RSS Mining Pty Ltd | Rock Support Systems
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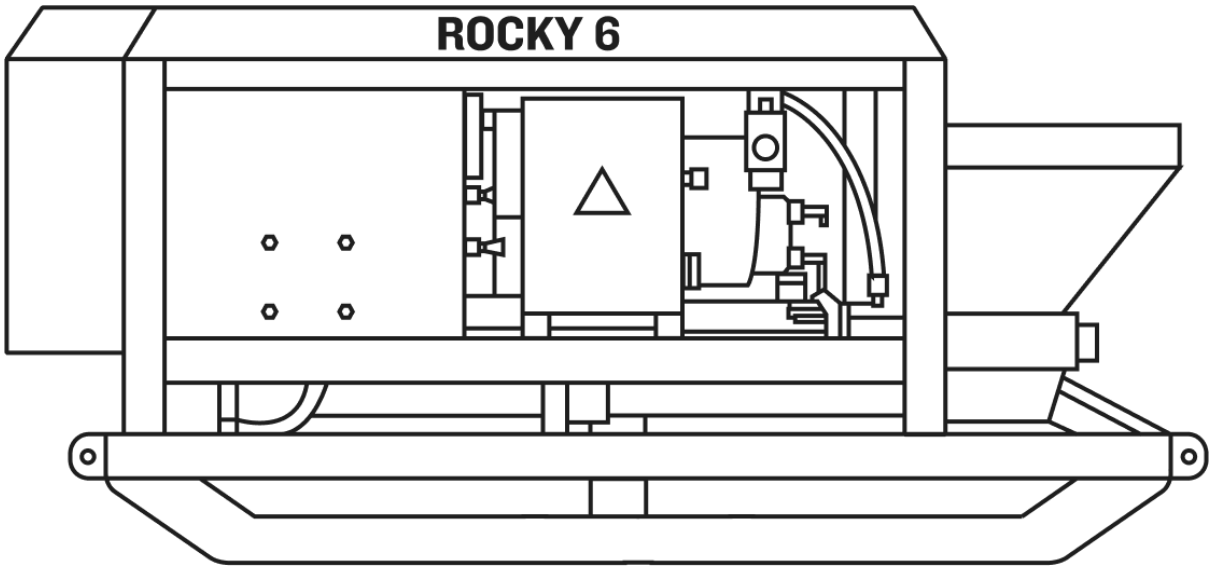
OPERATORS MANUAL



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1. Rocky 6 Technical Specifications

Category	Concrete Pumps, Plaster Pumps, Wet Shotcrete Machines
Output Capacity	Variable 0-6 m3/h
Hydraulic Pressure	140 bar preset
Delivery Pressure	Variable 0-50 bar
Horizontal Delivery Distance	Up to 200m
Vertical Delivery Distance	Up to 70m
Aggregate Size	Up to 13mm (6mm-8mm for Shotcrete)
Power Supply	380V,525V,1000V 3-Phase
Drive Motor	15kW 380V,525V,1000V
Control Circuit	24V DC
Dry Weight	820 kg
Oil Capacity	120 litres
Oil Type	Mineral Hydraulic Oil
Length	2050mm
Width	750mm
Height	1050mm
Mounting Options	Skids/Trailer/Rail Car
Optional Extra 1	Dosing System Up to 120 l/hour
Optional Extra 2	Accelerator Tank

2. Operation & Safety

2.1. Introduction

The Rocky 6 Shotcrete Pump is a hydraulic pump for the spraying or pumping of wet concrete. The design is based on the proven dual-cylinder and swing-tube design. Drive power is supplied from a 380V, 525V or 1000V 3-phase electrical motor driving two gear pumps connected in tandem. The main pump supplies oil to the pumping and swing cylinders while the secondary pump drives the dosing pump. Direction changing is done through proximity switches and electrically operated hydraulic valves. All hydraulic valves and solenoids are placed inside the tank to reduce the risk of damage.

The pump is designed for the variable delivery of 0 m^3/h to 6 m^3/h with adjustable dosing flow. Hydraulic pressure is preset at 140 bar for a concrete delivery pressure of 50 bar. This setting also protects the pump and other hydraulic components against over-pressure.

2.2. Safety Before Operation

As with all other hydraulic and rotating machinery, safety is critical when operating and maintaining the Rocky. The safety precautions outlined in this manual should be used as a guide only and should not be considered comprehensive safety instructions.

Only personnel trained in the use of shotcreting pumps and systems must be allowed to operate the Rocky.

Always refer to local mining or other site regulations before and during the operation and use of the equipment.

Always make sure the machine is clean and in good physical condition. This will reduce the possibility of injury or damage.

Before operating the machine, check and make sure of the following (Also refer to **Section 7:** Daily Check List):

- The machine is placed on a suitable horizontal surface
- Necessary signs or arrangements are in place for the use of the machine
- All guards and covers are in place and secure
- Hopper grid is closed and in good condition
- Hopper is clean and free of foreign objects
- The lubrication box is clean and half-filled with hydraulic oil or water
- The lubrication box lid is closed
- The electrical panel is closed and free of damage
- All switches are secured and in good working condition
- Electrical wiring and cables are correctly and securely connected and free of damage
- All proximity switches are secured and undamaged
- Hydraulic pipes are secured and free of damage
- The pressure gauge is operational and undamaged
- The temperature and Level gauge are operational and free of damage

2.3. Safety During Operation

- Follow all local site regulations in terms of machine operation and personnel requirements
- Wear the required personal protective equipment
- Do not try to remove any foreign objects from the hopper through the grid. Completely switch off and isolate the machine before entering any part
- Keep clear of all moving parts
- Never open the electrical panel while the machine is in operation
- Do not remove pipes or clamps under pressure
- Regularly check temperature and pressure to be within limits. Normal temperature during operation is between 30° Celsius and 60° Celsius
- Oil pressure should never read higher than 140 bar

- Only trained personnel should operate the machine

2.4. Operating the Pump

- Set the machine up on a suitable horizontal surface
- Follow all precautions and safety regulations
- Make sure the hopper is clean
- Close hopper grid
- Make sure the lubrication box is clean
- Fill the lubrication box with oil or water to the centre of the cylinder rod
- Close the lubrication box lid to prevent concrete from entering
- Connect the concrete hoses to the Outlet
- Connect the dosing line from the dosing pump to the nozzle. Depending on the type of accelerator used, bleeding of this line to ensure air evacuation and correct dosage before connection to the nozzle
- Connect the dosing supply to the dosing pump inlet
- Connect the air supply line to the nozzle
- Switch off the Main Breaker and connect the machine to a suitable power supply
- Switch on the main breaker. The LED on the phase sequence relay will only light up once the lines are connected in the correct order to ensure correct motor rotation. Incorrect motor rotation will damage the pump and hydraulic components
- Enable the pump by turning the red Emergency Stop Button clockwise
- Start the motor using the Start Button. The motor will run whilst the cylinders are still stationary
- Start the pump in Forward and make sure the machine runs smoothly.
- NOTE: The pump is equipped with self-bleeding hydraulic cylinders. When the pump is switched on in the Forward or Reverse position, it might take a few seconds to correct itself by removing any trapped air or correcting cylinder positions.
- Check the oil level and pressure rise to be below 40 bar with the pump in Neutral
- Add the required amount of an approved lubricant to the hopper to lubricate the concrete hoses
- Follow the guidelines for applying shotcrete
- Stop the pump using the Forward/Reverse switch
- Switch off the motor with the red Emergency Stop Button
- Blockages can be removed by running the pump in Reverse

2.5. Cleaning and Storage

- Always clean the machine properly after every use while the concrete is still wet.
- Wash out the S-Tube and Concrete Cylinders through the Outlet with the machine running. Remove all concrete from the hopper by washing it out through the bottom gate.
- Drain and clean the lubrication box and replace the plug and lid.

- Do NOT put hands or any objects into the lubrication box while the machine is switched on.
- Wash out the Dosing Pump with clean water by running it at low speed with the water supply connected to the suction port.
- Refill the hydraulic tank with the correct oil to the centre of the level gauge.

3. Maintenance

3.1. Pre- and Post-Operational Inspections

Regular inspection and maintenance will ensure optimum pump performance and increased machine life expectancy. Regular inspection will reduce the risk of injury or plant and equipment damage. Worn and damaged parts should be replaced immediately with OEM-approved parts.

- Hydraulic fluid leaks
- Swing Cylinder clevis, pin and securing pin
- Condition of hydraulic pipes and fittings
- Condition of all guards and covers
- Condition of the electrical panel, switches, cables and wires
- Level of hydraulic oil in the tank
- Excessive movement of the S-Tube indicates worn bushes and seals
- Concrete inside the lubrication box indicates worn piston cups
- Drastically reduced output is an indication of an incorrect mix or possible pump or cylinder damage
- Condition of seals
- General condition of the frame and structure
- Proper closing of the bottom gate

3.2. Running Maintenance

- For replacement of parts, always refer to the Spares List
- Replacement of the oil filter
- Greasing of the following points:
- Change-Over cylinder pin
- S-Tube bushes front and rear
- Hopper grid hinges
- Draining off moisture/water from the oil tank
- Refilling of the oil tank
- Retightening of any loose bolts or fittings

3.3. Resetting of Wear Ring and Wear Plate Clearance

- Once the Wear Plate or Wear Ring is worn to the point that the Wear Ring is loose inside the S-Tube, the S-Tube must be adjusted to ensure correct sealing between the two faces.
- Loosen Locking Cap Screw
- Loosen Outlet Nuts
- Tighten up the S-Tube Shaft Nut until the Wear Ring presses firmly against the Wear Plate. Do not over-tighten.
- Replace and tighten the Locking Cap Screw
- Adjust the outlet gap by equally tightening the Adjusting Nuts. The gap should be adjusted between 0.5mm and 1mm
- Retighten Outlet Nuts

3.4. Replacing the Piston Cups

When excess concrete is pushed out behind the concrete cylinders and into the lubrication box, the concrete cylinder cups are worn through and need to be replaced.

