Project Information

No Project Information required.

Please refer to the Table of Contents to find other sections in the manual.

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</tr>
<tr>
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<td>Tag Number</td>
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<tr>
<td>Revision</td>
<td>Description</td>
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<td>-----------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Revision 0</td>
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1 Introduction

The Installation, Operation and Maintenance manual (IOM) included in the shipment MUST be read thoroughly before installing or operating the pump. All instructions regarding maintenance MUST be retained for reference.

Warman® centrifugal slurry pumps are one of the world’s most comprehensive range of centrifugal slurry pumps for use in mining, chemical and industrial applications.

A wide variety of impellers and shaft seals used in MU pumps provide a perfect fit for multiple applications.

1.1 Scope of the Manual

This manual describes the installation, operation, and maintenance of Weir MU pumps. The manual MUST be used as a reference in conjunction with the Weir Minerals product-specific training.

1.2 Intended Audience

This manual is intended for:

- Weir Minerals service personnel.
- Personnel who have at least a basic level of trade/professional competency.

1.3 Disclaimer

Please contact your local Weir Minerals representative for any assistance.

- This manual provides basic information about the product. The product purchased may contain equipment variations to this manual.
- Operating conditions specified in the manual may vary to the operating conditions of the product installed on-site.
- Illustrations shown in the manual are for reference only and may not match the specific product.

WARNING

PERSONNEL INJURY
The pump must be installed, operated, and maintained only by personnel who are trained and have sufficient knowledge about the hazards that may occur during pump operation.
1.4 Overview of the IOM manual

Table 1-1 describes the organisation of the manual.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
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<tbody>
<tr>
<td>Introduction</td>
<td>Contains an introduction to the Weir MU pumps and the scope of the manual.</td>
</tr>
<tr>
<td>Safety</td>
<td>Lists the safety guidelines that must be adhered to while installing, operating and maintaining the pump.</td>
</tr>
<tr>
<td>Technical Data</td>
<td>Contains the technical aspects of the pump.</td>
</tr>
<tr>
<td>Description</td>
<td>Describes the working principle and different components of the pump.</td>
</tr>
<tr>
<td>Transport and Storage</td>
<td>Provides information on safety guidelines and procedures to follow while delivering the pump to a customer location, bringing the pump to workshop for maintenance, and storing the pump.</td>
</tr>
<tr>
<td>Installation</td>
<td>Lists the procedures to install the pump.</td>
</tr>
<tr>
<td>Commissioning</td>
<td>Provides information on initial checks and settings to be done, before putting the pump into operation.</td>
</tr>
<tr>
<td>Operation</td>
<td>Contains the information on pump pre-start up procedures, pump start-up, problems that may occur during the pump start-up, and shut-down procedures.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Lists running and overhaul maintenance procedures.</td>
</tr>
<tr>
<td>Lubrication</td>
<td>Contains details about the lubrication requirements, specifications, lubrication checks and service intervals.</td>
</tr>
<tr>
<td>Decommissioning and Disposal</td>
<td>Provides guidelines regarding a pump out of service, and disposing or selling it.</td>
</tr>
<tr>
<td>Troubleshooting</td>
<td>Provides information regarding various problems that may occur during pump operation and respective solutions.</td>
</tr>
<tr>
<td>Assembly</td>
<td>Contains safety guidelines and procedures to be followed while performing pump assembly.</td>
</tr>
<tr>
<td>Disassembly</td>
<td>Contains safety guidelines and procedures to be followed while performing pump disassembly.</td>
</tr>
<tr>
<td>Special Tools</td>
<td>Lists special tools that are required for assembly and disassembly.</td>
</tr>
<tr>
<td>Appendix</td>
<td>Contains additional information such as tie-down instructions, lifting instructions, check lists, and spare parts.</td>
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Table 1-1: Overview of the Manual

1.5 Contact Information

If you need any assistance, please contact your local Weir Minerals representative or visit:

www.weirminerals.com/contacts/worldwide.aspx

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Todmorden Fax.: +44 1706 815 350
Lancashire sales.uk@weirminerals.com
OL14 5RT www.w
United Kingdom
## 1.6 Glossary of Abbreviation

<table>
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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>ATEX</td>
<td>Equipment for Potentially Explosive Atmospheres</td>
</tr>
<tr>
<td>COR</td>
<td>Chain of Responsibility</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic Compatibility</td>
</tr>
<tr>
<td>FGD</td>
<td>Flue Gas Desulphurisation</td>
</tr>
<tr>
<td>GA</td>
<td>General Arrangement</td>
</tr>
<tr>
<td>GSW</td>
<td>Gland Seal Water</td>
</tr>
<tr>
<td>IOM</td>
<td>Installation, Operation &amp; Maintenance</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organisation for Standardisation</td>
</tr>
<tr>
<td>LOTO</td>
<td>Lock Out and Tag Out</td>
</tr>
<tr>
<td>P&amp;I</td>
<td>Piping and Instrumentation</td>
</tr>
<tr>
<td>PED</td>
<td>Pressure Equipment Directive</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>PTFE</td>
<td>Polytetrafluoroethylene</td>
</tr>
<tr>
<td>QBEP</td>
<td>Q (flow rate - m³/hr) Best Efficiency Point</td>
</tr>
<tr>
<td>RTV</td>
<td>Room Temperature Vulcanising</td>
</tr>
<tr>
<td>SDS</td>
<td>Safety Data Sheets</td>
</tr>
<tr>
<td>TDS</td>
<td>Total Dissolved Solids</td>
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Table 1-2: Abbreviations
2 Safety

The instructions in this chapter must be followed for safe and efficient operation.

2.1 Safety Symbols

The safety symbols used in this manual are indicated in Table 2-1.

<table>
<thead>
<tr>
<th>Signal</th>
<th>Warning Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>DANGER</td>
<td>DANGER</td>
<td>Indicates a hazard with a high level of risk which, if not avoided, could result in death or catastrophic equipment damage.</td>
</tr>
<tr>
<td>WARNING</td>
<td>WARNING</td>
<td>Indicates a hazard with a medium level of risk which, if not avoided, could result in serious or moderate injury, or serious equipment damage.</td>
</tr>
<tr>
<td>CAUTION</td>
<td>CAUTION</td>
<td>Indicates a hazard with a low level of risk which, if not avoided, could result in moderate or minor injury, or moderate equipment damage.</td>
</tr>
<tr>
<td>NOTICE</td>
<td>NOTICE</td>
<td>Indicates important information for the user.</td>
</tr>
</tbody>
</table>

Table 2-1: Safety Symbols
2.2 Important Information

2.2.1 Explosion and Pressure Hazards

**DANGER**

PUMP BLOCKAGE CAN CAUSE LETHAL EXPLOSION

- **DANGER**
  - WEIR MINERALS STRONGLY WARNS YOU OF THE POTENTIAL HAZARD CAUSED BY THE CONTINUED OPERATION OF CENTRIFUGAL PUMPS WHEN THE INTAKE AND DISCHARGE ARE BLOCKED!
  - EXTREME HEAT IS GENERATED LEADING TO VAPORISATION OF THE ENTRAPPED LIQUID. THIS CAN RESULT IN A FATALLY LETHAL EXPLOSION IF OPERATION IS CONTINUED!
  - CONTACT YOUR LOCAL WEIR MINERALS REPRESENTATIVE TO PROVIDE METHODS TO ELIMINATE AND/OR MINIMISE THE RISK OF EXPLOSION.

**DANGER**

OVERPRESSURE IN THE PUMP CAN CAUSE LETHAL EXPLOSION

- **DANGER**
  - PUMPS THAT ARE NOT FITTED WITH AN OVER PRESSURE RELIEF DEVICE ARE AT RISK OF GENERATING EXCESSIVE PRESSURES AND TEMPERATURES WHEN RUN WITH RESTRICTED OR NO DISCHARGE FLOW, SUCH AS AGAINST A CLOSED DISCHARGE VALVE.
  - THE SYSTEM DESIGN MUST INCLUDE SUITABLE PRESSURE RELIEF MEASURES AND OPERATION WITH RESTRICTED DISCHARGE FLOW MUST BE LIMITED SUCH THAT THE STATIC PRESSURE LIMIT OF THE PUMP IS NOT EXCEEDED.
  - RUNNING THE PUMP WITH THE DISCHARGE VALVE CLOSED (WHILE NECESSARY AT SHUT-DOWN) PRODUCES HEAT AND PRESSURE BUILD-UP IN THE PUMP.
  - THE TIME BETWEEN CLOSING THE VALVE AND PUMP SHUT-DOWN MUST BE MINIMISED TO REDUCE THE RISK OF EXCEEDING THE PUMPS TEMPERATURE AND PRESSURE LIMITS.
  - SUITABLE PRESSURE RELIEF MUST BE INCLUDED IN THE PIPEWORK.

**DANGER**

PUMP OPERATING AT LOW FLOW (BELOW 25% QBEP - Q (FLOW RATE - M³/HR) BEST EFFICIENCY POINT))

- **DANGER**
  - THIS HAS A NUMBER OF PROBLEMS AND IS NOT GENERALLY RECOMMENDED:
  - IF THE PUMP/SYSTEM IS OPERATING AT NORMAL FLOW AND THEN THROTTLED TO LESS THAN 25% QBEP, THERE IS A POSSIBILITY OF THE PARTICLES SETTLING IN THE INLET AND OUTLET PIPES AND PLUGGING THE FLOW THAT WOULD CAUSE HEAT/VAPORISATION INSIDE THE PUMP WITH SUBSEQUENT EXPLOSION AS ZERO FLOW.
  - DISCHARGE AND SUCTION RECIRCULATION MAY CAUSE VIBRATION AND CAVITATION THAT IMPACTS BEARING LIFE IN A HIGH ENERGY PUMP AT LOW FLOW (BELOW 25% QBEP).
  - THE PUMP ENERGY EFFICIENCY IS POOR AT LOW FLOW (BELOW 25% QBEP) AND HIGHER AXIAL LOADING ON THE IMPELLER MAY IMPACT BEARING AND GLAND OR MECHANICAL SEAL LIFE.
  - THE PUMP HEAD PERFORMANCE CURVE MAY BE UNSTABLE AT LOW FLOW (BELOW 25% QBEP) CAUSING FLOW SURGING AND HUNTING OF THE PUMP OPERATING POINT.
2.2.2 Isolate Electrical, Hydraulic and Mechanical Services

**DANGER**

**ISOLATE ALL PUMP SERVICES - ELECTRICAL, HYDRAULIC, MECHANICAL**

- NEVER CARRY OUT MAINTENANCE WORK WHEN THE UNIT IS CONNECTED TO POWER. THE PUMP MUST BE FULLY ISOLATED BEFORE ANY MAINTENANCE WORK, INSPECTION OR TROUBLESHOOTING INVOLVING WORK ON SECTIONS WHICH ARE POTENTIALLY PRESSURISED (CASING, GLAND, CONNECTED PIPEWORK) OR INVOLVING WORK ON THE MECHANICAL DRIVE SYSTEM (SHAFT, BEARING ASSEMBLY, COUPLING).
- POWER TO THE ELECTRIC MOTOR MUST BE ISOLATED AND TAGGED OUT.
- ENSURE THAT THE INTAKE AND DISCHARGE OPENINGS ARE TOTALLY ISOLATED FROM ALL POTENTIALLY PRESSURISED CONNECTIONS AND THAT THEY ARE, AND CAN ONLY BE EXPOSED TO ATMOSPHERIC PRESSURE.
- DO A FINAL CHECK BEFORE STARTING ANY MAINTENANCE WORK TO ENSURE THAT THE PUMP IS ELECTRICALLY, HYDRAULICALLY, AND MECHANICALLY ISOLATED.

2.2.3 Material Shattering Hazards

**DANGER**

**APPLYING ANY HEAT TO IMPELLER CAN CAUSE LETHAL SHATTERING**

- DO NOT APPLY HEAT TO THE IMPELLER BOSS OR NOSE IN AN EFFORT TO LOOSEN THE IMPELLER THREAD PRIOR TO IMPELLER REMOVAL. DO NOT USE HEAT TO EXPAND OR CUT AN IMPELLER FROM THE SHAFT. PERSONNEL INJURY AND DAMAGE TO EQUIPMENT OCCURS AS A RESULT OF AN EXPLOSION OR THE IMPELLER SHATTERING.
- A SHAFT WRENCH IS AVAILABLE TO ASSIST IMPELLER REMOVAL.
- IN SOME CASES, AN IMPELLER RELEASE COLLAR HAS ALSO BEEN PROVIDED TO ASSIST IMPELLER REMOVAL.

**DANGER**

**WELDING OR FLAME-CUTTING TO PUMP CAN CAUSE LETHAL SHATTERING**

- CASTINGS MADE FROM A SERIES WEIR MINERALS MATERIALS, FOR EXAMPLE, A05, A61, ETC. ARE BRITTLE AND HAVE LOW THERMAL SHOCK RESISTANCE. ATTEMPTS TO REPAIR OR REBUILD BY WELDING CAUSES CATASTROPHIC FAILURE.
- REPAIRS OF SUCH CASTINGS USING THESE METHODS MUST NOT BE ATTEMPTED.
2.2.4 Lifting Hazards

**DANGER**

**LIFTING EQUIPMENT SAFETY**
- USE LIFTING EQUIPMENT TO LIFT HEAVY OR AKWARD COMPONENTS.
- THE LIFTING EQUIPMENT MUST BE IN GOOD CONDITION, CERTIFIED AND TAGGED.
- THE LIFTING EQUIPMENT MUST BE OF ADEQUATE CAPACITY AND MUST BE USED WHENVEVER THEY ARE REQUIRED.
- PERSONNEL MUST NEVER WORK UNDER SUSPENDED LOADS.

**DANGER**

**LIFTING POINT SAFETY**
- REFER TO THE LIFTING INSTRUCTIONS AT ALL TIMES.
- TAPPED HOLES (FOR EYEBOLTS) AND CAST-ON LUGS (FOR SHACKLES) ON WEIR PARTS ARE FOR LIFTING INDIVIDUAL PARTS ONLY.
- SOME HEAVY PARTS OF THE PUMP HAVE THREADED HOLES FOR LIFTING. DURING ASSEMBLY, EYEBOLTS ARE SCREWED INTO HOLES TO ENABLE LIFTING. AFTER ASSEMBLY, THE EYEBOLTS MUST BE REMOVED AND THE HOLES FILLED WITH RTV SILICONE TO PROTECT THE THREAD OF THE HOLES FOR FURTHER USE.

**DANGER**

**LIFTING POINT FAILURE**
LIFTING POINTS, INCLUDING THE PUMP BASEPLATE AND LIFTING LUGS, MAY NOT BE FIT FOR PURPOSE DUE TO CORROSION. IF YOU ARE IN ANY DOUBT ABOUT THE STRENGTH OR INTEGRITY OF ANY LIFTING POINT, DISASSEMBLE THE PUMP INTO SMALLER SECTIONS TO SAFELY REMOVE IT FROM SITE.

2.2.5 Release of Fluids or Gases Under Pressure Hazard

**DANGER**

**RELEASE OF FLUIDS OR GASES UNDER PRESSURE HAZARD**
UNPROTECTED BODY PARTS EXPOSED TO THE RELEASE OF FLUIDS OR GASES UNDER PRESSURE CAN BE AT RISK OF INJECTION OR INGESTION HAZARDS. THIS CAN OCCUR DURING THE LOOSENING OF FIXINGS TO PRESSURE CONTAINMENT COMPONENTS.
ENSURE THAT THE CORRECT PPE IS USED WHEN THIS HAZARD IS PRESENT.

2.2.6 Pump Material Temperature Hazards

**DANGER**

**THERMAL SHOCK TO PUMP MATERIALS**
DO NOT FEED VERY HOT LIQUID INTO A COLD PUMP OR VERY COLD LIQUID INTO A HOT PUMP. THERMAL SHOCK MAY CAUSE DAMAGE TO THE INTERNAL COMPONENTS AND RUPTURE THE PUMP CASING.
2.2.7 Noise and Vibration Hazards

**DANGER**

**NOISE EMISSION DECLARATION**

- THE OVERALL SOUND PRESSURE LEVEL ‘A’ WEIGHTING dB(A) NOISE LEVELS GENERATED BY A STANDARD BARE-SHAFT (WITHOUT DRIVE FITTED) PUMP OPERATING UNDER NORMAL CONDITIONS USING CLEAR FLUIDS (WATER) MEASURED ABOVE 70 dB(A) AND WHEN FITTED WITH AN ELECTRICAL MOTOR DOES NOT NORMALLY EXCEED 85 dB(A) WHEN MEASURED AT 1m DISTANCE USING ISO 3746 GRADE 3 BASIC NOISE EMISSION STANDARD.

- FOR THE MOTOR ONLY SOUND PRESSURE LEVELS, REFER TO THE RELEVANT PROPRIETARY ELECTRICAL MOTOR MANUAL.

- FOR AN IN SERVICE PUMP UNIT, INCLUDING ITS DRIVE, THE ACTUAL NOISE LEVELS GENERATED ARE DEPENDENT ON A NUMBER OF VARIABLE FACTORS, SUCH AS DRIVE TYPES, SLURRY TYPES, SURROUNDING EQUIPMENT, WHETHER IT IS INSTALLED INDOOR / OUTDOORS, TYPE OF FOUNDATION OR ANY COMBINATION OF THE ABOVE AND LOCAL ENVIRONMENTAL FACTORS. THESE FACTORS ARE BEYOND THE CONTROL OF WEIR MINERALS, THEREFORE THE SOUND PRESSURE LEVEL VALUES SHOWN IN THIS MANUAL ARE INDICATIVE ONLY AND SHOULD BE ASSESSED IN SERVICE BY THE USER.

- SUITABLE PRECAUTIONS SUCH AS USE OF PPE SHOULD BE TAKEN TO PROTECT PERSONNEL FROM EXPOSURE TO NOISE IN ACCORDANCE WITH GOVERNING HEALTH & SAFETY REGULATIONS.

**DANGER**

**VIBRATION LEVELS**

- PUMPS ARE NOT INTENDED TO BE INSTALLED AT WORKSTATIONS OR REQUIRE CONTINUAL CLOSE CONTACT BY OPERATIVES. IF THIS IS UNAVOIDABLE, THEN THE FREQUENCY AND LEVEL OF EXPOSURE TO PUMP VIBRATION TO ANY OPERATIVE SHOULD BE ASSESSED. ATTENTION SHOULD BE GIVEN TO VIBRATIONS TRANSMITTED THROUGH THE FEET TO THE BODY FROM THE PUMP’S FOUNDATIONS.

- THE EUROPEAN DIRECTIVE 2002/44/EC REFERENCES VIBRATION EXPOSURE LIMIT AND ACTION VALUES FOR THE HAND-ARM AND THE WHOLE BODY.

2.2.8 Wear Hazards

**DANGER**

**INSPECT IMPELLER AT REGULAR INTERVALS**

- IMPELLERS MUST BE ROUTINELY INSPECTED FOR FATIGUE. FAILURE TO INSPECT ROUTINELY MAY RESULT IN CATASTROPHIC PUMP FAILURE.

- FOR IMPELLERS WITH LOW WEAR APPLICATIONS, OTHER NON-VISUAL METHODS OF INSPECTION ARE REQUIRED.

- CONTACT YOUR LOCAL WEIR MINERALS REPRESENTATIVE FOR MORE INFORMATION.
2.2.9 Guarding and Trap Hazards

**DANGER**

GUARDING OF ROTATING COMPONENTS

ROTATING COMPONENTS MUST BE GUARDED AT ALL TIMES WHEN THE PUMP IS OPERATIONAL.

THE PUMP MUST ONLY BE WORKED ON WHEN IT IS STATIONARY AND THE DRIVE MECHANISMS ARE LOCKED OUT.

THE PUMP MUST NOT BE OPERATED IF THE SUCTION AND DISCHARGE OPENINGS ARE NOT SECURELY FASTENED AND CONNECTED TO FIXED PIPEWORK.

2.2.10 Chemical and Dangerous Substance Hazards

**DANGER**

TOXIC VAPOURS FROM GLAND

- VAPOURS CAN LEAK PAST GLAND GUARDS.
- APPROPRIATE RISK ASSESSMENT MUST BE MADE REGARDING THE NATURE OF THE PRODUCT IN THE PUMP AND NECESSARY SAFETY PRECAUTIONS PUT IN PLACE TO PROTECT FROM EXPOSURE TO PRODUCT VAPOURS.

**WARNING**

HAZARDOUS CHEMICALS

During any work activity on the pump, personnel may come in contact with hazardous chemicals. These chemicals must be identified before any work begins, and the correct SDS must be made available and appropriate safety management precautions put in place.

**WARNING**

HOT OR DANGEROUS SUBSTANCES

Protection of personnel from the ejection of fluids or vapours may be necessary during the pumping operations of hot or dangerous substances. These protection measures may include the exclusion of personnel from the immediate area, or by installing protective guarding around the pump. These dangerous substances are classified according to the EC directive (67/548/EEC) as explosive; extremely flammable; highly flammable; flammable; very toxic; toxic or oxidising.

Please be aware that the pump sealing integrity cannot be ensured by monitoring alone.
2.2.11 Duty Conditions

**CAUTION**

DUTY CONDITIONS
The pump must never be operated outside of its duty conditions for any significant period of time.

2.3 Operating Conditions

The standard ambient operation temperatures recommended are -10 °C to +40 °C. If the operating range is outside this contact your local Weir Minerals representative for more information.

**WARNING**

FAILURE DUE TO OPERATING CONDITIONS
If the pump is operated outside the recommended duty conditions it may cause mechanical failure leading to safety issues.

**NOTICE**

OPERATING RANGES FOR MATERIALS
Contact your local Weir Minerals representative for further information on the operating temperature ranges of alloys and elastomers.

2.4 Efficient Use and Intended Use

Weir MU slurry pumps are built in a variety of designs and materials and for many different slurry services. We advise that you carefully read this IOM manual before performing any operations or activities on our MU pump range.

For the safety of operating personnel, please note that the information contained in this manual applies only to the fitting of genuine Weir parts and Weir recommended bearings to MU pumps.

**DANGER**

GENUINE PARTS

- GENUINE PARTS AND ACCESSORIES ARE DESIGNED, TESTED AND INCORPORATED INTO THE PRODUCTS TO HELP ENSURE THEY MAINTAIN CONTINUED PRODUCT QUALITY AND PERFORMANCE IN USE.
- AS WEIR MINERALS DOES NOT TEST THE PARTS AND ACCESSORIES SOURCED FROM OTHER VENDORS, THE INSTALLATION OF SUCH PARTS AND ACCESSORIES ADVERSELY AFFECTS THE PERFORMANCE AND SAFETY FEATURES OF THE PRODUCTS.
- THE FAILURE TO PROPERLY SELECT, INSTALL OR USE AUTHORISED PARTS AND ACCESSORIES IS CONSIDERED MISUSE. DAMAGE OR FAILURE CAUSED BY MISUSE IS NOT COVERED BY OUR WARRANTY.
- IN ADDITION, ANY MODIFICATION OF WEIR MINERALS PRODUCTS OR REMOVAL OF ORIGINAL COMPONENTS MAY IMPAIR THE SAFETY OF THESE PRODUCTS IN THEIR USE.

The pumps must not be operated beyond the allowable limits of pressure, temperature and speed specified for the application. These limits are dependent on the pump type, configuration and materials used. If there is any doubt about the suitability of the product for the intended application, contact Weir Minerals, quoting the serial number.

If the conditions of service on the purchase order are going to be changed (for example liquid pumped, temperature or duty), it is requested that the user seek the manufacturer’s written agreement before start-up.
2.5 General Safety

Legal requirements and local regulations may differ substantially with regard to particular safety requirements and may be regularly modified by relevant authorities without notice. As a consequence, applicable laws and regulations must be consulted to ensure compliance. The following cannot be guaranteed for its completeness or continuing accuracy.

These instructions are intended to facilitate familiarisation with the product and its permitted use. Operating the product in compliance with these instructions is important to help ensure reliability in service and avoid risks. The instructions may not take into account local regulations. It is the responsibility of the purchaser of the product to ensure such regulations are observed by all, including those installing the product. Always coordinate repair activities with operations personnel and follow all plant safety requirements, applicable workplace health and safety laws and regulations.

These instructions must be read prior to installing, operating, using and maintaining the equipment in any region, worldwide. The equipment must not be put into service until all the conditions relating to health and safety are completed.

Information in these user instructions is believed to be reliable. In spite of all the efforts to provide correct and necessary information, the content of this manual may appear insufficient and is not guaranteed as to its completeness or accuracy.

2.6 Qualified Workers

All personnel involved in the operation, installation, inspection, and maintenance of the pump must be qualified to carry out the work involved. If your personnel do not have the necessary knowledge and skill, appropriate training and instruction must be provided.

If required, the operator may engage the manufacturer/supplier to provide applicable training.

Always coordinate repair activities with operations and workplace health and safety personnel. Follow all plant safety requirements and workplace health and safety laws and regulations, where applicable.

2.7 Safe Working on Pumps

The Weir MU centrifugal slurry pump is a piece of rotating equipment which contains pressure under service conditions. All standard safety precautions for such equipment must be followed before and during installation, operation, and maintenance.

Drain the pump and isolate pipework before dismantling the pump. The appropriate workplace health and safety precautions must be taken where the pumped liquids are hazardous.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SHARP EDGES</strong></td>
</tr>
<tr>
<td>• Before starting any work, identify and examine any parts that could be hazardous due to sharp edges. All metal components must be considered to have sharp edges.</td>
</tr>
<tr>
<td>• Worn pump components can have sharp or jagged edges. Handle worn parts carefully, to prevent damage to slings or personnel injury.</td>
</tr>
</tbody>
</table>

Mixing of new and worn pump components may increase the incidence of premature pump wear and leakage. All metal mating faces must be cleaned of dirt, rust, paint and other adhering substances prior to pump assembly. Failure to clean parts can affect pump assembly and running clearances and could lead to catastrophic failure of parts.

Avoid contamination:

• Burning of elastomer pump components causes emission of toxic fumes and results in air pollution which leads to personnel injury/illness.
• Leakage in excess of the specified packing lubrication requirements from pump shaft seals and/or leakage from worn pump components or seals, causes water and/or soil contamination.
• Liquid waste disposal from servicing of pumps or stagnant water from pumps stored for long periods, causes water and/or soil contamination.
2.8 Markings and Approvals

It is a legal requirement that machinery and equipment put into service within certain regions of the world must conform to the applicable marking directives and standards such as CE marking directives covering machinery and, where applicable, low-voltage equipment, Electromagnetic Compatibility (EMC), Pressure Equipment Directive (PED), and Equipment for Potentially Explosive Atmospheres (ATEX).

Where applicable, the directives and any additional approvals cover important workplace health and safety aspects relating to machinery and equipment and the satisfactory provision of technical documents and workplace health and safety instructions.

Where applicable, this document incorporates information relevant to these directives and approvals. To confirm the applying approvals, and if the product is CE marked, check the serial number plate markings and the certification.

2.9 Safety Equipment

Do not operate the pump without properly installed seal, vee-belt and coupling guards in place. If guards are removed during maintenance or gland adjustment, they must be replaced prior to operating the pump. During gland seal adjustment, the fixed guard is removed while the pump is in operation. This exposes the rotating pump shaft. Additional safety management measures must be implemented to manage this specific hazard, and only suitable trained and qualified personnel must work on gland adjustment. The guard must be replaced when adjustment is complete.

![WARNING]

**ROTATING PARTS**

Injury or illness may result from contact with rotating parts, seal leakage or spray from the rotating shaft.

![WARNING]

**GLAND ADJUSTMENT**

During gland seal adjustment the fixed guard needs to be removed while the pump is operational. When the guard is removed, the rotating shaft is exposed. Additional safety management measures must be implemented to manage this specific hazard and only suitable trained and qualified personnel must work on gland adjustment. The guard must be replaced when adjustment is complete.

For auxiliary equipment (motors, belt drives, couplings, gear reducers, variable speed drives, mechanical seals, etc.), standard workplace health and safety precautions must be followed and appropriate instruction manuals consulted before and during installation, operation, adjustment, and maintenance.

2.10 Fire Fighting

A number of possible emissions or leakage of hazardous substances may be possible depending of the product being pumped. Ensure you are familiar with site and local procedures and requirements.
2.11 Emergency Procedures

Ensure you are familiar with site and local procedures and requirements. If there is an emergency, follow site and local procedures.

Emergency shut-down is usually forced by a complete power failure. Another emergency, which is less likely, is a major bursting of the pipeline and a loss of head resulting in increased flow from the pumps. Typically, this causes the power drawn to increase rapidly and the electrical controllers would cause all or most pumps to trip the safety switches.

There is little that can be done in either of the above cases for a simple or controlled system. If all power fails, the gland water pumps will also stop. Before pumps are restarted, it is recommended that the gland packings be inspected and possibly replaced as slurry will enter the glands with no GSW. If the pumps stop but the GSW pumps continue to operate, then there will be minimum effects on the glands.

For systems fitted with an automatically opening dump valve, this is activated and some of the pipeline contents are dumped. Runback and major flooding of the pump and the sump is thereby minimised. The effects of runback are also minimised, if slow acting non-return valves are fitted.

Intake sumps can be sized with reserve capacity to take the runback in emergencies.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLOCKED IMPELLER</td>
</tr>
<tr>
<td>Do not operate the pump if solids have settled and the rotating element cannot be turned by hand.</td>
</tr>
</tbody>
</table>

Where possible:
- Clear blockages.
- Barricade the pump, where head is present to minimise slurry spillage.
- Do not cool the pump with water.

After an emergency, stop and check for blockages and then follow the commissioning procedure.

2.11.1 Emergency Pump Shut-down

In the event of an unplanned pump shut-down through loss of power or any other reason, the settlement of slurry within the pump should be avoided. If power and gland seal water is available, follow the pump shut-down procedure (refer to "Pump Shut-Down" on page 63).

If power and gland seal water are not available after the slurry has drained back to the sump, and the impeller has stopped rotating, perform the following steps;

Follow this procedure;

1. Isolate the pump from the pumping process by slowly closing the pump feed and discharge valves.
2. Open the water flushing and air vent valves to dilute the slurry.
3. Flush the pump with clean water until clear liquid is observed coming from the flush drain.
4. Close water flushing valve and drain the water from the pump.
5. Isolate the pump from its driver and manually rotate the impeller via the pump driveshaft to ensure its free rotation, if the driveshaft/impeller is not free to rotate then further flushing, investigation and disassembly may be required.
6. Close the drain valve and completely fill the pump with water in preparation for start-up. Note the pump should be left drained in cold weather conditions to prevent freezing damage until it is required for normal start-up.
7. Close the water flushing and air vent valves.
8. Follow the start-up procedures (refer to "Normal Pump Start-up" on page 60).

The procedure described above assumes feed, discharge valves and facilities for pump flushing are available. They are not normally supplied with the pump but may be included within the pump's installation pipework (supplied by external suppliers). Where they are not available, the slurry within the pump should be regularly agitated to prevent its settlement. This can be achieved by rotation of the pump impeller at regular intervals. The duration and frequency of rotation is dependent on the slurry type and its operating duty conditions.
3 Technical Data

This section describes the:

- Pump identification, nameplate, size, frame and bearing sizes, type, and part identification.
- Power requirements for bearings.
- Torque settings for bolts.
- Materials used for construction of slurry pumps.

3.1 Pump Identification

The pump identification is as shown in Figure 3-1.

Table 3-1 shows pump identification codes.

