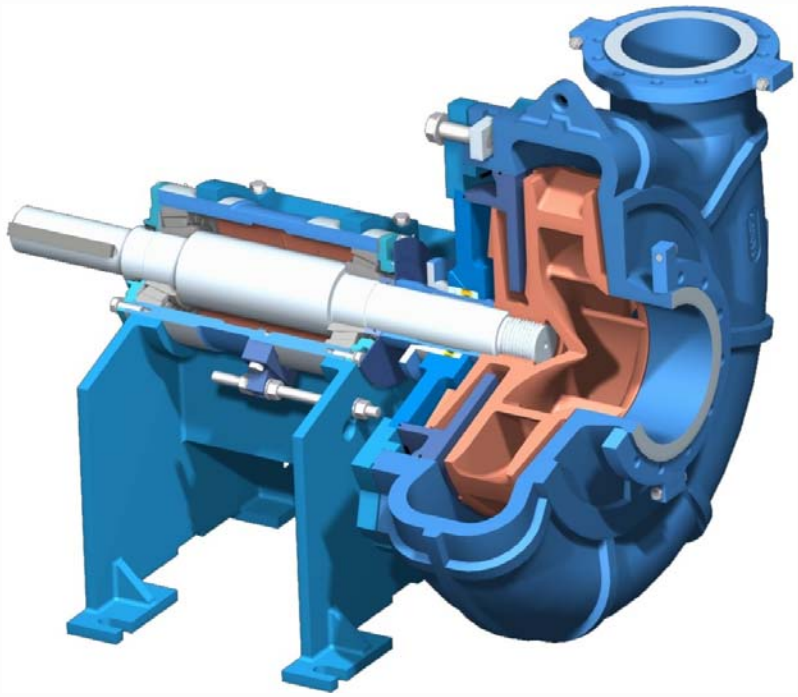
Operation & Maintenance Manual

# The Orion Series of Horizontal Slurry Pumps HM200 MHC-S C5

**Pump No**
**301599258.0101 / P-105**

**Supplier / Order No**
**Metso Minerals (Austria) GmbH / 308012**

**Customer Name**
**Harsco Minerali d.o.o**



**Note!**

**This pump is equipped with mechanical shaft sealing.**
**Mechanical seals must never run dry!**
**Adjust the quench liquid to the specifications**
**in chapter 9.5.3**
**If the seal runs dry it will be destroyed within seconds.**

Original language
Date: 2012-08-16

# 8. OPERATING INSTRUCTIONS



# 9. CARE AND MAINTENANCE



# 10. SPARE PARTS



# 11. APPENDICES

# 1 GENERAL

## 1.1 About this manual

This manual is a part of the equipment to which it relates. It is written for the use of installers, commissioning engineers, operators and maintainers. It should be kept for the life of the equipment and, in case of re-sale, passed on to any subsequent purchaser.

Information contained in this manual is specific to the equipment and is correct at the date of publication. As improvements are continually being made, **Metso Minerals** reserve the right to make alterations to the equipment design and specification without giving prior notice. Any amendments issued by **Metso Minerals** should be promptly inserted into this manual.



## 1.2 Transport and storage

### 1.2.1 Delivery

A pump is either dispatched as an individual unit (bare shaft pump) or mounted complete with drive unit on a bedplate (pump-set). In either case, any exposed machined parts are coated with a suitable rust inhibitor.

Each pump is supplied complete with inlet and outlet flanges and gaskets, drive key, and with the bearing cylinder charged with grease.

The packing or boxing will always be more than adequate for the method of shipment and subsequent storage.

On receipt of the pump, check that the items listed on the consignment list have been supplied and have not been damaged in transit. Ensure that the inlet and outlet apertures are clear and that the impeller runs freely when the shaft is turned manually.

If the pump has been disassembled for shipment, a consignment list will contain complete information on the identification of parts. Where parts are boxed, each box is numbered and the corresponding number is noted on the consignment list.

If damage has occurred or any items are missing, immediately file a report with the carrier making the delivery. Also, submit a written report to **Metso Minerals** detailing the damage and/or missing items, as soon as possible.

## 1.2.2 Handling and lifting

Whether at the depot or on site, **ALWAYS** follow normal handling and lifting procedures and instructions contained or referred to in this manual.

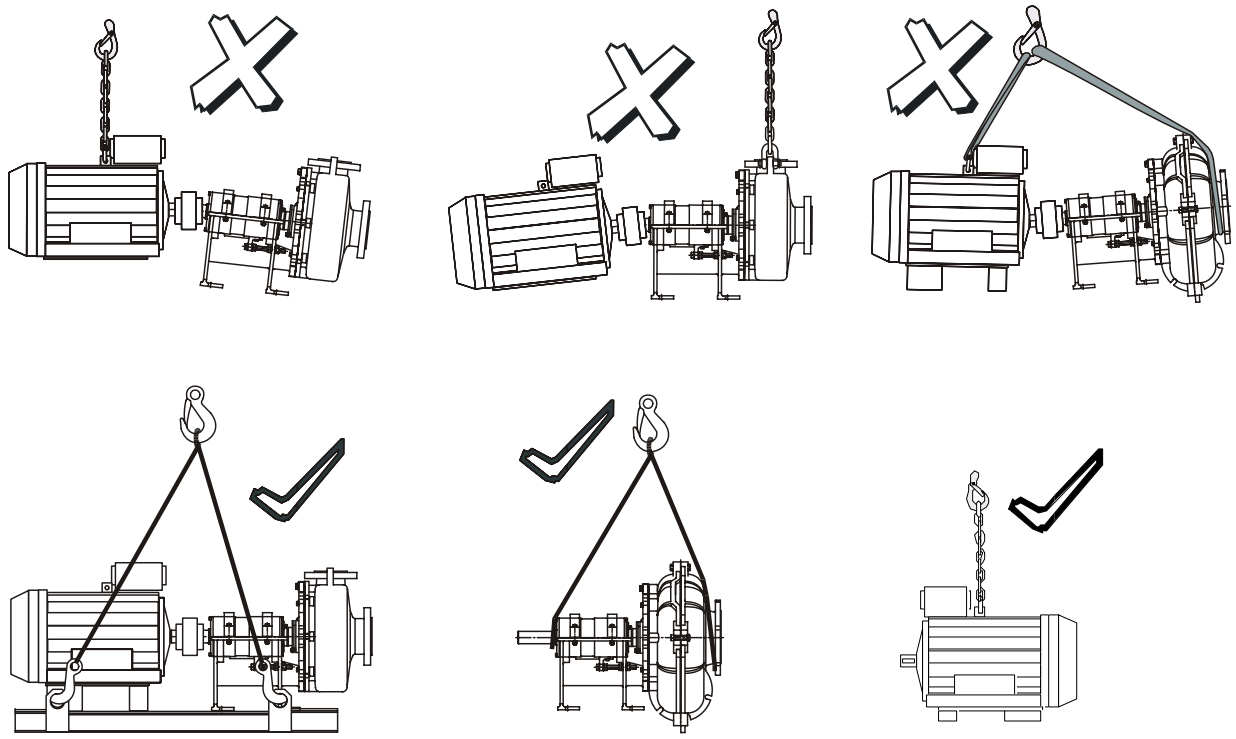
Handling of centrifugal pumps requires great care, especially larger or more cumbersome items of machinery. All slinging, lifting or conveying **MUST** be carried out by appropriately skilled personnel.

Always lift slowly and smoothly, maintaining the pump in a level attitude.

For your convenience and safety, approximate weight of the pump, or pump complete with drive unit and baseplate, is in the Appendices, Section 11.

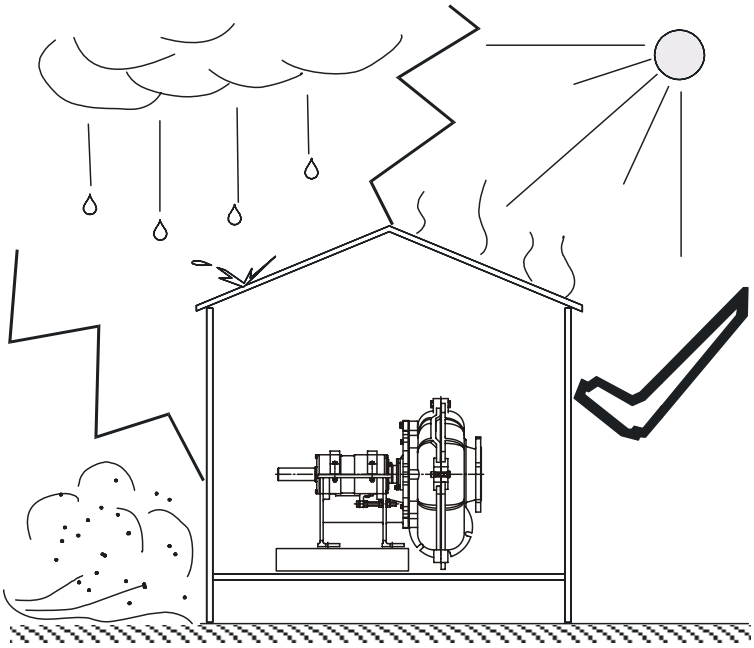
**WARNINGS**

MAKE SURE THAT ALL SLINGS, SHACKLES, ETC. USED ARE OF ADEQUATE LOAD CARRYING CAPACITY FOR THE UNIT TO BE LIFTED. CHECK THAT ALL LIFTING EQUIPMENT CERTIFICATES ARE CURRENT.

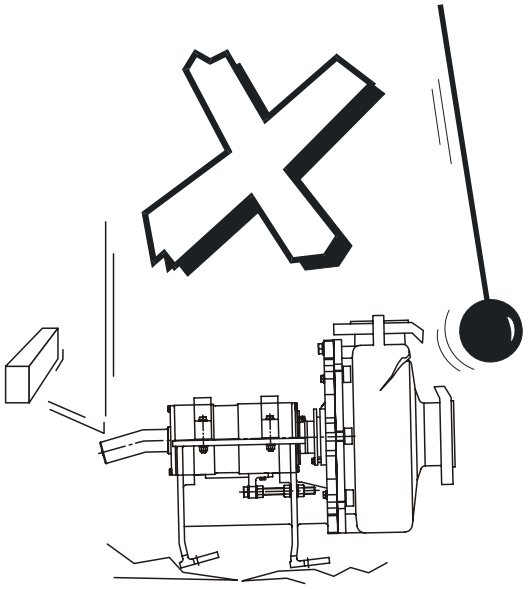


### 1.2.3 General storage instructions

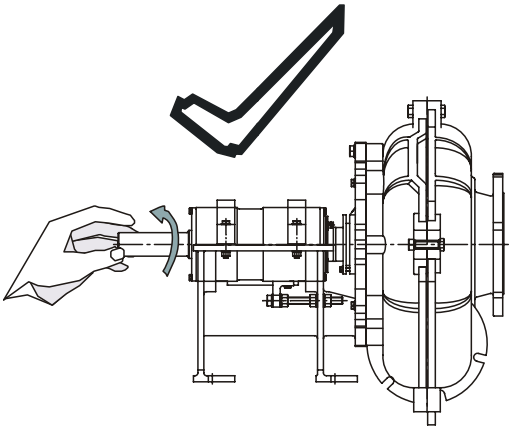
- Re-apply rust inhibitor to all moving parts, at least, every two months.



Protect pump against dust and weather by storage indoors or under weatherproof cover



Protect pump against impact



Turn shaft at least every month

## 1.2.4 Long-term field storage

Minimum requirement for storage and maintenance of centrifugal type pumps on site before their installation and start-up.

1. Medium term storage

Indoor storage of equipment is recommended in order to prevent the harmful effects of exposed conditions, particularly in dust laden atmospheres.

The standard anti-rust protection provided prior to dispatch remains adequate for periods not exceeding two months.

Whenever indoor storage is not possible, it is necessary to follow the guidelines given below:

a) Locate the pump set with its bedplate on a concrete floor and supported on wooden joists of approximately 100 mm x 100 mm in section.

b) Cover the pump set, whether located indoors or outdoors, with a strong, waterproof cover extending down to the baseplate. The cover must be securely fixed to withstand ambient weather conditions.

c) Prior to fitment of the cover, ensure that:-

   i. all openings, including inlet and outlet apertures, are properly sealed, and;
   ii. the bearing cylinder and drive are properly protected against dust.

2. Prolonged storage -up to 2 years

The following steps are essential in all cases where prolonged storage is foreseen:

a) The pumps are to be adequately warehoused in a closed dry and, if possible, a temperature controlled building.

b) Every six months, the stuffing box/shaft seal sleeve area should be inspected, cleaned and re-coated with a suitable anti-rust compound, if required.

c) If disassembly of the pump is not practical then proceed as follows:-

   i. Desiccate the pump case with hot air at 35°C to 65°C.
   ii. Seal all pump openings and attach sachets of hygroscopic salts (silica gel).
   iii. During the desiccation with hot air, ensure that no other parts become overheated as this may be detrimental.

d) The pump rotor should be turned over several times by hand at intervals not exceeding one month.

e) The bearing grease should be checked at least once every twelve months.

f) The bearing cylinder must be disassembled, cleaned and regreased prior to reassembly at least once every 24 months.

During prolonged storage, it may prove difficult to rotate the pump rotor manually for normal maintenance. In such cases proceed as follows:-

a) Loosen the bearing end covers which limit the axial displacement of the bearings.

b) Move the pump rotor along its axis, thus freeing the assembly and allowing manual rotation.

3. Storage in excess of two years

For prolonged storage in excess of two years in adverse ambient conditions, special protection may be necessary. Any moisture absorbing devices used must be absolutely effective and regularly maintained. Whenever possible for storage periods in excess of two years, it is recommended that all pump components are disassembled, washed, dried, protected and reassembled afterwards. This work may be done by **Metso Minerals** and charged to the purchaser under normal rates in force at the time the service is carried out.

## 1.2.5 Storage of spares

In general, unless otherwise instructed, keep all spares parts in a cool, dry environment and protect rubberised/synthetic components from sunlight and high voltage electrical equipment.

Rubber is affected by ageing and its rate of deterioration is dependent on the type of rubber and the storage conditions. Rubber perishes most rapidly when exposed to heat, ultra violet light and oxidants. The more commonly overlooked sources of which are sunlight and electrical machinery. Rubber can become permanently deformed if compressed out of shape during storage. Mineral oils, solvents, dust, contact with metals and moisture can also damage rubbers depending on type.

Certain types of rubber such as chloroprene rubber (CR) harden at temperatures below +5°C. In conditions of extreme cold these types of rubber harden to such an extent that they could develop cracks and be damaged by handling. Chloroprene rubber does not regain its normal hardness when the ambient temperature rises but has to be reconditioned.

To ensure rubber products maintain their original properties, storage conditions must be controlled. Where practicable, ensure rubber products are:

1. kept sealed in their original packing which should be opaque;
2. kept away from direct sunlight;
3. kept away from electrical machinery -e.g. motors and generators;
4. kept in a cool, dry environment between 15° C to 25° C;
5. stored away from exhaust fumes;
6. stored separately from chemicals and fuels;
7. stored loosely packed;
8. rotated on a first in - first out basis.

Storage life for different types of rubber stored under recommended conditions are as indicated in Table 1.2.5-1.

NOTE: AT 15°C THE STORAGE LIFE WILL BE ABOUT DOUBLE AND AT 35 °C ABOUT HALF OF THAT STATED IN THE TABLE.

| Type of rubber | Product ref. | Storage life @ 25°C (years) |
|---|---|---|
| Natural | NR | 5 |
| Nitrile | NBR | 7 |
| Chloroprene | CR | 7 |
| Butyl | IIR | 7 |
| Ethylene-propylene | EPDM | 10 |
| Chlorosulphonated polyethylene (Hypalon) | CSM | 10 |

Table 1.2.5-1 Types of rubber and their expected storage life.

| Headline | Description | Qty |
|---|---|---|
| | P-105 | |
| Order part no: | 301599258.01 | |
| Complete pump: | PDWC55132 | |
| Pump type: | HM200 MHC-S C5 | |
| Product code: | | 1 |
| Pump no: | 301599258.0101 | |
| Frame size: | FR500 | |
| Wear parts, quality: | High Chrome | |
| Special design: | OH motor arr. Metso mechanical slurry seal double (BA095). Metric bearings. | |
| Painting: | MP15 | |
| Capacity m³/h: | 166,9 | |
| Total head m: | 6,5 | |
| Pump speed rpm: | 397 | |
| Specific gravity kg/l: | 1,198 | |
| Input power kW: | 5,1 | |
| Motor: | WEG W22 IEC180-6 400/690V 15KW 50HZ IP55 | |
| Special req.: | For VFD | |
| Motor supplied by: | Metso Minerals(Sweden) AB | |
| Drive supplied by: | Metso Minerals(Sweden) AB | |
| Motor sheave: | 3SPB180 | |
| Motor bushing: | 2517D48 | |
| Pump sheave: | 3SPB450 | |
| Pump bushing: | 3535D80 | |
| V-belts: | SPB2650 | |
| Instruction: | Two hard copies in english + CD by mail to Ingrid N. + PDF to Ingrid N. | |

## 1.4 Customer service

For any inquiry regarding the servicing and repair of Metso Minerals Slurry pumps please contact the local Metso Minerals Branch. For information on the Metso Minerals Branch closest to you, contact one of the Metso Minerals Global Sites listed below:

**Metso Minerals (Sweden) AB**
Norrängsgatan 2
Box 302
S-73325 SALA Tel: (+46) 224 374 00
Sweden Fax: (+46) 224 169 69

**Metso Minerals Industries, Inc.**
4820 Centennial Blvd., Suite 115
Colorado Springs, CO 80919 Tel: (+1) 719 471 3443
USA Fax: (+1) 719 471 4469

**Metso Minerals (Austria) GmbH**
Josef-Benc-Gasse 3
A-1230 Wien Tel.: 0043/1/813 65 08 - 0
Austria Fax: 0043/1/813 65 08 - 49

Please provide the following information:

1. model and size of equipment;
2. serial number;
3. approximate date of purchase;
4. details of enquiry, apparent fault etc..

# 2 DESCRIPTION

## 2.1 Product and warning signs

### 2.1.1 Product signs

All product signs attached to the pump are shown below.

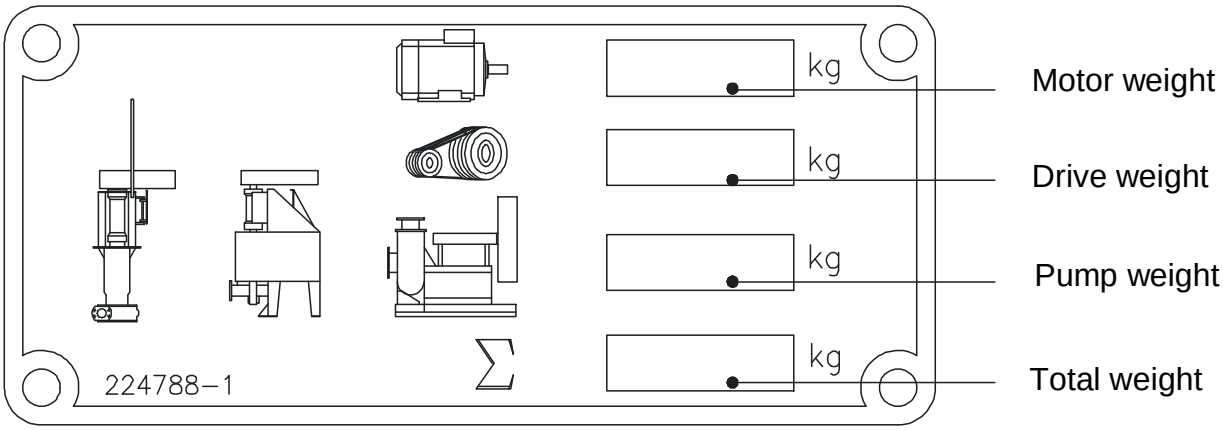



Figure 2.1.1-1 Weight plate

The weight sign is mounted next to the machine sign. When the pump is supplied without motor and drive, only the weight of the pump is stamped on the sign. In which case the total weight is stamped on the sign by the mechanic who fits the motor and drive on the pump.

Pump delivered without motor

Pump delivered with motor

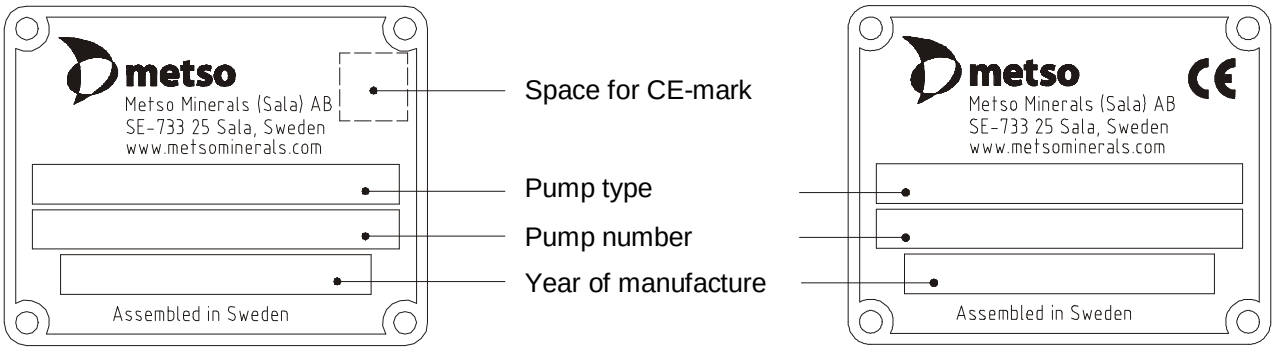
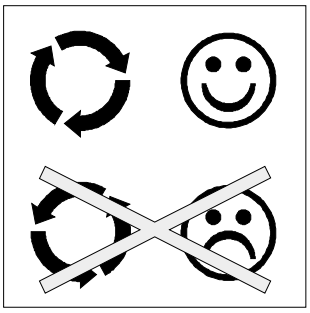



Figure 2.1.1-2 Machine plate

A machine sign containing information as above is affixed to the pump.
A pump delivered with motor has a machine sign with CE-mark. When the pump is delivered without motor the CE-mark has to be affixed when the motor is assembled. The CE-mark is included in the pump delivery.

## 2.1.2 Warning and caution signs



This sign, attached to the drive cover, indicates the direction of rotation of the pump when viewed from the drive end.
**THERE IS RISK OF SERIOUS DAMAGE TO THE PUMP IF IT IS ALLOWED TO ROTATE IN THE WRONG DIRECTION.**

This sign is a hazard warning and is usually accompanied by text indicating the nature of the hazard.
**THERE IS RISK OF SERIOUS INJURY IF THESE WARNING INSTRUCTIONS ARE NOT OBSERVED.**

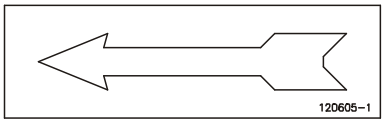
The guard should always be fitted when the pump is in operation.

If the guard is to be removed, check that the motor is disconnected from the mains or that the main switch is turned off and locked so that the motor cannot be started inadvertently.

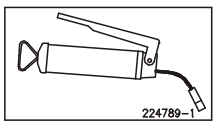
The guard must always be refitted before the pump is started.


The sign is mounted on the V-belt guard.


This sign is attached to a direct-drive coupling guard.




Direction of rotation of the pump is indicated by this sign attached to the front of the case.




This sign, attached to the frame, indicates that the pump requires periodic greasing.

## 2.2 Applications

The Metso Minerals Slurry Pump has been designed for a wide variety of abrasive pumping duties. While the pumps may be used in many different industries, they are all designed for constant use in the most arduous conditions. These high-efficiency pumps are of a simple design, providing ease of maintenance and facilitating replacement of wearing parts.

## 2.3 Design

### 2.3.1 General

Slurry Pumps are made up of four basic modules, the frame (A), the bearing cylinder (B), the shaft seal (C) and the wet-end (D) assemblies – see Figure 2.3.1-1.

A comprehensive range of modules are available, to configure pumps to suit a wide range of applications.

Pumps are supplied bareshaft or as fixed-base pumpsets with various choices of motor mounting position. Manual or hydraulic slide-bases are optional.

Maximum efficiency is maintained by setting impeller running clearance(s). The adjustment is easily carried out during maintenance and shut-down periods.

Standard bearing cylinders are grease lubricated, but oil lubricated bearings are an option.

Pump designation is made up of letters which identify the range and numbers which indicate the inlet diameter in millimetres –e.g. HM150.

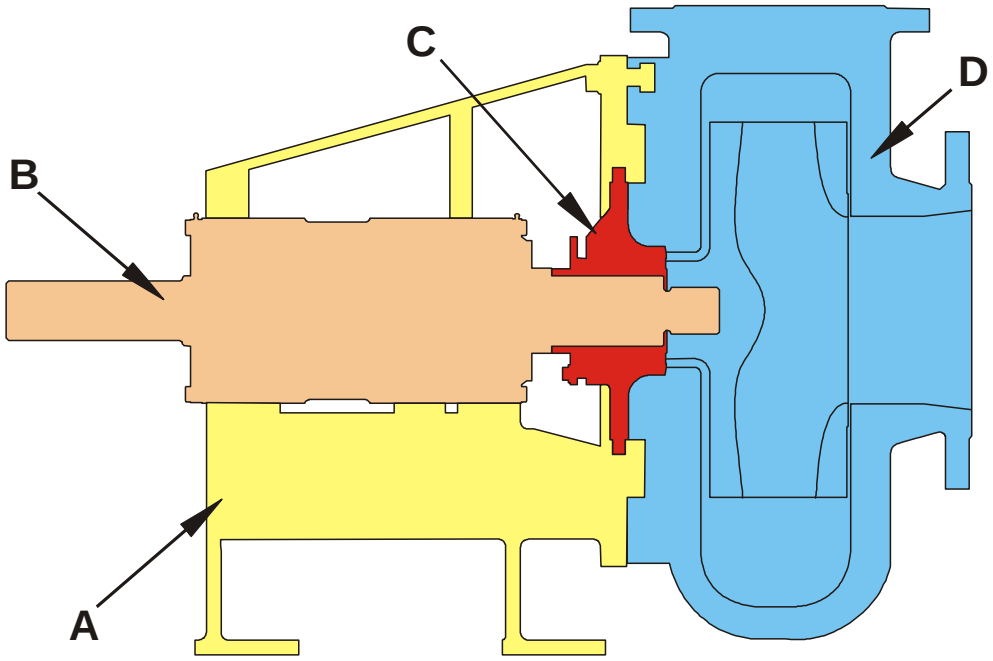



Figure 2.3.1-1 Typical outline design of Metso Minerals Slurry Pumps showing the basic pump modules: Frame (A), Bearing cylinder(B), Shaft seal(C), Wet-end (D)

### 2.3.2 Noise level

In certain installations and outside the optimum operating conditions, the noise level of 70 dB(A) may be exceeded. The motor generates most of the noise and, in general, the noise level for properly designed installations will be about 2dB(A) above that of the motor.