1. Using the Operating Procedure, start the machine in Neutral
2. Switch the pump to Reverse and push the one cylinder to the front
3. Switch off the pump using the Emergency Stop
4. Make sure the Bolt (R014) head holding the Piston Cap is clean
5. Redo 1-4 for the second cylinder
6. Switch off the mains to the machine
7. Use a Metric 17mm socket and suitable extensions to loosen and remove the Bolt (R014) and Piston Cap (R123). Hold the Piston Cup Connector (R124) through the Lubrication Box with a 28mm flat spanner to prevent turning
8. Remove all tools and push the cylinder forward in Reverse
9. Remove the Cup (R306) and Scraper (R128) and replace with new parts using a suitable grease lubricant
10. Replace Piston Cap (R123) with Bolt (R014). Add grease to the bolt thread before inserting
11. Repeat steps 6-10 for the second cylinder

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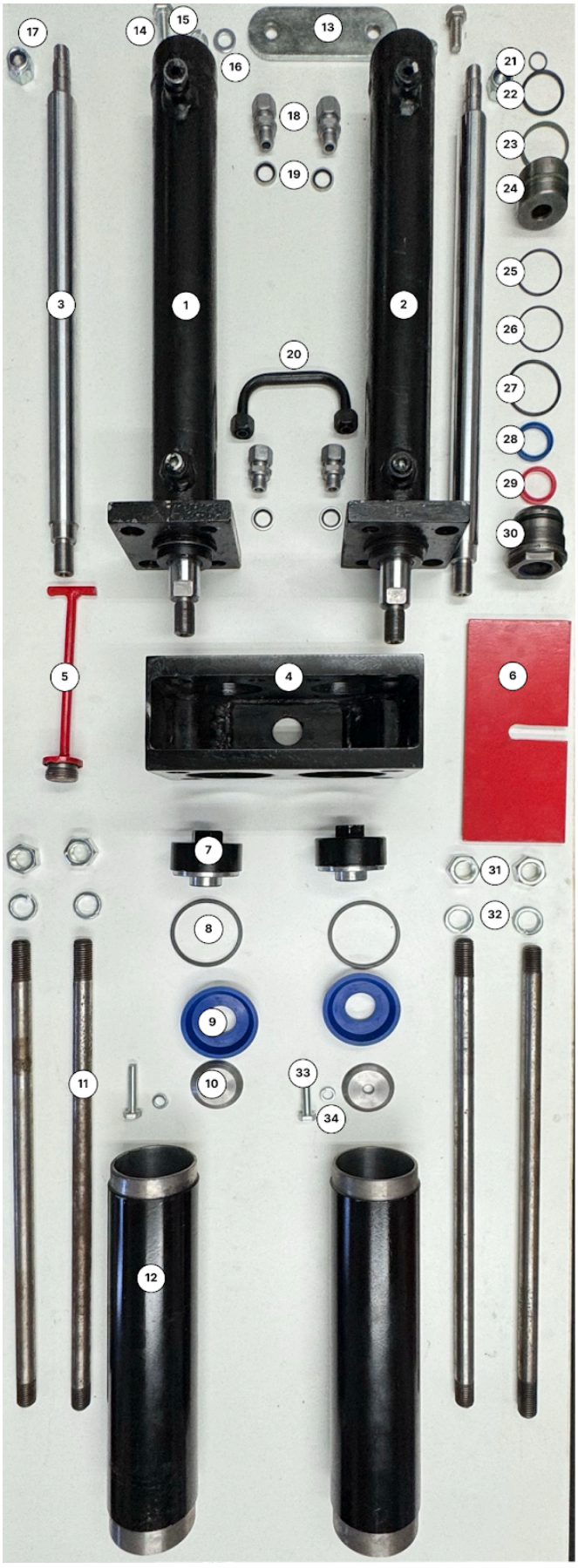

1	6ER210V (L)	Hydraulic Cylinder 2.5 - Pumping (Left)
2	6ER210V (R)	Hydraulic Cylinder 2.5 - Pumping (Right)
3	6ER425V	Piston Rod 6 - Pumping Cylinder
4	R116	Lubrication Box
5	45077353	Plug - 1" BSP
6	R142	Lubrication Box Lid
7	R124	Piston Cup Connector
8	R128	Scraper
9	R306	Piston cup
10	R123	Piston Cap
11	6ER132	Tie Rod 6
12	6ER104	Feeder Cylinder 6 (Concrete Cylinder)
13	R136	Cylinder Support Plate
14	CON0095	Hex Bolt M12 x 45mm
15	CON0090	Spring Washer M12
16	CON0036	Flat Washer M12
17	CON0010	Nut M10mm
18	051-1214	12mm x 3/8" BSP Straight Male Stud Coupling
19	085-1023	12" Bonded Washer
20	R211	12L Ubend Fem-Fem
21 to 23 & 25 to 29	R2101	Seal Kit - pumping cylinder 2.5/6
24	R2102	Piston head pumping cylinder 2.5/6
30	R2103	Hydraulic head pumping cylinder 2.5/6
31	CON0171	Nut M20mm
32	CON0060	Spring Washer M20
33	CON0231	Hex Bolt M10 x 50mm
34	CON0089	Spring Washer M10

3.5. Replacing S-Tube Seals and Bushes

1. Remove Hopper (R113) from Feeder Box (R108) to allow access
2. Loosen nuts and remove Outlet Flange (R137) and Outlet Bush Housing (R118)
3. Remove Internal Circlip (R301) and replace Seals (R308) and/or Outlet Bush (R102) if necessary. Make sure the lubrication holes in the Bush are correctly aligned with the housing. Use a suitable grease lubricant on seals and bushes.
4. Remove S-Tube Locking Nut (R013)
5. Split S-Tube (R130) and S-Tube Shaft (R131) inside Feeder Box (R108)
6. Remove S-tube (R130)
7. Remove S-tube Shaft (R131)
8. Remove Inlet Bush Housing Cover (R115)
9. Remove Shaft Seal (R307) and/or Inlet Bush (R101) and replace. 10
10. Replace Thrust Washers (R311), adding grease
11. Reverse the procedure to rebuild.
12. Follow the Wear Plate Spacing Procedure to reset the S-Tube
13. Grease all points

3.6. Replacing the Wear Ring and Wear Plate

1. Follow the procedure outlined in Steps 1-8 to loosen the S-Tube. Do not split the S-Tube
2. Pull back the S-Tube just enough to remove the Wear Ring and the Wear Ring O-Ring
3. Loosen Wear Plate Bolts
4. Remove and replace the Wear Plate. Make sure the surface is clean to ensure proper sealing and alignment.
5. Replace the Wear Ring and the Wear Ring O-Ring
6. Reverse the procedure to reassemble
7. Grease all points
8. Reset Wear Plate and Outlet gaps

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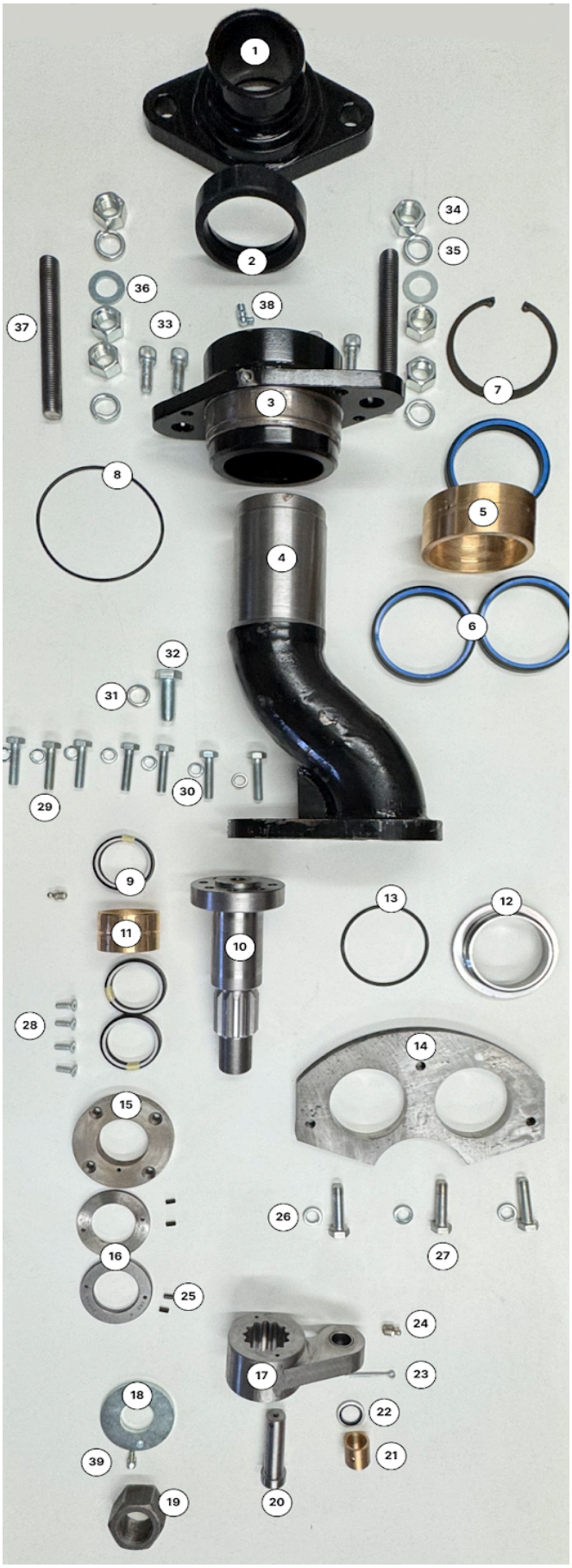
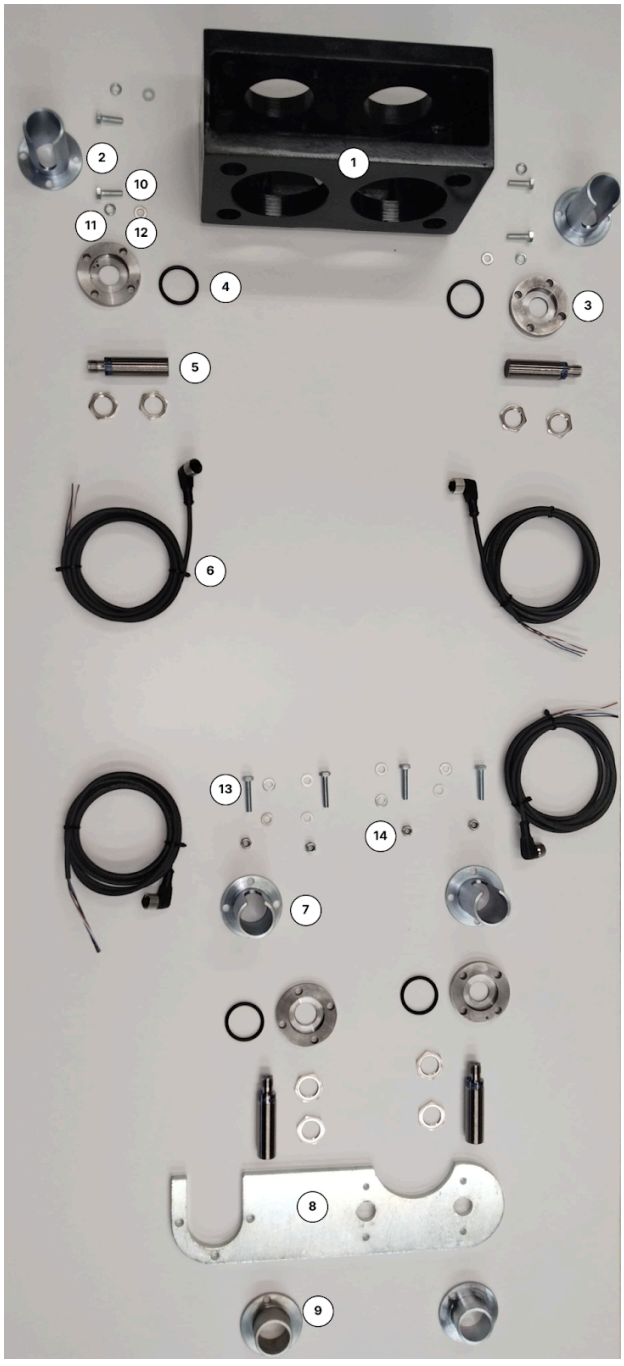