<table>
<thead>
<tr>
<th>Pump Size</th>
<th>Frame Size</th>
<th>Wet-end Type</th>
<th>Shown as</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>B</td>
<td>MU</td>
<td>80 BMU</td>
</tr>
<tr>
<td>100</td>
<td>C</td>
<td>MU</td>
<td>100 CMU</td>
</tr>
<tr>
<td>150</td>
<td>D</td>
<td>MU</td>
<td>150 DMU</td>
</tr>
<tr>
<td>200</td>
<td>D</td>
<td>MU</td>
<td>200 DMU</td>
</tr>
<tr>
<td>200</td>
<td>E</td>
<td>MU</td>
<td>200 EMU</td>
</tr>
</tbody>
</table>

Table 3-1: Pump Identification Code
3.1.1 Discharge Positions

Based on the position of the discharge pipework, the pump casing can be fitted to the frame in any of the eight possible positions (refer to Figure 3-2).

![Figure 3-2: Discharge Position](image)

3.1.2 Pump Nameplate

A nameplate is attached to the frame of every MU pump (refer to Figure 3-1 on page 14). The nameplate contains details such as pump serial number, pump duty conditions and identification codes.

3.1.3 Pump Part Identification

Check the following during pump part identification (refer to Figure 3-3):

- Every Weir part consists of name and a three digit basic part number.
- Parts with the same name, irrespective of size, have the same basic part number. For example, the 4 vane impeller of some MU pump has the basic part number as 145.
- To identify a specific component of a particular pump, additional letters and digits are added before and after a given basic number. This indicates the part number of that component.
- The part number is cast or marked on every part.

![Figure 3-3: Pump Part Identification - Example](image)

**NOTICE**

CORRECT USE OF NAMES AND PART NUMBERS

In all correspondence with Weir Minerals or their representatives and when you order spare parts, use correct names and full part numbers to prevent misunderstandings or wrong deliveries. In case of doubt, quote the pump serial number.
3.2 Bearing Power Requirements

The values provided in Table 3-2 are for reference only. Sometimes, power exceeds the limit. Consult your local Weir Minerals representative, when the power exceeds the limit.

Table 3-2 provides the power rating of the basic bearing assembly.

<table>
<thead>
<tr>
<th>Bearing Assembly</th>
<th>Power Rating (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>15</td>
</tr>
<tr>
<td>C</td>
<td>30</td>
</tr>
<tr>
<td>D</td>
<td>60</td>
</tr>
<tr>
<td>E</td>
<td>120</td>
</tr>
</tbody>
</table>

Table 3-2: Power Rating - Basic Bearing Assembly

3.3 Tightening Torques

Table 3-3 provides recommended torque settings for metric bolts used in MU pumps.

<table>
<thead>
<tr>
<th>M# Bolt (size)</th>
<th>Recommended Torque (± 10%) (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12</td>
<td>25</td>
</tr>
<tr>
<td>M16</td>
<td>50</td>
</tr>
<tr>
<td>M20</td>
<td>90</td>
</tr>
<tr>
<td>M24</td>
<td>150</td>
</tr>
<tr>
<td>M27</td>
<td>220</td>
</tr>
<tr>
<td>M30</td>
<td>300</td>
</tr>
</tbody>
</table>

Table 3-3: Torque Settings for M Bolts

Table 3-4 provides the recommended torque settings for bearing housing clamp bolts.

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Recommended Torque (± 10%) (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>25</td>
</tr>
<tr>
<td>C</td>
<td>90</td>
</tr>
<tr>
<td>D</td>
<td>150</td>
</tr>
<tr>
<td>E</td>
<td>300</td>
</tr>
</tbody>
</table>

Table 3-4: Torque Settings for Bearing Housing Clamp Bolts
3.4 Materials

A major advantage of the MU pump is the superior materials used in their construction. This ensures the optimum performance that is right for your requirements.

For any assistance with the selection of specific material, consult local Weir Minerals representative.

**NOTICE**

**PUMP WEAR IS AFFECTED BY SLURRY PROPERTIES**

Large variations in slurry properties, increases the rate of wear and corrosion of pump components.

- Wear increases exponentially with velocity and slurry particle size.
- Corrosion rate doubles for every 10 °C increase in slurry temperature.
- Corrosion rate increases exponentially as slurry pH decreases.

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Series</td>
<td>Abrasion or Erosion-Corrosion Resistant Alloys</td>
</tr>
<tr>
<td>C Series</td>
<td>Corrosion Resistant Alloys</td>
</tr>
<tr>
<td>D Series</td>
<td>Ductile Irons</td>
</tr>
<tr>
<td>E Series</td>
<td>Carbon Steels and Low Alloy Steels</td>
</tr>
<tr>
<td>G Series</td>
<td>Grey Cast Irons</td>
</tr>
<tr>
<td>J Series</td>
<td>Abrasion Resistant Spray</td>
</tr>
<tr>
<td>N Series</td>
<td>Nickel Based Alloys</td>
</tr>
<tr>
<td>P Series</td>
<td>Polymer and Polymer Composite Materials</td>
</tr>
<tr>
<td>Q Series</td>
<td>Seal Packing Materials</td>
</tr>
<tr>
<td>R Series</td>
<td>Natural Rubbers</td>
</tr>
<tr>
<td>S Series</td>
<td>Synthetic Elastomers</td>
</tr>
<tr>
<td>U Series</td>
<td>Polyurethane Elastomers</td>
</tr>
<tr>
<td>Y Series</td>
<td>Ceramics</td>
</tr>
<tr>
<td>Z Series</td>
<td>Composite Materials Coatings</td>
</tr>
</tbody>
</table>

Table 3-5: Material Types
4 Description

This section provides:

- Introduction to MU pump.
- Basic description of the pump assembly.

4.1 Introduction to MU Pump

The features of the MU pump (refer to Figure 4-2 on page 20 and Figure 4-1 on page 19) are:

- Used for slurries containing high concentrations of erosive solids, or where an extremely robust or medium duty pump is required.
- All Weir Minerals standard seal options are available: Centrifugal, Gland or Mechanical seal types.
- Discharge sizes range from 80 mm to 200 mm.
- A range of frames are available to accommodate varying drive power requirements.
- The centrifugal pump operates by increasing pressure from the inlet (lower pressure) to the outlet (higher pressure).
1. Adaptor Plate
2. Stuffing Box O-ring
3. Shaft Spacer
4. Packing
5. Impeller O-ring
6. Backliner
7. Impeller
8. Discharge Joint
9. Intake Joint
10. Casing
11. O-ring
12. Stuffing Box
13. Lantern Restrictor
14. Shaft Sleeve O-ring
15. Shaft Sleeve
16. Gland
17. Base
18. Clamp Bolt
19. Bearing Housing
20. Adjusting Screw
21. Shaft
22. Grease Nipple
23. Bolt
24. Gland Bolt
25. Adaptor Stud
26. Case Fixing Bolt

Figure 4-1: Basic MU Pump - Gland Seal

All diagrams use a '12 o'clock' clock face layout to indicate the position of the red call-out lines. For example, item 1 is in the 12 o'clock position at the centre of the diagram. Read the diagram in a clockwise direction.
All diagrams use a '12 o'clock' clock face layout to indicate the position of the red call-out lines. For example, item 1 is in the 12 o'clock position at the centre of the diagram. Read the diagram in a clockwise direction.

Figure 4-2: Basic MU Pump - Centrifugal Seal

1. Adaptor Plate
2. Expeller Ring
3. Expeller Ring O-ring
4. Packing
5. Impeller O-ring
6. Backliner
7. Impeller
8. Discharge Joint
9. Intake Joint
10. Casing
11. O-ring
12. Expeller
13. Lantern Ring
14. Shaft Sleeve O-ring
15. Shaft Sleeve
16. Gland
17. Base
18. Clamp Bolt
19. Bearing Housing
20. Adjusting Screw
21. Shaft
22. Grease Nipple
23. Bolt
24. Gland Bolt
25. Adaptor Stud
26. Case Fixing Bolt
27. Grease Cup
28. Grease Cup Adaptor
4.2 Pump Component Description

This section describes the various drive configurations and types of shaft seals.

4.2.1 Drive Configurations

The various drive configurations are shown in Figure 4-3.

---

**Figure 4-3: Examples of Drive Configurations**

1. Motor Support
2. Adjusting Screw
3. Base Plate
4. Drive Guard
5. Motor Support Bolt
6. Coupling Guard
7. Base
4.2.2 Shaft Seals

The three types of shaft seals used in this pump are:

- Gland seal
- Centrifugal seal
- Mechanical seal

**Figure 4-4: Gland Seal**

1. Shaft Spacer
2. Shaft Sleeve O-ring
3. Gland
4. Packing
5. Lantern Restrictor
6. Stuffing Box
7. Impeller O-ring
8. Stuffing Box O-ring
9. Shaft Sleeve

**Figure 4-5: Centrifugal Seal**

1. Shaft Sleeve O-ring
2. Gland
3. Packing
4. Lantern Ring
5. Grease Cup
6. Grease Cup Adaptor
7. Expeller Ring
8. Expeller
9. Impeller O-ring
10. Expeller Ring O-ring
11. Shaft Sleeve
5 Transport and Storage

This section provides the instructions to follow during:

- Transportation of the pump
- Tie-down
- Lifting
- Storage of the pump

5.1 Transportation

This section describes the following:

- Transport safety
- Chain of Responsibility (COR)
- Load restraint commandments and tools
- Shaft locking

5.1.1 Transport Safety

The transport vendor must pack the freight such that it:

- Ensures any instructions required to lift or re-tether the load are fully visible.
- Does not cause any hazard to the supply staff, transport personnel, and the general public.
- Complies with all legal requirements including mass, dimension, and load restraint requirements.
- Can withstand high-speed road transport over rough terrain.
- Can be safely loaded/unloaded from the transport vehicles.
- Minimises the risk of injury to all personnel involved in the freight transportation.
- Minimises the risk of damage to the freight.
- Minimises the risk of damage to other freight and the general public.
- Has packing labels that specify the weight of the items and details of the recipient.
- Has ratchet-strap tie-downs over painted areas to minimise paint damage.
- Secures the loose items.

5.1.2 Chain of Responsibility

Under the Chain of Responsibility (COR) regulations, all parties with some control in the supply chain have legal responsibilities to ensure compliance with relevant heavy vehicle road laws, including mass, dimension, and load restraint laws. This includes people involved in consigning, loading, packing, and receiving freight as well as drivers of those vehicles (for example, in relation to speeding and fatigue management).
5.1.3 Load Restraint

The securement systems must withstand the forces associated with the following four deceleration/accelerations, applied separately.

Key requirements for load security are:

1. Ensure that the load platform, bodywork, and any load securing equipment are in a serviceable condition before loading the vehicle.
2. Secure the cargo so that it cannot move, roll-over, wander because of vibrations, fall off the vehicle, or make the vehicle tip over.
3. Determine the securing method(s) best adapted to the characteristics of the cargo (locking, blocking, direct lashing, top-over lashing, or a combination of these).
4. Ensure that the vehicle and blocking equipment manufacturers’ recommendations are adhered to.
5. Ensure that the cargo securing equipment is commensurate with the constraints it encounters during the journey. Ensure that the securing equipment can withstand the following conditions, which are considered as normal circumstances, that may occur during journey:
   - Emergency braking
   - Strong cornering to avoid an obstacle
   - Bad road or weather conditions
6. Inspect the cargo and check for overload and/or poorly balanced weight distribution before starting when cargo is loaded, unloaded, or redistributed each time. Ensure that the cargo is distributed in such a way that the centre of gravity of the total cargo lies as close as possible to the longitudinal axis and is kept as low as possible (heavier goods below, lighter goods above).
7. Use equipment which supports the cargo securing such as friction mats, walking boards, straps, edge beams, etc. wherever possible.
8. Ensure that the securing arrangements do not damage the goods transported.
5.1.3.1 Load Restraint Tools

The basic safety principles related to the load restraint tools are:

- The securing of any pump must be undertaken by a suitably experienced person who is familiar with applicable safety and transportation legislation, site requirements, and best practices. This person must be able to assess the load, create a plan, and then apply it safely.
- Inspect tensioners, chains, straps, and other restraint mechanisms regularly, to ensure that they are suitable to secure the proposed load.
- Do not use ropes or over-centre load chain binders (dogs) (refer to Figure 5-2), when you secure loads for collection or delivery from Weir Minerals Division.

![Figure 5-2: Over-centre Load Chain Binder]

**WARNING**

PERSONNEL INJURY WHILE LASHING/UNLASHING

The use of over-centre load chain binders (dogs) results in the release of the stored energy in the load restraint tools while unlashing. This can cause personnel injury.

**DANGER**

LIFTING POINT FAILURE

NO OTHER POINTS ON THE PUMP OR PUMP BASEPLATE MUST BE USED OTHER THAN THOSE INDICATED IN THE TIE-DOWN INSTRUCTIONS (REFER “TIE-DOWN INSTRUCTIONS” ON PAGE I). IF OTHER LIFTING POINTS ARE USED, THEY MAY BE UNSUITABLE, DAMAGED OR CORRODED. THIS CAN LEAD TO A DROPPED LOAD.

5.2 Tie-Down Instructions

The Tie-Down instructions indicate the points on the pump and pump baseplate that are safe to use as tie-down points for the bareshaft pump. See “Tie-Down Instructions” on page I.

5.3 Lifting Instructions

During assembly, installation and transportation of the pump, various parts of the pump need lifting. For information on how to carry out the lifting activity using the recommended equipment, refer to “Lifting Instructions” on page III.
5.4 Storage

To store the pumps for prolonged periods, Weir Minerals recommends the following:

- Plug the ports. If the assembly is stored in an open area with major temperature fluctuations, it is preferable to install a desiccant breather instead of one plug.
- If the stand-by assemblies/pumps are idle for long periods, it is advisable to turn their shafts 10 revolutions, once every week. In this way, all the bearing rollers are made to carry static loads and external vibration.
- Do not store spare bearing assemblies near vibration or in a damp area.

**NOTICE**

PUMP STORAGE

It is possible for operational and storage problems to arise due to environmental conditions the pump is subjected to. These problems must be corrected at the owner’s expense prior to operation. Weir Minerals will accept no responsibility for these problems. These provisions are applicable to Weir Minerals proprietary items only. For the appropriate storage procedures for non-Weir Minerals items refer to specific requirements from the manufacturer.

**NOTICE**

MAINTENANCE SCHEDULE

Maintenance must start within three months of the date of manufacture.

5.4.1 Standard Instructions

To store the pump:

- Weir Minerals recommends indoor storage, if possible.
- If stored outside, protect the equipment from extreme temperature, humidity, exposure to excessive dust, moisture, and vibration. For outdoor or excessively unfavourable environment including dust and rain, cover the equipment with some type of protective sheeting that allows air circulation.
- Turn each pump shaft at least 10 revolutions, once every week.
- To prevent hardening of packing, loosen all glands to release pressure on the packings.
- Once in every six months, purge the labyrinth (if fitted) with grease to prevent dirt and/or moisture contamination of the bearings. In a dusty environment, the labyrinth must be purged once a month.
- Cover the suction and discharge flange openings unless the pump is installed and connected to the pipework. Avoid removal of intake and discharge protection covers, while in storage.
- Removal of intake and discharge protection covers may allow ingress or tramp material, water or harmful substances to the pump head which may damage elastomer or other components when commissioning.
- All external machined surfaces are factory coated with a rust preventative prior to dispatch. Maintain the protective coating on machined surfaces.
- Maintain written records of labyrinth purging and shaft rotation intervals, when the storage period exceeds six months from the time of dispatch. The records must be available for Weir inspection upon request.
- If the pumps are stored for more than 18 months since the time of dispatch, additional provisions are required. In such cases, to prevent void of all warranty provisions, obtain prior agreement from Weir Minerals.
- These provisions are applicable to Weir proprietary items only. For the appropriate storage procedure of non-Weir items, refer to the specific requirements of the manufacturer.
5.4.2 Medium-term Storage

**DANGER**

ISOLATE ALL PUMP SERVICES - ELECTRICAL, HYDRAULIC, MECHANICAL

• NEVER CARRY OUT MAINTENANCE WORK WHEN THE UNIT IS CONNECTED TO POWER. THE PUMP MUST BE FULLY ISOLATED BEFORE ANY MAINTENANCE WORK, INSPECTION OR TROUBLESHOOTING INVOLVING WORK ON SECTIONS WHICH ARE POTENTIALLY PRESSURISED (CASING, GLAND, CONNECTED PIPEWORK) OR INVOLVING WORK ON THE MECHANICAL DRIVE SYSTEM (SHAFT, BEARING ASSEMBLY, COUPLING).

• POWER TO THE ELECTRIC MOTOR MUST BE ISOLATED AND TAGGED OUT.

• ENSURE THAT THE INTAKE AND DISCHARGE OPENINGS ARE TOTALLY ISOLATED FROM ALL POTENTIALLY PRESSURISED CONNECTIONS AND THAT THEY ARE, AND CAN ONLY BE EXPOSED TO ATMOSPHERIC PRESSURE.

• DO A FINAL CHECK BEFORE STARTING ANY MAINTENANCE WORK TO ENSURE THAT THE PUMP IS ELECTRICALLY, HYDRAULICALLY, AND MECHANICALLY ISOLATED.

If you do not plan to operate the used pump for more than two months, do the following within a day of shut-down:

1. Flush the pump with process water for one hour to flush out the pumps, pipes, hoppers, and associated equipment.
2. Drain the hoppers, pumps, and pipelines. Leave all drain valves open.
   Rain may fill hoppers at some stage, if no dump valves are available. In such a condition, remove a short section of suction pipework.
3. Hose pump exterior while avoiding direct hosing of bearing labyrinths.
4. Remove suction pipe and pump casing.
5. Hose inside of the pump using clean water to remove all traces of solids which may form hard deposits and process water which may contain high levels of dissolved salts or corrosive fluids.

**WARNING**

HAZARDOUS CHEMICALS

During disassembly, personnel may come in contact with hazardous chemicals. These chemicals must be identified before disassembly, and the correct Safety Data Sheet (SDS) must be made available and appropriate safety management precautions put in place.

6. Ensure that the suction pipes are clean.
7. Insert mechanical seal setting plates (distance plates), and lock in position.
   • Flush low-pressure, clean water into the rear of the seal area, to remove any solid deposits.
   • Gently clean external mechanical seal area with soft brush.
8. Dismantle the pump head to allow complete cleaning and drainage if water or residual solids are corrosive, or likely to deposit.
9. Check operation of all valves, remove solids built-up and lubricate according to the valve manufacturer’s instructions. Put emphasis on suction valve operation.
10. Reassemble the pump.
11. Ensure that the pump shaft rotates freely and readjust the impeller if required. For more information on impeller adjustment, refer to “Impeller Adjustment” on page 104.
12. While rotating the pump by hand, grease labyrinths through the end cover nipples at both ends of the bearing assembly, until grease is expelled beyond the labyrinths.
13. Apply a protective coating to exposed metal components that may corrode.
   • Lightly grease motor support adjustment bolts and pump casing bolts.
   • If in a high humidity area, apply Denso tape or similar tape to the threads.
14. To remove electrical cables:
   • Cover exposed ends to keep the ends clean and moisture free.
   • Tie cable to support above ground level.
   • Plug the cable entry gland of the motor terminal box.

15. Protect the pump from extreme temperature, humidity, and exposure to excessive dust, moisture, and/or vibration.

16. Rotate the shaft 10 revolutions, once every week and inspect the general condition of the pump and equipment.

17. Every six months, purge the labyrinth with grease to prevent dirt and/or moisture contamination of the bearings.

18. Cover the suction and discharge flange openings. Do not apply excessive pressure to elastomer liners to prevent the elastomer taking a compression set.

19. Indoor storage is recommended.

20. For outdoor or excessively unfavourable environment, cover the pump with some type of protective cover which allows proper air circulation.

21. Apply paint on any damaged paint surfaces. Also, note the following:
   • Store the recirculation pumps such as used in FGD systems, with discharge valves closed to prevent the possibility of corrosive gases entering the pump. If the discharge valves are not fitted, then fill the pump with clean water of a neutral pH. If the gases can reach the recirculation pumps, then check the pH of the water in the pump every two months, to ensure that it has not become acidic.
   • Protect the equipment from extreme temperature, humidity, exposure to dust, and moisture.
   • Protect the elastomer lined pumps from sunlight, heat, and exposure to ozone, if applicable.
   • When the shut-down period exceeds two months, maintain the written records for the labyrinth purging and shaft rotation intervals.

5.4.3 Long-term Storage

To store and safely keep the new and stand-by pumps for long-term:
   • Limit the long-term storage to a maximum of 24 months.
   • Inspect the pump for any transport or installation damage.
   • Do not stack other pieces of equipment on top of the pumps.
   • Cover any bare metal exposed by scratches to the pump's paintwork with a suitable paint or protective coating.
   • Flush and clean with clean water prior to storage.
   • Use a suitable absorbent cloth to wipe the inside of the pump to remove any water.
   • Due to the design, the pump does not have a drip tray, therefore, dismantle the pump, and dry all parts of excess water. Remove the slurry that has collected in any of the joints or seals and clean the parts with clean water.
   • Rotate the shaft 10 revolutions, once every week.
   • Follow the motor manufacturer’s instructions for storage, if applicable.

**NOTICE**

**WARRANTY REQUIREMENT**
Maintaining records of labyrinth purging and shaft rotation intervals is mandatory during warranty period, to maintain warranty validity.
5.4.4 Before Start-up

Follow the pre-commissioning instructions provided in the “Pump Commissioning Check Sheet” on page V.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WARRANTY REQUIREMENT</strong></td>
</tr>
<tr>
<td>A report must be submitted stating that the storage procedures listed in this section are carried out on a weekly basis. Failure to follow this advice will void the warranty issued by Weir Minerals.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NON-WEIR WARMAN ITEMS</strong></td>
</tr>
<tr>
<td>These provisions are applicable to Weir proprietary items only. For the appropriate storage procedures for non-Weir items, refer to specific requirements from the manufacturer.</td>
</tr>
</tbody>
</table>
6 Installation

This section describes the factors that affect the installation of the pump.

6.1 Installation Safety

**DANGER**

LIFTING POINT SAFETY
SOME HEAVY PARTS OF THE PUMP HAVE THREADED HOLES FOR LIFTING. DURING ASSEMBLY, EYEBOLTS ARE SCREWED INTO HOLES TO ENABLE LIFTING. AFTER ASSEMBLY, THE EYEBOLTS MUST BE REMOVED AND THE HOLES FILLED WITH RTV SILICONE TO PROTECT THE THREAD OF THE HOLES FOR FURTHER USE.

**WARNING**

ACCIDENTAL START-UP AND SHUT-DOWN
Weir Minerals Europe does not supply control systems. When installing the pump into a pumping process, or if it is operated in isolation, the start-up and shut-down controls should be configured to prevent accidental start-up or shut-down by the pump operator or other persons.
An Emergency Stop should be included in the pump controls and configured to stop the pump in a safe manner that protects the pumping process and plant operations.

**WARNING**

TIPPING OR FALLING
The pump can tip over or fall if the recommended lifting points are not used.

**WARNING**

HAZARDOUS CHEMICALS
During disassembly, personnel may come in contact with hazardous chemicals. These chemicals must be identified before disassembly, and the correct SDS must be made available and appropriate safety management precautions put in place.
6.2 Pump

This section describes the various factors that affect the installation of the pump.

**Delivery**

a. Check and report any missing components and variation or damage against packing list.

b. Remove any packaging and blanking plates on the pump intake and discharge flanges.

**NOTICE**

**COUPLING FLANGES**

If ordered, pumps are delivered with slip-on matching flanges secured to the pump flanges. Remove these and weld to prepared piping for later connection to the pump.

---

**WARNING**

**LIGHTNING PROTECTION**

- When the pump is installed outside of an enclosed building or is connected to the outside by conductive parts, the pump should be included within the site's lightning protection system assessment.
- Where it has been assessed that the pump must be protected from lightning strike by bonding to the site's lightning strike grounding system, the connection should be made to meet or exceed the requirements of the governing standard such as the EU standard EN 62305.
- As part of the user's scheduled maintenance program, the connection should be visually inspected and tested in accordance with that standard and its exposed parts protected from corrosive environments.

**CAUTION**

**ELECTROSTATIC CHARGES**

- If the pump is to be used with low conductive flammable petroleum based fluids or its operating conditions has caused the pump to become conductively isolated from earth, for example by mounting on an ungrounded foundation such as anti-vibration matting / mountings this may lead to a build-up of static electricity leading to risk of electrical discharges (ignition source) in potentially hazardous environments and electric shock.
- To prevent this, a bonded connection from the pump to the site's earth grounding system should be made to meet or exceed the requirements of the governing standards such as the international standard IEC 60364. As part of the user's scheduled maintenance program the connection should be visually inspected and tested in accordance with that standard and its exposed parts protected from corrosive environments.
6.2.1 Pump Working Envelope

The working envelope allows for safe working or replacing parts on any part of the pump assembly. The pump unit working envelopes are (refer to Figure 6-1):

- Small pumps: 1.5 m all around including above
- Medium pumps: 2 m all around including above

![Figure 6-1: Complete Pump Unit Working Envelope](image-url)
6.2.2 Foundations

Installing the pump on adequate foundations provides efficient pump service. Ensure that:

- The steel and concrete foundations meet local geological requirements.
- The steel and concrete foundations are designed to withstand all loads from the pump and motor, and to absorb any vibrations.
- All securing bolts are correctly tightened.
- Locate the pump so that the length of the intake pipe is as short as possible.
- Adequate space is available to access the pump for installation and disassembly procedures.

6.2.2.1 Align and Grout the Weir Baseplates

**NOTICE**

**BASEPLATES**
Contact your local Weir Minerals representative for more information on fixing baseplates.

**NOTICE**

**ALIGN AND GROUT THE WEIR BASEPLATES**
Plinths are normally formed in a high compressive strength concrete with suitable anchor bolts located according to the individual certified dimension drawing and generally arranged as shown in Figure 6-2.

![Figure 6-2: Example of Aligning and Grouting Weir Baseplate](image-url)
6.2.2.2 Mount the Pump Base on a Steel Framework

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASEPLATES</td>
</tr>
<tr>
<td>Contact your local Weir Minerals representative for further information on fixing baseplates.</td>
</tr>
</tbody>
</table>

To mount the pump base directly on a steel framework:
1. Design a frame of sufficient strength to withstand normal pumping operational stress.
2. Ensure that there is no distortion to the frame when the pump and the pump base are installed.

6.2.3 Shaft Alignment

Whether direct coupled or vee-belt driven, ensure that the pump and motor shafts are accurately aligned:
1. In direct coupled drives, misalignment causes unnecessary vibration and wear of the coupling.
2. In vee-belt drives, non-parallel shafts cause excessive belt wear.
3. Avoid rigid couplings.

MU pumps are not factory-aligned. Check and ensure that alignment is correct during installation. Align and tension the vee-belt and flexible transmissions as described in “Alignment” on page 35 and “Tensioning” on page 36.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP DAMAGE</td>
</tr>
<tr>
<td>Direct coupling large pumps to prime movers must be avoided as a sudden stoppage of the prime mover can cause unscrewing of the pump impeller and consequent pump damage. A clutch or fluid coupling fitted between the pump and the prime mover is recommended.</td>
</tr>
</tbody>
</table>

6.2.4 Alignment, Tensioning, and Adjustment of Vee-belt Drives

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALIGNMENT, TENSIONING, AND ADJUSTMENT OF VEE-BELT DRIVES</td>
</tr>
<tr>
<td>The following is recommended as a basis for alignment, tensioning, and adjustment of vee-belt drives. Contact your local Weir Minerals representative or belt supplier for further information on a specific product.</td>
</tr>
</tbody>
</table>

For optimum performance of vee-belts:
- Use only matched new sets of belts.
- Ensure that the belts lie within a range of two to four set numbers according to the belt length.
- Always place belts with the lowest code numbers closest to the bearings.
- Clean any oil or grease from the pulleys and remove any burrs and rust from the grooves before fitting the belts.
6.2.4.1 Alignment

If the alignment of the pulley is not correct, the belt flanks wear quickly. For correct alignment of pulleys:

- Reduce the centre distance by jacking the motor towards the pump using the jacking bolts supplied, until the belts can be put on the pulley grooves without forcing.
- Use laser alignment equipment.
- It is important to align the two pulleys to a tolerance whereby daylight is non-existent or at a minimum between the pulleys and the straight edge.

1. Shafts are not parallel to one another
2. Shafts are not in correct alignment although they appear parallel when seen from above
3. Shafts are parallel and in alignment, but pulleys are not in alignment
4. Correct installation - both shafts and pulleys are parallel and in alignment

The dotted lines emphasise the faults by indicating the correct position.

Figure 6-3: Shaft and Pulley Alignment

⚠️ CAUTION

RECHECK PULLEY ALIGNMENT

After pump impeller adjustments, recheck the pulley alignment and adjust as necessary before restarting the pump.
6.2.4.2 Tensioning

The proper tensioning of the belts ensures high performance and longer life for the belts and bearings. To ensure the proper tensioning of the belts, refer to Figure 6-4 and proceed as follows:

1. Measure the length of the span.
2. Apply a force at right angle to the belt at the centre of the span which is sufficient to deflect one belt by 16 mm per metre of span.

3. Compare the force required with the value stated in the Table 6-1 on page 37. If the measured force is within the values stated in the Table 6-1 on page 37, the belt tensioning must be satisfactory. If the force measured is below or above the value stated, the belt must be tightened or slackened respectively. Provision must be made for periodic checking of belt wear during the life of a belt and adjusting the belts to correct tension as necessary.

**CAUTION**

TENSIONING

- Under-tensioning of the drive causes vibration resulting in damage to the bearing cartridge, as well as the loss of transmission efficiency. It can also cause the belts to slip and overheat, resulting in belt fatigue and subsequently shortening the belt life.
- Over tensioning of belts also shortens their life. Also, bearings tend to overheat due to excessive radial forces on the rolling elements and this leads to premature bearing failure.

**NOTICE**

NEW BELTS

New belts must be tensioned at the higher level stated (using a vee-belt tension indicator) to allow for a drop in tension during the normal running period. New belts must be run under load for two hours, stopped, and the tension rechecked, resetting the adjustment to achieve the correct tension as necessary. During the first 24 hours running, it is recommended that a further check is carried out and the belts adjusted as required.
6.2.4.3 Adjustment

Check and adjust the tension of vee-belts after:

- New belts are fitted.
- A new installation is completed.
- A drive run for approximately two hours.

Check the drive subsequently, at regular maintenance intervals.

<table>
<thead>
<tr>
<th>Belt Section</th>
<th>Small Pulley Diameter (mm)</th>
<th>Force required to Deflect the Belt by 16 mm per metre of Span, newton (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPZ</td>
<td>56 to 95</td>
<td>13 to 20</td>
</tr>
<tr>
<td></td>
<td>100 to 140</td>
<td>20 to 25</td>
</tr>
<tr>
<td>SPA</td>
<td>80 to 132</td>
<td>25 to 35</td>
</tr>
<tr>
<td></td>
<td>140 to 200</td>
<td>35 to 45</td>
</tr>
<tr>
<td>SPB</td>
<td>112 to 224</td>
<td>45 to 65</td>
</tr>
<tr>
<td></td>
<td>236 to 315</td>
<td>65 to 85</td>
</tr>
<tr>
<td>SPC</td>
<td>224 to 355</td>
<td>85 to 115</td>
</tr>
<tr>
<td></td>
<td>375 to 560</td>
<td>115 to 150</td>
</tr>
<tr>
<td>A</td>
<td>80 to 140</td>
<td>10 to 15</td>
</tr>
<tr>
<td>B</td>
<td>125 to 200</td>
<td>20 to 30</td>
</tr>
<tr>
<td>C</td>
<td>200 to 400</td>
<td>40 to 60</td>
</tr>
</tbody>
</table>

Table 6-1: Vee-belt Tensioning Force Requirements

6.2.5 Alignment of Direct-coupled Pumps

**NOTICE**

ALIGNMENT OF DIRECT-COUPLED PUMPS

The following is recommended as a basis for alignment of direct-coupled pumps. MU pumps are not factory-aligned. Contact your local Weir Minerals representative for more information on a specific product.