### 2.3.3 Vibration

The international standard ISO 10816-1 is valid for all slurry pumps.
When the pump is new, the vibration level at any bearing should not exceed 4,5 mm/s, if the pump is fixed to foundation. If the pump is installed on slide base, the vibration should not exceed 7,1 mm/s.
Vibration levels above 4,5 mm/s should always receive attention.

**CAUTION**

| |
|---|
| SHOULD VIBRATION LEVELS EXCEED 11 mm/s, STOP THE PUMP IMMEDIATELY. |

Common reasons for high vibrations are:

- ⇒ inadequately tightened fasteners;
- ⇒ slack V-belt;
- ⇒ misalignment of the drive;
- ⇒ the pump impeller is blocked by debris.

## 2.4 Materials and maximum working pressures

Metso Minerals Slurry Pumps are constructed from materials selected to give excellent wear characteristics over the full range of pumping duties. This section lists the materials of construction and working pressures for STANDARD duty applications. Other materials are also used for specialist applications or as specified by the customer – see section 1.3.

| MATERIALS OF CONSTRUCTION | | | |
|---|---|---|---|
| **Item** | **Material Type** | **Material Code** | **Material Standard** |
| Case | White Cast Iron | JN3049 | EN 12513 |
| Impeller | White Cast Iron | JN3049 | EN 12513 |
| Back Liner | White Cast Iron | JN3049 | EN 12513 |
| Bearing Frame | Cast Iron | JS1030 | EN 1563 |
| Expeller | White Cast Iron | JN3049 | EN 12513 |
| Expeller Ring | White Cast Iron | JN3049 | EN 12513 |
| Stuffing Box | Cast Iron | JS1030 | EN 1563 |
| Shaft Sleeve | White Cast Iron | JN3049 | EN 12513 |
| Shaft Sleeve (option) | Stainless Steel | 1.4401 | EN 10088 |
| Shaft Sleeve (option) | Stainless Steel | 1.4021 | EN 10088 |
| Shaft Sleeve (option) | Stainless Steel | 1.4462 | EN 10088 |
| Shaft | Steel | 1.1191 | EN 10083 |
| Seals | Nitrile Rubber | NBR | - |

| **PUMP SIZE** | **MAX. WORKING PRESSURES** | |
|---|---|---|
| | **Bar** | **kPa** |
| HM50 – HM150 | 25.0 | 2500 |
| HM200 – HM300 | 20.0 | 2000 |

## 2.5 Surface treatment

### 2.5.1 Standard finish

The external surfaces of the pump are protected by the anti-corrosive system specified in Table 2.5.1-1, except exposed machined surfaces which are coated with an air drying rust inhibitor. Drive motors are supplied in the original manufacturer's standard finish. Stainless steel, plastic or elastomeric parts are not painted.

Table 2.5.1-1 Paint specification

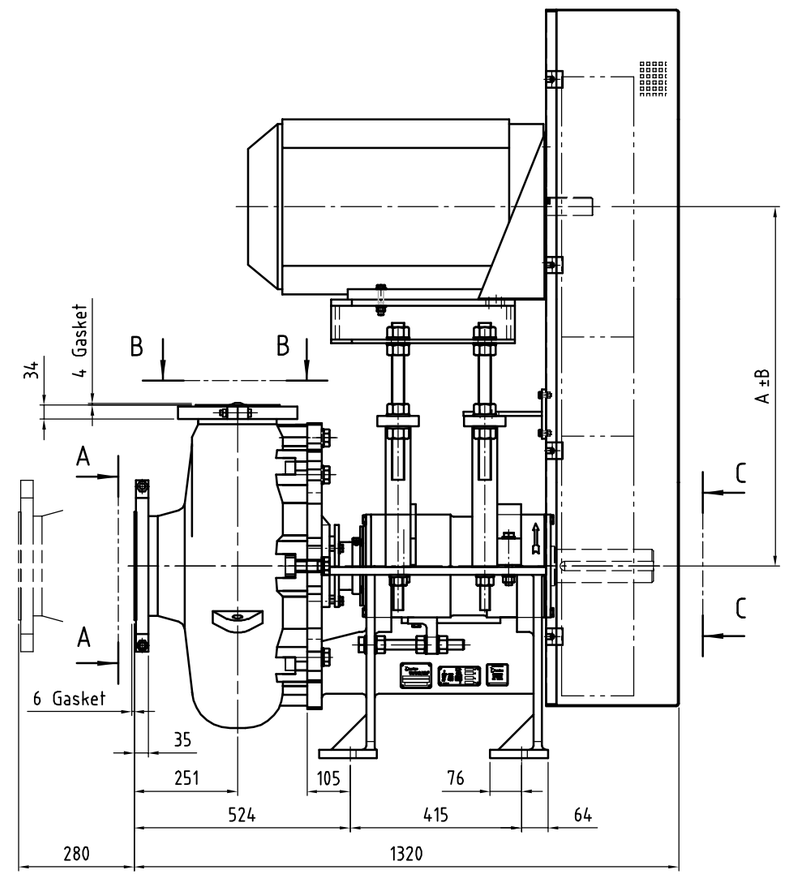
| COATING | TYPE | COLOUR | Finish 70 | DFT (μm) |
|---|---|---|---|---|
| Finish (all except guards) | Two-pack gloss oxiranester thick coat paint | Blue (RAL 5009) | Gloss | 120 |
| Finish (guards only) | Epoxy powder | Yellow (RAL 1032) | Gloss | 100 |

### 2.5.2 Paint repairs

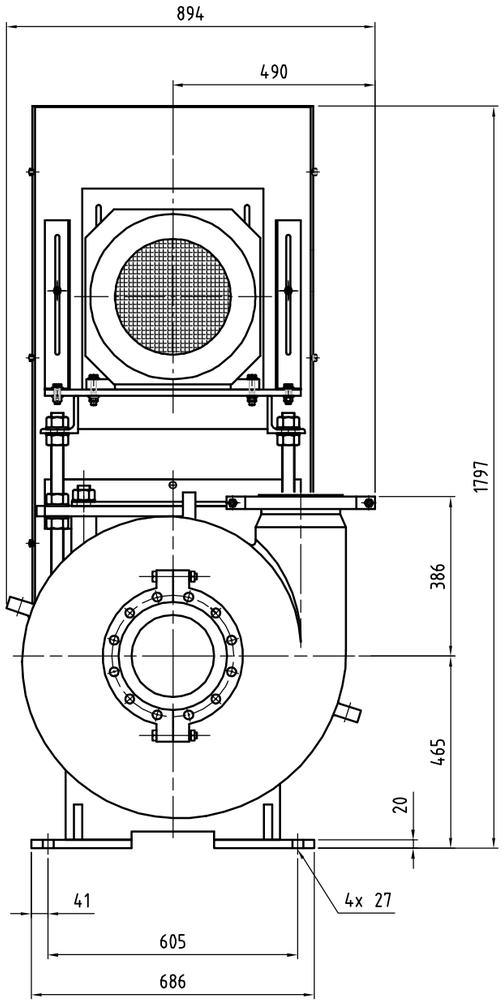
To repair damage to a painted surface;

1. remove any trace of oil and dirt using solvent wash;
2. remove all loose paint by chipping or scraping back until only sound paintwork remains and clean the exposed surface by wire brushing or other mechanical means to grade St2 of Swedish Standard SS 055900 (ISO 8501-1:1988);
3. sand down and feather a 25mm band of the sound bordering paintwork;
4. vacuum the surface to remove all dust and debris;
5. apply the paint system specified in Table 2.5.1-1.

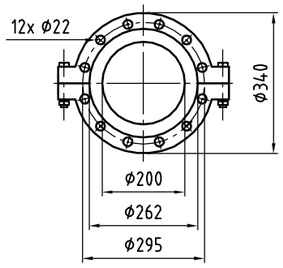
| Date | Sign | Rev | Changed from |
|---|---|---|---|




Min space for wear parts dismounting

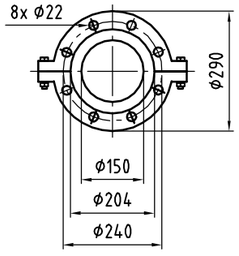



Suitable counter flange
DN 200 PN 16
Optional flange on request




A-A

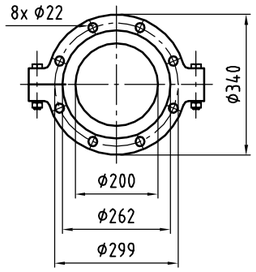
Suitable counter flange
DN 150 PN 16
Optional flange on request




B-B

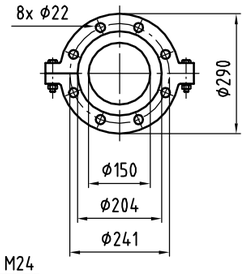
OPTIONAL inlet flange

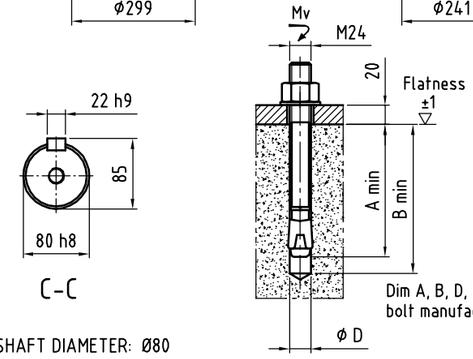
Suitable counter flange
ANSI 8" 150 lb




OPTIONAL outlet flange

Suitable counter flange
ANSI 6" 150 lb



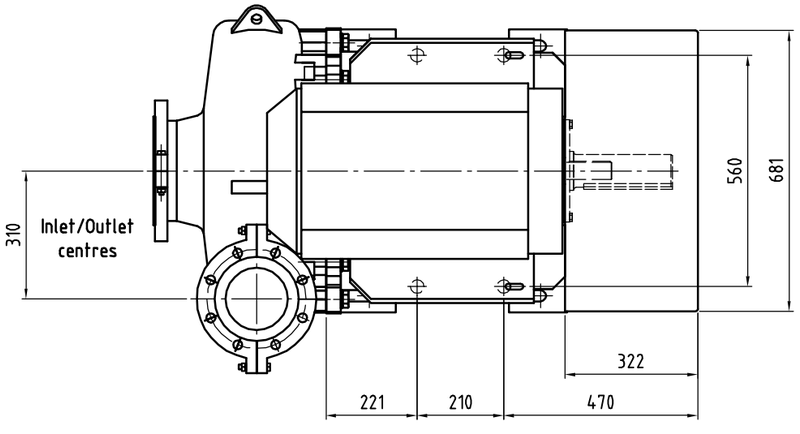



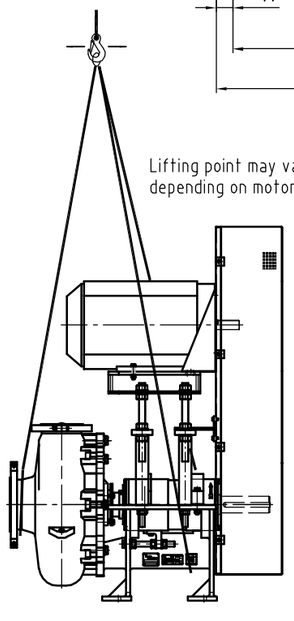

Dim A, B, D, Mv acc to bolt manufacturers instruction

Anchor bolts, proposal design



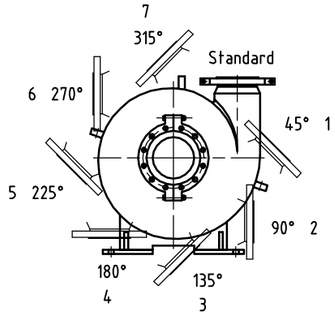

C-C



Lifting point may vary depending on motor size

Lifting instruction




Outlet position

PUMP SHAFT DIAMETER: Ø80
MAX MOTOR SHEAVE: Ø630
MAX PUMP SHEAVE: Ø630
MAX SHEAVE WIDTH: 175

| DISTANCE BETWEEN SHAFTS | | |
|---|---|---|
| Motor | A | B |
| IEC180/ NEMA 284T-286T | 840 | 85 |
| IEC200/ NEMA 324T-326T | 850 | 95 |
| IEC225/ NEMA 364T-365T | 870 | 100 |

If water flushed stuffing box, connection is G1/2"

Measurements subject to change without notice

Mass excl motor and drive 1200 kg

Description
HM200-S PUMP WITH
OH-MOUNTED MOTOR IEC180-225 /
NEMA 284T-365T
GENERAL ARRANGEMENT

| | | |
|---|---|---|
| Drawn | BSH | Date 04-09-20 |
| Checked | AKM | Date 04-09-20 |
| Approved | MHD | Date 04-09-20 |
| Reference Dwg | | |

metso minerals



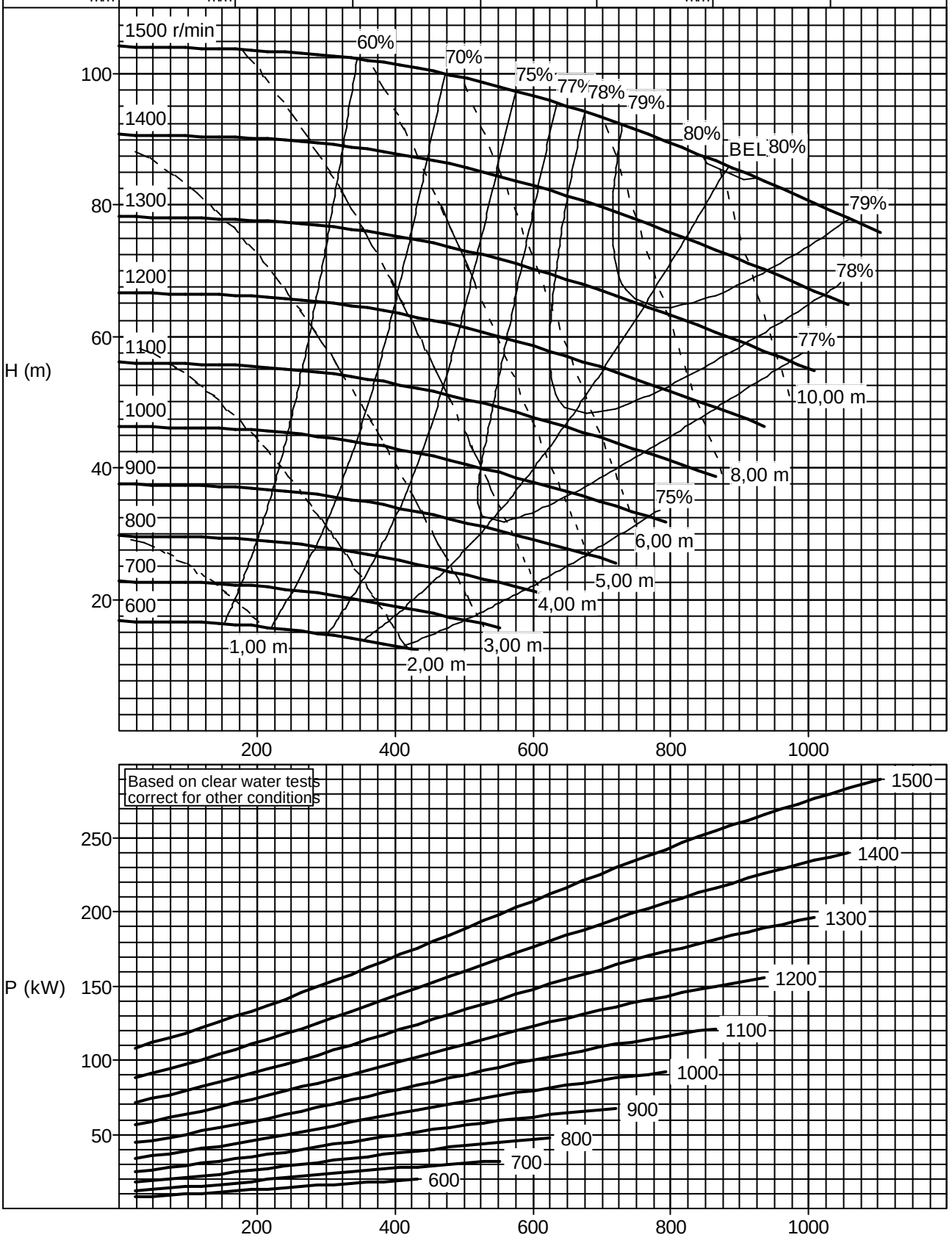
| Projection | File Name | Scale | Revision |
|---|---|---|---|
| 1st angle | SA502144 | 1:10 | A |

| Size | Drawing Number | Sheet |
|---|---|---|
| A2 | SA 502144 | 1 |
| | | Cont. - |

Intern. Distr. 1D

## *Pump HM200 C5*
## *Performance curve*

| Full impeller dia | Vane diameter | Vane config | Impeller type | No. of vanes | Max sphere | Impeller material | Liner material |
|---|---|---|---|---|---|---|---|
| **500** mm | **500** mm | **Full** | **Closed** | **5** | **60** mm | **Metal** | **Metal** |



## 2.8 Certificates and test results

# EC DECLARATION OF CONFORMITY

(Original)

We, Metso Minerals (Sweden) AB, Norrängsgatan 2, 733 25 SALA, SWEDEN declare that the slurry pump

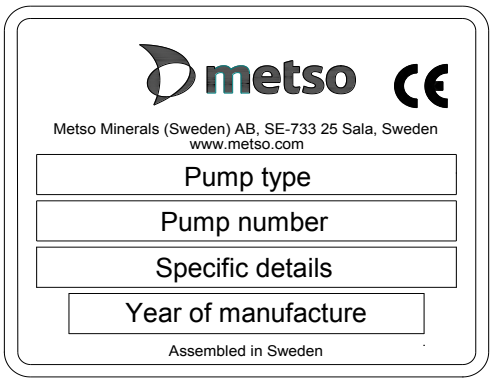
| | |
|---|---|
| Manufacturer | Metso Minerals (Sweden) AB |
| Pump type | HM200 MHC-S C5 |
| Pump number | 301599258.0101 |
| Year of manufacturing | 2012 |

to which this declaration relates is in conformity with the following standards

| | | |
|---|---|---|
| - | EN ISO12100-1 | Safety of machinery – Basic terminology, methodology |
| - | EN ISO12100-2 | Safety of machinery – Technical principles and specifications |
| - | EN 809 | Pumps and pump units for liquids - common safety Requirements |
| - | EMC/LVD | When Motor is included |

following the provisions of Directive 2006/42/EC

Additional information:
The Declaration of conformity for the motor, delivered with the pump, is enclosed in the pump manual.




2010-10-01 in Sala, Sweden

| | | |
|---|---|---|
| Name: | Jan Andersson | Authorized representative for |
| Position: | General manager Slurry pump division | Metso Minerals (Sweden) AB and responsible for technical documentation |

# EC DECLARATION OF CONFORMITY

**WEG Equipamentos Elétricos S/A**
Av. Prefeito Waldemar Grubba, 3000
89256-900 - Jaraguá do Sul – SC – Brazil,

and its authorised representative established in the European Community,
**WEGeuro – Industria Electrica SA**
Rua Eng Frederico Ulrich, Apartado 6074
4476-908 – Maia – Porto – Portugal

hereby declare that the products:

WEG induction motors and components for using in these motors:

Three-phase
**IEC frames 63 to 630**
**Nema frames 42, 48, 56 and 143 to 9610**

.....

Single-phase
**IEC frames 63 to 132**
**Nema frames 42, 48, 56 and 143 to 215**

.....

when installed, maintained and used in applications for which they were designed, and in compliance with the relevant installation standards and manufacturer's instructions, comply with the requirements of the following European Directives and standards where applicable:

Directives:
**Low Voltage Directive 2006/95/EC**
**Regulation (CE) Nº 640/2009**
**Directive 2009/125/EC**
**EMC Directive 2004/108/EC** (induction motors are considered inherently benign in terms of electromagnetic compatibility)

Standards:
**EN 60034-1/2-1/5/6/7/8/9/11/12/14/30 and 60204-1**

From 29/12/2009 on low voltage electric motors are no longer considered under the scope of the current **Machinery Directive 2006/42/EC.**

CE marking in: **1996**

Milton Oscar Castella
*Engineering Director*

Jaraguá do Sul, May 30th, 2011

# 3 HEALTH AND SAFETY

## 3.1 General

**HEALTH AND SAFETY STATEMENT**

DO TAKE TIME TO ENSURE THAT YOUR SAFETY AND THAT OF OTHERS IS NOT PUT AT RISK. FAILURE TO OBSERVE CERTAIN ELEMENTARY SAFETY PRECAUTIONS MAY RESULT IN PERSONAL INJURY OR DAMAGE TO THIS PUMP EQUIPMENT. THE SAFETY INFORMATION IN THIS AND OTHER SECTIONS IS INTENDED TO ENCOURAGE A SAFETY CONSCIOUS APPROACH TO OPERATING AND CARRYING OUT MAINTENANCE.

### 3.1.1 Warnings and cautions

For the purpose of definition in this manual, a **WARNING** gives information which if ignored could lead to serious injury of personnel. A **CAUTION** gives infomation which if ignored could lead to serious damage to the pump or associated equipment.

**WARNING**

PARAGRAPHS WHICH PURELY PROVIDE A WARNING NOTICE ARE BOXED AND HIGHLIGHTED IN THIS STYLE.

**CAUTION**

PARAGRAPHS WHICH PURELY PROVIDE A CAUTIONARY NOTICE ARE BOXED AND HIGHLIGHTED IN THIS STYLE.

### 3.1.2 Training

It is strongly recommended that all customers' production and maintenance personnel and site visitors are made fully aware of potential dangers of this equipment. If any doubt exists, please contact Metso Minerals for advice.

FOR YOUR OWN PERSONAL SAFETY , READ AND TAKE NOTE OF THE FOLLOWING:

**HAZARDOUS AREAS**

- These are in the areas of the impeller, shaft seal, impeller release mechanism, drive motor shaft, direct drive coupling or drive belts. Under normal operating conditions these areas **MUST** be enclosed by safety covers or guards. Pump intake and discharge ports, when open, are also hazardous areas. **NEVER** insert your hand into either of these ports without first ensuring that the pump drive has been isolated.

**LIFTING THE PUMP**

- Make sure that **ALL** slings, shackles, etc. are of adequate load carrying capacity. Metso Minerals Slurry pumps may be provided with lifting eyes designed for lifting individual components. These should NOT be used to lift the pump unit or the pump set. Individual pumps should **ALWAYS** be lifted by using slings passed through the bearing frame. See sub-section 1.2.2 for recommended lifting techniques.

**OPERATING THE PUMP**

- Ensure that **ALL** safety covers and guards are in position and securely fitted.

  **DO NOT** wear loose clothing when working in close proximity to rotating parts.

  **NEVER** allow water or slurry to rise above the top of the pump base.

**MAINTAINING THE PUMP**

- **SWITCH OFF** and **ISOLATE** the electrical supply to the pump motor and allow rotating parts to come to rest before carrying out any maintenance or adjustments.

## 3.2 Warning and caution signs

See sub-section 2.1.

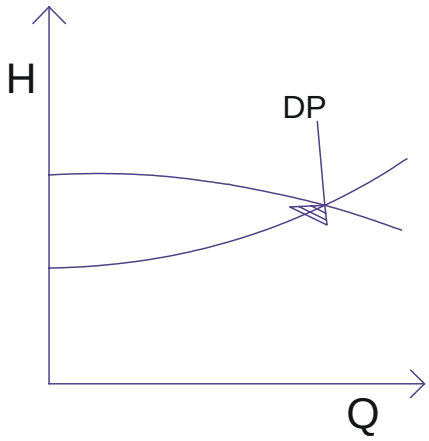
# 4 DESCRIPTION OF OPERATION

## 4.1 General

Centrifugal pumps work best with minimum wear and other mechanical stress if the operating point is close to the pump's best efficiency point (BEP). To choose a pump that works close to its best efficiency line (BEL), it is important to understand how the pump interacts with the piping system in which it is installed.

In simple terms, a pump and its piping system act as two communicating vessels. The piping sysem has a resistance curve that starts at the static delivery head, at zero flow. As the flow increases, the resistance increases with pipe friction. A radial centrifugal pump has a descending discharge/flow curve for each rpm. The pump's operating point (DP) at a given pump speed is the point of intersection between the piping system's resistance curve and the pump's discharge/flow curve. See diagram below.

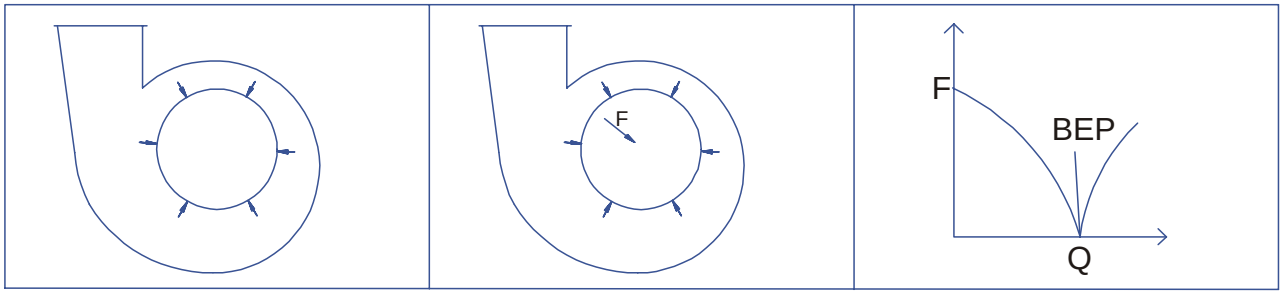
It is therefore important to calculate the piping system's resistance curve correctly and to take into account the manner in which the admixture of solid particles, for example, affects the curves of the piping system and pump. We recommend using **Pumpdim™ for Windows™** for our pump applications.