1	R137	Outlet Flange
2	R309	Gasket to clamp 3" (Pressure seal)
3	R118	Outlet Bush Housing
4	R130	S-Tube
5	R102	Brass Bush - Outlet
6	R308	Shaft seal - Outlet (Polypac)
7	R301	Circlip Internal
8	45077311	O ring - 120.24 x 3.53
9	R307	Shaft seal - Inlet (Polypac)
10	R131	S-Tube Shaft
11	R101	Inlet Bush - Brass
12	R134	Wear Ring
13	R305	O-ring wear ring
14	R133	Wear Plate
15	R114	Inlet Bush Cover
16	R311	Thrust washer
17	R126	Swivel Arm
18	R117	Swivel Arm Spacer
19	R013	S-Tube Lock Nut
20	R125	Clevis Pin with washer & split pin
21	R100	Brass Bush (Change Over Cylinder + Swivel Arm)
22	085-1023	12" Bonded Washer
23	R125/1	Split pin for Clevis Pin
24	R304	Grease nipple
25	R310	Sirlock pin 4mm x 10 mm
26	CON0090	Spring Washer M12
27	CON0095	Hex Bolt M12 x 45mm
28	CON0326	Capscrew 6 x 25mm
29	CON0323	Hex Bolt M10 x 45mm
30	CON0089	Spring Washer M10
31	CON0091	Spring Washer M16
32	CON0058	Hex Bolt M16 x 45mm
33	CON0070	Cap Screw M12 x 30 (SKT)
34	CON0171	Nut M20mm
35	CON0060	Spring Washer M20

36	CON0083	Flat Washer M20	38	R304	Grease Nipple
37	CON0043	Threaded Rod M20	39	CON0118	Cap Screw M6 x 10

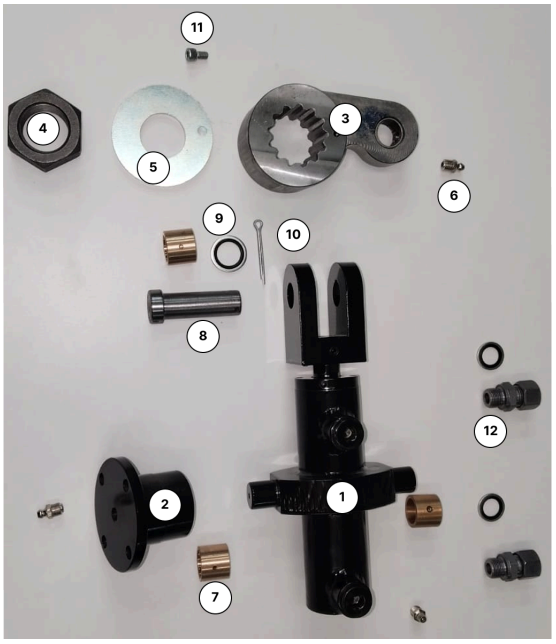
4. Parts Identification

4.1. Proximity Assembly



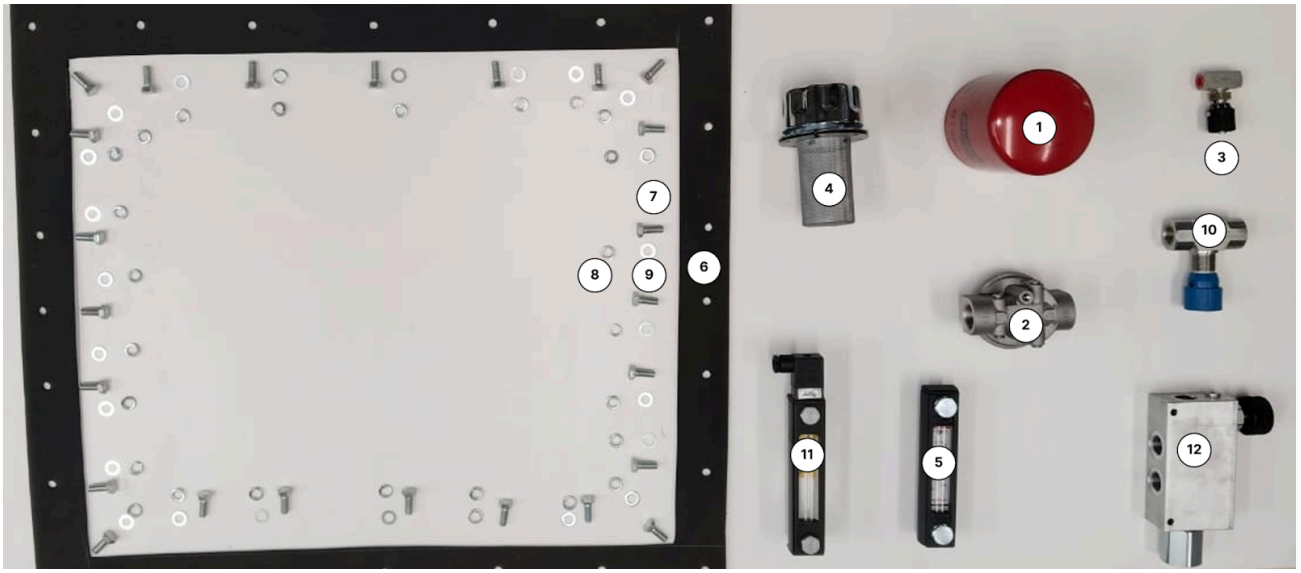
1	R116	Lubrication Box
2	R141	Proximity Cover - Long
3	R1412	Proximity mounting ring
4	R313	O-Ring 29.75 x 3.53
5	R405	Proximity sensor 24 DC
6	R406	Proximity Cable
7	R141	Proximity Cover - Long
8	R122	Proximity Base Plate
9	R1411	Proximity Cover - Short
10	CON0093	Hex Bolt M6 x 20mm
11	CON0087	Spring Washer M6
12	CON0081	Flat Washer M6
13	CON0207	Hex Bolt M6 x 30mm
14	CON0199	Nylock Nut M6

4.2. Change-over Assembly



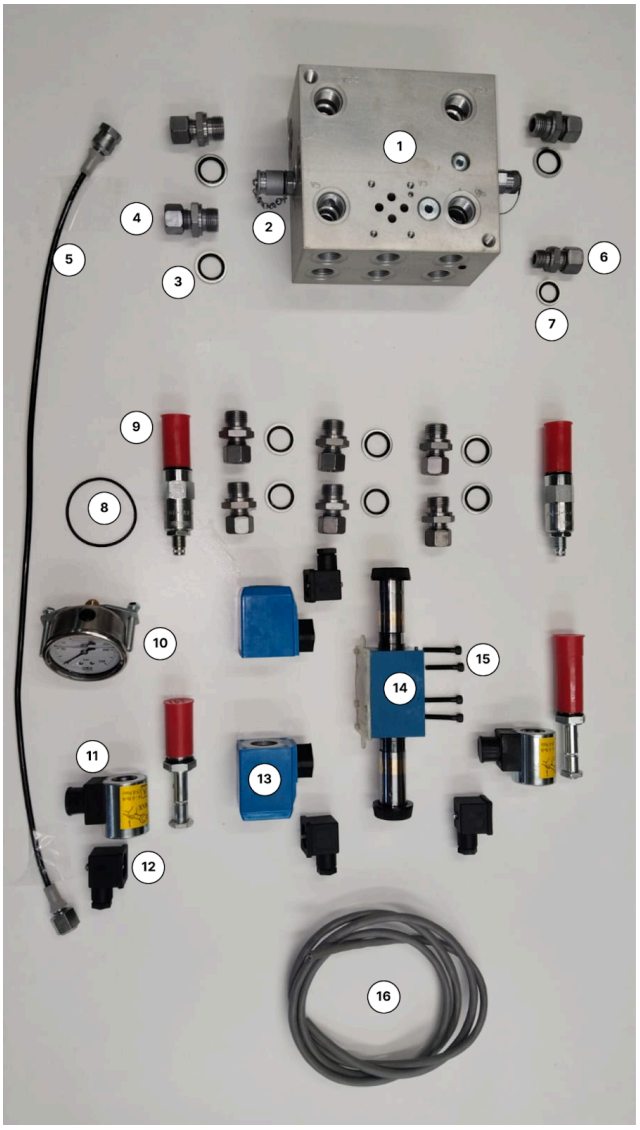
1	R211V	Hydraulic Cylinder - Change over
2	R148	Bush Housing - Change over cylinder
3	R126	Swivel Arm
4	R013	S-Tube Lock Nut
5	R117	Swivel Arm Spacer
6	R304	Grease nipple
7	R100	Brass Bush Small
8	R125	Clevis Pin
9	085-1023	1/2" Bonded Washer
10	R127	Split Pin
11	CON0118	Cap Screw M6 x 10
12	051-1214	3/8" BSSP Straight Male Stud

