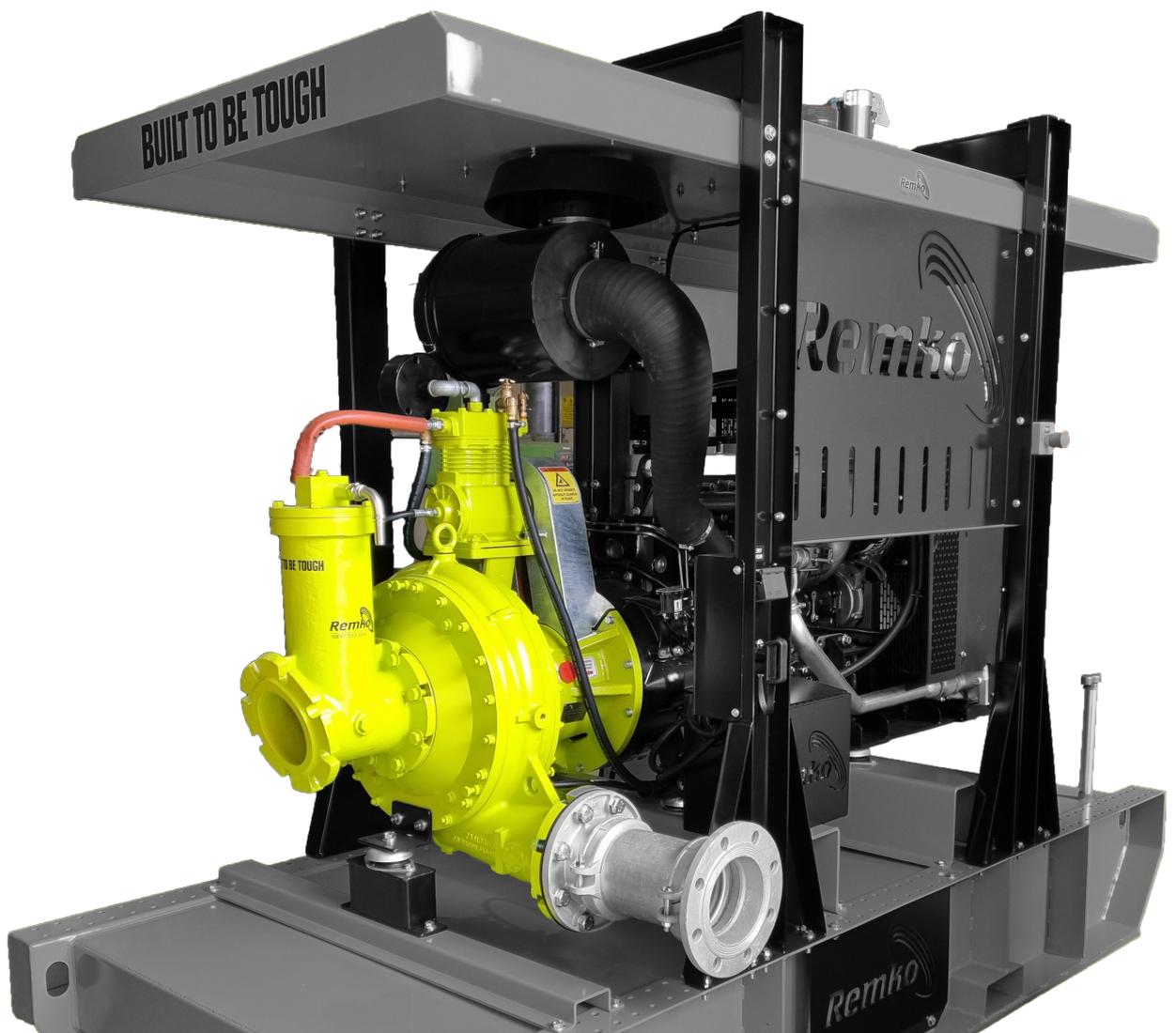




# RA Series 4 Automatic Dry Priming Pumps (Compressor Venturi Priming System)

## Operation & Maintenance Manual

Rev 1.0 (Jun 2025)



*Remko Pumps - Australia's go-to pump solutions provider.*

Corporate Office: 4 McHarry Place, Shepparton VIC 3630

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# 1. INTRODUCTION

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## 1.1 GENERAL

### **Congratulations on the purchase of your new Remko Pump**

With Remko's established quality control systems you can be assured your pump was manufactured with a high level of control and has undergone extensive testing on a certified test facility.

Remko / Dealer are pleased to offer a 12 month or 2,000hrs warranty, whichever occurs first, on your new pump. As with all warranties, Remko's warranty is subject to regular maintenance. To ensure your warranty is maintained, make sure your pump is regularly serviced. Remko/Dealer offer maintenance and repairs on our entire range and are able to offer regular service agreements if required.

Remko/Dealer provide local service through a highly trained network of branches and are able to meet your service and spare parts requirements around the clock.

Turnaround on parts is rapid with Remko/Dealer customer service ready to meet your needs 24 hours a day with spare parts located at branches Australia wide and around the globe.

Our Remko/Dealer trained staff will assess your application and help to set up optimum operating settings which will help to reduce unnecessary wear and tear on the pump whilst ensuring the pump is operating at its most efficient duty point.

## 1.2 DISCLAIMER

Information in this Installation, Operation & Basic Service Manual is believed to be reliable. In spite of all the efforts of Remko Pty Ltd to provide sound and all necessary information the content of this manual may appear insufficient and is not guaranteed by Remko as to its completeness or accuracy.

## 1.3 COPYRIGHT

Remko reserves the right to make changes in this manual at any time without prior notice and accepts no responsibility for the accuracy or otherwise of the information contained within. No part of these instructions may be reproduced, stored in a retrieval system or transmitted in any form or by any means without prior permission of Remko Pump Division.

## 1.4 PUMP NAMEPLATE INFORMATION

### **Important information for enquires or ordering**

Every Pumpend or Pumpset has a nameplate that provides information about the pump unit.

The nameplate is generally located:

- for pumpend – on pump casing
- for pumpset with lifting frame – on lifting frame
- for pumpset without lifting frame – on chassis/base frame

## 2. Transportation, Handling and Storage

### 2.1 CONSIGNMENT RECEIPT AND UNPACKING

Upon receipt verify that the equipment received is in exact compliance with the list on the packing list and if there has been no damage in transportation. Any shortage and/or damaged must be reported immediately to the transport company and to Remko.

Check any crate, boxes or wrappings for any accessories or spare parts that may be packed separately with the equipment or attached to side walls of the box or equipment.

Discard through controlled disposals all packing materials which may constitute personal injury (sharp objects, nails, etc...)

### 2.2 HANDLING / LIFTING METHODS



#### Caution

This section is added for information purposes only and not to be used as a Handling/Lifting Manual.

Remko encourages thorough training and maintenance of high safety standards in the use of this equipment, but responsibility for complying with the proper handling/lifting instructions resets with the owner of the product.



#### Warning

All necessary tie down/moving/lifting should only be carried out by suitably trained personnel, in accordance with local regulations. If not strictly observed, could result in severe personal injury or loss of life.

The pump unit must **ALWAYS** be tied down/moved/lifted and transported in the horizontal position. Prior to moving/lifting the unit find the following:

- total weight (refer nameplate information)
- centre of gravity
- maximum outside dimensions
- lifting points location
- towing points location
- tie down points location
- forklift pockets location

 All personal must wear clean, correctly fitted clothing and safety footwear.

 Whilst moving/lifting the equipment keep all personal well away and never allow people underneath.

 Assembled units and their components are heavy. Failure to properly tie down/move/lift and support this equipment can result in serious physical injury and/or equipment damage. Tie down/move/lift equipment only at the specifically identified tie down/towing/lifting points.

 Tie down/moving/lifting equipment eyebolts, slings and spreaders bars must be rated, selected and used for the entire load being tie downned/moved/lifted.

 Care must be taken to move/lift the equipment above centre of gravity to prevent the unit from flipping.

 Do not lift equipment with forklift unless forklift pockets are provided.

 Lifting eyebolts if fitted on single components of the assembly (e.g. pump or motor) should not be used to lift the total assembly.

 Do not attach sling to shaft ends.

 Maximum lift angle from vertical about lifting eye to be +/- 5°.

 Avoid lifts whereby the slings, form a triangle with the top angle over 90°.

 Hoisting acceleration should not exceed 0.6m/sec<sup>2</sup>.

#### Lifting Frame Certifications

All lifting frames fitted to Pumpset units are certified and attached with WLL label. If require further information contact Remko / Dealer

Below are figures showing recommended means of lifting methods. They are intended for guidance only. If in doubt, consult Remko or a local lifting expert.



Figure 1: Typical SAE #3 & 4 Bearing Bracket without Non-Return Valve



Figure 2: Typical SAE #3 & 4 Bearing Bracket c/w Non-Return Valve



Figure 3: Typical SAE #1 Bearing Bracket without Non-Return Valve



Figure 4: Typical SAE #1 Bearing Bracket c/w Non-Return Valve

## 3. SAFETY INFORMATION

### 3.1 SAFETY PRECAUTIONS

This section is added for information purposes only and not to be used as a Safety Manual.

#### Caution

Remko encourages thorough training and maintenance of high safety standards in the use of this equipment, but responsibility for complying with the proper safety instructions rests with the owner of the product.

**For queries, please contact Remko personnel at your nearest branch.**

#### 3.1.1 GENERAL

Pumpsets are designed to be safe when used in the correct manner. Responsibility for safety, however, rests with the personnel who install, use and maintain the equipment. The following safety precautions, if followed, will minimize the possibility of accidents. Before performing any procedure or operating technique, it is up to the user to ensure that it is safe. The pumpset should only be operated by personnel who are authorized and trained. Refer to **Job Safety Analysis (JSA)** for details.



**Read and understand all safety precautions and warnings before operating or performing maintenance on the pumpset.**

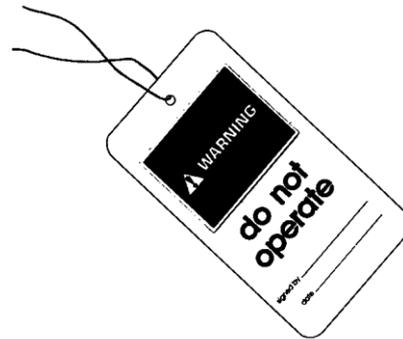


**Ensure that all of the warning signs are legible. Clean the warning signs or replace the warning signs if the words cannot be read or if the pictures are not visible.**



**Failure to follow the instructions, procedures, and safety precautions in this manual may increase the possibility of accidents and injuries.**

### General Hazard Information



Attach a “Do Not Operate” warning tag to the start switch or controls before the pumpset is serviced or repaired. Attach the warning tags to the control panel. When appropriate isolate at the battery isolator.

Cautiously remove the following parts. To help prevent spraying or splashing of pressurized fluids, hold a rag over the part that is being removed.

- Filler caps
- Grease fittings
- Pressure taps
- Breathers
- Drain plugs
- Wear a hard hat, protective glasses, and other protective equipment as required.
- When work is performed around a Pumpset that is operating, wear protective devices for ears in order to help prevent damage to hearing.
- Do not wear loose clothing or jewellery that can snag on controls or on other parts of the engine.
- Ensure that all protective guards and all covers are secured in place on the engine.
- Never put maintenance fluids into glass containers. Glass containers can break.
- Use all cleaning solutions with care.

**Unless other instructions are provided, perform the maintenance under the following conditions:**

- The engine or energy sources is stopped. Ensure that the pumpset cannot be started. Allow engine to cool down.
- The protective locks or the controls are in the applied position.
- Disconnect the batteries when maintenance is performed or when the electrical system is serviced. Disconnect the battery ground leads. Tape the leads in order to help prevent sparks.
- Do not attempt any repairs that are not understood. Use the proper tools. Replace any equipment that is damaged or repair the equipment.
- Start the engine with the operator controls. Never short across the starting motor terminals or the batteries. This method of starting the engine could bypass the engine neutral start system and/or the electrical system could be damaged.

**Remote Starting of Pumpset**

- Some pumpsets have been set up with the ability to be remotely started without warning.
- Ensure unit is isolated before servicing.

**Pressurized Air and Water**

Pressurized air and/or water can cause debris and/or hot water to be blown out or pumped out. This could result in personal injury.

When pressurized air and/or pressurized water is used for cleaning, wear protective clothing, protective shoes, and eye protection. Eye protection includes goggles or a protective face shield.

**Lines, Tubes and Hoses**

Do not bend or strike high pressure lines. Do not install lines, tubes, or hoses that are damaged.

Repair any fuel lines, oil lines, tubes, or hoses that are loose or damaged. Leaks can cause fires.

Inspect all lines, tubes and hoses carefully. Do not use bare hands to check for leaks. Always use a board or cardboard for checking engine components for leaks. Tighten all connections to the recommended torque.

Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Wire that is exposed in reinforced hose
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armouring that is embedded in the outer covering

Ensure that all of the clamps, the guards, and the heat shields are installed correctly. Correct installation of these components will help to prevent these effects: vibration, rubbing against other parts, and excessive heat during operation.

## Inhalation



Relieve all pressure in system, in the lubrication system, in the fuel system, or in the cooling system before any lines, fittings or related items are disconnected.

## Coolant

When the engine is at operating temperature, the engine coolant is hot. The coolant is also under pressure. The radiator and all lines to the compressors or to the engine contain hot coolant.

Any contact with hot coolant or with steam can cause severe burns. Allow cooling system components to cool before the cooling system is drained.

Check the coolant level after the engine has stopped and the engine has been allowed to cool.

Ensure that the filler cap is cool before removing the filler cap. The filler cap must be cool enough to touch with a bare hand. Remove the filler cap slowly in order to relieve pressure.

Cooling system conditioner contains alkali. Alkali can cause personal injury. Do not allow alkali to contact the skin, the eyes, or the mouth

## Oils

Hot oil and hot lubricating components can cause personal injury. Do not allow hot oil to contact the skin. Also, do not allow hot components to contact the skin.

## Slip & Trips

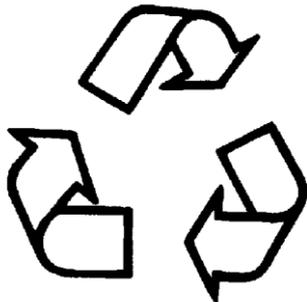
Ground conditions may change quickly. Poor footing conditions may cause slips and falls from equipment and loss of balance. Use extreme caution when maneuvering on or near loose materials or uneven surfaces.

For secure footing, slip resistant boots should be worn. Consider conditions that often lead to slips such as rain, mud, steep terrain, debris and use three points of contact when mounting and dismounting. Make sure the access area is free of tools, gloves and loose objects

## Exhaust

Use caution. Exhaust fumes can be hazardous to your health. If you operate the equipment in an enclosed area, adequate ventilation is necessary.

## Dispose of Engine Coolants & Fluids Properly



Improperly disposing of waste can threaten the environment. Potentially harmful fluids should be disposed of according to local regulations.

Always use leak proof containers when you drain fluids during inspection, maintenance, testing, adjusting and repair. Be prepared to collect the fluid with suitable containers before disassembling any component containing fluids. Do not pour waste onto the ground, down a drain, or into any source of water.

## Burn Prevention

Do not touch any part of an operating engine. Allow the engine to cool before any maintenance is performed on the engine.

### **Mounting and Dismounting Equipment**

Inspect the steps, the handholds, and the work area before mounting. Keep these items clean and keep these items in good repair.

Mount and dismount at locations that have steps and/or handholds.

Face the unit in order to mount and dismount the pumpset. Maintain a three-point contact with the steps and handholds. Use two feet and one hand or use one foot and two hands. Do not use any controls as handholds.

Do not stand on components which cannot support your weight. Use an adequate ladder or use a work platform. Secure the climbing equipment so that the equipment will not move.

### **Engine Starting**

If a warning tag is attached to the engine start switch or to the controls, DO NOT start the engine or move the controls. Consult with the person that attached the warning tag before the engine is started.

All protective guards and all protective covers must be installed if the engine must be started in order to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

### **Engine Stopping**

Stop the engine according to the procedure in the Operation and Maintenance Manual, "Engine Stopping (Operation Section)" in order to avoid overheating of the engine and accelerated wear of the engine components.

Use the Emergency Stop Button (if equipped) ONLY in an emergency situation. Do not use the Emergency Stop Button for normal engine stopping. After an emergency stop, DO NOT start the engine until the problem that caused the emergency stop has been corrected.

### **Trailer Style Pumps**

- Take care not to reverse vehicle into trailer, as this may damage brake components.
- Check vehicle towing hitch load rating and ball/hitch size and type are compatible with trailer.
- Check doors are latched closed.
- Check tyres are correctly inflated as per the trailer vin plate
- Check all stabilizer legs are raised.
- Connect hitch, safety chains and electrical plug (if fitted) to vehicle.
- Check jockey wheel is fully retracted and secured horizontally.
- Store wheel chocks (if supplied).
- Check that the brake reversing lock tab on hitch is open (if brakes are fitted).
- Check brake fluid level, brake operation, cables are not frayed, and that adjustment is correct (if brakes are fitted). Check brake fluid pressure by pulling on the brake handle - pressure should be felt on the first stroke. Rectify if necessary.
- Check tail light operation (if lights are fitted).

**⚠ When towing a trailer observe all codes, standards or other regulations and traffic laws. These include those regulations specifying required equipment, maximum and minimum speeds.**

**⚠ Maximum recommended towing speed on sealed surfaces is 80km/h (dependent on conditions and local limits).**

**⚠ Maximum recommended towing speed is reduced on unsealed surfaces (dependent on conditions and local limits).**

**⚠ Do not permit personnel to ride in or on the trailer. Do not permit personnel to stand or ride on the drawbar or to stand or walk between the trailer and the towing vehicle.**

### **Unhitching Trailer**

- Check that the ground is level, the surface secure, and the position is not too close to a dropping embankment.
- Check parking brake is applied on the towing vehicle, and apply parking brake on trailer.
- Install wheel chocks (if supplied) ensuring that the trailer will not roll down any incline.
- Remove chains and electrical plug (if fitted).
- Set the jockey wheel in place ensuring that the swivel plate locks into the vertical position.
- Raise trailer from hitch using the jockey wheel.
- Lower stabilizer legs.

