor (45.45), Drive Adaptor (52.52) and Outer Magnet Ring (51.51) away from pump.

Note that Outer Magnet Ring (51.51) will be attached to motor shaft via the Drive Adaptor (54.54)

Allow the Outer Magnet Ring to be withdrawn squarely from the Coupling Housing (43.43).

2.04 Fit 2 off Eye Bolts to tapped holes in webs of Motor Adaptor (45.45).

These Eye Bolts should be positioned in between the Lifting Eyes of electric motor and on the same side as the motor terminal box.

5/16” Eye Bolts for NEMA Motors

M16 Eye Bolts for IEC Motors

2.05 Use a second lifting device and attach lifting gear to eye bolts on Motor Adaptor (45.45).

Lift motor assembly into a horizontal position.

Lower assembly onto a wooden pallet or similar so that motor is resting on pallet whilst Motor Adaptor overhangs the edge by a minimal amount.

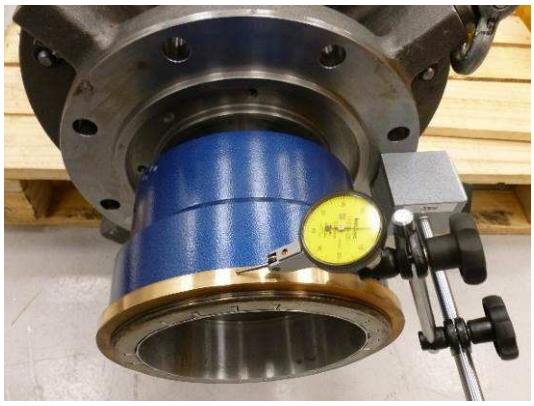
2.06 There is no need to dismantle the assembly further unless inspection or replacement of parts is required.

Move to Stage 3 if assembly is in good order.

A run-out check of the Outer Magnet Ring (51.51) should be performed to ensure it is within limits.

Set magnetic base on mounting face of Motor Adaptor (45.45) and check run-out of bump ring with Dial Test Indicator.

Maximum allowable run-out is 0.25 mm (0.010”)



2.07 <u>To dismantle the assembly further if required</u>

Loosen and remove 2 off Screws (52.S41) holding Outer Magnet Ring (51.51) to Drive Adaptor (52.52).

¼" Hex

2.08 Pull Outer Magnet Ring (51.51) from location in Drive Adaptor (52.52).

2.09 Fit 2 off Eye Bolts and suitable lifting gear to tapped holes in webs of Motor Adaptor (45.45).

5/8" Eye Bolts for NEMA motors

M16 Eye Bolts for IEC motors

2.10 **<u>NEMA Motors</u>**

Loosen and remove Nuts (45.N15) and Washers (45.W15) that retain Motor Adaptor (45.45) to Adaptor Plate (45.16).

¾" AF for NEMA motors

Hexagon Head Set Screws are used instead of Studs, Nuts and Washers for smallest NEMA Motors.

Fasteners may be either top side or under side of Adaptor Plate, depending on motor size.

2.11 NEMA Motors

Remove Motor Adaptor (45.45) from Adaptor Plate (45.16).

2.12 NEMA Motors

NEMA motors are face mounted, an Adaptor Plate (45.16) will always be mounted to the front face of the NEMA motor.

To remove the Adaptor Plate loosen and remove Cap Screws (45.S42).

143TC to 145TC - 5/16” Hex

182TC to 286TSC – 3/8” Hex

324TC to 365TSC – ½” Hex

2.13 NEMA Motors

Remove Adaptor Plate (45.16) from front face of Motor.

2.14 IEC Motors WITHOUT Adaptor Plate

IEC motors are flange mounted, in most cases an Adaptor Plate will not be required.

Loosen and remove Screws (45.S42) and Washers (45.W15) that retain Motor Adaptor (45.45) to motor.

Frame 225 2 pole motor will also require removal of Nuts (45.N15) and Washers (45.W15).

90 Frame – 17 mm AF

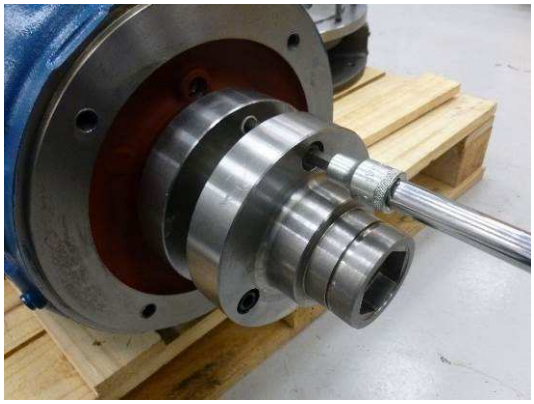
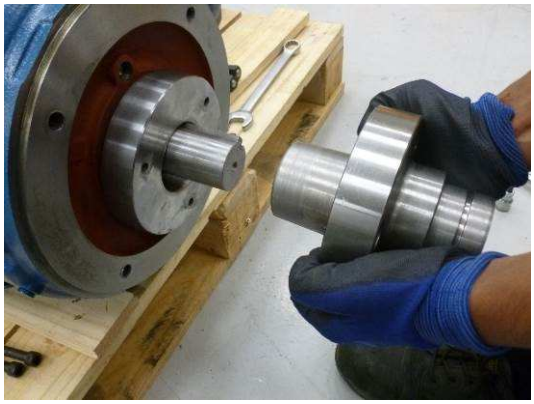
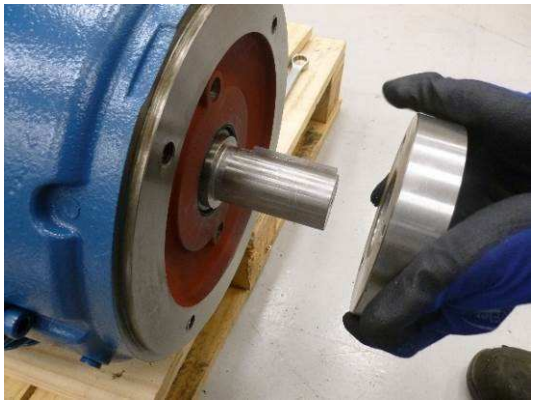
100 to 132 Frame – 19 mm AF

160 to 225 Frame – 24 mm AF

Image not available

2.15 IEC Motors WITHOUT Adaptor Plate Remove Motor Adaptor (45.45) from Motor.	Image not available
2.16 IEC Motors WITH Adaptor Plate A separate Adaptor Plate (45.16) is only required for the largest motors. Loosen and remove Nuts (45.N15) and Washers (45.W15) that retain Motor Adaptor (45.45) to Adaptor Plate (45.16).  15/16" AF	Image not available
2.17 IEC Motors WITH Adaptor Plate Remove Motor Adaptor (45.45) from Adaptor Plate (45.16).	Image not available
2.18 IEC Motors WITH Adaptor Plate Loosen and remove Screws (45.S42) and Washers (45.W15) that retain Adaptor Plate (45.16) to Motor.	Image not available

2.19 IEC Motors WITH Adaptor Plate Remove Adaptor Plate (45.16) from Motor.	Image not available

2.20 Remove Draw Screws (52.S42) from Drive Adaptor (52.52). IEC Motors – 8 mm Hex NEMA 143TC to 215TC – 7/32” Hex NEMA 254TC to 365TSC – 5/16” Hex A large screw driver or similar tool can be used behind the flange between one of the screws and the Drive Adaptor body to prevent the Drive Adaptor from turning.	
2.21 Fit removed Draw Screws (52.S42) into tapped holes in front face of Drive Adaptor (52.52) and tighten down onto taper ring to push ring free from taper.	Image not available
2.22 Once taper ring has been loosened the Drive Adaptor (52.52) can be pulled free from the motor shaft.	
2.23 Finally, remove taper ring from motor shaft.	

Disassembly - Stage 3 – Magnet Drive Unit

3.01 The image shows Magnet Drive Unit mounted to pump Casing (41.41). The next stage is to work on the Magnet Drive Unit so first it must be removed from the pump Casing.	
3.02 Loosen and remove 12 off Nuts (41.N11) and Washers (41.W11).  1-1/4” AF	
3.03 3 off Jacking Screws (43.S12) are provided in the Coupling Housing (43.43) if required.  3/8” Hex	

3.04 Fit 2 off Eye Bolts to tapped holes in outside of top flange of Coupling Housing (43.43)

Attach suitable lifting gear to Eye Bolts and withdraw Magnet Drive Unit from pump Casing (41.41).

(Image shows optional inducer fitted to impeller)

½" Eye Bolt

3.05 Fit 1 off Eye Bolt to tapped hole in outside of bottom flange of Coupling Housing (43.43.

Use a second lifting device to raise the Magnet Drive Unit into a horizontal position.

(Image shows optional inducer fitted to impeller)

½" Eye Bolt

3.06 Remove 2 off Jacking Screws (16.S51) from Adaptor Ring (16.16) and replace with 2 off Eye Bolts.

Lift front of Magnet Drive Unit into the vertical position and set down on a suitable working surface.