4.3. Hydraulic Tank Assembly



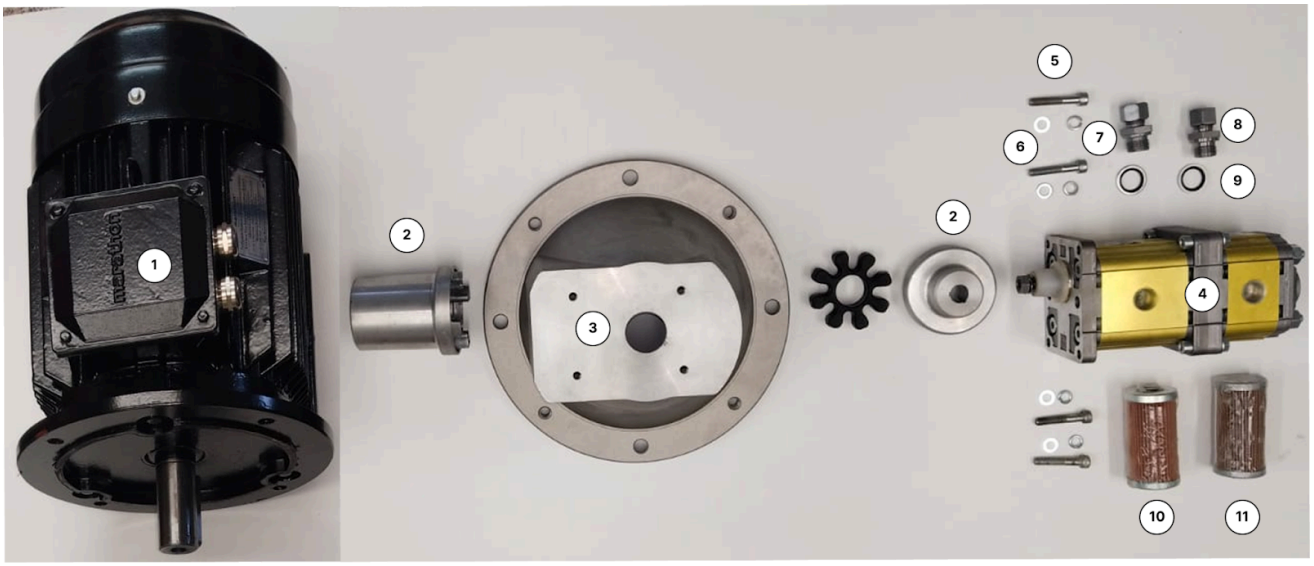
1	R215	Return Filter Element - SMALL	7	CON0110	Hex Bolt M8 x 25
2	R216	Filter housing (Oil) - Filter head small	8	CON0088	Spring Washer M8
3	R207	Flow control valve (Dosing) - Small	9	CON0055	Flat Washer M8
4	R206	Filler breather Cap	10	6ER207	Flow control valve 6E
5	R213	Oil Level & Temp Gauge	11	R427	Temperature switch 80
6	6ER119	Oil Tank Lid Gasket	12	R2071	Flow Divider Rocky 6 E/D

4.4. Hydraulic Assembly



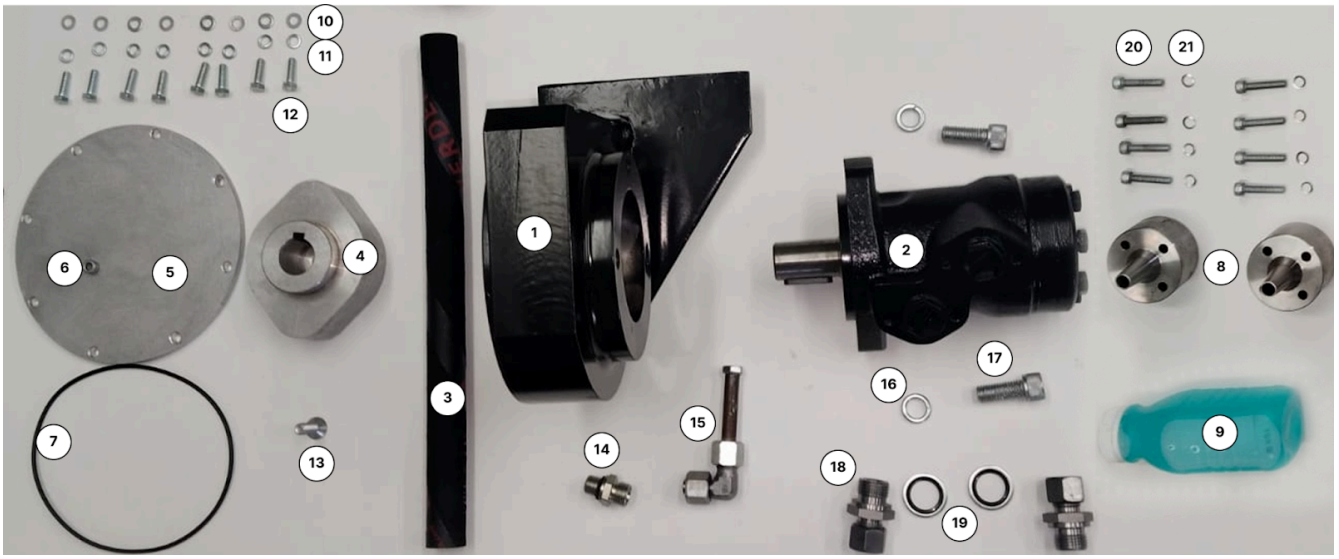
1	R218V	Manifold - Block only
2	061-2007	Pressure Gauge Connector
3	085-1023	1/2" Bonded Washer
4	051-1216	1/2" BSP Straight Male Stud
5	R228	Minimes Gauge Connector
6	051-1214	3/8" BSP Straight Male Stud
7	085-1022	3/8" Bonded Washer
8	45077305	O ring
9	R217V	Relief valve
10	R214	Pressure gauge 0 - 250 Bar
11	R2041V	Coil 24V DC for Cartridge Valve
12	R227	Plug for coil
13	R2031V	Coil - Pumping Valve 24v
14	R203V	Direction Valve Pumping
15	CON0067	Cap Screw M5 x 35
16	R922	Communication Cable

4.5. Drive Assembly



1	6ER303	Electric Motor 15kw	7	CON0088	Spring Washer M8
2	6ER2011V	Coupling 15kw	8	051-1216	1/2" BSSP Straight Male Stud
3	6ER2011	Bellhousing 15-22kw	9	085-1023	1/2" Bonded Washer
4	6ER209V	Gear pump - Primary (40+6CC)	10	R229	3/4" Suction Strainer
5	CON0191	Cap Screw M8 x 40 (SKT)	11	R230	1" Suction Strainer
6	CON0055	Flat Washer M8			

4.6. Dosing Pump Assembly



1	R6203	Dosing Pump Housing	12	CON0093	Hex Bolt M6 x 20mm
2	R2122V	Hydraulic motor OMP 80	13	CON0197	Cap Screw M8 x 30 (CSK)
3	R6201	EPDM - DURA 10mm x 360mm Hose	14	051-1301	St Male 10Lx1/4
4	R6205	Cam for Dosing pump	15	R6209	Dosing pump breather
5	R6204/1	Cover for Peristaltic pump - Aluminium	16	CON0090	Spring Washer M12
6	CON0118	Cap Screw M6 x 10	17	CON0070	Cap Screw M12 x 30 (SKT)
7	R6208	O Ring for Cover Dosing Pump	18	051-1216	12L x 1/2" BSP Straight Male Stud
8	R6206	Flange - Stainless Steel (Hose Ends)	19	085-1023	Bonded Washer 1/2"
9	R920	Verderlube	20	CON0059	Cap Screw M6 x 30
10	CON0081	Flat Washer M6	21	CON0076	Cap Washer M6
11	CON0087	Spring Washer M6	22	R620	Peristaltic Dosing Pump Complete

4.7. Nozzle System

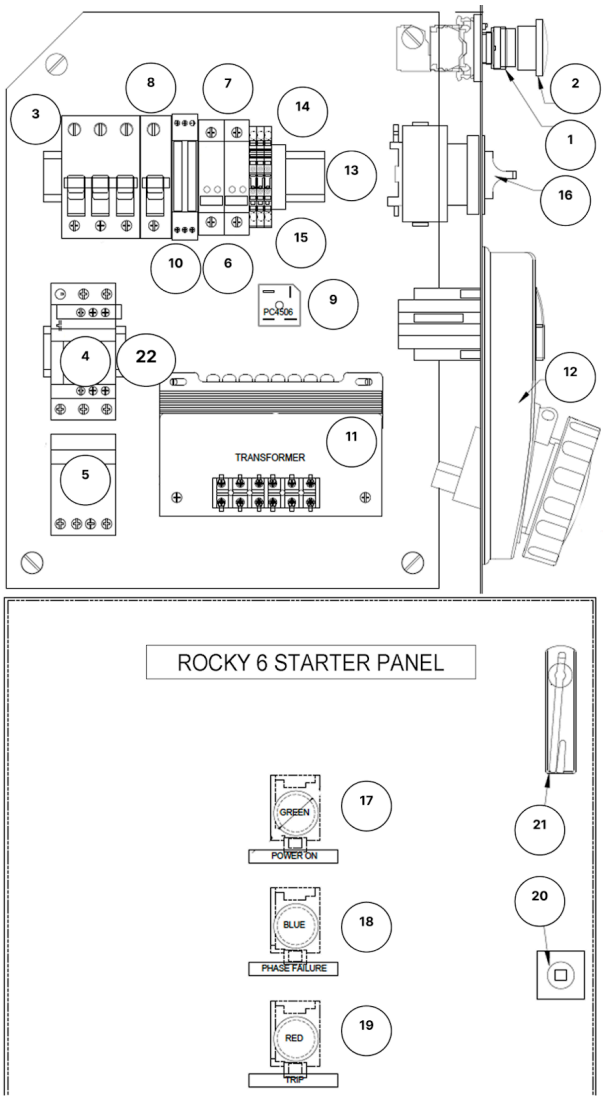
1	RN5000	Nozzle 50mm complete
2	RN5002	Ball Catcher
3	RN5060	Hose Cleaning Tool 2"
4	RN5007	Reducer 75 - 50mm
5	R309	Gasket to clamp 3" (Pressure seal)
6	RN5030	Clamp 3"
7	45076882	Sponge Balls DN60
8	CON0176	Safety Pin Big
9	RN5045	O Ring for 50mm Injector
10	CON0176	Safety Pin Small
11	RN5040	Non-return valve 1/2"
12	CON0136	Push Lock hose tail 1/2"
13	CON0177	Hose Clamp 1/2"
14	RN5039	Clamp 1"
15	RN5037	Claw Coupling 1" Suage - Tail