### **Pontoon Safety**

- Ensure that the pontoon is not overloaded with people and equipment.
- Know the location of emergency firefighting equipment
- Use three points of contact if accessing pontoon ladder from boat
- Avoid accessing pontoon in adverse weather conditions.
- Know the location of the life buoy (floatation ring)

### **Fire and Explosion Prevention**

Fuels and fumes associated with pumpsets are combustible and potentially explosive. Proper care in handling these materials can dramatically reduce the risk of fire or explosion. However, safety dictates that fully charged fire extinguishers are kept on hand. Personnel must know how to operate them.

Always perform a Walk-Around Inspection, which may help you identify a fire hazard. Do not operate a product when a fire hazard exists.

Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire. Fire may cause personal injury and property damage.

Wiring must be kept in good condition. Properly route and attach all electrical wires. Check all electrical wires. Repair any wires that are loose or frayed before you operate the engine. Clean all electrical connections and tighten all electrical connections.

Arcing or sparking could cause a fire. Secure connections, recommended wiring, and properly maintained battery cables will help to prevent arcing or sparking.

Inspect all lines and hoses for wear or for deterioration. Properly route all hoses. The lines and hoses must have adequate support and secure clamps. Tighten all connections to the recommended torque. Leaks can cause fires.

Use caution when you are refuelling pumpset. Do not smoke while you are refuelling. Do not refuel near open flames or sparks. Always stop the engine before refuelling.

Gases from a battery can explode. Keep any open flames or sparks away from the top of a battery. Do not smoke in battery charging areas.

Check lines, tubes and hoses carefully. Do not use your bare hand to check for leaks. Use a board or cardboard to check for leaks. Tighten all connections to the recommended torque.

Replace the parts if any of the following conditions are present:

- End fittings are damaged or leaking.
- Outer coverings are chafed or cut.
- Wires are exposed.
- Outer coverings are ballooning.
- Flexible part of the hoses are kinked.
- Outer covers have embedded armouring.
- End fittings are displaced.

Make sure that all clamps, guards, and heat shields are installed correctly in order to prevent vibration, rubbing against other parts, and excessive heat.

 **Never store flammable liquids near the engine.**

 **Do not smoke or allow sparks, flames or other sources of ignition around fuel or batteries. Fuel vapours are explosive.**

 **Do not refill the fuel tank while the engine is running.**

- If unit is with a fire suppression system or fire extinguisher ensure fire equipment is maintained and serviceable.
- Access environment surrounding pump unit and application before operating or servicing the pumpset.
- Ensure pump unit is operated within the pump operating range.
- With canopy style pump units ensure the ventilation inlet & out take vents are unobstructed and free of debris.
- Ensure areas inside canopy enclosures are free from spills and leaks
- Maintain and service unit at recommended service intervals.
- Stop pumpset before refueling unit if using a manual fill, if other fuel system is used follow their safe operating procedure.

### **Mechanical**

The pump unit is designed with guards for protection from moving parts. Care must still be taken to protect personnel and equipment from other mechanical hazards when working around the equipment.

**⚠ Do not attempt to operate the pump with any safety guards or panels removed. While the pump is running, do not attempt to reach under or around the guards for any reason.**

**⚠ Ensure that the engine is operated only from the control panel.**

**⚠ Keep hands, arms, long hair, loose clothing and jewellery away from pulleys, belts and other moving parts.**

**⚠ Attention: Some moving parts cannot be seen clearly when the set is running.**

**⚠ Keep access doors on enclosures, if equipped, closed and locked when not required to be opened.**

**⚠ Avoid contact with hot oil, hot coolant, hot exhaust gases and hot surfaces.**

**⚠ If your skin comes into contact with high pressure fuel/hydraulic oil, obtain medical assistance immediately.**

**⚠ Wear protective clothing including glove when working around the pump unit.**

**⚠ Do not remove the radiator filler cap until the coolant has cooled. Then loosen the cap slowly to relieve any excess pressure before removing the cap completely.**

**⚠ Ethyl Ether starting aids must not be used on engines with combustion air preheating devices. In general, these starting aids are not recommended on any engine as they will reduce the efficient working life of the engine.**

### **Chemicals**

Fuels, oils, coolants, lubricants and battery electrolyte used in pump units are typical of the industry.

However they can be hazardous to personnel if not treated properly.

**⚠ Do not swallow or have skin contact with fuel, oil, coolant, lubricants or battery electrolyte. If swallowed, seek medical treatment immediately. Do not induce vomiting if fuel is swallowed. For skin contact, wash with soap and water.**

**⚠ Do not wear clothing that has been contaminated by fuel or lube oil.**

**⚠ Wear an acid resistant apron and face shield or goggles when servicing the battery. If electrolyte is spilled on skin or clothing, flush immediately with large quantities of water.**

### **Noise**

Pump sets that are not equipped with sound attenuating enclosures can produce noise levels in excess of 85 dBA. Prolonged exposure to noise levels above 85 dBA is hazardous to hearing.

**⚠ Ear protection must be worn when operating or working around the pump unit.**

## 3.2 TRAILER MAINTENANCE

### Warning

All necessary service work should only be carried out by suitably trained personnel

### 3.2.1 HITCH MAINTENANCE

#### Check

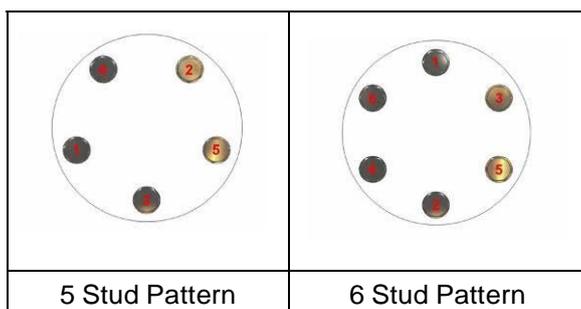
- ✓ All moving parts operate smoothly.
- ✓ Positive lock mechanism is functional (if fitted).
- ✓ Lightly grease moving components.

### 3.2.2 TYRES AND WHEELS

Regular maintenance of tyres and wheels is essential to safe operation of the machine and to maximize component life. Tyre or wheel failure will result in unsafe towing conditions, increasing risk of machine tip-over. Component damage may also result if problems are not discovered and resolved.

#### Check

- ✓ Tyre tread and sidewalls for damage (including cuts, punctures, cracks or uneven wear patterns).
- ✓ Tyre air pressure of each tyre. Refer to Specifications on sidewall or on machine placard
- ✓ Each wheel for damage (including bends and cracked welds).
- ✓ Ensure that the wheel and hub/brake drum are dimensionally compatible. This means that the P.C.D., wheel bolts and inset must all be compatible with both the hub/brake drum and the wheel rim.
- ✓ Each wheel nut or lug bolt is tightened to vendor's recommended specifications using a torque wrench or similar and in the correct sequence. (shown below).



### Warning

It is essential to check the torque settings prior to first use after the first 50km (30mi) for the first 350km. Over/under tightening of the nuts/bolts may result in the nuts/bolts working loose and possible damage or shearing of the nut/bolt, causing wheel separation from the vehicle.

### Warning

Use a torque wrench to tighten to specified values. Improper torque can cause component failure which could result in property damage, serious personal injury, or loss of life

### 3.2.3 CHECKING BRAKE LINING (IF FITTED)

Checks must be performed on the wheel brake linings after every 5000 km (3000 mi) or every 3 months - adjust as necessary. Where continuous travel in hilly regions or high mileage is experienced, earlier inspection and adjustment may be necessary.

#### Check

- ✓ For gouging on any components
- ✓ Thickness on shoes (drum) or pads.
- ✓ Maintain greater than 1mm clearance from rivets; replace if necessary
- ✓ Brake adjustment

### Warning

Brake adjustment is required if travel of mechanical override shaft is more than 60%.

Replace and adjust as required

### 3.2.4 MAINTENANCE AND CARE OF GALVANISED VEHICLE PARTS

The formation of white rust is only a blemish and can never be excluded completely.

Procedure recommended to minimize formation of white rust

- ensure an adequate air circulation during storage.
- clean the galvanized surfaces with clear water (e.g. steam clean) after journeys in winter.
- regularly re-grease and/or oil joints and bearing points

### 3.2.5 STABILIZER LEGS AND JOCKEY WHEEL MAINTENANCE

Inspect the jockey wheel every 3 months.

#### **Check**

- ✓ Free operation of the winding mechanism and rotation of the wheel
- ✓ Free rotation of swivel plate
- ✓ Drop down legs operate smoothly
- ✓ Check jock stands operate correctly and lock into place
- ✓ No slack in mechanism
- ✓ Condition of wheel (if fitted). Ensure no flat spots.
- ✓ Wheel pressure for pneumatic tyres

Replace faulty components as required

Spray all moving parts with silicon based lubricant every 12 months

## 3.3 BATTERY

The battery is an assembly of "cells" containing a number of plates, immersed in an electrically conductive fluid. The electrical energy from the battery comes from chemical reactions taking place within the cells. These reactions are reversible which means that the battery can be repeatedly charged and discharged.

### 3.3.1 BATTERY MAINTENANCE

#### **Warning**

Batteries give off combustible gases which can explode. A spark can cause the combustible gases to ignite. Do not smoke when batteries are being serviced.

#### **Electrolyte**

The electrically conductive fluid, called electrolyte, in a lead-acid battery is a diluted sulphuric acid solution. It aids the chemical reactions occurring at the plates and it acts as the carrier for the electrical current.

#### **Specific Gravity**

Specific gravity is a unit of measurement for determining the sulphuric acid content of the electrolyte which compares the weight of the electrolyte compared to the weight of pure water. At 25° C (77° F) a fully charged battery should have a specific gravity of 1.270. The concentration of sulphuric acid will be lowered when the specific gravity lowered.

As the battery is discharged, the chemical reactions lower the specific gravity of the electrolyte. Therefore, this measurement can be used as a guide to the state of charge of the battery.

#### **Hydrometer**

Specific gravity can be measured directly using a hydrometer. This device is a bulb- type syringe which will extract electrolyte from a cell in the battery. A glass float in the hydrometer barrel is calibrated to indicate the specific gravity. Hydrometer readings should not be taken immediately after water is added to the cell. The water must be thoroughly mixed with the underlying electrolyte, by charging, before hydrometer readings are reliable. Also, if the reading is being taken immediately after the battery has been subjected to prolonged cranking, the reading will be higher than the true value. The water formed in the plates during the rapid discharge will not have had time to mix with the electrolyte above the plates.

#### **Warning**

Wear an acid resistant apron and face shield or goggles when servicing the battery. Flush immediately with large quantities of water if the electrolyte is spilled on skin or clothing.

### Filling

The battery will often be shipped dry. Pre-mixed electrolyte of the correct specific gravity will have to be added.

### Topping Up

Occasional topping up of the battery is required, as normal operation and charging of the battery will cause some of the water to evaporate.

Clean the battery first to avoid contamination and remove the vent plugs. Add distilled water, until the level is 8mm (5/16 inch) above the separators. Replace vent plugs.

## 3.3.2 CHARGING THE BATTERY

### Warning

Always ensure battery charging is carried out in a well-ventilated area away from sparks and naked flames.

 Never operate a battery charger where unprotected from rain or snow. The charger should never be used near water. Always switch the charger off prior to disconnecting the battery.

## 3.4 FIRST AID FOR ELECTRICAL INJURIES

### Caution

This section is added for information purposes only and not to be used as a First Aid Manual.

In case of emergency, medical advice should always be sought immediately.

While Remko encourages thorough training of First Aid personnel, responsibility for complying with adequate First Aid instructions rests with the owner of the product.

### Check the Victim's Response

When it is safe, check whether the victim is conscious. Speak loudly to the victim and gently touch the shoulder. Ask, "Can you hear me?" or "Squeeze my hand". If the victim does not respond to your voice or touch, assume unconsciousness and follow the ABC of resuscitation.

Remove the vent plugs and fill each cell with the electrolyte until the level is 8 mm (5/16 inch) above the top edge of the separators. Allow the battery to stand for 15 minutes. Check and adjust the level as necessary.

**A Airway** – Clear and Open

**B Breathing** – Check and be prepared to start EAR.

**C Circulation** – Check for circulation and use CPR if there is no pulse.

### Clear and Open the Airway

If there is no response, quickly turn the victim onto one side into the recovery position. Using two fingers clear the mouth of any food or fluids. Then, gently tilt back the head and support the jaw, keeping the face turned slightly downwards for drainage.

### Check for Breathing

Look and feel over the lower ribs for any chest movement. Listen & feel for the escape of air from the mouth or nose. If there is no sign of breathing, resuscitation is needed, so quickly roll the victim onto their back. Begin mouth to mouth resuscitation if you know how. Otherwise, call for help from a trained bystander.

### Expired Air Resuscitation (EAR):

Whilst maintaining head tilt and jaw support, make a tight seal around the victim's mouth with your mouth close the victim's nostrils with your cheek and give five initial breaths in about 10 seconds. Breathe into the victim until you see the chest rise. Allow the chest to empty whilst your mouth and nose are turned to the side to avoid the exhaled air.

### Check for Circulation

After five breaths have been given, check the pulse in the neck to feel if the heart is beating. If a pulse can be felt, continue EAR at the slower rate of 1 breath every 4 seconds. Recheck the pulse every two minutes to be sure that the heart is still beating. If you cannot feel a pulse, begin cardiopulmonary resuscitation (CPR) if you have been trained.

### **Cardiopulmonary Resuscitation (CPR):**

Find the lower edge of victim's rib cage with your lower hand. Slide your index finger up the edge of the rib cage to the notch where the ribs meet the sternum. Leave your index finger on this notch. With the index finger of your upper hand, find the notch at the top of the sternum where the collarbones join it. Leave your index finger on this notch. Extend both thumbs equally to find the middle of the sternum. Place the heel of your compressing hand on the sternum just below the midpoint. Grasp the wrist of the hand on the chest with your other hand and compress the chest.

CPR is given in cycles of 15 compressions and 2 breaths. This cycle should take about 15 seconds.

After 4 cycles (1 minute), check for a pulse. If there is no pulse continue CPR and check for a pulse every two minutes until emergency personnel arrive.

### **Shock**

Most injured people show the signs and symptoms of shock. These are:

- Pale, cool, moist skin.
- A weak, rapid pulse.
- Altered conscious states.
- Rapid breathing.
- Nausea / vomiting.
- Restlessness / irritability.
- Extreme thirst.

Do not give any food, fluids or stimulants. Where possible, the conscious victim should be assisted to lie down in the most comfortable position with all injured parts supported. If injuries permit, raise both legs to boost the circulation to the heart and brain. The unconscious victim should be placed in the recovery position. Maintain the victim's body temperature.

### **Burns**

Electrical burns are often deep, and the victim will have both an entrance and exit wound. Although these wounds may look superficial, the tissues below may be severely damaged. After ensuring the scene is safe:

- Cool burns by flushing with cool water
- Remove victims rings and jewellery (metal retains heat)
- Cover the burn with a dry, sterile dressing
- Take steps to minimize shock

 **In all emergencies, call Emergency Services as soon as possible.**

### **Australian Red Cross**

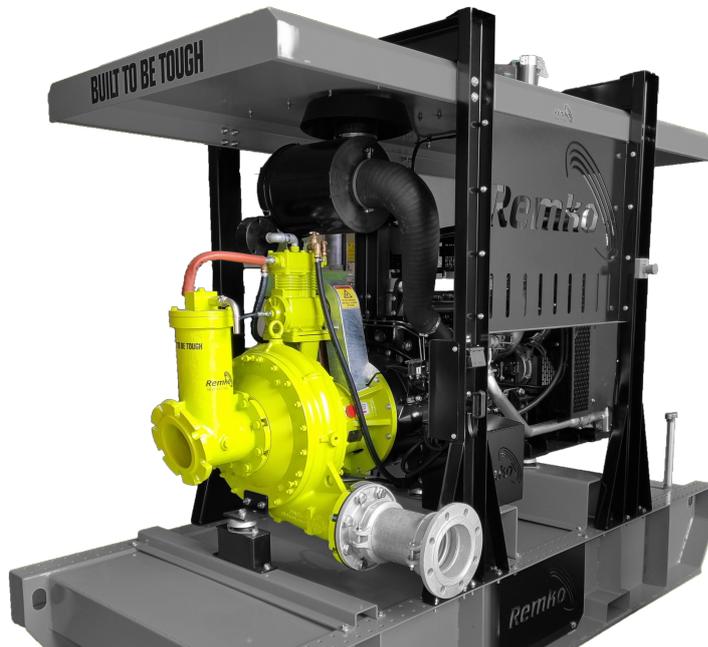
Information supplied by Australian Red Cross. To respond appropriately in a first aid emergency, Australian Red Cross recommends that you complete a first aid course. Call 1300 367 428 (Australia).