To obtain the best wear properties the pump can be provided with different materials in the parts exposed to the greatest wear.

## 4.2 Best efficiency point

Pressure conditions in the pump casing are shown in Figure 4.2-1. At the BEP there is even pressure round the impeller, resulting in small radial forces which in their turn exert little load on bearings and cause little shaft deflection. When the pump operates at low capacity and not at BEP, differential pressure builds up over the casing volute. This gives rise to a radial force F on the impeller which is a function of the differential pressure (Pa) and the impeller's projected area ($mm^2$).




When the pump operates at best efficiency point, uniform pressure is obtained in the casing which in its turn eliminates radial forces on the impeller.

When the pump's flow capacity is not utilized, uniform pressure in the pump casing will not be obtained and this results in a radial force **F** on the impeller.

The magnitude of the radial force F is greatest when the pump runs against closed valve = 0 flow. The force subsequently diminishes up to **BEP** where it is close to zero. At flows above **BEP** the force changes direction.

Figure 4.2-1 Best efficiency point

When the pump is not operating at BEP the bearings will have a shorter service life on account of shaft deflection. In addition, the differential pressure over the impeller gives rise to the transport of slurry between the impeller and the inlet liner, causing rapid wear of the liner.

## 4.3 Hydraulic effects of operation at, and outside, BEP

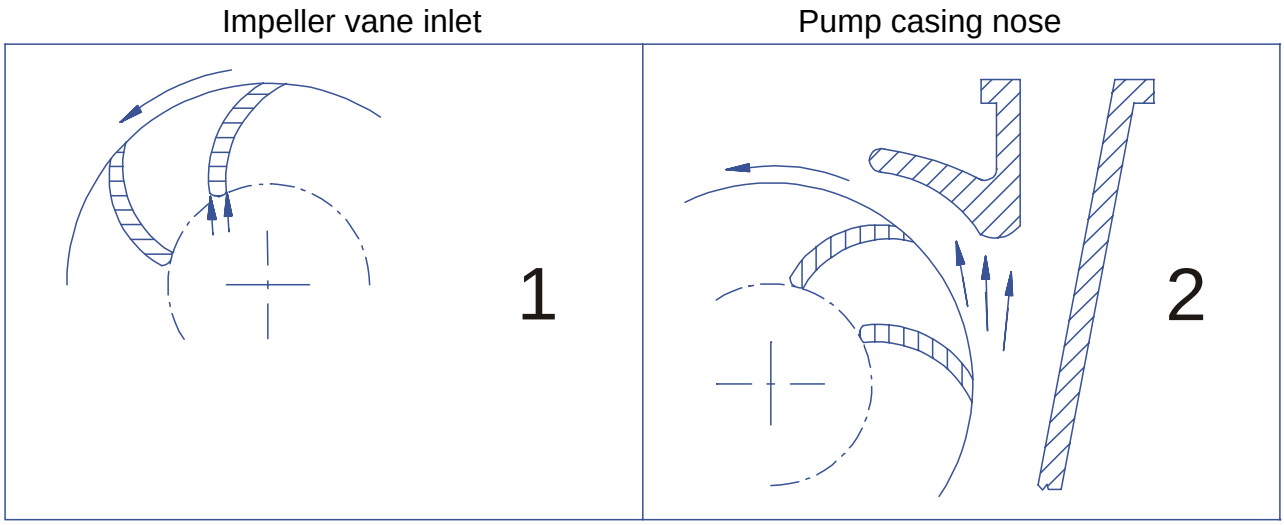



Figure 4.3-1 Operating at best efficiency point

1. The slurry's inflow angle coincides with the impeller's vane angle and no erosive vortices occur.
2. The slurry's flow angle harmonizes with the angle of the pump casing nose and no erosive vortices occur.

The way in which the hydraulic work is affected when the pump does not operate at BEP is shown in Figure 4.3-2 and Figure 4.3-3 This is of decisive importance in slurry pumping.

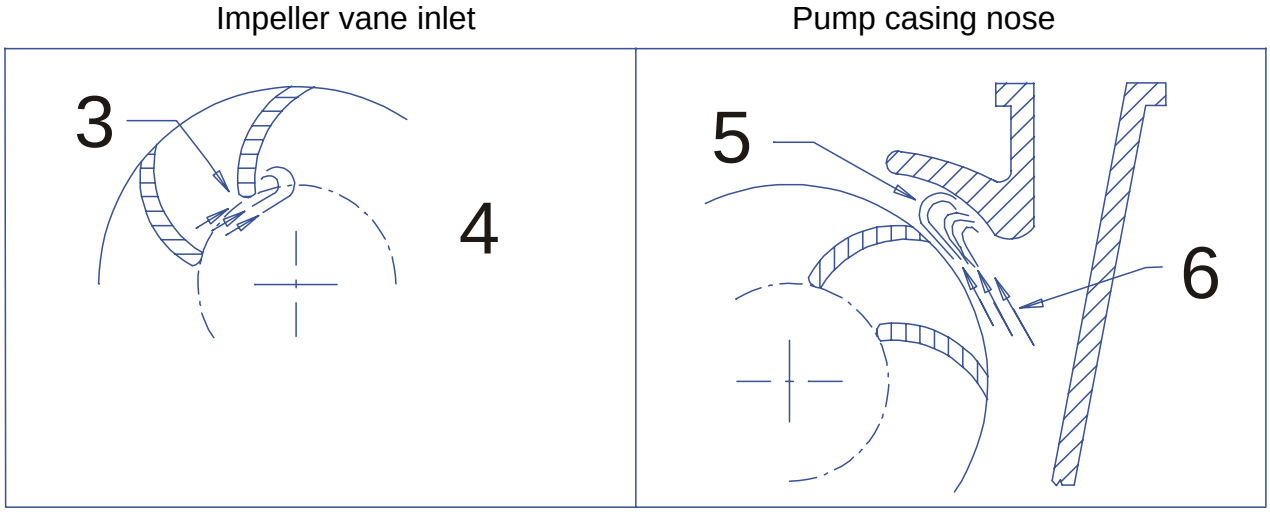



Figure 4.3-2 Operating outside BEP - At low load

3. Abrasion on the impeller vane's discharge side.
4. Vortices occur on the vane's vacuum side.
5. Vortices.
6. Abrasion caused by particles striking and bouncing against the surface.

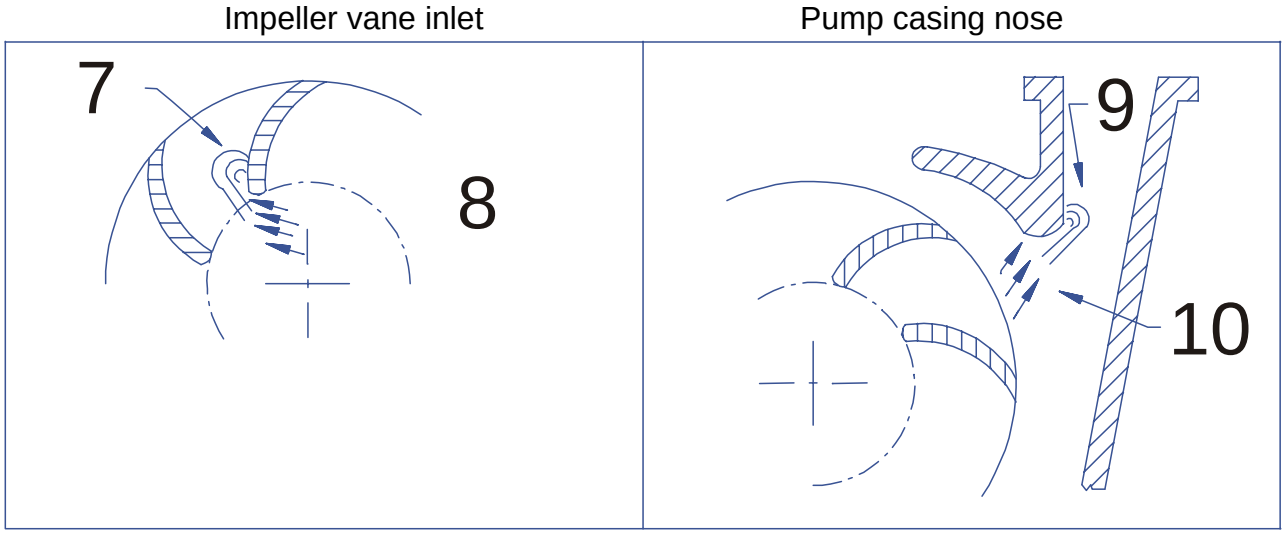



Figure 4.3-3 Operating outside BEP - On overloading

7. Vortices are formed on the discharge side of the impeller vane.
8. Abrasion occurs on the vacuum side of the vane tip.
9. Vortices.
10. Abrasion on the pump casing nose.

Hydraulic efficiency is a function of hydraulic turbulence - the more turbulence, the less efficiency. In slurry pumping, a high level of efficiency is therefore important.

Little hydraulic turbulence is formed at BEP and the abrasion is chiefly of a sliding nature, since the differential pressure is low when the slurry passes through the impeller and pump casing. The rate of abrasion is low and the wear is spread evenly over the surfaces. The rasping wear or high-pressure wear that occurs between the impeller and suction side liner is lower, since the evenly distributed hydraulic pressure reduces recirculation.

When the full capacity of the pump is not used and its efficiency is less than at BEP, hydraulic turbulence occurs and the solid particles in the slurry strike and rasp the impeller and pump casing. This causes local wear damage and the service life of these components is severely shortened. At the inlet to the impeller the slurry's flow angle is not the same as the pump vane angle, which gives rise to turbulence and results in recirculation of slurry in the channel. At the pump casing nose the flow from the impeller does not harmonize with the shape of the casing, causing turbulence to occur immediately after the pump casing nose.

In the worst case, oversized pumps which do not operate at BEP result in bearing breakdown, shaft fracture and unevenly worn inlet and pump casing liners with deep wear marks at the casing nose.

## 4.4 Choice of pump size

For preference, choose the pump size which operates as close as possible to the pump's best efficiency point (BEP).

# 5 CONTROL SYSTEM

(NOT APPLICABLE)

# 6 INSTALLATION

## 6.1 General

Refer to sub-section 1.2 for handling instructions.

## 6.2 Foundation requirements

Ideally, the pump and its drive should be mounted on a common bedplate which is fixed to a level foundation of adequate strength. All bedplates supplied by Metso Minerals incorporate holding-down bolt holes. It is recommended that the pump is installed in such a way that maintenance and adjustments can be carried out easily. It is essential that the pump is not subjected to flooding.

A foundation must provide a rigid and durable support, while absorbing shock loads and vibrations to and from the machine. Many criteria influence its design, its construction materials and its preparation: vibration and loading characteristics, operating environment and effect of nearby machinery are some. Each installation is, therefore, a special case needing careful examination of its particular requirements. The following are general guidelines for preparing a foundation for Metso Slurry Pumps –refer to Figure 6.2-1 for details.

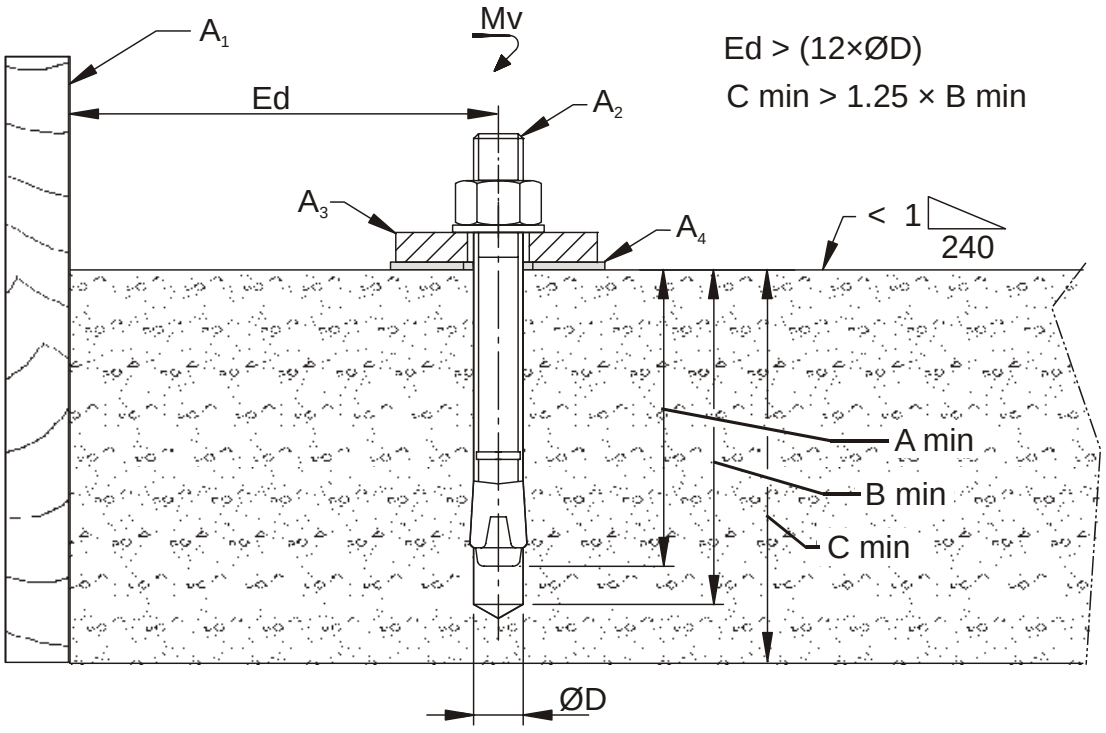



Figure 6.2-1 Foundation and fixings, general arrangement

1. The foundation must be poured on a well prepared solid ground.
2. A mixture of good quality cement and coarse aggregate is suitable in most cases, but, where applicable, the chemistry of the soil and the operating environment may impose additional requirements. Reinforcement bars may also be necessary depending on application.
3. The total foundation mass and its related support structures should be **at least** five times the total weight of the rotating assembly. The weight of the rotating assembly – excluding the rotating parts of the motor – is roughly ¼ of the weight of the bare shaft pump. See section 11.3 for the bareshaft assembly weight.
4. Foundation depth ($C_{min}$) should be at least 125% of the anchor hole depth ($B_{min}$).
5. For maximum strength, anchor fixings should be positioned more that 12 times the anchor hole diameter (ØD) from the edge of the concrete slab (Ed).
6. The concrete slab should be level to within 12.5 mm in 3000 mm.
7. If the installation is in close vicinity of other moving machinery, then necessary precautions should be taken to prevent cross-talk.

## 6.3 Installation tools and equipment

Apart from suitable lifting equipment, a standard fitter's tool kit together with suitably-sized hexagon key wrenches and torque wrenches are normally sufficient to install the pump. See Toolkit, sub-section 10.6.

Metso Minerals can supply all recommended fixtures and tools at additional cost.

## 6.4 Installation procedure

### 6.4.1 Pump

When the foundation has fully cured, the anchor bolts may be installed –refer to Figure 6.2-1 and Figure 6.4-1.

a) Spacing between anchor fixings should normally be more than 10 times their diameter, unless otherwise instructed. Refer to manufacturer's instructions for specific details.

b) Lift the pumpset into position over the foundation and align it as required in the plant layout drawing.

NOTE: IF LIFTING THE PUMPSET INTO POSITION IS NOT CONVENIENT, PREPARE A FOOTPRINT PATTERN OF THE BEDPLATE ($A_3$) USING HARDBOARD.

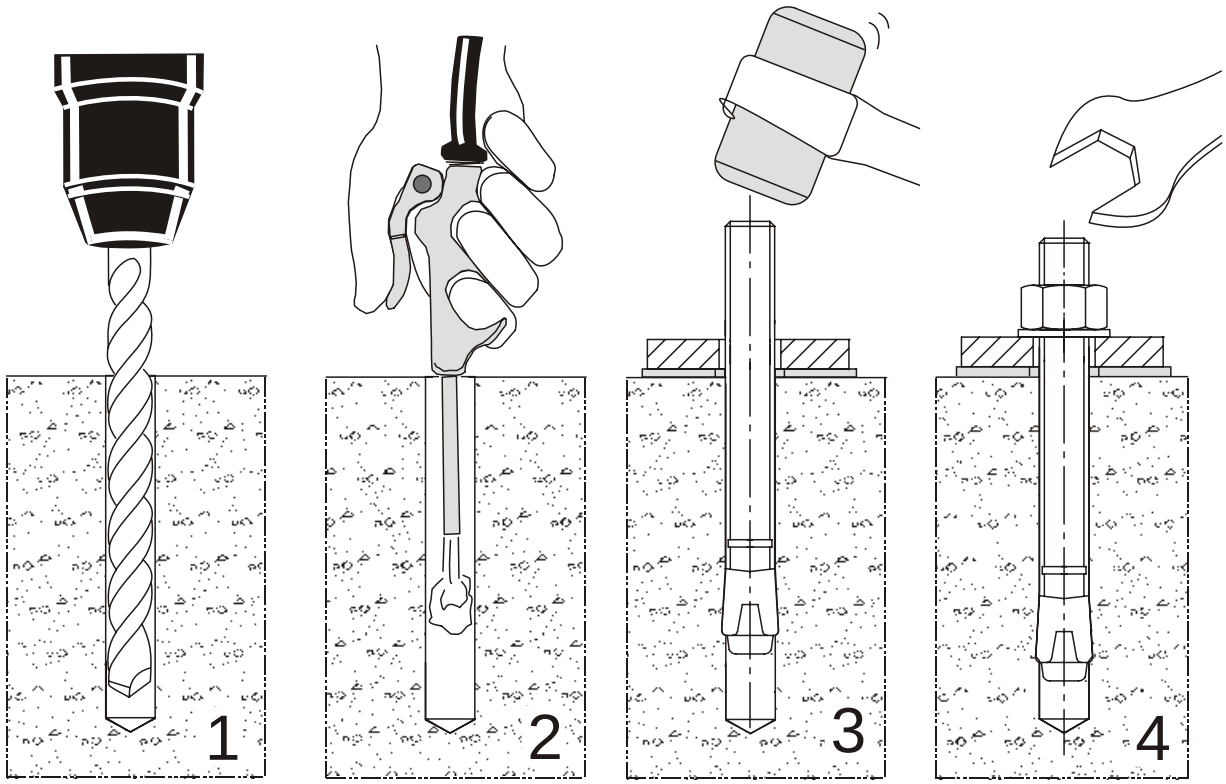



Figure 6.4-1 Installing the anchor fixings

1. With the pumpset (or the pattern) in position, drill the required number of holes in the foundation.

NOTE: ENSURE THAT THE HOLE DEPTH ($B_{MIN}$) AND DIAMETER (ØD) CONFORM TO THE BOLT MANUFACTURER'S SPECIFICATION.

2. Blow out the dust and debris from the holes.

3. With the pumpset in position, level the bedplate using shims ($A_4$), if necessary, and tap in the anchor fixings to a depth ($A_{min}$), as specified by the bolt manufacturer.

4. Assemble the fixing nuts to the anchor fixings and tighten to the torque setting (Mv), as specified by the bolt manufacurer.

### 6.4.2 Belt driven pumps

1. Make allowances for possible pump shaft forward adjustment when positioning the drive pulley on the shaft.
2. Align the pump and motor pulleys correctly. Misalignment between pulleys could cause excessive belt wear, heat generation and noise.

### 6.4.3 Direct driven pumps

NOTE: ALWAYS CHECK DRIVE ALIGNMENT AFTER INSTALLATION.

Where practicable, fit a spacer coupling so that the pump "back pull-out" method can be used, thus avoiding the need to remove the drive or other equipment. Where applicable, the minimum distance between shaft ends needed to facilitate the "back pull-out" method is given in, 'General Arrangement', sub-section 2.6.

### 6.4.4 General installation procedure

1. Check that the inlet and outlet openings and the case are clear of any debris and that the respective joint seals are in position before connecting the pipework.
2. DO NOT force the pipes into alignment with the inlet and outlet joint flanges. Avoid unnecessary loads on the pump by ensuring that all pipework is adequately supported and is not resting on the pump. See Table 6.5-1.

NOTE: THE JOINT FLANGES ARE SPLIT FOR EASE OF ASSEMBLY. IF FOUND TO BE LOOSE, TIGHTEN THE RESPECTIVE SCREWS TO THE TORQUE LOADING NOTED IN THE TORQUE TABLE, SUB-SECTION 11.1.

3. Disconnect the drive belts or coupling before connecting the electrical supply to the drive motor.
4. Run the motor and check that it turns in the direction indicated by the arrow sign – see section 2.1.2.

**CAUTION**

THE PUMP MUST NOT BE RUN IN THE OPPOSITE DIRECTION AS THIS COULD RESULT IN THE IMPELLER UNWINDING FROM THE SHAFT, CAUSING EXTENSIVE DAMAGE TO THE PUMP.

5. Reconnect the drive belts or couplings as necessary.
6. Re-check drive component alignments, and re-set if necessary –see section 9.5.6 .

NOTE: ALWAYS CHECK DRIVE ALIGNMENT AFTER INSTALLATION.

7. Connect the gland water supply pipe, in case of pumps with a water flush gland seal. Water must be clean, and at the correct pressure and flow rate. See section 9.5.3.
8. Check lubrication – see section 9.4. Where applicable, also top up the motor and gearbox lubrication in accordance with the manufacturer's instructions.

NOTE: IF THE PUMP HAS BEEN BROUGHT OUT OF STORAGE, LUBRICANT RENEWAL MAY BE ADVISABLE. SEE LONG TERM STORAGE RECOMMENDATIONS IN SECTION 1.2.4 .

9. Ensure that all safety covers are fixed securely in position.

### 6.4.5 Cold climates

Where there is the likelihood of pump being exposed to below freezing conditions the following precautions are strongly recommended.

1. If practical, on site all pumps should be installed with their outlets in position-3 as shown in 'General Arrangement', sub-section 2.6.
2. Immediately pump is stopped drain discharge pipework.
3. Where practicable, fix adequate drain plugs on discharge pipework local to pump.
4. Disconnect flange fixings to pump oulet and inlet. Siphon out as much of the slurry as possible.

A small amount of slurry can remain in bottom of pump case provided it does not come in contact with the impeller.

These precautions will make it possible to drain the pump and its pipework of all slurry during shut-downs.

### 6.4.6 Pump outlet positions

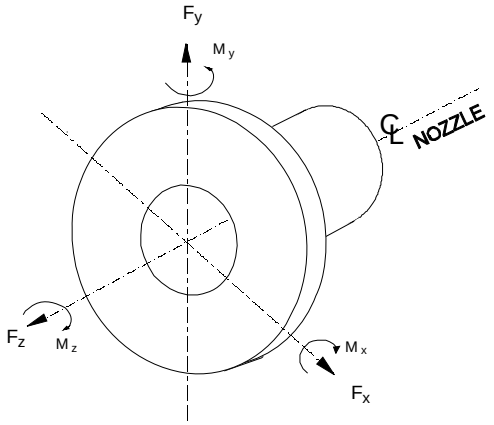
To reposition the pump case outlet to suit existing pipework, follow relevant instructions in Dismantling and Assembly, section 9.5. 'General Arrangement', sub-section 2.6 shows the possible outlet positions.

## 6.5 Pipe connections and pump sump

**CAUTION**

**DO NOT** INSTALL THE PIPEWORK IN SUCH A WAY THAT IT PUTS ANY EXCESSIVE LOAD ONTO THE PUMP CASE. TABLE 6.5-1 INDICATES THE STANDARD ALLOWABLE FLANGE FORCES. PLEASE CONSULT METSO MINERALS SHOULD THE FLANGE LOAD REQUIREMENT BE GREATER.

PUMPS EQUIPPED WITH AN ADJUSTABLE INLET DOOR MUST HAVE ADEQUATE FLEXIBILITY, OR PROVISION FOR ADJUSTMENT, BUILT INTO THEIR INLET PIPES AS A MEANS OF AVOIDING EXTRA STRUCTURAL FORCES WHEN THE INLET DOOR IS RE-ADJUSTED.




| FLANGE SIZE | $F_X$ AND $F_Y$ (N) | $F_Z$ (N) | $M_X$ AND $M_Y$ (Nm) | $M_z$ (Nm) |
|---|---|---|---|---|
| 32 | 350 | 700 | 165 | 325 |
| 50 | 510 | 1000 | 240 | 475 |
| 80 | 800 | 1600 | 370 | 750 |
| 100 | 1100 | 2200 | 510 | 1000 |
| 150 | 2000 | 4000 | 895 | 1790 |
| 200 | 2900 | 5800 | 1325 | 2650 |
| 250 | 4350 | 8700 | 2000 | 4000 |
| 300 | 5800 | 11600 | 2650 | 5300 |
| 350 | 7600 | 15200 | 3500 | 6900 |
| 400 | 9700 | 19400 | 4500 | 8900 |
| 500 | 15200 | 30300 | 7000 | 13900 |
| 600 | 21800 | 43700 | 10000 | 20000 |
| 700 | 29700 | 59500 | 13600 | 27200 |
| 800 | 38800 | 77600 | 17800 | 35500 |

Table 6.5-1 Allowable flange forces

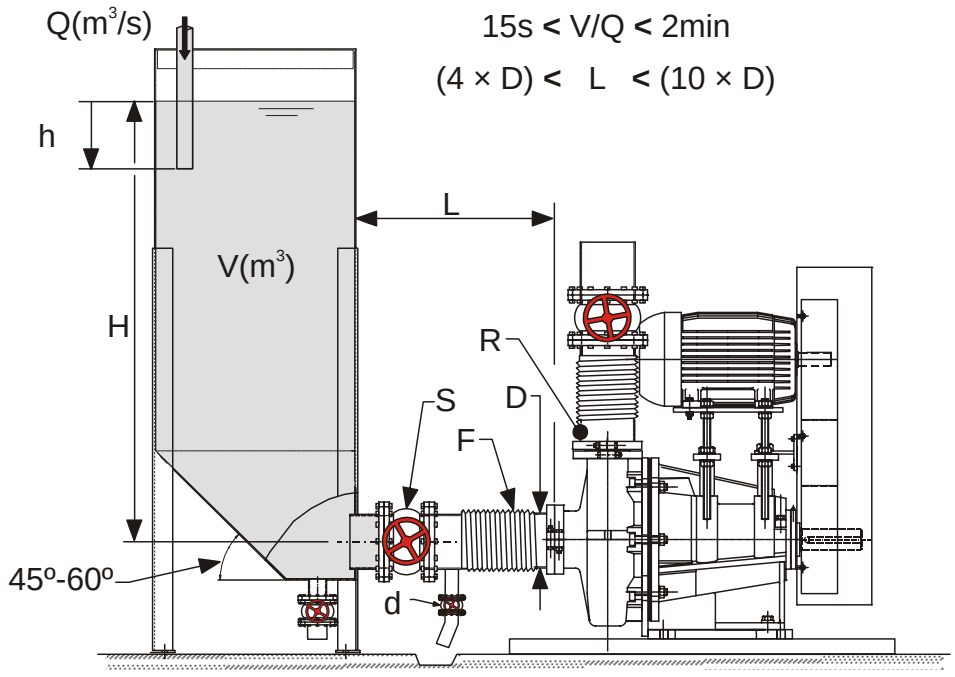



Figure 6.5-1 Recommendations for pipework layout

**WARNING**

WHERE THE PIPEWORK IS DESIGNED IN SUCH A WAY THAT THE PUMP INLET AND OUTLET LINES CAN BE SHUT OFF, OR BLOCKED, SIMULTANEOUSLY, ENSURE THAT AN APPROPRIATE PRESSURE RELIEF DEVICE (R) IS INSTALLED AND SET TO THE PRESSURE SPECIFIED IN 'MATERIALS AND MAXIMUM WORKING PRESSURES', SECTION 2.4. THIS IS TO ELIMINATE THE RISK OF THE PUMP BURSTING, IN SUCH EVENTUALITY.
THE CHOICE OF PRESSURE RELIEF DEVICE AND ITS LOCATION IN THE PIPEWORK WITH RESPECT TO THE PUMP IS THE RESPONSIBILITY OF THE PIPEWORK INSTALLATION SUPPLIER.