In a direct-coupled drive, misalignment causes unnecessary vibration and wear on the bearings. Avoid rigid couplings (that is, couplings that bolt directly together without any flexible member in between) and do not use them without consultation with Weir Minerals Europe.
The following procedures outline a suggested practice for checking shaft alignment. This method is independent of the coupling or shaft and is therefore not affected by angled coupling faces or eccentricity of the outside diameter of the coupling.

**CAUTION**

INCORRECT SHAFT ALIGNMENT
Ensure that no damage occurs when the shaft of the driven unit is turned.

Before starting the alignment procedures:
1. Isolate the drive unit from the power supply.
2. Rotate each shaft independently to check that the shaft and bearings turn without undue friction and that shaft is true to within 0.04 mm or better as measured on a dial indicator.
3. Ensure that the couplings are loosely coupled, that is, each half must move freely relative to the other. Otherwise, it results in incorrect dial indicator readings.
4. Where tightly fitting pins or springs prevent loose coupling:
   a. Remove the pins or springs.
   b. Scribe a line across both half couplings and take the readings only when both the half couplings are aligned.
5. On couplings with a serrated rim, ensure that as the couplings are rotated, the gauge plungers do not fall into a groove and become damaged.

### 6.2.5.1 Angular Shaft Alignment

To ensure proper angular shaft alignment:
1. Refer to the left hand portion of Figure 6-5 on page 39 and clamp two dial indicators at diametrically opposite points (180 degrees) on one half coupling, with the plungers resting on the back of the other half coupling.
2. Rotate the couplings until the gauges are in line vertically, and set the gauges to read zero.
3. Rotate the couplings through half a revolution (180 degrees) and record the reading on each dial indicator. The readings must be identical though not necessarily zero because of possible end float. Either positive or negative readings are acceptable provided they are equally positive or equally negative. For the maximum allowable tolerance, refer to "Tolerances" and adjust the position of one of the units if necessary.
4. Rotate the couplings until the gauges are in line horizontally and reset the gauges to read zero.
5. Repeat Step 3 and adjust the unit position until the correct tolerance is achieved and no further adjustment is necessary.

### 6.2.5.2 Radial Shaft Alignment

To ensure proper radial shaft alignment:
1. Clamp a dial indicator to one half coupling or to the shaft, as shown in right hand portion of Figure 6-5 on page 39, with the plunger resting on the rim of the other half coupling.
2. Set the gauge to read zero.
3. Rotate the couplings and note the reading at each quarter revolution (90 degrees). Any variation in the readings indicate a deviation from alignment. In such cases, adjust the position of one of the units until the readings at each quarter revolution are identical or within the tolerances given (refer to "Tolerances" on page 39).

**NOTICE**

PROVISIONAL ALIGNMENT
Provisional alignment can be carried out with the unit cold. However, where the working temperature of the pump can raise the centre line of one machine relative to the other, allowances must be made. The units must then be realigned when each have attained their correct operating temperature.
6.2.5.3 Tolerances

Follow the manufacturer's recommendation, if recommendations are not available. Following are the variations which can be tolerated when checking alignment and are suggested as a general guidance.

- **Angular Alignment**
  - Couplings up to 300 mm diameter, 0.05 mm accuracy
  - Couplings more than 300 mm diameter, 0.07 mm accuracy
- **Radial Alignment**
  - Not to exceed 0.1 mm on dial indicator (that is, 0.05 mm eccentricity)

![Angular Shaft Alignment (parallelism of axes)](image1)

![Radial Shaft Alignment (intersection of axes)](image2)

*Figure 6-5: Angular and Radial Shaft Alignment*
### WARNING

**FLANGE LOADS MUST BE ZERO**

The suction and discharge flanges of the pump are brittle and can break if subjected to excessive external loads. Ensure that the specified flange seals are used and that the flange pipework / bellows units are correctly aligned and independently supported. The use of Tied-Compensator bellows units to reduce external flange loads is recommended.

---

*Figure 6-6: Tied-Compensator*

1. MU Pump  
2. Bolt  
3. Threaded Tie-bars  
4. Threaded Tie-bar Nuts  
5. Pipe Flange  
6. Nuts  
7. Tied-Compensator Unit
The guidelines for pipework are:

- Align the pipelines and valves correctly with pump flanges.
- Ensure the pipelines and valves are supported independently of the pump.
- Ensure all pipe designs are on the basis of zero pump flange loading. If this condition cannot be achieved, consult your local Weir Minerals representative to obtain values for the maximum allowable external loads and moments on the pump flanges.
- Use appropriate Weir joint rings (when required) at the pump flanges. The joint rings form an effective seal between pipework and pump casing.
- In some pumps, the metal liner projects a short distance past the flange. In such instances, do not overtighten the flange bolts to prevent the damage to the joint rings.
- Note that the removal of the intake pipe is facilitated if a flexible joint is used in the place of the flanged connection.
- Ensure that all pipe joints are airtight for correct priming of the pump.
- Consult your local Weir Minerals representative for recommendations and procedures related to inter-stage piping of multi-stage installations.

### NOTICE

**INTAKE PIPE LENGTH**

A removable piece of pipe must be used on the intake side of the pump. This pipe must be of sufficient length to allow removal of the pump casing and to enable access to pump wearing parts and impeller.

### 6.2.6.1 Observations

1. Do not use concentric reducer on pump suction as this may cause air lock.
   
   **Suction Pipe Size** - The diameter of the suction pipe must be sized according to the flow and allowable head loss in any case it must be equal in diameter to the pump inlet connection. If a pipe larger than the pump inlet is to be used, good practise stipulates that an eccentric reducer must be fitted to avoid the possibility of air pockets.

   ![Figure 6-7: Concentric (Not Recommended)](image)
   ![Figure 6-8: Eccentric (Recommended)](image)

2. All pipework must be correctly aligned and independently supported, pump flanges not to be overloaded. Pipework restraints must be saddles, rather than stands, such that axial and radial movement can be restrained.

3. Shim material selection to ensure that they do not corrode or compress.

4. Area must be kept clean to ensure safe working environment and effective use of pump set.
5. Never tamper with pump set construction. Modifications to pump set components result in catastrophic failure.

6. Always use cross pattern (180 degrees) for tightening bolts, for even pressure. Repeat sequence two-three times. Use calibrated torque wrench for correct tension.

![Bolting Sequence](image)

Figure 6-9: Bolting Sequence

7. Apply grease, anti-seize, or denso tape for bolts to allow easier removal when required.

### 6.2.7 Flanges

**CAUTION**

NO STRAIN SHOULD BE IMPOSED ON THE PUMP CASING EITHER BY WEIGHT OF PIPES OR BY TIGHTENING BADLY FITTED PIPES.

Special caution should be used on uncased pumps such as MU types. Experience has shown that such strain can seriously affect the alignment of the pumping unit.

- All pipework attached to the pump must be the correct size and fully supported.
- The mating faces of the pipe flanges must abut squarely, with all bolt holes in line. In joining the pipework to the pump on no account should excessive force be used as this could result in damaged castings and flange damage.
- Flange loads must be zero.
- A removable piece of pipe (preferably flexible on the intake side) should be fitted to the intake and discharge pipework. The removable intake/discharge pipes should be of sufficient length to allow removal of the casing for easy access when renewing worn parts.
6.2.8 Intake Conditions

**CAUTION**

**INTAKE PIPEWORK**
- Suitable isolation must be fitted in the intake pipe as near to the pump as possible.
- The intake pipe must be as short as possible.
- An arrangement of intake pipework which is common to two or more pumps operating on suction lift is not recommended.
- If such an arrangement is unavoidable, any points of possible air ingress such as valve glands must be liquid sealed and isolating valves must be fitted at appropriate points.

The diameter of the intake pipe required depends upon its length and bears no fixed relationship to the diameter of the intake branch of the pump. The size of the pipe must be such that the velocity is kept to a minimum, but above the solids particle critical settling velocity to reduce friction losses, that is a long intake pipe, (or one with numerous bends) which passes a given quantity of liquid must be of larger bore than a short straight one passing the same quantity of liquid.

**CAUTION**

**AIRTIGHTNESS OF PIPEWORK**
- When the bore of the intake pipe is increased to a size larger than that of the pump intake branch, the form of taper pipe used must not allow the formation of air pockets.
- To avoid air pockets, the installation of intake pipework must be arranged with as few bends as possible and the pipework must be completely airtight.

6.2.9 Delivery Conditions

A suitable isolation valve should be fitted in the delivery pipe as near to the pump as possible.

**CAUTION**

**USE WEIR JOINT RINGS**
When piping up the intake and discharge flanges of the pump it is important that the appropriate Weir joint rings be used. The joint rings form an effective seal between pipework and pump flanges. Care should be taken not to over-tighten the flange bolts. This prevents damage to joint rings.

**NOTICE**

**THE DISCHARGE PIPE MUST BE FULLY SUPPORTED**
Ensure the discharge pipe is fully supported.
7 Commissioning

This section is a general guide and is applicable to direct drive and belt drive complete pump units. This section also describes in detail, the:

- Pump commissioning steps
- Motor rotation check procedure
- Seal commissioning

Information on pump auxiliary equipment must also be referred as the details can vary with manufacturer or supplier.

7.1 Commissioning Safety

This section lists the safety guidelines to be followed while commissioning the pump.

<table>
<thead>
<tr>
<th><strong>DANGER</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PERSONNEL INJURY</strong></td>
</tr>
<tr>
<td>DO NOT STAND NEAR AN OPERATING PUMP DURING COMMISSIONING AS PUMP MAY FAIL DURING THIS PERIOD.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th><strong>DANGER</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>EXPLOSION</strong></td>
</tr>
<tr>
<td>EXCESS LOADING FROM THE DISCHARGE PIPE WILL CRACK THE PUMP CASING / PUMP CASING FLANGE. THIS CAN LEAD TO FATAL INJURIES IF THE PUMP CASING VIOLENTLY EXPLODES INTO FRAGMENTS OF HIGH- VELOCITY METAL.</td>
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<table>
<thead>
<tr>
<th><strong>DANGER</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PUMP OPERATING AT ZERO FLOW</strong></td>
</tr>
<tr>
<td>• DO NOT OPERATE THE PUMP AT LOW OR ZERO FLOW CONDITIONS, OR UNDER ANY CIRCUMSTANCES THAT CAUSE THE PUMPING LIQUID TO VAPORISE.</td>
</tr>
<tr>
<td>• THIS MUST NOT BE DONE UNDER ANY CIRCUMSTANCES FOR ANY SIGNIFICANT PERIOD OF TIME (MORE THAN 3 MINUTES) DUE TO THE RISK OF HEAT/ VAPORISATION OF PUMPED FLUID IN THE CASING THAT MAY CAUSE SUBSEQUENT EXPLOSION.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>WARNING</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HOT SURFACES</strong></td>
</tr>
<tr>
<td>Pump bearing assembly becomes hot during operation. Do not touch bearing assembly surfaces without taking appropriate precautions to protect against personnel injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CAUTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THERMAL SHOCK</strong></td>
</tr>
<tr>
<td>Be aware that thermal shock may damage pump components during priming.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CAUTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLANGE DAMAGE</strong></td>
</tr>
<tr>
<td>Over torquing of the flange bolts may cause flange damage.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CAUTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FIT JOINT RINGS</strong></td>
</tr>
<tr>
<td>Failure to fit joint can lead to slurry leakage.</td>
</tr>
</tbody>
</table>
7.2 Commissioning Steps

For a detailed commissioning checklist, refer to “Checklists” on page V.

Check the following before commissioning the pump:

1. Alignment and grouting of the baseplate unit.
   - Level baseplate within 1 mm per 1000 mm or less (for more information, refer to “Foundations” on page 33).

2. Shaft rotation:
   a. Remove any pump or motor shaft clamps.
   b. Check that the mechanical seal (if fitted) setting tabs are removed.
   c. Turn the shaft by hand to ensure that components turns freely.

   a. Start motor and check rotation. Correct if necessary to produce pump shaft rotation as indicated by the arrow on the pump casing.
   b. Reinstall vee-belts or shaft coupling.
   c. Align and tension vee-belts to the recommended settings of the manufacturer or as shown on Weir outline drawing for the specific unit or as per this manual.

**CAUTION**

TAPER LOCK
Check taper lock tension after first 3 hours of operation.

**CAUTION**

VIBRATION
Components may become loose under excessive vibration. Ensure tensioning and locking procedures are followed.

**WARNING**

PERSONAL INJURY
Based on the type of connection either remove all vee-belts or completely disconnect the shaft coupling. Apply Lock out and Tag out (LOTO).

**DANGER**

PUMP ROTATION DIRECTION
ROTATION IN THE OPPOSITE DIRECTION AS INDICATED BY THE ARROW ON THE PUMP UNSCREWS THE IMPELLER WHICH MAY LEAD TO CATASTROPHIC DAMAGE.

a. Start motor and check rotation. Correct if necessary to produce pump shaft rotation as indicated by the arrow on the pump casing.

b. Reinstall vee-belts or shaft coupling.

c. Align and tension vee-belts to the recommended settings of the manufacturer or as shown on Weir outline drawing for the specific unit or as per this manual.

**WARNING**

REPLACE GUARDS
Guards removed for maintenance and other purposes must be replaced and secured prior to operating the pump.
4. Impeller adjustment:
The impeller is factory-set with a minimum running gap between the impeller and the pump casing. If required for any reason, check and readjust the impeller. For impeller checking and readjustment procedure, refer to “Impeller Adjustment” on page 104.

5. Pipework

Ensure that the:

a. Pipework is correctly aligned with the pump and is supported independently of the pump.
b. Weir joint rings are in the correct position on pump intake and discharge flanges. The pipe flanges to support joint rings must be flush.
c. Isolating valve is fitted on intake pipe and/or pipe spools are correctly positioned close to the pump.
d. Intake pipe is as short as possible.
e. Air pockets are avoided by correct installation of any reducers in the intake pipe.

6. Fasteners:
Check that all the fasteners are tight, particularly the:

• Bearing housing and pump base hold down bolts
• Bearing assembly adjusting screw
• Foundation bolts

7. Cabling and piping Gland Seal Water (GSW)

The following are the commissioning steps normally done with clean water:

1. Turn GSW ON:
   Turn ON the GSW supply and check that there is sufficient pressure and flow.

2. Priming the pump:
   Open the inlet valve and allow the pump to flood.

3. Turn the pump ON:
   a. Check whether pump starts correctly and runs smoothly.
   b. Open the discharge valve before start-up.
   c. If faults occur, check for possible cause as mentioned in “Troubleshooting” on page 80.
   d. Check and adjust gland leakage as required.
4. Monitor performance:
   Check operating parameters are within limits as mentioned in Table 9-1 on page 67.

5. Turn the pump OFF:
   a. Close the discharge valve.
   b. Turn OFF the pump and allow to stop. Close the intake valve (if any).
   c. Turn OFF GSW supply.

7.2.1 Avoidance of Impeller Loosening - Runback and Reverse Rotation

The loosening of the impeller can be avoided by checking the direction of rotation of pump and impeller before starting the pump. This section describes this aspect in detail.

7.2.1.1 Correct Direction of Rotation and Input Torque via Pump Shaft

Each MU pump impeller features a right-hand impeller thread in its boss and engaged to the pump shaft, which is screwed to suit the impeller thread. The correct driven direction of rotation of the impeller when viewed from the intake end of the pump is anticlockwise for all standard MU impellers as shown in Figure 7-1.

![Figure 7-1: Impeller Tightening](image-url)

DANGER

OVERPRESSURE IN PUMP

- PUMPS THAT ARE NOT FITTED WITH AN OVER PRESSURE RELIEF DEVICE ARE AT RISK OF GENERATING EXCESSIVE PRESSURES AND TEMPERATURES WHEN RUN WITH RESTRICTED OR NO DISCHARGE FLOW, SUCH AS AGAINST A CLOSED DISCHARGE VALVE.
- THE SYSTEM DESIGN SHOULD INCLUDE SUITABLE PRESSURE RELIEF MEASURES AND OPERATION WITH RESTRICTED DISCHARGE FLOW MUST BE LIMITED SUCH THAT THE STATIC PRESSURE LIMIT OF THE PUMP IS NOT EXCEEDED.
- SUITABLE PRESSURE RELIEF MUST BE INCLUDED IN THE PIPEWORK.
The correct rotation of the pump is indicated by a small adhesive label (yellow colour) on the wet-end of the bearing housing (Figure 7-2).

![Figure 7-2: Rotation Direction Arrow shown on Pump Casing](image)

When the impeller is driven in the correct direction by the pump shaft, torque is applied to the impeller. This torque reinforces the fastening of the impeller to the shaft.

### 7.2.1.2 Incorrect Direction of Rotation and Input Torque via Pump Shaft

If power is transmitted to the impeller via the pump shaft in the incorrect (clockwise) direction of rotation as shown in Figure 7-3, the torque unscrews the impeller from the shaft.

![Figure 7-3: Impeller Loosening](image)

Perform the motor rotation test referring to “Motor Rotation Check (Jog Test)” on page 51. The danger of an impeller loosening is present regardless of whether the pump is started empty or when containing liquid or slurry.
7.2.1.3 Effects of Unrestricted Runback and Reverse Rotation

Under certain conditions, the impeller can unfasten from the drive shaft and cause the rotational motion of the impeller to stop momentarily. This is a dangerous condition that can allow leakage to occur past the impeller O-ring and enter the bearing assembly. Also, at the next pump start-up the pump shaft would very rapidly screw the loosened impeller back towards its fastened position. The impact of this rapid axial movement can cause significant damage to the shaft sleeve, bearing assemblies and other components.

To avoid these unwanted events, please read and observe the following safety notices below.

**DANGER**

**PUMP MOTOR START-UP ROTATION DIRECTION IMPELLER UNSCREW**

- BEFORE INITIAL PUMP START-UP, FOR EXAMPLE DURING COMMISSIONING OR AFTER MOTOR REPLACEMENT OR MAINTENANCE, THE MOTOR MUST BE MECHANICALLY DISCONNECTED FROM THE PUMP BY REMOVAL OF THE DRIVE BELTS, OR COUPLING IF DIRECT DRIVEN. START THE MOTOR AND CHECK THAT THE ROTATION DIRECTION IS CORRECT TO PRODUCE THE IMPELLER ROTATION INDICATED BY THE ARROW ON THE PUMP CASING. ONLY THEN CAN THE DRIVE BELTS OR COUPLING BE FITTED.

- THE PUMP SHOULD NEVER BE STARTED WITH THE MOTOR ROTATING IN THE WRONG DIRECTION EVEN FOR A SHORT TIME PERIOD AS THIS WILL UNSCREW THE IMPELLER FROM THE SHAFT.

**WARNING**

**IMPELLER UNSCREWING CAUSED BY HIGH STATIC SUCTION HEAD**

- If the pump is in a stopped position and the pump is exposed to a high static suction head caused by slurry flows from a high level header tank or a pumping system, then this can drive the impeller rotation in the (correct) direction. However, the impeller will lead the shaft rotation which itself may be subjected to inertia drag from the motor drive system. In such a scenario, it would be possible for the impeller to unscrew itself from the shaft (loosen).

- This type of event is infrequent but can be encountered when the suction side static head is greater than the discharge side static head. For example, when the discharge side of the pump system has been drained.

**WARNING**

**REVERSE IMPELLER ROTATION AFTER PUMP STOP**

- After normal running and the pump has stopped, slurry flowing back into the discharge side of the pump can cause the impeller to reverse rotation causing it to act like a turbine rotor. This can lead the casual observer to falsely believe that the reverse rotation through its threaded connection will unscrew the impeller from the shaft. This is incorrect. The reverse rotation causes the impeller to screw itself tighter onto the shaft and drives the motor drive system in reverse.

- However, if the impeller is stopped or slowed down then it would be possible to unscrew the shaft from the impeller due to the motor drive system inertia, which continues to rotate the shaft.
**WARNING**

**EXCEEDING ROTATIONAL SPEEDS**

- Catastrophic failure of components and the drive system may occur if excessive rotational speeds are encountered. Such speeds could be attained, for example when shutting a pump down when it has been pumping against a pressurised system, fluid in this situation may flow back through the pump under pressure causing it to turbine.
- Another example could be failure of an inverter drive allowing possible over speed. Runback flows should be controlled by draining or throttling valves to restrict flow.

**CAUTION**

**ENSURE COMPLETE SYSTEM DE-PRESSURISATION**

Always ensure complete system de-pressurisation. Unrestricted fluid runback would not occur if there was no differential pressure between the suction and discharge sides of the pump.

**CAUTION**

**STATIC HEAD**

For any proposed application where the system static head exceeds 50m and the length of the discharge pipeline exceeds 200m, contact your local Weir Minerals representative for specific advice regarding precautions required to avoid these problems.
7.3 Motor Rotation Check (Jog Test)

Check drive rotation before vee-belts or shaft couplings are connected. The correct pump rotation is indicated by an arrow on the bearing housing (yellow adhesive label).

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP ROTATION DIRECTION</td>
</tr>
<tr>
<td>ROTATION IN THE OPPOSITE DIRECTION AS INDICATED BY THE ARROW ON THE BEARING HOUSING (YELLOW ADHESIVE LABEL) WILL UNSCREW THE IMPELLER WHICH MAY LEAD TO CATASTROPHIC DAMAGE.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAND INJURY</td>
</tr>
<tr>
<td>Never touch the rotating elements with your hands to establish the direction of rotation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP ROTATION DIRECTION</td>
</tr>
<tr>
<td>Always check the direction of the pump shaft and not the gearbox input shaft which may be in the opposite direction and is the incorrect direction for the pump.</td>
</tr>
</tbody>
</table>

Perform the following test, before operating the pump after any maintenance. This is to ensure that the direction of rotation of the pump is correct.

1. Isolate the drive unit power supply.
2. Remove the vee-belt / coupling guarding.
3. Remove the vee-belts / coupling. Ensure the motor shaft key is secure or removed.
4. Erect a safety barrier at 1m distance all around the drive unit.
5. Reconnect the drive unit power supply.
6. Stand behind the safety barrier and turn ON the motor and then immediately turn OFF.
7. Observe and confirm the direction of the motor pulley.
8. Isolate the drive unit from the power supply.
9. Replace the vee-belts and tension them / reconnect the coupling.
10. Replace the vee-belt / coupling guarding.
11. Reconnect the drive unit to the power supply.
7.4 Gland Seal Water (GSW)

This section provides the following information on the gland seal water (GSW) seal:
- Flow and pressure requirements
- Adjustment
- Controls
- Quality requirements

The GSW supply must be steady as pressure fluctuations make gland adjustment for optimum performance difficult.

Glands must be adjusted to provide reasonable leakage when GSW pressure is at a minimum and therefore when this pressure rises, leakage is necessarily excessive. If glands are adjusted to provide optimum leakage at the higher GSW pressures, insufficient lubrication is obtained when this pressure falls.

The GSW must be as clean as possible as even small amounts of solids can quickly wear gland components. Requirements for gland operation on the first stage of a multi-stage installation are different from the other stages. The GSW for the first stage pumps must:
- Flush slurry away from the shaft sleeve.
- Provide lubrication for the gland packing.
- Pressurise the gland to prevent ingress of air when the pressure at the shaft falls below atmospheric pressure.

For the second and succeeding stages, the GSW is only required to flush slurry away from the shaft sleeve and provide lubrication for the gland packing.

Check the GSW supply and discharge periodically. Always maintain a very small amount of clean water leakage along the shaft by regularly adjusting the gland. When gland adjustment is no longer possible, replace all packings with new ones.

GSW requirements can be reduced to a minimum using Weir low flow lantern restrictor (refer to Figure 7-4).

![Figure 7-4: Gland Seal Arrangement](image-url)

1. Lantern Restrictor
2. Stuffing Box
3. Gland
4. Packing
5. Shaft Sleeve

Type 1 - Restricted Flow

*Figure 7-4: Gland Seal Arrangement*
7.4.1 GSW Flow and Pressure Requirements

Gland seal water (GSW) must be supplied at the correct pressure and flow to achieve a long packing and sleeve life. Correct pressure is the most critical requirement to achieving satisfactory gland life. Flow is the next most important requirement. Flow is governed to some extent by the gland dimensions and also is adjustable within limits by means of the gland adjustment using the gland nuts.

The GSW pressure must be controlled to acceptable limits. For normal gland operation, the GSW pressure must be set at +35 kPa to +70 kPa more than the pump discharge pressure. This ensures that water enters the gland with sufficient pressure to flush solids away.

If the GSW pressure is too low, the pump pressure can force slurry into the gland and even up into the GSW pipe and possibly into the GSW pumps. This is to be avoided.

GSW pressure that is too high causes extrusion of the packing at the gland and wet-end of the stuffing box. Extrusion of packing causes both the degradation of the packing and less flow from the gland overtime. Both these conditions lead to packing failure. GSW pressure which is up to 200 kPa more than the pump discharge pressure must not cause too much degradation although the packing life is likely to be greatly reduced. Hence, avoid high pressures.

The recommended, minimum total GSW flows for standard applications are provided in Table 7-1 on page 54.

7.4.1.1 GSW Gland Adjustment

**WARNING**

**PRESSURE LOSS DUE TO FLOW CONTROL**
A flow control device on the GSW line causes a significant pressure drop (about 140 kPa for a Maric flow control valve).

**DANGER**

**TOXIC VAPOURS FROM GLAND**
- VAPOURS CAN LEAK PAST GLAND GUARDS.
- APPROPRIATE RISK ASSESSMENT MUST BE MADE REGARDING THE NATURE OF THE PRODUCT IN THE PUMP AND NECESSARY SAFETY PRECAUTIONS PUT IN PLACE TO PROTECT FROM EXPOSURE TO PRODUCT VAPOURS.

**WARNING**

**GLAND ADJUSTMENT**
During gland seal adjustment the fixed guard needs to be removed while the pump is operational. When the guard is removed, the rotating shaft is exposed. Additional safety management measures must be implemented to manage this specific hazard and only suitable trained and qualified personnel must work on gland adjustment. The guard must be replaced when adjustment is complete.

**NOTICE**

**OPERATIONAL PUMP**
The pump must be running for gland adjustment procedure.

New pumps are normally supplied with the GSW gland follower loosened. This is to avoid compression of the gland packing before the pump is commissioned into service. GSW gland seal adjustment must only be undertaken by trained and qualified personnel in accordance with safety control procedures.

Follow this procedure;

1. Ensure that the pump is running and that the gland seal water is available at the correct pressure.
2. Remove the gland guarding and fixings.
3. Adjust the gland so that gland seal water flow is high and plenty of water is visually observed coming from the gland (This step can be omitted for routine gland adjustment procedure).

4. Use a ring spanner to adjust the gland by rotating clockwise each gland bolt by approximately 60 degrees (or one flat position) in alternate sequence, do not reduce flow too low during first period of operation.

5. Allow gland to bed-in and re-check gland operation at the second start-up and period of operation.

6. Gradually adjust the gland and visually monitor the leakage. It should be a steady trickle of gland seal water and not contain any slurry. The recommended available water flow rates are shown in Table 7-1. Ensure that flow from the gland is maintained at all times when the pump is running indicating lubrication and cooling to the packing wear faces.

7. Replace the gland guarding and fixings.

To adjust the gland:
1. Ensure the pump is running.
2. Remove gland guarding.
3. Adjust gland bolts to maintain recommended flow rate as shown in Table 7-1.
4. Replace gland guarding.

Figure 7-5: Gland Adjustment

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Type 1 - Restricted Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New GSW flow values (L/min)</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
</tr>
<tr>
<td>D</td>
<td>9</td>
</tr>
<tr>
<td>E</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 7-1: GSW Flows (L/min)
7.4.2 GSW Control Devices

There are different GSW control devices that can be used:

- Visual flow indicator
- Throttle valve
- Constant flow orifice valve
- Combined rotameter
- Flow regulator or selected length of capillary throttling tube
- Positive displacement pump

The most common type is a constant flow orifice valve. This maintains a reasonably constant flow into a gland irrespective of the GSW pressure.

The constant flow orifice valve is generally useful when there is considerable fluctuation in the GSW pressure. It can also assist when a group of pumps are fed by one GSW line and one or more pumps are not operating or they have worn glands. In this instance, it can prevent starvation of GSW on the pumps which are operating.

7.4.2.1 Requirements for GSW Quality

Water used for gland sealing must be clean and generally have the properties that are mentioned in this section. Failure to observe these conditions results in excess time and effort being spent on gland maintenance.

Suspended and Dissolved Solids

- Water quality is an extremely important factor in gland seal operation. The recommended water quality specification is pH 6.5 - 8.0.

Solids Content

- Dissolved - 1,000 ppm (mg/L)
- Suspended - 100 ppm (mg/L)
- 100% of +250 mesh (60 μm) particles removed

Maximum Individual Dissolved Ions

- Hardness (Ca\(^{+}\), Mg\(^{+}\)) 200 ppm (mg/L) as CaCO\(_3\)
- Calcium Carbonate (CaCO\(_3\)) 10 ppm (mg/L)
- Sulphate (SO\(_4^{2-}\)) 50 ppm (mg/L)
- Chloride (Cl\(^{-}\)) 1,000 ppm (mg/L)

Inadequate or Excessive GSW Pressure

- Inadequate GSW pressure results in contamination of the packing by the pumped slurry.
- Once solids are imbedded in the packing, they cannot be flushed out and the packing must be replaced.

**CAUTION**

GSW PRESSURE

GSW pressure must be +35 kPa to +70 kPa above the stuffing box pressure. GSW pressure in excess of this results in more wear on the packing and shaft sleeve.

Inadequate Flow

- Inadequate flow results in contamination of the packing by the pumped slurry.
- A low pressure pump starves the higher pressure pump of GSW. Flow to each gland must be controlled.

To achieve the flow limits (refer to Table 7-1 on page 54), it may be necessary to filter the water to reduce any solids content as low as reasonably practicable.

**DANGER**

GSW FLOW

THE GSW SUPPLY MUST BE RELIABLE, AS SLURRY PUMPS MUST NOT BE OPERATED WITHOUT GSW SUPPLY.
7.5 Centrifugal Seal

New pumps are supplied with the centrifugal seal gland followers loosened. This is to avoid undue compression of the gland packing before the pump is commissioned into service. When the pump is running, there should be no leakage of fluid from the shaft seal. If there is leakage and it is persistent, then contact WME for further advice.

The centrifugal seal gland adjustment must only be undertaken by suitably trained and qualified personnel in accordance with safety control procedures.

When the pump is stopped there may be leakage of fluid from the centrifugal seal. If the leakage is excessive, then lubricate the seal by rotation of the grease cup: Two complete turns are recommended.

If excessive leakage persists, follow this procedure;

1. Ensure the pump is stopped and isolated from power.
2. Remove the seal guarding and fixings.
3. Tighten the gland follower bolts by rotating each bolt clockwise by approximately 60 degrees (one flat position) in alternate sequence until the leakage of liquid from the gland is reduced to a steady trickle. Do not overtighten the bolts as this will cause the packing to come into contact with the shaft sleeve and generate heat during pump operation.
4. Replace the gland guarding and fixings.
5. Run the pump and observe for any smoke or steam indicating that the packing is in contact with the shaft, if this is found repeat the above procedure until the correct gland seal tightness has been reached.
6. If excessive leakage of fluid during running still persists, repack the complete seal assembly (refer “Centrifugal Seal” on page 100).
7.6 Mechanical Seal

For pumps fitted with a mechanical seal, follow the assembly and maintenance instructions supplied by the manufacturer.