2 x Eye Bolts 5/8"

CAUTION – Assembly is stable but top heavy

3.07 Remove 12 off Cap Screws (43.S55) from Adaptor Ring (16.16). 5/16” Hexagon	
3.08 Lift away Adaptor Ring (16.16). Lifting gear can be used BUT be careful not to topple unit if ring is reluctant to become free. Alternatively remove Eye Bolts and re-fit Jacking Screws (16.S51), Adaptor Ring may be lifted by hand after jacking free.	
3.09 Remove O-ring (14.OR2) from front shoulder of Casing Plate (14.14) and discard. O-ring may have been left in Diffuser (33.33) when Magnet Drive was lifted from Casing (41.41). Find O-ring and discard.	
3.10 Remove O-ring (14.OR3) from groove in outside diameter of Casing Plate (14.14) and discard.	

3.11 Remove Gasket (20.17) from shoulder of Containment Shell (20.20) and discard.

Gasket may have been left in Adaptor Ring (16.16).

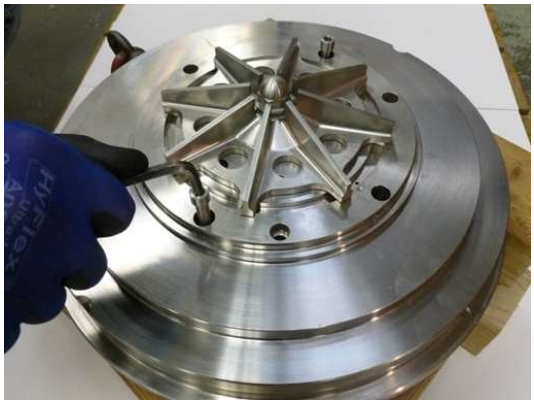
Find Gasket and discard.

3-12 Remove 3 off Cap Screws (20.S41) from Casing Plate (14.14).

Some sizes of Impeller (06.06) may cover or partly cover Screws. If this is the case, remove Impeller to access the Screws and then replace but do not fully tighten (see later for Impeller removal)

7/32" or 1/4" Hex

3.13 If required, fit 2 off Screws removed from Casing Plate (14.14) into recessed tapped holes in face of Casing Plate in order to jack Casing Plate free from Containment Shell (20.20).



3.14 Fit 2 off Eye Bolts to tapped holes in outside diameter of Casing Plate (14.14).

Lift Casing Plate (14.14) complete with rotating assembly away from Containment Shell (20.20)

CAUTION - strong magnetic attraction of ferrous objects to Inner Magnet Ring.

3.15 Stand assembly upright on the Inner Magnet Ring (37.37) with impeller (06.06) uppermost.

For ZeroLoss Containment Shell the Inner Magnet Ring (37.37) has a protruding nut and must be supported either side of the nut.

3.16 Turn down tab of Impeller Tab Washer (02.05A).

Loosen Impeller Fastener (02.03) and remove.

LEFT HAND THREAD

Loosen in a **CLOCKWISE** direction

3/4" (Narrow Line Impellers)

1-1/8" (Wide Line Impellers)

3.17 Occasionally an Inducer (76.01) will take the place of the Impeller Fastener.

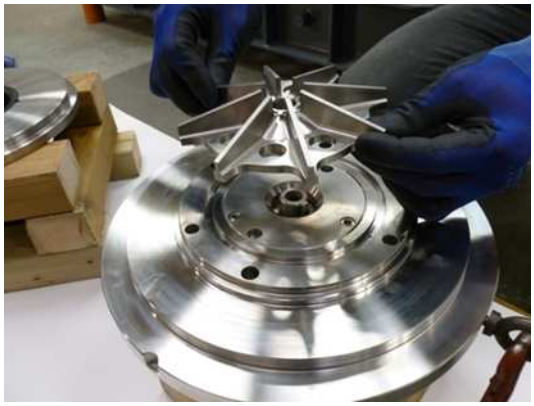
An Inducer will be connected to the Pump Shaft (02.02) with an Inducer Stud (02.48A).

Turn down tab of Tab Washer (02.05A).

Loosen Inducer with hexagon provided on nose of Inducer and remove.

Inducer Stud may come away with Inducer or remain in Pump Shaft.

3.18 Remove Tab Washer (02.05A) and Impeller (06.06) from Pump Shaft (02.02).



3.19 Remove 3 off Screws (14.S45) from Casing Plate Cover (14.40).

7/32" or 1/4" Hex

3.20 Fit 2 off Screws (14.S45) to recessed tapped holes provided and lift away Casing Plate Cover (14.40).

Screws (14.S45) can also be used to jack Casing Plate Cover if required.

3.21 Fit 2 off Screws (14.S45) from Casing Plate Cover to tapped holes provided in back of Thrust Washer Holder (07.07).

Lift Thrust Washer Holder away from Pump Shaft (02.02)

Note that Front Thrust Washer (07.07A) is located in back of Thrust Washer Holder (07.07) and may drop out of its location when the Thrust Washer Holder is removed. Care must be taken to avoid damage to Thrust Washer which is made of Silicon Carbide.	

3.22 Remove Front Thrust Washer (07.07A) from its location in Thrust Washer Holder (07.07).

Note that if Thrust Washer (07.07A) is in good condition it can be left in place in the Thrust Washer Holder (07.07).

If Thrust Washer is difficult to remove, use compressed air or decontamination bath to loosen solidified product. In extreme cases it may have to be broken into pieces with hammer and punch.

Wear correct protective clothing, including overalls, gloves, safety glasses or face shield. Ensure location groove is clean and free from burrs, dents etc. before inserting new Front Thrust Washer.

3.23 Very carefully lift Casing Plate (14.14) together with attached Bush Holder (09.09) away from Pump Shaft (02.02) and Inner Magnet Ring (37.37).

Extreme care must be taken not to damage Silicon Carbide bearings.

Note that occasionally the rear Thrust Washer (37.12) may be wrung together and come away with rear Thrust Pad (09.13).

To help lifting by hand, hold Eye Bolts fitted either side of Casing Plate.

Casing Plate with attached Bush Holder can weigh more than 25kg (55 lbs).

3.24 Position Casing Plate (14.14) face down on the bench with Bush Holder (09.09) uppermost.

3.25 Remove 4 off Bush Holder Screws (14.S41).

Fit 2 off Screws to tapped holes for jacking if required.

Only two of the tapped holes will have correct thread for the screws.

3/16" Hex

3.26 Remove Bush Holder (09.09) from Casing Plate (14.14).

Only store Bush Holder on its side, or if stored vertically ensure Silicon Carbide bearing rests on soft protective matting surface.

For changing Silicon Carbide Bushes and Thrust Pad refer to appropriate section shown on Contents page at the beginning of this manual.

If Bushes and Thrust Pad are not worn or damaged they can be left in place.

3.27 Wedge rags inside Inner Magnet Ring (37.37) and up to Back Thrust Washer (37.12) to prevent Thrust Washer from falling out during handling.

The Inner Magnet Ring contains strong magnets and care should be taken near ferrous materials.

For example, if workbench top is metal ensure it has a covering of hardboard, plywood, or plastic sheeting. Also be careful when using tools around this component.

3.28 Turn over Inner Magnet Ring (37.37) and hold in a vice with soft jaws fitted. Turn assembly clockwise until key (02.K31) locks against jaw before fully tightening vice.

Turn down tab on Coupling Washer (02.05) and loosen but do not remove Coupling Nut (02.36).

LEFT HAND THREAD

Loosen in a **CLOCKWISE** direction

50mm AF

3.29 Stand Inner Magnet Ring (37.37) on its side on protective surface and remove Coupling Nut (02.36) and Tab Washer (02.05).

Drift out Shaft (02.02) with a soft mallet.

Support Pump Shaft as it comes free from its location to protect Silicon Carbide Sleeves (02.86) and Thrust Washer (37.12).

3.30 Remove Back Thrust Washer (37.12) from Inner Magnet Ring (37.37).

Note that if Back Thrust Washer (37.12) is in good condition it can be left in place in the Inner Magnet Ring (37.37).

If difficult to remove, use compressed air or decontamination bath to loosen solidified product. In extreme cases it may have to be broken into pieces with hammer and punch.

Wear correct protective clothing, including overalls, gloves, safety glasses or face shield. Ensure location groove is clean and free from burrs, dents etc. before inserting new Front Thrust Washer when re-building.

3.31 If the Back Thrust Washer (37.12) has been removed then also remove and discard Alignment Pad (37.39) from Inner Magnet Ring (37.37).

3.32 Hold main body of Pump Shaft (02.02) in a vice with soft jaws.

Grip the Silicon Carbide Sleeve (08.86) with both hands and pull Sleeve from Pump Shaft (02.02).

A sharp pulling action may be required to overcome friction of the locating O-rings (02.OR1) in the bore of the Sleeve.

Wear appropriate gloves and eye protection as Silicon Carbide is brittle and can produce sharp edges when broken.

If Shaft Sleeves (02.86) are not worn or damaged they can be left in place.

Image not available

3.33 ALTERNATIVE METHOD

Carefully grip Silicon Carbide Sleeve (02.86) in soft jaws of a bench vice.

Use a soft mallet to drift Pump Shaft (02.02) from Sleeve.

Support Shaft as it exits Sleeve.

Soft jaws with fibre faces must be used to avoid cracking Silicon Carbide Sleeves.