The pump is **NOT** self-priming, which means that the pump case must be full of liquid before the pump is started. Additionally, take note of the following (see also Figure 6.5-1):

- Sump bottom should have an angle of 45º. Fast settling particles may require up to 60º.
- Sump feed (h) should be below the sump liquid surface to avoid air entrainment. Allowing the pump to draw air will drastically reduce the useful life of the hydraulic parts.
- Sump volume should be as small as possible. Slurry ***'Retention Time'*** is the relevant parameter for determining the size of the sump. It ranges between 15 seconds and 2 minutes for slurries containing coarse particles and fine particles, respectively.
- Separate sumps are preferred for standby pump installations. This will avoid settling out in the standby pump when not in use.
- For slurry applications, ensure a steady, uniform feed to the pump, where practicable.
- Install the pump as close as possible to the sump.
- Keep the length of suction pipe and the number of bends in the pipework to the minimum practicable. Use reinforced flexi-pipes (F) to connect to inlet and outlet.

NOTE: INLET PIPE SHOULD, HOWEVER, HAVE A STRAIGHT LENGTH (L), AT LEAST, 4 TIMES ITS DIAMETER TO ENSURE FAVOURABLE FLOW CONDITIONS INTO THE PUMP. IF A VALVE (S) IS FITTED ON THE INLET SIDE, IT MUST BE FULLY OPEN WHEN THE PUMP IS RUNNING AND SHOULD HAVE A STRAIGHT FLOW PATH OF THE SAME AREA AS THE CONNECTED PIPE. SUCTION PIPES WHICH ARE LONGER THAN 10 TIMES THE DIAMETER SHOULD BE AVOIDED.

- Sump level (H) should be 6 times pump inlet diameter (D) when measured from the centre line of pump.
- The diameter of the inlet pipe should be the same as, or larger than, the pump inlet diameter.
- A drain valve (d) should be incorporated in the inlet pipe. A floor channel should also be provided directly beneath it for recovering the waste slurry.
- Secure the pump inlet and outlet pipes separately to avoid unnecessary transmission of vibrations, forces or moments to the pump.
- Use expansion joints for high-pressure applications.

## 6.6 Shaft gland

See Care and Maintenance, Section 9, for specific installation instructions.

## 6.7 Motor and drive

See Care and Maintenance, Section 9, for specific installation instructions.

# 7 COMMISSIONING

**WARNING**

**BEFORE** CARRYING OUT THE FOLLOWING CHECKS, ISOLATE THE ELECTRICAL SUPPLY TO THE MOTOR.

NOTE: SEE ALSO THE WARNING IN SECTION 6.5 .

1. If the pipework has not been connected to the pump on installation, ensure that the pump case and associated pipework are clear of any construction debris, slurry etc. before connection.
2. Ensure that the foundation and the securing bolts are tight.
3. Check that the rotating assembly is free to turn manually.
4. Check that the direction of rotation is correct -see General installation procedure, section 6.4.4.

**CAUTION**

THE PUMP MUST NOT BE RUN IN THE OPPOSITE DIRECTION AS THIS COULD RESULT IN THE IMPELLER UNWINDING FROM THE SHAFT, CAUSING EXTENSIVE DAMAGE TO THE PUMP.

5. Check lubrication - see section 9.4 .

NOTE: ON GREASE LUBRICATED UNITS, THE BEARINGS AND SEAL ASSEMBLIES ARE GREASE PACKED ON ASSEMBLY. OIL LUBRICATED UNITS ARE *NORMALLY* SUPPLIED DRY AND WILL, THEREFORE, REQUIRE REPLENISHMENT.

6. Ensure that the openings on each side of the bearing frame and the area around the gland are clear of debris, dried slurry, etc.
7. Check that all safety guards are secured in position.

# 8 OPERATING INSTRUCTIONS

## 8.1 Start-up

1. If the pump has just been maintained or has not been put into operation for some time, then carry out the pre-start checks as described in Commissioning, section 7.
2. Open the pump inlet and outlet valves.

**WARNING**

NEVER RUN THE PUMP WITH BOTH INLET AND OUTLET VALVES CLOSED. SEE THE WARNING NOTICE IN SECTION 6.5 .

3. Check for leakage from the inlet and outlet connections.

NOTE: AN INLET-SIDE LEAK MAY CAUSE THE PUMP TO DRAW AIR DURING OPERATION, THUS DRASTICALLY REDUCING ITS PUMPING CAPACITY.

4. If a water flushed gland is fitted, ensure that the water supply is turned on, and water is available at the correct pressure and flow rate.
5. If a mechanical seal is fitted, see section 9.5.3 before start up.
6. If auxiliary priming equipment is fitted, start the priming pump.
7. Start the pump drive motor.

## 8.2 Shutting down

The appropriate shutdown procedure for any installation depends on the slurry being pumped, and more generally on the process requirements upstream and downstream of the pump. What follows, therefore, may only be regarded as general guidelines for ensuring some degree of protection for the pump without reference to the particular application.

- Where practicable, switch the pump to clean water and allow the pipeline to be flushed through before shutting down.
- In case of systems with substantial discharge pipework and/or head of slurry, means of isolating the pump or draining the system should be provided –see section 6.5.

**CAUTION**

STOPPING THE PUMP WHEN THERE IS A HEAD OF SLURRY IN THE DISCHARGE PIPE SHOULD BE AVOIDED AS THIS COULD RESULT IN DAMAGE TO THE GLAND AND/OR PUMP.

- Having shut down the pump on clean water, close its isolating valves and then drain the pump and its pipework, if required.

**CAUTION**

**ALWAYS** CLOSE THE OUTLET VALVE FIRST. **NEVER** CLOSE THE INLET VALVE WHILE THE PUMP IS RUNNING.

NOTE: REVERSE FLOW, IN ADDITION TO POSING A RISK OF DAMAGE TO THE SHAFT SEAL, CAN ALSO CAUSE THE IMPELLER TO SPIN IN THE REVERSE DIRECTION. STARTING THE PUMP UNDER THESE CONDITIONS MIGHT CAUSE DAMAGE TO A MECHANICAL SEAL, IF FITTED, AND/OR CAN IN EXTREME CASES CAUSE THE SHAFT TO SHEAR. AN OVERRIDE CIRCUIT IS RECOMMENDED TO PREVENT THE PUMP BEING STARTED INADVERTENTLY WHILE THE IMPELLER IS ROTATING.

- For short stoppage periods **ONLY** and where there is **NO** risk of the slurry settling out, or solidifying in the system:

| | |
|---|---|
| Pumps with expeller seal - | immediately after shutting down, close the isolation valves and then drain the pump and the sump, if necessary. |
| Pumps with water flushed gland or mechanical seal | leave the flush water '**ON**' when shutting down the pump, then close the isolation valves and finally drain the pump and the sump, if necessary. |

Where there is a risk of slurry settling out, or solidifying, refer to the plant operation manual for the appropriate shutdown procedure.

**CAUTIONS**

FORMATION OF ICE CAN BLOCK OR BURST THE PIPEWORK AND THE PUMP CASE. IN BELOW FREEZING CONDITIONS, ENSURE THAT THE PUMP CASE, AND PUMP INLET AND OUTLET PIPEWORK IS DRAINED OF ALL SLURRY FOR ANY LENGTHY SHUT-DOWN.

## 8.3 Running checks

During pump operation, the following checks should be made:

1. Check for leakage from the inlet and outlet connections, and from the gland seal.

NOTE: AN UNTIGHT INLET FLANGE MAY NOT BE EASILY NOTICEABLE DURING OPERATION, AS THE PUMP COULD BE DRAWING AIR. CHECK FOR INLET-SIDE LEAKS BEFORE START-UP.

2. Check for excessive noise and vibration -see Description, section 2.
3. Check bearing temperature and lubrication –see Lubrication, sub-section 9.4.
4. Periodically verify that the shaft seal is correctly adjusted. If a water flush gland seal is fitted, ensure that the water supply is at the correct pressure and flow rate. (Refer to section 9.5.3 for shaft seal setting details.)
5. Check that the pump performance is satisfactory. (See Capacity Curves, section 2.7)

**NOTE:** IF THE RUNNING CHECKS ARE UNSATISFACTORY, PUMP ADJUSTMENT OR MAINTENANCE MAY BE REQUIRED.

**IMPORTANT NOTE:** AFTER THE FIRST 100 HOURS OF OPERATION, CHECK AND ADJUST THE IMPELLER AXIAL CLEARANCE. SEE SECTION 9.5.1.

# 9 CARE AND MAINTENANCE

## 9.1 Safety measures

**WARNINGS**

ISOLATE THE PUMP FROM ALL SOURCES OF ELECTRICITY AND POWER, **BEFORE** COMMENCING ANY MAINTENANCE WORK.

**ALWAYS** ASCERTAIN THE NATURE OF THE PROCESS LIQUID BEFORE COMMENCING WORK ON A PUMP AND FOLLOW THE HEALTH AND SAFETY PROCEDURES RELEVANT TO THE PROCESS LIQUID. IT MAY BE **HARMFUL** TO HEALTH.

Should the process liquid be of a harmful or hazardous nature take the following precautions as a minimum;

1. always use protective goggles and rubber gloves;
2. flush the pump thoroughly with clean water, before opening the pump;
3. after removing the components, flush them thoroughly with clean water.
4. follow the health and safety instructions provided in section 3.

## 9.2 Preventive maintenance & service schedule

### 9.2.1 Routine maintenance

Use the maintenance schedule below as a basis from which to produce a schedule suitable to each pumping application after experience in operation has been gained.

**WARNING**

**BEFORE** CARRYING OUT ANY MAINTENANCE ENSURE THAT ALL ELECTRICAL SUPPLIES TO THE MOTOR AND ASSOCIATED EQUIPMENT ARE SWITCHED OFF AND ISOLATED. LOCK IN THE OFF POSITION OR ATTACH SUITABLE WARNING PLATES TO THE RELEVANT SWITCHES.

| ITEM | ACTION | RUNNING HOURS | | | |
|---|---|---|---|---|---|
| | | 10 | 100 | 250 | 1000 |
| Pump Case, Bearing Cylinder Housing and Gland Area Pipework | Keep all areas clean and free from debris, slurry etc. | × | | | |
| Hydraulic cylinders (where applicable) | Check for oil leaks. Rectify, as required. | | | | × |
| Inlet/Outlet Connections | Check for security and leaks. Rectify as required. | | × | | |
| Gland Seal - General | Check for leaks. Tighten gland follower screws or renew seal as necessary. | | × | | |

| ITEM | ACTION | RUNNING HOURS | | | |
|---|---|---|---|---|---|
| | | 10 | 100 | 250 | 1000 |
| Water flushing gland seal. | Check stuffing box connection for leaks. Rectify as necessary. | | × | | |
| Centrifugal Gland Seal | Tighten gland follower screws or renew seal as necessary. | | × | | |
| Bearing Cylinder | Lubricate bearings. See section 9.4. | | | × | |
| | Check Bearings for overheating. | | | × | |
| All fixings | Ensure attachments are secure. Tighten to correct torque as necessary. | | | | × |
| Adjusting Screw Locknut (P38) | See Torque Table, Section 11.1. | | | × | |
| Pump/Drive unit installation | Inspect Drive Belts, if fitted, for deterioration and damage. Replace as necessary. Check drive belt tension and adjust as necessary. | | | | × |
| | Check drive couplings, if fitted, for security of connection. | | | | × |
| | Check safety covers for security of attachment - **important** | | | × | |
| | Check drive motor holding down bolts for security of attachment. | | | | × |
| | Keep drive motor clean and free from debris, slurry etc. | × | | | |
| | Service Drive Motor as necessary. | In accordance with manufacturer's instructions. | | | |
| Pump impeller | Check axial clearance after run-in period. Adjust clearance by shimming. Refer to Setting Pump Clearances, sub-section 9.5.1. | After first 100 running hours and repeat at intervals equal to 25% of the anticipated life of the pump. | | | |

### 9.2.2 Maintenance recommendations

Metso Minerals recommends that the following actions are carried out prior to any maintenance:

- clean down the pump, removing any accumulation of debris and/or slurry;
- ensure that inlet and outlet pipeline valves, if fitted, are closed;

**WARNING**

**BEFORE** OPENING UP THE PUMP, MAKE SURE THAT ANY LIQUID PRESSURE HAS BEEN RELEASED.

- on breaking a joint face, keep the gasket and ensure it is replaced on assembly;
- if using lifting gear to remove components, ensure that it is of adequate capacity and that test certificates are valid;
- on larger size pumps it is recommended that special tools are used to help assembly or maintenance.

For information regarding special tools please refer to Special Tools, section 9.3.

## 9.3 Tools and special equipment for service and maintenance

NOTE: THE FOLLOWING SPECIAL TOOLS ARE AVAILABLE FOR PUMPS WITH EITHER SINGLE, OR DOUBLE, ADJUSTMENT FRAMES.

1. A special crank-handle to fit over the drive-shaft end diameter and locate the drive key is advantageous when fitting the impeller to the shaft. See Dismantling and Fitting the Hydraulic Parts, section 9.5.2.

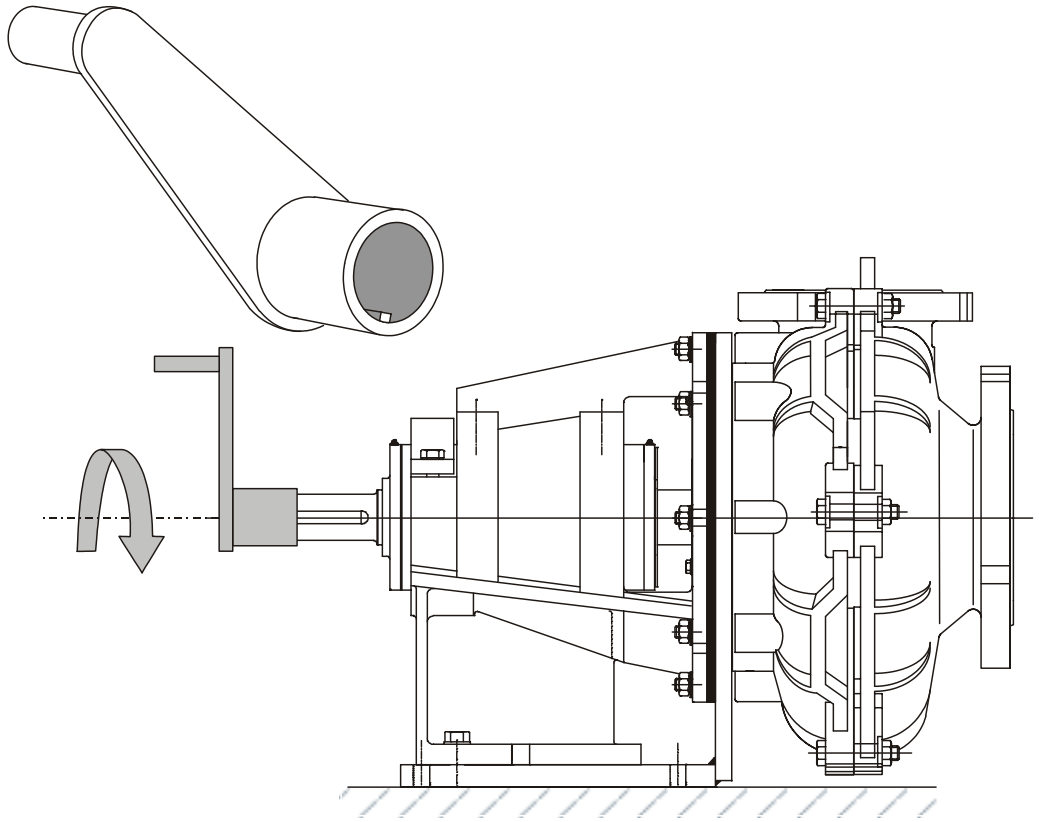


Figure 9.3-1 Special crank handle

2. Two proprietary packing extractors to facilitate the removal of the packing will also be advantageous.

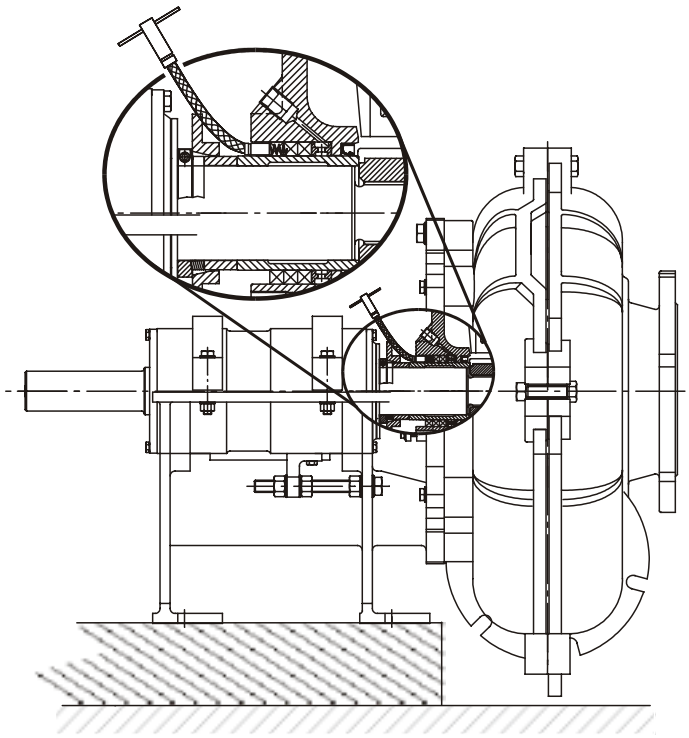


Figure 9.3-2 Packing extractor

3. Back-liners for large pumps are very heavy. Specially designed back-liner lifting tools allow safe handling of the components.

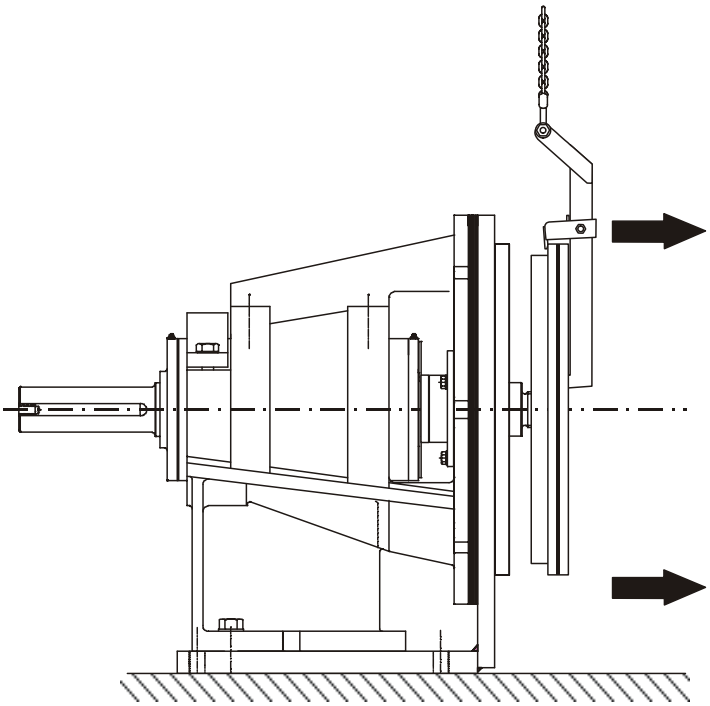


Figure 9.3-3 Back-liner lifting tool for metal pumps

4. Shaft seals for large pumps are also quite heavy. A special shaft extension (E) facilitates removal and refitting of the seal assembly. The tool is also useful for removing the bearing assembly.

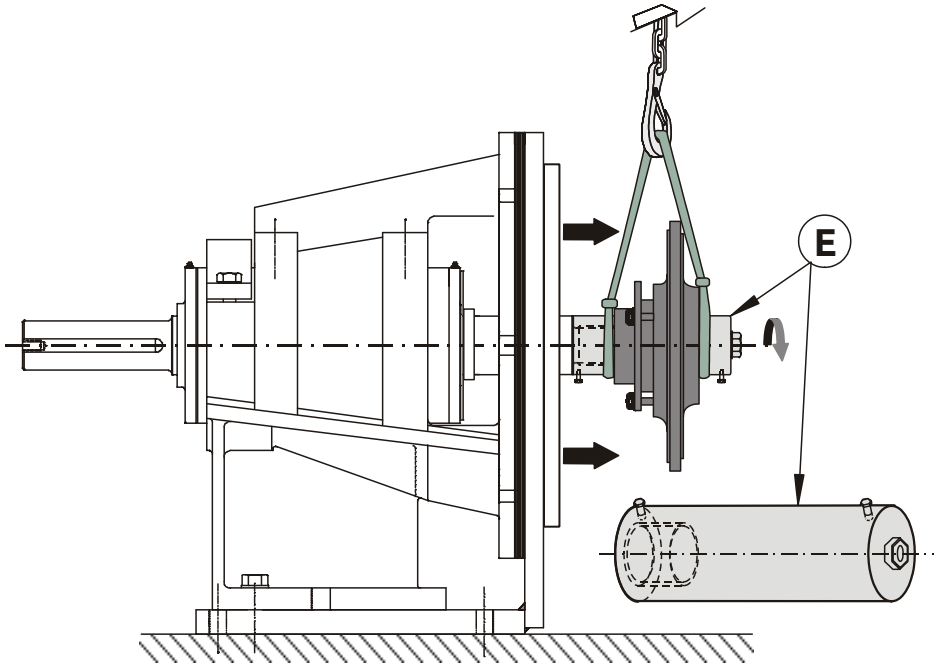



Figure 9.3-4 Shaft extension tool

5. A soft sling (strop) of appropriate lifting capacity (See Approximate Weights Table, section 11.3) to lift the case assembly is required.

**CAUTION**

TO PREVENT DAMAGE, **ONLY** USE A SOFT SLING (STROP) TO LIFT THE CASE.

All of the above special tools can be obtained from Metso Minerals. See section 10.6.

## 9.4 Lubrication

### 9.4.1 First-fill and re-packing after major servicing

Metso Minerals Slurry pumps are lubricated with SKF LGMT3 before dispatch. When renewing or re-fitting the bearings, they must again be re-packed with grease of the same specification as detailed in Table 9.4.1-1. The required quantity for each bearing is specified in Table 9.4.1-2.

| Characteristic | Specification |
|---|---|
| Thickening agent : | Lithium soap |
| Base oil viscosity at 40 °C : | 120 cST |
| Base oil type : | Mineral oil |
| Consistency NLGI : | 3 |

Table 9.4.1-1 Grease specification

| Frame size | Grease quantity (g) |
|---|---|
| FR250 | 100 |
| FR300 | 230 |
| FR400 | 430 |
| FR500 | 850 |
| FR600 | 1000 |
| FR750 | 1400 |

Table 9.4.1-2 Bearing lubrication - First fill & re-packing

## 9.4.2 Lubrication interval

The bearings may be re-greased with any lithium-based grease that conforms to the specification detailed in Table 9.4.1-1.

The lubrication interval depends upon the shaft speed and the bearing operating temperature, as shown in Table 9.4.2-1.

| Frame Size | Grease (g) | Pump speed (rpm) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 500 | 800 | 1000 | 1500 | 2000 | 2500 | 3000 |
| FR250 | 15 | 6900 | 4100 | 3100 | 1900 | 1250 | 850 | 600 |
| FR300 | 20 | 6400 | 3700 | 2800 | 1650 | 1050 | 700 | 450 |
| FR400 | 35 | 6000 | 3500 | 2600 | 1500 | 900 | - | - |
| FR500 | 45 | 5400 | 3000 | 2200 | 1200 | - | - | - |
| FR600 | 60 | 4900 | 2700 | 1900 | 900 | - | - | - |
| FR750 | 70 | 4000 | 2100 | 1450 | 600 | - | - | - |

Table 9.4.2-1 Recommended lubrication interval (hours) for bearings @ 70°C

The pump should initially be re-greased after 250 running hours or the recommended interval (whichever is less), unless stored for longer than 12 months before start-up, in which case the long-term storage instructions should be followed (See section 1.2).

Multiply above lubrication intervals by the factors given below if the normal bearing operating temperature (measured on the rim of the bearing end cover) differs from 70 °C.

| ***Temperature (°C)*** | ***50*** | ***60*** | ***70*** | ***80*** | ***90*** | ***100*** | ***110*** | ***120*** |
|---|---|---|---|---|---|---|---|---|
| *Multiplier* | *2.5* | *1.6* | *1.0* | *0.65* | *0.40* | *0.25* | *0.15* | *0.10* |

While the bearings and specified grease have a maximum operating temperature of 120°C, it is recommended that temperatures above 100 °C be avoided. However, transient temperatures between 100 °C and 120 °C are acceptable immediately following re-greasing.

