



STREAMLINE SL-VI PRO III 60 WATERJET INTENSIFIER

OPERATION AND MAINTENANCE MANUAL



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KMT WATERJET SYSTEMS 2016



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APPENDIX

Exhibit

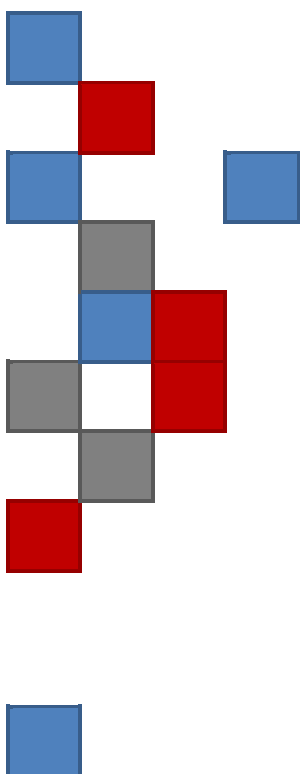
System Schematic
 Electrical Schematic(s)
 Compliance with EN60204
 Declaration of Conformity
 Declaration of Incorporation
 Material Safety Data Sheets

SECTION 1

INTRODUCTION

The Introduction highlights:

- Equipment features and options
- Operational overview
- Equipment safety
- Contact information



1.1 Overview

The SL-VI Pro III 60 combines all the unique capabilities and advantages of waterjet cutting systems with the reliability, ease of operation and service support that have made KMT Waterjet Systems a leader in waterjet technology.

Table 1-1
SL-VI Pro III 60

Model	Motor Horsepower Rating		Maximum Operating Pressure	Maximum Flow Rate (at full pressure)	Maximum Single Orifice Diameter (at full pressure)
	HP	Kw			
SL-VI Pro III	60	45	85,000 psi (5,860 bar)*	0.73 gpm @ 60 Hz (2.76 L/min) @ 50 Hz	0.011" @ 60 Hz 0.279 mm @ 50 Hz

***Note:** Maximum pressure with cutting head valve open is 85,000 psi (5,860 bar). Maximum pressure with cutting head valve closed is 90,000 psi (6,200 bar).

1.2 Features and Options

The modular design of the SL-VI Pro III 60 allows the customer to build a pump that maximizes efficiencies and enhances production for their specific cutting requirements.

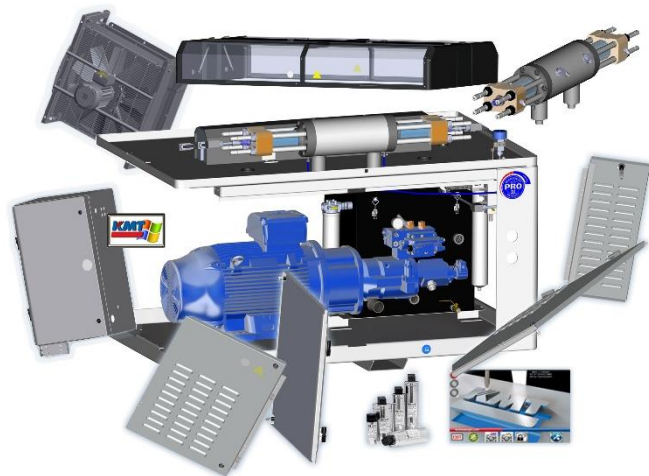




Table 1-2
Standard Equipment and Optional Modules

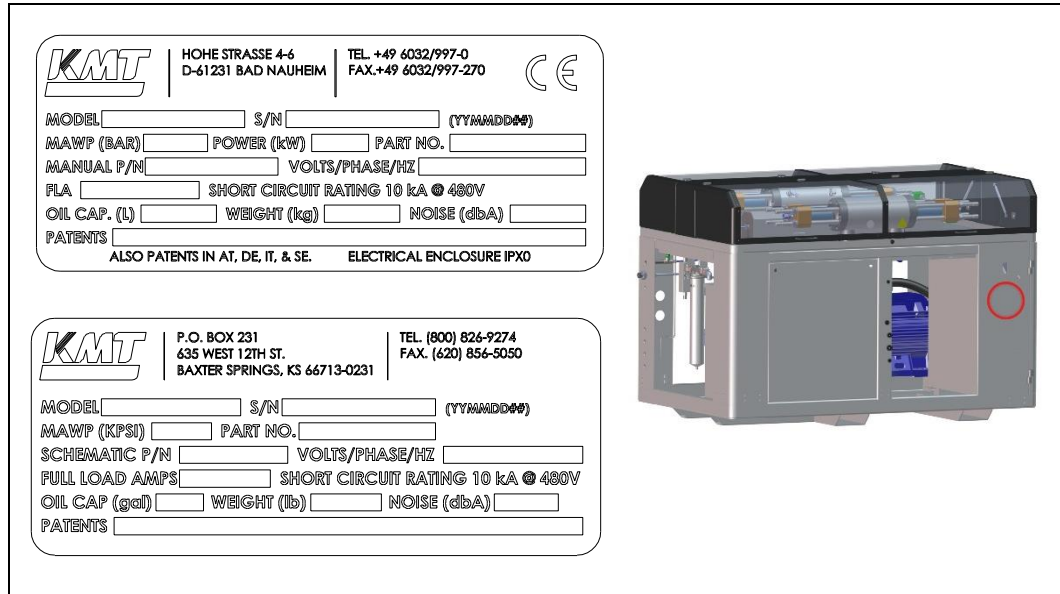
	S-Series	SL-VI Pro III 60
Electrical enclosure and controls		●
Color touch screen display		●
Ethernet/Profinet		●
Isolated high voltage components meet IEC 60204 standards		●
Remote interface plug		●
IE3 and NEMA premium motor design optimizes efficiency and reduces electrical consumption	●	●
Patented topworks design	●	●
Dual solenoid controlled dump valve	●	●
Oil-to-water cooling circuit	●	●
Onboard air-to-water cooling circuit	○	○
Combination air/water cooling circuit	○	○
Doors	○	○
Top cover	○	○
Redundant intensifier	○	○
Proportional pressure control	●	●
High pressure transducer	●	●
Remoteline		○
Power factor correction reduces electrical demand		○

Note: Optional modules are available at the time of purchase, or as upgrades for existing equipment.

1.3 Product Nameplate

The product nameplate contains the pump model, serial, identification and part numbers for each individual machine.

Figure 1-1: Product Nameplate



1.4 Operational Overview

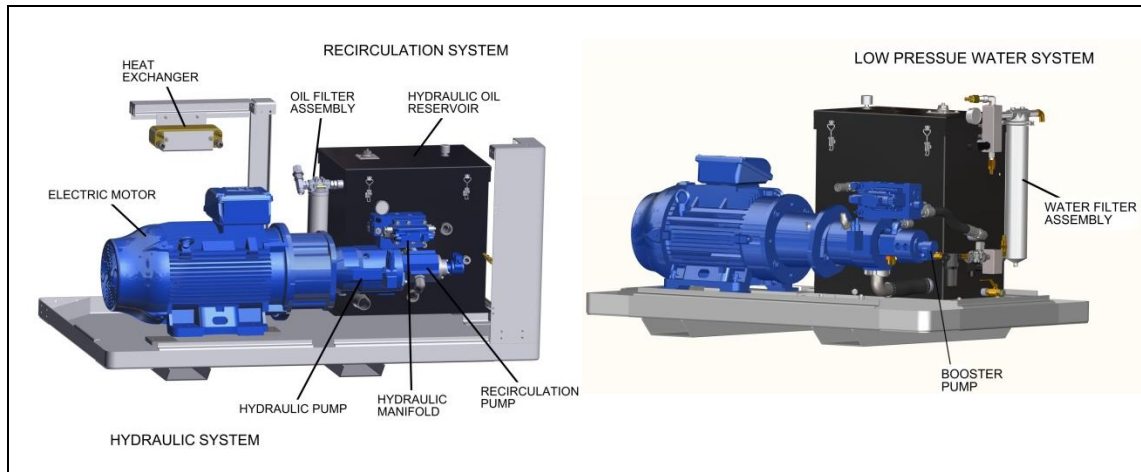
The Streamline SL-VI Pro III 60 intensifier pumps utilize hydraulic power to generate water pressure up to 90,000 psi (6,200 bar). Applications include all industrial pure water and abrasive waterjet applications.

The following provides a brief overview of the function and primary components associated with the individual systems. A detailed discussion of each system is provided in Sections 4 through 9.

Low Pressure Water System

The low pressure water system supplies the cutting water flow to the intensifier. Major system components include the water filter assembly and the booster pump.

Figure 1-2: System Components



Recirculation System

The recirculation system is a cooling and filtration system that provides properly conditioned oil to the main hydraulic system. Major system components include the recirculation pump, heat exchanger, oil filter assembly and the hydraulic oil reservoir.

Hydraulic System

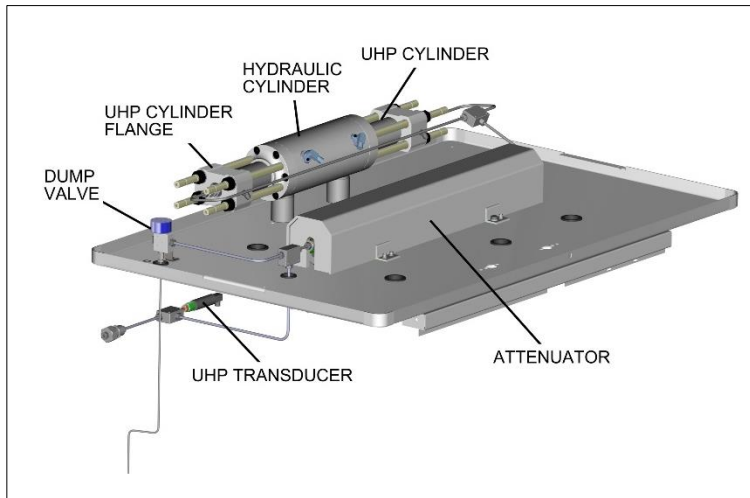
The hydraulic system supplies the intensifier with the hydraulic oil required to produce high pressure water. Major system components include the electric motor, hydraulic pump and a 4-way directional control valve mounted on the hydraulic manifold.