Over-tightening the vice will break the Sleeve.

Eye protection must be worn in case Silicon Carbide fractures or splinters.

3.34 Remove O-Rings (02.OR1) from their grooves on both ends of Shaft and discard.

Put all parts disassembled so far in clean, dry, safe place until rest of Pump has been stripped.

Magnet Drive Unit is now completely disassembled

Disassembly - Stage 4 – Casing and Diffusers

Casing with Diffuser fitted, ready for disassembly	Image not available
4.01 Fit 3 off Eye Bolts to tapped holes in top face of Diffuser (33.33). Attach suitable lifting gear and lift Diffuser from pump Casing (41.41).  3 x Eye Bolts 3/16”	
4.02 ALTERNATIVE METHOD If a large diameter impeller is fitted there may not be enough wall thickness for eye bolt holes in Diffuser (33.33). If this is the case use a 3 leg puller (with reverse legs) through the eye of the Diffuser to enable extraction from the Casing (41.41).	

4.03 Remove O-Ring (33.OR2) from Diffuser (33.33) and discard.

4.04 Remove O-Ring (41.OR1) from bottom face of Casing (41.41) and discard.

4.05 High head hydraulics are fitted with a Cone Extension in the side wall of pump Casing (41.41) positioned in line with the discharge nozzle.

Removal of Cone Extension is only required for inspection or replacement purposes.

To remove Cone Extension, push in one end and the other end will slide out. Remove completely from cavity.

A Soft Mallet may be required to aid removal.

4.06 Two pins (41.49B) in the bottom face of Casing (41.41) can be left in place unless they are damaged in which case they will need to be pulled out.

ASSEMBLY OF PUMP

To prevent leaks, ensure all Jacking Screws used to disassemble the Pump are either removed or withdrawn to their original position during assembly.

Make sure all machined surfaces are clean and free from debris, bumps, bruises and scratches.

Note that small errors of alignment near the motor are magnified further away from the motor where the Outer Magnet Ring (51.51) will be running with close clearances to other components.

Dress any surface damage with a stone.

When tightening fasteners, refer to the Torque Settings table located at the end of the manual for the correct torque requriements.

Refer to Sectional Drawing and Parts List supplied with pump documents for component identification. Numbers below in parenthesis refer to item numbers shown on the Parts List.

The pump can be split into three discrete assemblies for maintenance purposes:

- Motor and Motor Support
- Magnet Drive Unit
- Casing and Diffuser

These will be considered at different stages in the instructions below.

The Inner Magnet Ring (37.37) and Outer Magnet Ring (51.51) contain strong magnets and care should be taken in the vicinity of ferrous materials.

For example, if workbench top is metal, ensure it has a covering of hardboard, plywood, or plastic sheeting. Also be careful when using tools around these components.

Note that two cranes or lifting devices will be required to maneuver the pump parts into position for maintenance.

Assembly - Stage 1 – Casing and Diffuser

1.01 Fit new pins (41.49B) to bottom face of Casing (41.41) if required.

Hammer

Punch

1.02 Ensure machined cone in Cone Extension is clean and free of debris.

Replace Cone Extension into cavity in wall of Casing (41.41) and ensure it is flush with Casing bore.

Ensure Cone Extension is correct way round so that discharge hole in Cone Extension lines up with discharge hole in Diffuser when Diffuser is fitted.

1.03 Fit new O-Ring (33.OR2) up to shoulder on Diffuser (33.33).

1.04 Fit new O-Ring (14.OR1) in bottom corner of bore of Casing (41.41).

Stretch O-Ring by hand before fitting to ensure it is pushed up to Casing inside diameter.

This will prevent it getting pinched when the Diffuser (33.33) is fitted.

1.05 Fit 3 off Eye Bolts to tapped holes in top face of Diffuser (33.33) and fit suitable lifting gear.

Attach suitable lifting gear to Eye Bolts.

Line up with holes in face of Diffuser (33.33) with pins in Casing (41.41) and lower Diffuser carefully into Casing.

5/16" UNC Eye Bolts (3 off)

Pins are not equi-spaced to ensure discharge of Diffuser (33.33) will be aligned with discharge of Casing (41.41).

1.06 ALTERNATIVE METHOD

If a large diameter impeller is fitted there may not be enough wall thickness for eye bolt holes in Diffuser (33.33).

If this is the case use a 3 leg puller (with reverse legs) through the eye of the Diffuser to enable the Diffuser to be lowered into Casing (41.41).

Casing and Diffuser are now complete

Assembly - Stage 2 – Magnet Drive Unit

2.01 Hold main body of shaft in vice fitted with soft jaws.

Fit O-Rings (02.OR1) into their grooves on both ends of Pump Shaft (02.02).

Ensure Pump Shaft centre hole and cross-holes are clear of sludge or solidified product.

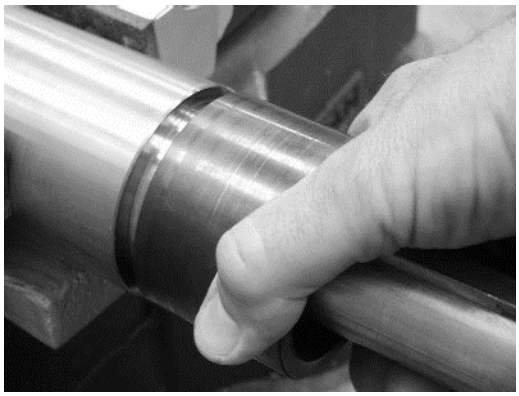
2.02 Fit new Shaft Sleeves (02.86).

Note that a firm rotating and pushing action will be needed to fit Sleeve over O-Rings.

If Kalrez® or similar type O-Rings are less pliable than standard Viton® type O-Rings, Sleeves may therefore need to be fitted with care using a hand operated or small pneumatic press.

Use a suitable lubricant compatible with the pumped liquid in the bore of the Sleeve to aid assembly (if permitted).

Wear appropriate gloves and eye protection as silicon carbide is brittle and can produce sharp edges when broken.



2.03 Fit new Alignment Pad (37.39) to Inner Magnet Ring (37.37) and ensure Alignment Pad locates correctly over Thrust Washer Drive Pin (37.49).

Ensure location groove is clean and free from burrs, dents etc. before inserting new Alignment Pad and

2.04 Fit new Back Thrust Washer (37.12).

Note that one side may have grooves.

ENSURE PLAIN SIDE IS FACE UP.

Ensure Back Thrust Washer locates correctly over Thrust Washer Drive Pin (37.49).

Some Thrust Washers are plain on one side and grooved on the other. Make sure the grooved side is facing down and sitting on the Alignment Pad (37.39).

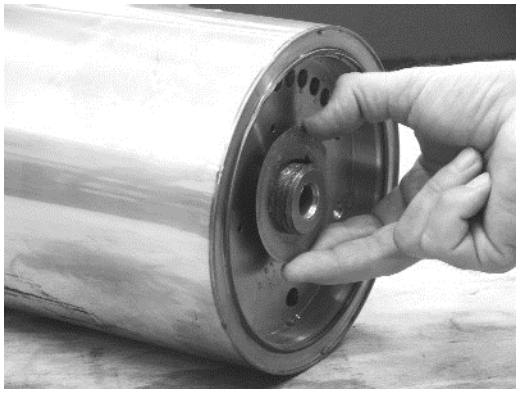
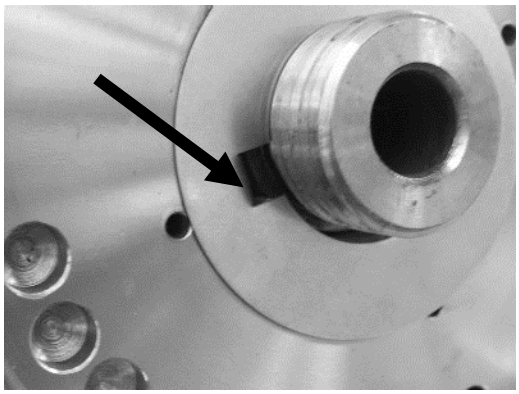
Use fingers to rotate Thrust Washer from side-to-side about Pin to ensure Thrust Washer is seated correctly and free to move.

2.05 Fit Impeller Location Key (02.K31) to Pump Shaft (02.02) if required.

Check that impeller (06.06) fits correctly over pump shaft and key.

Image not available

2.06 Fit Pump Shaft (02.02) to Inner Magnet Ring (37.37).

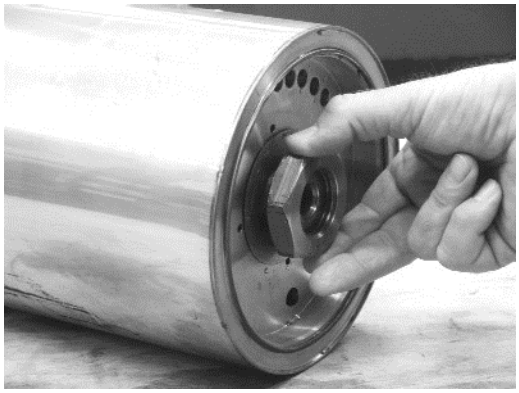
2.07 After fitting Pump Shaft (02.02), pack clean lint-free rag around Pump Shaft and down onto Back Thrust Washer (37.12). This will prevent Back Thrust Washer falling from its location during handling of the Inner Magnet Ring (37.37). The Inner Magnet Ring contains strong magnets and care should be taken near ferrous materials. For example, if workbench top is metal ensure it has a covering of hard board, plywood or plastic sheeting. Also be careful when using tools around this component.	
2.08 Fit new Coupling Washer (02.05) to Pump Shaft (02.02).	
2.09 Ensure anti-rotation tab (arrowed) is turned down into location hole.	