### 3.5 JOB SAFETY ANALYSIS (JSA)

| No. | Task or type of Exposure             | Hazard  | Risk Rating | Controls  | Skid Pumpset | Trailer Pumpset | Sound Attenuating Enclosures Pumpset | Hydraulics/ Pumpset | Pontoon | Electric Pumpset |
|-----|--------------------------------------|---|-------------|---|--------------|-----------------|--------------------------------------|---------------------|---------|------------------|
| 1   | Operating Pump Unit                  | Operation of pumpset without referring to operating instructions and reading <b>Operation JSA</b> may cause damage to tower or personal injury.               | 2           | Ensure all service personnel have access to and have read operation instructions and JSA.   | X            | X               | X                                    | X                   | X       | X                |
| 2   | Access to Site                       | Site workers un-aware of your presence on site.   | 2           | Ensure to sign on & obtain permission to enter site.  | X            | X               | X                                    | X                   | X       | X                |
| 3   | Induction & Training                 | Being untrained on site operations & procedures pose a safety risk.   | 2           | Complete Induction for each site operation and enforce requirements for special site licenses.  | X            | X               | X                                    | X                   | X       | X                |
| 4   | First Aid & Safety Awareness         | Not following correct First Aid and Safety procedures in the event of an accident or injury.  | 5           | Check vehicle First Aid Kit is located at the nearest Site First Aid Centre and identify site First Aid Officers.                           | X            | X               | X                                    | X                   | X       | X                |
| 5   | Travelling on Site                   | Conditions and vehicle access may impose on site vehicles causing accident.   | 4           | Be aware which roads are accessible to service vehicles and monitor ground and weather conditions.  | X            | X               | X                                    | X                   | X       | X                |
| 6   | Personal Safety                      | Injury caused by not wearing correct Personal Protection Equipment.   | 4           | Wear correct PPE appropriate for each task and check for any special site requirements.   | X            | X               | X                                    | X                   | X       | X                |
| 7   | Inspection of Work Area              | Area around site may pose safety risks.   | 4           | Inspect work area before commencing work, clean up if required & park work vehicles out of traffic area.                                    | X            | X               | X                                    | X                   | X       | X                |
| 8   | Isolation of Equipment               | Machine must be electrically mechanically isolated before work can commence.  | 2           | Tag and Lock-out equipment before work commences.   | X            | X               | X                                    | X                   | X       | X                |
| 9   | Permits                              | Without Site Permits for different operations, NO Work can commence.  | 2           | Ensure all Work Permits are in place before commencing work.  | X            | X               | X                                    | X                   | X       | X                |
| 10  | Avoid Spillage of Liquids            | May result in environmental pollution.  | 9           | Ensure all Work Permits are in place before commencing work.  | X            | X               | X                                    | X                   | X       | X                |
| 11  | Isolation Tags, Locks & Open Permits | Failure to remove or sign out these will result in the equipment being unavailable for use. Unauthorised removal may result in operation of unsafe machinery. | 2           | Remove Tags and sign off open permits once work is complete. DO NOT remove tags or locks or sign off on permits unless authorised to do so. | X            | X               | X                                    | X                   | X       | X                |
| 12  | Hot Engine Parts                     | Hot engine parts may cause serious burns to exposed skin.   | 5           | Wear correct PPE appropriate for each task and check any special site requirements.   | X            | X               | X                                    | X                   | X       | X                |
| 13  | Clean Up                             | Debris and liquid spills may result in environmental pollution.   | 9           | Clean up area after servicing and dispose of all waste products according to site procedures.   | X            | X               | X                                    | X                   | X       | X                |
| 14  | Safety Warnings                      | Failure to observe safety warnings in individual procedures may result in serious injury or damage to machine   | 5           | Ensure all staff involved in maintenance procedures observe safety warnings and take measures to reduce risk.                               | X            | X               | X                                    | X                   | X       | X                |
| 15  | Drawing (Pontoon)                    | Failure to wear flotation devices   | 2           | Ensure that staff have available life rings and personal flotation devise when working on Pontoon mounted pumpsets                          |              |                 |                                      |                     |         |                  |

## 4. PUMP UNIT INFORMATION

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### 4.1 Description of Standard Pump Unit

The pump is basically a simple end suction pump which has a completely automatic priming system built into the design. This enables the pump to self-prime from a completely dry condition even with a long suction line. No liquid of any nature is required to prime the pump.

These pumps are offered in a variety of mounting options, including trailer-mounted, skid-mounted, conventional channel base-mounted

configurations or bare shaft pumps may be mounted by a third party. They are available with either electric or diesel motors. For detailed guidance on startup, installation, and maintenance, refer to the corresponding engine and motor manuals.

Each unit is backed by a Limited Manufacturer's Warranty. Warranty durations vary depending on the product type. For complete details, please contact the Remko team.

#### Notes

- *If your pumpset has been mounted on a trailer chassis, it is recommended that after approximately 5 km of travel that all wheel nuts be inspected and re-tightened.*
- *Guards are fitted as standard to all moving parts.*

## 4.2 Pump Bearing Lubrication

### Grease Set Up

| Grease Type  | Operating Temperature Range |
|--|-----------------------------|
| Multi Lube Lithium Grease EP Additives NLGI#2                                | -25 / +160 °C*              |
| Advanced Multi Purpose Aviation Grease^<br>MIL-G-23827B (US)<br>G-354 (NATO) | -73 / +149 °C*              |

### Oil Set Up

| Oil Type               | Operating Temperature Range |
|------------------------|-----------------------------|
| Hydraulic ISO Grade 68 | -10 / +60 °C*               |
| Royal Purple FDA34^    | -50 / +50 °C*               |

\* = Use as a guide only, Confirm with vendor in regards specifications

^ = Or equivalent product

### 4.3 Generic Torque Rating

Remko uses the following bolts and studs in their pump builds and it is recommended to use the following torque settings

| <b>HIGH TENSILE BOLT CLASS 8.8</b> |                                     |                      |
|------------------------------------|-------------------------------------|----------------------|
| <b>Size</b>                        | <b>Recommended Assembly Torques</b> |                      |
|                                    | <b><i>Nm</i></b>                    | <b><i>ft.lbs</i></b> |
| M8                                 | 22                                  | 16                   |
| M10                                | 44                                  | 32                   |
| M12                                | 77                                  | 57                   |
| M16                                | 190                                 | 140                  |
| M20                                | 370                                 | 270                  |
| M24                                | 640                                 | 470                  |

| <b>ENGINEERING STUD CLASS 4.6</b> |                                     |                      |
|-----------------------------------|-------------------------------------|----------------------|
| <b>Size</b>                       | <b>Recommended Assembly Torques</b> |                      |
|                                   | <b><i>Nm</i></b>                    | <b><i>ft.lbs</i></b> |
| M8                                | 8.5                                 | 6.3                  |
| M10                               | 17                                  | 12                   |
| M12                               | 30                                  | 22                   |
| M16                               | 73                                  | 54                   |
| M20                               | 143                                 | 106                  |
| M24                               | 248                                 | 183                  |

## 5. SAFE OPERATING PROCEDURES

### 5.1 Safe Operating Procedure (SOP) – Fuel Filling

#### **DO NOT start until you have read and understood the SOP**

*This SOP does not necessarily cover all possible hazards associated with the machine and should be used in conjunction with other references  
It is designed to be used as an adjunct to teaching Safety Procedures and to act as a reminder to users prior to machine use*



Safety glasses must be worn at all times in work areas displaying this sign.



Close fitting, HI VIS protective clothing must be worn.



Sturdy footwear must be worn at All times in work areas.



Hearing protection must be used in areas displaying this sign.



Always wear the correct gloves

#### **PRE-OPERATIONAL SAFETY CHECKS**

1. Ensure no slip/trip hazards are present in workspaces and walkways.
2. Check that all guards are in position.
3. Locate and ensure you are familiar with the operation of the ON/OFF starter and E-Stop (if fitted).
4. Faulty equipment must not be used. Immediately report suspect machinery.

#### **OPERATIONAL SAFETY CHECKS**

1. Ensure dispensing hose and nozzle are in good condition.
2. Ensure fuel has finished flowing before removing from filler nozzle.
3. DO NOT overfill
4. When using automatic systems ensure manual fill points are isolated and locked

#### **HOUSEKEEPING**

1. Leave the machine in a safe, clean and tidy state.
2. Maintain clear access
3. Keep work area clean and tidy
4. Clean any spills with the appropriate spill kit materials

#### **POTENTIAL HAZARDS**

- Spillage may produce slippery surfaces
- Spillage entering drainage system
- Splashes (avoid splashing while filling)
- Ignition sources
- Movement of mobile equipment
- Exposure to diesel
- Heat sources

### **MANUAL HANDLING**

Aim to eliminate or reduce manual handling wherever possible.  
Use mechanical devices where possible

### **FIRE PROTECTION**

Know the location of emergency fire equipment and emergency shut off switches.

### **EMERGENCY CONTAINMENT**

1. Know the location of emergency spill kits
2. Contact your area Supervisor

### **JOB STEPS**

1. **Shut Down Pump**
  - Follow operating manual procedure to shut down pump
  - If pump cannot be shut down a risk assessment must be completed.
2. **Diesel Dispensing**
  - Check operating manual to ensure correct nozzle is used.
  - Secure nozzle by hand.
  - Don't jam open dispensing nozzle.
  - Carefully monitor the filling rate to avoid over filling.
  - Do not remove nozzle hose until discharge flow has stopped.
  - Thoroughly clean up any surface spills
3. **Return Dispensing Nozzle**
  - Return nozzle to holder on storage tank.
  - On completion of refuelling reinstate filler cap to mobile fuel tank
4. **Security**
  - Secure storage tank door with padlock to prevent unauthorized access

## 5.2 Safe Operating Procedure (SOP) – Battery Charging

### **DO NOT start until you have read and understood the SOP**

*This SOP does not necessarily cover all possible hazards associated with the machine and should be used in conjunction with other references  
It is designed to be used as an adjunct to teaching Safety Procedures and to act as a reminder to users prior to machine use*



Safety glasses must be worn at all times in work areas displaying this sign.



Close fitting, HI VIS protective clothing must be worn.



Sturdy footwear must be worn at all times in work areas.



Hearing protection must be used in areas displaying this sign.



Always wear the correct gloves



Rings and jewellery must not be worn.

#### **PRE-OPERATIONAL SAFETY CHECKS**

1. Check workspaces and walkways to ensure no slip/trip hazards are present.
2. Wear eye protection when working around batteries
3. Ensure charger is not used near ignition sources, there is good ventilation and avoid producing sparks.

#### **OPERATIONAL SAFETY CHECKS**

1. Use suitable battery tester/hydrometer to check battery charge.
2. Assess size and weight of battery and determine suitable lifting/ removal technique.
3. Remove from plant as per manufacturer's instructions.
4. Do NOT carry by terminal posts- use strap or cradle. Do not carry against body. Keep upright.
5. Check battery condition before charging, if terminals/casing are severely rusted, or battery damaged, do NOT recharge. Place in battery recycling area.
6. Check the acid levels before recharging.
7. If acid covering the top of the plates, do not use water. Clean first then use distilled water for refilling.
8. If battery has sealed vents, do NOT recharge the battery with a current greater than 25amps. Follow manufacturer's instructions for voltage (6v or 12v), for fast charge (30amps), do NOT exceed 1 hour.
9. Follow manufacturer's instructions for attaching and removing cables. Example: Unplugging or turning off the charger before connecting or disconnecting the clamp connections. Carefully attach the clamps to the battery with proper polarity (positive + clamp, usually red, to the positive terminal and negative – clamp, usually black to the negative terminal).
10. If battery becomes hot or if acid spills from the vent, turn OFF the charger temporarily. Resume recharging using a lower current or charge rate.
11. Recheck fluid level after battery has been charged and disconnected.

### **HOUSEKEEPING**

1. Leave the battery charger and work area in a safe, clean and tidy state.

### **POTENTIAL HAZARDS**

- Exposure to electricity
- Sparks
- Fire
- Explosion
- Slips, Trips, Falls
- Manual Handling
- Eye injuries
- Burns

### **FORBIDDEN**

- Never leave a battery on charge overnight.

## 6. PUMP INSTALLATION & OPERATING INSTRUCTIONS

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### 6.1 Pump Commissioning / Installation and Operating Front Sheet

| Pump Commissioning / Installation and Operating Front Sheet             |            |           |
|---|------------|-----------|
| <b>Customer Name</b>  |            |           |
| <b>Customer Representative</b>  |            |           |
| <b>Remko Representative</b>   |            |           |
| <b>Pump Type</b>  |            |           |
| <b>Pump Serial Number</b>   |            |           |
| <b>Date of Commissioning</b>  |            |           |
| <b>Commission / Installation &amp; Operation Completed Satisfactory</b> | <b>YES</b> | <b>NO</b> |
| <b>Customer Representative Sign</b>                                     |            |           |
| <b>Remko Representative Sign</b>  |            |           |
| <b>Date (Day/Month/Year)</b>  |            |           |

## 6.2 Generic Diesel Driven Pumpset Installation and Operating Instructions

| PUMP x DIESEL ENGINE INSTALLATION & OPERATING INSTRUCTIONS - GENERIC VERSION |           |                     |  |                |
|--|-----------|---------------------|--|----------------|
| CODE   | STEP      | ITEM                | INSTRUCTIONS   | CHECKED<br>(√) |
| POI1   | Pre Start | Pump Application    | Ensure pump selected is correct for duty required  |                |
| POI2   | Pre Start | HSE Compliance      | Carry out and comply with relevant HSE site, government rules, acts, regulations and codes of practice   |                |
| POI3   | Pre Start | Delivery Inspection | Pump and associated equipment has been supplied in full and in operational condition                     |                |
| POI4   | Pre Start | Pumpset Set Up      | Pumpset is level and on firm ground  |                |
| POI5   | Pre Start | Pumpset Set Up      | Pumpset and associated equipment is accessible by service vehicles and/or relevant equipment             |                |
| POI6   | Pre Start | Suction Hose        | Hose is non-collapsible type, free of kinks and internal blockages                                       |                |
| POI7   | Pre Start | Suction Hose        | Hose size at least to be equal or larger than pump inlet size  |                |
| POI8   | Pre Start | Suction Hose        | Hose set up to be short and straight as possible   |                |
| POI9   | Pre Start | Suction Hose        | No elbow fitted directly to pump inlet   |                |
| POI10  | Pre Start | Suction Hose        | No undulating suction hose set up (i.e. no possibility of trapped air in suction hose set up)            |                |
| POI11  | Pre Start | Suction Hose        | No excessive static suction lift   |                |
| POI12  | Pre Start | Suction Hose        | Strainer hole size to be less than pump solids handling capability                                       |                |
| POI13  | Pre Start | Suction Hose        | Strainer position to avoid air intake and clogging due to silt/mud etc. from floor of tank/pond/dam etc. |                |
| POI14  | Pre Start | Suction Hose        | Strainer open area to be at least four times the area of the suction hose                                |                |
| POI15  | Pre Start | Suction Hose        | No foot valve in suction hose set up, please contact Remko for assistance.                               |                |
| POI16  | Pre Start | Discharge Hose      | Hose diameter at least the same diameter as pump outlet  |                |
| POI17  | Pre Start | Discharge Hose      | Correctly rated discharge hose and fittings (non-return valves, gearbox butterfly valves etc.)           |                |
| POI18  | Pre Start | Discharge Hose      | Control valve has fine adjustment capabilities and is designed for throttling conditions                 |                |
| POI19  | Pre Start | Discharge Hose      | Pressure gauge fitted in discharge pipe work as close as possible to pump outlet                         |                |
| POI20  | Pre Start | Discharge Hose      | Suitable rated pressure bleed valve  |                |

**PUMP x DIESEL ENGINE INSTALLATION & OPERATING INSTRUCTIONS - GENERIC VERSION**

| CODE                    | STEP         | ITEM                                       | INSTRUCTIONS   | CHECKED<br>(✓) |
|-------------------------|--------------|--|--|----------------|
| POI21                   | Pre Start    | Discharge Hose                             | Free from air leaks, kinks and internal blockages  |                |
| POI22                   | Pre Start    | Discharge Hose                             | Discharge hose straight and short as possible  |                |
| POI23                   | Pre Start    | Operator Expertise                         | Operator familiar with pumpset stop / start operating procedures   |                |
| POI24                   | Daily Checks | Pump Area                                  | Ensure the area is clean and free of debris  |                |
| POI25                   | Daily Checks | Pump                                       | Check for any oil, coolant, quench fluid or water leaks  |                |
| POI26                   | Daily Checks | Gland Packing                              | Inspect gland packing, check for wear and burn marks   |                |
| POI27                   | Daily Checks | Mechanical Seal                            | Check for mechanical seal fittings, and hoses leaks.   |                |
| POI28                   | Daily Checks | Mechanical Seal                            | Inspect for mechanical seal reservoir leaks  |                |
| POI29                   | Daily Checks | Mechanical Seal                            | Check mechanical seal oil for milkiness/contamination or coolant contamination. Change mechanical seal oil or coolant radiator fluid.  |                |
| POI30                   | Daily Checks | Volute                                     | Inspect pressure gauge/sender; indication needle operation, glycerine level, glycerine contamination, clearness of gauge viewing glass |                |
| POI31                   | Daily Checks | Tee Piece                                  | Inspect vacuum gauge/sender; indication needle operation, glycerine level, glycerine contamination, clearness of gauge viewing glass   |                |
| POI32                   | Daily Checks | Radiator Coolant                           | Inspect and fill as required.  |                |
| POI33                   | Daily Checks | Fuel                                       | Inspect and fill as required.  |                |
| POI34                   | Daily Checks | Radiator Coolant, Lube and Fuel Quick Fill | Visually inspect for leaks. Ensure that protective caps are in place.  |                |
| POI35                   | Daily Checks | Engine                                     | Check for any oil, coolant, quench fluid and water leaks   |                |
| POI36                   | Daily Checks | Radiator Fins                              | Inspect for blockages and clean as required  |                |
| POI37                   | Daily Checks | Gearbox                                    | Visually inspect for leaks. Ensure that protective caps are in place.  |                |
| POI38                   | Daily Checks | Guards                                     | Check that all guards and covers are in place and secure.  |                |
| POI39                   | Start        | Control valves                             | Pump Suction and Discharge isolation/control valves are fully <b>OPEN</b> for initial prime and pump operating stages                  |                |
| POI40                   | Start        | Battery Power                              | Switch battery isolator <b>ON</b>  |                |
| <b>MANUAL OPERATION</b> |              |  |  |                |
| POI41                   | Operation    | Default Setting                            | The default setting on the diesel engine control panel is "MANUAL"   |                |