⚠️ CAUTION

**MECHANICAL SEAL TABS**

- For pumps fitted with mechanical seals always follow the appropriate instruction manuals.
- Always remove the mechanical seal setting tabs prior to starting the pump.
- Failure to remove the tabs will result in damage to both the pump and the seal.
- Ensure that the grub screws are tight before removing the setting tabs.

7.7 Check and Tighten all Nuts and Bolts

Although MU pumps are carefully assembled in the factory before they are supplied, precise balance cannot be achieved in operation because of the uneven wear that can take place. Pumps are therefore subject to some vibration while running. This can result in the loosening of some bolts. It is recommended that a routine maintenance program be established and checks are made at regular intervals to ensure that all the fasteners are tight. To avoid any possible movement between the bearing assembly and the base, the bearing housing clamp bolt must be always fully tightened. If any location is found where bolts consistently loosen, nylock nuts, or other suitable locking devices must be fitted.

7.8 Labyrinth Grease Purging

To improve the sealing properties of the labyrinths on the end covers of some types of Weir bearing assemblies, grease purging is utilised to purge out grit and moisture. Preventing the ingress of contaminants into the bearing assembly results in longer bearing assembly life, and ultimately cost savings for your company. Therefore, careful attention paid to labyrinth purging is an essential maintenance requirement. For more information, refer to “Lubrication” on page 72.

7.9 Bearing Assembly Lubrication

A correctly assembled and pre-greased bearing assembly has a long trouble-free life, provided it is protected against ingress of water or other foreign matter and that it is adequately maintained.

It must be left to the good judgement of maintenance personnel, to open bearing housings at regular intervals (not longer than 12 months) to inspect bearing assembly and grease, to determine the effectiveness of the re-lubrication program and to make any adjustments to the program for the period up to the next inspection.

In the case of infrequent bearing assembly re-greasing being required, the bearing assembly grease plug can be temporarily replaced with grease nipples at the time of greasing.

If a regular addition of grease is judged to be necessary, then the plugs on the bearing assembly must be replaced with grease nipples. It is preferable to lubricate often and sparingly, than to add large amounts at long intervals.

⚠️ NOTICE

**LUBRICANT USAGE**

- Use only recommended and clean grease.
- Bearing assemblies must NEVER be lubricated with excessive grease amounts!
8 Operation

This section describes the:

- Safety guidelines to be followed while operating the pump.
- Procedures to be followed before pump start-up, such as priming.
- Pump start-up procedures.
- Problems that may occur during pump start-up.
- Pump shut-down procedures.
- Information on glands, impeller adjustment, maximum allowable pressures, and bearing fault frequencies.

The principal requirements for operation of MU pumps are:

- Priming arrangements to raise water in the intake pipe and fill the pump.
- GSW provided at adequate pressure and flow.
- Wearing parts replaced when performance falls below required operating pressure.
- All applicable seals maintained to prevent leakage.
- Grease purged labyrinths (where used) lubricated regularly to prolong bearing life by removing dust and dirt from the bearing assembly.

8.1 Operation Safety

**DANGER**

**MONITOR PUMP PERFORMANCE**

INADEQUATE MONITORING OF TEMPERATURE, FLOW, PRESSURE AND VIBRATION CAN CAUSE EXTREMELY HAZARDOUS SITUATIONS TO DEVELOP. THIS CAN LEAD TO THE CATASTROPHIC FAILURE OF THE PUMP AND EXPOSE PERSONNEL TO POTENTIALLY LETHAL RISKS. WEIR MINERALS RECOMMENDS FOLLOWING ISO STANDARDS FOR PUMP MONITORING.

**WARNING**

**LARGE SIZE PUMPS**

The operation and maintenance of the large pumps has an increased risk due to the size and weights of components as well as the physical size of the complete pump unit.

**WARNING**

**GLAND ADJUSTMENT**

During gland seal adjustment the fixed guard needs to be removed while the pump is operational. When the guard is removed, the rotating shaft is exposed. Additional safety management measures must be implemented to manage this specific hazard. Only suitably trained and qualified personnel must work on gland adjustment. The guard must be replaced when adjustment is complete.

**CAUTION**

**SOLIDS IN SLURRY INCREASE PUMP WEAR**

- Large foreign objects or tramp entering a pump will increase the incidence of higher wear and/or damage to the pump.
- Routine inspection and maintenance of mill trommel screens will assist to reduce the danger of grinding balls entering a mill discharge pump.
8.2 Shaft Seal Adjustment

⚠️ **DANGER**

TOXIC VAPOURS FROM GLAND
VAPOURS CAN LEAK PAST GLAND GUARDS.
APPROPRIATE RISK ASSESSMENT MUST BE MADE REGARDING THE NATURE OF THE PRODUCT IN THE PUMP AND NECESSARY SAFETY PRECAUTIONS PUT IN PLACE TO PROTECT FROM EXPOSURE TO PRODUCT VAPOURS.

⚠️ **WARNING**

GLAND ADJUSTMENT
During gland seal adjustment the fixed guard needs to be removed while the pump is operational. When the guard is removed, the rotating shaft is exposed. Additional safety management measures must be implemented to manage this specific hazard and only suitable trained and qualified personnel must work on gland adjustment. The guard must be replaced when adjustment is complete.

⚠️ **WARNING**

MECHANICAL SEAL AND PUMP DAMAGE
Remove the mechanical seal setting tabs and torque the locking collar fasteners to the specified values prior to starting the pump, otherwise serious seal and pump damage could result.

For gland seal water pumps, check that GSW is available and is of sufficient quantity and correct pressure. GSW pressure must be approximately 35 kPa above the pump discharge pressure. GSW pressure must not exceed 200 kPa above the pump discharge pressure, otherwise reduced gland packing life could occur.

### 8.2.1 Gland Seal Water (GSW) gland seals

To adjust the GSW seal, loosen the gland follower and then adjust it so that a low flow of GSW is visually observed exiting from the gland and running along the shaft. Refer to “Gland Seal Water (GSW)” on page 52.

### 8.2.2 Centrifugal Seal gland seals

For centrifugally sealed pumps, screw the grease cup down a few turns to charge the static seal chamber with grease. Refer to “Centrifugal Seal” on page 56.

### 8.3 Priming

Gland Seal Water (GSW) must be supplied to the pumps and turned on prior to start-up. To ensure trouble-free operation of glands, the GSW pressures must be at least 35 kPa higher than the pump’s operating discharge pressure.

Arrangements for raising water in the intake pipe and filling the pump, or first stage of a multi-stage installation, must be provided in preparation to starting-up.

⚠️ **NOTICE**

GSW
GSW must be turned on and continuously supplied during all subsequent operations, namely, start-up, running, shut-down, and runback. GSW may be turned OFF only after shut-down and then only after all the slurry in the pipeline has drained back to the pit.
8.4 Normal Pump Start-up

**CAUTION**

**BLOCKED IMPELLER**

Do not operate the pump if solids have settled and the rotating element cannot be turned by hand.

1. Check once more that all the bolts are tight and that the impeller turns freely. Ensure that shaft seal is in order and the pressure of GSW, where used, is correct.

**DANGER**

**ISOLATE PUMP BEFORE ANY MANUAL WORK**

BEFORE APPLYING MANUAL TORQUE TO THE PUMP SHAFT, ENSURE THAT THE INTAKE AND DISCHARGE LINES ARE ISOLATED AND THAT THE MOTOR IS DISCONNECTED.

2. It is good practice whenever possible to start-up pumps on water before introducing solids or slurry into the stream.

3. Open intake valve (if any) and check that water is available at the inlet. Check drain valve (if any) is closed.

4. If a discharge valve is installed, it is a common practice to close it or slightly open for start-up. This is however mandatory only in some special cases, where the motor could overload.

**DANGER**

**OVERPRESSURE**

IF A DISCHARGE VALVE IS INSTALLED AND IS TURNED TO THE CLOSED POSITION, THIS CAN LEAD TO A LETHAL INCREASE OF HEAT, STEAM AND PRESSURE IN THE PUMP. THIS WILL CAUSE THE PUMP TO VIOLENTLY EXPLODE AND SHATTER INTO LETHAL FRAGMENTS OF HIGH-VELOCITY METAL.

5. Start pump and run to operating speed. If the pump is on suction lift, execute priming procedure for facilities provided. When the pump is priming, isolate priming facilities (if any). Open discharge valve. Monitor intake and discharge pressures and flow (if gauges are provided).

6. Check gland leakage - If leakage is a constant flow, tighten the gland nuts until the flow is dripping at the required rate. If leakage is insufficient and the gland shows signs of heating, then try loosening the gland nuts. If this is ineffective and the gland continues to heat up, stop the pump and allow gland to cool. Do not loosen the gland nuts to such an extent that the gland follower is allowed to disengage the stuffing box.

**WARNING**

**GLAND ADJUSTMENT**

During gland seal adjustment the fixed guard needs to be removed while the pump is operational. When the guard is removed, the rotating shaft is exposed. Additional safety management measures must be implemented to manage this specific hazard and only suitable trained and qualified personnel must work on gland adjustment. The guard must be replaced when adjustment is complete.

**CAUTION**

**HOT GLAND LEAKAGE WATER**

It is normal for gland leakage water to be hotter than the supply because it is conducting away the heat generated by friction in the gland. Take care, as this gland water may be hot enough in some operating conditions to cause a risk of scalding.
At low pressures (single stage operation) very little leakage is required and it is possible to operate with only a small amount of water issuing from the gland. It is not essential to stop a pump because of gland heating unless steam or smoke is produced.

This difficulty is normally only experienced on initial start-up on gland sealed pumps. When initial heat up of the gland is encountered, it is only necessary to start-up - stop - cool and start the pump two or three times before the packing beds-in correctly and the gland operates satisfactorily.

It is preferable at start to have too much leakage than not enough.

After the pump has run for 8 to 10 hours, gland bolts can be adjusted to give optimum leakage (refer to Table 7-1 on page 54). If heating of the gland persists, the packing must be removed and the gland repacked.

MU pumps are normally packed with non-asbestos packing, Weir material code Q05.

8.5 Abnormal Start-up

If the pump fails to operate, one or more of the following faults below may be the cause;

8.5.1 Blocked Intake or Discharge Pipe During Start-up

When the pump has not been operated for some time, it is possible for slurry to settle in the intake pipe or around it if operating from a pit and thereby prevent water flow to the pump. Open the bleed valve just before the intake flange, to see if the water is at the pump intake before start-up.

8.5.2 Air Entering Gland

If one of the following conditions applies, air may have entered into the pump through the gland. This may prevent the pump from priming or cause it to lose its suction during operation.

- GSW pressure too low.
- Packing is excessively worn.
- Shaft sleeve is excessively worn.
- GSW connection into stuffing box is blocked.
- High suction lift causes air intake through the gland.

Inspection of the gland will reveal above faults.
8.5.3 Slurry Settlement in the Pump

If on pump start-up the motor trips, or if abnormal noises and vibrations are observed, the pump should be shut-down immediately. This could indicate that slurry has settled within the pump. This will prevent free impeller rotation. If any of these events occur, perform the following steps:

Follow this procedure;

1. Isolate the pump from its driver and the pumping process.
2. Remove the belt/coupling guard.
3. Manipulate the drive belts or pump shaft by hand causing a rocking motion to the impeller until it is free to rotate.
4. Return the belt/coupling guards and follow the normal start-up procedures (refer to “Normal Pump Start-up” on page 60).
5. If the impeller cannot be freed then further investigation, pump disassembly and cleaning may be required.

8.6 Operating Faults

The major faults that can occur are described in this section.

8.6.1 Overloading

Overloading can occur when the pump is discharging into an empty system as the delivery head will be temporarily lower and the throughput will be in excess of that for which the pump is designed. Careful regulation of the delivery valve until the system is fully charged will prevent this (refer to “Fault Finding Chart” on page 84).

![DANGER]

OVERPRESSURE IN PUMP

- PUMPS RUN AT ZERO FLOW WILL LEAD TO A LETHAL INCREASE OF HEAT, STEAM AND PRESSURE IN THE PUMP. THIS WILL CAUSE THE PUMP TO VIOLENTLY EXPLODE AND SHATTER INTO LETHAL FRAGMENTS OF HIGH-VELOCITY METAL.
- PUMPS THAT ARE NOT FITTED WITH AN OVER PRESSURE RELIEF DEVICE ARE AT RISK OF GENERATING EXCESSIVE PRESSURES AND TEMPERATURES WHEN RUN WITH RESTRICTED OR NO DISCHARGE FLOW, SUCH AS AGAINST A CLOSED DISCHARGE VALVE.
- THE SYSTEM DESIGN MUST INCLUDE SUITABLE PRESSURE RELIEF MEASURES AND OPERATION WITH RESTRICTED DISCHARGE FLOW MUST BE LIMITED SUCH THAT THE STATIC PRESSURE LIMIT OF THE PUMP IS NOT EXCEEDED.
- SUITABLE PRESSURE RELIEF MUST BE INCLUDED IN THE PIPEWORK.

8.6.2 Low Pit Level During Operation

Pumps (or first stage pumps in a multi-stage installation) may lose suction if air enters through the gland. Pumps may also lose their suction if the water level in the pit falls sufficiently low to allow air to enter into the pump intake by vortex action.

In order to obtain the best possible pump operation, sump (or hopper) make-up water controls must be arranged to maintain and control as high a level in the sump (or hopper) as runback requirements will allow.
8.6.3 Blocked Intake Pipe During Operation

It is possible during operation of pump for a piece of foreign material to be drawn across the bottom of the intake pipe and thereby cause a partial obstruction. Such an obstruction may not be sufficient to stop operation completely but will result in a reduced output from the pump. It will also cause a drop in discharge pressure and motor current, and will increase the vacuum reading on the pump intake. Rough running and vibration of the pump may also occur due to the high induced suction causing cavitation within the pump.

8.6.4 Blocked Impeller During Operation

Impellers are capable of passing a certain size particle. If a particle larger in size enters the intake pipe it may become lodged in the eye of the impeller thereby restricting the output of the pump. Such an obstruction will usually result in a drop in motor current and a drop in both discharge pressure and intake vacuum readings. Pump vibrations will also occur due to the out of balance effects.

8.6.5 Blocked Discharge Pipe During Operation

Blocked discharge pipe may be caused by abnormally high concentration of coarse particles in the pump discharge pipe or by the velocity in the discharge pipe being too low to adequately transport the solids. Such a blockage will be shown up by a rise in discharge pressure and a drop in motor current and intake vacuum readings.

8.7 Pump Shut-Down

To shut-down a pump:

1. Isolate the slurry feed from the pump.
2. Flush the pump with clean water.
   a. For small to medium pumps, flush the pump for 10 to 15 minutes.
   b. For large pumps, flush the pump for 15 to 20 minutes.
3. Isolate the flushing water from the pump.
4. Shut-down the pump.
5. Close the discharge valve.
6. De-pressurise the pump suction.
7. GSW (if any) must be left ON during all subsequent operations; start-up, running, shut-down, and runback.
8. Shut-down the GSW supply.

8.8 Glands

For information on glands, refer to “Gland Seal Water (GSW)” on page 52.
8.9 Bearing and Impeller Tip Speeds

Contact your local Weir Minerals representative for maximum bearing and impeller tip speeds.

8.10 Maximum Allowable Pressures

The following are the characteristics of the maximum allowable pressures:

1. All pressures are in units of kPa.
2. Standard materials of construction and Weir material codes are indicated for each pump type.
3. Maximum allowable pressures are tabulated for the following standard conditions:
   - Slurry is not corrosive and will not affect pump material properties.
   - Normal ambient and slurry temperatures (-10 °C to +40 °C).
   - Static test pressures applicable to pumps in new condition.
   - Working pressures allow for normal wear which is for liners or casings worn to approximately half thickness.
   - Pumps under cover or protected from weather (rain, snow, ice, etc.) pressures remain steady with no pressure surges or such effects from water hammer, etc.
4. Static pressure tests on centrifugally sealed pumps are not possible. To test the pump casing, the pump must be assembled as gland seal unit.
5. Materials
   - The MU pump casing is only available in A05 material. All other wearing components are A61.
6. A05 brittle-type materials are used for expeller rings, stuffing boxes, and mechanical seal adaptors.
   - Typically, pumps with A05 stuffing box:
     - Maximum allowable working pressure = 700 kPa
     - Maximum allowable static test pressure = 1,050 kPa

8.11 Bearing Fault Frequencies for Conditioning Monitoring

Contact your local Weir Minerals representative for bearing fault frequencies for conditioning monitoring figures, if applicable.
9 Maintenance

This section provides the:
- Safety guidelines to be followed while performing maintenance procedures.
- Maintenance checkpoints on the pump.
- Routine maintenance intervals.
- Maintenance procedures to be performed while the pump is in operation.
- Maintenance procedures to be performed when components need to be replaced.

9.1 Maintenance Safety

This section lists the safety guidelines to be followed while performing maintenance procedures.

**DANGER**

**TOXIC VAPOURS FROM GLAND**
- VAPOURS CAN LEAK PAST GLAND GUARDS.
- APPROPRIATE RISK ASSESSMENT MUST BE MADE REGARDING THE NATURE OF THE PRODUCT IN THE PUMP AND NECESSARY SAFETY PRECAUTIONS PUT IN PLACE TO PROTECT FROM EXPOSURE TO PRODUCT VAPOURS.

**DANGER**

**IMPELLER INSPECTION**
- IMPELLERS MUST BE ROUTINELY INSPECTED FOR FATIGUE. FAILURE TO INSPECT ROUTINELY MAY RESULT IN CATASTROPHIC PUMP FAILURE.
- FOR IMPELLERS WITH LOW WEAR APPLICATIONS, OTHER NON-VISUAL METHODS OF INSPECTION ARE REQUIRED.
  CONTACT YOUR LOCAL WEIR MINERALS REPRESENTATIVE FOR MORE INFORMATION.

**WARNING**

**HOT SURFACES**
Pump bearing assembly becomes hot during operation. Do not touch bearing assembly surfaces without taking appropriate precautions to protect against personal injury.

**CAUTION**

**ISOLATE PUMP COMPLETELY BEFORE MAINTENANCE**
- Never carry out maintenance work when the pump is connected to power. Power to the electric motor must be isolated and tagged out.
- Ensure that the intake and discharge openings are totally isolated from all potentially pressurised connections and that they are only exposed to atmospheric pressure.
- Drain the pump and isolate pipework before dismantling the pump. The appropriate safety precautions must be taken where the pumped liquids are hazardous.
9.2 Maintenance Check Points

Check the indicated parts of the pump periodically as a part of the maintenance process as shown in Figure 9-1.

![Figure 9-1: Check Points for Periodic Maintenance](image)

2. Bearing Temperature  5. Tightness of Bearing Assembly  8. Motor Amps

9.3 Running Maintenance

This section contains information on the maintenance procedures to perform while the MU pump is in operation.

MU pumps are of robust construction and when correctly assembled and installed, they provide long trouble-free service with a minimum amount of maintenance.

The maintenance required for pumps are:

- Gland adjustment
- Repacking gland
- Tightening nuts and bolts
- Labyrinth grease purging
- Bearing assembly lubrication

**CAUTION**

DUST / DIRT ACCUMULATIONS

As part of the user’s scheduled maintenance program, inspect and clean the external surfaces of the pump and electrical motor casing so that it is free from dust, dirt accumulations or sources of ignition that could cause motor tripping or fire hazards. It is recommended that dust accumulations no greater than 5 mm depth be allowed. Ensure that the electrical motor is adequately ventilated at all times.

**NOTICE**

MU PUMPS AND GEMEX® VEE BELT TENSIONING SYSTEM

For more information on integrated MU pumps and Gemex belt tensioning system, refer “Spare Parts” on page XXXIX.
Table 9-1 provides the routine maintenance intervals.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Interval</th>
<th>Detail of Inspection</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearing assembly greasing</td>
<td>Refer to “Lubrication” on page 72.</td>
<td>Refer to “Lubrication” on page 72.</td>
<td>Small amounts often.</td>
</tr>
<tr>
<td>Labyrinth greasing</td>
<td>Refer to “Lubrication” on page 72.</td>
<td>Refer to “Lubrication” on page 72.</td>
<td>Daily on wet-end.</td>
</tr>
<tr>
<td>Bearing assembly</td>
<td>Every shift</td>
<td>Monitor if &gt; 80 °C (M).</td>
<td>Stop pump if &gt; 95 °C.</td>
</tr>
<tr>
<td>temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bearing assembly</td>
<td>Every shift</td>
<td>Monitor if high (M and VI).</td>
<td>Investigate if &gt; 7.5 mm/s (RMS).</td>
</tr>
<tr>
<td>vibration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump performance</td>
<td>Weekly</td>
<td>Measure motor amps, pump speed and discharge pressure (M).</td>
<td>If pump power changes by more than ± 15% compared to normal running conditions or if speed control is at maximum speed, stop and find the cause (D).</td>
</tr>
<tr>
<td>Fastening bolts</td>
<td>Monthly</td>
<td>Tightness (M).</td>
<td>Especially bearing housing clamp bolts.</td>
</tr>
<tr>
<td>Pump casing</td>
<td>Every three months</td>
<td>Damage or wear (D and VI).</td>
<td>Replace as required (D).</td>
</tr>
</tbody>
</table>

(VI) = Visual Inspection, (M) = Measurement, (D) = Disassembly

Table 9-1: Commissioning and Maintenance Schedule

### 9.3.1 Gland Adjustment

Gland must be checked and adjusted to maintain the leakage at the required flow rate. For gland adjustment procedure, refer to “GSW Gland Adjustment” on page 53.

### 9.3.2 Repacking Gland

**WARNING**

HAND INJURY

Never touch the rotating elements with your hands to establish the direction of rotation.

When gland packing has deteriorated to such an extent that adjustment cannot be obtained by tightening the gland follower, all the packing must be removed and replaced with new ones.

**CAUTION**

GLAND PACKING ADJUSTMENT

One new ring of packing on top of the old rings must not be inserted to correct the adjustment.

When the gland follower has reached the limit of its travel, remove all the old packing from the gland and repack the gland with new packing.

To repack a gland:

1. Remove the gland bolts and gland clamp bolts and the two halves of the gland follower from the pump.
2. Remove the old packing.
3. Clean the stuffing box recess.

4. Place the rings of new packing in position and tamp them home one at a time. Ensure that the ends of each ring come hard together and joints in successive rings are staggered around the stuffing box.

5. Replace the gland halves. Secure the gland halves with clamp bolts and nip them with gland bolts.

6. Back off the nuts of gland bolts. Keep the nuts finger tight, until the pump is started.

After start-up, glands may be adjusted until leakage is at the required flow rate.

These glands are designed for water lubrication and some leakage is necessary during operation to lubricate and cool the packing and shaft sleeve. Gland leakage must be clean and free from solids at all times. If there is any sign of slurry leaking from a gland then one of the following must be occurring:

- GSW pressure is too low.
- Gland packing and/or shaft sleeve requires replacement.
- GSW connection to stuffing box is blocked.

When a gland is being repacked during a complete pump overhaul it is easier to pack the stuffing box and assemble the gland while the stuffing box is out of the pump.

The lantern restrictor, packing, and gland may be assembled into the stuffing box with the shaft sleeve in position in the stuffing box. The stuffing box, assembled gland, and shaft sleeve may then be fitted to the pump as one unit.

To put the packing in a stuffing box:

1. Put the packing around the shaft sleeve and bring the scarf ends together.
2. Push the joint into the gap between the stuffing box and shaft sleeve.
3. Push the remaining packing into the gap by starting near the joint and working around the opposite side of the ring.
4. After the packing ring starts:
   a. Push evenly all the way around the packing.
   b. Push gently to the bottom keeping the packing as a ring.
   c. Use a gland follower to push the packing down square.

9.3.3 Inspect and Service Adjusting Screws

To prevent the corrosion and seizure of the impeller adjusting screw and motor plate adjusting screws, follow the instructions in the caution safety notice below:

- The impeller adjusting screw and motor plate adjusting screws should be inspected and serviced at regular intervals to prevent their seizure due to corrosion.
- Protect them with anti-corrosion tape (Denso) or grease.
- If the screw is seized, then manual loosening methods such as the use of penetrating oils, manual force, or the use of a hacksaw should be used before any type of hot-working is considered.
9.4 Overhaul Maintenance

This section provides details on the maintenance carried out when components need to be replaced. When the pump has worn to such an extent that the performance obtained is no longer satisfactory then dismantle the pump for inspection and/or replace the worn parts, for example the impeller.

If the bearing assembly requires maintenance, then dismantle the wet-end before the bearing assembly is removed from the pump.

### NOTICE

RECONDITIONING OF BEARING ASSEMBLIES

Bearing assemblies must be reconditioned only in a workshop, preferably in a specific area set aside for the work. A clean environment is essential. You can also have your bearing assemblies serviced by us at one of our Service Centres. Please ask your local Weir Minerals representative for more details, or click [http://www.weirminerals.com/contacts/worldwide.aspx](http://www.weirminerals.com/contacts/worldwide.aspx).

9.4.1 Pump Disassembly

Isolate the pump from the system and wash it to reduce particle and chemical contamination. Remove drive items as necessary after noting the alignment of drive.

Disassembling of the wet-end of the pump can be done on site if suitable lifting facilities and working space are available. If they are not available, remove the complete pump unit to a maintenance workshop.

### DANGER

DO NOT HEAT PARTS - EXTREME RISK OF DEATH FROM EXPLODING HIGH-VELOCITY METAL FRAGMENTS!

- DO NOT APPLY HEAT, INCLUDING WELDING OR HARD FACE COATING, TO ANY WEIR METAL WEAR RESISTANT COMPONENTS. THIS CAN CAUSE CRACKS, RESIDUAL STRESSES, AND CHANGES THE FRACTURE TOUGHNESS OF THE PARENT MATERIAL!
- THIS CAN LEAD TO CATASTROPHIC FAILURE AND COULD RESULT IN PERSONNEL INJURY, DEATH AND CATASTROPHIC DAMAGE EVEN IF OPERATING WITHIN RECOMMENDED SPEED AND PRESSURE LIMITS!

The procedure for removing the pump or bearing assembly is a reversal of the assembly procedure for the pump and bearing assembly.

All MU pumps use a thread to fasten the impeller to the pump shaft.

9.4.2 Inspection and Removal of Bearing Assemblies

Use the following recommendations as a general guideline, as greasing requirements vary with operating conditions and environment.

When new bearing assemblies are fitted or reassembled after overhaul they must be correctly packed with grease. It is recommended to establish a systematic program of investigation to decide the following:

- If additional grease is required between overhauls?
- How frequently grease addition is required?
- What quantity of grease addition is required?

A suggested program of investigation is briefly described below for the case of a number of the same pumps operating on similar or the same duties (that is, the pumps have identical bearing assemblies).

1. Start with two pumps with bearing assemblies correctly packed with grease.
2. After a set number of hours, depending on the duty and environment, dismantle the bearing assembly of one pump and inspect condition and disposition of the grease.
3. From inspection, assess whether grease addition is required at this interval. If grease addition is not required, assess whether the second pump can safely run to twice the set number of hours without greasing.
4. By repeating this procedure on the remaining pumps in turn, the maximum time interval before re-greasing may be determined and it may be found possible to run pumps for the life of the wearing parts without regreasing bearing assemblies.

If these conditions can be achieved then bearing assembly contamination is avoided and an overall saving in labour obtained.

It is recommended that a spare bearing assembly unit is carried in store so that the assembly may be changed when worn parts are being replaced. The assembly taken out may then be reconditioned in the workshop to make it ready for installation in the next drive assembly overhaul.

With proper care and maintenance, detect the deterioration of bearing assemblies during routine overhauls before malfunctions become obvious in operation.

---

**NOTICE**

**DISASSEMBLY OF BEARING ASSEMBLIES**

- It is recommended to disassemble and overhaul the bearing assemblies only in the workshop.
- When bearing assembly components are removed from a pump, identify them with suitable tags so that if they are reused they may be replaced in the same position in the pump with their correct mating parts.
- Bearing assembly components which are an interference fit on the shaft must be removed only if replacement is necessary.

---

9.4.2.1 When to Remove Bearing Assemblies

Remove and replace the bearing assemblies when any of the following faults are observed:

1. Face of race is worn to such an extent that a detectable shoulder is evident at the edge of the rolling track.
2. Cage is worn to such an extent that there is excessive slackness or burrs.
3. Any roughness or pitting of rollers or rolling track.

The rolling track will often be slightly darker (stained) than the unused portion of the race. This does not mean that the bearing assembly has reached the end of its useful life provided no other symptoms are present.

9.4.2.2 Removing Bearing Assemblies

Care must be exercised during dismantling. When driving bearing assembly cups out of the assembly with shaft and rollers, hold the shaft in the direction of driving so that rollers are seated hard up against the face of the cup and the effects of impact on the bearing assembly faces are thereby minimised.

If inspection of bearing assemblies shows that they require replacement, then a press must be used to remove the bearings from the journal.

Identify the bearing components with suitable tags when they are removed from a pump, so that if they are reused they can be replaced in the same position in the pump with their correct mating parts.

If any portion of a bearing assembly requires replacement, then replace the entire bearing assembly. Do not mix worn parts with new parts. It is recommended best practice to replace both sets of bearings at each end of the bearing assembly at the same time.
9.4.3 Replacement of Wearing Parts

**CAUTION**

**AVOID USING WORN OUT PARTS**
- Mixing of new and worn pump components may increase the incidence of premature pump wear and leakage.
- All metal mating faces must be cleaned of dirt, rust, paint, and other adhering substances prior to pump assembly. Failure to clean parts can affect pump assembly and running clearances and could lead to catastrophic failure of parts.

The wear rate of a solids handling pump is a function of the severity of the pumping duty and of the abrasive properties of the material handled. Therefore, the life of wearing parts, such as impellers and liners, varies from pump to pump and from one installation to another.

As pump impellers and liners become worn, the head developed by the pump decreases. As the head decreases a consequent drop in rate of discharge occurs. When the rate of discharge falls to such a level that either the required quantity of slurry cannot be discharged or the line velocity is too low for satisfactory transportation of the slurry, dismantle the pump(s) for inspection of the impeller and liners.

Replacement of the impeller only, results in the pump regaining almost new pump performance.

Where a pump is used on a particular duty for the first time and especially where failure of a wearing part during service could have serious consequences, it is recommended to open the pump at regular intervals, inspect parts, and estimate their wear rate so that the remaining life of the parts may be established.

9.4.4 Reassembling Pump after Overhaul

When pumps are dismantled for complete overhaul, closely inspect all parts and check new parts for correct identification.

**WARNING**

**IMPELLER ASSEMBLY**
Ensure that the impeller is tight on the shaft before fitting the pump casing. That is, all components on the shaft between the impeller and the pump end bearing must fully butt up metal to metal against each other without any gaps.

**CAUTION**

**RUBBER SEALS REPLACEMENT**
It is recommended that all rubber seals are replaced during major overhauls as rubber tends to harden and seals lose their effectiveness.