2.10 Fit Coupling Nut (02.36) to Pump Shaft (02.02).

Tighten finger tight.

EFT HAND THREAD

Tighten in an **ANTI-CLOCKWISE** direction



2.11 Turn over Inner Magnet Ring (37.37) and hold in a vice with soft jaws fitted. Turn assembly anti-clockwise until key (02.K31) locks against jaw before fully tightening vice.

Tighten Coupling Nut (02.36).

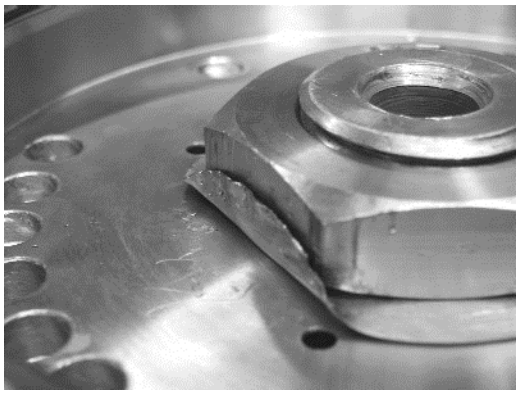
LEFT HAND THREAD

Tighten in an **ANTI-CLOCKWISE** direction

50mm AF

100 Nm (74 lbf-ft)

2.12 Use pry bar to turn up section of Coupling Washer (02.05) onto Coupling Nut (02.36).



2.13 Remove Pump Shaft with IMR attached from vice and place on low level work surface.

Remove rag that was previously pushed between Pump Shaft (02.02) and Inner Magnet Ring (37.37).

For ZeroLoss Containment Shell (20.20) the Inner Magnet Ring (37.37) must be supported either side of the protruding nut.

2.14 Fit Bush Holder (09.09) to Casing Plate (14.14) and align off-set retention holes.

Fit Bush Holder retention Screws (14.S41) and tighten evenly by hand.

3/16" Hex

Fully tighten by hand.

2.15 Very carefully lower Casing Plate (14.14) complete with Bush Holder (09.09) over Pump Shaft (02.02).

Extreme care must be taken not to damage Silicon Carbide bearings as Bush Holder slides over Pump Shaft.

Casing Plate with attached Bush Holder can weigh more that 25 kg (55 lbs).

2.16 Fit new Thrust Washer (07.07A) if required to Thrust Washer Holder (07.07).

Ensure it locates correctly over Thrust Washer Location Pin (07.49).

Ensure location groove is clean and free from burrs, dents etc. before inserting new Front Thrust Washer when re-building. Rotate Thrust Washer from side-to-side about Pin to ensure Thrust Washer is seated correctly.	
2.17 Tip assembly over and lower Casing Plate (14.14) onto bench. Lift Inner Magnet Ring (37.37) so that Pump Shaft (02.02) runs uphill towards the Inner Magnet Ring. Support Inner Magnet Ring.	

2.18 Slide Thrust Washer Holder assembly (07.07) over Pump Shaft (02.02) and up to Shaft Sleeve (02.86).

Stand assembly vertically again.

Ensure Thrust Washer (07.07A) remains seated correctly in Thrust Washer Holder during fitting.

Fit Casing Plate Cover retention Screws (14.S45) to tapped holes provided in back of Thrust Washer Holder to aid assembly.

2.19 Lower Casing Plate Cover (14.40) into Casing Plate (14.14) location.

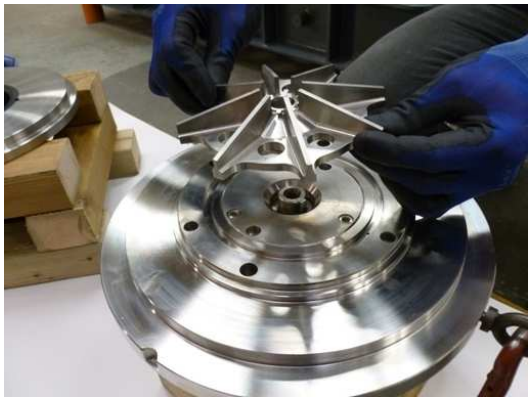
Fit retention Screws (14.S45) and tighten with torque wrench.

7/32" or 1/4" Hex

25 Nm (18 lbf-ft)

Fit screws to tapped holes in Casing Plate Cover to aid assembly.

2.20 Fit Impeller (06.06) to Pump Shaft (02.02).

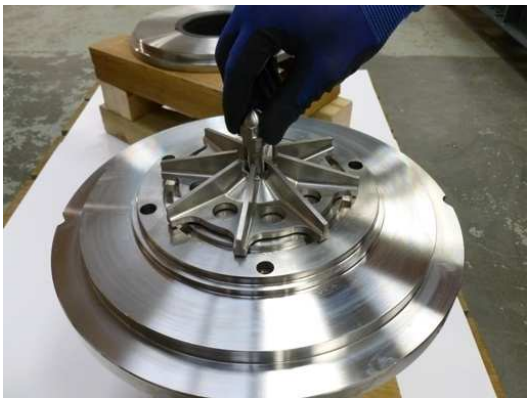


2.21 NO INDUCER OPTION

Fit Impeller Tab Washer (02.05A) and Impeller Fastener (02.03).

LEFT HAND THREAD

Do not fully tighten at this stage.



2.22 INDUCER OPTION

Occasionally an Inducer (76.01) will be fitted in place of the Impeller Fastener.

Fit Stud (02.48A) into Inducer (76.01) and tighten until Stud bottoms in hole.

Fit Inducer together with Stud and Tab Washer (02.05A) to retain Impeller (06.06) to Pump Shaft (02.02).

LEFT HAND THREAD

Do not fully tighten at this stage.

2.23 Stand Coupling Housing (43.43) vertically on bench with large flange uppermost.

Image not available

2.24 METAL CONTAINMENT SHELL OPTION Lower Containment Shell (20.20) into Coupling Housing (43.43). Align retention screw holes in Coupling Housing with tapped holes in rear of Containment Shell flange.	Image not available
2.25 METAL CONTAINMENT SHELL OPTION Fit Retention Screws (20.S42) through Coupling Housing (43.43) and tighten evenly from side to side.  5/16” Hex **35 Nm (26 lbf-ft)**	Image not available
2.26 ZEROLOSS CONTAINMENT SHELL OPTION Fit Containment Shell Flange into recess in flange of Coupling Housing (43.43). Align retention screw holes in Coupling Housing with tapped holes in rear of Containment Shell flange.	Image not available
2.27 ZEROLOSS CONTAINMENT SHELL OPTION Fit Retention Screws (20.S42) through Coupling Housing (43.43) and tighten evenly from side to side.	Image not available

5/16” Hex **35 Nm (26 lbf-ft)**	
2.28 ZEROLOSS CONTAINMENT SHELL OPTION Fit O-ring (20.OR1) to groove in metallic flange. O-ring will need to be slightly stretched in order to fit into groove, this can easily be done by hand. Care should be taken when stretching PTFE. Ensure O-ring and groove are clean.	Image not available
2.29 ZEROLOSS CONTAINMENT SHELL OPTION Lower Containment Shell (20.20) into metallic flange so that shell lip drops into location bore. Align cut-outs in shell face with tapped holes on metallic flange. Ensure O-ring remains seated in groove when fitting Containment Shell.	Image not available
2.30 Fit 2 off Eye Bolts to tapped holes in outside diameter of Casing Plate (14.14). Attach suitable lifting gear and lift Casing Plate complete with rotating assembly. 5/16” Eye Bolts x 2	Image not available

2.31 Carefully lower Casing Plate and rotating assembly into bore of Containment Shell (20.20).

Align retention screw holes with tapped holes in flange of Containment Shell.

For ZeroLoss Containment Shell ensure O-Ring has already been fitted between flange and shell.

Avoid bumping ZeroLoss Containment Shell as O-ring may be dislodged from its groove.

To identify the correct position for hole alignment, the internal feed hole in the face of Casing Plate (14.14) is 45° to the left of the lifting eye hole in the flange outside diameter of Coupling Housing (43.43)

(feed hole may be hidden behind impeller).

2.32 Fit 3 off Casing Plate retention Screws (20.S41).

7/32" or 1/4" Hex

25 Nm (18 lbf-ft)

NOTE

In some cases the Impeller may cover or partially cover the screw holes. If this is the case the Impeller will need to be removed in order to fit the screws and then replaced.

After refitting the Impeller check that it rotates freely before fully tightening Impeller Fastener.

If the Impeller does not rotate freely it is possible the rear Thrust Washer may have become unseated when the shaft dropped as the impeller fastener was loosened.