Ultra-High Pressure Water System

The ultra-high pressure water system is the heart of the waterjet system. Water is pressurized and continuously delivered to the cutting head. As water passes through a tiny hole in the orifice, water pressure is converted to water velocity capable of cutting most any material.

The major components include the high pressure cylinder assemblies, hydraulic cylinder assembly, hydraulic piston, attenuator and the dump valve.

Figure 1-3: Ultra-High Pressure Water System Components



Operating System

A programmable logic controller (PLC) provides basic intensifier shift control and monitors out of limit conditions. Operator interface is through the control panel display where operating parameters are set and monitored.

Figure 1-4: Main Screen



1.5 Intended Use of Equipment

The Streamline SL-VI Pro III 60 series of waterjet pumps have been designed solely for the generation of high pressure cutting water for industrial and commercial applications in non-explosive atmospheres, such as cutting parts from raw material on an x-y table.

The intended working liquid is potable water. The use of any other liquid should only be considered after consulting with KMT Waterjet. Use of the pumps for hydrostatic testing purposes should also only be considered after consulting with KMT.

The intended use further includes compliance with the operating, maintenance and repair conditions prescribed by the manufacturer as detailed in this manual.



This machine is intended solely for the purpose described above. Use of the machine for a different purpose or conversion of the machine without the written agreement of the manufacturer shall not be considered as intended use. The manufacturer shall not be liable for damage incurred as a result in such cases. The risk shall be borne solely by the owner.

1.6 Safety

The high pressure waterjet cutting system is a high energy cutting tool capable of cutting many dense or strong materials. Do not touch or be exposed to high pressure water. High pressure water will penetrate all parts of the human body. The liquid stream and the material ejected by the extreme pressure can result in severe injury.

Warning Labels

Warning labels are posted on the machine to indicate potential hazards. The operator and service personnel shall pay particular attention to these warning labels. Table 1-3 describes the necessary precautions and provides the part number required to order replacement labels.

Table 1-3
Warning Label Precautions

1



P/N 72135562

The Emergency Stop circuit provides an EN 13849-1 performance level of PL d. Pushing in the emergency stop button immediately stops the pump and bleeds high or ultra-high water pressure.

Resetting, pulling out, the emergency stop button will not restart the pump. The emergency stop safety function should be tested at the beginning of each shift. See the Electrical Schematic in the Appendix for remote connection to the emergency stop circuit.

2



P/N 05114962

The electrical enclosure and motor junction box can present an electrical shock hazard. Always disconnect and lockout the main power before opening the enclosure.

Always disconnect and lockout the main power and the circuit breaker/disconnect on the electrical enclosure door before performing any type of maintenance.

Table 1-3
Warning Label Precautions

3



P/N 72164268

Never open or perform maintenance on the unit with the main power disconnect on. Before any maintenance or repairs are performed, the machine shall be isolated, and rendered inoperative.

The lockout/tagout procedure applies to any employee who operates and/or performs service or maintenance on the machine.

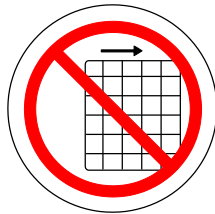
4



P/N 05114970

The surface of high pressure water and hydraulic components becomes hot during normal operation. Failed, or failing components, can become extremely hot during operation.

5



P/N 80082209

Ensure that all protective guards, shields or covers are in place on the equipment at all times. Never operate the pump with the guards removed.

6



P/N 05098017

High pressure water and/or hydraulic pressure can remain in the system even when the pump has been shut off. All pressure can be safely bled from the system by opening the high pressure cutting water valve for a few seconds after shutting off the pump.

Pressing the emergency stop button turns the control power to the intensifier off, stops the pump and bleeds the high pressure water through the dump valve.

Depressurization of the high pressure system creates a loud hissing sound when the dump valve opens. The sound fades quickly as the pressure drops.

Table 1-3
Warning Label Precautions

7



P/N 20415794

All personnel involved in the installation, operation and/or service of the intensifier must carefully read, understand and follow the procedures in this manual to avoid creating unsafe conditions, risking damage to the equipment, or personal injury.

8



P/N 72164242

The weight of the machine is not evenly distributed from one end to the other, particularly on the larger horsepower models. The center of gravity is clearly identified on the sides of the crate. Position the forklift accordingly.

9



P/N 72164250

When the machine is removed from the crate, note the position of the fork pockets on the bottom of the machine. The pockets are positioned in relationship to the center of gravity to balance the weight on the forklift.

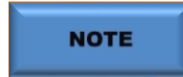
Safety precautions and warnings for specific procedures are emphasized throughout this manual as illustrated in the following examples. All operating and maintenance personnel must review and understand these precautions prior to installing, operating or servicing the machine. Adherence to all Warnings, Cautions and Notes is essential to safe and efficient service and operation.



Warnings emphasize operating or service procedures, or conditions that can result in serious personal injury or death.



Cautions emphasize operating or service procedures, or conditions that can result in equipment damage or impairment of system operation.



Notes provide additional information that can expedite or improve operating or service procedures.

Training

All personnel operating, servicing or working near the waterjet cutting equipment shall adhere to all safety precautions described in this manual, as well as the applicable plant safety precautions.

Only KMT factory trained, qualified personnel shall service, maintain and operate the equipment.

Personal Protective Equipment

All maintenance and operating personnel shall practice and promote safety at all times to avoid potential injury and unnecessary downtime. Maintenance procedures should be performed in a well-ventilated area.



Any personnel in proximity of the equipment are to wear proper personal protective equipment to include at a minimum, safety glass with side shields and hearing protection.

Fire Fighting Equipment

Exposed hydraulic fluid would be the major source of combustible material. Dry chemical, carbon dioxide, foam and water spray are all acceptable means of fire fighting. For detailed information on flammability and flash points, refer to the Material Safety Data Sheets in the Appendix of this manual.

Additional Precautions



The work area around the equipment shall be clean and free of debris and oil spills.

To reduce the likelihood of slip, trip and fall hazards, it is the responsibility of the user of this equipment to clean up spills near



All protective guards, shields or covers shall be in place on the equipment at all times.

With the top cover open and the unit running, the risk of exposure to steam or a high pressure stream exists. Electrical cover interlocks are available that automatically shut down the intensifier pump if the covers are opened.

Once the intensifier pump is integrated into a system (i.e. with an x-y table), a risk assessment must be completed for the combined system to determine any additional hazards that require additional guarding or protective devices.

A risk assessment in accordance with EN12100 is recommended. Isolation of personnel from the cutting area, such as light curtains and/or warning beacons should be considered.

Lockout/Tagout Procedure



This lockout/tagout procedure is designed to protect all employees from injuries caused by the unexpected energizing or startup of the machine, or the release of stored energy during service and maintenance.

This is accomplished with energy isolating devices that prevent the transmission or release of energy. An energy source is any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy source that could cause injury to personnel.

A lockout device utilizes a lock and key to hold an energy isolating device in the safe position and prevents the machine from being energized. A tagout device is a prominent warning device that can be securely attached to the machine warning personnel not to operate the energy isolating device. This procedure requires the combination of a lockout device and a tagout device.

The lockout/tagout procedure applies to any employee who operates and/or performs service or maintenance on the machine. Before any maintenance or repairs are performed, the machine shall be isolated, and rendered inoperative as follows.

1. Shut down the machine by pressing the stop button, and open the high pressure cutting water valve to bleed the water and hydraulic pressure from the system.
2. Disconnect, lockout and tag the main, customer supplied, power source.
3. Lockout and tag the circuit breaker/disconnect on the electrical enclosure door.
4. Close, lockout and tag the manual shutoff valves for all service connections: cutting water in, cooling water in and out, and air.

Emergency Medical Treatment

An emergency medical card is included in the binder of this manual. This information should be used to aid in the treatment of a waterjet injury. Additional cards may be obtained by contacting KMT Waterjet Systems using the address or telephone number shown on the card.

Medical Alert

This card is to be carried by personnel working with high pressure waterjet equipment. Obtain medical treatment immediately for ANY high pressure waterjet injuries.

**KMT Waterjet Systems
635 West 12th Street
Baxter Springs, KS 66713
(620) 856-2151**

This person has been working with water jetting at pressures to 90,000 psi (621 MPa, 6,205 bar, 6328 Kg/cm²) with a jet velocity of 3,69 fps (1100 mps). Foreign material (sand) may have been injected with water. Unusual infections with microaerophilic organisms occurring at lower temperatures have been reported, such as gram negative pathogens as are found in sewage. Bacterial swabs and blood cultures may therefore be helpful. This injury must be treated as an acute surgical emergency and be evaluated by a qualified surgeon. Circulation may be compromised, therefore, **DO NOT APPLY HEAT TO INJURED PART**. For first aid: (1) Elevate injured part (2) Antibiotics (3) Keep injured person NPO.

1.7 Worldwide Product Support

The KMT Waterjet Customer Service Department is available to answer your questions regarding equipment installation and service. Technical assistance is available by phone and on-site support is available on request.