**NOTICE**

**CORRECT OVERHAULING PROCEDURES**
- Used parts which are being reused must be thoroughly cleaned and painted. Mating faces must be free from rust, dirt, and burrs and given a coat of grease before they are fitted together.
- It is preferable to renew small bolts and set screws during overhaul and coat all threads with ‘CopaSlip’ grease before reassembly. If High-Tensile bolts are specified, they must not be re-used in any circumstances for pump re-assembly or re-securing it to its base plate.

9.4.4.1 Maintenance - Stand-by Pumps

Where stand-by pumps are standing idle for long periods, it is advisable to turn their shafts a quarter of a turn by hand once per week. In this way, all rollers in turn are made to carry static loads and external vibrations.
10 Lubrication

This section describes the:

- Recommended characteristics of bearing lubricating grease.
- Effects of excess grease usage.
- Recommended grease lubrication intervals for wet-end and drive-end bearings.
- Advantages of Weir-patented ‘-10’ labyrinth grease purging technique.
- Recommended initial quantities of grease to be used for each bearing.
- Recommended centrifugal seal lubrication.

10.1 Lubrication Safety

**DANGER**

FIRE HAZARD

BEARING ASSEMBLIES MAY CATCH FIRE IF BEARINGS ARE NOT LUBRICATED OR IF LABYRINTHS ARE NOT PURGED.

**CAUTION**

ENSURE CORRECT LUBRICATION

- Ensure that the correct type and correct grade of grease is used.
- Do not rely on bearing housing end cover or labyrinth greasing to provide adequate grease to the bearings. The bearings must always be re-lubricated according to the recommendations.

**NOTICE**

LUBRICATION

- This section provides the general recommended information only.
- Contact your local Weir Minerals representative for any assistance.

10.2 Bearing Assembly

<table>
<thead>
<tr>
<th>Factors</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.L.G.I. consistency number</td>
<td>2</td>
</tr>
<tr>
<td>Drop point</td>
<td>≥ 260 °C</td>
</tr>
<tr>
<td>Work penetration at 25 °C (A.S.T.M.)</td>
<td>265 - 295</td>
</tr>
<tr>
<td>Recommended grease</td>
<td>Mobilith SHC 220</td>
</tr>
<tr>
<td>Approximate base oil viscosity at 40 °C (cSt)</td>
<td>220</td>
</tr>
<tr>
<td>Use Mobilith SHC 220 synthetic grease.</td>
<td></td>
</tr>
</tbody>
</table>

Table 10-1: Recommended Bearing Grease Characteristics

The required initial quantity of grease is given in Table 10-2.

<table>
<thead>
<tr>
<th>Bearing Assembly</th>
<th>Grams per Bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>15</td>
</tr>
<tr>
<td>C</td>
<td>23</td>
</tr>
<tr>
<td>D</td>
<td>75</td>
</tr>
<tr>
<td>E</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 10-2: Basic Bearing Assemblies - Initial Grease Fill Quantities
Before fitting the shaft into bearing housing fill the bearings with grease. Leave the space between the inner flange and the bearing half full with grease. Fill the space between the bearing and the end cover with grease. After assembly, pump grease through the grease nipple on the end cover until grease is pressed out through the labyrinth before starting the pump for the first time.

### 10.2.1 Excess Grease

The immediate effect of an excess of grease within a bearing is increased temperature due to churning. This is to be completely avoided. If bearings run too hot after a change of grease, the trouble is likely to be due to over-greasing.

**CAUTION**

**OVERHEATING**

*Do not add more lubricant to correct the overheating.*

There is always some risk of damage due to over-lubricating, especially in the case of the frame sizes of D and smaller. However, do not neglect bearing lubrication. Judgement and experience must be the final determining factors in establishing routine lubrication procedures. Consequently it is advisable to observe the bearing frequently at the outset of operations taking careful note of any unusual conditions regarding temperature and cleanliness.

Use only recommended clean grease.

For normal conditions of continuous operation where bearing operating temperatures do not exceed the temperature where the grease loses its ability to lubricate and seal, the guidelines in Table 10-3 on page 74 can be used.
## 10.2.2 Suggested Lubrication Intervals for both Wet-end and Drive-end Bearings (hours)

<table>
<thead>
<tr>
<th>Frame</th>
<th>Bearing</th>
<th>Add grams per Bearing</th>
<th>Pump Speed (r/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>B009</td>
<td>10</td>
<td>200 2,200 1,800 1,400 1,050 800 650 500 370</td>
</tr>
<tr>
<td>C</td>
<td>C009</td>
<td>15</td>
<td>200 2,200 1,750 1,400 1,200 800 580 460 350</td>
</tr>
<tr>
<td>D</td>
<td>D009</td>
<td>25</td>
<td>200 2,500 1,750 1,450 1,100 850 650 NA NA NA</td>
</tr>
<tr>
<td>E</td>
<td>E009</td>
<td>40</td>
<td>200 3,300 2,050 1,500 1,100 850 650 500 NA NA</td>
</tr>
</tbody>
</table>

Table 10-3: Lubrication Intervals - Basic Bearing Assemblies
10.2.3 Qualification

The Table 10-3 on page 74 is based on normal operating conditions and intended to be a guideline. Normal operating conditions include:

- Clean environment - Pump gland correctly adjusted.
- A pump that is located indoors.
- Normal ambient temperatures (-10 °C to +40 °C).
- Minimal spray from either badly maintained gland or from heavy washing down.
- Pump running below full power or speed rating.
- Values are based on bearing temperatures of 70 °C measured on the bearing housing.

Contaminated or damp atmospheric conditions or conditions that varied from those listed above would require that the recommendations be stepped up to a level that prevents contaminants from entering the bearings.

10.2.3.1 Labyrinth Grease Purging

Less contaminants entering the bearing assembly results in longer bearing life and ultimately is cost saving. Consequently, careful attention paid to labyrinth grease purging is an essential maintenance requirement.

10.2.3.2 Type '-10' Bearing Assembly Sealing Arrangement

Type '-10' is Weir standard bearing sealing arrangement and is patented world-wide. The design uses a V-ring seal and larger flinger-labyrinth arrangement for added protection against grit and moisture penetrating to the bearing cavity. To improve the sealing of the wet-end and drive-end of bearing assemblies, a radially drilled hole in the end covers allows grease to be fed into the space between the piston rings to form a pressurised barrier between the two piston rings. A small groove in the end cover allows the majority of the purging grease to enter the labyrinth seal and hence purge away contaminants. The small amount of grease that enters the bearings will assist in their lubrication and the grease that escapes outwards together with the centrifuging effect when the pump is running will keep the labyrinth purged of grit and moisture. To improve the purging, particularly on the wet-end of the bearing assembly, the standard labyrinth grease purging nipple can be replaced with an automatic grease feeder (with three months capacity on smaller frames).

The type of grease used for labyrinth sealing must be the same as that used for lubricating the bearings. If an automatic grease feeder is used it will be necessary to check at regular intervals that it has not fully discharged. If grease nipples are used, the guidelines in the Table 10-4 on page 76 must be followed.

Grease purging of the end cover labyrinth seals only adds minor amounts of grease to the bearings. Consequently, bearing maintenance and greasing must not be neglected, and the recommendations (bearing lubrication) need to be followed.

CAUTION

PERMISSIBLE OPERATING TEMPERATURE

Intervals must be halved for every 15 °C increase above 70 °C, but the maximum permissible operating temperature for the grease must not be exceeded.

CAUTION

Intervals must be halved for every 15 °C increase above 70 °C, but the maximum permissible operating temperature for the grease must not be exceeded.
10.2.3.3 Recommended Intervals for ‘-10’ Labyrinth Grease Purging

**NOTICE**

LABYRINTH GREASE PURGING

- Always pump grease into each labyrinth end cover seal until it emerges on the outside before starting the pump for the first time.
- Labyrinth grease purging is normally carried out when the pump is running.
- Pump labyrinth end cover greasing is best carried out by installing an automatic greaser. If a reliable automatic feeder is used the grease quantities can be reduced to half of the values tabulated below.

<table>
<thead>
<tr>
<th>Based on 24 hour continuous operation</th>
<th>Frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labyrinth Type</td>
<td>B-E</td>
</tr>
<tr>
<td>Wet-end Labyrinth</td>
<td>8 shots daily</td>
</tr>
<tr>
<td>Drive-end Labyrinth</td>
<td>8 shots weekly</td>
</tr>
</tbody>
</table>

Shots are from a standard hand operated grease gun (1 shot = 1 gram)

Table 10-4: Grease Quantities for Labyrinth Grease Purging

10.2.4 Recommended Lubricants

**Grease (for Labyrinth Grease Purging)**

- For general applications: Mobilith SHC 220, or equivalent.
- When water splashing is likely: Shell Gadus greases, or equivalent.

10.3 Centrifugally Sealed Pump

In centrifugally sealed pumps, apply lubricant to the static seal chamber sparingly but regularly, using the grease cup.

The grease for the centrifugally sealed pump static seal chamber must conform to the recommended specifications. See Table 10-5 below;

<table>
<thead>
<tr>
<th>Factors</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.L.G.I. consistency number</td>
<td>2</td>
</tr>
<tr>
<td>Drop point</td>
<td>≥ 260 °C</td>
</tr>
<tr>
<td>Work penetration at 25 °C (A.S.T.M.)</td>
<td>265 - 295</td>
</tr>
<tr>
<td>Recommended grease</td>
<td>Mobilith SHC 220</td>
</tr>
<tr>
<td>Approximate base oil viscosity at 40 °C (cSt)</td>
<td>220</td>
</tr>
</tbody>
</table>

Use Mobilith SHC 220 synthetic grease.

Table 10-5: Recommended Bearing Grease Characteristics
11 Decommissioning and Disposal

This section describes the decommissioning and disposal of the complete pump units.

11.1 Decommissioning Safety

**DANGER**

**LIFTING EQUIPMENT SAFETY**

- USE LIFTING EQUIPMENT TO LIFT HEAVY OR AWKWARD COMPONENTS.
- THE LIFTING EQUIPMENT MUST BE IN GOOD CONDITION, CERTIFIED AND TAGGED.
- THE LIFTING EQUIPMENT MUST BE OF ADEQUATE CAPACITY AND MUST BE USED WHENEVER THEY ARE REQUIRED.
- PERSONNEL MUST NEVER WORK UNDER SUSPENDED LOADS.

**DANGER**

**LIFTING POINT SAFETY**

REFER TO THE LIFTING INSTRUCTIONS AT ALL TIMES.

- TAPPED HOLES (FOR EYEBOLTS) AND CAST-ON LUGS (FOR SHACKLES) ON WEIR PARTS ARE FOR LIFTING INDIVIDUAL PARTS ONLY.
- SOME HEAVY PARTS OF THE PUMP HAVE THREADED HOLES FOR LIFTING. DURING ASSEMBLY, EYEBOLTS ARE SCREWED INTO HOLES TO ENABLE PARTS TO BE LIFTED WITH A CRANE. AFTER ASSEMBLY, THE EYE BOLTS MUST BE REMOVED AND THE HOLES FILLED WITH RTV SILICONE TO PROTECT THE THREAD OF THE HOLES FOR FURTHER USE.

**WARNING**

**TIPPING OR FALLING**

During decommissioning, ensure that the pump components are secured properly, so that they do not fall or tip over, or cause injury.

**WARNING**

**SHARP EDGES**

- Before starting any work, identify and examine any parts that could be hazardous due to sharp edges.
- Worn pump components can have sharp or jagged edges. Handle worn parts carefully, to prevent damage to slings or personnel injury.
- Assess the components before moving or lifting and use mechanical devices wherever possible.

**WARNING**

**HAZARDOUS CHEMICALS**

During disassembly, personnel may come in contact with hazardous chemicals. These chemicals must be identified before disassembly, and the correct SDS must be made available and appropriate safety management precautions put in place.
### WARNING

**GLOVES MUST BE WORN**

Appropriate gloves must be worn when handling parts with sharp edges. For example, puncture-resistant or cut-resistant gloves. If in doubt, please ask your Safety Representative for advice.

### CAUTION

**WORKING AREA SAFETY**

Barricade and clearly mark the working area.

### CAUTION

**FOLLOW SAFE WORKING PRACTICES**

Follow safe working practices during all assembly and maintenance work.

### NOTICE

**TOOLING**

Use only specifically designed impact sockets when using air-driven or electrically-driven impact tools.

### NOTICE

**PPE**

Correct PPE must be worn when disassembling pumps.

### 11.2 Decommissioning

To decommission the slurry pumps, Weir Minerals recommends the following steps:

1. Flush the pump with clean water.
   - For small to medium pumps, flush the pump for 10 to 15 minutes.
   - For large pumps, flush the pump for 15 to 20 minutes.
2. Confirm the hazards associated with the slurry last pumped and adopt necessary safety precautions.
3. Isolate the pump electrically, hydraulically, and mechanically.
4. Disconnect the pump electrically, hydraulically, and mechanically.
5. Decontaminate by a static flush and drain.

### WARNING

**HAZARDOUS CHEMICALS**

Personnel may come in contact with hazardous chemicals. Adopt necessary safety precautions such as wearing appropriate PPE.

Follow the above procedure to make the pump ready for resale or disposal.
11.3 Disposal

When a pump is sold, all pump documentation and guarding must be supplied with it. That includes this IOM manual, and the pump's CE Declaration of Conformity.

To sell or dispose of a complete pump unit, Weir Minerals recommends the following steps:

1. Confirm the hazards associated with the slurry last pumped.
2. Ensure that all lifting points are suitable for use.

3. Remove complete pump unit to a decontamination area.
4. Decontaminate by a static flush and drain.

5. Disassemble the main components from the baseplate.
6. Grease, oil, rubber, and urethane must be disposed under applicable waste and environmental regulations.
7. All metal and alloys can be recycled if they are decontaminated and are not classified as hazardous material under applicable environmental regulations.

<table>
<thead>
<tr>
<th>Weir Minerals</th>
<th>Environmental recycling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wet-end alloy components are valuable as scrap. Contact your local Weir Minerals representative <a href="http://www.weirminerals.com/contacts/worldwide.aspx">www.weirminerals.com/contacts/worldwide.aspx</a> to find out more about recycling these items.</td>
</tr>
</tbody>
</table>
12 Troubleshooting

This section describes the:

- Gland Seal Water (GSW), Centrifugal Seal and Mechanical Seal problems
- Bearing and impeller tip speeds
- Fault finding chart

12.1 Gland Seal Water Problems

This section describes reasons for gland problems and the methods to troubleshoot them.

12.1.1 Common Reasons

Most gland problems are due to two reasons:

- Inadequate or excessive gland seal water (GSW) pressure
- Inadequate flow

12.1.1.1 Inadequate or Excessive Gland Seal Water Pressure

Inadequate GSW pressure results in contamination of the packing by the pumped slurry. Once solids are imbedded in the packing, they cannot be flushed out and the packing must be replaced. GSW pressure must be 35 kPa - 70 kPa above the pump discharge pressure. The pressure in excess of this value results in more wear on the packing and shaft sleeve.

**NOTICE**

**PRESSURE LOSS FROM FLOW CONTROL**

Introducing a flow control device on the GSW line causes a significant pressure drop (about 140 kPa for a Maric flow control valve). This could lead to errors in specifying the pressure required from a GSW pump. This has the potential to improve the reliability and performance of the gland seals on all MU pumps.

12.1.1.2 Inadequate Flow

Like inadequate pressure, the inadequate flow results in contamination of the packing by the pumped slurry. Often this problem occurs due to a GSW system which supplies GSW to several pumps, without flow control to each pump. In this case, the low pressure pump takes all the available GSW and starves the high pressure pump. Hence, flow to each gland must be controlled.

The guidelines are:

- Filter the water to reduce the solids content to the lowest possible level.
- Ensure that the GSW is reliable as slurry pumps must not be operated without GSW. Otherwise major gland problems are experienced due to the high pressure forcing slurry into the gland region and causing wear and leakage.

**CAUTION**

**GLAND MAINTENANCE**

- Gland must not be loosened to an extent that it disengages from the stuffing box.
- Inserting additional rings into a stuffing box when problems occur is a short-term fix. Extra packing increases any general wear and eventually leads to excessive leakage.
- Use appropriate alloys to minimise corrosion by saline GSW.
- The leakage of saline GSW from the gland must be trapped and converted to waste to avoid corrosion of the pump base and other components.
Table 12-1 lists the Gland Seal Water problems, causes and the respective solutions.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short packing life</td>
<td>• Slurry wears the packing.</td>
<td>• Increase the GSW pressure.</td>
</tr>
<tr>
<td></td>
<td>• Slurry wears the shaft sleeve.</td>
<td>• Increase the GSW flow.</td>
</tr>
<tr>
<td>Short sleeve life</td>
<td>• Packing over heating and burning due to low GSW flow.</td>
<td>• Loosen the gland to increase the flow.</td>
</tr>
<tr>
<td>Slurry exits the gland</td>
<td>NA</td>
<td>• Stop, cool down, repack and then start again with the correct GSW pressure and flow.</td>
</tr>
<tr>
<td>Flow from the gland is too low. In the worst case, steam exits from the gland.</td>
<td>• Pressure too high, causing packing extrusion and flow restriction. • Gland too tight. • Packing too soft for high pressure.</td>
<td>• Stop, cool down, repack and then restart with correct GSW pressure and flow. • Loosen the gland. • Review packing type. • Use packing retainer ring. • Reduce GSW pressure.</td>
</tr>
<tr>
<td>GSW flows around or outside of packing rings</td>
<td>• Packing rings of wrong size or fit-up wrong.</td>
<td>• Pack the gland again with correct packing. • Review the order of assembly.</td>
</tr>
<tr>
<td>Too much flow from the gland</td>
<td>• Shaft sleeve worn out. • Wrong size packing. • Worn out packing.</td>
<td>• Disassemble and refurbish the gland with new parts.</td>
</tr>
</tbody>
</table>

Table 12-1: Troubleshooting Gland Seal Water Problems

12.2 Centrifugal Seal Problems

Table 12-2 lists the Centrifugal Seal problems, causes and the respective solutions.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short packing life</td>
<td>Not having packing greased / not greasing at regular intervals.</td>
<td>Ensure packing is adequately greased at all times.</td>
</tr>
</tbody>
</table>

Table 12-2: Troubleshooting Centrifugal Seal Problems
12.3 Mechanical Seal Problems

Table 12-3 lists the Mechanical Seal problems, causes and the respective solutions.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature or catastrophic</td>
<td>• Seal faces cracked, chipped, broken or misaligned.</td>
<td>• Review and revise the installation and the operating conditions.</td>
</tr>
<tr>
<td>failures</td>
<td>• Pressure x velocity is too high.</td>
<td>• Obtain new seal suitably-rated for duty.</td>
</tr>
<tr>
<td></td>
<td>• Spring failure.</td>
<td>• Replace spring.</td>
</tr>
<tr>
<td></td>
<td>• Seal springs clogged and inoperative.</td>
<td>• Add flush or throttling bush to reduce contaminants reaching the seal.</td>
</tr>
<tr>
<td></td>
<td>• Seal faces over-compressed.</td>
<td>• Reset to original factory settings.</td>
</tr>
<tr>
<td>Seal leakage</td>
<td>• Seal faces cracked.</td>
<td>• Review and revise the installation and the operating conditions.</td>
</tr>
<tr>
<td></td>
<td>• Seal faces worn out, scored or misaligned.</td>
<td>• Replace worn seal faces, O-ring or secondary seals.</td>
</tr>
<tr>
<td></td>
<td>• O-ring leaking.</td>
<td>• Relap seal faces.</td>
</tr>
<tr>
<td></td>
<td>• Secondary seal worn or cracked.</td>
<td></td>
</tr>
<tr>
<td>Contaminated barrier fluid</td>
<td>• Seal faces cracked or worn out.</td>
<td>• Review and revise the installation and the operating conditions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reduce TDS of barrier fluid.</td>
</tr>
<tr>
<td>Short seal life</td>
<td>• Operating pressure or temperature above the seal rating.</td>
<td>• Reduce variations in operating conditions.</td>
</tr>
<tr>
<td></td>
<td>• Seal body worn out.</td>
<td>• Use a harder material for the seal face.</td>
</tr>
<tr>
<td></td>
<td>• Failure of seal face drive pins.</td>
<td>• Obtain new seal suitably-rated for duty.</td>
</tr>
<tr>
<td></td>
<td>• Seal faces worn out.</td>
<td></td>
</tr>
</tbody>
</table>

Table 12-3: Troubleshooting Mechanical Seal Problems

**CAUTION**

**MECHANICAL SEALS**

- Mechanical seals require a controlled and stable environment to ensure continuous and reliable operation. Please refer to the mechanical seal specifications.
- The seal manufacturer’s operating and maintenance instructions/procedures must be adhered to. Note that these instructions may include torque settings for the locking collar of the mechanical seal.
- The warranty of the mechanical seal will become void if a failed seal is subjected to dry running, water hammer, low suction pressures or high suction lifts, cavitation, excess vibration, thermal shock, reverse rotation, or dead-heading low-flow conditions that are linked to its failure.
- Prior to operating for the first time, the mechanical seal setting tabs must be removed and any flush or quench liquid connections checked to ensure that the required flow and pressure are supplied. Access to the mechanical seal is obtained by first removing the seal guard.
12.4 Bearing and Impeller Tip Speeds

Contact your local Weir Minerals representative for maximum bearing and impeller tip speeds.

**DANGER**

MAXIMUM ALLOWABLE PUMP SPEEDS

FOR RECOMMENDED MAXIMUM ALLOWABLE PUMP SPEEDS, REFER TO THE SPECIFIC PUMP PERFORMANCE CURVE WHICH TAKES INTO CONSIDERATION THE IMPELLER AND THE MAXIMUM ALLOWABLE PERIPHERAL VELOCITY.

**WARNING**

LUBRICATION OR OVER TEMPERATURE PROBLEMS

Pumps operating at, or close to, 25% of the maximum bearing speed must generally be reserved for lightly loaded applications (for example, single-stage pumps) to avoid possible lubrication or high temperature problems.
## 12.5 Fault Finding Chart

<table>
<thead>
<tr>
<th>Fault Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake Faults</td>
<td>Pump not primed</td>
</tr>
<tr>
<td></td>
<td>Pump or suction pipe not completely filled with liquid</td>
</tr>
<tr>
<td></td>
<td>Suction lift too high</td>
</tr>
<tr>
<td></td>
<td>Insufficient margin between suction pressure and vapour pressure</td>
</tr>
<tr>
<td></td>
<td>Excessive amount of air or gas in the liquid</td>
</tr>
<tr>
<td></td>
<td>Air pocket in the suction line</td>
</tr>
<tr>
<td></td>
<td>Air leaks into suction line</td>
</tr>
<tr>
<td></td>
<td>Air leaks into pump through stuffing box</td>
</tr>
<tr>
<td></td>
<td>Foot valve too small</td>
</tr>
<tr>
<td></td>
<td>Foot valve partially clogged</td>
</tr>
<tr>
<td></td>
<td>Inlet of suction pipe insufficiently submerged</td>
</tr>
<tr>
<td></td>
<td>Blocked suction line</td>
</tr>
<tr>
<td></td>
<td>Inlet pipe diameter too small or length of inlet pipe too long</td>
</tr>
</tbody>
</table>

Table 12-4: Fault Finding Sheet
### Troubleshooting

**Hopper Overflow**
- Overheating or seizure of pump
- Short life of bearings
- Vibration and noise from pump

**Packing has short life**

**Leakage from stuffing box**

**Excessive horsepower required**

**Pump loss prime**

**Inefficient pressure**

**Reduced discharge delivery**

**Discharge failure**

<table>
<thead>
<tr>
<th>Description</th>
<th>Fault Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed too low</td>
<td>System Faults</td>
</tr>
<tr>
<td>Speed too high</td>
<td></td>
</tr>
<tr>
<td>Wrong direction of rotation</td>
<td></td>
</tr>
<tr>
<td>Total head of system higher than design</td>
<td></td>
</tr>
<tr>
<td>Total head of system lower than design</td>
<td></td>
</tr>
<tr>
<td>Specific gravity of liquid different from design</td>
<td></td>
</tr>
<tr>
<td>Viscosity of liquid differs from that for which designed</td>
<td></td>
</tr>
<tr>
<td>Operation at very low capacity</td>
<td></td>
</tr>
<tr>
<td>Entrained air in pump. Pump hopper requires baffles</td>
<td></td>
</tr>
<tr>
<td>Badly installed pipe line or gaskets partly blocking pipe</td>
<td></td>
</tr>
<tr>
<td>Misalignment</td>
<td>Mechanical Faults</td>
</tr>
<tr>
<td>Foundations not rigid</td>
<td></td>
</tr>
<tr>
<td>Shaft bent</td>
<td></td>
</tr>
<tr>
<td>Rotating part rubbing on stationary part</td>
<td></td>
</tr>
<tr>
<td>Bearings worn</td>
<td></td>
</tr>
</tbody>
</table>

Table 12-4: Fault Finding Sheet (Continued)
### Table 12-4: Fault Finding Sheet (Continued)

<table>
<thead>
<tr>
<th>Fault Type</th>
<th>Description</th>
<th>Fault Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overheating or Seizure of Pump</td>
<td>Impeller damaged or worn</td>
<td>Mechanical Faults</td>
</tr>
<tr>
<td>Short Life of Bearings</td>
<td>Casing gasket defective, permitting internal leakage</td>
<td></td>
</tr>
<tr>
<td>Vibration and Noise from Pump</td>
<td>Shaft or shaft sleeves worn or scored at the packing</td>
<td></td>
</tr>
<tr>
<td>Packing has Short Life</td>
<td>Packing improperly installed</td>
<td></td>
</tr>
<tr>
<td>Leakage from Stuffing Box</td>
<td>Incorrect type of packing for operating conditions</td>
<td></td>
</tr>
<tr>
<td>Excessive Horsepower Required</td>
<td>Shaft running off-centre because of worn bearings or misalignment</td>
<td></td>
</tr>
<tr>
<td>Pump Loss Prime</td>
<td>Impeller out of balance, resulting in vibration</td>
<td></td>
</tr>
<tr>
<td>Insufficient Pressure</td>
<td>Gland too tight, resulting in no flow of liquid to lubricate packing</td>
<td></td>
</tr>
<tr>
<td>Reduced Discharge Delivery</td>
<td>Foreign matter in impeller</td>
<td></td>
</tr>
<tr>
<td>Discharge Failure</td>
<td>Dirt or grit in sealing liquid, leading to scoring shaft sleeve</td>
<td></td>
</tr>
<tr>
<td>Hopper Overflow</td>
<td>Excessive thrust caused by a mechanical failure inside the pump</td>
<td></td>
</tr>
<tr>
<td>Overheating or Seizure of Pump</td>
<td>Excessive amount of lubricant in bearing housing causing high bearing temperature</td>
<td></td>
</tr>
<tr>
<td>Short Life of Bearings</td>
<td>Lack of lubrication</td>
<td></td>
</tr>
<tr>
<td>Vibration and Noise from Pump</td>
<td>Improper installation of bearings</td>
<td></td>
</tr>
<tr>
<td>Packing has Short Life</td>
<td>Dirt getting into bearings</td>
<td></td>
</tr>
<tr>
<td>Leakage from Stuffing Box</td>
<td>Rusting of bearings due to water getting into housing</td>
<td></td>
</tr>
<tr>
<td>Excessive Horsepower Required</td>
<td>Expeller worn or blocked</td>
<td></td>
</tr>
<tr>
<td>Pump Loss Prime</td>
<td>Excessive clearance at bottom of stuffing box, forcing packing into pump</td>
<td></td>
</tr>
</tbody>
</table>
13 Assembly

This section describes the procedure for assembling the MU pump. A component diagram of the particular pump being assembled assists in following the pump assembly instructions. The pump must be assembled in the following sequence:

1. Bearing assembly - This describes the procedure for assembling and testing the bearing assemblies.
2. Drive-end assembly - This describes the procedure for assembling the bearing assembly on the base.
3. Seal assembly - This describes the procedure for assembling the seal assembly. There are three types of seal assemblies.
4. Wet-end assembly - This describes the procedure for assembling the impeller and pump casing.

13.1 Assembly Safety

⚠️ DANGER

LIFTING EQUIPMENT SAFETY
- USE LIFTING EQUIPMENT TO LIFT HEAVY OR AWKWARD COMPONENTS.
- THE LIFTING EQUIPMENT MUST BE IN GOOD CONDITION, CERTIFIED AND TAGGED.
- THE LIFTING EQUIPMENT MUST BE OF ADEQUATE CAPACITY AND MUST BE USED WHENEVER THEY ARE REQUIRED.
- PERSONNEL MUST NEVER WORK UNDER SUSPENDED LOADS.

⚠️ DANGER

LIFTING POINT SAFETY
REFER TO THE LIFTING INSTRUCTIONS AT ALL TIMES.
- TAPPED HOLES (FOR EYEBOLTS) AND CAST-ON LUGS (FOR SHACKLES) ON WEIR PARTS ARE FOR LIFTING INDIVIDUAL PARTS ONLY.
- SOME HEAVY PARTS OF THE PUMP HAVE THREADED HOLES FOR LIFTING. DURING ASSEMBLY, EYEBOLTS ARE SCREWED INTO HOLES TO ENABLE PARTS TO BE LIFTED WITH A CRANE. AFTER ASSEMBLY, THE EYE BOLTS MUST BE REMOVED AND THE HOLES FILLED WITH RTV SILICON TO PROTECT THE THREAD OF THE HOLES FOR FURTHER USE.

⚠️ WARNING

SHARP EDGES
- Before starting any work, identify and examine any parts that could be hazardous due to sharp edges. All metal components must be considered to have sharp edges.
- Worn pump components can have sharp or jagged edges. Handle worn parts carefully, to prevent damage to slings or personnel injury.

⚠️ CAUTION

FOLLOW SAFE WORKING PRACTICES
Follow safe working practices during all assembly and maintenance work.
13.2 Preparations Before Assembly

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Obtain and wear the correct PPE.

2. Perform risk assessment:
   Check and ensure that a local risk assessment has been performed to identify any hazards connected
   with the assembly of the pump and its components. Apply the appropriate safety measures to prevent
   any injury to people, plant and the environment.

3. Lifting facilities:
   Check and ensure that suitable lifting facilities are available. Check and ensure that all lifting equipment
   correctly-rated, is in good condition, is certified for use and has the correct inspection date tags.

13.3 Tightening Torques

Table 13-1 provides recommended torque settings for Grade 8.8 metric bolts used in MU pumps.

<table>
<thead>
<tr>
<th>M# Bolt (size)</th>
<th>Recommended Torque (± 10%) (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12</td>
<td>70</td>
</tr>
<tr>
<td>M16</td>
<td>170</td>
</tr>
<tr>
<td>M20</td>
<td>335</td>
</tr>
<tr>
<td>M24</td>
<td>580</td>
</tr>
<tr>
<td>M27</td>
<td>850</td>
</tr>
<tr>
<td>M30</td>
<td>1155</td>
</tr>
</tbody>
</table>

Table 13-1: Torque Settings for M Bolts

Table 13-2 provides the recommended torque settings for Grade 8.8 metric bearing housing clamp bolts.

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Recommended Torque (±10%) (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>70</td>
</tr>
<tr>
<td>C</td>
<td>335</td>
</tr>
<tr>
<td>D</td>
<td>580</td>
</tr>
<tr>
<td>E</td>
<td>1155</td>
</tr>
</tbody>
</table>

Table 13-2: Torque Settings for Bearing Housing Clamp Bolts
13.4 Bearing Assembly

To assemble the bearing assembly:

1. Fit the bearing cones to the shaft.
2. Fit the impeller-end bearing cup to the housing.
3. Fit the shaft to the bearing housing.
4. Measure the gap limit.
5. Measure the end play limit.
6. Fit the labyrinth, piston rings, bearing seal, and locknut.