**WARNING**

DO NOT RE-GREASE DURING THE FIRST 8H OF THE RUNNING-IN PERIOD FOR NEW BEARINGS.

## 9.4.3 Lubrication points

The pumps have two bearing lubrication points. See Figure 9.4.3-1.

| Part | Position | Qty.(cc) | Frequency | Lubricant |
|---|---|---|---|---|
| Bearing cylinder | A | See Table 9.4.2-1. | See Table 9.4.2-1. | SKF LGMT3 or equivalent - see Table 9.4.1-1. |
| Motor and/or gearbox (where applicable) | – | – | – | See manufacturer's instruction manual. |

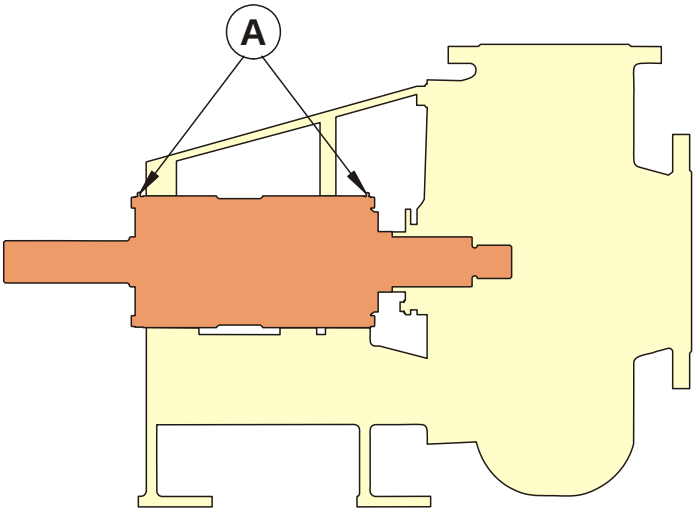



Figure 9.4.3-1 Lubrication point diagram- Bearing greasing points (A)

## 9.5 Dismantling and assembly

### 9.5.1 Setting pump clearances

- **Impeller clearance adjustment**

This adjustment enables the impeller inlet-side running clearance to be kept to a minimum so that maximum operating efficiency is maintained throughout the wear life of the pump.

When no further adjustment is possible, the pump must be disassembled and inspected and worn parts renewed.

1. Isolate the drive motor and attach suitable warning plates to the relevant switches. It is advisable to remove the fuses and/or lock the isolator open to prevent accidental starting.
2. Remove the drive safety guard and disconnect the belt drive or direct coupling as applicable.
3. Where fitted, a mechanical seal requires ***setting*** for disassembly. Section 9.5.3 would provide the relevant instructions, where applicable.
4. Inlet-side clearance

   This clearance is set by moving the complete rotating assembly towards the inlet end:

   a) Loosen the two adjusting screw locknuts (P38 a & b) –see Figure 9.5.1-1.

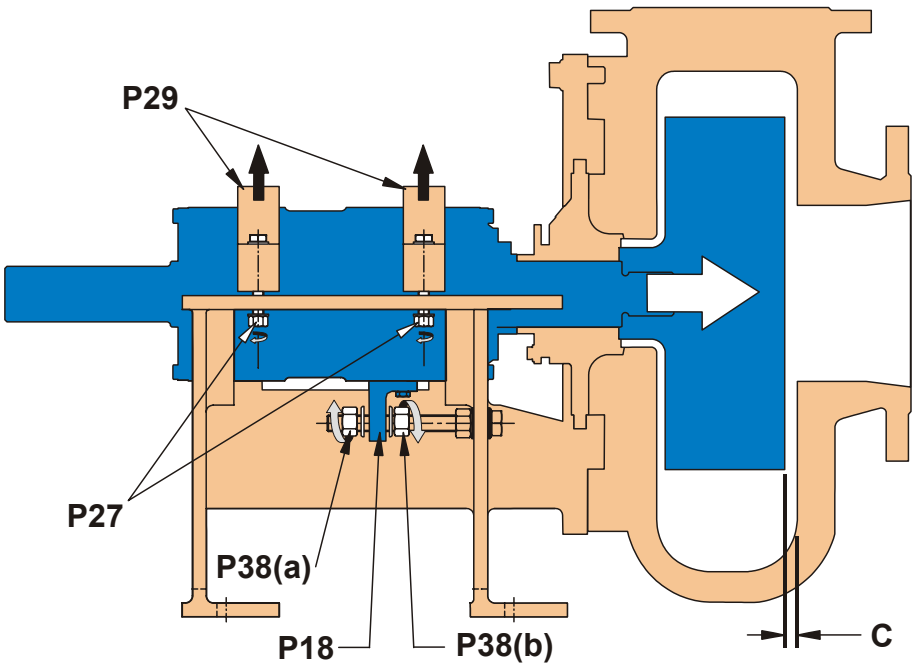



Figure 9.5.1-1 Adjusting the impeller inlet-side clearance

b) Loosen housing clamp fixings (P16 & P27), and slacken bearing housing clamps (P29).

c) Ensure that the bearing cylinder assembly is free to move.

d) While rotating the shaft (B11) manually, take up the inlet-side clearance (C) by tightening adjustment screw locknut (P38 a) until impeller (W3) makes contact with the case assembly on the inlet-side.

e) Back off locknut (P38a) by one turn.

f) Tighten locknut (P38b) to pull back the rotating assembly until locknut (P38a) is tight against saddle (P18).

g) Check that impeller (W3) rotates freely.

h) Tighten locknuts (P38) and housing clamp screws (P16).

**CAUTION**

**DO NOT** OVER-TIGHTEN HOUSING CLAMP SCREWS (P16). OVER-TIGHTENING MAY DISTORT BEARING HOUSING (B14). REFER TO SECTION 11.1 FOR THE CORRECT TORQUE SETTING.

5. If fitted, reset the mechanical seal.
6. Re-connect the drive belt or half coupling as applicable making sure that the drive is aligned correctly. Adjust as necessary to obtain the correct alignment.
7. Fit all safety guards.

## 9.5.2 Hydraulic parts and frame - dismantling and fitting

### (i) Opening and closing the pump – fixed base

**WARNING**

MAKE SURE THAT **ALL** SLINGS, SHACKLES, ETC. ARE OF ADEQUATE LOAD CARRYING CAPACITY. APPROXIMATE WEIGHTS OF MAJOR COMPONENTS ARE PROVIDED IN SUB-SECTION 11.3.

LIFTING POINTS INCORPORATED IN INDIVIDUAL COMPONENTS ARE INTENDED SOLELY FOR LIFTING THAT SPECIFIC COMPONENT. **NEVER** USE THESE FOR LIFTING ASSEMBLIES OF COMPONENTS.

1. General

The base (L) supports the case, the bearing and the rotating assemblies. See Figure 9.5.2-1.

The bearing frame vertical plate incorporates a number of important features. Slots in its periphery provide locations for case bolts (B), and also facilitate the assembly of the case. Vertical plate's inner flange provides a spigot for an expeller ring or a stuffing box and threaded holes in its outer flange are intended for jacking screws.

The open construction of the bearing frame allows easy access to the shaft seal (F), and the impeller adjustment screw (G).

Fixing holes (D) are provided in the frame top plates to mount the drive motor overhead, if required.

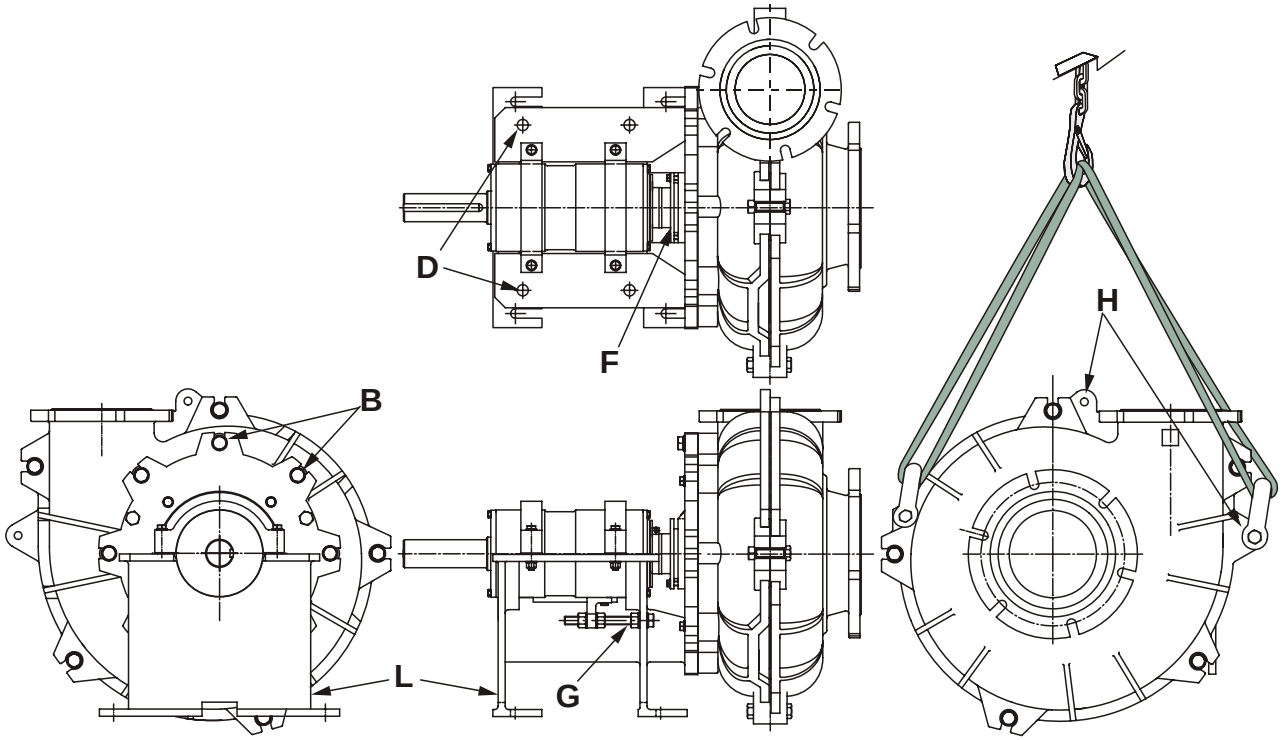



Figure 9.5.2-1 Bareshaft pump (typical)

2. Opening the pump

Figure 9.5.2-1 and parts list drawings in section 10.4 identify parts referenced in this section.

a) Run the pump on clean water or flush clean the inside of the case.

b) Isolate the pipework and drain the pump case.

c) Isolate the drive motor and attach suitable warning plates to the relevant switches. It is advisable to remove the fuses and/or lock the isolator open to prevent accidental starting.

d) Remove the drive safety guard and disconnect the belt drive or direct coupling as applicable.

e) Disconnect the inlet and outlet pipework from the pump.

NOTE: METAL PUMPS ARE EQUIPPED WITH INLET AND OUTLET FLANGE GASKETS (F2, F4). ENSURE THAT THESE ARE SAVED FOR REASSEMBLY. RUBBER PUMPS HAVE INTEGRAL GASKETS.

f) Note the position of the outlet to ensure correct reassembly.

g) Where fitted, a mechanical seal requires setting for disassembly and section 9.5.3 would provide the relevant instructions.

h) Disconnect the flush water tapping, if fitted.

i) Support the case in slings –cases for large pumps incorporate lugs (H) for attaching lifting shackles.

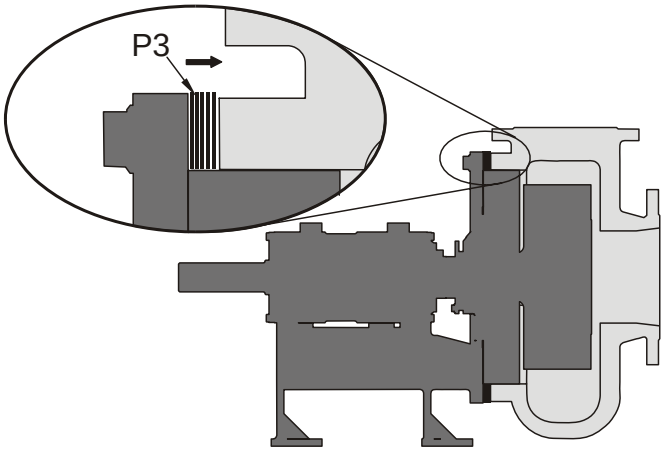
j) Remove case fixings (B). Keep them safe for reassembly.

k) Use jacking screws (P10) to ease apart the case and the rotating assembly.

l) Withdraw the case over back-liner (W4) and impeller (W3) and lower it onto a suitable support.

m) Remove jacking screws (P10).

NOTE: CASING SHIMS (P3) ARE FITTED ON SOME PUMPS TO ACHIEVE THE REQUIRED IMPELLER CLEARANCES. WHERE APPLICABLE, ENSURE THAT THEY ARE REMOVED AS SETS AND REFITTED ON ASSEMBLY IN THE SAME POSITION.



3. Closing the pump

   a) Lift and push the case assembly over impeller (W3) and back liner (W4) against the vertical plate.

NOTE: WHERE APPLICABLE, ENSURE CASE SHIMS (P3) ARE IN POSITION. CASE SHIMS (P3) MAY BE NECESSARY IF THE CASE HAS BEEN RENEWED. CONTACT METSO MINERALS SPARES DEPARTMENT –SEE SECTION 10.3 .

   b) Ensure that case fixings (B) enter their respective holes around the flange joint.

   c) Incrementally tighten opposite pairs of case fixings (B) to the torque values given in sub-section 11.1. until all fixings are tightened –ensure that impeller remains free to rotate manually.

   d) Set the impeller clearance –see sub-section 9.5.1.

   e) Check inlet and outlet gaskets and re-connect the respective pipework.

**CAUTION**

REFER TO SECTION 6.5 BEFORE RENEWING PIPE FLANGES.

   f) If a mechanical seal is fitted, *reset* it for operation.

   g) Where applicable, reconnect the flush water tapping.

   h) Fit the drive belts or connect the drive coupling, ensuring that they are in correct alignment.

   i) Fit and secure the drive safety guard and the gland guard in position.

   j) Check that all fixings are secure.

   k) Remove warning plates and safety locks from power switches and restore power supply to the motor.

## 9.5.2 Hydraulic parts and frame - dismantling and fitting

### (ii) Wet-end - disassembly and reassembly

1. General

Case (W1), impeller (W3) and back-liner (W4) are high quality, high-chrome iron castings. Larger size pump cases are ribbed and incorporate a number of lifting lugs. The inlet and outlet branches are fitted with joint seals (F2, F4) and split flanges (F1, F3) to provide a leak-proof and secure pipework connection.

The back-liner, which forms the rear face of the case, is attached to bearing frame (P14) by tee bolts (W19) and hexagon-headed nuts (W20). For ease of assembly, the bolts are retained in the slots by means of a rubber strap (W18). O-rings (W6) are used to seal the back liner and the case.

The wide choice of impellers available permit the most efficient case-impeller combination to be adopted for each application.

2. Removing impeller (W3) and back-liner (W4)

a) If an impeller release mechanism is fitted refer to section 9.5.2 (iii); otherwise, insert a suitable bar between two impeller vanes and lock the bar against a suitable static object. Apply a shock load by turning shaft (B11) in a direction opposite to the pump rotation. Alternatively, lock the shaft and shock the impeller. Sub-section 2.1.2 identifies the direction of rotation of the pump during operation.

b) Steady and suitably support impeller (W3) as it moves off shaft (B11).

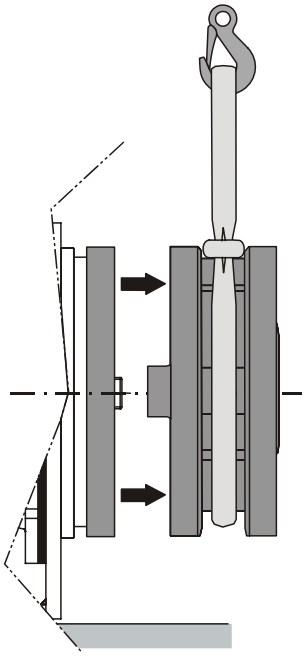


Figure 9.5.2-A Removing impeller (W3)

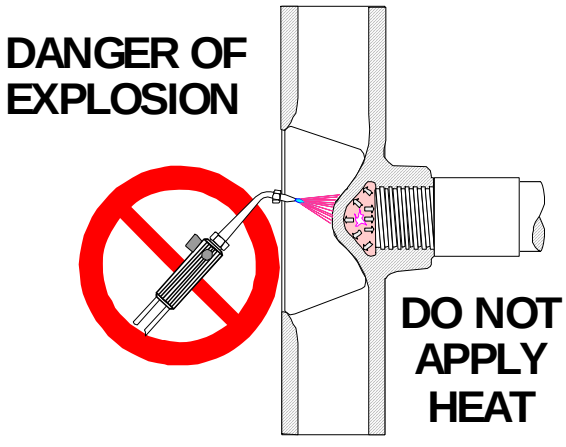



Figure 9.5.2-B Do not apply heat in order to remove the impeller

c) Remove nuts (W20) from the four back liner bolts (W19) and withdraw back liner (W4). The bolts are retained in position by a rubber strap.

**WARNING**

BACK-LINERS ON LARGE PUMPS ARE EXTREMELY HEAVY. USE THE BACK-LINER LIFTING TOOL RECOMMENDED IN SECTION 9.3.

3. Inspection

a) Clean and inspect case (W1), impeller (W3) and back-liner (W4) for severe scoring, extensive wear, pitting, corrosion and damage. Renew if necessary.

b) Inspect back-liner seal (W6). Renew it , if it shows any signs of damage.

c) Refer to sections 9.5.3 and 9.5.4 for Shaft Seal and Bearing Maintenance.

4. Assembly

a) Ensure that the impeller release mechanism, where applicable, and the shaft seal components are in position. See parts list drawings in section 10 for details.

b) Fit back-liner seal (W6) into the groove around back-liner (W4). Grease the seal to aid assembly.

c) Locate back-liner bolts (W19) into the lugs around back-liner (W4) and retain in position with back-liner bolt retaining strap (W18).

d) Offer back-liner (W4) to the frame, engaging back liner bolts (W19) in the frame holes.

**WARNING**

WHERE APPLICABLE, USE THE BACK-LINER LIFTING TOOL RECOMMENDED IN SECTION 9.3.

e) Fit and tighten nuts (W20) to the correct torque (refer to sub-section 11.1).

NOTE: WHEN FITTING NEW PARTS TO PUMPS FITTED WITH EXPELLER TYPE SHAFT SEALS, IT MAY BE NECESSARY TO ADJUST THE BEARING ASSEMBLY AXIALLY USING THE ADJUSTING SCREW TO PREVENT THE EXPELLER FOULING THE BACK LINER.

f) Clean the thread on the shaft and grease with appropriate lubricant or anti-seize compound.

g) Renew impeller gasket (W17), or O-ring seal (W31), as appropriate.

h) Lift impeller as shown in Figure 9.5.2-A and mount it onto the shaft end.

i) Block impeller (W3) using a bar inserted in between two of its vanes, then turn the shaft with the special crank-handle until the impeller is locked tight –refer to sub-section 9.3.

j) Set the impeller back clearance, where applicable – see section 9.5.1.

k) Apply grease liberally around back-liner seal (W6) to assist entry into case (W1).

## 9.5.2 Hydraulic parts and frame - dismantling and fitting

### (iii) Impeller Release Mechanism (IRM)

Not applicable.

## 9.5.2 Hydraulic parts and frame - dismantling and fitting

### (iv) Hydraulic system

Not applicable

## 9.5.3 Shaft seal - dismantling and fitting

- **Metso Minerals Mechanical Seal (H3) – Double**

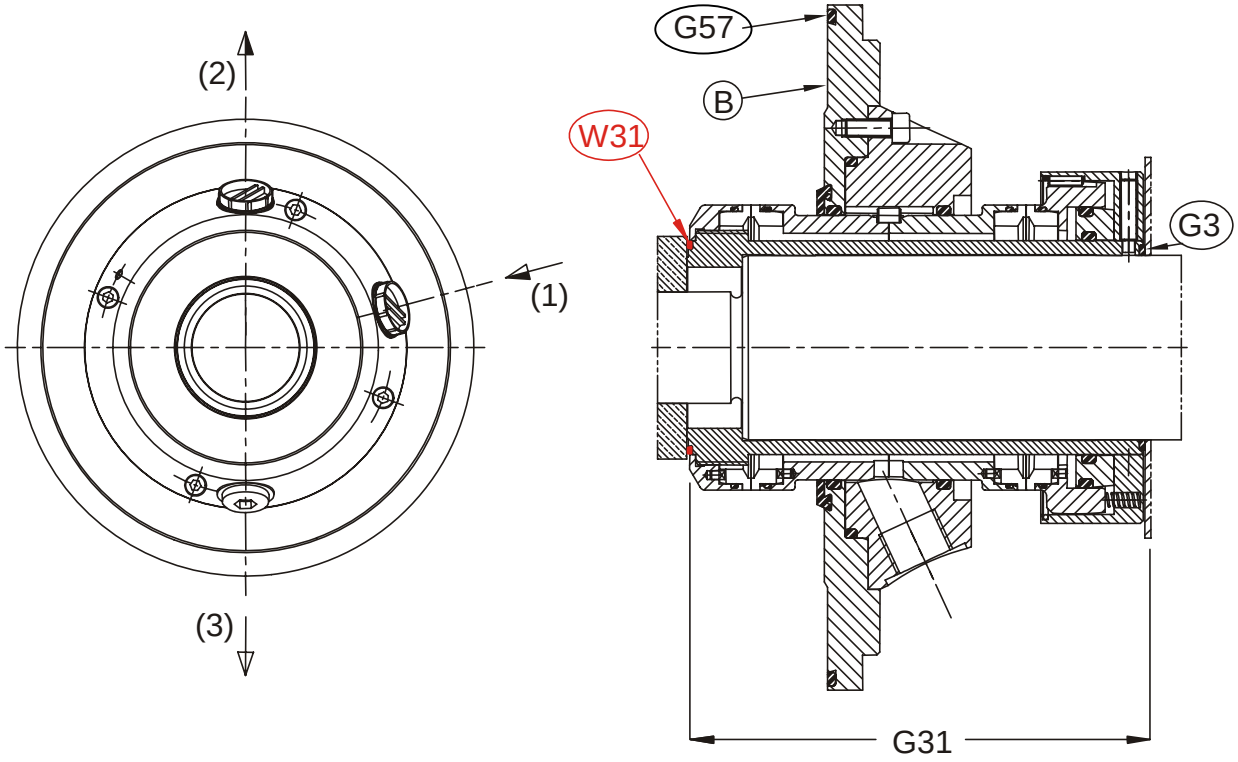
1. General observations

A large variety of mechanical seals are suitable for use with the Metso Minerals Slurry pumps. The Metso Minerals Mechanical Seal, however, is designed to provide excellent performance when fitted to Metso Minerals Slurry pumps.

**CAUTION**

| |
|---|
| INSTRUCTIONS INCLUDED IN THIS SECTION ARE CRITICAL TO THE CORRECT INSTALLATION AND OPERATION OF THE SEAL. FAILURE TO OBSERVE THEM MAY CAUSE IRREPARABLE DAMAGE TO BOTH THE SEAL AND THE PUMP. |
| INSTALLATION AND REMOVAL OF THE SEAL MUST **ONLY** BE CARRIED OUT BY QUALIFIED PERSONNEL WHO HAVE READ AND UNDERSTOOD THE INSTRUCTIONS. |
| ENSURE THAT THE PUMP IS NOT EXPOSED TO FREEZING CONDITIONS AND **ALWAYS** DRAIN THE SEAL'S WATER FLUSH SYSTEM OF ALL LIQUID AS PREPARATION FOR ANY MAJOR SHUTDOWN. |

Information on pump vibration is provided in section 2. To identify parts referenced in this section, see Figure 9.5.3-1 and parts list drawings in section 10.4 .




*[Quench liquid: (1) Inlet, (2) Outlet, (3) Drain]*

Figure 9.5.3-1 Metso Minerals Mechanical Seal – Double

## 2. Operating considerations

The double acting Metso Minerals Mechanical Seal has silicon carbide seal faces on both the product and the atmospheric sides. The seal requires flushing liquid at all times during operation, otherwise the seal faces are destroyed within seconds.

NOTE: DEPENDING ON THE APPLICATION, THE FLUSHING LIQUID PRESSURE MAY BE EITHER HIGHER OR LOWER THAN THE PUMP PRESSURE.

Flushing rate varies with shaft diameter, D, as shown in Figure 9.5.3-2. Total flushing rate, $T_f$, is, however, dependent on both the shaft running speed, R, and shaft diameter, D (See Table 9.5.3-1), and is calculated using the formula:

$$\text{Total flushing rate, } T_f = F \times R_f$$

Where, $R_f$ , is the shaft speed factor as tabulated in Table 9.5.3-2.

| Frame Size | Shaft Diameter (mm) |
|---|---|
| FR250 | 47.5 |
| FR300 | 63.0 |
| FR400 | 75.0 |
| FR500 | 95.0 |
| FR600 | 111.7 |
| FR750 | 120.0 |

Table 9.5.3-1 Frame size to shaft diameter correspondence table (Frame size for your pump is stated in 'Pump Specification', section 1.3).