**PUMP x DIESEL ENGINE INSTALLATION & OPERATING INSTRUCTIONS - GENERIC VERSION**

| CODE  | STEP      | ITEM              | INSTRUCTIONS   | CHECKED<br>(√)         |
|-------|-----------|-------------------|--|------------------------|
| POI42 | Operation | Start Engine      | To start press Manual/Start on Control Panel (engine will start in 5 seconds) and allow to warm up at idle; the engine control panel screen will display the engine data (diesel engine speed, oil pressure, run hours, voltage and temperature). Other engine and pump data can be displayed on the engine control panel depending on pump monitoring options fitted.         |                        |
| POI43 | Operation | Pump Duty         | Slowly increase RPM to operating speed required to ensure correct pump/engine operation by either adjusting the vernier control mechanism (mechanical diesel engines) or toggle switch (electronic diesel engines) located on the engine control panel; once the pump is primed ensure flow and pressure are set and maintained within the pump's recommended operating range. |                        |
| POI44 | Operation | Pump Duty         | Allow 2-5 minutes for pump operation to stabilise  |                        |
| POI45 | Operation | Pump Monitoring   | <b>Monitor and record for a minimum period of 10 minutes;</b>  | <b>CHECKED<br/>(√)</b> |
| POI46 | Operation | Pump Monitoring   | Pump bearing temperatures  |                        |
| POI47 |           | Pump Monitoring   | Pump bearing bracket oil level   |                        |
| POI48 | Operation | Pump Monitoring   | Mechanical seal quench level   |                        |
| POI49 | Operation | Pump Monitoring   | Mechanical seal quench contamination   |                        |
| POI50 | Operation | Pump Monitoring   | Check gland packing drip rate, ensure enough fluid is coming out of gland  |                        |
| POI51 | Operation | Pump Monitoring   | Pump pressure gauge reading  |                        |
| POI52 | Operation | Pump Monitoring   | Pump suction gauge reading   |                        |
| POI53 | Operation | Pump Monitoring   | Pump flow meter reading  |                        |
| POI54 | Operation | Engine Monitoring | Engine speed reading   |                        |
| POI55 | Operation | Pump Monitoring   | Other pump monitoring devices fitted   |                        |
| POI56 | Operation | Pump Monitoring   | Pump system leaks - pump / control valves / suction & discharge pipe systems)  |                        |
| POI57 | Operation | Pump Monitoring   | Pump system leaks - control valves / suction & discharge pipe systems)   |                        |
| POI58 | Operation | Pump Monitoring   | Pump system leaks - suction pipe systems   |                        |
| POI59 | Operation | Pump Monitoring   | Suction hose / strainer set up (no vortex, i.e. no air being sucked into suction pipe)   |                        |
| POI60 | Operation | Pump Monitoring   | Pump system leaks - discharge pipe systems   |                        |
| POI61 | Operation | Pump Monitoring   | Pump system leaks - discharge pipe systems   |                        |

**PUMP x DIESEL ENGINE INSTALLATION & OPERATING INSTRUCTIONS - GENERIC VERSION**

| CODE  | STEP      | ITEM                 | INSTRUCTIONS   | CHECKED<br>(✓) |
|---|-----------|----------------------|--|----------------|
| POI62   | Operation | Engine Monitoring    | Engine temperature reading   |                |
| POI63   | Operation | Engine Monitoring    | Engine voltage reading   |                |
| POI64   | Operation | Engine Monitoring    | Engine load reading  |                |
| POI65   | Operation | Engine Monitoring    | Engine pressure reading  |                |
| POI66   | Operation | Engine Monitoring    | Engine emissions   |                |
| POI67   | Operation | Engine Monitoring    | Other engine monitoring devices fitted   |                |
| POI68   | Operation | Gearbox Monitoring   | Gearbox pressure reading   |                |
| POI69   | Operation | Gearbox Monitoring   | Gearbox temperature reading  |                |
| POI70   | Operation | Air Comp Monitoring  | Compressor relief valve is not blowing off (relieving), sounds like a rattle gun   |                |
| POI71   |           |                      | <b><i>Special Note:</i></b><br><i>Any abnormal noises need to be investigated immediately</i>  |                |
| POI72   | Operation | Shutdown             | To shut down pump reduce the speed to diesel engine idle RPM by either adjusting the vernier control mechanism (mechanical diesel engines) or toggle switch (electronic diesel engines) located on the engine control panel; and press stop once for cool down timer, basically the engine will operate at diesel engine idle speed for a set period before shutting down, or press stop a second time to bypass cool down timer process (not recommended) |                |
| POI73   | Operation | Shutdown Timer       | Shutdown Timer is available for required run time  |                |
| <b>AUTOMATIC OPERATION</b>  |           |                      |  |                |
| POI74   | Operation | Automatic Stop/Start | Auto Operation is available if required but due to the numerous Automatic start up triggers and functions it is recommended to consult your local Remko representative for these set ups.  |                |
| <p><b><u>Special Note:</u></b><br/> <i>For additional MANUAL and AUTOMATIC diesel engine control panel operation and setting information please refer to Engine Control Panel Manuals and /or your local Remko representative</i></p> |           |                      |  |                |

## 6.3 Air Compressor

### 6.3.1 General Description

#### Application

These compressors are positive displacement type, reciprocating and single acting. The cylinder barrels are air-cooled while the cylinder head is cooled by water circulated from the vehicle engine cooling system.

The salient features of these compressors are robust overhung design crankshaft for reliability & easy maintenance, solid end connecting rods, highly thermal efficient interfolding, totally reliable splash lubrication & force feed lubrication for smooth vibration free operation.

#### Single Stage Compressor

These compressors have cylinders of the same size. The principle of operation is as follows: On the suction stroke of the individual piston, air at atmospheric pressure enters the crankcase/cylinder through the inlet filter and the valve located in airhead. On the compression stroke of the each piston, air is forced out through the valve and passes into a common discharge.

#### General Specifications

|   |            |           |
|---|------------|-----------|
| Bore  | 75         | mm        |
| Stroke                                      | 50         | mm        |
| Swept Volume                                | 37.4       | CFM       |
| Maximum Recommended Speed                   | 2400       | rpm       |
| Maximum Recommended Delivery Pressure       | 9 / 130    | BAR / PSI |
| Operating Temperature Range                 | -40 to +80 | °C        |
| Maximum Continuous delivery Air Temperature | 200        | °C        |
| Weight                                      | 20         | kg        |

### 6.3.2 Operation

The following instructions should be used by the operator as a guide for the general operation of the compressor. As the operator gains experience with the compressor under actual conditions, a set routine should be established. After a general overhauling or installation of new parts, the operator should be guided by the instructions as though the compressor was new.

#### Initial Start:

#### **IMPORTANT**

It is very important that the intake piping be clean and properly installed. It is essential that this be done after installation or relocation of the compressor and after a long shutdown or new parts installation

#### Preparation

When the installation of the compressor has been completed in accordance to the instructions given, carry out the following procedure before starting the machine.

1. Remove oil, dirt and dust from the exterior of the compressor.
2. Remove the air head and clean out with safety solvent every portion of the interior and the crankcase oil sump to ensure a clean interior, free from dust and dirt, which may have entered during shipping and installation. Never use waste or a linty cloth to clean the interior of the machine.

*The running and finished parts inside the crankcase are covered with a heavy anti-rust compound previous to shipment. It is not necessary to remove this coating before starting the compressor, as it is soluble in the pump lubricating oil.*

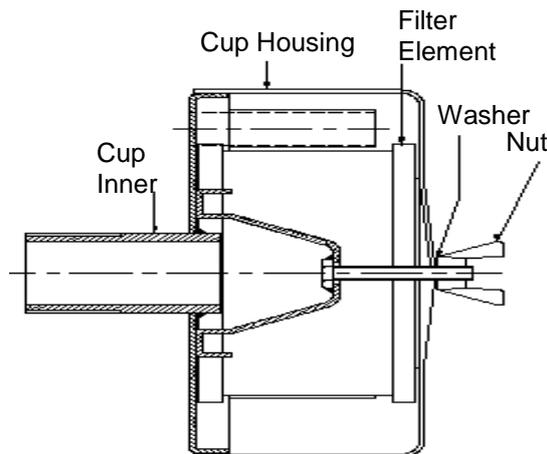
3. Fill the crankcase to the proper oil level on the oil sight glass with the recommended grade of crankcase lubricating oil. Pour oil over all the bearings, which can be easily reached through the frame or openings. On lubricated units, fill the cylinder lubricator with the recommended grade of air cylinder lubricating oil.
4. Prime the frame lubricating oil pump.
5. On lubricated units each cylinder force feed lubricator line must be disconnected at the point where it is attached to the oil inlet side of the check valve. The lubricator feeds must then be operated manually until all the air is forced out of the lines and oil appears. The lines should now be reconnected and the lubricator given several additional turns to assure proper lubrication of the cylinder as soon as the compressor is started. Once the compressor is started, the oil lines will remain full of oil and require no further attention.

6. Drain the air intake pipe of any moisture, which may have accumulated. Be sure that the air-intake filter is properly installed and protected.
7. Before starting a new compressor be sure you are familiar with the starting and stopping controls, and with the regulation and regulator controlling the load and no-load operation.
8. Check the machines thoroughly to be sure there are no loose parts and that the machine has not been tampered with since its erection.
9. The compressor lubricating oil is circulated under pressure from the vehicle engine lubricating oil system.

### 6.3.3 Accessories

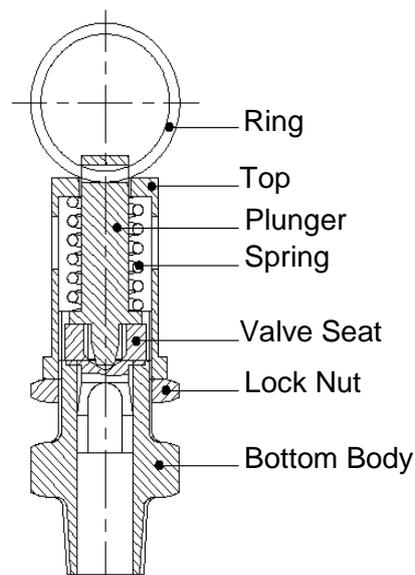
#### Inlet Air Filter

The air that is drawn into a compressor should be free from dust, dirt and abrasive or gritty particles that could damage cylinders, valves & moving parts. It is the purpose of the inlet filter to remove all such particles from the ambient air, in order to safeguard the performance of the compressor and prevent what might otherwise results in high maintenance costs and needless compressor down time. Suction air filters also helps in reducing the noise level of the compressors.



#### Safety Valve

This is provided as standard on air compressor. Safety valve is set to open, when the delivery pressure of the compressor has exceeded 630Kpa (90 PSI), thus protecting compressor.



#### 6.3.4 Piping

Discharge piping is considered to be the piping between the compressor and the system.

The discharge pipe should be of the full size as of the compressor outlet or larger and it should run directly to the system.

The discharge should be as short and direct as possible with long radius elbows, where bends are necessary.

All pipe fittings must be considered for the operating pressure. All pipe joints should be tight and having no leaks in discharge system, leaks will reduce output of the compressor. Leaks are easily located by squirting soap and water solution around all joints and watching for bubbles.

Where a bare compressor is supplied, it is very important to observe the following when installing the piping between the compressor and the system.

1. Never install a shut off valve (such as a gate or globe valve) between the compressor and the system unless a safety valve is put in the piping between the valve and the compressor.

The compressor should be mounted where the maximum air flow will pass over it to help in ensuring that the delivered air temperature does not exceed 220°C.

**WARNING**

**DO NOT USE PLASTIC PIPE OR RUBBER HOSE AS DISCHARGE PIPE, AS THEY CAN RESULT IN MECHANICAL FAILURE, PROPERTY DAMAGE & SEVERE INJURY OR DEATH**

## 6.4 Link Belt Installation and Maintenance Procedure

### 6.4.1 Link Belt Description

Nut link belts are detachable 'V' belts



#### **Material**

Detachable 'V' belts are made from polyester / polyurethane composites

#### **Benefits**

- High resistance to extreme temperatures (-40<sup>o</sup> to +100<sup>o</sup>C)
- High resistance to abrasive materials
- High resistance to water, steam, oil and most chemicals
- Fit in minutes, no need to break pump / engine coupling arrangement
- Reduce vibration and noise by up to 50%

### 6.4.2 Link Belt Installation Procedure

1. Measure the belt by pulling the belt tight around the pulley to check hand tight length, overlapping the two holes on end of belt with corresponding studs in the opposite end to determine start length – refer to Fig. 13.

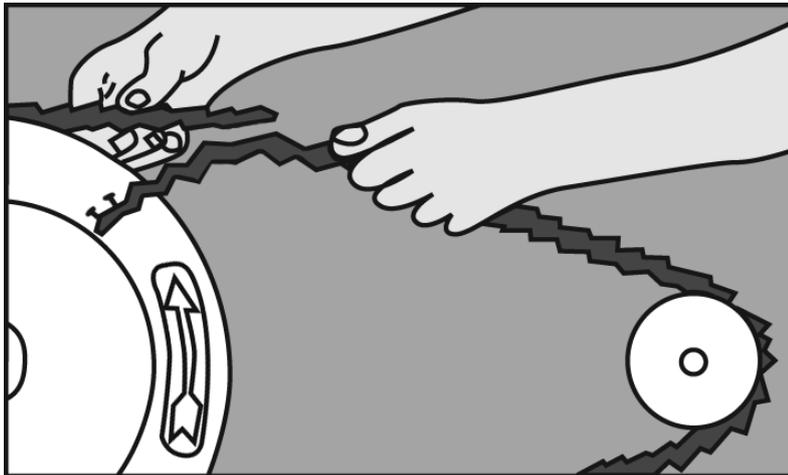


Figure 13

2. Count the total number of link and remove the appropriate number of link to obtain the necessary pre-tension.
  - a. SPA & SPB – 1 in 15 links
  - b. On multi belt drives ensure that each belt has the same number of links
3. Turn 2 adjacent stud heads 90° to fasten belt – refer to Fig. 14.

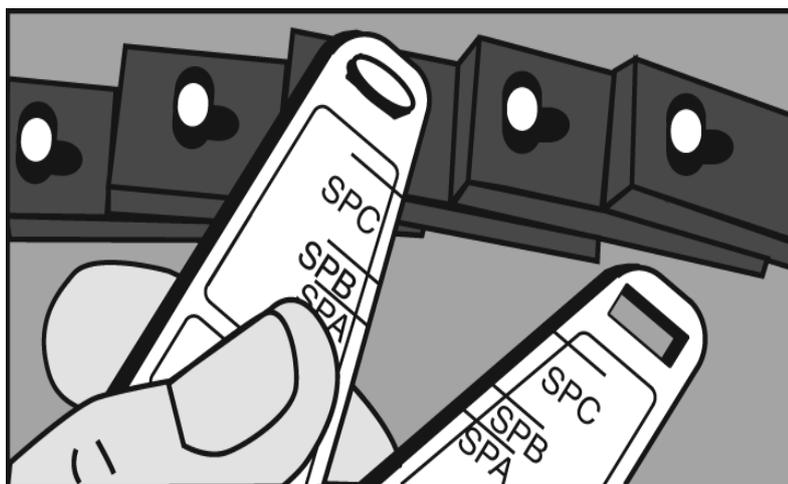
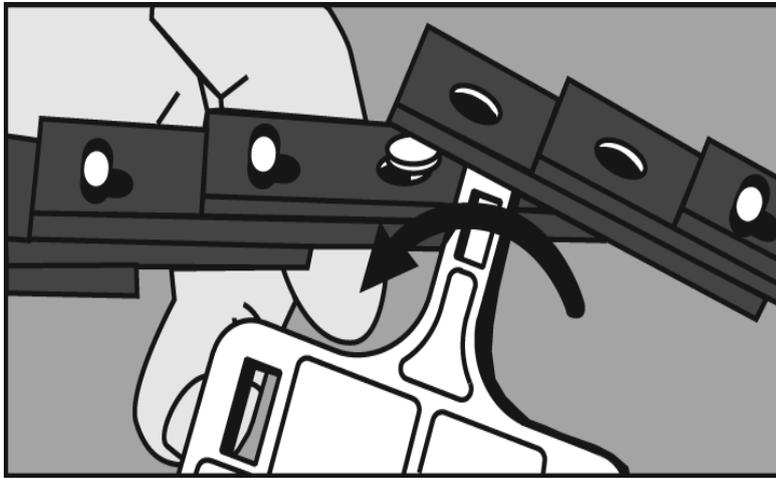


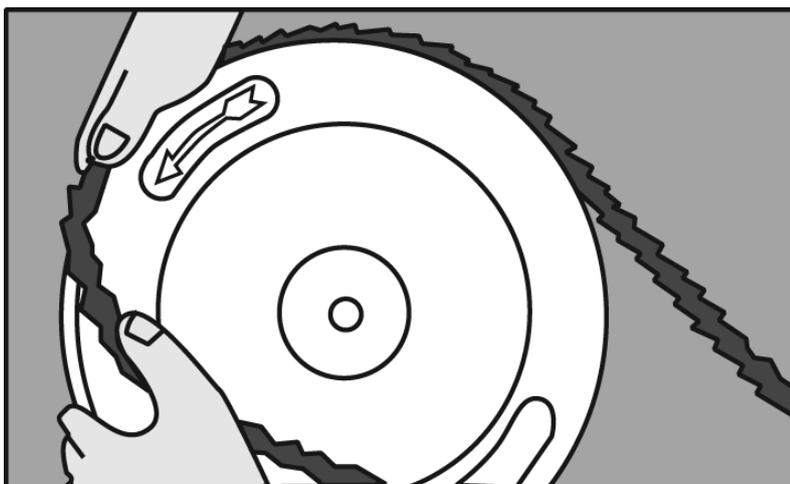
Figure 14

4. Use tool or pliers to twist stud heads



*Figure 15*

5. Ensure that multiple belt drives run in the same direction
6. Make belt endless, around pulley shaft if necessary, by inserting the stud heads of the last link into the corresponding holes and turning heads 90°
7. Fit belt into nearest groove of the smallest pulley and roll / push belt onto larger pulley using a round bar or equivalent rounded tool (no sharp edges that could damage pulley or belt during belt fitting stage) – refer to Fig. 16. The belt may seem very tight, this is normal. DO NOT JOG MOTOR.