13.4.1 Fitting Bearing Cones to the Shaft

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.
2. Fit the bearing cones to the shaft:
   a. Apply oil or light grease to bearing lands on shaft.
   b. Slide one grease retainer on the shaft, with its flange against the shaft shoulder.
   c. Fit the cone of bearing to the shaft with the large diameter against the retainer.

   It is advisable to preheat the bearing cone. A propriety bearing induction heater must be used
   preferably, following the manufacturer’s recommendations.

   d. With shaft in vertical position, the heated cone can be slipped on and pressed or tapped up to grease retainer.
   e. Fit the other grease retainer and bearing cone, as described in steps 1 to 4. It is important that both grease retainers be located hard against the shoulders and the bearing cones in turn, hard against grease retainers. This must be checked further, after the bearings cool.
13.4.2 Fitting the Impeller-end Bearing Cup to the Housing

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Fit the impeller-end bearing cup to the housing:
   a. Apply oil or light grease to the bore at each end of bearing housing.
   b. Press, or with a mallet carefully tap, the cup of bearing into one end of bearing housing until the outer cup is slightly below end face of housing.
   c. Place end cover with one shim in the housing and insert end cover set screws. Use one thick shim only, for sealing (usually 0.4 mm or 0.5 mm).
   d. Tighten the set screws evenly. The end cover will now push the bearing cup into correct position.

**WARNING**

Do not insert bearing by inner race.

**NOTICE**

Fitting Bearings in the Housing

The bearing housing is symmetrical and bearing cup can be fitted to either end. The small diameter of cup must face out. Assembly will be easier, if the housing is supported in vertical position.

- Place end cover with one shim in the housing and insert end cover set screws. Use one thick shim only, for sealing (usually 0.4 mm or 0.5 mm).
- Tighten the set screws evenly. The end cover will now push the bearing cup into correct position.
13.4.3 Recommended Bearing Grease

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. L. G. I. consistency number</td>
<td>2</td>
</tr>
<tr>
<td>Drop Point</td>
<td>≥260 °C</td>
</tr>
<tr>
<td>Work penetration at 25 °C (A.S.T.M)</td>
<td>265 to 295</td>
</tr>
<tr>
<td>Recommended bearing grease</td>
<td>Mobilith SHC 220 synthetic grease</td>
</tr>
<tr>
<td>Approximate base oil viscosity at 40 °C (cSt)</td>
<td>220</td>
</tr>
</tbody>
</table>

Table 13-3: Recommended Bearing Grease Characteristics

The recommended initial quantity of grease for each bearing is given in Table 13-4.

<table>
<thead>
<tr>
<th>Bearing Assembly</th>
<th>Gram Per Bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>15</td>
</tr>
<tr>
<td>C</td>
<td>23</td>
</tr>
<tr>
<td>D</td>
<td>75</td>
</tr>
<tr>
<td>E</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 13-4: Bearing Assembly - Initial Grease Fill Quantities

Before fitting shaft into the bearing housing, fill the bearings with recommended grease (refer to Table 13-3 and Table 13-4). Leave the space between the inner flange and the bearing half full with grease. Fill the space between the bearing and the end cover with grease. After assembly, pump grease through the grease nipple on the end cover until grease is pressed out through the labyrinth before starting the pump for the first time.

13.4.4 Fitting the Shaft to the Bearing Housing

Figure 13-3: Fitting the Shaft to the Bearing Housing
1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Fit the shaft to the bearing housing:
   a. Obtain the recommended type and quantity of grease for the bearings (refer to Table 13-3 on page 91 and Table 13-4 on page 91).
   b. Apply this grease with a grease gun into the bearing on the shaft, to fill the space between cone, rollers and roller cage. Spread the remaining grease between the bearing and the grease retainer.
   c. Apply grease to the other bearing, in the same way.

13.4.5  Gap Measurement (at drive-end)

**NOTICE**

END PLAY MEASUREMENT
Contact your local Weir Minerals representative for further information on end play measurement values.

13.4.5.1 Fitting the Shaft to the Bearing Housing and Setting End Play - Method 1

To set end play:
1. Fit shaft with impeller-end down, into the bearing housing.
2. Press the remaining cup into the housing, until it is slightly below the housing face.
3. Fill outside surface of the bearing and recessed area of end cover with grease.
4. Place the end cover with remaining shims and insert end cover set screws.
5. Evenly tighten the end cover set screws.
6. Proceed to “End Play Measurement” on page 93 and obtain the measured end play. The end play must be in excess of the values.
7. Calculate the amount of shims to be removed, to give correct end play.
8. Remove end cover and excess shims.
9. Replace end cover with required shims and insert end cover set screws.
10. Evenly tighten the end cover set screws.
11. Proceed to “End Play Measurement” on page 93 to re-check end play.

13.4.5.2 Fitting the Shaft to the Bearing Housing and Setting End Play - Method 2

Acro-set is a technique developed by the Timken Company for obtaining reliable tapered roller bearing end play settings.

**NOTICE**

END PLAY MEASUREMENT
Contact your local Weir Minerals representative for further information on Acro-set end play setting values.

To set the end play by Acro-set method:
1. Fit the shaft with the threaded end into bearing housing.
2. Press the remaining cup into the housing.
3. Fit the end cover and two end cover set screws.
4. While rotating the shaft slowly by hand, tighten two set screws (180 degrees apart), gradually to the pre-load torque. Before doing this, ensure that the shaft is well seated and does not rotate by hand.
5. Measure gap between the end cover flange and the housing face with a taper gauge (preferred over feeler gauge).
6. Select shims of total thickness equal to shim pack.
7. Fit shims, replace the end cover and insert the end cover set screws. Screw the set screws temporarily to within approximately 3 mm of fully tightened position.
8. Press or gently tap the shaft at impeller-end, until the bearing cup at opposite end has moved to the loosely fitted end cover. Take care not to damage thread.
9. Tighten the set screws evenly, to move the bearing cup into correct position. Both the bearing cups must now be hard against their respective end covers and correct end play must be obtained.

13.4.5.3 Acro-set End Play Setting Values

- While Acro-set must give consistent results it is recommended that end play is checked on each assembly (refer to “End Play Measurement” on page 93).
- While investigation of Acro-set method has also been carried out for D and E frames, results are not consistent enough to be included.

13.4.5.4 End Play Measurement

![Diagram of End Play Measurement](image)

To measure the end play:

1. Ensure that the shaft is in its lowest position by turning the shaft several times and knocking it down with a soft hammer.
2. Place a magnetic base dial indicator on the shaft and position the dial needle on the end cover.
3. Set the dial indicator to zero.
4. Raise the shaft and housing with the crane from the eyebolt in the shaft. B and C frame shafts can be moved by hand or by levering off the drive-end labyrinth lock nut and end cover.

---

**WARNING**

**TIPPING, ROLLING OR FALLING**

B, C, D and E bearing assemblies must be secured in a vice.

**NOTICE**

**END PLAY MEASUREMENT**

Contact your local Weir Minerals representative for further information on end play measurement values.
5. The end play value can now be recorded from the dial indicator. Check if the measured values are within the limits.

6. Repeat steps 1 to 5 to confirm the result.

### 13.4.6 Fitting the Labyrinths, Piston Rings, Bearing Seal, and Locknut

**Figure 13-5: Fitting the Labyrinths, Piston Rings, Bearing Seal, and Locknut**

1. Piston Ring
2. Seal
3. Labyrinth
4. Labyrinth Locknut
5. Grease Nipple or Automatic Grease Feeder
6. Plug

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Fit the labyrinths, piston rings, bearing seals, and locknut:
   a. Apply grease on the piston rings and fit to the grooves of each Labyrinth. Position the piston ring grooves 120 degrees apart and away from the grease hole and the groove in the end cover.
b. For frames C to E, fit bearing seal into the groove in the end cover with the lip pointing into the bearing assembly. For frame B, fit the bearing seal on the labyrinth with the lip pointing into the pump (refer to Figure 13-5 and Table 13-5 on page 95).

c. Slide the labyrinths over shaft and push them into the end covers, until piston ring prevents further entry.

d. Compress the rings with ring compressor (refer to “Special Tools” on page 118) and push the labyrinths right into the end covers and against the bearing cones.

e. Fit labyrinth locknut and tighten with C-spanner (refer to “Special Tools” on page 118).

f. Fit hexagonal plugs to the bearing housing and grease nipples to the end covers.

g. Pump grease into each end cover seal, until it emerges on the outside, before starting the pump for the first time.

Bearing assembly is ready for installation.

<table>
<thead>
<tr>
<th>Frame</th>
<th>To Labyrinth</th>
<th>To End Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Yes</td>
<td>—</td>
</tr>
<tr>
<td>C</td>
<td>—</td>
<td>Yes</td>
</tr>
<tr>
<td>D</td>
<td>—</td>
<td>Yes</td>
</tr>
<tr>
<td>E</td>
<td>—</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 13-5: Fitting of Bearing Seal

Yes = Indicates where bearing seal is fitted
13.5 Drive-End Assembly

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a JSA (Job Safety Analysis). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Obtain a base frame:
   a. Obtain the correct base frame for the size of pump being assembled.
   b. Small MU base frames can be manually handled but this is not recommended. Large MU base frames are very heavy. Obtain and use the correct lifting equipment to lift them.
   c. Ensure the lifting equipment is suitably-rated, in good condition, is certified for use and has the correct inspection date tags.
   d. Attach the lifting equipment securely to the base frame. Hoist the slack slowly until the load is fully taken and securely held.
   e. Move the base frame to the required assembly location. Place it on a suitable flat surface or assembly table.
   f. Remove the lifting equipment.
   g. Ensure the base frame is safely and securely fastened down to prevent any tipping or falling hazards. For example, bolting it to the floor or using a specially prepared base or frame with pre-drilled holes to bolt the base frame to.
   h. Check and confirm that a pump nameplate is fitted. If not, obtain a pump nameplate. Obtain the correct fasteners and fix it in the correct position on the base frame. Refer to Figure 3-1 on page 14 to identify the correct position for the nameplate.

3. Apply a light coating of assembly grease to the machined semi-circular bearing cartridge locating surfaces.

4. Fit the adjusting screw:
   a. Obtain the impeller adjusting screw and fasteners.
   b. Insert the adjusting screw into its locating hole at the drive-end of the base frame.
   c. Screw the first nut onto the adjusting screw. No washer is required. Tighten the nut securely until the adjusting screw is securely fastened to the base frame.
d. Screw a second nut onto the adjusting screw. This is the 'Front Nut'. It is used to adjust the impeller forwards. Screw the nut along the threads until almost touches the first fastening nut. Leave a gap of approximately 25-50mm between them.

e. Place a washer onto the adjusting screw. Ensure it is seated against the front nut.

f. Place a second washer onto the adjusting screw. Slide it along the threads until there is a gap of approximately 50-75mm between it and the front nut washer. This gap must be wide enough for the bearing cartridge lug to fit between them when it is lowered onto the base frame. Check the bearing cartridge lug size when you perform this step to accurately measure the required gap size.

g. Screw a third nut onto the adjusting screw. This is the 'Rear Nut'. It is used to adjust the impeller backwards. Screw it along the threads until it touches the washer.

h. Check and ensure there is sufficient space between the front and rear adjustment nuts and washers to allow the bearing cartridge lug to be lowered between them.

5. Lift and fit the bearing cartridge:
   a. Obtain the correct bearing cartridge for the size of pump being assembled.
   b. Obtain the bearing cartridge clamp bolts and fasteners.
   c. Small MU bearing cartridges can be manually handled but this is not recommended. Large MU bearing cartridges are very heavy.
   d. Assess how to lift the load. Normally, slings are used to lift the bearing cartridge.
   e. Obtain and use the correct lifting equipment. Ensure it is suitably-rated, in good condition, is certified for use and has the correct inspection date tags.
   f. Attach the slings securely to the bearing cartridge at both ends. Hoist the slack slowly until the load is fully taken and securely held.
   g. Check that the bearing cartridge is in the correct direction. The threaded part of drive shaft must be pointing towards the wet-end of the pump.
   h. Lower the bearing cartridge onto the base frame. Ensure the adjusting lug slot is located correctly on the impeller adjusting screw. Ensure it fits between the adjusting nuts and washers.
   i. Remove the slings.

6. Fasten the bearing cartridge clamp bolts:
   a. Insert a bearing cartridge clamp bolt through the base frame. This must be done from the underside. The bolt threads must be pointing up.
   b. Place a clamp bolt washer on the bolt. Ensure the domed-side of the washer is facing up; the flat side of the washer must be placed down onto the machined face of the base frame.
   c. Screw a nut onto the clamp bolt. Do not fully-tighten it at this point.
   d. Repeat step a, b and c for each clamp bolt, washer and nut.
   e. Determine the Left-Hand (LH) and Right-Hand (RH) sides of the pump.
   f. Fully tighten the clamp bolts on the LH side only.

7. Lift and fit the adaptor plate:
   a. Obtain the correct adaptor plate for the size of pump being assembled.
   b. Obtain the adaptor plate studs and fasteners.
   c. Small MU adaptor plates can be manually handled but this is not recommended. Large MU adaptor plates are very heavy.
   d. Assess how to lift the load. Obtain and use the correct lifting equipment. Ensure it is suitably-rated, in good condition, is certified for use and has the correct inspection date tags.
e. Attach the lifting equipment securely to the adaptor plate. Hoist the slack slowly until the load is fully taken and securely held.

f. Lift and move the adaptor plate to its final assembly position at the wet-end of the base frame. Ensure the adaptor plate locating lugs are correctly seated in the base frame locating recesses.

g. Insert the adaptor plate studs into the base frame. Screw them into the adaptor plate. Ensure the studs are correctly tightened and securely fastened.

h. Screw the fasteners onto the adaptor plate studs. Ensure the fasteners are correctly tightened and securely fastened.

i. Remove the lifting equipment.

13.6 Seal Assembly

Perform the procedures below to assemble the various seal types.

13.6.1 Gland Seal Water (GSW)

**CAUTION**

**BEWARE OF LOOSE GSW GLAND COMPONENTS**

The Gland Seal Water (GSW) shaft sleeve is loose and unsecured during the GSW gland assembly procedure. Move the gland assembly with extreme care to prevent the shaft sleeve from falling out. This could cause injury to personnel, or cause serious damage to the shaft sleeve.

![Figure 13-7: Gland Seal](image)

- Fit stuffing box, lantern restrictor, (or neck and lantern rings), packing, gland, shaft sleeve, shaft spacer and shaft sleeve O-rings according to Figure 13-7.
- Figure 13-8 lists components which are assembled on the shaft in the order of fitting, starting at the wet-end labyrinth. Pumps with similar arrangements are grouped together.
1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Assemble the gland assembly:
   a. Place the stuffing box flat on a bench (gland side up).
   b. Assembly of all gland parts in stuffing box must be carried out in the following manner:
      i. Fit the lantern restrictor or neck ring inside stuffing box against the retaining lip.
      ii. Hold the shaft sleeve vertically and slide it through the lantern restrictor.
      iii. Fit first packing ring of correct length to fill the gap and push against neck ring.
      iv. Slide lantern ring and press to flatten first ring. When a lantern restrictor is used, the lantern ring is omitted.
      v. Fit packing rings to almost completely fill the gap (stagger packing joints and flatten each ring).

   c. Assemble gland halves, insert gland clamp bolts and fully tighten. Place gland in stuffing box and push down to compress packing rings. Insert gland bolts and nip up nuts sufficiently to hold shaft sleeve (final adjustment is made when testing pump).

   d. Insert assembled stuffing box and tap into position with a copper-faced or nylon-faced mallet. Locate stuffing box with water connection at top.

---

**NOTICE**

**STAGGER PACKING JOINTS**

When a neck ring is used, place lantern ring on top of first ring of packing and press down to flatten first ring, then fit remaining packing rings (stagger packing joints).

---

**NOTICE**

**SET SHAFT SLEEVE TO POSITION**

The shaft sleeve may remain forward. It must be pushed back to the mating part on the shaft. Check that any O-rings are correctly positioned in grooves.
e. Apply a light coating of 'CopaSlip' grease to the exposed area of the pump shaft. Fit the remaining O-rings and shaft spacers.

<table>
<thead>
<tr>
<th>i NOTICE</th>
</tr>
</thead>
</table>

**USE SILICONE GREASE TO HOLD O-RINGS IN POSITION**

- To assist in holding the last O-ring in position which seals against the impeller, apply heavy silicone grease to the O-ring groove.
- All the O-rings in their respective grooves will be compressed and fully covered by these metallic parts when the impeller is screwed on the shaft.

f. Apply a light coating of assembly grease to the shaft thread.

### 13.6.2 Centrifugal Seal

> **CAUTION**

**BEWARE OF LOOSE COMPONENTS HAZARD**

The complete expeller assembly is unsecured to shaft during the following steps. The assembly should be moved with extreme care. This is because it is loose and may slide off shaft. This could cause potential injury to personnel, or result in serious part damage.

---

**Figure 13-9: Centrifugal Seal**

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Assemble the centrifugal seal assembly
   a. Place the expeller ring on a bench, gland side up. Insert one packing piece into the bore of expeller ring. Push it into the bottom of the bore. Fill lantern ring with the correct amount of grease and insert into bore of expeller ring along with remaining packing, ensuring that the packing joints are staggered.
   b. Assemble the gland using gland clamp bolts and loosely fit into expeller ring using gland bolts. Grease the outside diameter of shaft sleeve and slide into bore of packings. Tighten gland bolts sufficiently to retain shaft sleeve.

---

| 1. Shaft Sleeve O-ring | 5. Grease Cup | 9. Impeller O-ring |
| 4. Lantern Ring | 8. Expeller | |
c. On BMU and CMU pumps, fit the O-ring to the outside diameter of expeller ring. For DMU and EMU pumps, insert the O-ring into the groove located in the front face. The O-ring may be secured using a small amount of contact adhesive or silicon sealant.

d. Apply a light coating of 'CopaSlip' grease to the exposed surface of the pump shaft and fit the O-ring. Ensure it touches the labyrinth.

e. Slide complete expeller ring assembly onto the shaft until face of expeller ring contacts adaptor plate and shaft sleeve contacts labyrinth. The expeller ring can be rotated to engage anti-rotation key.

f. Fill the grease cup with the correct grease. Fit the grease cup adaptor and grease cup into the tapped hole in the expeller ring. Screw cup fully down to apply the correct grease amount. Refill and rotate a further two turns.

g. Fit the remaining shaft sleeve O-ring into the groove in the shaft sleeve and gently slide the expeller on until it fully touches it. If contact with shaft sleeve is not possible, this can be caused by the expeller touching the expeller ring. If this happens, adjust the bearing assembly forwards so that full contact can be made.

h. Fit the impeller O-ring into the exposed groove in the expeller. The O-ring may be secured using a small amount of contact adhesive or silicon sealant.

13.6.3 Mechanical Seal

For pumps fitted with a mechanical seal, follow the assembly and maintenance instructions supplied by the manufacturer.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
</table>

**MECHANICAL SEAL TABS**

- For pumps fitted with mechanical seals always follow the appropriate instruction manuals.
- Always remove the mechanical seal setting tabs prior to starting the pump.
- Failure to remove the tabs will result in damage to both the pump and the seal.
- Ensure that the mechanical seal shaft sleeve grub screws are tight before removing the setting tabs.
13.7 Wet-end Assembly

13.7.1 Fitting the Backliner and Impeller

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Fit the backliner and impeller:

   a. Grease the inner bore of the backliner where it meets the expeller ring or stuffing box for BMU and CMU pumps or Grease the interlocking device for larger pumps.
   b. On BMU and CMU pumps, push backliner over expeller ring or stuffing box O-ring, this will hold backliner in place. Please note that on BMU and CMU pumps with mechanical seals these instructions can be ignored as the backliner and seal holder are integrated into one part (see manufacturer’s instructions for fitting mechanical seal).
   c. On DMU and EMU pumps, check that O-ring in the expeller ring, stuffing box or seal holder is in position. Fit the backliner making sure that the positions of the interlocking teeth are suitably aligned and rotate anticlockwise to engage interlocks. In BMU and CMU pumps with mechanical seal, backliner is replaced by seal holder (see manufacturer’s instructions for fitting mechanical seal).
   d. Attach a recommended shaft wrench to the end of the shaft. Check that the clamp bolts that hold the bearing housing are suitably tight to hold the bearing housing against the tightening torque of the impeller.
   e. Grease the internal thread of the impeller using assembly grease. For example, Mobilith SHC 220.
   f. Lift the impeller into position and rotate the shaft to engage threads. Insert a suitable bar into the impeller vanes and tighten impeller onto shaft.

**WARNING**

**IMPELLER ASSEMBLY**

Ensure that the impeller is tight on the shaft before fitting the pump casing. All components on the shaft between the impeller and the drive-end bearing cartridge must be fully seated against each other without any gaps.
13.7.2 Fitting the Pump Casing

**WARNING**

CORRECT FITTING OF THE PUMP CASING O-RING

- For workshop assembly ensure that the O-ring is correctly located against the backliner tapered face before the wet end assembly complete with impeller is lifted and lowered into the casing recess.
- For site assembly where the pump base and bearing assembly remain in place the O-ring should be located against the backliner tapered face and the casing is lifted and positioned into place. Be aware of any uneven clamping of the casing flange or high torquing applied to fixings caused by O-ring misalignment if in doubt repeat the O-ring installation.
- Over-torquing of fixings on a misaligned O-ring can result in a cracked pump casing. This can cause de-pressurisation or a release of fluids when in operation.

**NOTICE**

PUMP ASSEMBLY

- The following steps assume you are assembling the pump in a workshop equipped with a suitably-rated crane or hoist, and access to suitable lifting equipment that has been inspected and tested.
- If you are assembling the pump in the field, please consult your own local rules and techniques for lifting.

![Diagram of pump assembly](image)

**Figure 13-11: Fit the Pump Casing**

1. Case Fixing Bolt
2. Eyebolt
3. Bearing Housing
4. Casing
1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Fit the pump casing:
   a. Place the pump casing on a flat and stable surface, intake-side down.
   b. Use the adjusting screw to move the impeller to its furthest back position.
   c. Apply a light coating of 'CopaSlip' grease onto the male section of the adapter plate.
   d. Screw an eyebolt into the threaded hole at the end of the drive-end of the pump shaft.
   e. Lift the drive-end assembly to the vertical position, wet-end pointing down.
   f. Orientate the pump casing so the discharge outlet is in the desired position.
   g. Lower the drive-end assembly and fit it to the pump casing.
   h. Leave the drive-end assembly connected to the lifting equipment to prevent it from tipping or falling over.
   i. Apply a light coating of 'CopaSlip' grease to the threads of the pump casing bolts.
   j. Insert pump casing bolts into their holes and tighten. Refer to Table 13-6 for the correct torque values.

13.7.3 Impeller Adjustment

![Figure 13-12: Impeller Adjustment]

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Adjust the impeller:
   a. Loosen the clamp bolts.
   b. Adjust the adjusting screw until the impeller touches the pump casing.
   c. Turn the adjusting screw back one-quarter turn.
   d. Check that the impeller turns freely by rotating the drive-end of the shaft by hand.
e. If the impeller does not rotate freely, adjust the adjusting screw back until it does.
f. Check that it now rotates freely. If not, repeat Step 4 until it does.
g. Ensure the impeller rotates freely.
h. Tighten the adjusting screw to lock the bearing assembly and impeller in the correct position.

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Recommended Torque (± 10%) (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>45</td>
</tr>
<tr>
<td>D</td>
<td>45</td>
</tr>
<tr>
<td>E</td>
<td>185</td>
</tr>
</tbody>
</table>

Table 13-6: Bearing Housing Clamp Bolt Torque

The pump is now complete and ready for assembly of drive components and installation. The packings will require final adjustment during initial start-up.
13.7.4 Lowering the Assembled Pump to the Horizontal Position

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.
2. Lower the assembled pump to the horizontal position:

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP ASSEMBLY</td>
</tr>
<tr>
<td>• The following steps assume you are assembling the pump in a workshop equipped with a suitably-rated crane or hoist, and access to suitable lifting equipment that has been inspected and tested.</td>
</tr>
<tr>
<td>• If you are assembling the pump in the field, please consult your own local rules and techniques for lifting.</td>
</tr>
</tbody>
</table>

a. Ensure the eyebolt is still screwed into the threaded hole at the end of the drive-end of the pump shaft. If not, screw an eyebolt into position.

b. Ensure the lifting equipment is still connected to eyebolt. If not, attach it.

c. Lower the crane hook slowly. Gently start to guide the pump into the horizontal position. If necessary, gently push the pump past its vertical position as you lower the crane hook.

d. Continue lowering the crane hook slowly until the pump is completely horizontal.

e. Remove the lifting equipment from the eyebolt.

f. Remove the eyebolt from the pump.

13.7.5 Assembled Pump - Fitting Joint Rings

1. Pre-task checks:
   a. Ensure the work area is clean and tidy.
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Obtain and wear the correct PPE.

2. Fit joint rings to the fully assembled pump:
   a. Fit the intake joint ring and the discharge joint ring as shown in Figure 13-14. Use rubber cement to hold joints in position while connecting intake and discharge pipework.
   b. Install pipe from drip tray in base, if required as part of a gland seal assembly.
14 Disassembly

This section describes the procedure to disassemble the MU pump.

14.1 Disassembly Safety

**DANGER**

FIRE HAZARD
IF FLAME-CUTTING MUST BE USED FOR CUTTING WORK, ASSESS THE WORK AREA TO ENSURE THAT FLAMMABLE MATERIALS ARE NOT PRESENT.

**DANGER**

LIFTING EQUIPMENT SAFETY
- USE LIFTING EQUIPMENT TO LIFT HEAVY OR AWKWARD COMPONENTS.
- THE LIFTING EQUIPMENT MUST BE IN GOOD CONDITION, CERTIFIED AND TAGGED.
- THE LIFTING EQUIPMENT MUST BE OF ADEQUATE CAPACITY AND MUST BE USED WHENEVER THEY ARE REQUIRED.
- PERSONNEL MUST NEVER WORK UNDER SUSPENDED LOADS.

**DANGER**

LIFTING POINT SAFETY
REFER TO THE LIFTING INSTRUCTIONS AT ALL TIMES.
- TAPPED HOLES (FOR EYEBOLTS) AND CAST-ON LUGS (FOR SHACKLES) ON WEIR PARTS ARE FOR LIFTING INDIVIDUAL PARTS ONLY.
- SOME HEAVY PARTS OF THE PUMP HAVE THREADED HOLES FOR LIFTING. DURING ASSEMBLY, EYEBOLTS ARE SCREWED INTO HOLES TO ENABLE PARTS TO BE LIFTED WITH A CRANE. AFTER ASSEMBLY, THE EYE BOLTS MUST BE REMOVED AND THE HOLES FILLED WITH RTV SILICONE TO PROTECT THE THREAD OF THE HOLES FOR FURTHER USE.

**DANGER**

IMPACT HAZARD
REMOVE THE PUMP CASING CAREFULLY. PRODUCT REMAINING INSIDE THE PUMP MAY FORCE THE PUMP CASING TO BE SUDDENLY THRUST OUTWARDS UNCONTROLLABLY.

**DANGER**

IMPELLER FALLING OUT
WHEN THE BOSS ON THE IMPELLER IS CORRODED, DAMAGED OR BROKEN, THERE IS A RISK THAT THE IMPELLER WILL FALL OUT OF THE PUMP WHEN CASING IS REMOVED.
**WARNING**

**SHARP EDGES**
- Before starting any work, identify and examine any parts that could be hazardous due to extremely sharp edges. In general, all metal components must be considered to have sharp edges.
- Worn pump components can have sharp or jagged edges. Handle worn parts carefully, to prevent damage to slings or personnel injury.

**WARNING**

**GLOVES MUST BE WORN**
Appropriate gloves must be worn when handling parts with sharp edges. For example, puncture-resistant or cut-resistant gloves. If in doubt, please ask your Safety Representative for advice.

**WARNING**

**HAZARDOUS CHEMICALS**
During disassembly, personnel may come in contact with hazardous chemicals. These chemicals must be identified before disassembly, and the correct SDS must be made available and appropriate safety management precautions put in place.

**CAUTION**

**WORKING AREA SAFETY**
Barricade and clearly mark the working area.

**CAUTION**

**FOLLOW SAFE WORKING PRACTICES**
Follow safe working practices during all disassembly and maintenance work.

**NOTICE**

**TOOLING**
Only impact type sockets must be used with air or electric impact tools.

**NOTICE**

**PPE**
Correct PPE must be worn when disassembling pumps.
14.2 De-pressurisation

De-pressurisation is the release of slurry and process material from the pump feed, suction inlet, pump, and the discharge line. There are three basic methods of de-pressurisation:

1. Automatic de-pressurisation valve (open/shut only).
2. Manual valve which can control the release of slurry and pressure.

**DANGER**

**SPLASHING OF HOT HAZARDOUS MATERIAL**
- WHEN THE DE-PRESSURISATION VALVES ARE OPENED, SLURRY OR PROCESS MATERIAL MAY GET RELEASED UNDER PRESSURE AND CAUSE PERSONNEL INJURY.
- IF THE PUMP IS OVERHEATED DUE TO LINE BLOCKAGES, AVOID OPENING THE DE-PRESSURISATION VALVE. PERSONNEL INJURY MAY OCCUR FROM THE RELEASE OF HOT SLURRY OR PROCESS MATERIAL.

14.3 Preparations Before Disassembly

1. Pre-task checks:
   a. Isolate the pump electrically, hydraulically and mechanically.
   b. Disconnect the pump electrically, hydraulically and mechanically.
   c. Note the alignment of drive, as necessary, before removing drive items.
   d. Obtain and wear the correct PPE.

2. Perform risk assessment:
   Check and ensure that a risk assessment has been performed to identify any hazards connected with the last slurry pumped. Apply the appropriate safety measures to prevent any injury to people, plant and the environment.

3. Flush the pump clean:
   Flush the pump with clean water for 10 to 15 minutes.

**DANGER**

**SPLASHING OF HAZARDOUS MATERIAL**
WHILE FLUSHING, THERE IS A RISK OF HAZARDOUS MATERIAL SPLASHING. TAKE APPROPRIATE SAFETY PRECAUTIONS.

4. Prepare lay-down area:
   Prepare a safe lay-down area of suitable size. This can be used to safely place disassembled components to prevent trip hazards, etc. The lay-down area can also be used to contain any environmental spills. For example, hazardous slurry, oils, etc, that may leak from the disassembled pump.

5. Lifting facilities:
   Ensure that all lifting equipment is correctly rated, is in good condition, is certified for use and has the correct inspection date tags. See “Lifting Hazards” on page 7.

14.4 Disassembly Procedure

Disassembly of the pump is the reverse of the assembly procedure. Disassemble the pump in the following sequence:

1. Disassembly of the wet-end.
2. Disassembly of the seal assembly (gland seal water, centrifugal seal, or mechanical seal).
3. Disassembly of the drive-end.
4. Disassembly of the bearing assembly.
14.4.1 Disassembly of the Wet-End

Figure 14-1: Disassembly of the Wet-End

1. Pre-task checks:
   a. Check and ensure the pump is correctly isolated, locked-out and tagged-out (LOTO). Check and ensure that the discharge and suction pipework is correctly isolated and safely disconnected.
   b. Check and ensure that the pump has been flushed clean of the last slurry pumped.
   c. Check and ensure that there are no settled contents inside the pump casing.
   d. Perform a JSA (Job Safety Analysis). Check and ensure it is safe to start work.
   e. Create a safe lay-down area to safely place removed components.
   f. Obtain and wear the correct PPE.