4.8. Nozzle Complete

1	RN5003	Nozzle Tip 50mm
2	RN5006	Mantel 50mm
3	RN5035	Clamp for Nozzle Tip
4	RN5001	Injector 50mm
5	RN5042	Nipple 1/2" JIC
6	RN5040	Non-return valve 1/2"
7	RN5041	Nipple 1/2" - Galv
8	RN5055	Ball Valve 1/2"
9	RN5045	O Ring for 50mm Injector
10	RN5036	Claw Coupling 1" BSP
11	RN5050	Ball Valve 1"
12	RN5038	Nipple 1" Galv
13	RN508510/Cpl	Concrete Hose 50mm x 10m 85 bar
14	RN508505/Cpl	Spraying Hose 50mm x 5m 85 bar
15	RN4004	Clamping collar
16	RN5020	Kamlock Female
17	RN5025	Nozzle System Complete 50mm x 25m
18	RN252230	Air Hose 1" 25m - Rubber (20Bar)
19	RN152230	Accelerator Hose 1/2" 25m

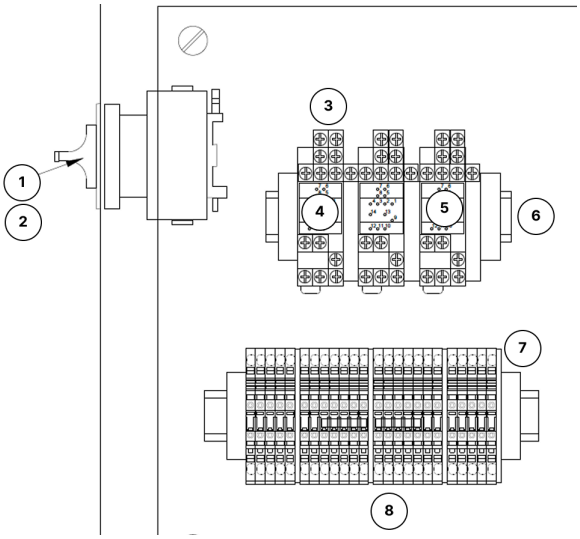
RN5025 Consists of the Following:
2 x RN508510/Cpl
1 x RN508505/Cpl
1 x RN5000
1 x RN5007
4 x R309
4 x RN5030
4 x CON0176
1 x RN252230
1 x RN152230
1 x RN5002

4.9. Electric Panels Assembly (Starter Panel)



1	R408	Start button
2	R409	Emergency stop
3	6ER401	Circuit breaker 64A
4	6ER402	Contactor 15 kW
5	6ER403	Overload 15 kW 32A
6	R448	2 Pole Fuse Holder
7	R449-2A	2A ceramic fuse
8	R404	Circuit breaker 16A
9	R420	Rectifier
10	R416	Phase sequence relay
11	R407	Transformer 200va
12	R426	Female Switch Plug
13	CON0258	Din Rail
14	R4231	End Stopper
15	R421	Terminal Blocks
16	R424	Lockout Switch
17	R428	Pilot Light - Green
18	R429	Pilot Light - Blue
19	R430	Pilot Light - Red
20	R451	Panel Lock Padlock
21	R447	Panel Lock Door
22	6ER4021	Auxiliary Contact

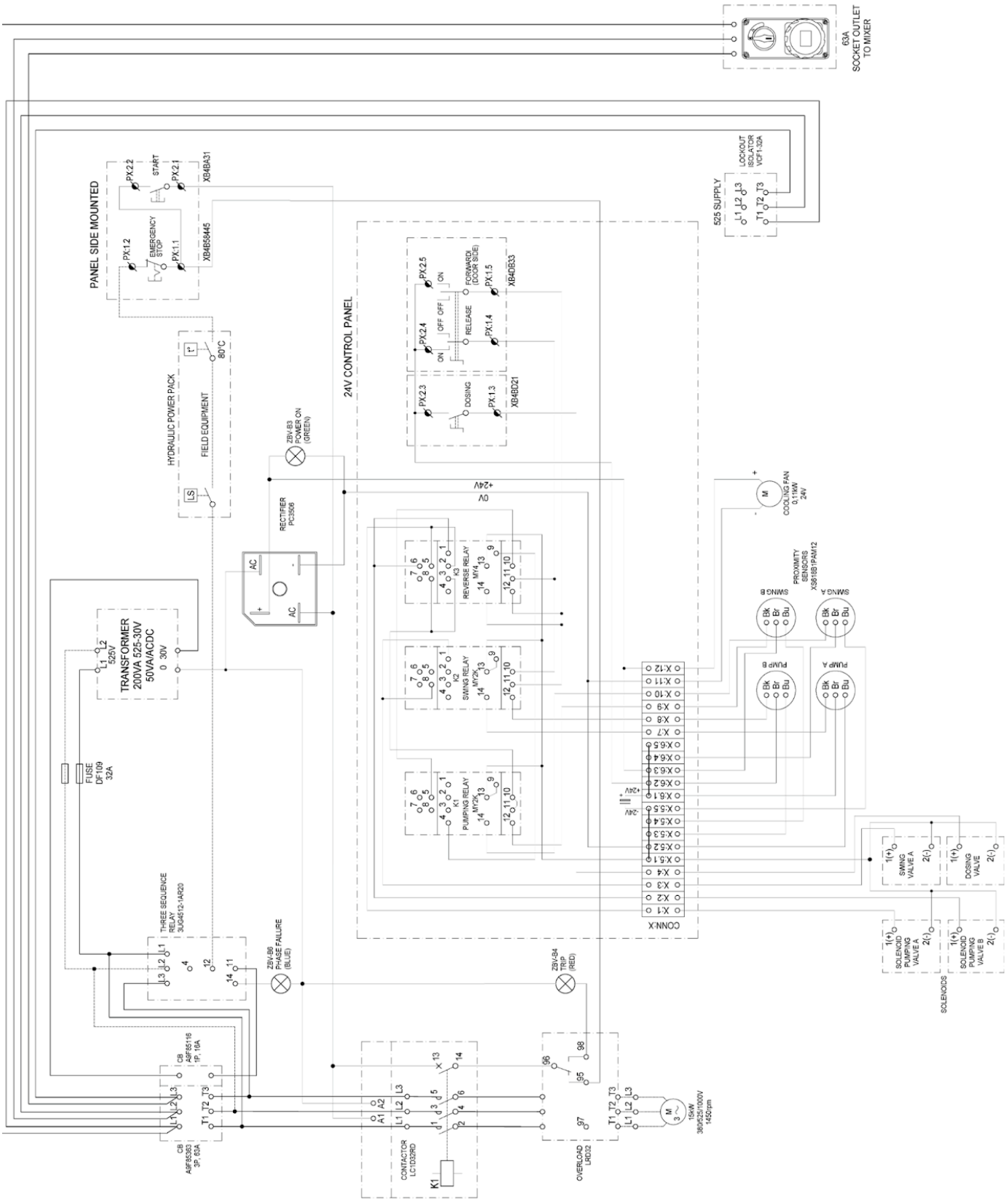
4.10. Electric Panels Assembly (Control Panel)



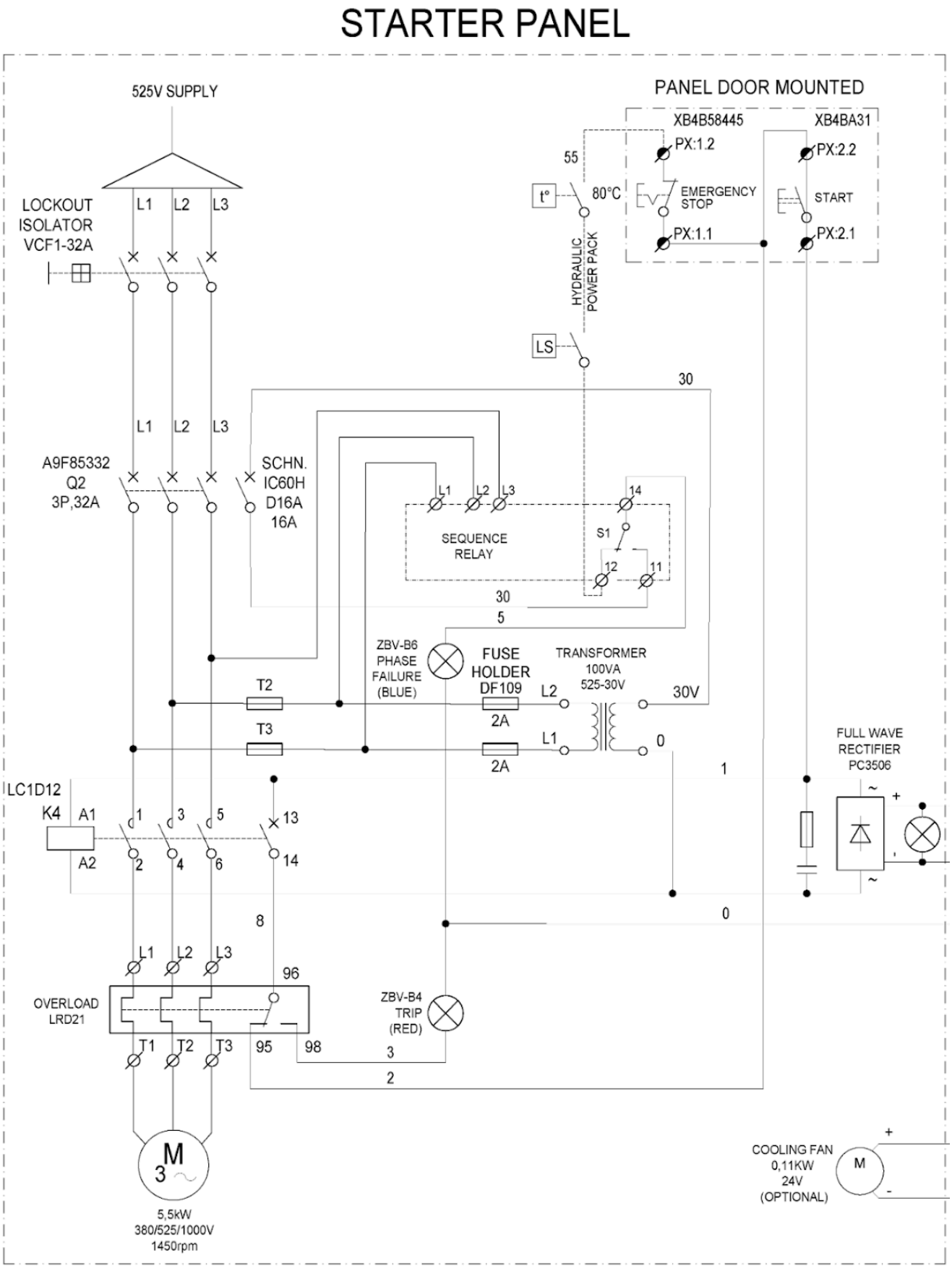
1	R410	Selector switch 2 Position
2	R412	Selector Switch 3 Position
3	R415	Relay base
4	R413	Latching relay MY2K 24vDC
5	R414	Relay MY4 24v DC
6	CON0258	Din Rail
7	R4231	End Stopper
8	R421	Terminal Blocks
9	R4001-CS	Electric Panel Control Side