2.33 Tighten Impeller Fastener (02.03) or Inducer (76.01), whichever is fitted **LEFT HAND THREAD** Tighten in an **ANTI-CLOCKWISE** direction Bend Tab Washer (02.05A) to ensure Impeller Fastener or Inducer does not come loose.  3/4" AF (Narrow Line Impeller) 1-1/8" AF (Wide Line Impeller) **50 Nm (37 lbf-ft)**  One of the impeller blades may be held with an adjustable spanner whilst tightening fastener.  The Inducer, if fitted, has a small pocket either side of the hub for tabs to bend into.  **CAUTION** – Assembly is stable but top heavy	
2.34 Measure end float of rotating assembly (axial clearance between thrust faces). Set magnetic base on front flange face of Coupling Housing (43.43). Place Dial Test Indicator on front face of Impeller (06.06). Set Dial Test Indicator to zero. Lift Impeller with suitable levers placed each side. **Allowable end float is 0.45 mm to 1.4 mm (0.018" to 0.055").**	No image available

2.35 Fit new Gasket (20.17) up to shoulder on flange of Containment Shell (20.20). Ensure Gasket seating face is free from dents and scratches etc. Ensure Gasket lies within the diameter of seating face or it may be damaged when Adaptor Ring (16.16) is fitted.	
2.36 Fit new O-ring (14.OR3) into groove in outside diameter of Casing Plate (14.14).	
2.37 Fit new O-ring (14.OR2) up to FIRST shoulder on front of Casing Plate (14.14). **Check O-ring is fitted on SMALLEST diameter of Casing Plate.**	

2.38 Replace Jacking Screws (16.S51) with Eye Bolts.

Attach suitable lifting gear and lower Adaptor Ring (16.16) over Casing Plate (14.14) and up to front face of Coupling Housing (43.43).

5/16” Eye Bolts x 2

Soft Mallet

Position so that vent hole in outer diameter of Casing Plate lines up with vent flange on Adaptor Ring.

Adaptor Ring will need to be tapped on with a soft Mallet due to friction of O-ring (14.OR3).

Be careful not to pinch Gasket (20.17).

2.39 Fit 12 off Retention Screws (43.S55) and tighten evenly from side to side.

1/2” Hex

125 Nm (92 lbf-ft)

Gasket (20.17) is fully seated when there is no longer a gap between Adaptor Ring (16.16) and Coupling Housing (43.43).

CAUTION – Assembly is stable but top heavy.

2.40 Attach suitable lifting gear to eye Bolts already fitted to Adaptor Ring (16.16).

Lift Magnet Drive Unit into the vertical position.

5/16” Eye Bolts x 2

2.41 Fit 1 off Eye Bolt to tapped hole in flange of Coupling Housing (43.43). Use a second lifting device to raise the Magnet Drive Unit into a horizontal position.  ½" Eye Bolt	
2.42 Remove Eye Bolts from Casing Plate (14.14) and replace with jacking Screws (16.S51). (Image shows optional Inducer fitted to Impeller)	
2.43 Fit Eye Bolts to tapped holes in outside of small flange of Coupling Housing (43.43). Use a second lifting device to lift pump into the vertical position with impeller at the bottom. (Image shows optional Inducer fitted to Impeller)	

2.44 Lower Magnet Drive Unit onto pump Casing (41.41).

Take care to keep Drive Unit vertical when fitting, especially if an Inducer (76.01) is fitted.

Align Eye Bolt hole in Coupling Housing flange with discharge nozzle of Casing

Guide pins may be fitted to aid alignment.

Ensure O-ring (14.OR2) does not fall from Casing Plate (14.14) during fitting.

Alternatively the O-ring may be positioned in the corresponding location diameter of the Diffuser (33.33).

If O-ring is fitted to Diffuser it will need slight stretching to avoid getting pinched as Casing Plate enters Diffuser.

2.45 Ensure 3 off Jacking Screws in flange of Coupling Housing (43.43) have been backed off to allow metal-to-metal contact between Coupling Housing and Casing (41.41)

3/8” Hex

2.46 Fit 12 off Washers (41.W11) and Retention Nuts (41.N11) to Studs (41.48).

Tighten Nuts evenly from side to side

1-1/4" AF

300 Nm (220 lbf-ft)

It may be helpful to number the nuts in order of tightening sequence.

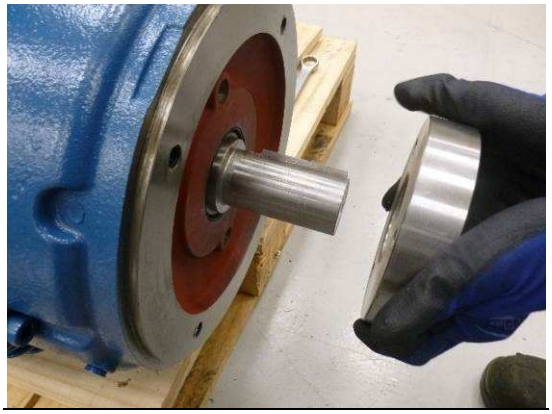
STAGE 1 & 2 COMPLETE MAGNET DRIVE UNIT FITTED TO CASING	

Assembly - Stage 3 – Motor & Motor Support (Close Coupled)

3.01 Fit taper ring part of Drive Adaptor (52.52) over motor shaft.

Ensure taper is correct way round to match taper on Drive Adaptor body.

Apply anti-seize compound to bore of taper ring.



3.02 Fit Drive Adaptor to motor shaft.

Push Drive Adaptor (52.52) on to motor shaft.

Shaft end must bottom out in bore of Drive Adaptor for correct axial positioning.

Use a soft mallet to tap the end of Adaptor to ensure shaft has bottomed.

Apply anti-seize compound to motor shaft.

3.03 Fit Draw Screws (52.S42) and tighten evenly to draw taper ring towards flange.

This will cause Drive Adaptor to grip motor shaft.

Leave final tightening for next step.

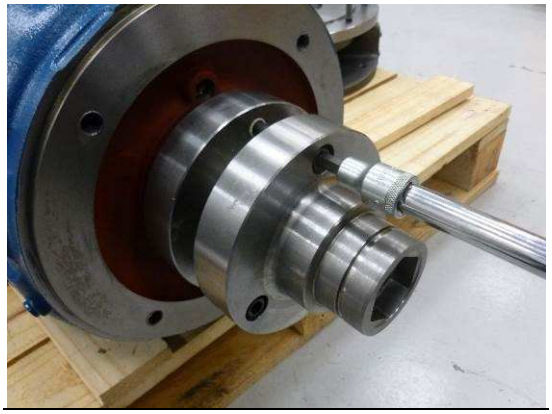
IEC Motors – 8 mm Hex

NEMA 143TC to 215TC – 7/32” Hex

NEMA 254TC to 365TSC – 5/16” Hex

Apply anti-seize compound to thread of Draw Screws.

A large screw driver or similar tool can be used behind the flange between one of the screws and the Drive Adaptor body to prevent the Drive Adaptor from turning



3.04 Attach magnetic base to front face of motor to check run-out of Drive Adaptor (52.52).

Set Dial Test Indicator to run in front bore which is the location for Outer Magnet Ring (51.51).

Tighten Retention Screws (52.S42) in a sequence that will keep run-out within limits.

Maximum allowable run-out 0.075 mm (0.003")

IEC 90 to 250 – 8 mm Hex – **75 Nm (55 lbf-ft)**

143TC to 215TC – 7/32" Hex – **35 Nm (26 lbf-ft)**

254TC to 365 TSC – 5/16" Hex – **60 Nm (44 lbf-ft)**

3.05 Fit 2 off Eye Bolts and suitable lifting gear to tapped holes in any two adjacent webs of Motor Adaptor (45.45).

2 x 5/8" Eye Bolts for NEMA Motors

2 x M16 Eye Bolts for IEC motors

3.06 **NEMA Motors**

NEMA motors are face mounted, an Adaptor Plate (45.16) will always be mounted to the front face of the NEMA motor.

Fit Adaptor Plate (45.16) to front face of motor.

3.07 **NEMA Motors**

Fit retention Screws (45.S42) and tighten down evenly from side to side.

143TC to 145TC – 5/16" Hex – **60 Nm (44 lbf-ft)**

182TC to 286TSC – 3/8" Hex – **150 Nm (111 lbf-ft)**

324TC to 365TSC – ½" Hex – **280 Nm (206 lbf-ft)**

3.08 **NEMA Motors**

Fit Eye Bolts and suitable lifting gear to webs of Motor Adaptor (45.45).

Position motor terminal box at 12 o'clock and fit Motor Adaptor to Adaptor Plate (45.16).

2 x 5/8" Eye Bolts for NEMA Motors

2 x M16 Eye Bolts for IEC motors

3.09 **NEMA Motors**

Fit Retention Nuts (45.N15) and Washers (45.W15).

Tighten evenly from side to side.

¾" A/F – **100 Nm (74 lbf-ft)**

3.10 **IEC Motors WITH Adaptor Plate**

A separate Adaptor Plate (45.16) is only required for the largest motors.

Fit Adaptor Plate (45.16) to motor.

No image available

3.11 **IEC Motors WITH Adaptor Plate**

Fit retention Screws (45.S42) and Washers (45.W15).