2. Disconnect the pipework:
   Unfasten and remove the fasteners connected to the suction and discharge pipework. Place them in a safe lay-down area.

3. Lift, support and remove the pump casing:
   a. Prepare to lift and support the pump casing during disassembly.
   b. Small MU pump casings can be manually handled but this is not recommended. Large MU pump casings are very heavy. Obtain and use the correct lifting equipment.
   c. Ensure the lifting equipment is suitably-rated, in good condition, is certified for use and has the correct inspection date tags.
   d. Assess the best method for lifting and supporting the load.
   e. Attach the lifting equipment securely to the pump casing. Hoist the slack slowly until the load is fully taken and securely supported.
   f. Unfasten and remove all the pump casing fasteners. Place them in a safe lay-down area.
   g. Lift and remove the pump casing. Place it in a safe lay-down area.
   h. Remove the lifting equipment.
4. Attach a shaft wrench to the drive-end of the shaft:
   Obtain and use a MU shaft wrench to securely hold the pump shaft in a fixed position during impeller disassembly. Check and ensure that it is securely attached, is locked in position and prevents the pump shaft from rotating.

5. Lift and support the impeller:
   a. Prepare to lift and support the impeller during disassembly. It must be unscrewed from the shaft.
   b. Small MU impellers can be manually handled but this is not recommended. Large MU impellers are very heavy.
   c. Assess the best method for lifting and securely supporting the load at all times during the disassembly procedure. The impeller must be allowed to slowly rotate as it is unscrewed from the shaft.
   d. Obtain and use the correct lifting equipment.
   e. Ensure the lifting equipment is suitably-rated, in good condition, is certified for use and has the correct inspection date tags.
   f. Attach the lifting equipment securely to the impeller. Hoist the slack slowly until the load is fully taken and securely supported.

6. Loosen the impeller:
   Use extreme care and carefully start to unscrew the impeller from the shaft. Use a suitable lever for extra leverage, if required. Ensure it is fully supported by the lifting equipment at all times. Fully unscrew it until the impeller is completely detached from the shaft and is fully supported by the lifting equipment.

7. Lift and remove the impeller:
   a. Lift and remove the impeller. Place it in a safe lay-down area.
   b. Remove the lifting equipment.

14.4.2 Disassembly of the Seal Assembly

This section describes the disassembly procedure for the seal assembly.

14.4.2.1 Gland Seal Water (GSW)

![Figure 14-2: Gland Seal](image)

| 2. Shaft Sleeve O-ring | 5. Lantern Restrictor | 8. Stuffing Box O-ring |

1. Pre-task checks:
   a. Check and ensure the pump is correctly isolated, locked-out and tagged-out (LOTO).
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Create a safe lay-down area to safely place removed components.
2. Disassemble the gland seal:
   a. Remove the water connections.
   b. Remove the gland bolt nuts.
   c. Remove the gland clamp bolts and remove the gland halves.
   d. Tap the stuffing box with a mallet to loosen it, if required.
   e. Remove the stuffing box from the shaft, along with the shaft spacers, lantern restrictor (or lantern ring and neck ring in some pumps), packings, and shaft sleeve and place it in a safe location.
   f. Remove all O-rings. If necessary, they must be replaced during assembly.

14.4.2.2 Centrifugal Seal

1. Pre-task checks:
   a. Check and ensure the pump is correctly isolated, locked-out and tagged-out (LOTO).
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Create a safe lay-down area to safely place removed components.
   d. Obtain and wear the correct PPE.
2. Disassemble the centrifugal seal:
   a. Remove the grease cup adaptor and the grease cup.
   b. Remove the gland bolt nuts.
   c. Remove the gland clamp bolts and the gland halves.
   d. Remove the expeller.
   e. Tap the expeller ring with a mallet, till it loosens from the expeller, if required.
   f. Remove the expeller ring from the shaft.
   g. The expeller ring can be disassembled further, and the packings, lantern ring, and shaft sleeve can be removed.
   h. Remove all O-rings and shaft spacers. If necessary, the O-rings must be replaced during assembly.

14.4.2.3 Mechanical Seal

Follow the manufacturer’s instructions for removal and maintenance of the mechanical seal.
14.4.3 Disassembly of the Drive-End

Follow these guidelines, while disassembling the drive-end of the pump.

- Disassemble and overhaul the bearing assembly in the workshop.
- Identify the bearing components with suitable tags when they are removed from a pump, so that if they are reused they can be replaced in the same position in the pump with their correct mating parts.
- Remove the bearing components which are interference fit on the shaft, only if replacement is necessary.

![Diagram of Disassembly of the Bearing Assembly from the Base]

1. Pre-task checks:
   a. Check and ensure the pump is correctly isolated, locked-out and tagged-out (LOTO).
   b. Perform a Job Safety Analysis (JSA). Check and ensure it is safe to start work.
   c. Create a safe lay-down area to safely place removed components.
   d. Obtain and wear the correct PPE.

2. Remove the bearing assembly from the base:
   a. Loosen the adjusting screw nuts.
   b. Remove the four clamp bolt nuts, bolts and washers.
   c. Lift the bearing assembly from the base. Some bearing assemblies are extremely heavy. Use suitable lifting equipment. Ensure it is correctly-rated, is in good condition, is certified for use and has the correct date tags.
3. Remove the labyrinths, piston rings, bearing seal, and locknut (left hand thread):
   a. Remove the drive-end labyrinth locknut with a C-spanner (refer to “Special Tools” on page 118).
   b. Remove the labyrinths from the respective shaft ends, along with the piston rings and bearing seals
      (bearing seals may be fitted to the labyrinth or the end cover depending on the type of assembly).

   **CAUTION**

   **PISTON RINGS SPRING OUT**
   The labyrinth must be removed carefully. The piston rings may spring out of the grooves.
4. Remove the shaft from bearing housing:
   a. Remove the end cover set screws from wet-end cover and drive-end cover.
   b. Remove end covers along with the end cover gaskets from the bearing housing.
   c. Place the bearing assembly, vertically on a secured build jig, or over a cavity, built in the ground for the shaft to enter.
   d. Fit the standard eyebolt into drive-end of shaft.
   e. Remove the shaft carefully from housing, using a crane (refer to Figure 14-6), if required.
   f. Remove the standard eyebolt from the drive-end of the shaft (refer to Figure 14-6).
5. Remove the bearings from the shaft and bearing housing:
   a. Remove the bearings from the shaft and bearing housing carefully.
   b. The bearings can be removed from the shaft and the bearing housing using tools like a bearing puller, a press or a drift and hammer.
   c. The tools must be set up to act on the bearing cone or the bearing inner ring, depending on the type of bearing.
   d. Identify the bearing components with suitable tags when removed from an assembly, so that if they are reused they can be replaced in the same position in the assembly with their correct mating parts.

**WARNING**

**TIPPING OR FALLING**

The bearing assembly can fall over if not secured properly and cause injury.

d. Fit the standard eyebolt into drive-end of shaft.

e. Remove the shaft carefully from housing, using a crane (refer to Figure 14-6), if required.

**NOTICE**

**DRIVING OUT ROLLER BEARINGS**

When driving the bearing cups out of the assembly, hold the shaft hard, with the shaft and rollers in the direction of driving so that rollers are seated hard up against the face of the cup and the effects of impact on the bearing faces are thereby minimised.

d. Identify the bearing components with suitable tags when removed from an assembly, so that if they are reused they can be replaced in the same position in the assembly with their correct mating parts.
e. Replace the entire bearing, if any portion of the bearing is to be replaced.

f. Install a new bearing at one end of the bearing assembly with a used bearing at the other end if required. However, economically it is better to replace the pair of bearings even if one requires replacement.

**WARNING**

INCORRECT ASSEMBLY
Do not mix worn out parts with the new parts.

**NOTICE**

BEARING LIFE
The rolling track will often be slightly darker (stained) than the unused portion of the race. This does not mean that the bearing has reached the end of its useful life provided no other symptoms are present.

**NOTICE**

GUIDELINES TO REPLACE BEARINGS
- If the face of the race is worn out to such an extent that a detectable muster is evident at the edge of the rolling track.
- If the cage is worn out to such an extent that there is excessive slackness or burrs.
- Any roughness or pitting of rollers or rolling track.
15 Special Tools

The special tools described in this section are listed in Table 15-1.

<table>
<thead>
<tr>
<th>Special Tool</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston Ring Compressor</td>
<td>301</td>
</tr>
<tr>
<td>C-spanner</td>
<td>305</td>
</tr>
<tr>
<td>Shaft Wrench</td>
<td>306</td>
</tr>
</tbody>
</table>

Table 15-1: List of Special Tools

15.1 Piston Ring Compressor

This is a special tool used to compress piston rings on the labyrinth, so that the labyrinth can be fitted into the end cover on bearing assemblies.

**WARNING**

PERSONNEL INJURY

Personnel must use piston ring compressor to fit piston rings. Use of inappropriate tools may result in personnel injury.

![Figure 15-1: Piston Ring Compressor](image-url)
15.2 C-spanner

This is a special tool used to tighten or remove the locking nut (left-hand threaded) on the bearing assemblies.

Figure 15-2: C-spanner
15.3 Shaft Wrench

This is a special tool used to lock the shaft during transportation and maintenance.

| CAUTION |
| SHAFT DAMAGE |
| Shaft damage occurs if other tools are used to hold the shaft. |

![Diagram of Shaft Wrench and Shaft]

These various tools in this section can be purchased from Weir Minerals, if required. Please contact your local Weir Minerals representative for more information.
Appendix 1  Tie-down Instructions

The tie-down instructions are carried out during transportation of the pump. The equipment required for tie-down activity are of the bareshaft pump. For information on how to carry out the tie-down activity using the recommended equipment, refer to instructions listed in the following section.
Safety Instructions

1. The illustration above shows the recommended safe tie-down method for transport. The securing of any pump must be undertaken by a suitably experienced person who is familiar with applicable safety and transport legislation, site requirements, and best practices. This person must be able to assess the load, create a plan, and then apply it safely.

2. Keep the angle of the tie-down points within 15 degrees each side of the lug as indicated, if applicable.

3. Only a soft strap should be used over the bearing housing, as indicated.

4. Do not use any other points to restrain the transport cradle, pallet or the pump. This may vary, depending on the specified method of transport. If in doubt, please consult your supervisor, or call your nearest Weir Minerals representative.
Appendix 2  Lifting Instructions

During assembly, installation and transportation of the pump, various parts of the pump need lifting. For information on how to carry out the lifting activity using the recommended equipment, refer to instructions listed in the following section.
Safety Instructions

1. The illustration above shows a safe method of lifting the pump. However, the lifting of the pump should be undertaken by a competent person who is familiar with slinging safety legislation and practices. This person must be able to select suitable lifting equipment and then apply it safely.

2. Check the thread in the eyebolt lifting point is in good condition before lifting the pump.

3. The mass of the pump is given on its nameplate.

4. The estimated centre of gravity for the pump is shown in the operation manual, the position of which will vary due to manufacturing variations. An alternative lifting point is shown on the diagram above to allow for these variations.

5. The sling length may require adjusting to get a level lift.

6. Use a Choke Hitch where indicated to prevent the pump rotating during the lift.

7. Where indicated a soft sling must be used to protect the pump from damage.

8. Pumps with the wet end lower or higher than the bottom of the base will require a chock putting under the wet end to prevent it tipping over prior to it being secured to its foundations.

9. Lifting points on the individual pump component parts are for lifting of that part only and are not designed to take the full weight of the pump.
### Appendix 3.1 Pump Commissioning Check Sheet

**NOTICE**

This list is intended as a guide only and other items may require inspection depending on specific installation requirements and equipment configuration.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Pre-commissioning</th>
<th>OK</th>
<th>Not OK</th>
<th>Comment</th>
<th>Signature</th>
<th>Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Visual Inspection, check for damage and correct equipment supply. Refer Drawings.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>Inspect baseplate and guarding, adequate concrete/grouting, etc.</td>
<td></td>
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<tr>
<td>3</td>
<td>Check required lifting tools, special tools, critical spares and IOMs available.</td>
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</tr>
<tr>
<td>4</td>
<td>Visually verify that all connections have been made (piping, instrument air, wiring, etc).</td>
<td></td>
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<td>5</td>
<td>Approximate elevation difference between pump outlet &amp; pump's pressure transmitter.</td>
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<tr>
<td>6</td>
<td>Approximate elevation difference between pump outlet &amp; pump's local pressure indicator.</td>
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<tr>
<td>7</td>
<td>Pump, Motor, &amp; Gearbox Anchor Bolts are tight &amp; lock washers or lock nuts have been used.</td>
<td></td>
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<tr>
<td>8</td>
<td>Visually verify level of the bedplates with an engineering level.</td>
<td></td>
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<tr>
<td>9</td>
<td>**Impeller has been adjusted by the factory, verify free rotation.</td>
<td></td>
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<tr>
<td>10</td>
<td>**Verify Impeller adjusting bolts have been tightened.</td>
<td></td>
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</tr>
<tr>
<td>11</td>
<td>If equipped, **Verify that the Mechanical Seal has been set &amp; that any shipping locks have been removed according to Manufacturer's instructions.</td>
<td></td>
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<td>12</td>
<td>If equipped, **Verify that the Gland Sealing Requirements are per the instructions as shown on the Arrangement Drawing. Note A below.</td>
<td></td>
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<tr>
<td>13</td>
<td>**Check that no Pump Bolts have been loosened during shipping.</td>
<td></td>
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<tr>
<td>14</td>
<td>Bearing Assembly has been factory greased. This can be verified by removing the plugs on top of the assembly. A small amount of blue factory grease will be seen protruding near the shaft.</td>
<td></td>
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<tr>
<td>15</td>
<td>Check that all belts are of the correct quantities and matched lengths.</td>
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<tr>
<td>16</td>
<td>Check pulley alignment.</td>
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<tr>
<td>17</td>
<td>Bump motor to check rotation.</td>
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</table>
**Field adjustment of the Impeller or the Mechanical Seal without oversight from the manufacturer will usually void warranty.**

**Note A**

GSW Flow and Pressure Requirements:

GSW must be supplied at the correct pressure and flow to achieve a long packing and sleeve life. Correct pressure is the most critical requirement to achieving satisfactory gland life. Flow rate is the next most important requirement.

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<tr>
<th>Sl. No</th>
<th>Pre-commissioning</th>
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<tr>
<td>18</td>
<td>Check vee-belt tensioning in accordance with pump manual.</td>
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<td>19</td>
<td>Before flooding of the suction tank, a full operating sequence test on local and then full remote must be conducted for all valves to make sure that all control systems and pneumatics are correctly installed before testing pump operation. Caution: The motor leads must not be connected during this dry starting sequence test. Refer to O&amp;M, SRS, and any other applicable Manuals for correct operational sequence.</td>
<td></td>
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<tr>
<td>20</td>
<td>Complete lubrication of pump, coupling, motor and gearbox (etc).</td>
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<tr>
<td>21</td>
<td>Check all bolts/nuts on pump and drive for correct torque.</td>
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<tr>
<td>22</td>
<td>Check hold down bolts and baseplate flatness/level.</td>
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<tr>
<td>23</td>
<td>Check inlet and outlet flanges/pipework is secured, without excessive flange strain.</td>
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<tr>
<td>24</td>
<td>Check and adjust impeller/throatbush clearance.</td>
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<tr>
<td>25</td>
<td>Check pump suction is clear (strainer), pipes free of debris.</td>
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<tr>
<td>26</td>
<td>Check pump and motor turn by hand (remove clamps, setting tabs, etc).</td>
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<td>27</td>
<td>Check surface treatment for possible damage during installation.</td>
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<tr>
<td>28</td>
<td>Complete I/O checks with drive uncoupled and motor disconnected.</td>
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<tr>
<td>29</td>
<td>Complete earth leakage/Megger test.</td>
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<tr>
<td>30</td>
<td>Check thermal, current, speed etc overload setting to confirm operating parameters.</td>
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<tr>
<td>31</td>
<td>Check available condition monitoring to verify flow, pressure, amps, etc.</td>
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<tr>
<td>32</td>
<td>Connect motor and check for correct rotation direction.</td>
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<tr>
<td>33</td>
<td>Run motor and monitor bearing temp/noise.</td>
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<td>34</td>
<td>Repeat applicable motor checks for the gearbox (rotation, etc).</td>
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<tr>
<td>35</td>
<td>Place commissioning tag.</td>
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Date: ________________________ Model: ________________________
Site: ________________________ Equip ID: ________________________
Start Time: ________________________ Serial #: ________________________
Finish Time: ________________________ Other: ________________________
### Pipework

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<td>Water flush line discharge</td>
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<td>Air vent discharge</td>
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<td>Pressure gauge location</td>
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<td>Drain facility</td>
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<td>7</td>
<td>Distance valves from bends</td>
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### Electric Motor

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<td>Max Vibration RMS</td>
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### Pump

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<td>Head to frame bolts</td>
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<td>Impeller adjustment</td>
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<td>Motor support bolts</td>
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<td>5</td>
<td>Bearing assembly bolts</td>
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<td>6</td>
<td>Bearing assembly adjust nuts</td>
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<td>7</td>
<td>Labyrinth greasing (drive-end)</td>
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<tr>
<td>8</td>
<td>Labyrinth greasing (wet-end)</td>
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### Mechanical Seal

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<td>Flushing water</td>
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<td>2</td>
<td>Grub screws</td>
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<td>3</td>
<td>Spacer and screws</td>
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### Other seals

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### Gearbox

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<tbody>
<tr>
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<td>Cleaned/Inspect</td>
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<td>Oil flush</td>
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<td>Oil filled</td>
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<td>Cooling water piping</td>
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<td>5</td>
<td>Gearbox motor run</td>
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<td>Vibration test</td>
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### Pump to Gearbox Alignment

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<td>Coupling angular</td>
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<td>2</td>
<td>Coupling offset</td>
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<td>3</td>
<td>Coupling gap</td>
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<td>Lubrication</td>
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<tr>
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<td>Gaskets list</td>
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### MU Pumps

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<td>Coupling angular</td>
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<td>Coupling gap 3 mm</td>
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<td>Belt tensioning 16 mm/m</td>
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<td>Pulley alignment</td>
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<td>4</td>
<td>Check taper locks after first 3 hours of operation</td>
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<th>Valve / Start System Test</th>
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<td>Drain valve local</td>
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<td>Motor start local</td>
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<td>Suction valve: remote</td>
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<td>Motor start: remote</td>
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<td>Discharge valve: remote</td>
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<td>Full sequence start: Auto</td>
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<td>Full sequence stop: Auto</td>
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<td>Record motor current (amps)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Discharge pressure (kPa)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Intake pressure (kPa)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Mechanical seal leakage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Gearbox bearing stable temps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Gearbox vibration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Pump bearing stable temp</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Pump vibration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Stop test and Drain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date: ________________________  Model: ________________________
Site: ________________________  Equip ID: ________________________
Start Time: ____________________  Serial #: ________________________
Finish Time: ____________________  Other: ________________________
### Data Collection Prior to Water Test Run

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Wet Commissioning</th>
<th>OK</th>
<th>Not OK</th>
<th>Comment</th>
<th>Signature</th>
<th>Date/time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Review O&amp;M for correct operational sequence.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Review pump curve. Calculate &amp; record discharge pressure for minimum flow.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Review pump curve. Calculate &amp; record discharge pressure for nominal flow.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Review pump curve. Calculate &amp; record discharge pressure for maximum flow.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Review pump curve &amp; record design RPM.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Review Pump Drawings &amp; Record Effective Motor Sheave OD.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Review Pump Drawings &amp; Record Effective Pump Sheave OD.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Final Check all connections, guards, and valve positions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Verify that the supply tank is filled past the minimum level specified in the O&amp;M. Record Level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Measure ambient air temperature &amp; record.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Isolate motor and connect drive pulleys/ couplings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Check belt tension (if applicable).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Check drive alignment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Replace drive guards.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Check discharge valves are operational.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Check discharge point is clear and personnel advised.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Supply water to sealing arrangement (correct flow and pressure).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Start pump and check rotation direction (Quick on and off).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Supply water to pump suction and ensure pump is primed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Measure temperatures for the Pump Bearing Assembly, Motor Bearing Caps, Shafts Through Guard, & Mechanical Seal. Record these temperatures on the following page until the temperatures stabilize (can take up to 3 hours).

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Action</th>
<th>OK</th>
<th>Not OK</th>
<th>Comment</th>
<th>Signature</th>
<th>Date/time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Start Water Test on full automatic control.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Start pump and check performance, select time intervals and number of readings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Verify that no part of the driveline is rubbing on guard.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Check that the intake &amp; discharge valves open fully once the pump is up to operating pressure.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Record pump operating speed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Data Collection Prior to Water Test Run

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Wet Commissioning</th>
<th>OK</th>
<th>Not OK</th>
<th>Comment</th>
<th>Signature</th>
<th>Date/time</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>(Slowly open discharge valve from closed position, record on separate sheet if needed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Flow and pressure at 10 minutes at 1 hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Data Collection Prior to Water Test Run

**Amps at 10 minutes at 1 hour**

<table>
<thead>
<tr>
<th>Pump: Drive-end</th>
<th>Wet-end</th>
<th>Motor: Drive-end</th>
<th>Wet-end</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C &amp; mm/s</td>
<td>°C &amp; mm/s</td>
<td>°C &amp; mm/s</td>
<td>°C &amp; mm/s</td>
</tr>
</tbody>
</table>

9 Record pump vibration.

10 Monitor for vibrations and unusual noises (example: cavitation sound).

11 Record gearbox vibration.

12 Record pump vibration.

13 Check pump for leakage, gland must have slow drip of water.

14 Check Mechanical Seal for leakage.

15 Record cooling water piping temperatures, in & out (if fitted).

16 If fitted with a lube oil pump record lubrication oil pressure and temperature.

17 Close the discharge valve and turn off the pump.

18 Turn off gland water after pump has come to a stop.

19 Remove commissioning tags.

**Other**

---

**Date:** _______________________

**Model:** _______________________

**Site:** _______________________

**Equip ID:** _______________________

**Start Time:** _______________________

**Serial #:** _______________________

**Finish Time:** _______________________

**Other:** _______________________

---

**NOTICE:** This document is a template and should be filled out according to specific requirements. It is important to ensure that all necessary data is recorded accurately and completely. Always consult with relevant experts and follow all safety guidelines during commissioning.

---

**UNCONTROLLED IF PRINTED**

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Appendix 3.2 Vee-belt Driven Slurry Pump Commissioning Checklist

Detailed Pump Description:

Date: ____________________________
Start Time: _______________________  

* Note: At initial start-up the bearing assembly may overheat, Do Not Add Grease; let the temperature reach 93.3 °C (200 °F), then shut-down the pump. Allow the pump bearings to return to near ambient temperature. Then restart the pump and record. This process may need to be completed a few times.

<table>
<thead>
<tr>
<th>Hours Past Start Time</th>
<th>a) NDE Motor Bearing</th>
<th>b) DE Motor Bearing</th>
<th>c) Check Motor Shaft Guard for Rubbing During Start</th>
<th>d) Check Pump Shaft Guard for Rubbing During Start</th>
<th>e) Pump DE Bearing</th>
<th>f) Pump NDE Bearing</th>
<th>g) Mechanical Seal</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0:01</td>
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<tr>
<td>0:05</td>
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</tr>
<tr>
<td>0:10</td>
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<td></td>
</tr>
<tr>
<td>0:15</td>
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<td></td>
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<tr>
<td>0:30</td>
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<td></td>
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<tr>
<td>0:45</td>
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<tr>
<td>1:00</td>
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<td></td>
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<tr>
<td>1:15</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1:30</td>
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<td></td>
<td></td>
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<tr>
<td>1:45</td>
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<td></td>
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<tr>
<td>2:00</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>2:15</td>
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<td></td>
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<tr>
<td>2:30</td>
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</tr>
<tr>
<td>2:45</td>
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<td></td>
</tr>
<tr>
<td>3:00</td>
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</tr>
</tbody>
</table>
Appendix 3.3 Multi-element Pump Commissioning

Purpose Statement:
The purpose of this document is to verify the actions required by the installation contractor to properly install and commission multi-element pump trains supplied by Weir Minerals. Read the manual for complete storage, installation, operation and safety information.

Cautionary Items:

- All piping is expected to be supported and constrained to minimise any piping forces acting on the pump.
- Adequate backing rings are required to compress the pump suction and discharge flange seals when connecting to non-metallic piping. The suction and discharge flanges connected to the pump must be capable of compressing the pump suction and discharge gaskets completely all the way to their inside diameter. This may require installation of a load distribution ring between the connecting flange and the pump and may require high flange bolt torques.
- Foundations must be adequately designed and constructed to accept the forces outlined on the Weir supplied general arrangement drawing.
- All bolts and bolt torques must be rechecked by the site installation contractor before the operation of any equipment.
- All manufacturer storage and maintenance requirements must be met and recorded in order to validate equipment warranties.
- The impeller clearance has been set at the factory. Resetting of the impeller clearance prior to pump commissioning/start-up phase at the site must only be completed under the supervision of the trained Weir service person.
- Motors equipped with cylindrical roller bearings must not be operated unloaded. Unloaded operation of motors equipped with cylindrical roller bearings will void the manufacturer's warranty.
- The system must include an adequate flushing system to completely flush the pump of solids at shut-down.
- The system must require the pump to be fully flooded with the suction valve completely open before operation of the pump.
- Special care must be given to equipment supplied with mechanical seals. Dry running and/or off-duty point operation will result in seal failure not covered under manufacturer's warranty.
### Pre-operational Inspection

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Circle One</th>
<th>Circle One</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mechanical Seal Flush Port</td>
<td>YES / NO / N/A</td>
<td>YES / NO / N/A</td>
</tr>
<tr>
<td>2</td>
<td>Mechanical Seal Quench Port. If Synthetic Lube Device, verify setup per seal manual.</td>
<td>YES / NO / N/A</td>
<td>YES / NO / N/A</td>
</tr>
<tr>
<td>3</td>
<td>Water Cooling Pipes</td>
<td>YES / NO / N/A</td>
<td>YES / NO / N/A</td>
</tr>
<tr>
<td>4</td>
<td>Oil Cooling Pipes</td>
<td>YES / NO / N/A</td>
<td>YES / NO / N/A</td>
</tr>
<tr>
<td>5</td>
<td>Instrumentation</td>
<td>YES / NO / N/A</td>
<td>YES / NO / N/A</td>
</tr>
</tbody>
</table>

### Bolt Torque Review

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Verify pump hold down bolt torque and record value (ft-lbs).</td>
<td></td>
</tr>
<tr>
<td>2. Verify pump bearing assembly hold down bolt torque and record value (ft-lbs).</td>
<td></td>
</tr>
<tr>
<td>3. Verify pump mechanical seal drive collar bolt torque and record value (ft-lbs).</td>
<td></td>
</tr>
<tr>
<td>4. Verify pump bearing assembly adjustment bolt nuts are tight.</td>
<td></td>
</tr>
<tr>
<td>5. Verify gear reducer hold down bolt torque and record value (ft-lbs).</td>
<td></td>
</tr>
<tr>
<td>6. Verify motor hold down bolt torque and record value (ft-lbs).</td>
<td></td>
</tr>
<tr>
<td>7. Verify low speed coupling bolt torque and record value (ft-lbs).</td>
<td></td>
</tr>
<tr>
<td>8. Hand check that all bolts are tight. Check once completed.</td>
<td></td>
</tr>
<tr>
<td>9. Verify suction piping flange bolt torque and record value (ft-lbs).</td>
<td></td>
</tr>
<tr>
<td>10. Verify discharge piping flange bolt torque and record value (ft-lbs).</td>
<td></td>
</tr>
<tr>
<td>11. Record shim quantity underneath gear reducer feet.</td>
<td></td>
</tr>
<tr>
<td>12. Record shim overall height underneath gear reducer feet (average).</td>
<td></td>
</tr>
<tr>
<td>13. Record shim quantity underneath motor feet.</td>
<td></td>
</tr>
<tr>
<td>14. Record shim overall height underneath motor feet (average).</td>
<td></td>
</tr>
<tr>
<td>15. Verify base plates are level with a machinest level 98 and record level.</td>
<td></td>
</tr>
<tr>
<td>16. Verify pump shaft is level with a machinest level 98 and record level.</td>
<td></td>
</tr>
<tr>
<td>17. Impeller has been adjusted by the factory, verify free rotation and record findings.</td>
<td></td>
</tr>
<tr>
<td>18. Verify that the mechanical seal has been set per the manufacturer's instruction manual.</td>
<td></td>
</tr>
<tr>
<td>19. Verify that the clips have been removed according to the seal manufacturer's instructions. Store the clips for future use. Note that the clips are generally shipped loose in a bag attached to the pump.</td>
<td></td>
</tr>
</tbody>
</table>
Properly first-fill oil lubricated equipment immediately before initial operation. Note manufacturer, type and volume of each below. Careful not to unseal any equipment sealed for long term storage unless immediately before initial run.

1. Pump
2. Gear Reducer
3. Motor

Take lubrication samples from each piece of equipment before operation. Replace if condition/quality does not meet lubricant manufacturer’s requirements.

1. Pump
2. Gear Reducer
3. Motor

Check lubricant levels in all pieces of equipment. Adjust constant level oilers if equipped.

1. Pump
2. Gear Reducer
3. Motor

4. Set low speed coupling gap per certified Weir general arrangement drawing and record. Set low speed coupling alignment.
5. Check for gear reducer soft foot. Do NOT loosen pump hold down bolts or remove factory installed shims.
6. Allowances for thermal growth need to be taken into consideration.
7. Record cold alignment values on attached sheets.

Uncoupled Motor Run

1. Confirm motor is properly lubricated.
2. Ensure motor is uncoupled from other drive components.
3. Verify shaft rotation by bumping motor.
4. For motors equipped with sleeve bearings, run motor uncoupled for two hours, check rotation, scribe magnetic centre, check vibration, prox probes output, stator and bearing temperature.
### Unloaded Motor / Gear Reducer Run

1. Set high speed coupling gap per certified Weir general arrangement drawing and record.
   - Set high speed coupling alignment.
2. Check for motor and gear reducer soft foot.
3. Allowances for thermal growth need to be taken into consideration.
4. Record cold alignment values on attached sheets.
5. Assemble and lubricate high speed coupling per manufacturer's instruction manual.
6. Verify high speed coupling bolt torque and record value (ft-lbs).
7. Confirm low speed coupling is not connected to the pump.

### Gear Reducer

1. Secure gear reducer low speed coupling hub for unloaded run.
2. Open inspection cover and add oil to normal operating level if not already completed.
3. Prime oil troughs and bearing dams.
4. Replace inspection cover.
5. Ensure breather is installed and in like new condition. Replace if necessary.
6. Lubricate shaft seals as required.
7. Insure cooling system is operational and functioning correctly.

### Gear Reducer Air-Oil Cooler (If Applicable)

1. Prime oil circulation pump and hoses.
2. Operate oil circulation pump to make sure it is functioning correctly.
3. Recheck gear reducer oil level after initial priming and operation of cooler system.
4. Install all guarding.
5. Perform unloaded motor/gear reducer test run.
6. Operate until gear reducer oil sump temperature stabilizes and record maximum value.
<table>
<thead>
<tr>
<th>Pre-operational Inspection</th>
<th>Installation Contractor</th>
<th>Weir</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Record Value or √ Initial &amp; Date</td>
<td>Record Value or √ Initial &amp; Date</td>
</tr>
</tbody>
</table>

### Clear Water Drive Train Run

1. Install pump bearing assembly breather (if applicable).
3. Verify low speed coupling bolt torque and record value (ft-lbs).
4. Install all guarding.
5. Final check all connections, guarding and valve positions.
6. Open suction valve to flood pump.
7. Check for any leaks in piping, connections or pump.
8. After ensuring the pump is flooded, start pump. Assembly must be run for a minimum of 4 hours before shutting off.