On-site technical assistance is available during equipment installation and startup. Additionally, technical support for service and maintenance issues and training of operators and maintenance personnel is available. Also, periodic training sessions are conducted at KMT Waterjet and customer facilities.

Contact the KMT Waterjet Customer Service Department for additional information.

USA Customer Service Department

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1.8 Spare Parts

KMT Waterjet maintains a well-stocked Spare Parts Department, staffed by trained, knowledgeable personnel. If required, emergency shipment is available. Contact the Customer Service Department to order spare parts, or for additional information.



1.9 Manual Organization

This manual contains operating and maintenance procedures for the complete SL-VI series. Information is organized as follows:

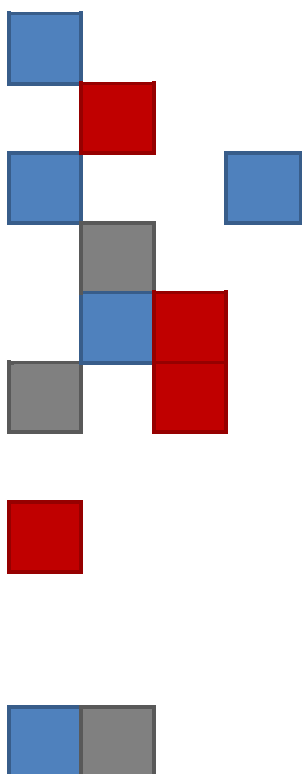
- Section 1, Introduction, provides equipment features and optional modules, a brief operational overview, details regarding safety issues and contact information for product support.
- Section 2, Installation, details installation requirements and procedures. Also provided are systematic guidelines for commissioning the intensifier.
- Section 3, Maintenance, highlights routine and preventive maintenance requirements and scheduling. Precautions associated with ultra-high pressure cutting equipment are also reviewed.
- Section 4, Operation, explains the control functions and the display panel where operating parameters are set and monitored.
- Sections 5 through 9 are specific to each individual system. Each section contains a detailed description of the principles of operation and the function of each system. Routine maintenance procedures associated with the system are also included.
- Section 10, Troubleshooting, is a comprehensive guide containing the information required to diagnose problems and repair the machine.
- Section 11, Specifications, contains a comprehensive list of equipment specifications; a detailed discussion of water quality standards and treatment guidelines; as well as horsepower requirements for various orifice sizes.
- Section 12, Parts List, contains part numbers, descriptions and drawings to facilitate the ordering of replacement parts.

SECTION 2

INSTALLATION

The Installation section details:

- Installation requirements and procedures
- Commissioning and decommissioning guidelines



2.1 Overview



This section details equipment installation, and commissioning requirements and procedures. These procedures require a thorough understanding of the individual components and systems, safety issues, and the overall operation of the intensifier.

All personnel involved in the installation, operation and/or service of the intensifier must carefully review this manual prior to installing and commissioning the machine.

The Technical Service Department at KMT Waterjet Systems is available to assist in the installation and commissioning process. Service and repair training for maintenance personnel is also available.

2.2 Installation Summary

The following summary lists the procedures required for the installation and commissioning of the intensifier system. A discussion of the details and requirements for each item will follow in this section.

- Upon receipt, the machine must be uncrated and moved into position on a level surface.
- Properly sized power drops with fused disconnects must be installed.

NOTE

The incoming cooling water source and cooling water drain are not required on models equipped with an air-to-oil cooling system.

- A pneumatic drop with a manual shutoff valve and regulator for the air connection must be installed.
- Plumbing and manual shutoff valves for the inlet and discharge cooling water (oil-to-water models), and the inlet and discharge cutting water must be installed.

Incoming source water must meet specific water quality standards, flow rates and pressure requirements. It may be necessary to install water conditioning and/or pressure boosting equipment to meet these water purity and pressure requirements.

NOTE

To ensure proper oil temperature and to conserve cooling water, the use of a ball valve to regulate the discharge cooling water is recommended.

- Drain water plumbing must be suitably located and installed for the proper disposal of wastewater.

- High pressure tubing runs from the intensifier to the cutting station are installed with the appropriate mountings, support brackets and hardware.
- Wiring must be installed and connected between the intensifier and the cutting station control system.

NOTE

The incoming cooling water source and cooling water drain are not required on models equipped with an air-to-oil cooling system.

- The machine must be commissioned and tested.

2.3 Site Requirements

The intensifier must be installed indoors where air borne dust and contaminants are minimal. The ambient temperature should be between 40° F (30° C) and 86° F (30° C) for continuous duty and 40° F (30° C) to 104° F (40° C) for intermittent duty (duties as defined in NFPA 70, National Electric Code.) Relative humidity should be a maximum of 95 percent.

Refer to Table 2-1, Equipment Dimensions and Weight, to establish a suitable installation site. A minimum clearance of 39 inches (990 mm) is required on all sides of the machine to facilitate service.

The intensifier is not typically anchored to the floor. The vibration created by the intensifier is not significant enough to cause it to move. Special consideration may be required for units installed on a mezzanine. Consult KMT Waterjet assistance is required.

Figure 2-1: Equipment Dimensions

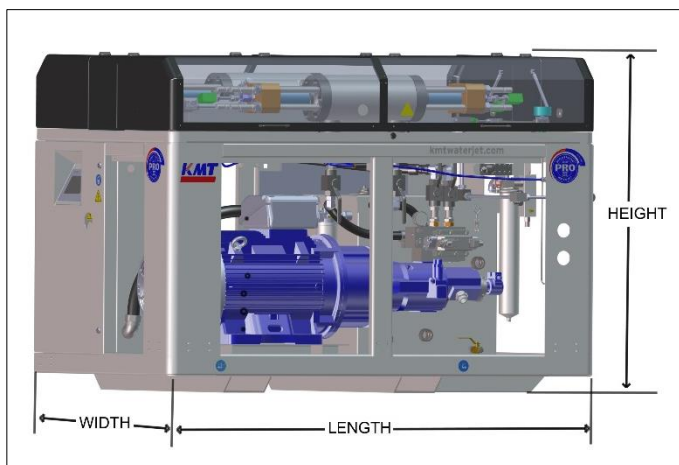


Table 2-1
Equipment Dimensions and Weight

Horsepower	Length	Width	Height	Weight
60 HP	82.50" (2,095 mm)	51.82" (1,320 mm)	57.58" (1,508 mm)	4,380 lbs (1,987 kg)
Redundant Models (same dimensions as above)				
60 HP				4,725 lbs (2,143 kg)

Transporting

The weight of the machine is not evenly distributed from one end to the other, particularly on the larger horsepower models. Do not attempt to lift the machine from either end. Note the warnings stamped on the crate. The center of gravity is clearly identified on the sides of the crate. The forklift should be positioned accordingly.

When the machine is removed from the crate, note the position of the fork pockets on the bottom of the machine. The pockets are positioned in relationship to the center of gravity to balance the weight on the forklift.

Figure 2-2: Fork Pockets

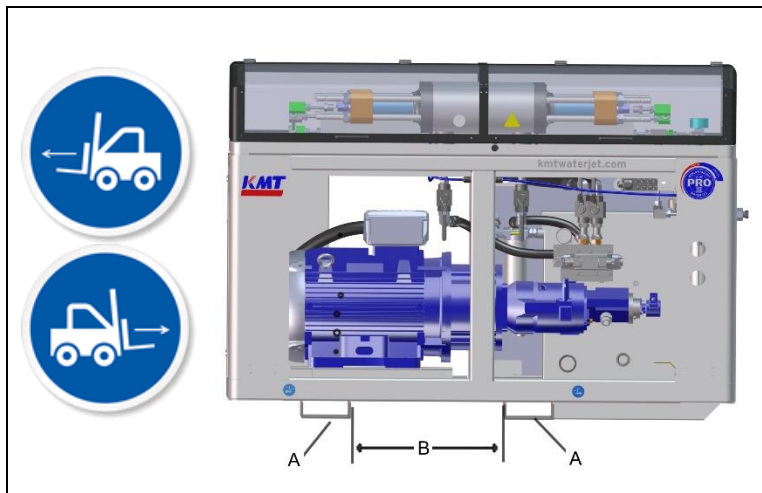


Table 2-2
Fork Pockets

A	Fork Pocket Dimensions	
	Height	2.87" (73 mm)
	Width	8.0" (203 mm)
	Length	51.00" (1,295 mm)
B	Distance Between Pockets	25.0" (635 mm)

If the machine will be installed in an overhead location, a forklift or crane can be used to position the pump. Heavy straps or chains, properly rated for the weight requirements, should be placed through each fork pocket, and wrapped around the sides of the machine so they meet on the top. The straps can then be attached to a crane or forklift to lift the machine.



The machine **must** be lifted from the bottom. **Do not** attempt to lift the machine from the intensifier.

2.4 Power Requirements

Power supplied to the pump, including overload protection, and wiring for remote control must comply with local, regional and national electrical codes. Service voltage and ampacity must meet the requirements of the specific model. Voltage fluctuations in excess of +/- 10 percent of nominal voltage may damage the machine and void the warranty.



Refer to the nameplate for machine specific ampacity and power voltage requirements.

2.5 Service Connections

The intensifier requires two incoming water sources, cooling water and cutting water; two drain lines, cooling water and wastewater; a high pressure discharge line, and an air supply line. All piping must comply with local, regional and national codes.



The incoming cooling water source and cooling water drain are not required on models equipped with an air-to-oil cooling system.



Thoroughly purge all supply plumbing prior to connection to remove any residue that could contaminate the system.