Tighten down evenly from side to side.

250 Frame motor with require addition of Nuts (45.N15) and Washers (45.W15).

24 mm AF

185 Nm (136 lbf-ft)

No image available

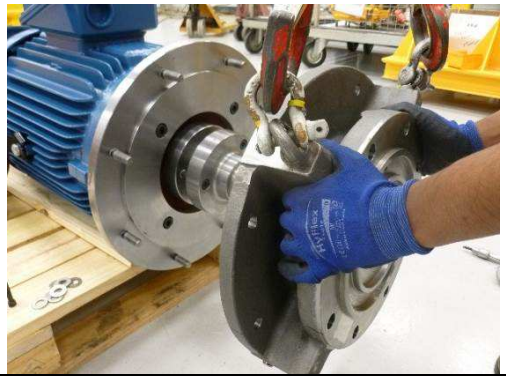
3.12 **IEC Motors WITH Adaptor Plate**

Fit 2 off Eye Bolts and suitable lifting gear to any adjacent webs of Motor Adaptor (45.45).

Position motor terminal box at 12 o'clock.

Fit Motor Adaptor to Adaptor Plate (45.16).

M16 Eye Bolts x 2



3.13 **IEC Motors WITH Adaptor Plate**

Fit Retention Nuts (45.N15) and Washers (45.W15).

Tighten evenly from side to side.

15/16" AF

200 Nm (147 lbf-ft)

3.14 **IEC Motors WITHOUT Adaptor Plate**

IEC motors are flange mounted, in most cases an Adaptor Plate will not be required.

Fit 2 off Eye Bolts and suitable lifting gear to any adjacent webs of Motor Adaptor (45.45).

Position motor terminal box at 12 o'clock.

Fit Motor Adaptor (45.45) directly to motor flange.

No image available

M16 Eye Bolts x 2

3.15 **<u>IEC Motors WITHOUT Adaptor Plate</u>**

Fit Screws (45.S42) and Washers (45.W15) that retain Motor Adaptor (45.45) to motor.

Frame 225 2 pole motor will also require Nuts (45.N15) and Washers (45.W15).

Tighten evenly from side to side.

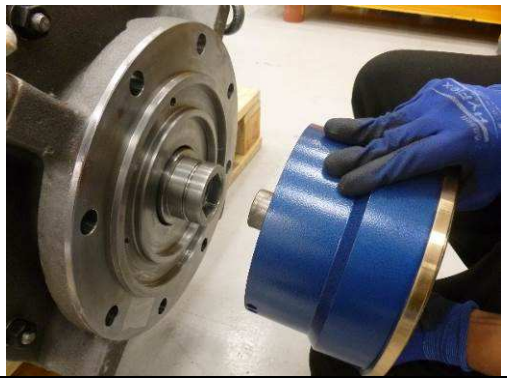
IEC 90 – 17 mm AF – **45 Nm (33 lbf-ft)**

IEC 100 to 132 – 19 mm AF – **75 Nm (55 lbf-ft)**

IEC 160 to 225 – 24 mm AF – **185 Nm (136 lbf-ft)**

No image available

3.16 Line up screw holes and fit Outer Magnet Ring (51.51) to hexagon drive of Drive Adaptor (52.52).



3.17 Add one drop of Loctite 242 Threadlocker (or similar product) to each of the Outer Magnet Ring Retention Screws (52.S41).

3.18 Fit 2 off Retention Screws (52.S41) through Outer Magnet Ring (51.51) and tighten.

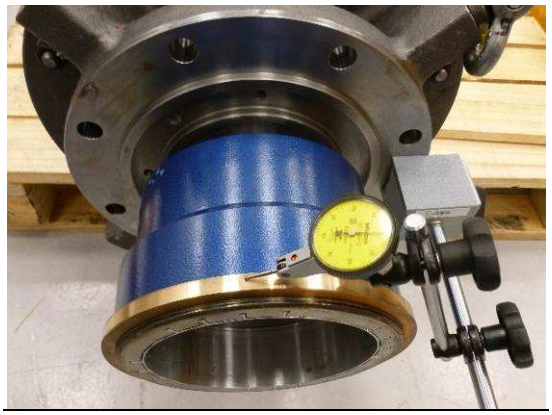
¼" Hex

25 Nm (18 lbf-ft)

3.19 Set magnetic base on mounting face of Motor Adaptor (45.45).

Check run-out of Bump Ring at front end of Outer Magnet Ring (51.51).

Maximum allowable run-out 0.25 mm (0.010")



If run-out is high, remove Outer Magnet Ring, rotate through 180° and re-fit.

Re-check run-out.

3.20 Attach one lifting device to Eye Bolts already fitted to Motor Adaptor (45.45).

Attach second lifting device to lifting eyes either side of Electric Motor.

Initially lift Motor Assembly horizontally and then lower Motor Adaptor completely so assembly is suspended vertically by the Motor only.

Remove lifting gear attached to Motor Adaptor.

Ensure motor lifting eyes are capable of lifting the additional weight of Motor Adaptor (45.45), Drive Adaptor (54.54) and Outer Magnet Ring (51.51).

The extra weight is shown on customer specific installation drawing under Motor Adaptor weight.

DO NOT LIFT COMPLETE PUMP WITH LIFTING EYES OF ELECTRIC MOTOR.

3.21 Position motor terminal box relative to pump nozzles and lower Motor Assembly onto Coupling Housing (43.43).

Guide Outer Magnet Ring (51.51) into Coupling Housing and over Containment Shell (20.20).

Ensure assembly is suspended vertically before lowering.

Avoid bumping Outer Magnet Ring as run-out of Outer Magnet Ring may be affected.

3.22 Remove Eye Bolts and lifting gear from Motor Adaptor (45.45)

Fit retention Nuts (43.N13) and Washers (43.W14) to Studs (43.48B) of Coupling Housing (43.43).

15/16" Ring attachment for torque wrench

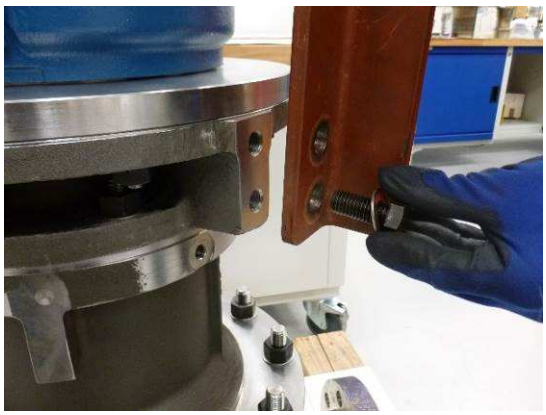
125 Nm (92 lbf-ft)

3.23 Remove lifting gear from motor.

Pump is now fully assembled and ready to be re-installed into pipework.

Assembly - Stage 4 – Re-Install Pump

4.01 Fit lifting lugs (98.98) to motor Adaptor (45.45) with High Tensile Retention Screws (98.S11) and Washers (98.W11).



Each new pump is furnished with the above lifting equipment.

2 off Lifting Lugs for pumps up to 750 kg (1650 lbs).

4 off Lifting Lugs for pumps over 750 kg (1650 lbs).

Lifting Lugs are only certified to the weight marked when used with Retention Screws supplied.

15/16” AF for NEMA motors

24 mm AF for IEC motors

125 Nm (92 lbf-ft) (NEMA & IEC)

4.02 Complete pump should be lifted with Lifting Lugs (98.98) that were originally supplied with the pump.

Fit suitable lifting gear to Lifting Lugs (98.98) and take up any slack to prevent toppling of pump.

Remove fixing down screws if used.

Lift pump away and re-fit to pipework.

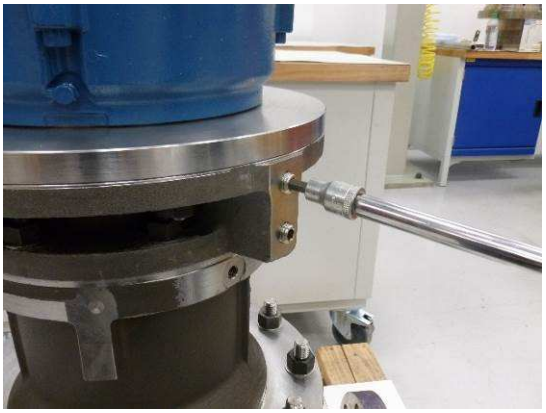
Re-fit orifice plate if necessary.

Securely fasten pump to suitable base during transport.

4.03 Remove Retention Screws (98.S11), Washers (98.W11) and Lifting Lugs (98.98) from Motor Adaptor (45.45).

15/16” AF for NEMA motors

24 mm AF for IEC motors

4.04	Re-fit grub screws (45.S53) to webs of Motor Adaptor (45.45). This will prevent corrosion of retention holes for Lifting Lug fasteners.	
	5/16” Hex Hand tight	

Pump is now ready for commissioning

Refer to Installation & Operating Manual for correct venting and start-up procedure.

REPLACEMENT OF BUSHES & THRUST PAD

Whilst Silicon Carbide has excellent wear resistance, it is brittle and care must be taken in handling this material. Wear eye protection to guard against fracturing of Silicon Carbide bearings.