### Complete Hot Alignments

1. Take readings to confirm the hot alignment meets the equipment manufacturers' requirements.
2. Record final hot alignment values in the attached sheet.
Appendix 3.4 Pump Commissioning Sheet

Detailed Pump Description:

<table>
<thead>
<tr>
<th>Pump</th>
<th>Serial #</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB Serial #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td>Serial #</td>
<td>Start Time:</td>
</tr>
</tbody>
</table>

Temperatures

<table>
<thead>
<tr>
<th>Time Recorded</th>
<th>a) NDE Motor Bearing</th>
<th>b) DE Motor Bearing</th>
<th>c) HS GrBox, Motor DE Bearing</th>
<th>d) HS GrBox, Motor NDE Bearing</th>
<th>e) LS GrBox, Pump NDE Bearing</th>
<th>f) LS GrBox, Pump DE Bearing</th>
<th>g) Pump Bearing Assembly, DE</th>
<th>h) Pump Bearing Assembly, NDE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Motor Bearing Temperature Rise
If the rate of bearing temperature rise appears excessive shut the motor down and inspect the bearings.
Under normal operating conditions, the rate of temperature rise must be from 51 °F (11 °C) to 57 °F (14 °C) for the first ten minutes of operation after start-up, and approximately 71 °F (22 °C) at 30 minutes. When the rate of bearing temperature rise is less than 2 °F per half-hour, the bearing temperature is considered stabilised.

Pump Bearings
Monitor pump bearings as measured on the surface of the bearing housing. If over 176 °F (80 °C) and/or rapidly rising then continue to closely monitor. Set alarm for bearing temperature devices at 194 °F (90 °C) continue to closely monitor establish the cause. At 203 °F (95 °C) stop and investigate reason for high temperatures.
Under normal operating conditions, the rate of temperature rise must be from 51 °F (11 °C) to 57 °F (14 °C) for the first ten minutes of operation after start-up, and approximately 71 °F (22 °C) at 30 minutes.

Gear Box Housings
Shut-down at 200 °F (93.3 °C).

Figure C: Pump with Gear Box Housings

| a. NDE Motor Bearing | f. LS GrBox, Pump DE Bearing |
| b. DE Motor Bearing   | g. Pump Bearing Assembly, DE |
| c. HS GrBox, Motor DE Bearing | h. Pump Bearing Assembly, NDE |
| d. HS GrBox, Motor NDE Bearing | i. Gland |
| e. LS GrBox, Pump NDE Bearing | |
Appendix 4  Mobilith SHC Grease Material Safety Data Sheet
SAFETY DATA SHEET

SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

As of the revision date above, this (M)SDS meets the regulations in the United Kingdom & Ireland.

1.1. PRODUCT IDENTIFIER
Product Name: (see Section 16 for Synonyms) MOBILITH SHC 220
Product Description: Synthetic Base Stocks and Additives
Product Code: 2015A0204040, 644021-60

1.2. RELEVANT IDENTIFIED USES OF THE SUBSTANCE OR MIXTURE AND USES ADVISED AGAINST
Intended Use: Grease

Uses advised against: None unless specified elsewhere in this SDS.

1.3. DETAILS OF THE SUPPLIER OF THE SAFETY DATA SHEET
Supplier: EXXONMOBIL LUBRICANTS & SPECIALTIES EUROPE, A DIVISION OF EXXONMOBIL PETROLEUM & CHEMICAL, BVBA (EMPC)
POLDERDIJKWEG
B-2030 Antwerpen
Belgium

E-Mail: sds.uk@exxonmobil.com
Supplier / Registrant: (BE) 32 35433111

1.4. EMERGENCY TELEPHONE NUMBER
24 Hour Environmental / Health Emergency Telephone:
(UK) 01372 222 000 / (IRELAND) 44 1372 222 000

SECTION 2 HAZARDS IDENTIFICATION

2.1. CLASSIFICATION OF SUBSTANCE OR MIXTURE
Classification according to EU Directive 67/548/EEC / 1999/45 EC

Not Classified
2.2. LABEL ELEMENTS

Not regulated according to EU Directive 67/548/EEC / 1999/45 EC

Contains: SUBSTITUTED ALKYL BENZOTRIAZOLE  May produce an allergic reaction.

2.3. OTHER HAZARDS

PHYSICAL / CHEMICAL HAZARDS

No significant hazards.

HEALTH HAZARDS

Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

ENVIRONMENTAL HAZARDS

No significant hazards. Material does not meet the criteria for PBT or vPvB in accordance with REACH Annex XIII.

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 3  COMPOSITION / INFORMATION ON INGREDIENTS

3.1. SUBSTANCES  Not Applicable. This material is regulated as a mixture.

3.2. MIXTURES

This material is defined as a mixture.

Reportable hazardous substance(s) complying with the classification criteria and/or with an exposure limit (OEL)

<table>
<thead>
<tr>
<th>Name</th>
<th>CAS#</th>
<th>EC#</th>
<th>Registration#</th>
<th>Concentration*</th>
<th>GHS/CLP classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH-BENZOTRIAZOLE-1-METHANAMINE, N,N-BIS(2-ETHYLHEXYL)-METHYL-</td>
<td>94270-86-7</td>
<td></td>
<td>NE</td>
<td>0.1 - 1%</td>
<td>Skin Irrit. 2 H315,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Skin Sens. 1 H317,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[Aquatic Acute 2 H401],</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Aquatic Chronic 2 H411</td>
</tr>
<tr>
<td>BENZENAMINE, N-PHENYL-, REACTION PRODUCTS WITH 2,4,4-TRIMETHYLPIENTENE</td>
<td>68411-46-1</td>
<td>270-128-1</td>
<td>NE</td>
<td>1 - 5%</td>
<td>[Aquatic Acute 3 H402],</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Aquatic Chronic 3 H412</td>
</tr>
<tr>
<td>LITHIUM HYDROXIDE MONOHYDRATE</td>
<td>1310-66-3</td>
<td></td>
<td>NE</td>
<td>0.1 - 1%</td>
<td>Acute Tox. 4 H302,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Skin Corr. 1B H314</td>
</tr>
<tr>
<td>LITHIUM SALT OF ALIPHATIC ACID</td>
<td>CONFIDENTIAL</td>
<td></td>
<td>NE</td>
<td>1 - 5%</td>
<td>Acute Tox. 4 H302</td>
</tr>
<tr>
<td>METHYLENE BIS(DIBUTYLDITHIOCARBAMATE)</td>
<td>10254-57-6</td>
<td>233-593-1</td>
<td>NE</td>
<td>1 - 5%</td>
<td>Aquatic Chronic 4 H413</td>
</tr>
</tbody>
</table>
**SECTION 4  \ FIRST AID MEASURES**

4.1. DESCRIPTION OF FIRST AID MEASURES

**INHALATION**
Under normal conditions of intended use, this material is not expected to be an inhalation hazard.

**SKIN CONTACT**
Wash contact areas with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

**EYE CONTACT**
Flush thoroughly with water. If irritation occurs, get medical assistance.

**INGESTION**
First aid is normally not required. Seek medical attention if discomfort occurs.

4.2. MOST IMPORTANT SYMPTOMS AND EFFECTS, BOTH ACUTE AND DELAYED
Headache, dizziness, drowsiness, nausea and other CNS effects. Local necrosis as evidenced by delayed onset of pain and tissue damage a few hours after injection. Itching and rash from allergic skin reaction.

4.3. INDICATION OF ANY IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT NEEDED
The need to have special means for providing specific and immediate medical treatment available in the workplace is not expected.

SECTION 5   FIRE FIGHTING MEASURES

5.1. EXTINGUISHING MEDIA

   Suitable Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

   Unsuitable Extinguishing Media: Straight streams of water

5.2. SPECIAL HAZARDS ARISING FROM THE SUBSTANCE OR MIXTURE

   Hazardous Combustion Products: Smoke, Fume, Aldehydes, Sulphur oxides, Incomplete combustion products, Oxides of carbon

5.3. ADVICE FOR FIRE FIGHTERS

   Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

FLAMMABILITY PROPERTIES

   Flash Point [Method]: >204°C (399°F) [EST. FOR OIL, ASTM D-92 (COC)]

   Upper/Lower Flammable Limits (Approximate volume % in air): UEL: No data available  LEL: No data available

   Autoignition Temperature: No data available

SECTION 6   ACCIDENTAL RELEASE MEASURES

6.1. PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES

   NOTIFICATION PROCEDURES
   In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

   PROTECTIVE MEASURES
   Avoid contact with spilled material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders.

6.2. ENVIRONMENTAL PRECAUTIONS

   Prevent entry into waterways, sewers, basements or confined areas.

6.3. METHODS AND MATERIAL FOR CONTAINMENT AND CLEANING UP

   Land Spill: Stop leak if you can do so without risk. Scrape up spilled material with shovels into a suitable container for recycle or disposal.

   Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other
shipping. Skim from surface

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

6.4. REFERENCES TO OTHER SECTIONS
See Sections 8 and 13.

SECTION 7  HANDLING AND STORAGE

7.1. PRECAUTIONS FOR SAFE HANDLING
Avoid contact with skin. Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is not a static accumulator.

7.2. CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES
Do not store in open or unlabelled containers.

7.3. SPECIFIC END USES: Section 1 informs about identified end-uses. No industrial or sector specific guidance available.

SECTION 8  EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1. CONTROL PARAMETERS

EXPOSURE LIMIT VALUES

Exposure limits/standards (Note: Exposure limits are not additive)

<table>
<thead>
<tr>
<th>Substance Name</th>
<th>Form</th>
<th>Limit/Standard</th>
<th>Note</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>LITHIUM HYDROXIDE MONOHYDRATE</td>
<td>STEL</td>
<td>1 mg/m3</td>
<td></td>
<td>UK EH40</td>
</tr>
<tr>
<td>LITHIUM HYDROXIDE MONOHYDRATE</td>
<td>Ceiling</td>
<td>1.8 mg/m3</td>
<td></td>
<td>AIHA WEEL</td>
</tr>
</tbody>
</table>

UK EH40 Workplace Exposure Limits. Exposure limits for use with Control of Substances Hazardous to Health Regulations 2002 (as amended)

Note: Information about recommended monitoring procedures can be obtained from the relevant agency(ies)/institute(s):
UK Health and Safety Executive (HSE)
8.2. EXPOSURE CONTROLS

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No protection is ordinarily required under normal conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

Chemical resistant gloves are recommended.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

Chemical/oil resistant clothing is recommended.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned.

Practice good housekeeping.

ENVIRONMENTAL CONTROLS
Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

9.1. INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES

- Physical State: Solid
- Form: Semi-fluid
- Colour: Red
- Odour: Characteristic
- Odour Threshold: No data available
- pH: Not technically feasible
- Melting Point: No data available
- Freezing Point: No data available
- Initial Boiling Point / and Boiling Range: > 316°C (600°F) [Estimated]
- Flash Point [Method]: >204°C (399°F) [EST. FOR OIL, ASTM D-92 (COC)]
- Evaporation Rate (n-butyl acetate = 1): No data available
- Flammability (Solid, Gas): [test method unavailable]
- Upper/Lower Flammable Limits (Approximate volume % in air): UEL: No data available LEL: No data available
- Vapour Pressure: < 0.013 kPa (0.1 mm Hg) at 20 °C [Estimated]
- Vapour Density (Air = 1): No data available
- Relative Density (at 15 °C): 0.9 [test method unavailable]
- Solubility(ies): water Negligible
- Partition coefficient (n-Octanol/Water Partition Coefficient): > 3.5 [Estimated]
- Autoignition Temperature: No data available
- Decomposition Temperature: No data available
- Viscosity: 220 cSt (220 mm2/sec) at 40°C [test method unavailable]
- Explosive Properties: None
- Oxidizing Properties: None

9.2. OTHER INFORMATION

None

NOTE: Most physical properties above are for the oil component in the material.

SECTION 10 STABILITY AND REACTIVITY

10.1. REACTIVITY: See sub-sections below.

10.2. CHEMICAL STABILITY: Material is stable under normal conditions.
10.3. POSSIBILITY OF HAZARDOUS REACTIONS:  Hazardous polymerization will not occur.

10.4. CONDITIONS TO AVOID:  Excessive heat. High energy sources of ignition.

10.5. INCOMPATIBLE MATERIALS:  Strong oxidisers

10.6. HAZARDOUS DECOMPOSITION PRODUCTS:  Material does not decompose at ambient temperatures.

<table>
<thead>
<tr>
<th>SECTION 11</th>
<th>TOXICOLOGICAL INFORMATION</th>
</tr>
</thead>
</table>

### 11.1. INFORMATION ON TOXICOLOGICAL EFFECTS

<table>
<thead>
<tr>
<th>Hazard Class</th>
<th>Conclusion / Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhalation</strong></td>
<td></td>
</tr>
<tr>
<td>Acute Toxicity: No end point data for material.</td>
<td>Minimally Toxic. Based on assessment of the components.</td>
</tr>
<tr>
<td>Irritation: No end point data for material.</td>
<td>Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.</td>
</tr>
<tr>
<td><strong>Ingestion</strong></td>
<td></td>
</tr>
<tr>
<td>Acute Toxicity: No end point data for material.</td>
<td>Minimally Toxic. Based on assessment of the components.</td>
</tr>
<tr>
<td><strong>Skin</strong></td>
<td></td>
</tr>
<tr>
<td>Acute Toxicity: No end point data for material.</td>
<td>Minimally Toxic. Based on test data for structurally similar materials.</td>
</tr>
<tr>
<td>Skin Corrosion/Irritation: No end point data for material.</td>
<td>Negligible irritation to skin at ambient temperatures. Based on assessment of the components.</td>
</tr>
<tr>
<td><strong>Eye</strong></td>
<td></td>
</tr>
<tr>
<td>Serious Eye Damage/Irritation: No end point data for material.</td>
<td>May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.</td>
</tr>
<tr>
<td><strong>Sensitisation</strong></td>
<td></td>
</tr>
<tr>
<td>Respiratory Sensitization: No end point data for material.</td>
<td>Not expected to be a respiratory sensitizer.</td>
</tr>
<tr>
<td>Skin Sensitization: No end point data for material.</td>
<td>Contains a substance that may cause skin sensitization. Based on assessment of the components.</td>
</tr>
<tr>
<td><strong>Aspiration</strong></td>
<td></td>
</tr>
<tr>
<td>Data available.</td>
<td>Not expected to be an aspiration hazard. Based on physico-chemical properties of the material.</td>
</tr>
<tr>
<td><strong>Germ Cell Mutagenicity</strong></td>
<td></td>
</tr>
<tr>
<td>No end point data for material.</td>
<td>Not expected to be a germ cell mutagen. Based on assessment of the components.</td>
</tr>
<tr>
<td><strong>Carcinogenicity</strong></td>
<td></td>
</tr>
<tr>
<td>No end point data for material.</td>
<td>Not expected to cause cancer. Based on assessment of the components.</td>
</tr>
<tr>
<td><strong>Reproductive Toxicity</strong></td>
<td></td>
</tr>
<tr>
<td>No end point data for material.</td>
<td>Not expected to be a reproductive toxicant. Based on assessment of the components.</td>
</tr>
<tr>
<td><strong>Lactation</strong></td>
<td></td>
</tr>
<tr>
<td>No end point data for material.</td>
<td>Not expected to cause harm to breast-fed children.</td>
</tr>
<tr>
<td><strong>Specific Target Organ Toxicity (STOT)</strong></td>
<td></td>
</tr>
<tr>
<td>Single Exposure: No end point data for material.</td>
<td>Not expected to cause organ damage from a single exposure.</td>
</tr>
<tr>
<td>Repeated Exposure: No end point data for material.</td>
<td>Not expected to cause organ damage from prolonged or repeated exposure. Based on assessment of the components.</td>
</tr>
</tbody>
</table>

### TOXICITY FOR SUBSTANCES

<table>
<thead>
<tr>
<th>NAME</th>
<th>ACUTE TOXICITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZINC DITHIOPHOSPHATE</td>
<td>Dermal Lethality: LD50 &gt; 2000 mg/kg (Rabbit); Oral Lethality: LD50 &gt; 2000 mg/kg (Rat)</td>
</tr>
</tbody>
</table>
OTHER INFORMATION

For the product itself:

An ingredient or ingredients that are classified as a skin sensitiser.

Contains:
Synthetic base oils: Not expected to cause significant health effects under conditions of normal use, based on laboratory studies with the same or similar materials. Not mutagenic or genotoxic. Not sensitising in test animals and humans.

Additional information is available by request.

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

12.1. TOXICITY
Material -- Not expected to be harmful to aquatic organisms.

12.2. PERSISTENCE AND DEGRADABILITY
Not determined.

12.3. BIOACCUMULATIVE POTENTIAL
Not determined.

12.4. MOBILITY IN SOIL
Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

12.5. PERSISTENCE, BIOACCUMULATION AND TOXICITY FOR SUBSTANCE(S)
This product is not, or does not contain, a substance that is a PBT or a vPvB.

12.6. OTHER ADVERSE EFFECTS
No adverse effects are expected.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

13.1. WASTE TREATMENT METHODS
Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.
REGULATORY DISPOSAL INFORMATION

European Waste Code: 12 01 12*

NOTE: These codes are assigned based upon the most common uses for this material and may not reflect contaminants resulting from actual use. Waste producers need to assess the actual process used when generating the waste and its contaminants in order to assign the proper waste disposal code(s).

This material is considered as hazardous waste pursuant to Directive 91/689/EEC on hazardous waste, and subject to the provisions of that Directive unless Article 1(5) of that Directive applies.

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14 TRANSPORT INFORMATION

LAND (ADR/RID): 14.1-14.6 Not Regulated for Land Transport

INLAND WATERWAYS (ADNR/ADN): 14.1-14.6 Not Regulated for Inland Waterways Transport

SEA (IMDG): 14.1-14.6 Not Regulated for Sea Transport according to IMDG-Code

SEA (MARPOL 73/78 Convention - Annex II):
14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
Not classified according to Annex II

AIR (IATA): 14.1-14.6 Not Regulated for Air Transport

SECTION 15 REGULATORY INFORMATION

REGULATORY STATUS AND APPLICABLE LAWS AND REGULATIONS

Complies with the following national/regional chemical inventory requirements: AICS, IECSC, KECI, TSCA

Special Cases:

<table>
<thead>
<tr>
<th>Inventory</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDSL</td>
<td>Restrictions Apply</td>
</tr>
</tbody>
</table>
15.1. SAFETY, HEALTH AND ENVIRONMENTAL REGULATIONS/LEGISLATION SPECIFIC FOR THE
SUBSTANCE OR MIXTURE

Applicable EU Directives and Regulations:

1907/2006 [...] on the Registration, Evaluation, Authorisation and Restriction of Chemicals ... and
amendments thereto]
689/2008/EC [...] concerning the export and import of dangerous substances and amendments
thereto]
1272/2008 [on classification, labelling and packaging of substances and mixtures... and
amendments thereto]

Refer to the relevant EU/national regulation for details of any actions or restrictions required by the above
Regulation(s)/Directive(s).

15.2. CHEMICAL SAFETY ASSESSMENT

REACH Information: A Chemical Safety Assessment has been carried out for one or more substances present in the
material.

SECTION 16 OTHER INFORMATION

REFERENCES: Sources of information used in preparing this SDS included one or more of the following: results
from in house or supplier toxicology studies, CONCAWE Product Dossiers, publications from other trade associations,
such as the EU Hydrocarbon Solvents REACH Consortium, U.S. HPV Program Robust Summaries, the EU IUCLID
Data Base, U.S. NTP publications, and other sources, as appropriate.

List of abbreviations and acronyms that could be (but not necessarily are) used in this safety data sheet:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full text</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>Not applicable</td>
</tr>
<tr>
<td>N/D</td>
<td>Not determined</td>
</tr>
<tr>
<td>NE</td>
<td>Not established</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile Organic Compound</td>
</tr>
<tr>
<td>AIHA WEEL</td>
<td>American Industrial Hygiene Association Workplace Environmental Exposure Limits</td>
</tr>
<tr>
<td>ASTM</td>
<td>ASTM International, originally known as the American Society for Testing and Materials (ASTM)</td>
</tr>
<tr>
<td>DSL</td>
<td>Domestic Substance List (Canada)</td>
</tr>
<tr>
<td>EINECS</td>
<td>European Inventory of Existing Commercial Substances</td>
</tr>
<tr>
<td>ELINCS</td>
<td>European List of Notified Chemical Substances</td>
</tr>
</tbody>
</table>
ENCS  Existing and new Chemical Substances (Japanese inventory)
IECSC  Inventory of Existing Chemical Substances in China
KECI  Korean Existing Chemicals Inventory
NDSL  Non-Domestic Substances List (Canada)
NZIoC  New Zealand Inventory of Chemicals
PICCS  Philippine Inventory of Chemicals and Chemical Substances
TLV  Threshold Limit Value (American Conference of Governmental Industrial Hygienists)
TSCA  Toxic Substances Control Act (U.S. inventory)
UVCB  Substances of Unknown or Variable composition, Complex reaction products or Biological materials
LC  Lethal Concentration
LD  Lethal Dose
LL  Lethal Loading
EC  Effective Concentration
EL  Effective Loading
NOEC  No Observable Effect Concentration
NOELR  No Observable Effect Loading Rate

KEY TO THE RISK CODES CONTAINED IN SECTION 2 AND 3 OF THIS DOCUMENT (for information only):
R22; Harmful if swallowed.
R38; Irritating to skin.
R41; Risk of serious damage to eyes.
R51/53; Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R52/53; Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R53; May cause long-term adverse effects in the aquatic environment.

KEY TO THE H-CODES CONTAINED IN SECTION 3 OF THIS DOCUMENT (for information only):
Acute Tox. 4 H302: Harmful if swallowed; Acute Tox Oral, Cat 4
Skin Corr. 1B H314: Causes severe skin burns and eye damage; Skin Corr/Irritation, Cat 1B
Skin Irrit. 2 H315: Causes skin irritation; Skin Corr/Irritation, Cat 2
Skin Sens. 1 H317: May cause allergic skin reaction; Skin Sensitization, Cat 1
Eye Dam. 1 H318: Causes serious eye damage; Serious Eye Damage/Irr, Cat 1
[Aquatic Acute 2 H401]: Toxic to aquatic life; Acute Env Tox, Cat 2
[Aquatic Acute 3 H402]: Harmful to aquatic life; Acute Env Tox, Cat 3
Aquatic Chronic 2 H411: Toxic to aquatic life with long lasting effects; Chronic Env Tox, Cat 2
Aquatic Chronic 3 H412: Harmful to aquatic life with long lasting effects; Chronic Env Tox, Cat 3
Aquatic Chronic 4 H413: May cause long lasting harmful effects to aquatic life; Chronic Env Tox, Cat 4

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:
No revision information is available.

SYNONYMS:  MOBILITH SHC 220 ELECTROLUBER

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(553335)

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ANNEX

Annex not required for this material.
SAFETY DATA SHEET
COPASLIP

Section 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product name: COPASLIP
Product code: 13000

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.3. Details of the supplier of the safety data sheet

Company name: Molyslip Atlantic Ltd
A1 Danebrook Court
Oxford Office Village, Langford Lane,
Kidlington
Oxfordshire
OX5 1LQ
Tel: 01865 370032
Fax: 01865 372030
Email: enquires@molyslip.co.uk

1.4. Emergency telephone number

Section 2: Hazards identification

2.1. Classification of the substance or mixture

Classification under CHIP: This product has no classification under CHIP.

2.2. Label elements

Label elements under CHIP:
Hazard symbols: No significant hazard.

2.3. Other hazards

PBT: This substance is not identified as a PBT substance.

Section 3: Composition/information on ingredients

3.2. Mixtures

Section 4: First aid measures

4.1. Description of first aid measures

Skin contact: Wash immediately with plenty of soap and water.
Eye contact: Bathe the eye with running water for 15 minutes.
Ingestion: Wash out mouth with water.

[cont...]
4.2. Most important symptoms and effects, both acute and delayed

Skin contact: There may be mild irritation at the site of contact.
Eye contact: There may be irritation and redness.
Ingestion: There may be irritation of the throat.
Inhalation: There may be irritation of the throat with a feeling of tightness in the chest.

4.3. Indication of any immediate medical attention and special treatment needed

Immediate / special treatment: Not applicable.

Section 5: Fire-fighting measures

5.1. Extinguishing media

Extinguishing media: Suitable extinguishing media for the surrounding fire should be used.

5.2. Special hazards arising from the substance or mixture

Exposure hazards: In combustion emits toxic fumes.

5.3. Advice for fire-fighters

Advice for fire-fighters: Wear self-contained breathing apparatus. Wear protective clothing to prevent contact with skin and eyes.

Section 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions: Refer to section 8 of SDS for personal protection details.

6.2. Environmental precautions

Environmental precautions: Do not discharge into drains or rivers.

6.3. Methods and material for containment and cleaning up

Clean-up procedures: Wash the spillage site with large amounts of water.

6.4. Reference to other sections

Reference to other sections: Refer to section 8 of SDS.

Section 7: Handling and storage

7.1. Precautions for safe handling

Handling requirements: Avoid the formation or spread of dust in the air.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions: Store in cool, well ventilated area.

7.3. Specific end use(s)

Specific end use(s): No data available.
Section 8: Exposure controls/personal protection

8.1. Control parameters

Workplace exposure limits: Not applicable.

8.2. Exposure controls

Hand protection: Protective gloves.
Eye protection: Safety glasses. Ensure eye bath is to hand.
Skin protection: Protective clothing.

Section 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

State: Paste
Colour: Gold-brown
Odour: Barely perceptible odour

Boiling point/range°C: >35  Flash point°C: >93
pH: Approx. 7

9.2. Other information

Other information: Not applicable.

Section 10: Stability and reactivity

10.1. Reactivity

Reactivity: Stable under recommended transport or storage conditions.

10.2. Chemical stability

Chemical stability: Stable under normal conditions.

10.3. Possibility of hazardous reactions

Hazardous reactions: Hazardous reactions will not occur under normal transport or storage conditions. Decomposition may occur on exposure to conditions or materials listed below.

10.4. Conditions to avoid

Conditions to avoid: Heat.

10.5. Incompatible materials

Materials to avoid: Strong oxidising agents. Strong acids.

10.6. Hazardous decomposition products

Haz. decomp. products: In combustion emits toxic fumes.

Section 11: Toxicological information

[cont...]
11.1. Information on toxicological effects

Toxicity values: Not applicable.

Symptoms / routes of exposure

Skin contact: There may be mild irritation at the site of contact.
Eye contact: There may be irritation and redness.
Ingestion: There may be irritation of the throat.
Inhalation: There may be irritation of the throat with a feeling of tightness in the chest.

Section 12: Ecological information

12.1. Toxicity

Ecotoxicity values: Not applicable.

12.2. Persistence and degradability

Persistence and degradability: Biodegradable.

12.3. Bioaccumulative potential

Bioaccumulative potential: No bioaccumulation potential.

12.4. Mobility in soil

12.5. Results of PBT and vPvB assessment

PBT identification: This substance is not identified as a PBT substance.

12.6. Other adverse effects

Other adverse effects: Negligible ecotoxicity.

Section 13: Disposal considerations

13.1. Waste treatment methods

NB: The user’s attention is drawn to the possible existence of regional or national regulations regarding disposal.

Section 14: Transport information

Transport class: This product does not require a classification for transport.

Section 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

15.2. Chemical Safety Assessment

Chemical safety assessment: A chemical safety assessment has not been carried out for the substance or the mixture by the supplier.

Section 16: Other information

[cont...]
Other information:

- This safety data sheet is prepared in accordance with Commission Regulation (EU) No 453/2010.

  * indicates text in the SDS which has changed since the last revision.

Legal disclaimer:

- The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. This company shall not be held liable for any damage resulting from handling or from contact with the above product.
Appendix 6  Spare Parts

When ordering spare parts, provide the pump model, serial number, part description, and complete part numbers.

WARNING

GENUINE PARTS

- GENUINE PARTS AND ACCESSORIES ARE DESIGNED, TESTED AND INCORPORATED INTO THE PRODUCTS TO HELP ENSURE THEY MAINTAIN CONTINUED PRODUCT QUALITY AND PERFORMANCE.
- AS WEIR MINERALS DOES NOT TEST THE PARTS AND ACCESSORIES SOURCED FROM OTHER VENDORS, THE INSTALLATION OF SUCH PARTS AND ACCESSORIES MAY ADVERSELY AFFECT THE PERFORMANCE AND SAFETY FEATURES OF PRODUCTS.
- THE FAILURE TO PROPERLY SELECT, INSTALL OR USE AUTHORISED PARTS AND ACCESSORIES IS CONSIDERED MISUSE. DAMAGE OR FAILURE CAUSED BY MISUSE IS NOT COVERED BY WEIR MINERALS WARRANTY.
- IN ADDITION, ANY MODIFICATION OF WEIR MINERALS PRODUCTS OR REMOVAL OF ORIGINAL COMPONENTS MAY IMPAIR THE SAFETY OF THESE PRODUCTS IN THEIR USE.

Spare parts for MU pumps consist in the main of liners, impellers, bearings, shaft sleeves, seals, and shaft seal parts. Weir Minerals recommends that sufficient spares are kept in stock based on expected wear life of each part to maximise operational availability of installed pumps.

In major plants it is usual to stock an additional bearing assembly for every 10 (or less) pumps of the same size. This enables a quick change out of the bearing assembly in any one of the pumps. Often this operation is carried out when wearing parts are being replaced. The removed bearing assembly can then be inspected in a workshop, overhauled if required and kept ready for the next pump.

In this way damage is prevented and all pumps are always kept in optimum condition with a minimum of down time.
Have you met GEMEX®?

GEMEX® Belt Tensioning System for MU pumps
Integrated Warman® Pumps & Gemex® Belt Tensioning Systems

Why have a Gemex® belt tensioning system?

The Gemex® belt tensioning system can enhance the efficiency of your machine, providing a boost to productivity and reduction in operating cost.

- Consistent high performance.
- Alignment only required at installation.
- Shorter (and fewer) production stops.
- Lower consumption of spare parts.
- Maximise longevity of all components.

Benefiting from over 20 years experience in belt transmission design and manufacture, Gemex® belt tensioning systems have become the standard in many process industries worldwide and are ideally suited to the Warman® slurry pump range.

We have now designed a specially adapted Gemex® unit for integrating with our Warman® pumps. The design makes maintenance and use of the pump even more efficient and less time consuming.
Did you know that Weir Minerals can cover a wide range of critical applications with a diverse range of slurry transportation and comminution equipment?
Focusing on what we do best, to deliver what matters to you most

Call your nearest Weir Minerals representative today

Some of our products and services are only available through our approved network of distributors.

**WARMAN®** Centrifugal Slurry Pumps  
**GEHO®** PD Slurry Pumps  
**LINATEX®** Rubber Products  
**VULCO®** Wear Resistant Linings  
**CAVEX®** Hydrocyclones  
**FLOWAY® PUMPS** Vertical Turbine Pumps  
**ISOGATE®** Slurry Valves  
**MULTIFLO®** Mine Dewatering Solutions  
**HAZLETON®** Specialty Slurry Pumps  
**LEWIS® PUMPS** Vertical Chemical Pumps  
**WEIR MINERALS SERVICES™**

For further information on any of these products or our support services contact your nearest sales office or visit:  
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