5. Electric Diagram

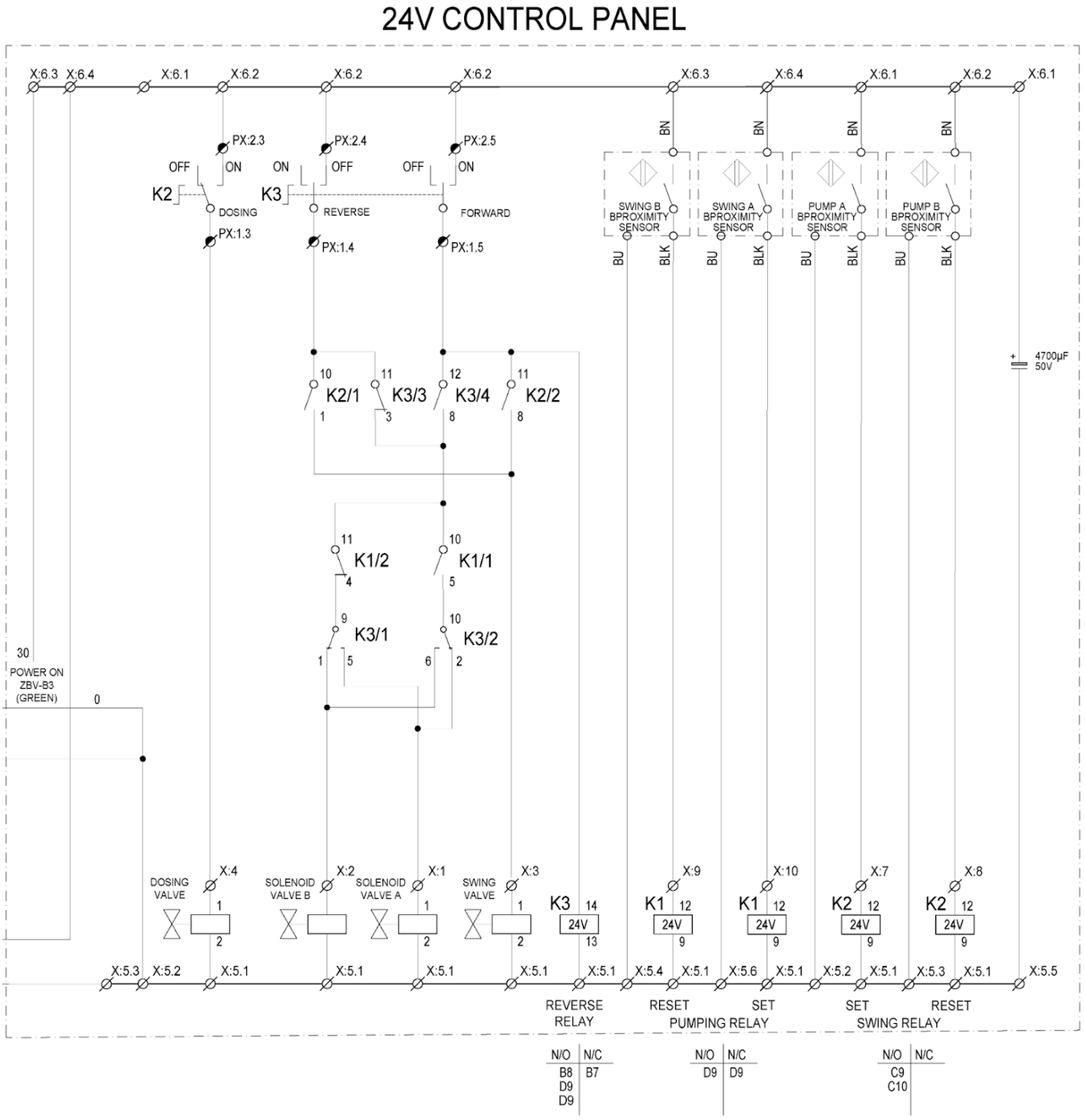
5.1. Legacy Electric Diagram



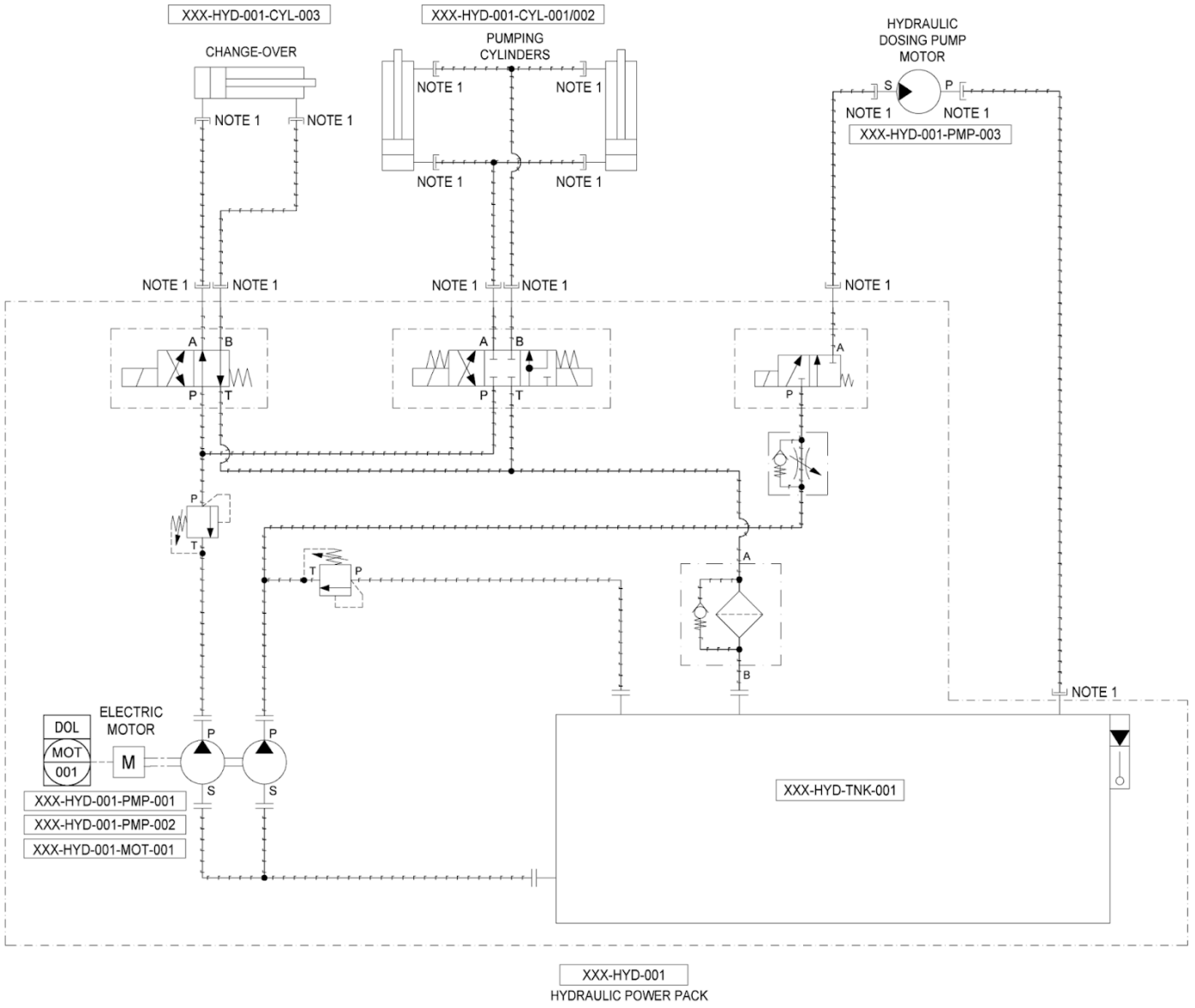
5.2. Electric Diagram New Configuration (Starter Panel)



5.3. Electric Diagram New Configuration (Control Panel)



6. Hydraulic Diagram



SYMBOL LEGEND	
SYMBOL	DESCRIPTION
	FLOW RESTRICTOR
	FILTER
	OIL MEASUREMENT
	PRESSURE RELIEF VALVE ADJUSABLE
	4-WAY 2-PISTON SOLENOID VALVE SPRING ACTUATED
	4-WAY 3-PISTON SOLENOID VALVE SPRING CENTER
	2-WAY SOLENOID VALVE SPRING ACTUATED
	FIXED DISPLACEMENT PUMP 1 ROTATION
	FIXED DISPLACEMENT MOTOR