All service connections are made on the bulkhead of the machine as shown in Figure 2-3, Service Connections. Table 2-3 lists the fittings required and the height of each interface connection.

With the exception of the drain and contaminated waste drain lines, manual shutoff valves should be installed for all connections. To facilitate service, the valves should be located as close as practical to the interface connection.

Figure 2-3: Service Connections

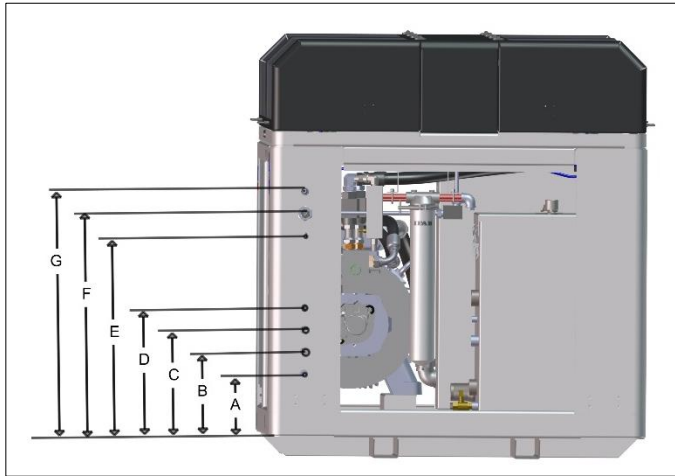


Table 2-3
Service Connections

		Connection	Height
A	Drain	1/2" NPT	11.61" (295 mm)
B	Cutting Water In	1/2" NPT	14.61" (371 mm)
C	Cooling Water In	1/2" NPT	17.61" (447 mm)
	Hydraulic Oil Out (oil-to-air models)	3/4" JIC	17.61" (447 mm)
D	Cooling Water Out	1/2" NPT	20.61" (523 mm)
	Hydraulic Oil In (oil-to-air models)	3/4" JIC	20.61" (523 mm)
E	Plant Air In	1/4" NPT	30.61" (777 mm)
F	Cutting Water Out	9/16" HP	33.61" (854 mm)
G	Contaminated Waste Drain	1/2" NPT	36.61" (929 mm)

Cooling Water (Oil-to-Water Models)

Inlet cooling water flows through the oil-to-water heat exchanger in the hydraulic system to control heat build-up in the hydraulic oil. The cooling water is then discharged through the cooling water out port to either the drain or routed to a customer supplied water chiller.

Cooling water supply piping must be sized to meet the flow and pressure requirements of the specific equipment. If municipal or well water is used for cooling, ensure the supply flow and pressure meet the requirements in Section 11, Specifications.

If a facility-wide chilled water system is used for cooling, ensure there is a minimum of 35 psi (2.4 bar) pressure differential between the facility supply and discharge plumbing. Installation of an in-line pressure boosting pump may be necessary to provide adequate cooling flow. Dedicated chilled water systems should be sized according to pump horsepower as illustrated in Table 2-4, Chilled Water Systems.

Table 2-4
Chilled Water Systems
Cooling Requirements at Full Capacity

Horsepower	BTU/HR
60	36,500

Note: Coolant flow to the heat exchanger is regulated by the temperature of the contents in the hydraulic reservoir and will be shut off at times.

Cutting Water

Inlet cutting water is filtered and then routed to the intensifier where it is pressurized and delivered to the cutting head. The cutting water supply must meet the minimum water quality standards outlined in Section 11, Specifications. Poor water quality will drastically shorten component life and void the warranty.

Cutting water supply piping must be sized to meet the flow and pressure requirements listed in Section 11, Specifications. Only PVC, copper or rubber hoses should be used between the cutting water source and the machine.

The inlet water must be maintained at a minimum pressure of 35 psi (2.4 bar) at all times. If the facility water pressure is below, or can fall below 35 psi (2.4 bar), a water pressure booster pump is required.



NOTE

The machine will not start if inlet cutting water pressure is below 30 psi (2 bar).



To avoid pressure spikes and premature component wear, adequate and consistent inlet water pressure is critical.

Drain

Cutting water released through the dump valve when the emergency stop button is initiated is discharged from the drain port. The discharge is considered wastewater and must be piped to an appropriate location, i.e. a sewer line. The volume of water released will be minimal and does not require high pressure plumbing; however, piping must comply with local, regional and national codes.

Plant Air

The facility compressed air connection should provide clean, dry air regulated to 85 psi (5.9 bar). Air usage is minimal, normally less than 1 scf/min.

NOTE

The reaction time of the pneumatic valve on the cutting head is a function of air and operating pressure. To achieve a consistent reaction time, when operating pressure is changed, the air pressure should also be changed accordingly.

The following table provides specifications for each ISO air quality classification. KMT recommends adherence to Quality Class 4.

Table 2-5
ISO Air Quality Classifications

ISO Quality Class	Maximum Particle Size (microns)	Maximum Pressure Dew Point (water @ 100 psi)	Maximum Oil Content (Mg/m ³)
1	0.1	-94° F (-60° C)	0.01
2	1	-40° F (-40° C)	0.1
3	5	-4° F (-20° C)	1
4	15	+38° F (+3° C)	5
5	40	+45° F (+7° C)	25
6	--	+50° F (+10° C)	--

Contaminated Waste Drain

Oil and water that can accumulate on the top pan and is disposed of through the contaminated waste drain. This oil and water mixture is considered contaminated and disposal must comply with local, regional and national codes. The volume of waste will be minimal and can be collected in a container of some appropriate type.

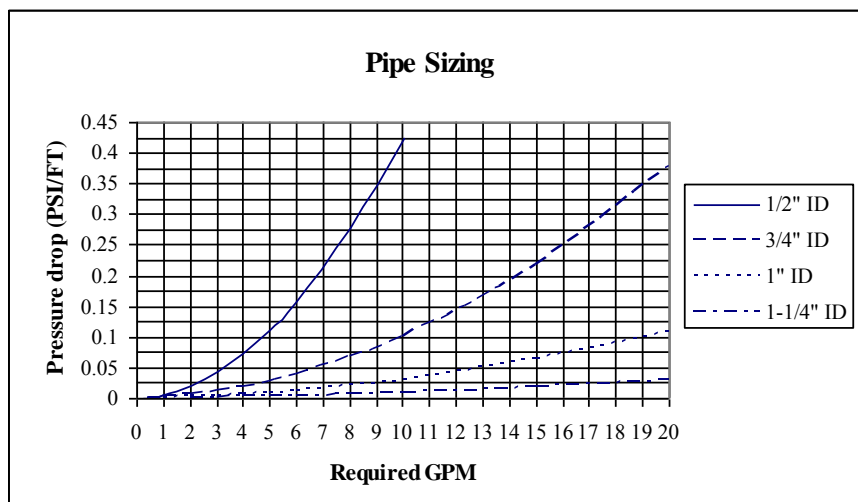
2.6 Flow Requirements

Figure 2-4, Pressure Drop Values, illustrates the pressure drop for four different pipe sizes. The graph can be used to calculate the minimum source water pressure.

2. Enter the graph at the required GPM and note the pressure drop figures for the different pipe sizes.
3. Multiply the pressure drop (PSI/FT) by the length in feet of each pipe size used from the water source to the intensifier. Add the values together for a total pressure drop value.
4. Add 30 to the total pressure drop to determine the minimum flowing, source water pressure required to provide adequate supply to the intensifier.

Cutting water and cooling water capacity should be calculated separately. Note that the cutting water requirements represent instantaneous, not average, demand. **The machine will not start if the inlet cutting water pressure drops below 30 psi (2 bar).**

Figure 2-4: Pressure Drop Values



2.7 Ultra-High Pressure Piping

Ultra-high pressure piping is used to transport high pressure cutting water from the machine to the cutting station. Ultra-high pressure piping and fittings must be properly rated and sized. When transporting ultra-high pressure water over long distances, tubing and fittings with an outside diameter of 9/16-inch are recommended. The large tubing size reduces vibration, strain and motion; as well as reducing pressure drop and pulsation.



Ultra-high pressure tubing and fittings must be rated for 90,000 psi (6,200 bar). Failure to use properly rated components may result in component failure causing equipment damage, personal injury or death.



Ultra-high pressure tubing lengths are coned and threaded prior to installation. KMT Waterjet provides both hand and power tools for coning and threading high pressure tubing. See Table 2-6, Coning and Threading Tools, for descriptions and part numbers.

Table 2-6
Coning and Threading Tools

	Part Number	
	Hand Tools	Power Tools
1/4" Coning Tool		05109897
3/8" Coning Tool		05109889
9/16" Coning Tool		05109871
1/4" Threading Tool	05108865	05122742
3/8" Threading Tool	05108873	05120258
9/16" Threading Tool	05108881	05122759
1/4" Tube Vise	05108782	
3/8" Tube Vise	05108790	
9/16" Tube Vise	05108774	

Measurements and Dimensions

Tubing must be cut to the proper length, both ends of the tubing must then be coned, threaded and deburred.

To determine the tube length, measure the distance between the fittings, and add two times the engagement allowance shown in Table 2-7. Table 2-8 lists the required cone and thread dimensions illustrated in Figure 2-6.