If visibly worn or damaged it is strongly recommended that Bushes and Pad are renewed before re-assembling Pump. Alternatively a complete new assembly can be purchased from Sundyne or their authorised representatives.

Read the whole of this Section thoroughly before proceeding with Bush and Pad replacement.

Guard against combustion of product residue on components.

Wear suitable protective clothing and heat resistant gloves at all times while handling hot components. Do not handle hot Bush Holder Sleeve (09.09) even when wearing heat resistant gloves, only use metal tongs to manoeuvre Sleeve.

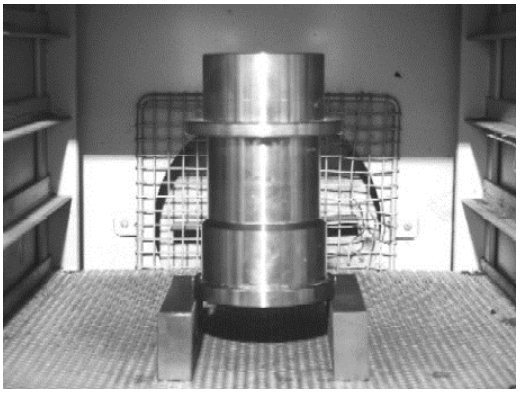
1.01 Replacement Silicon Carbide Bushes and Thrust Pad must be at a temperature of at least 15°C before fitting to Bush Holder.

1.02 To remove existing Silicon Carbide Bushes and Thrust Pad, place Bush Holder (09.09) in high temperature industrial oven or on industrial gas ring and heat to **300°C (572°F)**.

1.03 Stand Bush Holder (09.09) on metal blocks in such a way that Bush and Back Thrust Pad will be free to drop out when required temperature is reached.

For this method to work properly Bush Holder Sleeve must be exactly vertical.

If using an industrial gas ring, check Bush Holder Sleeve frequently with a temperature touch probe to ensure overheating does not occur.

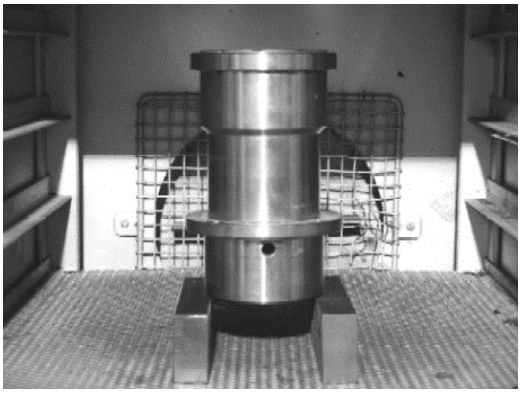


1.04 Bush Holder Sleeve will need to be inverted to allow second Bush to fall out.

After removing both Bushes and Back Thrust Pad, allow Bush Holder Sleeve to cool, then ensure Bush and Pad locations in Bush Holder are clean and free of damage before proceeding.

Use a non-mechanical cleaning method.

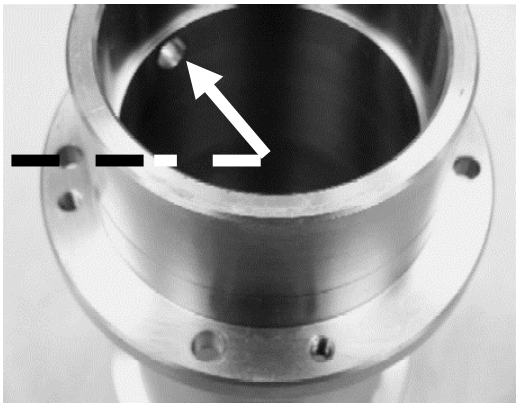
Wear heat resistant gloves suitable for Bush Holder temperature.



1.05 Stand Bush Holder Sleeve in high temperature oven or on gas ring with flange uppermost as shown and with internal feed hole (arrowed) positioned at 45° from retention hole (marked with dotted line).

Re-heat to a temperature of 300°C

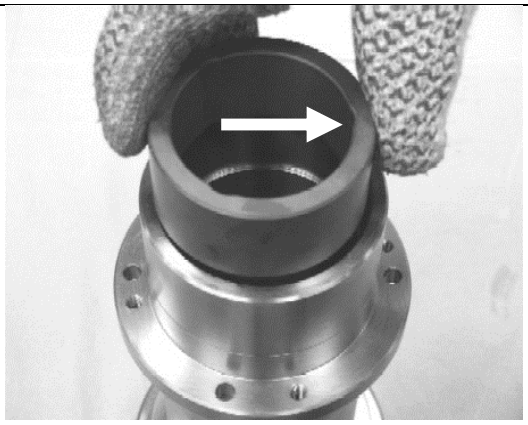
The following fitting operation must be carried out as quickly as possible to ensure Bushes and Pad do not become stuck as Bush Holder cools down.



1.06 Remove Bush Holder from oven and place on heat resistant surface with feed hole positioned at 45°.

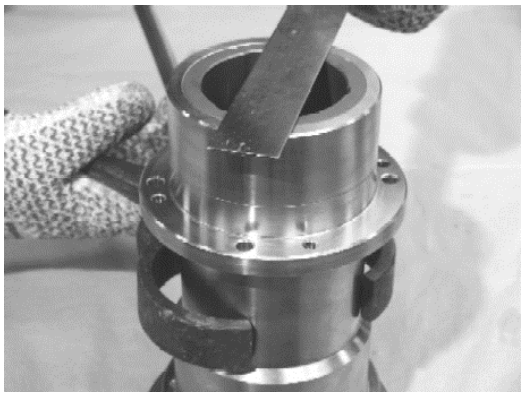
Fit Bush into Bush Holder with one of the lubrication grooves at 3 o'clock position (arrowed).

Bush should drop easily into pre-heated Bush Holder Sleeve.



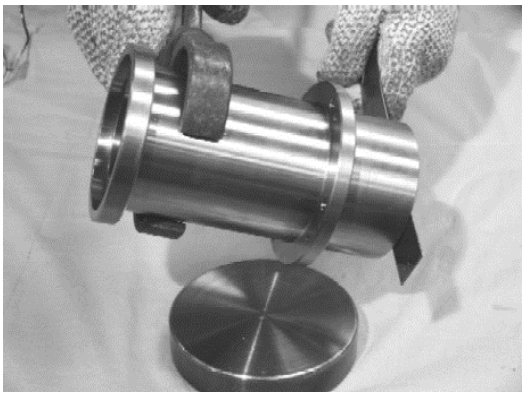
1.07 Hold Bush in place with one hand using thin metal strip.

Grasp body of Bush Holder Sleeve with the other hand using metal tongs or appropriate heat resistant gloves.

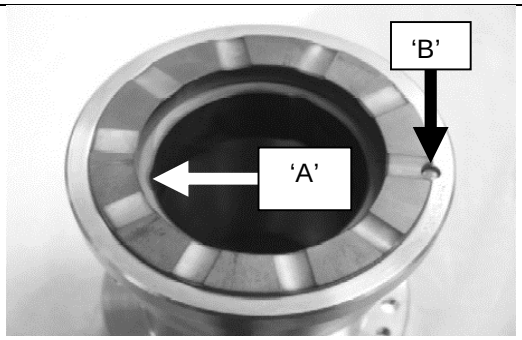


1.08 Turn assembly over whilst holding first Bush in place.

Lower assembly carefully and slide out thin metal strip.



1.09 Quickly fit second Bush with lubrication grooves in Bush at 9 o'clock position (arrow 'A') in line with Pin (09.49C – arrow 'B').



Quickly fit Thrust Pad with lubrication grooves uppermost.

Bush and Pad should drop easily into Bush Holder.

If Bush or Pad become stuck as Bush Holder cools down, reapply heat to Bush Holder.

1.10 Carefully place weight on Back Thrust Pad.

Allow assembly to cool in draught free atmosphere. Do not attempt to artificially accelerate cooling as this may result in damage to Bushes or Pad.

Check temperature of assembly with temperature touch probe.

When cool, visually inspect Bushes and Pad to ensure they are correctly seated in their locations.

Also check that there are no cracks or damage to Bushes and Pad.

Dimensions of weight should be Ø95 mm (Ø3.75”) max x Ø80 mm (Ø3.15”) min x 40 to 50 mm (1.5” to 2”) high.