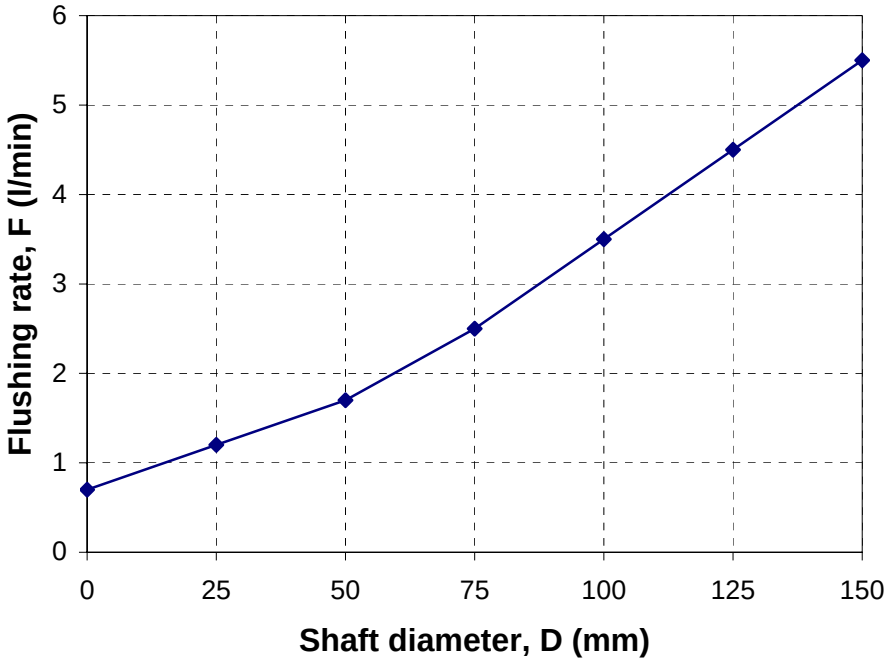



Figure 9.5.3-2 Variation of flushing rate with shaft diameter

The required water quality is specified as follows:

| R (rpm) | $R_f$ | R (rpm) | $R_f$ |
|---|---|---|---|
| 700 | 0.2 | 3950 | 1.1 |
| 1150 | 0.3 | 4200 | 1.2 |
| 1400 | 0.4 | 4900 | 1.4 |
| 1750 | 0.5 | 5250 | 1.5 |
| 2100 | 0.6 | 5600 | 1.6 |
| 2450 | 0.7 | 5950 | 1.7 |
| 2800 | 0.8 | 6300 | 1.8 |
| 3150 | 0.9 | 6650 | 1.9 |
| 3500 | 1.0 | 7000 | 2.0 |

Solid particles : max. 10 mg/l
Particle size : 10-50 µm
Critical particle size : 2 -5 µm (to be avoided)
Permanganate value : max. 30 (free from humus)
Ferro content : max. 1 mg/l
Hardness value : max. 10° dH

Table 9.5.3-2 Shaft speed factor table

a) Ensure that quench liquid is present at all times.

NOTE:SEALING LIQUID (WATER) MUST BE CIRCULATED AT 1 TO 2 BAR ABOVE SEAL PRESSURE.

**CAUTIONS**

THE MECHANICAL SEAL MUST NOT RUN WITHOUT QUENCH LIQUID, OTHERWISE THE SEAL WILL BE DESTROYED WITHIN SECONDS.

MINIMUM FLUSHING RATE IS 0.5 LITRES PER MINUTE.

MAXIMUM PUMPING TEMPERATURE IS 75 °C.

b) Check the leakage level of the seal periodically during operation. This is a measure of the condition of the seal. If there is noticable leakage from the seal, it should be renewed. It is recommended that a spare seal is held in stock to allow immediate renewal. No maintenance is possible while the seal is installed.

3. Start-up

Before start-up, **ALWAYS** ensure that liquid is present in the quench system and that it is fully vented.

4. Disassembly

a) Follow the appropriate procedure to stop the pump and isolate it from the power supply.

b) Flush the pump with clean water.

c) Close the inlet and discharge valves and drain the pump.

d) Shut off and disconnect quench water connection to the seal.

e) Gain access to the seal by opening up the pump using the Front or Back Pull-Out method.

f) With the impeller (W3) and backliner (W4) removed, slide the seal assembly off the shaft. Remove and discard O-ring (W31).

**WARNING**

SHAFT SEALS FOR LARGE PUMPS ARE QUITE HEAVY. USE THE SPECIAL SHAFT EXTENSION TO FACILITATES THEIR REMOVAL AND REFITTING –SEE SUB-SECTION 9.3.

5. Inspection

a) Ensure that the pump and bearings are in good condition.

b) Check that shaft (B11) and mechanical seal (G31) are free from damage.

NOTE: REPAIR KITS FOR THE SEALS, INCLUDING DETAILED SERVICE INSTRUCTIONS, ARE AVAILABLE ON REQUEST. A SERVICE TRAINING VIDEO SHOWING THE PROCEDURE FOR REPAIRING THE MECHANICAL SEAL IS ALSO AVAILABLE ON CD.

METSO MINERALS ALSO PROVIDE A SERVICE EXCHANGE PROGRAMME, WHERE THE SEALS ARE RETURNED FOR SERVICE.

6. Assembly

If the seal did not leak before dismantling it may be fitted back in the pump, otherwise a new seal must be fitted.

a) Check that O-rings (G3) and (G57) are in place.

b) Mount mechanical seal assembly (G31) onto shaft (B11) and push it along until its flange (B) makes contact with bearing frame (P14).

c) Ensure that quench water outlet is as close as possible to the 12 O'clock position.

d) Assemble the rest of the pump as appropriate to the pull-out method used for disassembly and take note of the following precautions:

i/ ensure that seal flange (B) is securely clamped between backliner (W4) and bearing frame (P14);

ii/ fit a new O-ring (W31) before screwing on impeller (W3);

iii/ ensure that inlet and outlet quench liquid pipes are connected to the seal and that quench liquid is available -see paragraphs (2) and (3) above for details;

iv/ adjust impeller clearances.

## 9.5.4 Shaft and bearing assembly - removal and fitting

The following instructions assume that the pump is installed complete with the drive unit and is connected to the suction and discharge pipework.

1. Removal

   a) Remove the wet end assembly (refer to sections 9.5.2 & 9.5.3).

   b) Remove the drive safety guard and disconnect the drive belts, or drive coupling, as applicable.

   c) If necessary, remove the drive motor to provide sufficient space to withdraw the bearing frame assembly from the case.

   d) Where applicable, remove impeller release mechanism from the shaft – see section 9.5.2 (iii).

   e) Slacken impeller adjusting fixings (P19, P38 & P42) and jiggle out the whole adjustment screw assembly.

   f) Unscrew saddle screws (P20) and remove saddle (P18).

   g) Unscrew housing clamp fixings (P15, P16, P27) and remove housing clamps (P29).

   h) Lift bearing cylinder assembly, as shown in Figure 9.5.4-1, out of the bearing frame.

   i) Place the assembly on suitable supports, ideally wooden vee blocks.

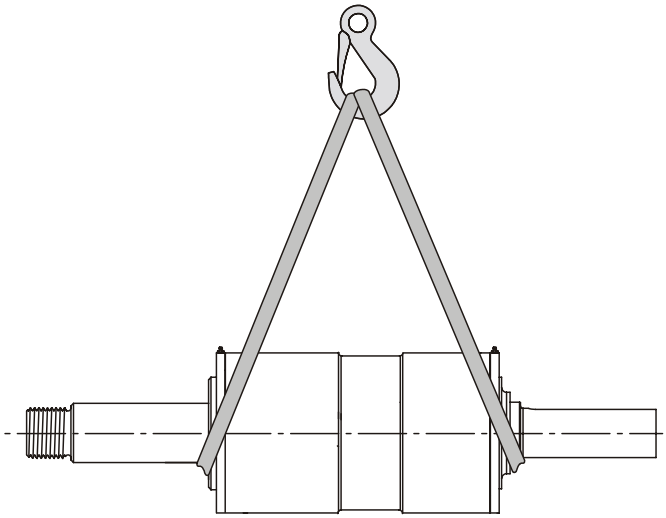


Figure 9.5.4-1 Lifting the bearing cylinder

2. Re-fitting

a) Clean and degrease the bearing frame contact surfaces. Coat the machined surfaces with anti-seize compound.

b) Lift the bearing cylinder assembly, as shown in Figure 9.5.4-1, and lower it onto bearing frame (P14).

c) Rotate (Ra or Rc as convenient) the bearing cylinder assembly in the bearing frame so that the tapped holes for the saddle screws are in-line with the slot in the frame for impeller adjusting screw (P19). As shown in Figure 9.5.4-2.

NOTE: IN EITHER POSITION, GREASE NIPPLES WILL BE VISIBLE ABOVE THE FRAME TOP PLATE.

d) Fix saddle (P18) to bearing housing (B14) using screws (P20), and tighten to the recommended torque setting.

e) Mount adjusting screw assembly (P19, P38 & P42) in position between frame (P14) & saddle (P18) – see Figure 9.5.4-2.

f) Tighten saddle-end locknut to the recommended torque setting. See section 11.1.

g) Where applicable, assemble impeller release mechanism to the shaft – see section 9.5.2 (iii).

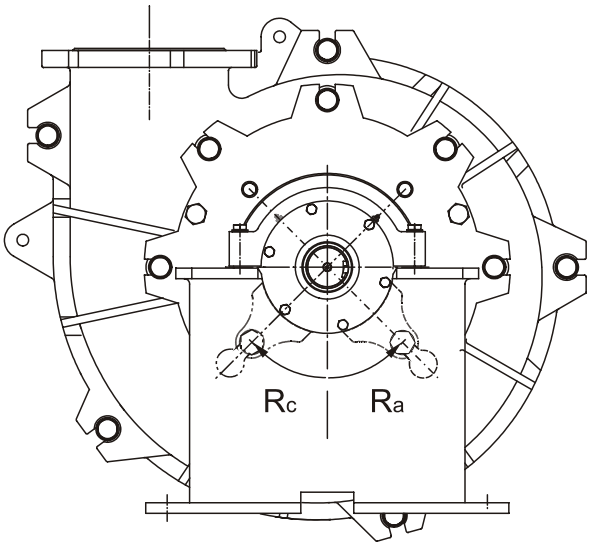



Figure 9.5.4-2 Bearing orientation

h) Reassemble the shaft seal and the wet-end as described in sub-sections 9.5.3 & 9.5.4.

i) Reassemble the drive, fit the guards and restore all the supplies to the pump.

## 9.5.5 Shaft and bearings - disassembly and re-assembly

1. General

The bearing cylinder assembly connects the drive to the impeller. Its general layout is shown in Figure 9.5.5-1.

It consists of a steel shaft, one end of which is threaded to receive the impeller, and the other end of which is keyed to accept a coupling or a belt drive arrangement. The shaft is supported by a floating, cylindrical roller bearing (Bd) at the drive-end and a fixed spherical roller bearing (Bw) at the wet-end.

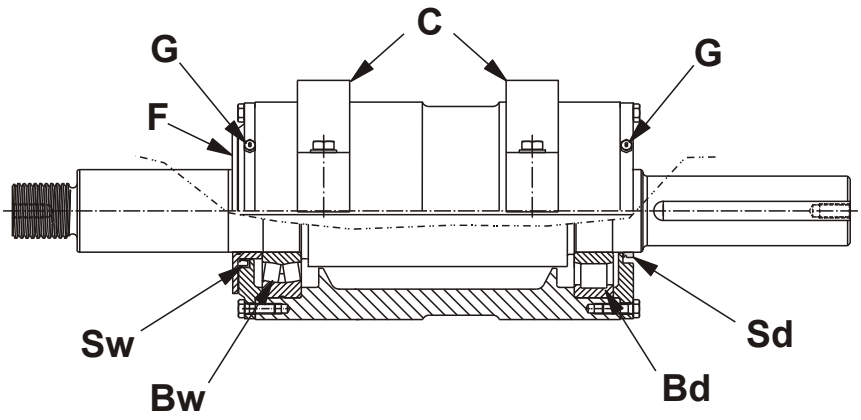



Figure 9.5.5-1 Standard bearing cylinder assembly

A V-ring (Sd), seals the drive-end bearing against dirt and other foreign matter. The wet-end is protected by a flinger (F) and a lipseal (Sw). Grease nipples (G) are provided to allow periodic lubrication of the bearings. Grease ways machined into the bearing housing channel the lubricant into the bearings.

The bearing assembly is secured in the bearing frame by two housing clamps (C). Its horizontal position relative to the frame is fixed by means of the impeller adjusting screw.

The central portion of the bearing housing is colour coded to allow the assembly type to be ascertained from the exterior. A coloured band is painted around the middle of the bearing housing (P14). Table 9.5.5-1 explains the coding.

Table 9.5.5-1 Bearing assembly type colour coding

| UNIT TYPE | STATUS | COLOUR CODE |
|---|---|---|
| Standard | New build | Mid Blue-18.E.53 |
| Standard | Reconditioned | Red |

2. Disassembly

a) With bearing cylinder assembly resting horizontally on V-blocks, remove flinger (B1) from the wet-end and the V-ring seal (B22.2) from the dry end.

b) Remove seal (B16) from flinger (B1).

c) Support the bearing cylinder assembly vertically in a secure stand, dry-end pointing down, as shown in Figure 9.5.5-2, and clamp it in position using securing screws (E).

d) Unscrew wet-end cover fasteners (B5, B26) and detach wet-end cover (B2.1).

e) Lift the shaft and bearing assembly out of bearing housing (B14) and lay it horizontally in V-blocks.

f) Tap or press off wet-end bearing (B8.1) and the inner race of dry-end bearing (B8.2).

g) Lay bearing housing (B14) horizontally in V-blocks.

h) Remove end-cover (B2.2) from the bearing housing dry-end.

i) Extract dry-end bearing (B8.2) outer race and roller assembly from bearing housing (B14).

j) Wash all parts in a suitable cleaning solvent and dry carefully.

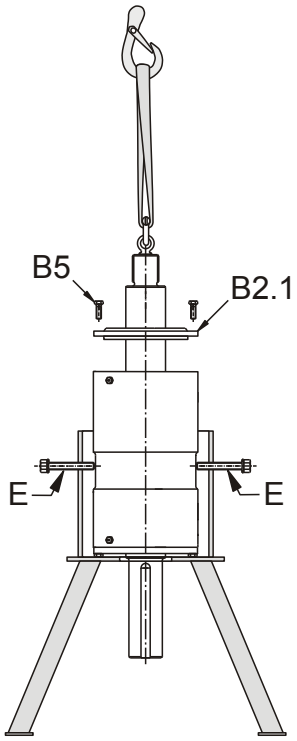



Figure 9.5.5-2 Supporting the bearing cylinder

3. Inspection

a) Inspect bearing housing (B14), for excessive wear around the bearing lands and check that all its threaded holes and grease passages are clear and undamaged.

b) Inspect end-covers (B2.1 & B2.2) for damage.

c) Carefully inspect bearings (B8.1 & B8.2) for wear, damage and corrosion. After inspection, if they are in good condition, dip them in gear oil and wrap them in a clean cloth or paper to protect them until installation.

d) Examine shaft (B11) for damage and corrosion. Check for wear around bearing lands. Remove any nicks and burrs with a carborundum stone.

e) Renew all seals and any defective parts.

4. Assembly

a) Support shaft (B11) in V-blocks and ensure all its surfaces are clean.

NOTE: DO NOT GREASE BEARING LANDS.

b) Press wet-end bearing (B8.1) onto the shaft, making sure that it is tight against the shaft inner shoulder. Similarly, assemble inner race (B8.2a) of dry-end bearing –see Figure 9.5.5-3.

NOTE: THE BEARINGS MAY BE HEATED IN OIL OR IN A BEARING HEATER TO A MAXIMUM OF 121 °C FOR EASE OF ASSEMBLY.

c) Coat the shaft between the bearings with a suitable corrosion preventive solution.

d) Ensure bearing housing (B14) is clean, particularly the grease passages.

**CAUTION**

DO NOT GREASE THE BEARING LANDS. CLEAN THEM WITH A PROPRIETARY DEGREASANT AND THOROUGHLY DRY THEM. ENSURE THAT THE LANDS ARE FREE FROM ALL DIRT, GRIT AND CONTAMINANTS BEFORE STARTING ASSEMBLY.

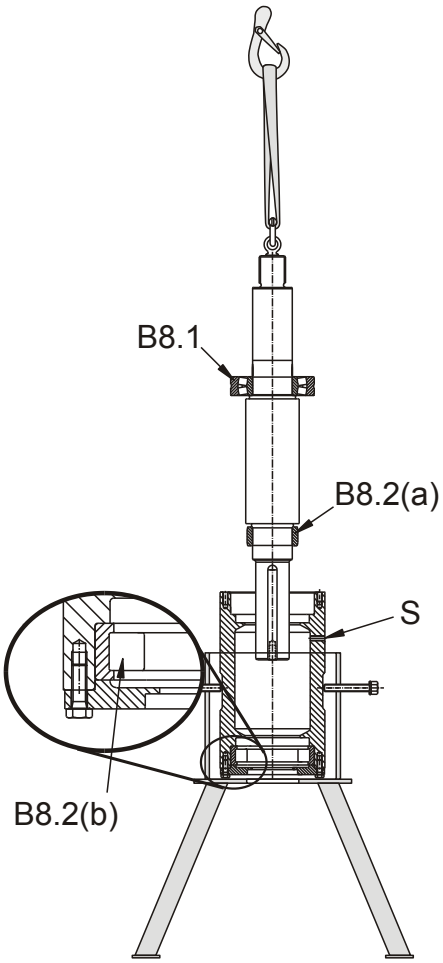



Figure 9.5.5-3 Assembling the bearing cylinder.

e) Press or tap the dry-end bearing outer race (B8.2b) –see Figure 9.5.5-3– into the bearing housing end farthest from the tapped saddle screw holes (S). Make sure that it is tight against the shoulder.

f) Pack both bearings (B8.1 & B8.2) with grease. See Lubrication, sub-section 9.4, for required quantities.

NOTE:WHEN HAND PACKING, FORCE GREASE THROUGH THE BEARING UNDER THE CAGE. ALWAYS USE THE CORRECT QUANITY OF GREASE. OVER OR UNDER GREASING CAN BE DETRIMENTAL TO THE LIFE OF THE BEARING.

g) Clean dry-end cover (B2.2), assemble it to bearing housing (B14) using fasteners (B5, B26) and tighten screws evenly to the correct torque. See Torque Table, section 11.1.

h) Support bearing housing (B14) securely in the stand –dry-end down.

**WARNING**

IN CASE OF LARGE PUMPS, BRACING WILL BE REQUIRED TO ENSURE BEARING HOUSING (B14) IS SAFELY SEATED.

i) Lift the shaft assembly, as shown in Figure 9.5.5-3, and lower it into the bearing housing –dry-end first.

**CAUTION**

TAKE CARE NOT TO DAMAGE THE DRY-END BEARING ROLLERS AS THE SHAFT ASSEMBLY IS LOWERED. MAKE SURE WET-END BEARING OUTER RACE IS SEATED SQUARELY AGAINST THE BEARING HOUSING SHOULDER.

j) Clean wet-end cover (B2.1), and assemble it to bearing housing (B14) using fasteners (B5, B26).

k) Tighten fasteners (B5, B26) evenly to the correct torque. See Torque Table, section 11.1.

l) Clean flinger (B1) and carefully fit new seals (B16 & B22.1) to it.

NOTE: FIT SEAL (B22.1) FACING THE DIRECTION SHOWN IN PARTS LIST DRAWINGS, SECTION 10.4.

m) Lightly lubricate the wet-end surface of shaft (B11) and the bore of the flinger.

n) Lower flinger assembly over the shaft and press it into cover (B2.1).

o) Tap or press flinger firmly down to ensure that seal (B22.1) is seated correctly in the end-cover (B2.1).

p) Lift bearing cylinder assembly off the blocks and lay it horizontally in V-blocks.

q) Apply a light coating of lubricant to shaft surface and fit a new V-ring seal (B22.2) to dry-end cover (B2.2).

r) Fit grease nipples (B13) to bearing housing, if not already fitted, and using a grease gun, pump several strokes of fresh grease through greaseways.

## 9.5.6 Pump drive - removal and re-fitting

- **V-drive**

1. Dismantling the drive

**WARNING**

ENSURE THAT THE PUMP MOTOR IS ISOLATED AND THE ISOLATOR IS LOCKED IN THE ISOLATED POSITION **BEFORE** REMOVING THE DRIVE GUARD.

TO PREVENT 'REVERSE MOTORING' OF THE PUMP, ENSURE THAT THE DISCHARGE LINE IS ISOLATED **BEFORE** REMOVING THE DRIVE GUARD.

a) Slacken off the screws securing the upper drive guard to the lower and remove the upper drive guard;

b) slacken off the motor support nuts, thus allowing the drive motor to move toward the bearing frame and slackening the drive belts, until the belts can easily be removed by hand;

c) remove the drive belts;

d) remove the pump and motor pulleys as described in Pulley – removal;

e) remove the drive guard set screws and washers and lift the lower drive guard from the assembly;

f) if required, the motor, or motor and support plate assembly, may be removed from the pump unit.

2. Reassembling the drive

The procedure is as follows;

a) fit the motor and/or motor support plate if these have been removed;

b) fit the lower drive guard to the pump unit and, ensuring the guard butts against the top of the upper bearing housing cover, secure it in position using the drive guard set screws and washers;

c) check that the motor butts against the underside of the lower drive guard. If this is not so then slacken off the motor mounting nuts and bolts, move the motor so that it butts against the lower drive guard, and tighten the motor mounting nuts and bolts on completion;

d) fit the pump pulley as described in Pulley –fitting, , ensuring a clearance of approximately 10mm between the underside of the pulley and the lower drive guard;

e) fit the motor pulley as described in Pulley - fitting, ensuring that it is correctly aligned with the pump pulley as described in Drive alignment;

f) fit the drive belts and tension as described in Drive belt tension;

g) fit the upper drive guard to the lower and secure in place using the screws provided.

3. Pulley – removal

a) Slacken, by several turns, all screws in the Taper Lock® bush. Remove one or two, according to the number of jacking holes (shown as '●' in Figure 9.5.6-1).

b) Oil the thread of each screw, the point of grub screws and under the head of cap screws. Insert the screws into the jacking holes.

c) Tighten the screws alternately until the bush is loosened in the pulley and the assembly is free on the shaft.

d) Withdraw the pulley, complete with Taper Lock® bush.

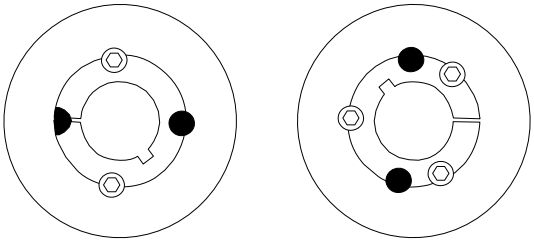


Figure 9.5.6-1 Taper Lock ® screw positions

4. Pulley - fitting

a) If a new pulley is to be fitted then remove the protective coating from the bore and outside of the Taper Lock® bush, and bore of the pulley;

b) ensure that the mating tapered surfaces are completely clean and free from oil or dirt, insert the bush into the pulley so that the holes are aligned;

c) sparingly oil the thread and point of grub screws, or thread and under the head of cap screws; place the screws loosely in holes in the pulley, shown as '⎔' in Figure 9.5.6-1;

d) clean the shaft, fit the key (if used), and fit the pulley to the shaft as one unit, locating in the desired position (note that the bush will nip the shaft first and the pulley will be drawn onto the bush as the screws are further tightened);

e) using a suitable hexagon wrench, tighten the screws gradually and alternately until the torque loading given in Table 9.5.6-1 is achieved;

f) using a suitable block to protect the bush, hammer against the large-end of the bush (this ensures that the bush is seated squarely in the bore of the pulley);

g) re-tighten the screws to the torque specified in Table 9.5.6-1;

| **Bush size** | | **1108** | **1210** | **1610** | **1615** | **2012** | **2517** | **3020** | |
|---|---|---|---|---|---|---|---|---|---|
| **Torque (Nm)** | | 5.7 | 20 | 20 | 20 | 31 | 49 | 92 | |
| **Screws** | **Quantity** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| | **Size (BSW)** | $^1/_4$" | $^3/_8$" | $^3/_8$" | $^3/_8$" | $^7/_{16}$" | $^1/_2$" | $^5/_8$" | |
| **Bush size** | | **3525** | **3535** | **4030** | **4040** | **4535** | **4545** | **5040** | **5050** |
| **Torque(Nm)** | | 115 | 115 | 172 | 172 | 192 | 195 | 275 | 275 |
| **Screws** | **Quantity** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | **Size (BSW)** | $^1/_2$" | $^1/_2$" | $^5/_8$" | $^5/_8$" | $^3/_4$" | $^3/_4$" | $^7/_8$" | $^7/_8$" |

Table 9.5.6-1 Taper Lock® screw torque loading

h) repeat the hammering and tightening a further once or twice to achieve maximum grip on the shaft;

i) after the drive has run under load for a short time, stop the pump and check the screws for tightness;

j) fill the empty holes with grease to exclude dirt and other arisings.

5. Drive belt re-fitting

**CAUTION**

**DO NOT** USE WEDGES, LEVERS ETC. TO FORCE DRIVE BELTS INTO POSITION. THIS PRACTICE WILL RESULT IN INTERNAL DAMAGE TO THE BELTS AND PREMATURE BELT FAILURE.

a) Ensure that the motor support nuts are slackened sufficiently to allow the drive belts to be fitted to the pulleys by hand and fit the drive belts;

b) tension the drive belts as described in Drive belt tension;

c) ensure that the pulleys are correctly aligned as described in Drive alignment;

d) lock the drive motor in position by tightening the motor support nuts on the *bearing frame side*, and recheck the alignment and tension;

e) fit the upper drive guard to the lower and secure in position with the screws provided.

6. Drive belt tension

The high performance of modern belts, particularly wedge belts, cannot be achieved without correct tensioning. To check for correct tension, refer Figure 9.5.6-2 and Table 9.5.6-2 and proceed as follows:

a) Install the belts to be a snug fit around the pulleys;

b) Spin the pulleys 3-4 revolutions to bed belts into the pulley grooves.

c) Multiply the distance between the motor and pump pulley centres (in metres) by 16. This gives the deflection distance in millimetres.

d) For belts already in service, the belt tension is correct when on applying the appropriate 'basic' setting force at right angles to one belt at the centre of the span, the belt deflects by the previously calculated distance.

NOTE: FOR SINGLE BELT DRIVES PLACE A STRAIGHT EDGE ACROSS THE TWO PULLEYS TO ACT AS A DATUM FOR MEASURING THE AMOUNT OF DEFLECTION. TO CHECK TENSION IN BANDED BELTS, USE A BAR ACROSS THE BAND WIDTH TO ENSURE EVEN DISTRIBUTION OF THE FORCE. THEN DIVIDE THE FORCE MEASURED BY THE NUMBER OF BELTS IN THE BAND FOR COMPARISON WITH THE VALUES IN THE TABLE. FOR SHORT CENTRE DISTANCE DRIVES WHERE THE DEFLECTION OF THE BELT IS TOO SMALL TO MEASURE ACCURATELY, DOUBLE BOTH THE DEFLECTION AND THE SETTING FORCE VALUES.

e) If a new belt is being installed, tension it to the '1.25×' setting.

f) Refit the guards and run the drive under load for 15 to 20 minutes.

g) Stop the drive, check the tension as previously described and re-set to the 'basic' value, if necessary.