Table 2-7
Engagement Allowance (EA)

1/4" Tubing	0.85" (21.6 mm)
3/8" Tubing	1.09" (27.7 mm)
9/16" Tubing	1.63" (41.4 mm)

Figure 2-5: Tube Length

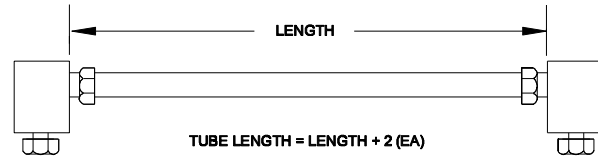


Figure 2-6: Cone and Thread Dimensions

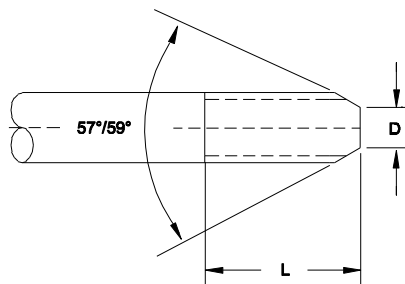


Table 2-8
Cone and Thread Dimensions

Tube OD	Tube ID	D (Maximum)	L (Maximum)	Thread UNF-LH
1/4" (6.35 mm)	0.083" (2.11 mm)	0.125" (3.2 mm)	0.765" (19.4 mm)	1/4" - 28
3/8" (9.52 mm)	0.125" (3.18 mm)	0.219" (5.6 mm)	1.135" (28.8 mm)	3/8" - 24
9/16" (14.29 mm)	0.188" (4.78 mm)	0.281" (7.1 mm)	1.520" (38.6 mm)	9/16" - 18

Power Coning

1. Secure the tubing in a tube vise. No more than the recommended length of tubing should extend beyond the face of the vice. See Table 2-9, Recommended Extension Length.
2. Mount the coning tool in a 3/8-inch or 1/2-inch, variable speed power drill. Apply cutting oil to the end of the tube and slide the coning tool on the tubing.
3. While the cone is being cut, apply steady pressure against the end of the tubing.
4. Apply cutting oil frequently and liberally throughout the cutting operation. Medium weight cutting oil with high sulfur content is recommended.
5. The tool will stop cutting when the tube angle and facing is complete.

NOTE

Clean the machining chips from the blade and body of the tool before coning the next tube.

Table 2-9
Recommended Extension Length

1/4" Tubing	1.25-1.50" (31.8-38.1 mm)
3/8" Tubing	1.25-1.50" (31.8-38.1 mm)
9/16" Tubing	1.75-2.00" (44.5-50.8 mm)

Hand Threading

1. Secure the coned tubing in a tube vise. No more than the recommended length of tubing should extend beyond the face of the vice. See Table 2-9, Recommended Extension Length.
2. Apply cutting oil to the end of the tube and slide the threading tool on the tubing.
3. Grip the handle of the tool firmly, apply steady pressure and turn the tool counter-clockwise. Approximately every half turn, reverse direction to break off and remove the chips.
4. Apply cutting oil frequently and liberally throughout the cutting operation. Medium weight cutting oil with high sulfur content is recommended.
5. Continue threading until the proper thread length is reached, see Table 2-8, Column L. Remove the tool from the end of the tubing.

NOTE

Clean the machining chips from the die and body of the tool before threading the next tube.

Power Threading

1. Secure the coned tubing in a tube vise. No more than the recommended length of tubing should extend beyond the face of the vice. See Table 2-9, Recommended Extension Length.
2. Mount the threading tool in a 3/8-inch or 1/2-inch, variable speed power drill. Apply cutting oil to the end of the tube and slide the threading tool on the tubing.

3. Make sure the drill is set to turn counter-clockwise. Apply steady pressure against the end of the tubing while the threads are being cut.
4. Apply cutting oil frequently and liberally throughout the cutting operation. Medium weight cutting oil with high sulfur content is recommended.
5. Continue threading until the proper thread length is achieved, see Table 2-8, Column L. Reverse the direction of the drill and remove the threading tool.

NOTE

Clean the machining chips from the die and body of the tool before threading the next tube.

2.8 Ultra-High Pressure Connections

When installing ultra-high pressure discharge piping it is essential that all burrs are carefully removed and the tubing sections purged with clean compressed air prior to assembly. Lightly spraying the inside of the tube with a carrier fluid, such as WD-40, before purging with air will help carry the burrs.

Ultra-high pressure piping must be installed without torsional or bending stresses and proper supports and guides must be provided. Torsional stress will cause premature component failure.

Pure Goop anti-seize compound must be applied to the threads and contact surfaces of all stainless steel components prior to assembly. Failure to lubricate components with Pure Goop will result in galling, rendering the components useless.

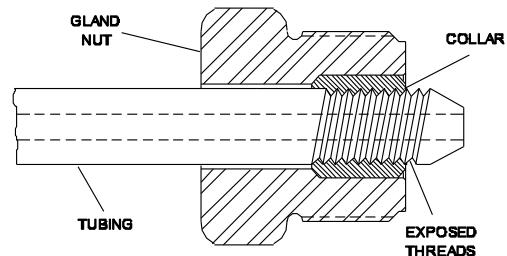


Do not use any other anti-seize compound. Apply Pure Goop **only** to **stainless steel** components.

Standard Connections

Use standard connections for general applications where internal pressure is the only load on the tubing.

1. Deburr the tubing ID and thoroughly clean the tubing threads.
2. Slip the gland nut onto the tubing.
3. Apply Pure Goop to the threads on the tubing. Screw the collar onto the threaded end of the tubing leaving 1-1/2 to 2-1/2 threads exposed on the tubing between the collar and the coned tubing.



4. Apply Pure Goop to the male threads on the gland nut and insert the tubing into the connection. Engage the gland nut and tighten finger tight.
5. Tighten the gland nut to the torque specifications in Table 2-10.



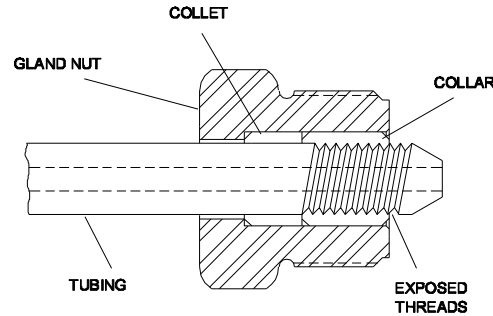
Proper piping supports and guides must be provided. End connections will not support the tubing load alone.

Anti-Vibration Connections

The bending stresses resulting from excessive vibration or shock on the threaded area of the tubing can cause premature failure at the back of the thread. Anti-vibration connections must be used when tubing will be subjected to vibration, rotation and movement.

The anti-vibration collet gland transfers the stress to the unthreaded section of the tubing, and the gripping action of the collet strengthens the entire assembly.

1. Deburr the tubing ID and thoroughly clean the tubing threads.
2. Slip the gland nut and the collet onto the tubing.
3. Apply Pure Goop to the threads on the tubing. Screw the collar onto the threaded end of the tubing leaving 1-1/2 to 2-1/2 threads exposed on the tubing between the collar and the coned tubing.
4. Apply Pure Goop to the male threads on the gland nut and insert the tubing into the connection. Engage the gland nut and tighten finger tight.



5. Tighten the gland nut to the torque specifications in Table 2-10.

When a flexible whip is used to allow cutting nozzle movement, anti-vibration fittings and proper supports and guides must be provided to prevent failures from non-water related stresses. The whip will only flex in a single plane without being subjected to torsional stress. The use of high pressure swivels is strongly recommended.

Table 2-10
Torque Specifications
Ultra-High Pressure Connections

1/4" Tubing	35 ft-lb (47 Nm)
3/8" Tubing	75 ft-lb (102 Nm)
9/16" Tubing	160 ft-lb (217 Nm)

2.9 Commissioning

When the machine has been positioned, all service connections installed, and the high pressure plumbing has been installed to the cutting area, the machine is ready to be commissioned.

The following procedure is used for the initial startup and testing of the machine.

1. Check all areas in and around the pump for foreign objects and debris. Remove all tools, parts, etc. from the area.

2. Check the hydraulic fluid level. The hydraulic system is pre-filled prior to shipping. If the hydraulic fluid is low or empty due to leakage during transit, the system must be filled. Follow the instructions and specifications in Section 6, Recirculation System.



Prior to shipping, the breather was removed from the reservoir, placed in a plastic bag and attached to the pump. The breather must be installed on the reservoir prior to operation.

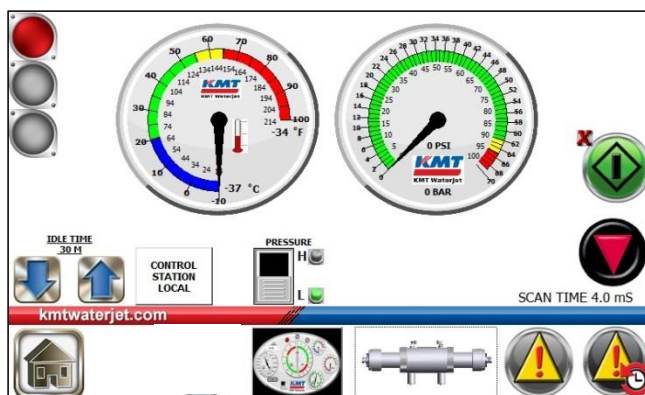


Prior to shipping, the filter element was removed from the housing and placed on the top pan. The filter element must be installed in the filter housing prior to operation.