7. Daily Check Lists

Pre-Use Check List				
Checked By:				
Date:				
PUMP	☑	X	**Comment**	**Action**
Hopper Grid	☐	☐		
Top Hopper	☐	☐		
Bottom Hopper	☐	☐		
S-tube spacing	☐	☐		
Cleaning Door	☐	☐		
Concrete Cylinders	☐	☐		
Outlet	☐	☐		
Water Box	☐	☐		
Electrical Panel	☐	☐		
Oil Level	☐	☐		
Electrical Motor	☐	☐		
Electrical Cables	☐	☐		
Hydraulic Cylinders	☐	☐		
Oil Leaks	☐	☐		
Lock Outs	☐	☐		
DOSING PUMP	☑	X	**Comment**	**Action**
Guard	☐	☐		
Flow Control	☐	☐		
Oil Leaks	☐	☐		
Do a pressure test	☐	☐		

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Address Farm Nooitgedach, Fochville | 26°30'30.35S | 27°30'24.52E

Pre-Use Check List				
Checked By:				
Date:				
MIXER	☑	**X**	**Comment**	**Action**
Grid for obstructions	☐	☐		
Inner Mixer, Paddles and Arms	☐	☐		
Discharges Door	☐	☐		
Gearbox	☐	☐		
Electrical Motor	☐	☐		
Guards	☐	☐		
Grease Nipples if they are greased	☐	☐		
Limit Switches	☐	☐		
Oil Leaks	☐	☐		
Lock-outs	☐	☐		
NOZZLE SYSTEM:	☑	**X**	**Comment**	**Action**
The 75mm-50mm Reducer	☐	☐		
If the Clamps are available and in position	☐	☐		
If the Gaskets are available and in place	☐	☐		
The condition of the delivery hoses	☐	☐		
The condition of the spryaing hoses	☐	☐		
The condition of the nozzle and tip	☐	☐		
The nozzle clamp if in position	☐	☐		
That the valves are operating and in good condition	☐	☐		
If the 25mm non return valve is in position	☐	☐		
The air hose condition and if the whip lashes are in place	☐	☐		
The condition of the accerlerator hose	☐	☐		
The Injector	☐	☐		

8. Risk Assessment

8.1. Introduction

This Risk Assessment was conducted for and on behalf of RSS Mining (Pty) Ltd, and the assessment was carried out on the Rocky 2.5, Rocky 6 and Rocky Mixer equipment.

The ROCKY equipment in question is a skid-bound hydraulic concrete pump with an attached pan mixer that is manually operated and loaded with the spray-crete product of choice. This pump feeds an application hose and nozzle, which an operator physically holds.

8.2. Scope of Assessment

The scope of this assessment is to identify and evaluate all activities and equipment that could lead to injuries, production loss or property damage when operating the hydraulic concrete pump. The assessment shall be carried out based on the entire operation of the pump and its
components.

8.3. Objective

The objective of this assessment is to identify, evaluate and risk-rank the hazards and associated risks when operating the hydraulic concrete pump, as well as to identify the required controls to eliminate or reduce the severity of the outcomes should an incident occur while operating the pump.

8.4. Methodology

In general, a risk assessment involves identifying the hazards present in some work activity or associated with the layout of the premises, the construction of the machinery or the failure of critical parts. This is followed by an evaluation of the extent of the risk involved, taking into account these precautions already being taken. In this guidance, the following definitions shall apply:

- A **"hazard"** is something that has the potential to cause harm. This includes substances, machines, and methods of work or other aspects of work organisation.
- A **"risk"** is the probability that the harm from a particular hazard will occur. The
- **"extent of the risk"** depends not only on the severity of the harm to a person, but also on the number of people who shall be harmed as well as the severity of a possible production fatality.
- **"Risk",** therefore, reflects both the probabilities that the harm shall occur and its severity in terms of the degree of harm and the number of people and assets harmed.

8.5. Bottom-up Risk Assessment Techniques

In this case, the approach is one of breaking down the system or problems into small components and then seeing how they or others may fail, building up to a major event.

Examples of this type of technique include Hazard and Operability Studies (HAZOP), which may address both hardware and human safety. A type of Failure Modes and Effects Analysis and its extension, in terms of critical analysis, will be applied.

8.6. Risk Measurement

Once hazards have been identified, it is necessary to prioritise them so that action can be programmed and so that they can be dealt with in a way which will satisfy the "Reasonably Practicable" requirement in the Customer Health and Safety Act.

The aim of risk assessment is to enable management to make better decisions. Risk assessment in itself does not make decisions; it only provides the basis for decision-making.

The setting of priorities is an important way to change employee understanding and to establish hazard awareness. It also sets the direction for management.

8.7. Due Diligence

This assessment was conducted to adhere to the requirements of the following legislation:

- Section 10 of the Occupational Health and Safety Act 58 of 1993.
- Section 2-21 of the Customer Health and Safety Act 29 of 1996.

A **"manufacturer"** is regarded as any person or organisation which designs, manufactures, imports, sells or supplies any article for use at work. Legislation requires that the equipment used is safe and without risk to the safety and health of the user when properly used.

This company therefore embarked on this assessment process to risk assess the pump, identifying the hazards and risks associated with the use of the product. It also identifies the training required, under which conditions it may be utilised, how it should be utilised and when it should be replaced or repaired.

8.8. Consequence/Severity Assessment

Here, the consequence shall relate to the potential severity or degree of harm or injury or losses that could result from an event taking place.

8.9. Probability

This is a compound of two separate factors, the first being **exposure**, which gives an indication of how often and how long employees are exposed to the hazard.

The second factor includes the **probability** that a person or a number of persons will be harmed or that production may suffer, and property damage may occur.

The matrix on the next page was used to determine the criticality and risk ranking of the hazards and associated risks identified.

8.10. Risk Matrix Used for Assessment 1

Safety of Personnel

PROBABILITY		DEFINITELY	VERY POSSIBLE	POSSIBLE	REMOTELY POSSIBLE	NOT AT ALL POSSIBLE
SEVERITY		A	B	C	D	E
Multi-fatalities	1	1	2	4	7	11
Fatality/Paralysis	2	3	5	8	12	16
Reportable injury	3	6	9	13	17	20
Loss time injury	4	10	14	18	21	23
Minor/no loss injury	5	15	19	22	24	25

RISK RANKING

Between 16 and 25 is a LOW risk	Probability "C" with Severity "3" = Risk Ranking of "13", which falls into the MEDIUM risk range
Between 7 and 15 is a MEDIUM risk	
Between 1 and 6 is a HIGH risk	

8.11. Risk Matrix Used for Assessment 2

Safety of Equipment

PROBABILITY		DEFINITELY	VERY POSSIBLE	POSSIBLE	REMOTELY POSSIBLE	NOT AT ALL POSSIBLE
SEVERITY		A	B	C	D	E
Permanent Damage	1	1	2	4	7	11
Multiple Damages	2	3	5	8	12	16
Major Cost implication	3	6	9	13	17	20
Loss time/ production	4	10	14	18	21	23
Minor/no cost implic.	5	15	19	22	24	25

RISK RANKING

Between 16 and 25 is a LOW risk	Probability "C" with Severity "3" = Risk Ranking of "13", which falls into the MEDIUM risk range
Between 7 and 15 is a MEDIUM risk	
Between 1 and 6 is a HIGH risk	

8.12. Equipment/Part-Based Risk Assessment

EQUIPMENT/PART BASED RISK ASSESSMENT CONDUCTED ON THE ROCKY SHOTCRETE EQUIPMENT				RISK RANKING (no controls in place)			MANUFACTURER OR SUPPLIER'S STRATEGIES OR CONTROLS	RECOMMENDED CONTROLS TO BE IMPLEMENTED BY THE CUSTOMER	RISK RANKING (with Supplier and Customer controls in place)		
Component and Function	**Functional Failure**	**Cause of Failure**	**Failure Effect or Consequence**	**S**	**P**	**PR**			**S**	**P**	**PR**
Pan Mixer Cover Hinges **Function:** to secure the lid of the Pan Mixer	The hinge pins or bolts come loose.	1) Lack of maintenance or checking of the hinge fixtures 2) Bolts corrode and break	The Pan Mixer cover comes loose, and the entire cover falls on someone's feet or legs	**3**	**C**	**13**	Substantial hinges have been provided to prevent sudden hinge failure	Follow the supplier's procedures	**4**	**C**	**18**
Pan Mixer Cover **Function:** to prevent unauthorised hands in the Pan Mixer during operation	The cover drops down, once lifted for inspection or maintenance, onto the fingers or hand of the operator	1) Cover hinges become dislodged, or the hinge pin is removed 2) Lack of concentration by the operator	Serious injury to fingers, hands and/or arms	**3**	**C**	**13**	1. Being redesigned to make it easier to open and close 2. Lockout Switch	Lock-out procedure to be followed as per **Appendix 1**	**4**	**D**	**21**
Hopper Bin and Swing Tube **Function:** where the concrete product is pumped and dispatched from	S-Tube becomes lodged or jammed	Product has solidified, and the S-Tube has to be manually moved or cleared	1. Hand or arm gets jammed between the hopper side and the S-Tube 2. Loss of production and extended downtime	**3**	**B**	**9**	Continuous on-the-job training and formal training to prevent the product from solidifying	1. Training requested by the customer from the supplier is regular 2. Lock-out procedures apply as per **Appendix 1**	**4**	**C**	**18**
Pump Coupling	Misalignment of the motor and pump	Coupling breaks under normal wear and tear	Loss of fingers	**4**	**B**	**14**	Steel guard fitted to the dosing pump coupling	Supervisors are to ensure that the guard on the dosing pump is always fitted, especially after maintenance and repairs	**5**	**D**	**24**