NOTE: COGGED RAW EDGED BELTS SHOULD BE RESET TO '1.25× 'SETTING

h) There should be no need for further attention during the life of the belts.

When comparing forces with the force range given in Table 9.5.6-2, if the measured force falls within the given range, the tension should be satisfactory. A lower measured force indicates under-tensioning while a higher measured force indicates over-tensioning. Under-tensioning can give rise to belt slip, together with resultant excessive belt wear and power loss. Over-tensioning will cause excessive wear to the bearings.

**WARNING**

**ALWAYS** REPLACE THE DRIVE GUARD BEFORE RUNNING THE PUMP.

| BELT SECTION | SMALL PULLEY DIAMETER (mm) | FORCE REQUIRED TO DEFLECT BELT 16mm PER METRE OF SPAN | |
|---|---|---|---|
| | | BASIC SETTING (N) | '1.25×' SETTING (N) |
| **SPZ** | 56 to 71 | 16 | 20 |
| | 75 to 90 | 18 | 22 |
| | 95 to 125 | 20 | 25 |
| | over 125 | 22 | 28 |
| **SPA** | 80 to 100 | 22 | 28 |
| | 106 to 140 | 30 | 38 |
| | 150 to 200 | 36 | 45 |
| | over 200 | 40 | 50 |
| **SPB** | 112 to 160 | 40 | 50 |
| | 170 to 224 | 50 | 62 |
| | 236 to 355 | 62 | 77 |
| | over 355 | 65 | 81 |
| **SPC** | 224 to 250 | 70 | 87 |
| | 265 to 355 | 92 | 115 |
| | over 375 | 115 | 144 |
| **8V** | 335 & above | 150 | 190 |
| **Z** | 56 to 100 | 5 to 7.5 | — |
| **A (& HA banded)** | 80 to 140 | 10 to 15 | — |
| **B** | 125 to 200 | 20 to 30 | — |
| **C** | 200 to 400 | 40 to 60 | — |
| **D** | 355 to 600 | 70 to 105 | — |

Table 9.5.6-2 Belt tension forces

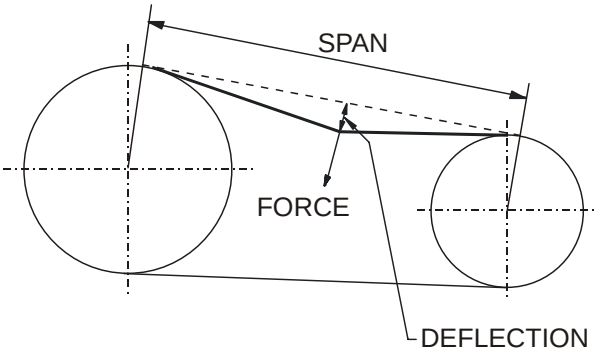



Figure 9.5.6-2 Drive belt tension diagram

7. Trouble shooting

   a) Small cracks on V-belt side and base
   This is generally caused by shortage of belt tension but excessive heat and/or chemical fumes can also give same failure.

   b) V-belt swelling or softening
   This is caused by excessive contamination by oil, certain cutting fluids or rubber solvent.

   c) Whipping during running
   This is usually caused by incorrect tensioning, principally on long centre drives. If a slightly higher (or lower) tension does not cure the problem there may be a critical vibration frequency in the system which requires re-design or use of banded belts.

8. Drive alignment

It is important that drive belts are correctly aligned. Belt misalignment results in increased noise, increased power absorption and reduced belt life. Figure 9.5.6-3 shows examples of parallel and angular misalignment.

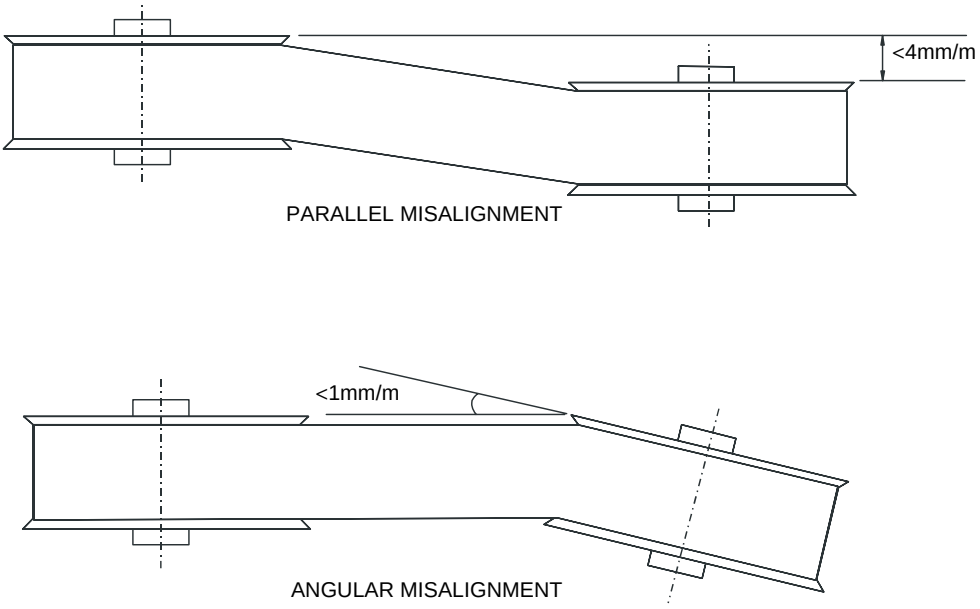



Figure 9.5.6-3 Drive belt misalignment

The motor and pump pulleys are fitted to their shafts with Taper Lock® bushes. This method allows the pulleys to be fitted at any position on the shaft, subject to certain constraints (length of shaft keyway etc.). However, to reduce bearing loading, it is important that each pulley is fitted close to the motor body/bearing frame.

The maximum permitted misalignment for the pump is ±4mm/m run parallel misalignment and ±1° angular misalignment. Details of alignment procedures are given in section (drive assembly - fitting).

**CAUTIONS**

V-BELTS FROM DIFFERENT MANUFACTURERS MUST NOT BE MIXED ON THE SAME DRIVE. THE SLIGHT DIFFERENCES IN CROSS SECTION AND INTERNAL DESIGN WILL SERIOUSLY AFFECT RUNNING LIFE. FOR THE SAME REASON, NEW AND USED V-BELTS SHOULD NOT BE USED ON THE SAME DRIVE. WHEN REPLACING BELTS, ALWAYS REPLACE THE ENTIRE SET TOGETHER.

TO PREVENT ABRASION AND DETERIORATION, THE BELT SYSTEM MUST BE KEPT CLEAN AND FREE FROM EXCESSIVE HEAT, OIL, GREASE AND CHEMICAL FUMES. IF THIS IS NOT POSSIBLE THEN SPECIAL BELTS SHOULD BE SPECIFIED.

## 9.6 Fault finding

### 9.6.1 General

Use the checklist provided to quickly establish the cause of any running problems. The checklist assumes that the equipment normally operates satisfactorily.

**WARNING**

WHERE POSSIBLE CHECKS MUST BE CARRIED OUT WITH THE POWER SUPPLY SECURELY ISOLATED. WHERE POWER IS REQUIRED FOR CARRYING OUT THE CHECKS, TAKE EVERY PRECAUTION PRESCRIBED IN ORDER TO AVOID INJURY TO PERSONNEL. ELECTRICAL WORK MUST ONLY BE CARRIED OUT BY A FULLY QUALIFIED ELECTRICIAN.

A multimeter, a test lamp and appropriate circuit diagrams will be required to carry out checks on electrical equipment.

**NOTE**: IF ALL FAILS, CONTACT METSO MINERALS FOR FURTHER ADVICE.

### 9.6.2 Pump fails to start

Is power supply live ?

Yes

⇓

⇓

⇓

⇓

⇓

No⇒ Check that:

- mains switch is closed;
- starter and its fuses are intact;
- control voltage is available for starting;
- overload protection has been reset;
- all phases are live;
- power cable to motor is not damaged.

Can pump be started manually ?

Yes

⇓

⇓

⇓

No⇒ Is there a fault with:

- level control equipment ?
- other monitoring or control equipment ?

Consult monitoring equipment documentation and change any faulty equipment.

Is the shaft jammed ?

Yes⇒ Securely isolate the power supply.

No

⇓

⇓

⇓

⇓

⇓

⇓

- Remove the belt guard and try to rotate the pump shaft by hand.
- Dismantle the pump and clean behind the impeller. See section 9.5.2. Flush out the pump and the pump sump.
- Dismantle the drive and check that both the motor and pump shaft can be rotated. Fit new bearings if necessary. See section 9.5 and the motor manufacturer's instructions.

### 9.6.3 The pump starts but the motor protection trips

Has flow path or pipe run been modified ?

Yes⇒

- Alter the flow path or pipe run, or adjust the rating of the drive motor and pump to suit new operating conditions.

No

⇓

⇓

Is motor protection setting too low ?

Yes⇒

- Check against the motor rating plate and adjust as necessary

No

⇓

⇓

Is shaft jammed or hard to turn?

Yes⇒

- Securely isolate the power supply.
- Remove the belt guard and try to rotate the pump shaft by hand.
- Dismantle the pump and clean behind the impeller. See section 9.5.2. Flush out the pump and the pump sump
- Dismantle the drive and check that both the motor and pump shaft can be rotated. Fit new bearings if necessary. See section 9.5 and the motor manufacturer's instructions.
- Check that pump clearances are correct. See section 9.5.1.

No

⇓

⇓

⇓

⇓

⇓

⇓

⇓

⇓

### 9.6.4 The pump is running but the flow rate is too low or nil

Has operating conditions or pipe run been modified ?

Yes⇒

- Alter the operating conditions, the pipe run, or adjust the rating of the drive, motor and pump to suit new operating conditions.

No

⇓

⇓

Has leakage been detected in plant ?

Yes⇒

- Renew or seal the leaking parts.

No

⇓

⇓

### 9.6.5 The pump runs unevenly or vibrates

Is the inlet flow uneven or is the pump drawing air ?

Yes⇒

- Either adjust the feed to the pump, or adjust the rating of the drive, motor and pump to suit the operating conditions.

No
⇓
⇓

Are all valves open and are the pipes clear ?

No⇒

- Remedy the fault.

Yes
⇓
⇓

Is the impeller clogged ?

Yes⇒

- Clean the impeller -see Dismantling and Assembly, section 9.5.

No
⇓
⇓

### 9.6.6 Abnormal leakage from the shaft gland

See Shaft Seal Removal and Fitting, section 9.5.3.

# 10 SPARE PARTS

## 10.1 Recommended stock of spares

To reduce the length of time a pump is out of service, it is advisable to always keep in stock a set of the recommended spare parts listed in this section. Please refer to the table below for part item number references.

| Item | Part Reference |
|---|---|
| Case (complete volute) | W1 |
| Impeller | W3 |
| Back-liner | W4 (+ W6) |
| Back-liner seal (O-ring) | W6 |
| Metso Minerals mechanical seal | G31 |
| Metso Minerals mech. seal repair kit | S1 (+ S2) |
| Metso Minerals mech. seal O-ring kit | S2 |
| Bearing cylinder assembly | B99 |
| Set of seals – Bearing (B16, B19.1, B19.2, B22.1, B22.2) | B98 |

| BEARING CYLINDER END-COVER SHIM PACK * | | |
|---|---|---|
| **Qty/pack** | **Shim thickness (mm)** | **Colour** |
| 2 | 0.05 | Dark blue |
| 2 | 0.075 | Green |
| 2 | 0.10 | Orange |
| 1 | 0.20 | Light blue |
| 1 | 0.25 | White |
| 1 | 0.375 | Red |
| 1 | 0.625 | Grey |
| **Shim material:** | | |
| up to & including 0.375 mm thick : | Polyester | |
| 0.625 mm thick : | Polypropylene | |

*** NOTE:** NOT APPLICABLE TO PUMPS WITH '**METRIC**' BEARING CYLINDERS

## 10.2 Storage of spares

See section 1.2.5.

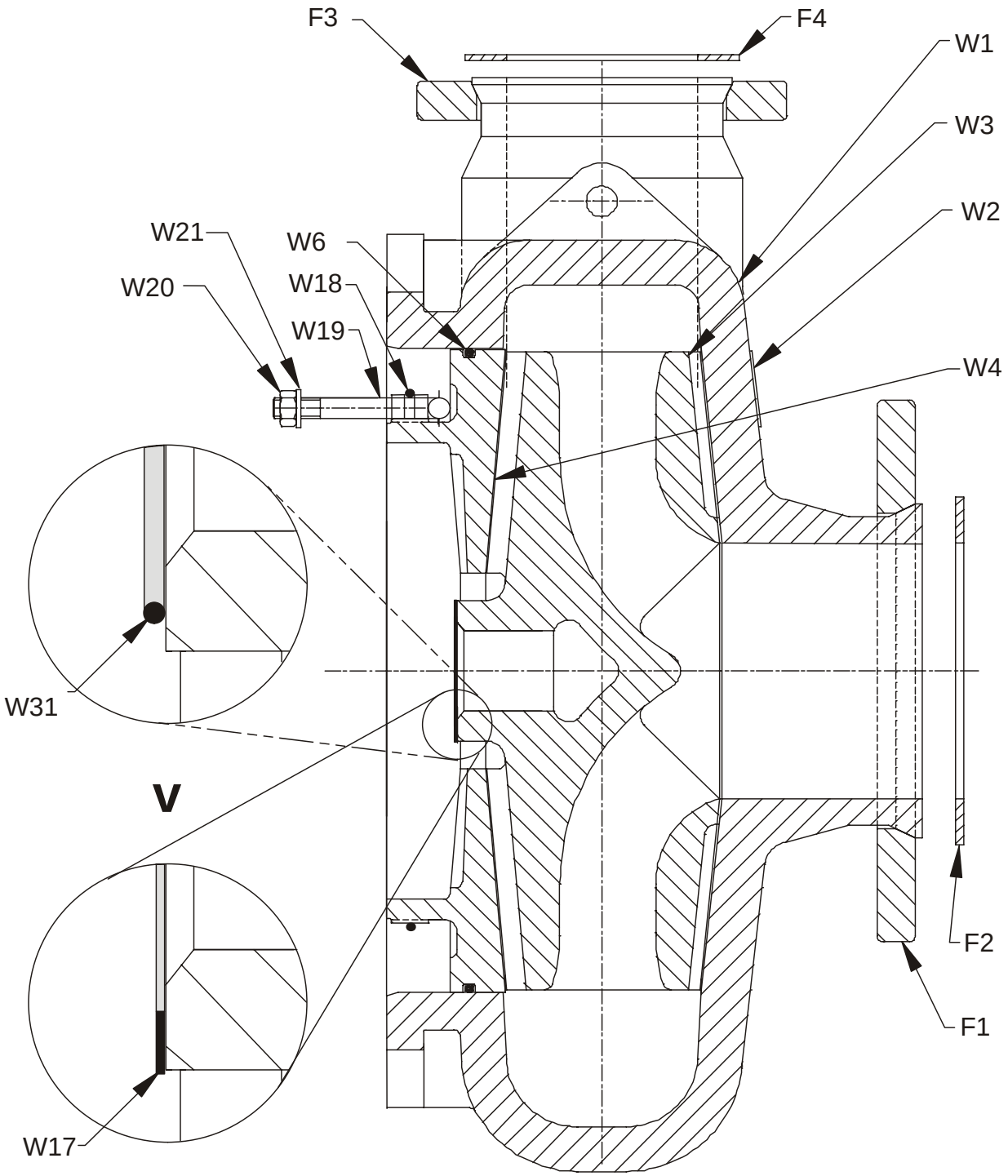
## 10.3 Spares ordering procedure

To assist our Spares Department process your order quickly, customers are requested to provide the following information when ordering spares:

- Model and Size of pump
- Serial Number
- Build Number
- Approximate date of purchase
- Part Number and Description of Required Spare Parts

This information should then be forwarded to the local Metso Minerals branch for action - - see sub-section 1.4.

## 10.4 Spare part drawing


F3
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W19
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W31
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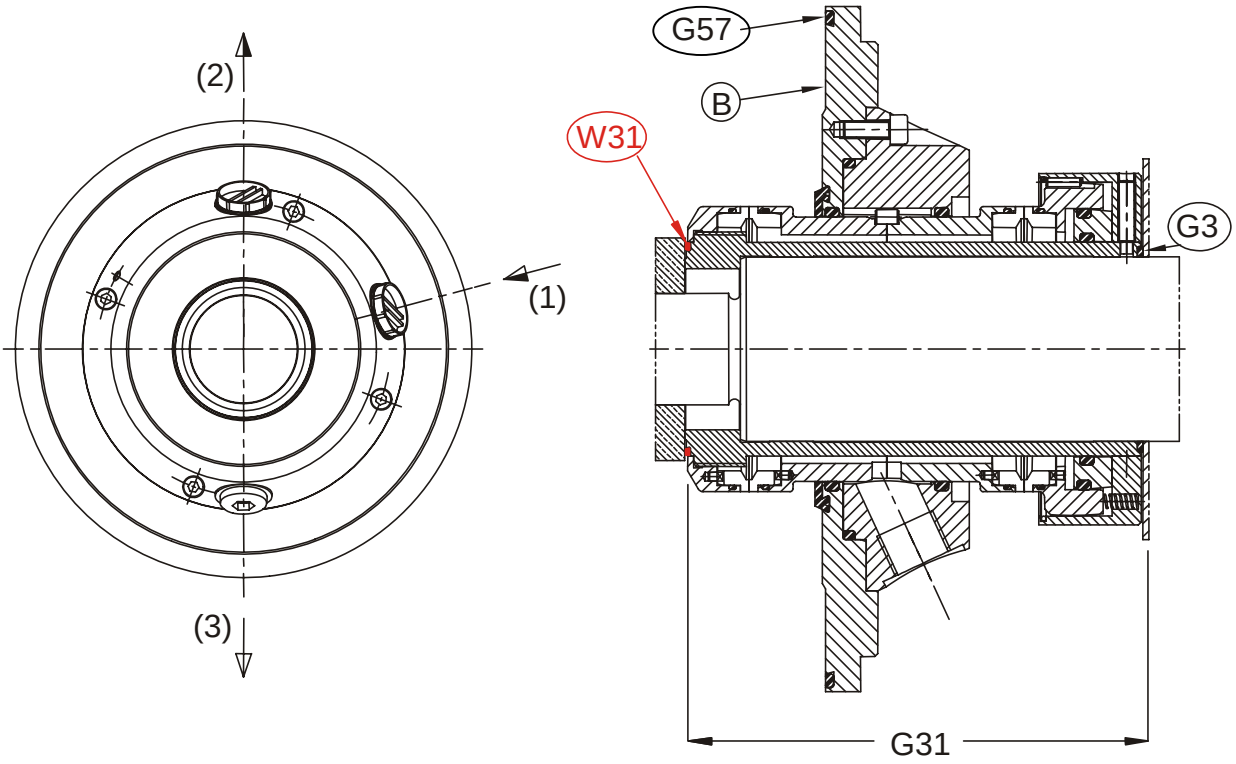
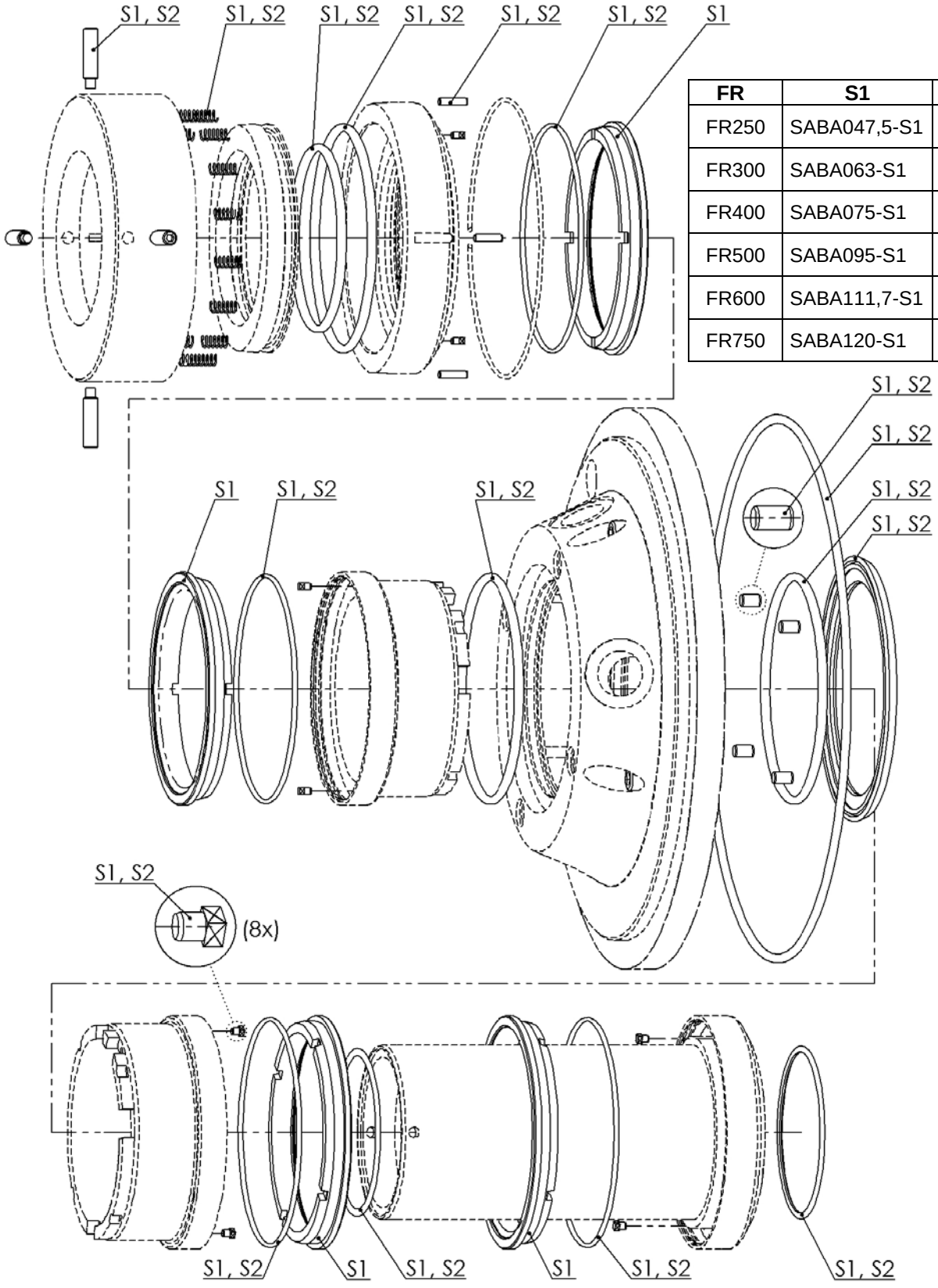
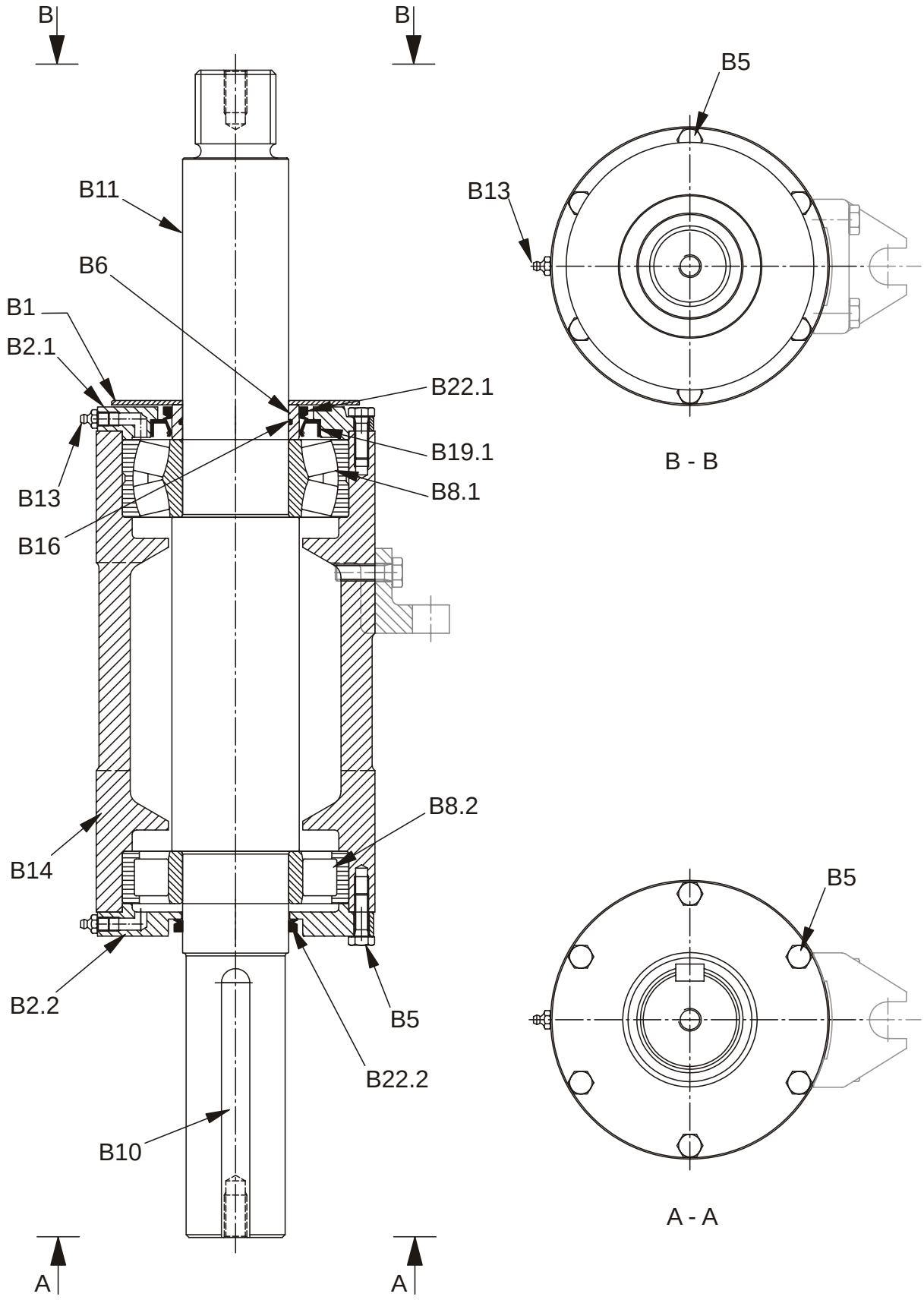



| FR | G57 | W31 | G3 |
|---|---|---|---|
| FR250 | SA982048 | SA986258 | SA986264 |
| FR300 | SA983074 | SA986259 | SA986265 |
| FR400 | SA986254 | SA986260 | SA986266 |
| FR500 | SA986255 | SA986261 | SA986267 |
| FR600 | SA986256 | SA986262 | SA986268 |
| FR750 | SA986257 | SA986263 | SA986269 |




| FR | S1 | S2 |
|---|---|---|
| FR250 | SABA047,5-S1 | SABA047,5-S2 |
| FR300 | SABA063-S1 | SABA063-S2 |
| FR400 | SABA075-S1 | SABA075-S2 |
| FR500 | SABA095-S1 | SABA095-S2 |
| FR600 | SABA111,7-S1 | SABA111,7-S2 |
| FR750 | SABA120-S1 | SABA120-S2 |