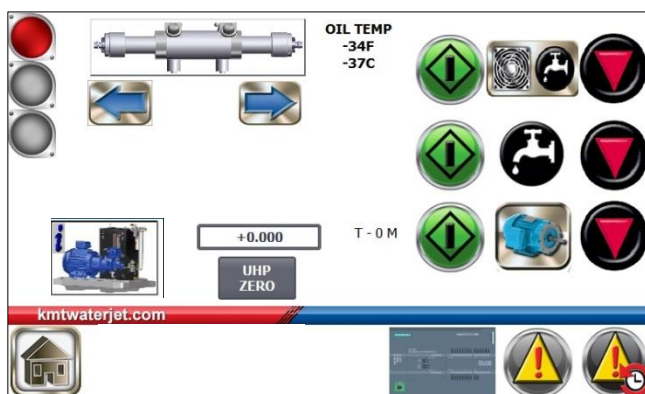
3. Open the shutoff valves on the service connections and check for leaks.
4. Check the connection between the main power disconnect and the disconnect/circuit breaker on the enclosure door. Verify the proper voltage supply. Close the enclosure door and turn the control power on.
5. To activate the control panel display, close the electrical enclosure and engage the circuit breaker/disconnect on the door. The control panel will go through a series of diagnostics, and the Main Screen will display. Refer to Section 4, Operation, for additional information regarding control panel functions.



6. On the Run Screen, press the PRESSURE switch for low pressure operation. The pressure is automatically set to the minimum operating pressure of 10,000 psi (689 bar) when the PRESSURE switch on the Run Screen is set to low pressure operation.



7. Check the motor rotation. On the Main Service Screen, press the motor START button. Observe the pressure gauge on the hydraulic manifold. If the motor rotation is correct, pressure will begin to build in just a few seconds. If the rotation is not correct, the gauge will not move.



If the motor shaft is rotating in the wrong direction, press the motor STOP button and turn the control power off by pressing the EMERGENCY STOP button.

The electrical power phase must be reversed to any two motor leads. The leads can be reversed at the disconnect/circuit breaker on the enclosure door, or at the main power disconnect.

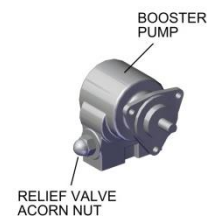


Do not allow the motor to run backward. Incorrect motor rotation will result in damage to the hydraulic pump.

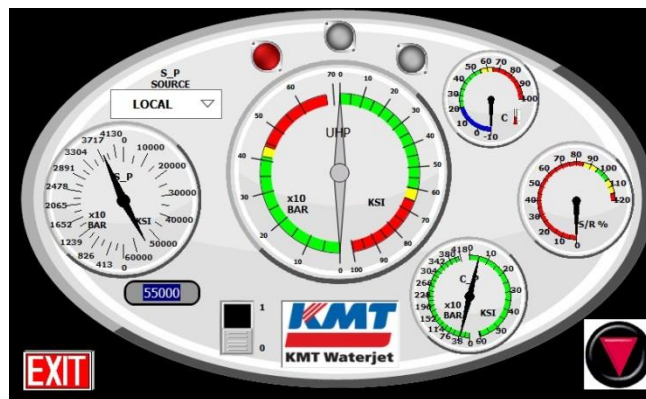
8. If the unit is equipped with an oil-to-air or a combination cooling system, check the fan motor rotation. When viewed from the motor end, the fan should rotate clockwise. If the rotation is not correct, the electrical power phase must be reversed to any two motor leads. The leads can be reversed at the junction box on the fan motor or at the electrical enclosure.

9. Remove the cutting orifice and open the nozzle valve.
10. Activate the control power and press the START button on the Run Screen to start the motor. The dump valve will open for a short time to allow trapped air to bleed from the high pressure cylinders. Run the machine in low pressure for approximately two minutes with the orifice removed to purge the system.
11. Install a large, inexpensive orifice and start the machine.
12. Check for any leaks in the plumbing, or around the high pressure cylinders. If leaks are detected, stop the machine and correct any problems.
13. Observe the Booster Pressure Gauge on the front of the machine to ensure the boosted cutting water pressure is 180 psi (12.4 bar). If not, the booster pump pressure must be adjusted. Refer to Section 5, Low Pressure Water System, for additional information.

Access the adjustment screw in the acorn nut on the side of the booster pump and use a flat blade screwdriver to turn the screw. Turn the screw clockwise to increase the pressure or counter-clockwise to decrease the pressure.



14. Check the safety circuits by pushing the EMERGENCY STOP button in and verifying the alarms activate and the high pressure water drains from the system. If applicable, check all remote start and emergency stop functions.
15. On the Run Screen, press the PRESSURE switch for high pressure operation.
16. From the Run Screen select the Dashboard. Press the pressure icon on the Dashboard to display the keypad.



17. Enter the desired operating pressure and press ENTER. Increase the high pressure setting in gradual increments, checking for leaks at each interval. Continue increasing the pressure until the operating pressure is reached.

NOTE

It is strongly recommended that the high pressure plumbing be purged under high pressure operating conditions, using a large, inexpensive orifice. Contamination can be released when the tubing expands under pressure. Early orifice failures could be experienced if the piping is not adequately purged.

2.10 Decommissioning

When the intensifier is decommissioned and taken out of service for any reason all local regulations must be adhered to.

All utilities must be de-energized and disconnected. The hydraulic oil contained in the unit must be drained and disposed of according to local codes. If the unit is to be disposed of, all local codes must be observed.

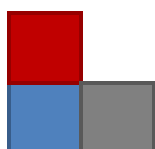
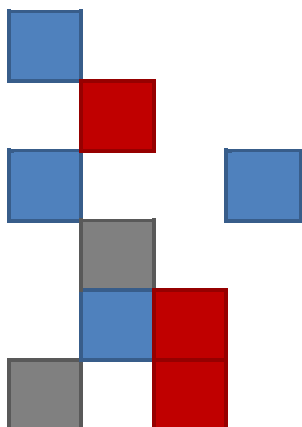
KMT Waterjet recommends recycling the unit. Most of the heavy metallic content of the unit can be recycled. Contact KMT is assistance is required in identifying materials.

SECTION 3

MAINTENANCE

The Maintenance section highlights:

- Routine and preventive maintenance requirements
- Precautions associated with high pressure cutting equipment
- Equipment tool kits



3.1 Overview

The SL-VI Pro III 60 has been designed to fail safely. Systems fail gradually; seals and connections begin to leak slowly or suddenly through specially designed weep holes. Water or oil dripping from a weep hole indicates internal seals or valves are beginning to fail, a warning that maintenance will be required.

The comprehensive fault detection and troubleshooting logic built into the programmable logic controller (PLC) monitors crucial pressure, temperature and fluid levels. Warning and shutdown sensors guard against potential injury and equipment damage.

3.2 Maintenance

The waterjet system is designed for ease of maintenance and long, reliable operation. In order to keep the equipment in optimum operating condition, routine and preventive maintenance is essential, see Table 3-1, Routine Maintenance Schedule.

Detailed maintenance and troubleshooting procedures for specific systems are provided in subsequent sections of this manual.

Daily Inspection

The following inspection procedures should be performed each shift. If problems are detected, they should be remedied before placing the machine in service.

- Prior to startup, inspect the area around the machine, the high pressure piping and connections for indications of leaks.
 - Make sure there is no maintenance work in process.
 - Check the hydraulic oil level.
- As the machine is started and water pressure increases, listen for unusual sounds.
 - Check for water or oil leakage.
 - Check the condition of the water filter and the oil filter.

Periodic Maintenance

A number of factors can contribute to component failure; poor water quality, operating conditions, or improper maintenance procedures. Maintaining a service log can be a useful method of tracking component life and maintenance trends. Analyzing service intervals will assist in preparing a preventive maintenance schedule tailored to your specific application and production requirements. Periodic maintenance, at regularly scheduled intervals, will minimize unscheduled downtime and premature component failure.

Improper assembly can lead to the premature failure of components. Follow maintenance procedures carefully; properly clean components prior to assembly and tightened to the correct torque specifications.

- Maintain a clean, dust and dirt free work area for maintenance.
- Clean water and hydraulic leaks or spills to prevent slick surfaces.
- Use only clean, dry air and clean, filtered solvent when flushing parts.
- Use lint free cloths for cleaning.

- Use extreme care when aligning close tolerance parts for assembly. Do not force the parts together. If parts bind during assembly, they must be disassembled and realigned.
- Use only original KMT Waterjet replacement parts for consistent performance and reliability; and to protect equipment warranty.



To avoid unsafe conditions and the risk of equipment damage, operating personnel and service technicians must carefully read and follow the procedures in this manual.

Table 3-1
Routine Maintenance Schedule

		Per Shift	Weekly	Monthly	3-Month	6-Month	Yearly/ 6,000 hours
Description							
Inspection for leakage and abnormal conditions	High pressure system	X					
	Low pressure system	X					
	Hydraulic system	X					
	Recirculation system		X				
Pressure checks	Discharge cutting water	X					
	Inlet cutting water	X					
	Booster water	X					
	Inlet cooling water	X					
	Hydraulic operating oil	X					
	Compressed air	X					
Temperature checks	Sealing head	X					
	High pressure cylinder	X					
	Hydraulic cylinder	X					
	Hydraulic oil	X					
	Inlet cooling water		X				
	Discharge cooling water		X				
	Dump valve	X					
	Electric motor		X				
	Hydraulic pump(s)		X				

Table 3-1
Routine Maintenance Schedule

Description		Per Shift	Weekly	Monthly	3-Month	6-Month	Yearly/ 6,000 hours
Filter units	Low pressure water filter [1]		X				
	Hydraulic oil filter [2]		X				
Rotating equipment vibrations	Electric motor			X			
	Hydraulic pump(s)			X			
Supply requirements	Hydraulic oil in reservoir [3]		X				R
Control panel checks	Lights	X					
	Safety functions [4]		X				

Note: X = to be observed
R = to be replaced

- [1] When the filter element is new, document the pressure reading from the gauge on the front of the machine. The element should be replaced when the pressure drops to 15 psi (1 bar) below the original value. When the element is replaced, the strainer should also be cleaned.
- [2] The hydraulic filter assembly on all SL-VI Pro 60 units is equipped with a differential pressure indicator. Change the filter element when the indicator enters the red zone at normal operating temperature or after 3,000 hours whichever comes first.
- [3] Change the hydraulic oil at intervals required to maintain ISO 4406 cleanliness level 18/15/13, not to exceed 6,000 hours.
- [4] Check the safety circuits by pushing the EMERGENCY STOP button in and verifying the alarms activate and the high pressure water drains from the system. If applicable, check all remote start and emergency stop functions.