*Figure 16*

8. For close ratio drives additional links may need to be added back in to ease installation
9. Drive tension should be checked after 20 – 30 minutes operating at full load
10. Another re-tension should be carried after 24 hours
11. Belt tension should be checked periodically and adjusted when necessary
12. Fit all guarding and check the belts and pulleys are free to rotate

## 7. BASIC SERVICE INFORMATION

### 7.1 Pumpset Service Schedule – Generic

| CODE        | COMPONENT       | INSTRUCTIONS  | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|-------------|-----------------|---|-------|----------|----------|----------|-----------|-------------|----------|
|             |                 |   |       | 3 months | 6 months | 9 months | 12 months |             |          |
| <b>PUMP</b> |                 |   |       |          |          |          |           |             |          |
| PU1         | Pump Area       | Ensure the area is clean and free of debris   | X     |          |          |          |           |             |          |
| PU2         | Pump            | Check for any oil, coolant, quench fluid or water leaks                                       | X     |          |          |          |           |             |          |
| PU3         | Pump            | Check gland packing drip rate, ensure enough fluid is coming out of gland but not excessively | X     |          |          |          |           |             |          |
| PU4         | Gland Packing   | Inspect gland packing, check for wear and burn marks  | X     |          |          |          |           |             |          |
| PU5         | Gland Packing   | Change gland packing; all of the installed rings  |       |          |          |          |           | X           |          |
| PU6         | Gland Packing   | Inspect gland packing sleeve look for worn areas or grooves                                   |       | X        | X        | X        | X         |             |          |
| PU7         | Gland Packing   | Inspect gland followers look for corrosion and excessive wear and damage                      |       | X        | X        | X        | X         |             |          |
| PU8         | Gland Packing   | Inspect gland housing look for corrosion and excessive wear and damage                        |       | X        | X        | X        | X         |             |          |
| PU9         | Gland Packing   | Inspect fasteners are secure, studs are not excessively corroded                              |       | X        | X        | X        | X         |             |          |
| PU10        | Mechanical Seal | Check for mechanical seal fittings, and hoses leaks.  | X     |          |          |          |           |             |          |
| PU11        | Mechanical Seal | Inspect for mechanical seal reservoir leaks   | X     |          |          |          |           |             |          |

| CODE | COMPONENT                    | INSTRUCTIONS  | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|------|------------------------------|---|-------|----------|----------|----------|-----------|-------------|----------|
|      |                              |   |       | 3 months | 6 months | 9 months | 12 months |             |          |
| PU12 | Mechanical Seal              | Inspect mechanical seal temperature / level gauge, gauge is readable  |       | X        | X        | X        | X         |             |          |
| PU13 | Mechanical Seal              | Change mechanical seal lubrication fluid, check information sign near mechanical seal for lubrication fluid type                      |       | X        | X        | X        | X         |             |          |
| PU14 | Mechanical Seal              | Check mechanical seal oil for milkiness/contamination or coolant contamination. Change mechanical seal oil or coolant radiator fluid. | X     |          |          |          |           |             |          |
| PU15 | Bearing Bracket              | Inspect bearing bracket guards for cracking, security and damage  |       | X        | X        | X        | X         |             |          |
| PU16 | Bearing - Oil & Grease Lubed | Check bearing temperature & record in comments box  |       | X        | X        | X        | X         |             |          |
| PU17 | Bearing - Oil Lubed          | Inspect pump shaft seals (bearing isolators) for oil leaks  |       | X        | X        | X        | X         |             |          |
| PU18 | Bearing - Oil Lubed          | Inspect bearing bracket oil filler, ensures cap is sealing  |       | X        | X        | X        | X         |             |          |
| PU19 | Bearing - Oil Lubed          | Change bearing chamber oil<br>Use Hydraulic ISO Grade 68  |       | X        | X        | X        | X         |             |          |
| PU20 | Bearing - Oil Lubed          | Inspect bearing bracket temperature/level gauge, gauge is readable  |       | X        | X        | X        | X         |             |          |
| PU21 | Bearing - Grease Lubed       | Inspect bearing grease nipples, ensure that they are not blocked or cracked   |       | X        | X        | X        | X         |             |          |
| PU22 | Bearing - Grease Lubed       | Grease bearing as per service manual instructions   |       | X        | X        | X        | X         |             |          |
| PU23 | Pump                         | Check pump mounts are secure  |       | X        | X        | X        | X         |             |          |
| PU24 | Volute / Tee Piece           | Inspect balance pipe/hose for leaks and kinks   |       | X        | X        | X        | X         |             |          |

| CODE                  | COMPONENT                   | INSTRUCTIONS   | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|-----------------------|-----------------------------|--|-------|----------|----------|----------|-----------|-------------|----------|
|                       |                             |  |       | 3 months | 6 months | 9 months | 12 months |             |          |
| PU25                  | Volute                      | Inspect gauge; indication needle operation, glycerine level, glycerine contamination, clearness of gauge viewing glass | X     |          |          |          |           |             |          |
| PU26                  | Tee Piece                   | Inspect gauge; indication needle operation, glycerine level, glycerine contamination, clearness of gauge viewing glass | X     |          |          |          |           |             |          |
| PU27                  | Pipework                    | Inspect gearbox butterfly valve handle and stem for looseness and operation  |       |          | X        |          | X         |             |          |
| PU28                  | Pipework                    | Inspect pump bleed valve for looseness and operation   |       |          | X        |          | X         |             |          |
| PU29                  | Pump                        | Check pump recommended operating sign is readable  |       | X        | X        | X        | X         |             |          |
| PU30                  | Non Return Valve            | Clean and inspect non return valve, check for ball or flap, seat and internal wear                                     |       | X        | X        | X        | X         |             |          |
| <b>AIR COMPRESSOR</b> |                             |  |       |          |          |          |           |             |          |
| AC1                   | Compressor Air Relief valve | Test operation to determine if working   |       | X        | X        | X        | X         |             |          |
| AC2                   | Priming Compressor          | Check compressor drive belt for tooth or wedge wear and signs of fraying   |       | X        | X        | X        | X         |             |          |
| AC3                   | Priming Compressor          | Check compressor pulleys for tooth or groove wear  |       |          | X        |          | X         |             |          |
| AC4                   | Priming Compressor          | Check air supply hose heat sleeve for damage   |       | X        | X        | X        | X         |             |          |
| AC5                   | Priming Compressor          | Inspect for air supply hose kinks etc  |       | X        | X        | X        | X         |             |          |
| AC6                   | Priming Compressor          | Inspect oil supply and drain hoses for leaks, cracks and damage  |       |          | X        |          | X         |             |          |
| AC7                   | Priming Compressor          | Check coolant supply and drain hoses for leaks, cracks and damage  |       |          | X        |          | X         |             |          |

| CODE              | COMPONENT          | INSTRUCTIONS   | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|-------------------|--------------------|--|-------|----------|----------|----------|-----------|-------------|----------|
|                   |                    |  |       | 3 months | 6 months | 9 months | 12 months |             |          |
| AC8               | Priming Compressor | Inspect compressor relief valve, cleanliness of spring and pin mechanism           |       | X        | X        | X        | X         |             |          |
| <b>DRIVE LINE</b> |                    |  |       |          |          |          |           |             |          |
| DL1               | Drive Line         | Inspect drive coupling; condition of rubber, drive ring and fasteners              |       |          | X        |          | X         |             |          |
| <b>GEARBOX</b>    |                    |  |       |          |          |          |           |             |          |
| GB1               | Gearbox            | Run machine to warm up oil.<br>Take live sample. Use Oil test sample bottle.       |       | X        | X        | X        | X         |             |          |
| GB2               | Gearbox            | Check bearing temperature & record in comments box                                 |       | X        | X        | X        | X         |             |          |
| GB3               | Gearbox            | Listen for abnormal noise  | X     |          |          |          |           |             |          |
| GB4               | Gearbox            | Clean the filter core and pick up filter   |       |          | X        |          | X         |             |          |
| GB5               | Gearbox            | Clean the hydraulic control system   |       | X        | X        | X        | X         |             |          |
| GB6               | Gearbox            | Inspect the inlet seals  |       |          | X        |          | X         |             |          |
| GB7               | Gearbox            | Inspect gearbox / pump coupling; condition of rubber, drive ring and fasteners     |       |          | X        |          | X         |             |          |
| GB8               | Gearbox            | Remove the inspection cover, turn coupling by hand and check the gear and clutches |       |          | X        |          | X         |             |          |
| GB9               | Gearbox            | Check and renew oil  |       | X        |          |          |           |             |          |
| <b>OIL COOLER</b> |                    |  |       |          |          |          |           |             |          |
| OC1               | Oil Cooler         | Inspect oil cooler main body for security, leaks, cracks and damage                |       | X        |          |          |           |             |          |
| OC2               | Oil Cooler         | Inspect radiator core for evidence of leaks  |       |          | X        |          | X         |             |          |
| OC3               | Oil Cooler         | Inspect header tank for evidence of leaks  |       |          | X        |          | X         |             |          |

| CODE                              | COMPONENT                                  | INSTRUCTIONS   | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|-----------------------------------|--|--|-------|----------|----------|----------|-----------|-------------|----------|
|                                   |  |  |       | 3 months | 6 months | 9 months | 12 months |             |          |
| OC4                               | Oil Cooler                                 | Inspect radiator fins for blockages and clean as required  |       | X        | X        | X        | X         |             |          |
| OC5                               | Oil Cooler                                 | Inspect hoses and connections for leaks, cracks and damage   |       | X        | X        | X        | X         |             |          |
| <b>DIESEL ENGINE LUBE SERVICE</b> |  |  |       |          |          |          |           |             |          |
| DELS1                             | Engine Oil                                 | Change Engine oil  |       | X        | X        | X        | X         |             |          |
| DELS2                             | Engine Oil Filters                         | Replace. Cut and inspect. Report any debris to the supervisor  |       | X        | X        | X        | X         |             |          |
| DELS3                             | Radiator Coolant                           | Inspect and fill as required.  | X     |          |          |          |           |             |          |
| DELS4                             | Radiator Coolant                           | Change if coolant is discoloured.  |       |          |          |          |           | X           |          |
| DELS5                             | Fuel Filter Primary                        | Replace  |       | X        | X        | X        | X         |             |          |
| DELS6                             | Fuel Filter Secondary                      | Replace  |       | X        | X        | X        | X         |             |          |
| DELS7                             | Radiator Coolant, Lube and Fuel Quick Fill | Visually inspect for leaks. Ensure that protective caps are in place.  | X     |          |          |          |           |             |          |
| DELS8                             | Fuel Tank                                  | Fill   |       |          |          |          |           | X           |          |
| <b>DIESEL ENGINE</b>              |  |  |       |          |          |          |           |             |          |
| DE1                               | Engine                                     | Check for any oil, coolant, quench fluid and water leaks   | X     |          |          |          |           |             |          |
| DE2                               | Engine                                     | Check vernier control operation (mechanical type engine) or toggle switch (electronic type of engine) engine control panel, shut down operations engine and pump |       | X        | X        | X        | X         |             |          |
| DE3                               | Controls                                   | Test operation of all gauges, warning, alarms and shutdowns  |       | X        | X        | X        | X         |             |          |
| DE4                               | Radiator Core and Header Tank              | Inspect for evidence of coolant leaks.   |       |          | X        |          | X         |             |          |

| CODE | COMPONENT                         | INSTRUCTIONS   | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|------|-----------------------------------|--|-------|----------|----------|----------|-----------|-------------|----------|
|      |                                   |  |       | 3 months | 6 months | 9 months | 12 months |             |          |
| DE5  | Radiator Fins                     | Inspect for blockages and clean as required  | X     |          |          |          |           |             |          |
| DE6  | Radiator Pressure Relief          | Ensure valve relieves pressure from radiator   |       |          | X        |          | X         |             |          |
| DE7  | Radiator Hoses                    | Inspect for cracks and damage. Inspect for evidence of coolant leaks                   |       | X        | X        | X        | X         |             |          |
| DE8  | Fan Blades and Guards             | Inspect for signs of cracking, damage and security                                     |       |          | X        |          | X         |             |          |
| DE9  | Fan / Alternator Drive Belts      | Inspect for evidence of cracking and wear. Inspect tension                             |       | X        | X        | X        | X         |             |          |
| DE10 | Alternator Mounting Brackets      | Inspect for security and alignment. Inspect the guard for signs of cracking or damage  |       |          | X        |          | X         |             |          |
| DE11 | Starter Motor                     | Inspect starter motor mounts for security  |       | X        | X        | X        | X         |             |          |
| DE12 | Engine Mounts                     | Inspect mounts are secure  |       |          | X        |          | X         |             |          |
| DE13 | Exhaust Manifold Pipes and Clamps | Inspect for exhaust leaks and evidence of cracking                                     |       |          | X        |          | X         |             |          |
| DE14 | Exhaust Shields                   | Inspect for condition and security   |       |          | X        |          | X         |             |          |
| DE15 | Engine Exhaust Rain Cap           | Test operation to determine if working   |       | X        | X        | X        | X         |             |          |
| DE16 | Turbo Oil Feed Lines              | Inspect condition of oil lines   |       |          | X        |          | X         |             |          |
| DE17 | Air Intake Hoses                  | Inspect for evidence of perishing and cracking. Inspect clamps are in place and secure |       |          | X        |          | X         |             |          |
| DE18 | Fuel Hoses and Pipes              | Inspect for leaks and correctly secured  |       | X        | X        | X        | X         |             |          |
| DE19 | Engine Area                       | Ensure the engine area is clean and free of debris                                     |       | X        | X        | X        | X         |             |          |

| CODE                  | COMPONENT          | INSTRUCTIONS   | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments   |
|-----------------------|--------------------|--|-------|----------|----------|----------|-----------|-------------|--|
|                       |                    |  |       | 3 months | 6 months | 9 months | 12 months |             |  |
| DE20                  | Hoses and Pipes    | Inspect for evidence of oil leaks, wear or chaffing. Inspect that all clamping are secure.         |       |          | X        |          | X         |             |  |
| <b>ELECTRIC MOTOR</b> |                    |  |       |          |          |          |           |             |  |
| EM1                   | Motor and Coupling | Check if abnormal noises, vibrations, excessive heating, wear signs, misalignment or damaged parts | X     |          |          |          |           |             |  |
| EM2                   | Motor              | Check condition of lifting eye   |       | X        | X        | X        | X         |             |  |
| EM3                   | Motor              | Measure and record the insulation resistance   |       | X        | X        | X        | X         |             |  |
| EM4                   | Motor Enclosure    | Clean the motor enclosure  |       |          | X        |          | X         |             |  |
| EM5                   | Motor Frame        | Remove oil spills and dust accumulation from the motor frame surface                               |       |          | X        |          | X         |             | This is to ensure better heat transfer to the surrounding ambient  |
| EM6                   | Cooling Fan        | Check cooling fan condition and clean the air inlet & outlet openings                              | X     |          |          |          |           |             | This is to ensure free air flow over the motor   |
| EM7                   | Motor Seals        | Check condition of seals   |       | X        | X        | X        | X         |             |  |
| EM8                   | Motor Drain        | Drain the condensed water from the inside the motor  |       | X        | X        | X        | X         |             | After draining, reinstall the drain plugs to ensure the degree of IP protection stated on the name plate. The motor must always be positioned so the drain hole is at the lowest position. |
| EM9                   | Terminal Box       | Check condition of Lifting eye   |       |          | X        |          | X         |             |  |
| EM10                  | Terminal Box       | Check condition of terminal box  |       | X        | X        | X        | X         |             |  |
| EM11                  | Terminal Box       | Check terminal box seals   |       | X        | X        | X        | X         |             |  |

| CODE              | COMPONENT                | INSTRUCTIONS  | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments  |
|-------------------|--------------------------|---|-------|----------|----------|----------|-----------|-------------|---|
|                   |                          |   |       | 3 months | 6 months | 9 months | 12 months |             |   |
| EM12              | Power Cables             | Check the connections of the power supply cables  | X     |          |          |          |           |             | Ensuring the correct distance between live and grounded parts |
| EM13              | Bolted Connections       | Check if the tightening torque of the bolted connections and fixations meets tightening torque  |       |          | X        |          | X         |             |   |
| EM14              | Power Cables             | Check the status of the cable passages, the cable gland seals and the seals inside the terminal box   | X     |          |          |          |           |             |   |
| EM15              | Bearings                 | Check the bearing operating conditions. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions, like motor temperature rise | X     |          |          |          |           |             |   |
| EM16              | Bearings                 | Check and record the oil level, the lube conditions and compare the working hours with the informed life time   |       | X        | X        | X        | X         |             |   |
| EM17              | Bearing - Grease Lubed   | Grease bearing as per service manual instructions   |       | X        | X        | X        | X         |             |   |
| EM18              | Bearing - Oil Lubed      | Oil bearing as per service manual instructions  |       | X        | X        | X        | X         |             |   |
| EM19              | Bearing - Oil Mist Lubed | Carry out maintenance plan as per service manual instructions   |       | X        | X        | X        | X         |             |   |
| <b>ELECTRICAL</b> |                          |   |       |          |          |          |           |             |   |
| EL1               | Batteries                | Clean batteries and enclosure.<br>Ensure batteries are securely clamped.<br>Inspect cabling and conduit for damage and security.                                    |       |          | X        |          | X         |             |   |