Quick Reference Torque Settings

Reference Number	Description	Tool Size	Thread Size	Left Hand Thread	Torque Setting	
					Nm	lbf-ft
02.03	Fastener (Impeller Narrow Line)	3/4" AF Deep Socket	1/2" UNF	LH	50	37
02.03	Fastener (Impeller Wide Line)	1-1/8" AF Deep Socket	1/2" UNF	LH	50	37
02.36	Retention Nut (Inner Magnet Ring)	50mm AF	M30 x2	LH	100	74
14.S41	Retention Screw (Bush Holder)	3/16" Hex Key	1/4" UNC		Fully hand tighten	
14.S45	Retention Screw (Cover Plate)	7/32" or 1/4" Hex Key	5/16" UNC		25	18
16.S51	Jack Screw (Coupling Housing)	5/16" Hex Key	5/8" UNC		By feel	
20.S41	Retention Screw (Casing Plate Cover)	7/32" or 1/4" Hex Key	5/16" UNC		25	18
20.S42	Retention Screw (Coupling Housing)	5/16" Hex Key	3/8" UNC		35	26
41.N11	Retention Nut, Heavy (Casing)	1-1/4" AF	3/4" UNC		300	220
43.N13	Retention Nut (Motor Adaptor)	15/16" AF	5/8" UNC		125	92
43.S12	Jack Screw (Casing)	3/8" Hex Key	¾" UNC		By feel	
43.S52	Jack Screw (Containment Shell)	5/16" Hex Key	5/8" UNC		By feel	
43.S55	Retention Screw (Adaptor Ring)	½" Hex Key	5/8" UNC		125	92
45.N15	Retention Nut (Motor Adaptor)					
	NEMA	¾" AF	½" UNC		100	74
	IEC (WITHOUT Adaptor Plate)	17 AF 90 Frame Motor	M10		45	33
		19 AF 100 to 132 Frame Motor	M12		75	55
		24 AF 160 to 225 Frame Motor	M16		184	136
	IEC (WITH Adaptor Plate)	15/16" AF	5/8" UNC		200	147

Reference Number	Description	Tool Size	Thread Size	Left Hand Thread	Torque Setting	
45.S42	Retention Screw (Adaptor Plate)					
	NEMA or IEC Motors (WITH Adaptor Plate)	5/16" Hex Key 143TC to 145TC Frame Motor	3/8"		60	44
		3/8" Hex Key 182TC to 286 TSC Frame Motor	½"		150	111
		½" Hex Key 324TC to365 TSC Frame Motor	5/8"		280	206
52.S41	Retention Screw (Outer Magnet Ring)	¼" Hex Key	5/16"		25 *	18 *
52.S42	Draw Screw (Taper Ring)					
	NEMA 143TC to 215TC	7/32" Hex Key	5/16"		35	55
	NEMA 254TC to 365TSC	5/16" Hex Key	3/8"		60	44
	IEC	8 mm Hex Key	M10		75	55

*Thread lock compound recommended where indicated with asterisk.

Torque settings in the above table have been specified by experience and generally cover all materials of construction. Note that for softer Nickel and some materials that comply with NACE MR0175 special care must be taken as maximum torque may be less than that shown in the table.

Hex = Hexagon Key
AF = Across Flats

Torque settings are also contained within the text of the manual

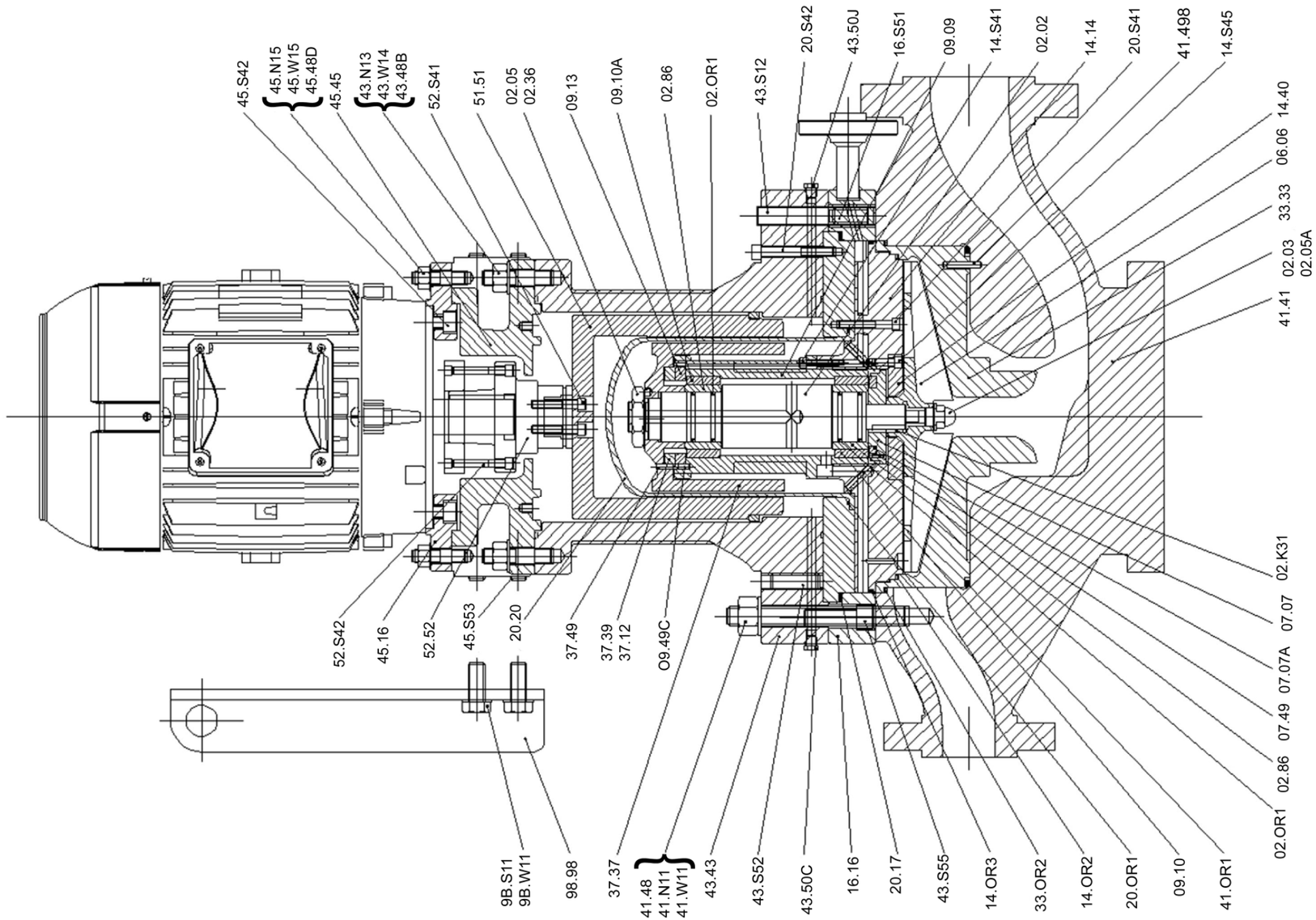
Pump Parts List

Table 13. Pump Parts List of a Typical Build

LMV-801S Parts List					
Item no.	Description	Qty	Item no.	Description	Qty
02.02	**Pump Shaft Assembly**	1	37.37	Inner Magnet Ring	1
02.03	Impeller Fastener	1	37.12	Thrust Washer (top)	1
02.05	Coupling Washer	1	37.39	Alignment Pad	1
02.05A	Impeller Tab Washer	1	37.49	Pin (thrust washer drive)	1
02.36	Coupling Nut	1	41.41	**Casing**	1
02.86	Sleeve Bearing (SiC)	2	41.48	Stud (casing retention)	12
02.K31	Impeller Key	1	41.48B	Pin (diffuser location)	2
02.OR1	O-Ring (sleeve support)	4	41.N11	Nut (casing retention)	12
06.06	Impeller	1	41.W11	Washer (casing retention)	12
07.07	Thrust Washer Holder	1	41.OR1	O-Ring (diffuser / casing, bottom)	1
07.07A	Thrust Washer (bottom)	1	43.43	**Coupling Housing Assembly**	1
07.49	Pin	1	43.48B	Stud (motor adaptor retention)	8
09.09	**Bush Holder Assembly**	1	43.50C	Blanking Plug (RTD probe)	1
09.10	Bush (bottom)	1	43.50J	Blanking Plug (Vapour View)	1
09.10A	Bush (top)	1	43.N13	Nut (motor adaptor retention)	8
09.13	Thrust Pad	1	43.S12	Screw (casing forcing)	3
09.49C	Pin	1	43.S52	Screw (containment shell forcing)	2
14.14	**Casing Plate Assembly**	1	43.S55	Screw (adaptor ring retention)	12
14.40	Casing Plate Cover	1	43.W14	Washer (motor adaptor retention)	8
14.OR2	O-Ring (casing plate / diffuser)	1	45.45	**Motor Adaptor Assembly**	1
14.S41	Screw (bush holder retention)	4	45.16	Adaptor Plate	1
14.S41	Screw (cover plate retention)	3	45.48D	Stud (adaptor plate retention)	4
14.OR3	O-Ring (casing plate / adaptor ring)	1	45.N15	Nut (adaptor plate retention)	4
16.16	**Adaptor Ring Assembly**	1	45.S42	Screw (motor retention)	4
16.S51	Screw (coupling housing forcing)	2	45.S53	Screw (plug)	8
20.20	**Containment Shell Assembly**	1	45.W15	Washer (adaptor plate retention)	4
20.17	Gasket	1	51.51	Outer Magnet Ring	1
20.OR1	O-Ring	1	52.52	**Drive Adaptor Assembly**	1
20.S41	Screw (casing plate retention)	3	52.S41	Screw (OMR retention)	2
20.S42	Screw (coupling housing retention)	2	52.S42	Screw (shrink ring)	3
33.33	Diffuser	1			
33.OR2	O-Ring (diffuser / casing, top)	1			

LMV801S Pump Cross Section (No Secondary Containment)

Figure 17. Pump Cross Section of a Typical Build



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