EQUIPMENT/PART BASED RISK ASSESSMENT CONDUCTED ON THE ROCKY SHOTCRETE EQUIPMENT				RISK RANKING (no controls in place)			MANUFACTURER OR SUPPLIER'S STRATEGIES OR CONTROLS	RECOMMENDED CONTROLS TO BE IMPLEMENTED BY THE CUSTOMER	RISK RANKING (with Supplier and Customer controls in place)		
Component and Function	**Functional Failure**	**Cause of Failure**	**Failure Effect or Consequence**	**S**	**P**	**PR**			**S**	**P**	**PR**
Piping and Clamps	1) Over-pressurised pipe and fittings 2) Pipe bursts under pressure if the nozzle is blocked	Blocked Nozzle and pipe during pump operation	Injury to the operator holding the nozzle	**4**	**B**	**14**	1. Single-piece clamps fitted to existing product 2. Only OEM seals to be supplied 3. SAE-rated hosing to be utilised on the application hose	1. Only OEM clamps to be fitted 2. The supervisor is to ensure that a pre-start checklist includes the checking of the clamps' security is carried out before every application	**3**	**D**	**17**

8.13. Task-Based Risk Assessment

TASK-BASED RISK ASSESSMENT CONDUCTED ON THE INSTALLATION OF THE ROCKY SHOTCRETE EQUIPMENT				RISK RANKING (no controls in place)			EXISTING CONTROLS	RECOMMENDED CONTROLS TO BE IMPLEMENTED BY THE CUSTOMER	RISK RANKING (with Supplier and Customer controls in place)		
TASK	**HAZARD**	**CAUSE OF FAILURE**	**UNDESIRED EVENT**	**S**	**P**	**PR**			**S**	**P**	**PR**
Potential Electrical shock from the electrical system	Unauthorised entry to the electrical control panel	Electrical inspection or breakdown, or electrical fault	Electrocution of a person or persons	**4**	**B**	**14**	Lock-out procedure is in place on all customer sites	1. Lock-out procedure enforced 2. Only authorised electrical personnel are to work on the electrics	**4**	**D**	**21**
Working in and around the hopper during operation	Jammed S-Tube or other blockage	Solidification of the product	Crushed arm whilst clearing blockage around S-Tube	**3**	**C**	**13**	Formal training to review the training and operating procedure	1. Supervisor to carry out task observations and planned inspections regularly 2. Follow up to ensure	**3**	**D**	**17**

TASK-BASED RISK ASSESSMENT CONDUCTED ON THE INSTALLATION OF THE ROCKY SHOTCRETE EQUIPMENT				RISK RANKING (no controls in place)			EXISTING CONTROLS	RECOMMENDED CONTROLS TO BE IMPLEMENTED BY THE CUSTOMER	RISK RANKING (with Supplier and Customer controls in place)		
TASK	**HAZARD**	**CAUSE OF FAILURE**	**UNDESIRED EVENT**	**S**	**P**	**PR**			**S**	**P**	**PR**
								compliance with the items they identify as unsafe practice.			
Hydraulic oil contamination during filling or topping up	The damage to hydraulic components, pumps, valves, etc	Ingress of dirt or silica into the hydraulic system by using dirty or contaminated filling devices	Costly replacement of hydraulic components and major down-line delays	**B**	**2**	**5**	1. The Supplier fits the machine with suitably rated in-line filters 2. Dedicated training on the filling of hydraulic/diesel compartments	1. Oil sampling to be carried out as per maintenance manuals 2. Refresher training to be carried out	**D**	**4**	**21**
Opening the Pan Mixer cover	Dropping the Pan Mixer cover onto hands and arms during the filing action	Cover being heavy and hard to deep in the upright position	Fracturing of limbs or the head whilst bending down over the mixer	**3**	**C**	**13**	None	1. Warning signs of "Heavy Object" to be fitted to the machine 2. Gloves issued and worn by all persons handling the Pan Mixer	**3**	**E**	**20**
Cleaning of the lubricator box	The pump is operated during the cleaning or repair operation	Maintenance of the lubricator box	Arm or hand injured or lost during this operation	**2**	**B**	**5**	Formal training on all underground or surface application units	Lock-out procedures to be followed	**3**	**E**	**20**
Cleaning and loading of Pan Mixer	The turbine accidentally started during these operations or tasks	Routine maintenance or loading of Pan Mixer	Loss of limbs if the turbine is accidentally started during loading or maintenance cleaning.	**2**	**B**	**5**	1. Formal training to be carried out with all operational staff regularly 2. Lock-out procedures to be followed as per **Appendix 1**	Lock-out procedures to be followed as per **Appendix 1**	**3**	**E**	**20**

TASK-BASED RISK ASSESSMENT CONDUCTED ON THE INSTALLATION OF THE ROCKY SHOTCRETE EQUIPMENT				RISK RANKING (no controls in place)			EXISTING CONTROLS	RECOMMENDED CONTROLS TO BE IMPLEMENTED BY THE CUSTOMER	RISK RANKING (with Supplier and Customer controls in place)		
TASK	**HAZARD**	**CAUSE OF FAILURE**	**UNDESIRED EVENT**	**S**	**P**	**PR**			**S**	**P**	**PR**
Low oil level in the lubrication box	1. Lack of lubrication to the product cylinders 2. Scoring or seizing of the product cylinders	Insufficient oil due to the oil level not being checked regularly	Costly damage to the cylinder bores, resulting in replacement	**B**	**2**	**5**	1. Operator and maintenance instructions highlighting this potential problem 2. Dedicated training about the regular checking of the oil level in the lube box	Correct supervision is carried out over operational staff	**E**	**4**	**23**
Un-manned discharge nozzle whilst the pump is started and the distributor valve is operated	The spray Nozzle shall spray the product freely in any direction, with possible injury to persons inthe near vicinity	1. The Pump is accidentally started with no operator handling the spray nozzle 2. The distributor valve is accidentally operated	Injury to personnel in the near vicinity of the nozzle head	**2**	**B**	**5**	Formal training of operators is currently being carried out before the pump is fully commissioned	1. Secure nozzle to sidewall 2. Refer to the OME manual for operating procedures 3. PPE to be worn	**3**	**C**	**13**
Pan Mixer discharge door	The discharge door has a guillotine effect when closing on the floor of the Pan Mixer. This could seriously injure hands and fingers if caution is not applied during operation	The door is accidentally closed whilst a person is carrying out cleaning or maintenance tasks in the Pan	Loss of or injury to hands or fingers	**3**	**B**	**9**	Formal training is currently being carried out before the pump being fully commissioned		**4**	**C**	**18**
Cleaning and loading of Pan Mixer	The turbine accidentally started during these operations or tasks	Routine maintenance or loading of Pan Mixer	Loss of limbs if the turbine is accidentally started during loading or maintenance cleaning.	**2**	**B**	**5**	1. Formal training to be carried out with all operational staff regularly 2. Lock-out procedures to be followed as per **Appendix 1**	Lock-out procedures to be followed as per **Appendix 1**	**3**	**E**	**20**

8.14. Appendix 1: Lockout Procedures

8.14.1. Definitions

- It is a safety standard used to control hazardous energy.
- It is a formal set of good practices that emphasises avoiding shortcuts and effective communication, ensuring that no one gets injured.
- It is a procedure that keeps machinery from being started up unexpectedly
- It also keeps energy stored within equipment from being released
- It should be used when servicing or repairing equipment.

8.14.2. Objectives

The objective of this procedure is to identify and establish a means of control to prevent the accidental energising or start of machinery or equipment, or release of stored energy, which could harm employees.

- Establish a safe and controlled means of shutting down machinery and equipment.
- Prohibit unauthorised personnel from starting machinery or equipment while it is being serviced.
- Establish responsibility for implementing and controlling lockout/tagout procedures.
- Ensure that only approved hardware (locks, tags, fastening devices) provided by the employer will be utilised in the lockout/tagout procedure

8.14.3. Lock-Out Steps

Because machines and equipment contain hazardous energy, it is important to adhere to site-specific lockout tagout procedures.

Step 1: Notify affected employees.
Authorised personnel need to notify all employees who will be affected by the shutdown and lockout before it occurs. The authorised employee shall know the type and magnitude of energy that the machine or equipment utilises and shall understand the hazard thereof.

Step 2: Identify procedures and hazards

- Energy type (electrical, mechanical, hydraulic, chemical)
- Energy magnitude (volts)
- Energy hazards
- Methods to control the energy

Step 3: Shut down
This step requires operating machines or equipment to be shut down.

Orderly shutdowns are necessary to avoid additional hazards caused due to stopping abruptly.

Mixers - Shut down with the stop button on the electrical panel, as well as depressing the emergency stop button.

Pumps - Shut down with the stop button on the electrical panel, as well as depressing the emergency stop button.

Step 4: Isolate equipment from the energy source
This can be achieved by switching off the main isolator and locking the isolator in the off position with a padlock.

Step 5: Verify Isolation, Try-out and test
Verify that the equipment is disconnected from the energy source by pushing the ON button. By performing this step, you're ensuring the equipment is now locked out.

Step 6: Bring equipment back online
Make sure that the equipment is fully reassembled and the electrical panel is closed and locked
Survey the work area, checking to see that all personnel are in a safe spot or removed from the area. Inform affected personnel that the equipment is ready for use

Service or Maintenance Involving More than One Person
When servicing and/or maintenance are performed by more than one person, each authorised employee shall place his/ her own lock or tag on the energy isolating source. This shall be done by utilising a multiple lock scissors clamp if the equipment is capable of being locked out. If the equipment cannot be locked out, then each authorised employee must place his/ her tag on the equipment.

8.14.4. Emergency Procedures

Emergency procedures for removing lockout/tagout should include the following

1. Verification by the employer that the authorised employee who applied the device is not at the facility by checking the clock-in system, parking lot, etc.
2. Making all reasonable efforts to contact the authorised employee to inform him/her that the lockout or tagout device has been removed.
3. Ensuring the machine or equipment components are operationally intact.

Each location must develop written emergency procedures to be utilised at that location.

8.14.5. Training

Each authorised employee who will be utilising the lockout/tagout procedure must be trained in the recognition of applicable hazardous energy sources, type and possible magnitude of energy available in the workplace, and the methods and means necessary for energy isolation and control.

Each affected employee (all employees other than authorised employees utilising the lockout/tagout procedure) must be instructed in the purpose and use of the lockout/tagout procedure, and the prohibition of attempts to restart or re-energise machines or equipment which are locked out or tagged out.

8.14.6. Periodic Inspection

The effectiveness of the entire program must be evaluated at least annually. The date of the inspection will be documented and maintained as part of this program until the next annual evaluation replaces it.

Where a tagout system is used, the inspection will be extended to include affected persons, because with tags, the role of the affected employee is important in avoiding accidental or inadvertent activation of the equipment or machinery being serviced.