Ultra-High Pressure System Maintenance

The ultra-high pressure system is conveniently mounted on a drip pan. All service components are readily accessible, and can easily be removed from the unit for maintenance and service.

- High pressure fittings, valves and tubing must be rated for 90,000 psi (6,200 bar). Failure to use properly rated components may result in component failure, equipment damage and personal injury.
- Do not over-torque fittings to stop leakage.
- Ensure all components are clean, free of burrs, metal particles, dirt and dust prior to assembly.

After servicing high pressure components the high pressure water system must be thoroughly flushed to remove any debris or contaminants.

1. Operate the intensifier for a short period with the nozzle valve open and the orifice removed.
2. Turn the intensifier off and install an orifice.
3. Turn the machine on and increase the operating pressure in gradual increments. Check all high pressure connections for leaks.

Many components are lubricated prior to assembly. Table 3-2 lists the recommended lubricants and their applications. Substitutions are not recommended.

Table 3-2
Lubrication Specifications

Description	Application	Part Number
Pure Goop, 1 ounce	Stainless steel threads and metal-to-metal joints	10084440
FML-2 Grease, 14-1/2 ounce	O-rings, backup rings, bearing rings, seal components	10087385
JL-M Grease, 16 ounce	Non-stainless steel threads	49832199

3.3 Maintenance Precautions

Make sure all safety devices are operational. Check each device on a specified schedule. If the device does not function, replace it before operating the machine.

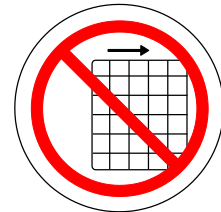
Check the EMERGENCY STOP button. The normal operating position is pulled out. Turn the power on and activate the emergency stop button by pushing it in to verify the power goes off and the safety dump valve opens to bleed the high pressure from the system.



Before performing any maintenance on the equipment, take the system out of service and make sure the controls are properly locked and marked. Never perform any maintenance on the equipment without making sure the main control power is locked out in the OFF position.

- **Never** service or maintain the equipment while it is operating.
- Steam or fog inside the top cover is an indication of a high pressure leak.

All high pressure leaks must be repaired immediately. Press the EMERGENCY STOP button to turn the control power off and bleed off the high pressure water from the intensifier **before** lifting the cover.



- Never service or maintain any high pressure component, or loosen any high pressure fitting when it is pressurized.

Press the EMERGENCY STOP button to turn the control power off and bleed off the high pressure water from the intensifier before servicing.

- If leakage occurs at a sealing surface, high pressure water is released through weep holes.

If a pressurized fitting is loosened, a jet of high pressure water will exit the nearest weep hole with **possible hazardous results**.



3.4 Tools Kits

Table 3-3 provides a list of the spare parts and maintenance tools included in standard tool kits for SL-VI Pro III 60 pumps. Components can also be ordered individually.

**Table 3-3
Tool Kits**

Part Number	Description	Tool Kit 72186872	Tool Kit 72186864
20476132	Hydraulic Tensioner Assembly	1	1
20477489	Crowfoot Wrench	1	1
20473684	Hex Bit Socket, 5/8 x 1/2 Drive	1	1
10149029	Emery Cloth, 320 Grit	2	2
10149037	Emery Cloth, 400 Grit	6	6
10149045	Emery Cloth, 600 Grit	6	6
72121395	Inlet Check Valve Rework Kit	1	1
20477460	Plunger Removal Tool	1	1
20470475	Seal Installation Tool Kit, Pneumatic Valve	1	1
80082191	JL-M Grease, 15 milliliter pack	2	2
10079986	Strap Wrench	1	1
10081370	Spanner Wrench, Adjustable	1	1
10084440	Pure Goop, 1 ounce	3	3
10087385	FML-2 Grease, 14-1/2 ounce	1	1
10087609	Crescent Wrench	1	1
80078256	Torque Wrench, 5-75 ft-lbs	1	1
05109889	Coning Tool, .38 Power		1



Table 3-3
Tool Kits

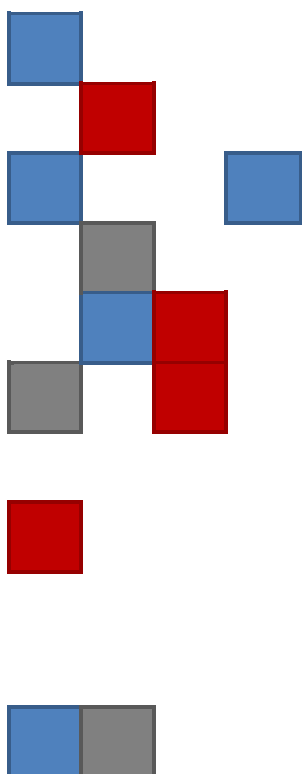
Part Number	Description	Tool Kit 72186872	Tool Kit 72186864
05109897	Coning Tool, .25 Power		1
05109871	Coning Tool, .56 Power		1
05108881	Threading Tool, .56 Hand		1
05108873	Threading Tool, .38 Hand		1
05108865	Threading Tool, .25 Hand		1

SECTION 4

OPERATION

The Operation section details:

- Principles of operation and function of the system
- Warnings and faults, along with possible remedies



4.1 Overview

The SL-VI Pro III 60 utilizes a programmable logic controller (PLC) to provide comprehensive fault detection and troubleshooting logic. The operator functions and warnings offer a comprehensive view of operating conditions, impending faults, shutdown faults and suggested remedies.

The operator interface is through a touch sensitive control display where operating parameters are set and monitored. Proportional pressure control allows the operator to select or vary the operating pressure from the control display or from a remote console. The pressure transducer allows the operating pressure to be viewed from the display.

Figure 4-1: Display



4.2 Home Screen

The Home Screen displays the operating status of the machine and provides access to a series of setup and monitoring screens. The pump serial number and the PLC and HMI versions are shown at the top of the screen.

Figure 4-2: Home Screen



A red light indicates a fault.



A flashing yellow light indicates the machine is in service mode.

A steady yellow light indicates a warning.



The green light flashes while the machine is starting.

When the intensifier is generating pressure, the green light is steady.



Press to exit to Windows operation system.



Press to display the Run Screen.



Factory Configuration Screen

The Factory Configuration Screen is used to set the initial pump parameters at the factory. It is password protected and is not intended for customer access.



Customer Configuration Screen

Password protected area where operating parameters are set and optional modules purchased as upgrades are configured.



Operator Configuration Screen

The Operator Configuration Screen allows the operator to set the display language and restore saved settings and parameters.



Main Service Screen

All maintenance and service activities are performed from the Main Service Screen.

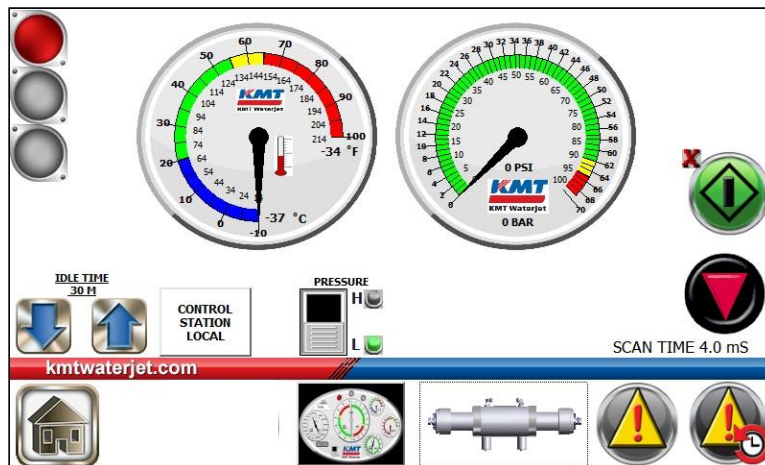
Before the Main Service Screen displays, the pump will shut down. When the shutdown warning is issued, press OK to continue or press CANCEL to abort the request



4.3 Run Screen

The Run Screen is the only location where the machine can be started to create pressure.

Figure 4-3: Run Screen



The temperature gauge on the Run Screen displays the hydraulic oil temperature in the reservoir. The pressure gauge indicates the operating pressure. The following functions are also displayed:



IDLE TIME

Press the up or down arrow to select an idle time from 0-60 minutes. The selected interval displays above the arrows.

Idle shutdown automatically stops the motor after a deadhead condition occurs. If the idle time is set to zero, motor shutdown is disabled.

The default idle time is set on the Customer Configuration Screen. However, it can be changed on the Run Screen during operation.



CONTROL STATION

Press to select local or remote control. When the shutdown warning is issued, press OK to change control station or press CANCEL to abort the request.

Remote control functions include, start, stop, alarm reset, high/low pressure and a pause function.



HIGH/LOW PRESSURE

Press the pressure switch to select high or low pressure operation. In the current state, high pressure is selected.

When low pressure is selected, the low pressure indicator illuminates.

When the machine is stopped and restarted, it will always start in low pressure. When the machine reaches production mode, it will go to high pressure or remain in low pressure, depending on the previous high/low pressure setting.