| CODE | COMPONENT                    | INSTRUCTIONS   | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|------|------------------------------|--|-------|----------|----------|----------|-----------|-------------|----------|
|      |                              |  |       | 3 months | 6 months | 9 months | 12 months |             |          |
| EL2  | Battery Terminal Connections | Inspect for security and terminal cleanliness.<br>Inspect terminals are covered with insulators.<br>Coat terminals with Korode Kure. |       |          | X        |          | X         |             |          |
| EL3  | Battery Isolator             | Inspect cabling and conduit for damage and security.<br>Check operation. Inspect terminal are secure and in good condition.          |       | X        | X        | X        | X         |             |          |
| EL4  | Jump Start Receptacle        | Inspect cabling and conduit for damage and security.<br>Check operation. Inspect terminal are secure and in good condition.          |       |          | X        |          | X         |             |          |
| EL5  | Alternator Connections       | Inspect for evidence of overheating and check for security.<br>Inspect terminal shrouds are secure and in good condition.            |       |          | X        |          | X         |             |          |
| EL6  | Starter Motor                | Inspect cabling and conduit for damage and security.<br>Ensure terminals are insulated.  |       | X        | X        | X        | X         |             |          |
| EL7  | Starter Motor Isolator       | Inspect cabling and conduit for damage and security.<br>Check operation. Inspect terminal are secure and in good condition.          |       | X        | X        | X        | X         |             |          |

| CODE | COMPONENT                 | INSTRUCTIONS   | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|------|---------------------------|--|-------|----------|----------|----------|-----------|-------------|----------|
|      |                           |  |       | 3 months | 6 months | 9 months | 12 months |             |          |
| EL8  | Engine/Pump Control Panel | Inspect cabling and conduit for damage and security.<br>Check operation.<br>Check control panel still complies with relevant IP rating.<br>Check controls and switches.<br>Inspect terminals, plugs and cables are secure and in good condition. |       | X        | X        | X        | X         |             |          |
| EL9  | Pressure Transducer       | Inspect pressure transducer unit, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display<br>Check operation   |       | X        | X        | X        | X         |             |          |
| EL10 | Vacuum Transducer         | Inspect vacuum transducer unit, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display<br>Check operation   |       | X        | X        | X        | X         |             |          |
| EL11 | Temperature Probe         | Inspect temperature probe unit, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display<br>Check operation   |       | X        | X        | X        | X         |             |          |
| EL12 | Temperature Gauges        | Inspect temperature gauge unit, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display  |       | X        | X        | X        | X         |             |          |

| CODE | COMPONENT                  | INSTRUCTIONS   | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|------|----------------------------|--|-------|----------|----------|----------|-----------|-------------|----------|
|      |                            |  |       | 3 months | 6 months | 9 months | 12 months |             |          |
| EL13 | Flow Meter                 | Inspect flow meter main body, flow meter control panel unit (including vibration mounts), cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display<br>Check operation |       |          | X        |          | X         |             |          |
| EL14 | Flow Switch                | Inspect flow switch unit, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display<br>Check operation   |       | X        | X        | X        | X         |             |          |
| EL15 | Trailing Wire Switch       | Inspect trailing wire switch unit, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display<br>Check operation  |       | X        | X        | X        | X         |             |          |
| EL16 | Inclinometer / Tilt Switch | Inspect inclinometer / tilt switch unit, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display<br>Check operation  |       |          | X        |          | X         |             |          |
| EL17 | Dam Level Transducer       | Inspect dam level transducer unit, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display   |       |          | X        |          | X         |             |          |

| CODE                 | COMPONENT                  | INSTRUCTIONS  | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments |
|----------------------|----------------------------|---|-------|----------|----------|----------|-----------|-------------|----------|
|                      |                            |   |       | 3 months | 6 months | 9 months | 12 months |             |          |
| EL18                 | Dam Level Floats           | Inspect dam level floats, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel display<br>Check operation      |       |          | X        |          | X         |             |          |
| EL19                 | Emergency Stops            | Inspect cabling and conduit for damage and security.<br>Check operation. Inspect terminal are secure and in good condition.   |       | X        | X        | X        | X         |             |          |
| EL20                 | Work Lights                | Inspect work light units, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel operation                       |       | X        | X        | X        | X         |             |          |
| EL21                 | Flashing Light             | Inspect flashing light unit, cabling, plugs and conduit for damage and security.<br>Ensure terminals are insulated.<br>Check control panel operation<br>Check operation |       |          | X        |          | X         |             |          |
| <b>MISCELLANEOUS</b> |                            |   |       |          |          |          |           |             |          |
| MISC1                | Skid Base                  | Check structure for any damage, wear and general condition.   |       |          | X        |          | X         |             |          |
| MISC2                | Single point Lifting Frame | Check structure for any damage, wear and general condition.   |       |          | X        |          | X         |             |          |
| MISC3                | Bull (Push) Bar            | Check structure for any damage, wear and general condition.   |       |          | X        |          | X         |             |          |
| MISC4                | Skid Wear Strips           | Check for any damage, wear and general condition.   |       |          | X        |          | X         |             |          |
| MISC5                | Boom (A-frame)             | Check structure for any damage, wear and general condition.   |       |          | X        |          | X         |             |          |

| CODE                      | COMPONENT                            | INSTRUCTIONS   | Daily | 250 hrs  | 500 hrs  | 750 hrs  | 1,000 hrs | As Required | Comments              |
|---------------------------|--------------------------------------|--|-------|----------|----------|----------|-----------|-------------|-----------------------|
|                           |                                      |  |       | 3 months | 6 months | 9 months | 12 months |             |                       |
| MISC6                     | Winch                                | Check suction line winch condition and operation.  |       |          | X        |          | X         |             |                       |
| MISC7                     | Handrails and Walkways               | Inspect for security and damage.   |       |          | X        |          | X         |             |                       |
| MISC8                     | Hoses (Suction & Discharge)          | Inspect for rubbing, hose damage and leaks. Inspect fittings and clamps for security.            |       |          | X        |          | X         |             |                       |
| MISC9                     | Fuel Tank                            | Inspect for condition and leaks. Drain water sediment and note the quantity of water (if any).   |       |          | X        |          | X         |             |                       |
| MISC10                    | Fuel Filler, Pick Up & Return Set Up | Inspect for rubbing, hose damage and leaks. Inspect fittings and clamps for security.            |       | X        | X        | X        | X         |             |                       |
| MISC11                    | Fuel Level Gauge                     | Inspect level gauge gauge, check glycerine level and needle position or display on control panel |       |          | X        |          | X         |             |                       |
| MISC12                    | Tow Chain                            | Check tow chain for any damage, excessive wear and general condition.                            |       |          | X        |          | X         |             |                       |
| MISC13                    | Guards                               | Check that all guards and covers are in place and secure.  | X     |          |          |          |           |             |                       |
| <b>FIRE EXTINGUISHERS</b> |                                      |  |       |          |          |          |           |             |                       |
| FE1                       | Fire Extinguishers                   | Inspect for correct charge. Inspect cylinder and mounting bracket for damage and security.       |       | X        | X        | X        | X         |             | Check inspection date |

## **7.2 General Service Information**

Preventive maintenance is the easiest and least expensive type of maintenance. The purpose of the maintenance is to extend the useful of the equipment. The non-compliance with one of the previous items can cause unexpected machine failures.

Ensure that the safety information, warnings and the instruction are read and understood before performing any maintenance procedures.

Follow the minor and major maintenance schedule outlined in Remko Maintenance Schedule. Use the service hours or calendar time, whichever occurs first, in order to determine the maintenance intervals.

Remko uses the latest technology and highest quality components to produce its pumps.

Do not reuse damaged or worn parts. Damaged or worn parts must be replaced by genuine Remko parts as if they were the original parts.

Use the correct mechanical seal coolant, pump bearing lubricant as specified.

Personnel at Remko / Dealers have been trained to provide expert service and parts support. All repairs, disassembly related services must be carried out only by qualified and well trained personnel by using proper tools and techniques. Ensure maintenance carried out complies with relevant HSE site, government rules, acts, regulations and codes of practice.

The company does not assume any responsibility or liability for repair services or maintenance operations executed by non-authorized Service Centres or by non qualified service personnel. The company shall have no obligation or liability whatsoever to the buyer for any indirect, special, consequential or incidental loss or damage caused or arising from the company's proven negligence.

If the pump is operated in ambient temperatures below  $-18^{\circ}\text{C}$  or above  $38^{\circ}\text{C}$  and / or under severe conditions, perform maintenance at shorter intervals.

Severe service includes the following conditions; low and high temperatures, continuous high loads, vibration and dusty conditions.

Record and file all changes performed on pump unit and pump unit related items.

**Please contact Remko / Dealers for assistance.**

### 7.3 Pump Bearing Lubrication

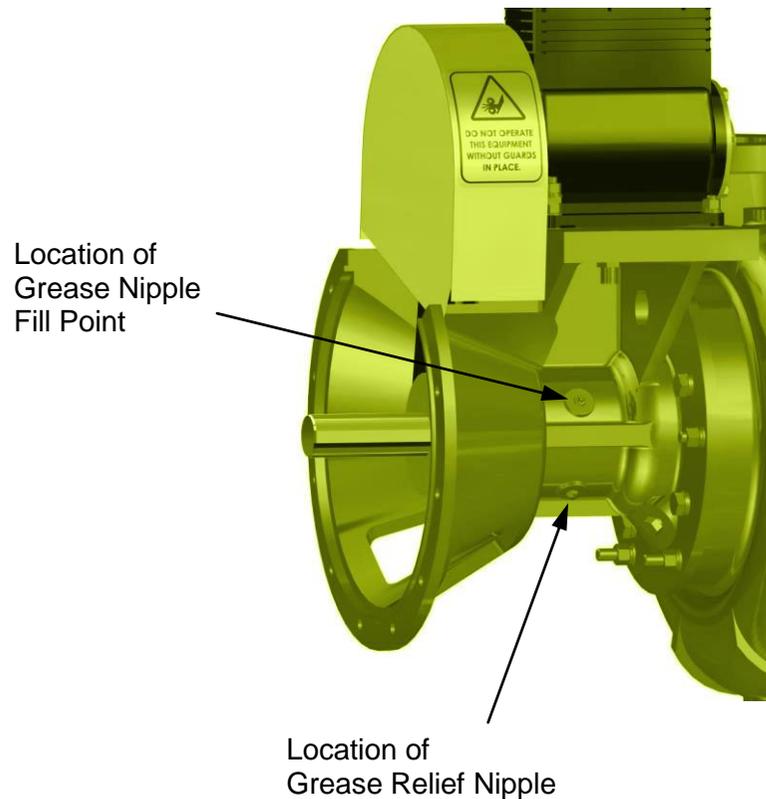


Diagram #1 – Typical SAE #4 Bearing Housing Grease Set Up

|                    |   |  |  |
|--------------------|---|--|--|
| <b>Grease Type</b> | Multi Lube Lithium Grease EP Additives NLGI#2 |  |  |
|--------------------|---|--|--|

| Condition 1                |          | Condition 2                |       |
|----------------------------|----------|----------------------------|-------|
| <b>Ambient Temperature</b> | 20 °C    | <b>Ambient Temperature</b> | 40 °C |
| <b>Humidity / Dust</b>     | Moderate | <b>Humidity / Dust</b>     | High  |
| <b>Vibration</b>           | Moderate | <b>Vibration</b>           | High  |
| <b>Load</b>                | Moderate | <b>Load</b>                | Heavy |

**! WARNING !**

**Use this re-greasing schedule as a guide only**

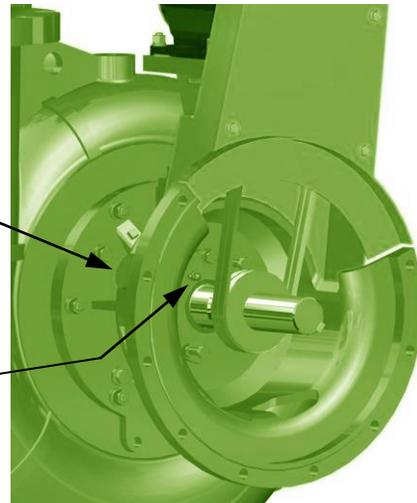
**Re-greasing quantities will change due to variances in Operating Conditions.**

**For re-greasing schedules to suit particular Operating Conditions please contact Remko for assistance.**

- Notes:**
1. Single point grease point to grease 2 off bearings.
  2. Single point grease relief nipple.
  3. Grease relief nipple set at 3 - 5 psi.

Remove Plastic Cap for Access to Fill Point

Location of Grease Nipple Fill Point



Location of Grease Relief Nipple

*Diagram #2 – Typical SAE #3 Bearing Housing Grease Set Up*

|                    |   |  |  |
|--------------------|---|--|--|
| <b>Grease Type</b> | Multi Lube Lithium Grease EP Additives NLGI#2 |  |  |
|--------------------|---|--|--|

| Condition 1                |          | Condition 2                |       |
|----------------------------|----------|----------------------------|-------|
| <b>Ambient Temperature</b> | 20 °C    | <b>Ambient Temperature</b> | 40 °C |
| <b>Humidity / Dust</b>     | Moderate | <b>Humidity / Dust</b>     | High  |
| <b>Vibration</b>           | Moderate | <b>Vibration</b>           | High  |
| <b>Load</b>                | Moderate | <b>Load</b>                | Heavy |

**! WARNING !**

**Use this re-greasing schedule as a guide only**

**Re-greasing quantities will change due to variances in Operating Conditions.**

**For re-greasing schedules to suit particular Operating Conditions please contact Remko for assistance.**

**Notes:**

1. Single point grease point to grease 1 off bearing.
2. Single point grease relief nipple.
3. Grease relief nipple set at 3 - 5 psi.

## 8. PUMP DIAGNOSTICS

### 8.1 Trouble Shooting Guide

| SYMPTOMS                                      |  |
|---|--|
| <b><i>Pump Does Not Prime</i></b>             |  |
| 1   | Insufficient available Pump Suction Lift   |
| 2   | Excessive Static Suction Lift (vertical distance between suction fluid level and pump centre line) |
| 3   | Inlet of suction pipe insufficiently submerged in fluid  |
| 4   | Clogged suction strainer   |
| 5   | Air pocket in suction line   |
| 6   | Suction line collapsed (internal / external)   |
| 7   | Air leaks into suction line  |
| 8   | Excessive amount of air gas in liquid  |
| 9   | Air in source of sealing liquid  |
| 10  | Vortex formation at suction  |
| 11  | Air leaks into pump through stuffing boxes or through mechanical seal                              |
| 12  | Leak path through tee piece volute plugs or gaskets  |
| 13  | Non return valve ball or flap not sealing correctly  |
| 14  | Viscosity / Specific Gravity (SG) of liquid differs from design conditions                         |
| 15  | Pump priming system blocked or worn (venturi or vacuum pump)                                       |
| 16  | Pump Tee Piece cover or filter (where venturi assembly is fitted) blocked                          |
| 17  | Pump priming floatation set up blocked / faulty / worn (vacuum pump primed pumps)                  |
| 18  | Faulty / worn pump self priming air compressor or vacuum pump                                      |
| 19  | Faulty or worn or loose Self priming air compressor vacuum pulleys or belts                        |
| <b><i>Pump loses prime after starting</i></b> |  |
| 1   | Pump suction pipe not completely filled with liquid  |
| 2   | Excessive amount of air of gas in liquid   |
| 3   | Air leaks into suction line  |
| 4   | Air leaks into pump through stuffing boxes or through mechanical seal                              |
| 5   | Air in source of sealing liquid  |
| 6   | Seal cage improperly mounted in stuffing box   |
| 7   | Inlet of suction pipe insufficiently submerged   |
| 8   | Vortex formation at suction  |

| <b>Pump Does Not Deliver Liquid</b>    |   |
|--|---|
| 1                                      | Pump not primed   |
| 2                                      | Pump suction pipe not completely filled with liquid   |
| 3                                      | Insufficient available Pump Suction Lift  |
| 4                                      | Air pocket in suction line  |
| 5                                      | Inlet of suction pipe insufficiently submerged  |
| 6                                      | Pump operated with closed or partially closed suction valve - suction and discharge recirculation                             |
| 7                                      | Clogged suction strainer  |
| 8                                      | Obstruction in suction line   |
| 9                                      | Clogged impeller  |
| 10                                     | Speed of pump too low   |
| 11                                     | Wrong direction of pump rotation (only applicable to electric and gearbox pump set ups)                                       |
| 12                                     | Static discharge head (vertical distance between pump centre line and discharge outlet fluid level) higher than shut-off head |
| 13                                     | Total dynamic head of system (suction and discharge static heights + system friction losses) higher than design of pump       |
| 14                                     | Parallel operation of pumps unsuitable for the purpose  |
| 15                                     | Viscosity of liquid differs from design conditions  |
| <b>Insufficient Capacity Delivered</b> |   |
| 1                                      | Pump suction pipe not completely filled with liquid   |
| 2                                      | Insufficient available Pump Suction Lift  |
| 3                                      | Excessive amount of air gas in liquid   |
| 4                                      | Air pocket in suction line  |
| 5                                      | Air leaks into suction line   |
| 6                                      | Air leaks into pump through stuffing boxes or through mechanical seal   |
| 7                                      | Air in source of sealing liquid   |
| 8                                      | Inlet of suction pipe insufficiently submerged  |
| 9                                      | Vortex formation at suction   |
| 10                                     | Pump operated with closed or partially closed suction valve-suction & discharge recirculation                                 |
| 11                                     | Clogged suction strainer  |
| 12                                     | Obstruction in suction line   |
| 13                                     | Excessive friction losses in suction line   |
| 14                                     | Clogged impeller  |
| 15                                     | Two elbows in suction piping at 90° to each other, creating swirl and pre-rotation  |
| 16                                     | Speed of pump too low   |
| 17                                     | Wrong direction of rotation   |
| 18                                     | Reverse mounting of double-suction impeller   |
| 19                                     | Uncalibrated instruments  |
| 20                                     | Friction losses in discharge system higher than design of pump  |
| 21                                     | Total head of system higher than design of pump   |