B
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B2.1
B22.1
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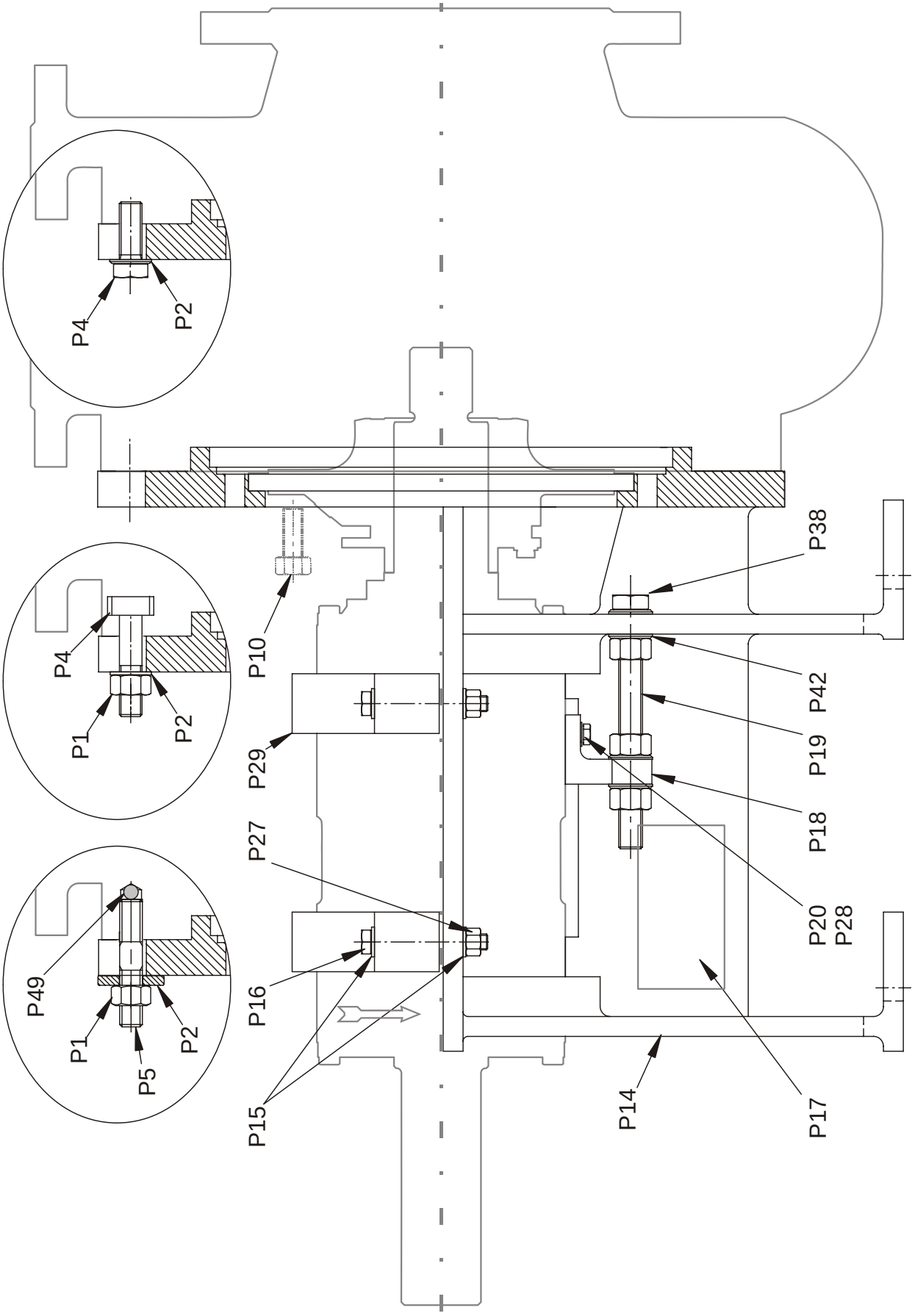
P4
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P4
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P19
P18
P20
P28
P14
P17

| Item | Part No. | Description | Qty | Unit weight Kg |
|---|---|---|---|---|
| | | **Wear parts** | | |
| W01 | PDCH2034 | Case | 1 | 0.00 |
| W03 | PDCH2019 | Impeller | 1 | 0.00 |
| W04 | PDCH2021 | Back-liner | 1 | 0.00 |
| W06 | SA981239 | O-ring (incl. in w04) | 1 | 0.00 |
| | | **Shaft seal** | | |
| G31 | SABA095 | Mechanical seal | 1 | 0.00 |
| | | **Bearing assembly parts** | | |
| B02.1 | SA502077-1 | End cover | 1 | 0.00 |
| B02.2 | SA500724-1 | End cover | 1 | 0.00 |
| B06 | SA501278-1 | Shaft spacer | 1 | 0.00 |
| B08.1 | SA982780 | Bearing | 1 | 0.00 |
| B08.2 | SA982781 | Bearing | 1 | 0.00 |
| B10 | SA899022-215 | Key | 1 | 0.00 |
| B11 | SA500726-1 | Shaft | 1 | 0.00 |
| B14 | SA502078-1 | Bearing cylinder housing | 1 | 0.00 |
| B22.2 | SA950545 | V-ring | 1 | 0.00 |
| B99 | PDWB065-S | Bearing /shaft assembly | 1 | 0.00 |
| | | **Spare parts** | | |
| P04 | SA507094-S7 | Case bolt | 8 | 0.00 |
| P18 | SA500729-1 | Saddle | 1 | 0.00 |
| W19 | SA501475-3 | Back liner bolt | 4 | 0.00 |

## 10.6 Toolkit

### 10.6.1 Standard tools

In addition to the special tools detailed in sub-section 9.3 and Table 10.6-2, and installation tools and equipment detailed in sub-section 6.3, Table 10.6-1 lists a basic toolkit for performing normal maintenance operations on the pump. A dial test indicator may also be required to set bearing clearances – verify by reference to section 9.5.5. Additional tools may also be listed in the motor installation and maintenance documentation. Refer to Reference Publications, sub-section 11.2.

Table 10.6-1 Toolkit

| Item | Qty. | Type | Sizes | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **HM50 - HM75** | **HM100** | **HM150** | **HM200** | **HM250** | **HM300** |
| 1 | 1 | Spanner AF (mm) | 17,24 | 17, 24 | 19, 30 | 19, 24, 36 | 24, 30, 46 | 24, 30, 55 |
| 2 | 1 | Socket AF (mm) | 17,24 | 17, 24 | 19, 30 | 19, 24, 36 | 24, 30, 46 | 24, 30, 55 |
| 3 | 1 | Torque wrench (Nm range) | 10 - 300 | | — 800 | | — 2500 | |
| 4 | 1 | Adjustable spanner (mm) | 25 | | 40 | | | |

### 10.6.2 Special tools

Table 10.6-2 Special tools

| Item | Size | Part No. | | | |
|---|---|---|---|---|---|
| | | Crank | Packing extractor | Back-liner lifter | Shaft extension |
| 1 | **HM50, HM75** | SA500244-M1 | 981865 | N/A | N/A |
| 2 | **HM100** | SA219594-M1 | | | |
| 3 | **HM150** | SA219595-M1 | | | |
| 4 | **HM200** | SA219596-M1 | 981607 | | SA501470-M1 |
| 5 | **HM250** | SA219598-M1 | | | SA501471-M1 |
| 6 | **HM300** | SA219598-M1 | | | SA501472-M1 |

# 11 APPENDICES

## 11.1 Torque table

The following table gives the recommended torque values for tightening bolts and screws.

NOTE: ALL TORQUE VALUE TOLERANCES ARE ±5%.

| *(Single Adjustment Pumps)* **ITEM** | **TORQUE VALUES (Nm)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **HM50** | **HM75** | **HM100** | **HM150** | **HM200** | **HM250** | **HM300** |
| Case fixings (B) | (M16) 197 | (M16) 197 | (M16) 197 | (M20) 385 | (M24) 665 | (M30) 1310 | (M36) 2280 |
| End-cover bolt (B5) | (M8) 24 | (M8) 24 | (M8) 24 | (M12) 81 | (M12) 81 | (M16)197 | (M20) 385 |
| Outlet flange half-clamp bolts NP16 (F3) | (M8) 24 | (M10) 47 | (M12) 81 | (M16) 197 | (M16) 197 | (M16) 197 | (M16) 197 |
| Inlet flange half-clamp bolts NP16 (F1) | (M8) 24 | (M12) 81 | (M16) 197 | (M16) 197 | (M16) 197 | (M16) 197 | (M16) 197 |
| Housing clamp screws (P16) | (M16) 115 | (M16) 115 | (M16) 115 | (M20) 175 | (M16) 115 | (M20) 175 | (M20) 175 |
| Back-liner bolts (W19) | (M10) 47 | (M10) 47 | (M10) 47 | (M12) 81 | (M16) 197 | (M20) 385 | (M20) 385 |

## 11.2 Reference publications

WEG - Motor

Motors | Automation | Energy | Transmission & Distribution | Coatings

# Low and high voltage electric motors
**Instructions manual for installation, operation and maintenance of electric motors**

# Motores elétricos de baixa e alta tensão
**Manual de instalação, operação e manutenção de motores elétricos**

# Motores Eléctricos de baja y alta tensión
**Manual de instalación, operación y mantenimiento de motores eléctricos**

# Nieder- und Hochspannungsmotoren
**Installations-, betriebs- und wartungsanleitung für asynchronmotoren**

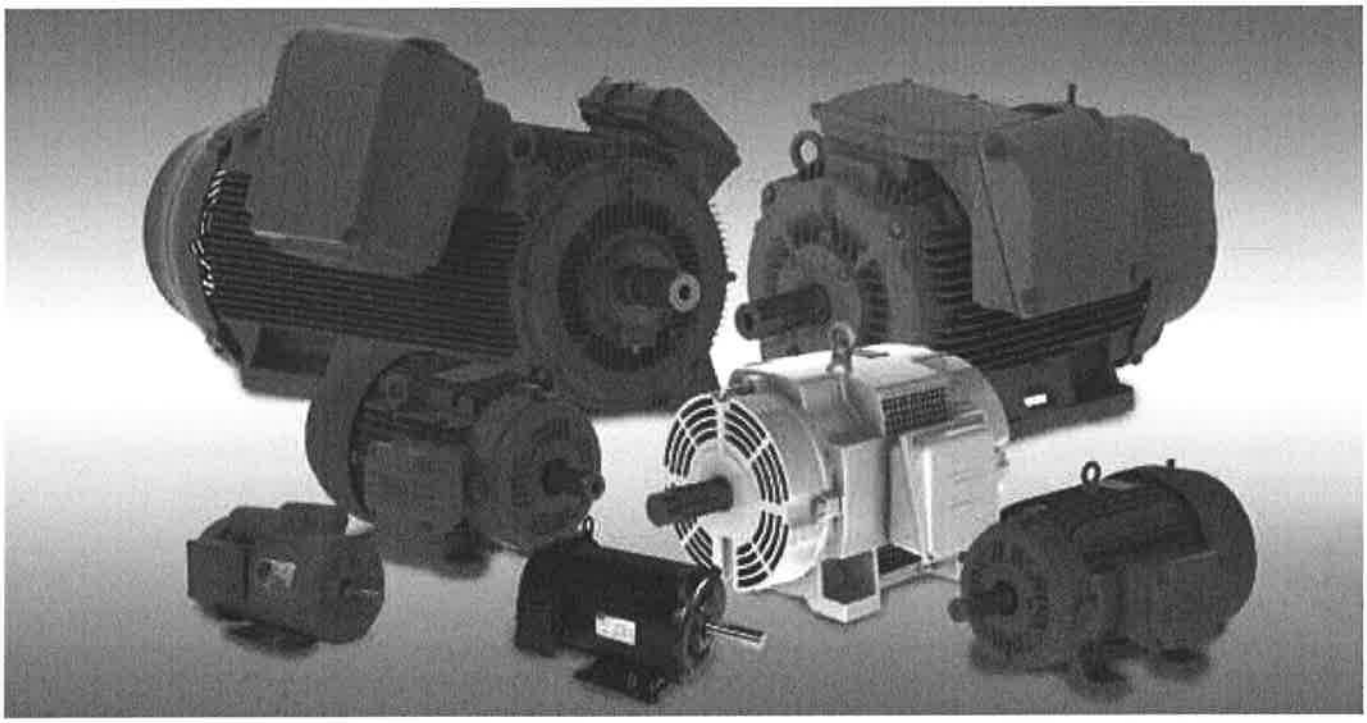
# Moteurs électriques à basse et haute tension
**Consignes de sécurité pour l'installation, l'utilisation et la maintenance de moteurs électriques**

# Электродвигатели двигателей низкого и высокого напряжения
Инструкции по установке, эксплуатации и техническом обслуживании электромоторов

# Elektrische motoren van lage en hoge spanning
**Veiligheidsinstructies voor installatie, bediening en onderhoud van elektrische motoren**

# Motori elettrici di bassa e alta tensione
**Manuale di installazione, gestione e manutenzione di motori elettrici**

# 低壓及高壓電動機
电动机安装、操作及维修安全手册



# ENGLISH

## TABLE OF CONTENTS

# 1. FOREWORD

**The installation, operation and maintenance of the motor must be always performed by qualified personnel using proper tools and methods and following the instructions contained in the documents supplied with the motor.**

The instructions presented in this document are valid for WEG motors with the following characteristics:
- Three-phase and single-phase induction motors (squirrel cage rotor);
- Three-phase permanent magnet motors;
- Three-phase hybrid motors (squirrel cage rotor + permanent magnets);

The objective of this manual is to provide important information, which must be considered during the shipment, storage, installation, operation and maintenance of WEG motors. Therefore, we advise to make a careful and detailed study of the instructions contained herein before performing any procedures on the motor. The noncompliance with the instructions informed in this manual and others mentioned on the website www.weg.net voids the product warranty and may cause serious personal injuries and material damages.

**Electric motors have energized circuits and exposed rotating parts which may cause injuries to people.**

# 2. SHIPMENT, STORAGE AND HANDLING

Check the conditions of the motor immediately upon receipt. When any damage is noticed, this must be reported in writing to the transportation company, and immediately communicated to the insurance company and to WEG. In this case, no installation job can be started before the detected problem has been solved. Check if the nameplate data matches the invoice data and the environmental conditions in which the motor will be installed. If the motor is not immediately installed, it must be stored in a clean and dry room protected against dust, vibrations, gases and corrosive agents, and with relative humidity not exceeding 60%.
In order to prevent water condensation within the motor during the storage period, it is recommended to keep the space heater ON (where provided). In order to prevent oxidation of the bearings and ensure an even distribution of the lubricant, rotate the motor shaft at least once a month (at least five turns), always leaving it in a different position. For bearings with oil mist lubrication systems, the motor must be stored horizontally, independently from the mounting configuration, with ISO VG 68 oil in the bearing, (the amount is indicated in the motor manual available on the website www.weg.net) and the shaft must be turned weekly. If the motors are stored for more than two years, it is recommended to change the bearings, or to remove, wash, inspect and relubricate them before the motor is started. After this storage period, it is also recommended to change the start capacitors of single-phase motors since they loss their operating characteristics.

**Handle the motor always carefully in order to prevent impacts and damages to the bearings and always install the shaft transportation/locking device (if supplied) when transporting the motor. Use only the eyebolts to lift the motor. However these eyebolts are designed for the motor weight only. Thus never use these eyebolts to lift the motor with additional loads coupled to it. The lifting eyebolts of the terminal box, fan cover, etc., are intended to handle only these parts when disassembled from the motor. Additional information regarding the maximum allowable angle-of-inclination is indicated in the general manual available on the website www.weg.net.**

Periodically and mainly before the initial star-up, measure the insulation resistance of the motor winding. Check the recommended values and the measuring procedures in the website.

# 3. INSTALLATION

**During the installation, the motors must be protected against accidental energization. Check the motor direction of rotation, turning it without load before it is coupled to the load.**

Motors must be only installed in places compatible with their mounting features and in applications and environments for which they are intended.
Those motors with feet must be installed on bases duly planned in order to prevent vibrations and assure

perfect alignment. The motor shaft must be properly aligned with the shaft of the driven machine. Incorrect alignment, as well as improper belt tension, will certainly damage the bearings, resulting in excessive vibrations and even causing the shaft to rupture. The admissible shaft radial and axial loads indicated in the general manual of the website must be respected. Use flexible coupling whenever possible.
When motors are fitted with oil lubricated bearings or oil mist lubrication systems, connect the cooling and lubrication tubes (where provided). Only remove the corrosion protection grease from the shaft end and flange immediately before the motor installation.
Unless specified otherwise in the purchase order, WEG motors are dynamically balanced with "half key" and without load (uncoupled). The driving elements, such as pulleys, couplings, etc., must be balanced with "half key" before they are mounted on the shaft of the motors.
Observe the correct assembly position of the drains as indicated in the manual on the website www.weg.net.

**Do not cover and block the motor ventilation openings. Ensure a minimum clearance of ¼ (25%) of the diameter of the air intake of the fan cover from the walls. The air used for cooling the motor must be at ambient temperature, limited to the temperature indicated on the motor nameplate.**

**Motors installed outdoors or in the vertical position require the use of additional shelter to protect them from water; for instance, use of a drip cover.**

**To prevent accidents, ensure that the grounding connection has been performed according to the applicable standards and that the shaft key has been securely fastened before the motor is started.**

**Connect the motor properly to the power supply by means of safe and permanent contacts, always considering the data informed on the nameplate, such as rated voltage, wiring diagram, etc.**

For power cables, switching and protection devices dimensioning, consider the rated motor current, the service factor, and the cable length, among others. For motors without terminal block, insulate the motor terminal cables by using insulating materials that are compatible with the insulation class informed on the nameplate. The minimum insulation distance between the non-insulated live parts themselves and between live parts and the grounding must be: 5.5 mm for rated voltage up to 690 V; 8 mm for voltages up to 1.1 kV; 45 mm for voltages up to 6.9 kV; 70 mm for voltages up to 11 kV and 105 mm for voltages up to 16.5 kV.

**In order to assure the degree of protection, unused cable inlet holes in the terminal box must be properly closed with branking plugs having and equal or higher degree of protection to that indicated on the motor nameplate.**

The motor must be installed with overload protection devices. When motor is fitted with temperature-monitoring devices, they must be connected during the operation and even during tests.
Ensure the correct operation of the accessories (brake, encoder, thermal protection, forced ventilation, etc.) installed on the motor before it is started.

**Motors fitted with Automatic Thermal Protectors will reset automatically as soon as the motor cools down. Thus, do not use motors with Automatic Thermal Protection in applications where the auto-reseting of this device may cause injuries to people or damage to equipment. Motors fitted with Manual Thermal Protectors require manual reset after they trip. If the Automatic Thermal Protector or the Manual Thermal Protector trip, disconnect the motor from the power supply and investigate the cause of the thermal protector tripping. Wmagnet motors must be driven by WEG variable frequency drives only.**

For more information about the use of variable frequency drives, follow the instructions in the motor manual on the website www.weg.net and in the manual of the variable frequency drive.

## 4. OPERATION

**During operation, do not touch the non-insulated energized parts and never touch or stay too close to rotating parts.**

**Ensure that the space heater is always OFF during the motor operation.**

The rated performance values and the operating conditions are specified on the motor nameplate. The voltage and frequency variations of the power supply should never exceed the limits established in the applicable standards.
Occasional different behavior during the normal operation (actuation of thermal protections, noise level, vibration level, temperature and current increase) must always be assessed by qualified personnel. In case of doubt, turn off the motor immediately and contact the nearest WEG service center.
Do not use roller bearings for direct coupling. Motors fitted with roller bearings require radial load to ensure their proper operation.
For motors fitted with oil lubrication or oil mist systems, the cooling system must be ON even after the machine is OFF and until the machine is at complete standstill.
After complete standstill, the cooling and lubrication systems (if any exist) must be switched OFF and the space heaters must be switched ON.

## 5. MAINTENANCE

**Before any service is performed, ensure that motor is it at standstill, disconnected from the power supply and protected against accidental energization. Even when the motor is stopped, dangerous voltages may be present in space heater terminals.**
**If motors are fitted with capacitors, discharge them before any handling or service is performed.**

**Motor disassembly during the warranty period must be performed by a WEG authorized service center only.**

**For motors with permanent magnet rotor (lines WQuattro and Wmagnet), the motor assembly and disassembly require the use of proper devices due to the attracting or repelling forces that occur between metallic parts. This work must only be performed by a WEG Authorized service center specifically trained for such an operation. People with pacemakers cannot handle these motors. The permanent magnets can also cause disturbances or damages to other electric equipment and components during maintenance.**

Regularly inspect the operation of the motor, according to its application, and ensure a free air flow. Inspect the seals, the fastening bolts, the bearings, the vibration and noise levels, the drain operation, etc.

## 6. ADDITIONAL INFORMATION

For further information about shipment, storage, handling, installation, operation and maintenance of electric motors, access the website www.weg.net.
For special applications and operating conditions (for example, smoke extraction motors, totally enclosed air over (TEAO), motors for high thrust applications, motors with brake) refer to the applicable manual on the website www.weg.net or contact WEG.
When contacting WEG, please, have the full description of the motor at hand, as well as the serial number and manufacturing date, indicated on the motor nameplate.

# EC DECLARATION OF CONFORMITY

**WEG Equipamentos Elétricos S/A**
Av. Prefeito Waldemar Grubba, 3000
89256-900 - Jaraguá do Sul – SC – Brazil,

and its authorised representative established in the European Community,
**WEGeuro – Industria Electrica SA**
Rua Eng Frederico Ulrich, Apartado 6074
4476-908 – Maia – Porto – Portugal

hereby declare that the products:

WEG induction motors and components for using in these motors:

Three-phase
**IEC frames 63 to 630**
**Nema frames 42, 48, 56 and 143 to 9610**

.....

Single-phase
**IEC frames 63 to 132**
**Nema frames 42, 48, 56 and 143 to 215**

.....

when installed, maintained and used in applications for which they were designed, and in compliance with the relevant installation standards and manufacturer's instructions, comply with the requirements of the following European Directives and standards where applicable:

Directives:
**Low Voltage Directive 2006/95/EC**
**Regulation (CE) Nº 640/2009**
**Directive 2009/125/EC**
**EMC Directive 2004/108/EC** (induction motors are considered inherently benign in terms of electromagnetic compatibility)

Standards:
**EN 60034-1/2-1/5/6/7/8/9/11/12/14/30 and 60204-1**

From 29/12/2009 on low voltage electric motors are no longer considered under the scope of the current **Machinery Directive 2006/42/EC.**

CE marking in: **1996**

Milton Oscar Castella
*Engineering Director*

Jaraguá do Sul, May 30th, 2011

## WARRANTY TERM

WEG Equipamentos Elétricos S/A, Motor Unit, offers warranty against defects in workmanship and materials for their products for a period of 18 months from the invoice issue date by factory or distributor / dealer, limited to 24 months from date of manufacture. Motors of the HGF Line are covered for a period of 12 months from the invoice issue date by the factory or distributor / dealer, limited to 18 months from the date of manufacture.

The paragraph above contains the legal warranty periods. If a warranty period is defined in a different way in the commercial, technical proposal of a particular sale, that will override the time limits set out above.

The periods above are independent of installation date and provided that the following requirements are met: proper transportation, handling and storage; correct installation in specified environmental conditions free of aggressive agents; operation within the capacity limits and observation of the Installation, Operation and Maintenance Manual; execution of regular preventive maintenance; execution of repairs and/or changes only by personnel with WEG's written authorization; in the occurrence of an anomaly, the product must be available to the supplier for the minimum period necessary to identify the cause of the anomaly and to repair it properly; the buyer must immediately notify WEG of any defects occurred and they must be later confirmed as manufacturing defects by WEG. The warranty does not include assembly and disassembly services at the buyer's premises, costs of product transportation, as well as travel, lodging and meals expenses for the technical assistance staff when requested by the customer. The warranty service will be provided exclusively at a WEG authorized Technical Assistance or at the plant.

Components, parts and materials whose useful life is usually less than 12 (twelve) months are not covered by the warranty.

Under no circumstance will warranty services extend the warranty period of the equipment. However, new warranty equivalent to the original one will be due only to the components repaired or replaced by WEG.

The present warranty is limited to the product supplied. WEG will not be liable for damages to people, third parties, other equipment and facilities, loss of profits or other incidental or consequential damages.

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50031142 | Rev.01 | Data (m/a): 12/2011- Sujeito a alterações sem aviso prévio.
As informações contidas são valores de referência.

## 11.3 Weights table

| Item | Description | Weight (kg) |
|---|---|---|
| - | Bare shaft pump | 1005 |
| W1 | Case | 318 |
| W3 | Impeller | 123 |
| W4 | Backliner | 52 |
| P14 | Frame | 278 |
| B99 | Bearing cylinder assembly | 162 |
| - | Shaft seal assembly | 41 |
| - | Back pull-out assembly | 660 |