|   |   |
|---|---|
| 22  | Viscosity of liquid differs from design conditions  |
| 23  | Excessive wear at internal running clearances   |
| 24  | Foreign matters in impellers  |
| 25  | Improper casing gasket material   |
| 26  | Inadequate installation of gasket   |
| <b><i>Insufficient pressure developed</i></b> |   |
| 1   | Excessive amount of air or gas in liquid  |
| 2   | Air leaks into suction line   |
| 3   | Air leaks into pump through stuffing boxes or through mechanical seal                             |
| 4   | Air in source of sealing liquid   |
| 5   | Inlet of suction pipe insufficiently submerged  |
| 6   | Vortex formation at suction   |
| 7   | Pump operated with closed or partially closed suction valve - suction and discharge recirculation |
| 8   | Clogged suction strainer  |
| 9   | Obstruction in suction line   |
| 10  | Excessive friction losses in suction line system  |
| 11  | Clogged impeller  |
| 12  | Two elbows in suction piping at 90° to each other, creating swirl and pre-rotation                |
| 13  | Speed of pump too low   |
| 14  | Wrong direction of rotation   |
| 15  | Uncalibrated instruments  |
| 16  | Running of pump at too high a flow  |
| 17  | Specific gravity of liquid differs from design conditions   |
| 18  | Viscosity of liquid differs from design conditions  |
| 19  | Excessive wear at internal running clearances (wear plates and impeller)                          |
| 20  | Foreign matters in impellers  |
| 21  | Improper casing gasket material   |
| 22  | Inadequate installation of gasket   |

| <b><i>Pump requires excessive power</i></b>          |   |
|--|---|
| 1  | Speed of pump too high  |
| 2  | Wrong direction of rotation   |
| 3  | Reverse mounting of double-suction impeller   |
| 4  | Uncalibrated instruments  |
| 5  | Impeller diameter larger than specified   |
| 6  | Total head of system higher than design of pump   |
| 7  | Total head of system lower than design of pump  |
| 8  | Running of pump at too high a flow  |
| 9  | Specific gravity of liquid differs from design conditions   |
| 10   | Viscosity of liquid differs from design conditions  |
| 11   | Excessive wear at internal running clearances (wear plates and impeller)  |
| 12   | Foreign matters in impellers  |
| 13   | Misalignment  |
| 14   | Rotating part rubbing on stationary part (wear plates and impeller)   |
| 15   | Incorrect type of packing for operating conditions  |
| 16   | Packing improperly installed  |
| 17   | Gland too tight, prevents flow of liquid to lubricate packing   |
| <b><i>Pump vibrates or is noisy at all flows</i></b> |   |
| 1  | Pump suction pipe not completely filled with liquid   |
| 2  | Clogged impeller  |
| 3  | Too close a gap between impeller vanes and volute tongue or diffuser vanes  |
| 4  | Transients at suction source (imbalance between pressure at surface of liquid & vapour pressure at suction flange) - incorrect suction line / sump set up (suction hose too close to the sump wall) |
| 5  | Foreign matters in impellers  |
| 6  | Misalignment  |
| 7  | Foundation insufficiently rigid   |
| 8  | Loose foundation bolts  |
| 9  | Loose pump or motor bolts   |
| 10   | Inadequate grouting of baseplate  |
| 11   | Excessive piping forces and movements on pump nozzles   |
| 12   | Improperly mounted expansion joints   |
| 13   | Starting the pump without proper warm-up  |
| 14   | Mounting surfaces of internal fits (at wearing rings, impellers, shaft sleeves, shaft nuts, bearing housings, etc) not perpendicular to shaft axis  |
| 15   | Bent shaft  |
| 16   | Rotor out of balance  |
| 17   | Parts loose on the shaft  |

|  |  |
|--|--|
| 18   | Shaft running off-centre because of worn bearings  |
| 19   | Pump running at or near critical speed   |
| 20   | Resonance between operating speed and natural frequency of foundation, baseplate or piping   |
| 21   | Rotating part rubbing on stationary part (wear plates and impeller)  |
| 22   | Excessive axial thrust caused by excessive wear at internal clearances or by failure or, if used, excessive wear of balancing device                                 |
| 23   | Wrong grade of grease or oil   |
| 24   | Excessive grease or oil in anti-friction bearing houses  |
| 25   | Lack of lubrication  |
| 26   | Improper installation of anti-friction bearings such as damage during installation, incorrect assembly of stacked bearings, use of unmatched bearings as a pair, etc |
| 27   | Dirt getting into bearings   |
| 28   | Moisture contaminating lubricant   |
| 29   | Excessive cooling of water-cooled bearings   |
| <b><i>Pump vibrates or is noisy at low flows</i></b> |  |
| 1  | Pump suction pipe not completely filled with liquid  |
| 2  | Insufficient available Pump Suction Lift   |
| 3  | Selection of pump with too high a suction specific speed   |
| 4  | Running the pump against a closed discharge valve without opening a bypass   |
| 5  | Operating pump below recommended minimum flow  |
| 6  | Running of pump at too low a flow  |
| 7  | Parallel operation of pumps unsuitable for the purpose   |
| 8  | Excessive radial thrust in single-volute pumps   |

| <b><i>Pump vibrates or is noisy at high flows</i></b>            |   |
|--|---|
| 1  | Pump suction pipe not completely filled with liquid   |
| 2  | Insufficient available Pump Suction Lift  |
| 3  | Inlet of suction pipe insufficiently submerged  |
| 4  | Vortex formation at suction   |
| 5  | Pump operated with closed or partially closed suction valve - suction and discharge recirculation                                       |
| 6  | Clogged suction strainer  |
| 7  | Obstruction in suction line   |
| 8  | Excessive friction losses in suction line system  |
| 9  | Clogged Impeller  |
| 10   | Two elbows in suction piping at 90° to each other, creating swirl and pre-rotation  |
| 11   | Total dynamic head of system (suction and discharge static heights + system friction losses) higher than design of pump                 |
| 12   | Running of pump at too high a flow (for low specific speed pumps)   |
| 13   | Excessive wear at internal running clearances (wear plates and impeller)  |
| <b><i>Shaft oscillates axially</i></b>                           |   |
| 1  | Two elbows in suction piping at 90° to each other, creating swirl and pre-rotation  |
| 2  | Selection of pump with too high a suction specific speed  |
| 3  | Impeller selection with abnormally high head coefficient  |
| 4  | Operating pump below recommended minimum flow   |
| 5  | Parallel operation of pumps unsuitable for the purpose  |
| <b><i>Impeller vanes are eroded on visible side</i></b>          |   |
| 1  | Insufficient available Pump Suction Lift  |
| 2  | Pump operated with closed or partially closed suction valve - suction and discharge recirculation - suction and discharge recirculation |
| 3  | Clogged suction strainer  |
| 4  | Obstruction in suction line   |
| 5  | Excessive friction losses in suction line system  |
| 6  | Excessive wear at internal running clearances (wear plates and impeller)  |
| <b><i>Impeller vanes are eroded on invisible side</i></b>        |   |
| 1  | Pump operated with closed or partially closed suction valve - suction and discharge recirculation                                       |
| 2  | Selection of pump with too high a suction specific speed  |
| 3  | Operating pump below recommended minimum flow   |
| <b><i>Impeller vanes are eroded at discharge near centre</i></b> |   |
| 1  | Too close a gap between impeller vanes and volute tongue or diffuser vanes  |

| <b><i>Impeller vanes are eroded at discharge near shrouds or at shroud/vane fillets</i></b> |   |
|---|---|
| 1   | Impeller selection with abnormally high head coefficient  |
| 2   | Operating pump below recommended minimum flow   |
| <b><i>Impeller shrouds bowed out or fractured</i></b>                                       |   |
| 1   | Impeller selection with abnormally high head coefficient  |
| 2   | Operating pump below recommended minimum flow   |
| <b><i>Pump overheats and seizes</i></b>   |   |
| 1   | Pump not primed   |
| 2   | Insufficient available Pump Suction Lift  |
| 3   | Pump operated with closed or partially closed suction valve - suction and discharge recirculation   |
| 4   | Running the pump against a closed discharge valve without opening a bypass  |
| 5   | Operating pump below recommended minimum flow   |
| 6   | Parallel operation of pumps unsuitable for the purpose  |
| 7   | Obstruction in balancing device leak-off line   |
| 8   | Transients at suction source (imbalance between pressure at surface of liquid & vapour pressure at suction flange) - incorrect suction line / sump set up (suction hose too close to the sump wall) |
| 9   | Misalignment  |
| 10  | Excessive piping forces and movements on pump nozzles   |
| 11  | Improperly mounted expansion joints   |
| 12  | Starting the pump without proper warm-up  |
| 13  | Mounting surfaces of internal fits (at wearing rings, impellers, shaft sleeves, shaft nuts, bearing housings, etc) not perpendicular to shaft axis  |
| 14  | Bent shaft  |
| 15  | Rotor out of balance  |
| 16  | Shaft running off-centre because of worn bearings   |
| 17  | Pump running at or near critical speed  |
| 18  | Too long a shaft span or too small a shaft diameter   |
| 19  | Resonance between operating speed and natural frequency of foundation, baseplate or piping  |
| 20  | Rotating part rubbing on stationary part  |
| 21  | Incursion of hard solid particles into running clearances (wear plates and impeller)  |
| 22  | Excessive radial thrust in single-volute pumps  |
| 23  | Excessive axial thrust caused by excessive wear at internal clearances or by failure or, if used excessive wear of balancing device   |
| 24  | Improper installation of anti-friction bearings such as damage during installation, incorrect assembly of stacked bearings, use of unmatched bearings as a pair, etc                                |
| <b><i>Internal parts are corroded prematurely</i></b>                                       |   |
| 1   | Pump materials not suitable for liquid handled  |

| <b><i>Internal clearances wear too rapidly</i></b>                    |  |
|---|--|
| 1   | Insufficient available Pump Suction Lift   |
| 2   | Running the pump against a closed discharge valve without opening a bypass   |
| 3   | Operating pump below recommended minimum flow  |
| 4   | Misalignment   |
| 5   | Excessive piping forces and movements on pump nozzles  |
| 6   | Improperly mounted expansion joints  |
| 7   | Starting the pump without proper warm-up   |
| 8   | Mounting surfaces of internal fits (at wearing rings, impellers, shaft sleeves, shaft nuts, bearing housings, etc)                                 |
| 9   | Bent shaft   |
| 10  | Rotor out of balance   |
| 11  | Shaft running off-centre because of worn bearings  |
| 12  | Too long a shaft span or too small a shaft diameter  |
| 13  | Rotating part rubbing on stationary part   |
| 14  | Incursion of hard solid particles into running clearances (wear plates and impeller)   |
| 15  | Pump materials not suitable for liquid handled   |
| 16  | Excessive radial thrust in single-volute pumps   |
| <b><i>Internal stationary joints are cut through wire-drawing</i></b> |  |
| 1   | Mounting surfaces of internal fits (at wearing rings, impellers, shaft sleeves, shaft nuts, bearing housings, etc) not perpendicular to shaft axis |
| 2   | Improper volute gasket material  |
| 3   | Inadequate installation of gasket  |
| 4   | Inadequate tightening of casing bolts  |
| <b><i>Packed box leaks excessively or packing has short life</i></b>  |  |
| 1   | Grease line plugged (grease line that feeds into lantern ring)   |
| 2   | Seal cage improperly mounted in stuffing box   |
| 3   | Misalignment   |
| 4   | Bent shaft   |
| 5   | Rotor out of balance   |
| 6   | Shaft running off-centre because of worn bearings  |
| 7   | Shaft or sleeves worn or scored at packing   |
| 8   | Incorrect type of packing for operating conditions   |
| 9   | Packing improperly installed   |
| 10  | Gland too tight, prevents flow of liquid to lubricate packing  |
| 11  | Excessive clearance at bottom of stuffing box allows packing to be forced into pump interior   |
| 12  | Dirt or grit in sealing liquid   |
| 13  | Failure to provide adequate cooling liquid to water-cooled stuffing boxes  |

|    |   |
|----|---|
|    | <b><i>Packed box sleeve is scored</i></b>   |
| 1  | Grease line plugged (grease line that feeds into lantern ring)  |
| 2  | Seal cage improperly mounted in stuffing box  |
|    | <b><i>Mechanical seal leaks excessively</i></b>   |
| 1  | Misalignment  |
| 2  | Bent shaft  |
| 3  | Pump duty outside recommended pump range  |
| 4  | Rotor out of balance  |
| 5  | Shaft running off-centre because of worn bearings   |
| 6  | Pump running at or near critical speed  |
| 7  | Incursion of hard solid particles into running clearances   |
| 8  | Incorrect type of mechanical seal for prevailing conditions   |
| 9  | Mechanical seal improperly installed  |
|    | <b><i>Mechanical seal has damaged faces, sleeve bellows</i></b>   |
| 1  | Misalignment  |
| 2  | Bent shaft  |
| 3  | Pump duty outside recommended pump range  |
| 4  | Rotor out of balance  |
| 5  | Shaft running off-centre because of worn bearings   |
| 6  | Pump running at or near critical speed  |
| 7  | Incursion of hard solid particles into running clearances   |
| 8  | Incorrect type of mechanical seal for prevailing conditions   |
| 9  | Mechanical seal improperly installed  |
|    | <b><i>Bearings have short life</i></b>  |
| 1  | Insufficient available Pump Suction Lift  |
| 2  | Operating pump below recommended minimum flow   |
| 3  | Excessive wear at internal running clearances   |
| 4  | Obstruction in balancing device leak-off line   |
| 5  | Misalignment  |
| 6  | Excessive piping forces and movements on pump nozzles   |
| 7  | Improperly mounted expansion joints   |
| 8  | Bent shaft  |
| 9  | Rotor out of balance  |
| 10 | Pump running at or near critical speed  |
| 11 | Excessive radial thrust in single-volute pumps  |
| 12 | Excessive axial thrust caused by excessive wear at internal clearances or by failure or, if used excessive wear of balancing device |
| 13 | Wrong grade of grease or oil  |

|                                    |  |
|------------------------------------|--|
| 14                                 | Excessive grease or oil in anti-friction bearing houses  |
| 15                                 | Lack of lubrication  |
| 16                                 | Improper installation of anti-friction bearings such as damage during installation, incorrect assembly of stacked bearings, use of unmatched bearings as a pair, etc |
| 17                                 | Dirt getting into bearings   |
| 18                                 | Moisture contaminating lubricant   |
| 19                                 | Excessive cooling of water-cooled bearings   |
| <b><i>Drive Coupling Fails</i></b> |  |
| 1                                  | Misalignment   |
| 2                                  | Excessive piping forces and movements on pump nozzles  |
| 3                                  | Excessive power transfer, greater than coupling power rating   |
| 4                                  | Torsional vibration  |
| 5                                  | Improperly mounted expansion joints  |
| 6                                  | Bent shaft   |

## 9. WARRANTY CLAIM PROCEDURE

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Remko warrants all manufactured product against faulty workmanship or material for a period of twelve (12) months or 2,000 hours from the invoice date.

The obligation, statutory or otherwise, of this warranty is limited to replacement or repair at Remko Facility, or at appoint designated by Remko, of parts which are found upon inspection by Remko at such point and completion of correct warranty claim forms, to be defective in materials or workmanship.

Assemblies and components purchase and installed on the product by Remko are included within this warranty, but will not be considered defective as units, and repair or replacement will be limited to the individual part proven defective. Any part so replaced will become property of Remko

Excluded from this warranty are:

1. Lip seals, "O" rings and other "rubber" components which age / degrade naturally over time if the failure is a result of natural ageing/degrading.
2. Any product which has been altered or repaired in such a way, in Remko's judgement, as to affect the product adversely.
3. Repair or replacement of any parts which has, in Remko's judgement, been subjected to damage through negligence, accident, abuse, improper use or storage.
4. Any product which has not been operated or maintained in accordance with normal practice and with the recommendation of Remko.
5. Use of non-genuine spare parts.
6. Normal wear and tear.
7. Products damaged in shipment or otherwise without the fault of Remko.

This warranty does not obligate Remko to bear costs of labour, overtime labour, travel time, travel expenses or freight charges in connection with the replacement or repair of defective parts.

Remko will not consider any warranty claim for warranty unless notified fourteen (14) days of the defect or end of warranty period, and parts subject to warranty are returned to Remko facility for assessment at the purchasers risk and expense.

### **Warranty Notification Procedure**

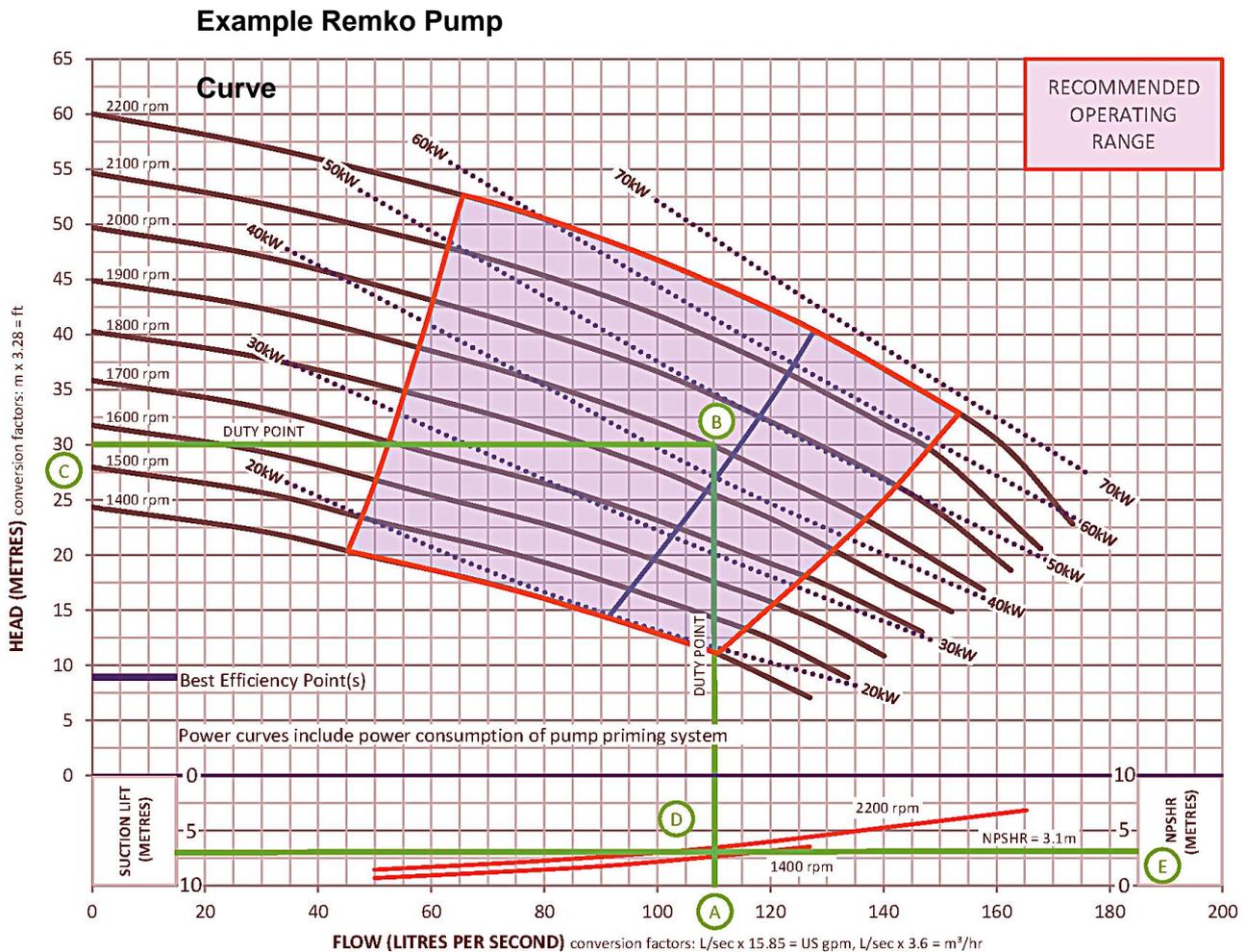
1. Upon determining a failure, the end user will advise an Remko representative of the failure and cause.
2. A decision will be made as to if a service person is sent to site or the unit is returned to Remko.
3. Freight is to be covered by the customer and a nil value order number is raised to cover any non-warranty issues.
4. The end user will then be required to complete an Remko warranty claim form, with all relevant information completed.
5. Digital photos, if applicable, will be taken and attached to the warranted claim form, to document failure and allow for a clearer interpretation of the failure.
6. Upon receiving the warranty claim form and relevant documentation Remko will review the cause of failure and advise the end user of the status within a reasonable period of time.

### **Warranty claim processing procedure**

1. The Service Manager will be the primary contact between the end user and Remko for all matters relating to warranty.
2. All correspondence will be done by or backed up by e-mail.
3. The local Remko Representative will be copied in on any warranty correspondence in their region.

## 10. MISCELLANEOUS ENGINEERING INFORMATION

### 10.1 How to Read a Performance Curve



The lines sloping downwards from left to right represent the varying quantities of liquid delivered by the pump with variations in head. The intersection of this line at 1900rpm with the zero flow line shows the shut off head (45m) of pressure developed by the pump.

$$\text{Total Dynamic Head (m)} = \text{Static Suction lift (m)} + \text{Static Discharge Head (m)} + \text{Friction Head (m)}$$

Where:

**Static Suction Lift:**

Difference in elevation between liquid level of the suction and the centre line of the pump.

**Static Discharge Head:**

Difference in elevation between liquid levels of the centre line of the pump and the discharge.

**Friction Head:**

Equivalent head necessary to overcome friction on the interior surfaces of the pipework system including all valves, bends and fittings.

**Duty Point:** A pump operating at **110l/s at 30m (Total Dynamic Head)**.

- 1) Draw a line upwards from Flow (x-axis) at 110l/s (point A).
- 2) Draw a line across from Total Head (y-axis) at 30m (point C)
- 3) Where the vertical line of 110l/s intersects the horizontal line of 30m (point B) determines the pump rpm speed and power required at this duty.
- 4) ∴ Pump Speed Curve = **1900rpm**.
- 5) ∴ Power Requirement = **50kW** to run the whole of the 1900rpm curve.
- 6) To obtain NPSHR (Net Positive Suction Head Required), draw a line across from where the vertical line of the 95l/s intersects the NPSHR curve (point D).
- 7) ∴ NPSHR = **3.1m** (point E).
- 8) Dynamic Suction Lift Available (DSL<sub>A</sub>)

DSL<sub>A</sub> = Atmosphere (m) – Velocity Head (allow 1m) – NPSHR (m)

= 10.3m – 1m – 3.1m

= **6.2m**

To determine the actual dynamic lift of pump, it is recommended to fit a vacuum gauge on the suction side of the pump to obtain a vacuum reading. The vacuum gauge, for this example, should read no more than 60.8kPa (6.2m). If the vacuum gauge reading is greater than 60.8kPa then the pump will experience cavitation.

Note:

*To ensure minimal losses to the total suction lift:*

- *Keep suction pipes as short and straight as possible.*
- *Eliminate all possibility of air pockets being trapped in suction pipework.*
- *When choosing foot valves, strainers, bends etc., select those, which will provide minimal restriction to the flow.*
- *The diameter of the suction pipe should be equal in diameter to the pump inlet connection.*
- *It is recommended to fit eccentric reducer in conjunction with pipe diameters larger than the pump inlet to avoid the possibility of air pockets in the suction pipework.*

### 10.1.1 Generalisations

- (1) Flow (l/s) decreases, as Total Head (m) increases.
- (2) Flow (l/s) increases, Power used increases.

It is **not** recommended to operate the pump outside the recommended pump operating range. To operate outside this area will lead to cavitation, vibration and non-uniform radial forces present in the pump. This drastically reduces the operating life of the mechanical seal, bearings and efficiency of the pump. In addition, the pump alignment will also be adversely effected due to excessive vibration. All this will result in an increase of maintenance cost of the pump.

### 10.1.2 Radial Thrust

When a pump is operated at its best efficiency flow-rate the velocities and hence the pressures acting on the impeller are uniform around the volute. This is shown in *Figure – A*.

At flow rates other than best efficiency point, the pressure distribution is no longer uniform. At reduced flow rates, the pressures increase spirally towards the cutwater resulting in a radial reaction F as shown *Figure – B*.

This will lead to the following operating problems:

- Low efficiency of pump.
- Noise vibration, reduced life of pump.
- Increased radial loads on bearings due to unbalanced volute pressures.
- Temperature rise due to dissipated energy created by low efficiency.

A similar situation exists at flow rates beyond best efficiency flow rates, with an approximate opposite (in direction) reaction.

This also will lead to similar problems associated with the reduced flow rates with an addition of poor suction performance (high NPSHR).

*Figure – C* shows typical variation of radial thrust with flow rate.

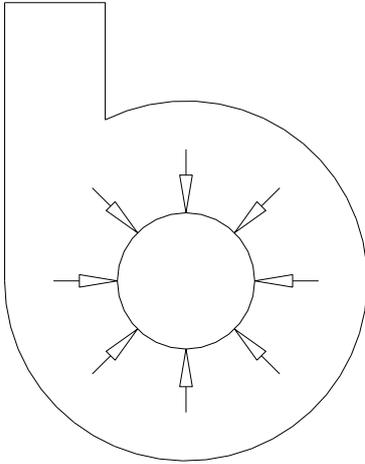


Figure A – 100% Best Efficiency Flow

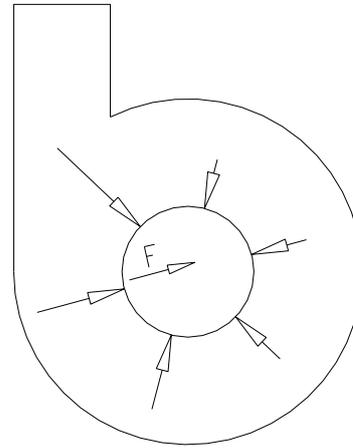


Figure B – Reduced Flow

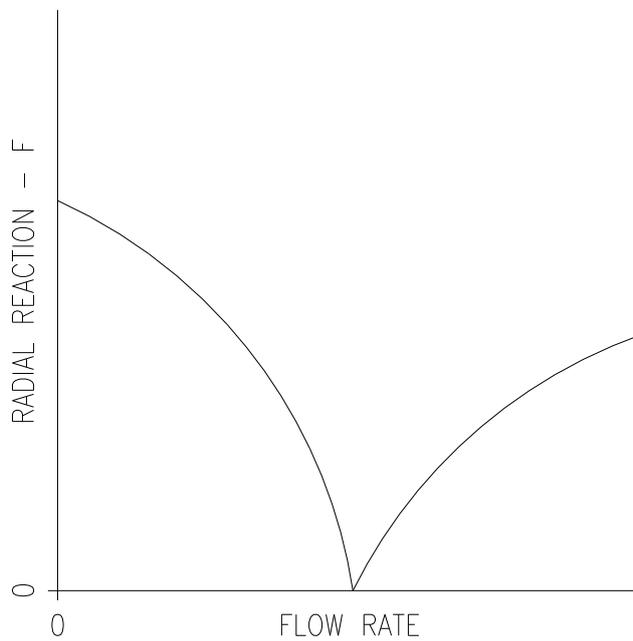


Figure C – Radial Thrust

### 10.1.3 Cavitation

If the Net Positive Head Available of the pump is less than the Net Positive Head Required, the pumped liquid will vaporize in the region of the impeller eye i.e. where the local pressure is less than the vapour pressure.

In this region, the fluid will consist of a liquid plus vapour cavities. This can, in the extreme, result in the formation of a vapour lock and the prevention of the fluid entering the impeller.

This phenomenon is called 'cavitation'. The cavitation cycle comprises therefore of two phase changes; one from liquid to vapour during the initiation and the other from vapour back to liquid during cavity collapse.

Cavitation may be caused by excessive suction lift, insufficient NPSHA or operation at too high a speed. The resulting effects include:

1. Pitting of material surfaces due to the continual hammering action of the collapsing vapour cavities.
2. Significant reduction of performance due to vapour formation.
3. The crackling noise (like gravel going through the pump) caused by vapour cavity collapse.

*Severe cavitation usually results in excessive noise, vibration and damage to pump, whereas mild cavitation may produce nothing more than a small reduction in pump efficiency and moderate wear of pump components.*

## **10.2 Automatic Priming NRV Function**

Remko Automatic Self Priming Pumps are supplied complete with discharge check valves as a part of the pump priming system.

The primary function of the check valve is for sealing the discharge side of the pump during the automatic priming process.

Whilst this check valve is rated for maximum pump performance it is not intended to be used as the discharge system non return valve.

Remko recommend that a suitable system non return valve be installed as part of the discharge pipe work.

### 10.3 Main Factors Affecting Pump Suction Lift

Pump's Suction Lift / NPSHR curve capabilities can be influenced by various factors in particular altitude (refer to *Table 1 – Effect of Altitude on Available Suction Lift*) and temperature of fluid being pumped (refer to *Table 2 – Effect of Temperature on Available Suction Lift*).

Remko manufacture automatic self-priming pumps where the available suction lift plays a critical part in the pump dynamic system.

Therefore, any increase in fluid temperature or altitude will adversely affect the available suction lift. The higher the temperature or altitude the greater the adverse effects on the available suction lift.

In addition, higher temperature will introduce thermal expansion of pump parts and reduce internal pump clearances.

Pump O-rings, gaskets and associated parts are rated as listed;

| Material                            | Minimum Temperature °C | Maximum Temperature °C |
|-------------------------------------|------------------------|------------------------|
| Viton                               | -40                    | 176                    |
| Buna N                              | -4.4                   | 121                    |
| Polyurethane                        | -4.4                   | 93.3                   |
| Teadit NA-1002<br>(Gasket Material) | -29                    | 260                    |
| Nylon (Wearlon)                     | -40                    | 160                    |

Remko recommend contacting Remko Engineering Department with high fluid temperature (> 60 C), altitude or any different applications to ensure the pump is correctly rated / set up.

***Please note that Remko Pump's Suction Lift / Net Positive Suction Lift Required (NPSHR) curves as published are based on standard clean water at 15C.°***

The below table show the effect of altitude on the Pump's Suction Lift / NPSHR curve capabilities;

| Altitude<br>(m)                     | Reduction in<br>Suction Lift<br>(m) |
|-------------------------------------|-------------------------------------|
| 0                                   | 0                                   |
| 250                                 | 0.30                                |
| 500                                 | 0.60                                |
| 750                                 | 0.89                                |
| 1000                                | 1.17                                |
| 1250                                | 1.44                                |
| 1500                                | 1.71                                |
| 1750                                | 1.97                                |
| 2000                                | 2.23                                |
| 2250                                | 2.48                                |
| 2500                                | 2.72                                |
| 2750                                | 2.96                                |
| 3000                                | 3.19                                |
| 3250                                | 3.41                                |
| 3500                                | 3.63                                |
| 3750                                | 3.84                                |
| 4000                                | 4.05                                |
| 4250                                | 4.25                                |
| 4500                                | 4.45                                |
| 4750                                | 4.64                                |
| 5000                                | 4.83                                |
| 5250                                | 5.01                                |
| 5500                                | 5.19                                |
| 5750                                | 5.36                                |
| 6000                                | 5.53                                |
| (International Standard Atmosphere) |                                     |

**Table 1 - Effect of Altitude on Available Suction Lift**

**Altitude**

In basic terms, the higher the altitude the less atmospheric pressure resulting in a reduction of pressure differential between atmosphere and vacuum created in Remko self priming system resulting in a reduction of available suction lift.

The below table show the effect of temperature on the Pump's Suction Lift / NPSHR curve capabilities;

| Temperature<br>(°C)          | Reduction in<br>Suction Lift<br>(m) |
|------------------------------|-------------------------------------|
| 15                           | 0                                   |
| 20                           | 0.06                                |
| 30                           | 0.22                                |
| 40                           | 0.52                                |
| 50                           | 0.98                                |
| 55                           | 1.32                                |
| 60                           | 1.73                                |
| 65                           | 2.23                                |
| 70                           | 2.85                                |
| 75                           | 3.60                                |
| 80                           | 4.51                                |
| 85                           | 5.59                                |
| 90                           | 6.88                                |
| 95                           | 8.39                                |
| 100                          | 10.18                               |
| (For Water Relative to 15°C) |                                     |

**Table 2 - Effect of Temperature on Available Suction Lift**

### **Temperature**

In basic terms, the higher the water temperature the greater the reduction in suction lift due to changing water vapour pressure and density.

### **10.4 Pump Suction Pipe Velocity**

Achieving correct suction pipe velocity is a significant part in obtaining satisfactory suction lift. Any increase of velocity (i.e. increase in flow) will result in greater friction losses and adversely affect the available suction lift.

Remko manufacture automatic self-priming pumps where the available suction lift plays a critical part in the pump dynamic system and therefore it is essential to take suction pipe velocity into consideration.

**Remko recommend the maximum suction pipe velocity is 4 m/s.**

This velocity is on the high side when comparing to other published recommended figures but Remko supply, in most instances, mobile dewatering equipment. To achieve lower velocities would result in large hoses that would be difficult and impractical to transport or install.

*Please note that the suction pipe velocity is an important part of the suction lift set up but other factors also affect suction lift such as static suction lift, elbows, valves, pipe internal roughness etc. All these factors combined determine the available suction lift of the pump.*

### 10.5 pH Compatibility Chart

The abbreviation pH means 'hydrogen potential' – or the ability of the liquid to take up acidic hydrogen ions and become more acid.

The numbers used are the logarithms or the actual numbers, which would otherwise be in millions.

pH 7.0 is neutral.

An already acid solution cannot take up as much additional acid. Therefore pH less than 7.0 is acidic.

pH greater than 7.0 is alkaline.

As each change of 1 on the log scale is equivalent to 10 times on the linear scale, a linear scale, a solution of pH5 is ten times more acidic than a solution of pH6.

Similarly, pH4 is 100 times more acidic than pH6, and so on.

#### Wetted Material Compatibility Guideline for Metals

| Fluid         | pH Level | Metals           |
|---------------|----------|------------------|
| Alkaline      | 14       | Stainless Steels |
|               | 13       |                  |
|               | 12       |                  |
|               | 11       |                  |
| Caustic Basic | 10       | Cast Iron        |
|               | 9        |                  |
| Neutral       | 8        | Aluminium        |
|               | 7        |                  |
|               | 6        |                  |
| Acid          | 5        | Cast Iron        |
|               | 4        |                  |
|               | 3        | Stainless Steels |
|               | 2        |                  |
|               | 1        |                  |
| 0             |          |                  |

## **10.6 Pump Dry & Snore Running Times**

Please note that the allowable dry and snore running times for Remko pumps vary from model to model. Contact Remko for more details on the supplied pump. Normally, allowable dry running times vary between 4-8 hours and the allowable "snore" running times vary between 0.5-2 hours.

### **Definitions**

#### ***Dry Running***

During initial pump start up, when there is no liquid available to the pump

#### ***Snore Running***

Pump has lost its prime; the pump is still drawing in liquid and air through the suction strainer; surging of fluid mixture, containing air and other contaminants (muds, slurries, rocks etc), into the pump suction / volute waiting for full and correct submergence of suction strainer that allows the pump to return to non-snore conditions and begin actively pumping out liquid.

#### **Special Note**

Operating Medium Head, High Head and Extra high Head style of pumps in extended "snore" conditions causes oscillating pressure within the pump system and possible pump equipment damage.



**www.remko.com.au  
Australia**

**1800 333 424**

*This Remko product is supplied by:*

A large, empty rectangular box with a dashed black border, intended for the name of the supplier.