START

The start button indicates when the machine is ready to start, designated by a green check mark next to the start button.

After the machine has been stopped, there is a delay before it can be started, designated by a red X next to the start button.



STOP

Press the stop button to stop the machine. After the five-second delay, the machine can be started, designated by a green check mark next to the start button.



ALARM RESET

Press to reset an active alarm. The icon is only visible if there is an active alarm.



E-STOP RESET

Press to reset the emergency stop. The icon is only visible if there is an active alarm and the e-stop was initiated. The icon will flash indicating it must be reset before the alarm can be reset.



Press to display the Home Screen.



Press to display Intensifier Control Screen.



Press to view the Active Alarms Screen.



Press to display the Alarm History Screen.

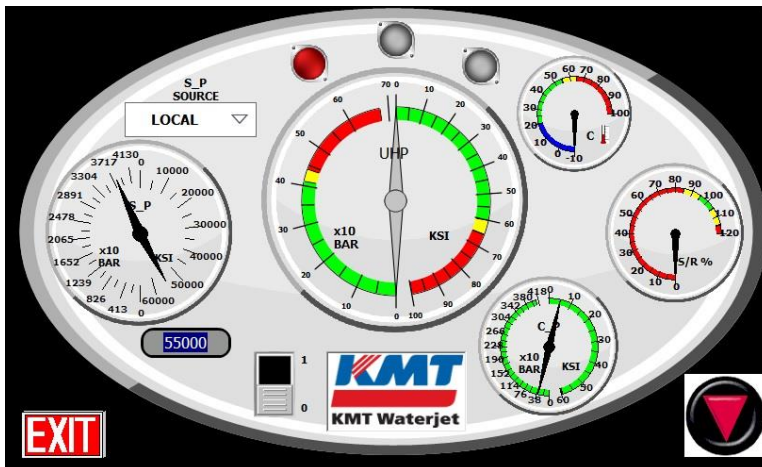


Press to display the Dashboard shown in Figure 4-4.

The pressure signal source and the desired operating pressure are set on the Dashboard.

The display provides monitoring gauges for the commanded pressure within the limits set on the Pressure Limit and Calibration Screen. The gauges include the pressure signal from the transducer, hydraulic oil temperature, percent of strokerate to machine capacity and the commanded pressure to the proportional pressure control.

Figure 4-4: Dashboard



1. Use the drop-down on the top left to select the pressure signal source, local or remote.
2. Press the pressure icon to display the keypad. Enter the desired operating pressure and press ENTER.

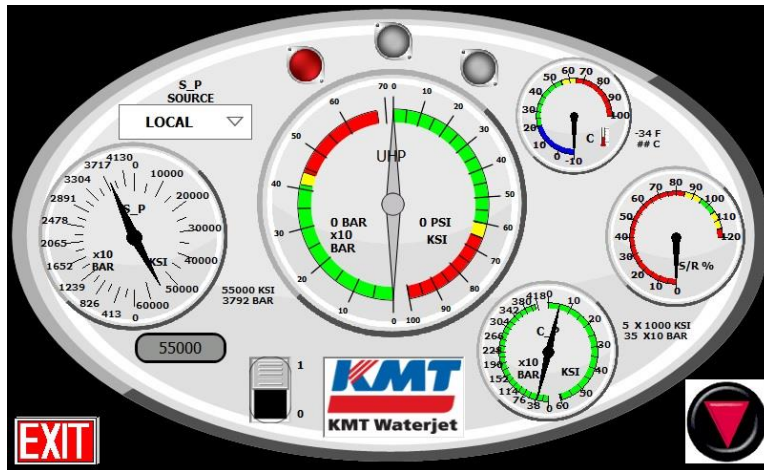
NOTE

The maximum and minimum pressure limits are set on the Pressure Limit and Calibration Screen. See Section 4.6, Machine Setup, Pressure Limit and Calibration Screen.

If the operating pressure is set outside these limits, the pressure will default to the minimum pressure, 10,000 psi (689 bar).

Press the switch to change the setting from zero to one to display a digital readout for each gauge.

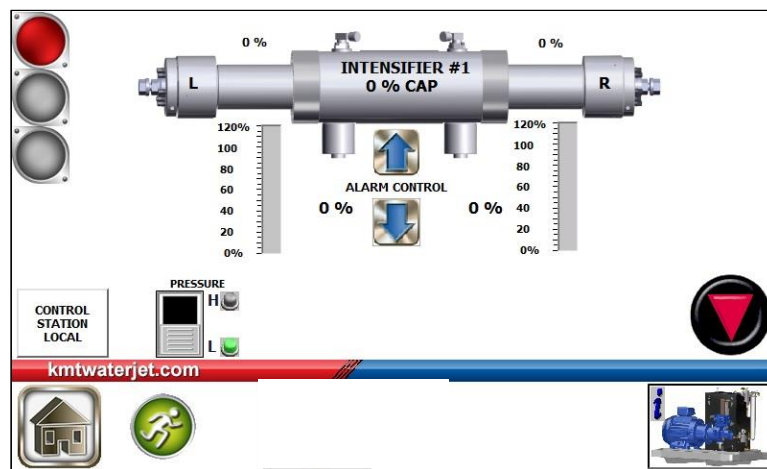
Figure 4-5: Dashboard with Digital Readout



4.4 Intensifier Control Screen

From the Intensifier Control Screen the operator can monitor the percent of stroke rate to the alarm setting and percent of machine capacity.

Figure 4-6: Intensifier Control Screen



The ALARM CONTROL automatically increases or decreases the alarm stroke rate.



Open the cutting head and run the pump until it reaches desired pressure and flow rate. Press the up arrow to set the alarm stroke rate to 100%. A warning is issued if the stroke rate reaches 105%. A pending shutdown will occur at 110% with a 30 second delay before shutdown.

NOTE

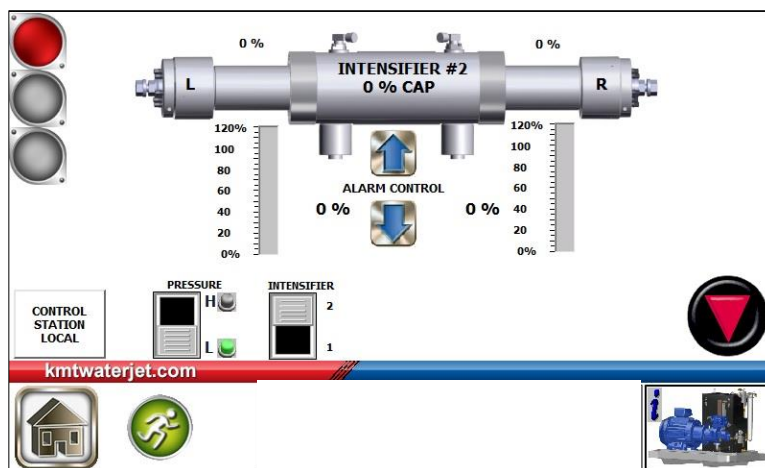
If the operating pressure is changed, the alarm stroke rate should be reset. If it not reset, the reading on the Intensifier Control Screen will not be correct.



Press to display the General Pump Data Screen

If the machine is equipped with an optional redundant topworks, the Intensifier Control Screen in Figure 4-7 will display. The same functions are displayed with the addition of a switch to select topworks 1 and 2.

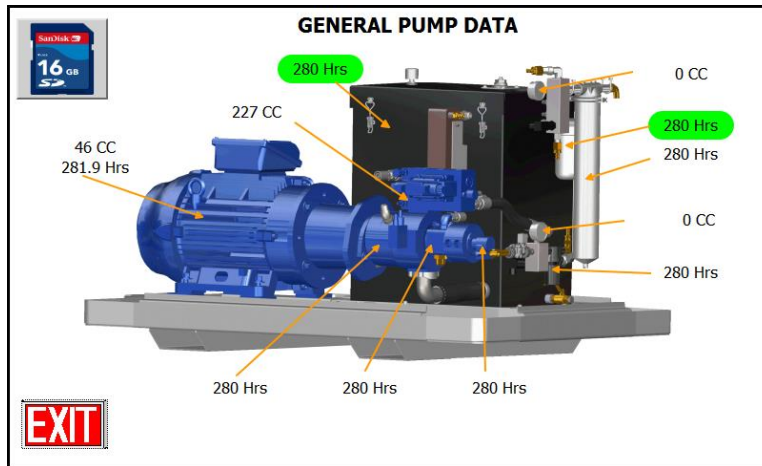
Figure 4-7: Intensifier Control Screen with Redundant Topworks



4.5 General Pump Data Screen

The General Pump Data Screen provides cycle count and/or total hours for maintenance and duty components on the pump. The indicator for the hydraulic oil filter and the hydraulic oil reservoir are color-coded to indicate when they are approaching the recommended replacement time, see Table 4-1, Indicator Status.

Figure 4-8: General Pump Data Screen



Press to return to the previous screen.



Press to save the current data displayed.

Table 4-1
Indicator Status

Hydraulic Oil Filter

0-2,960 hours	Green
2,960-2,990	Yellow
2,990-3,000	Red
3,000 and above	Flashing Red

Hydraulic Oil Reservoir

0-5,980	Green
5,980-5,990	Yellow
5,990-6,000	Red
6,000 and above	Flashing Red

The hydraulic oil filter should be replaced at 3,000 hours. The hydraulic oil should be replaced at intervals required to maintain ISO 4406 cleanliness level 18/15/13, not to exceed 6,000 hours. The oil should be replaced sooner if a fluid sample indicates contamination that cannot be rectified by filtering.

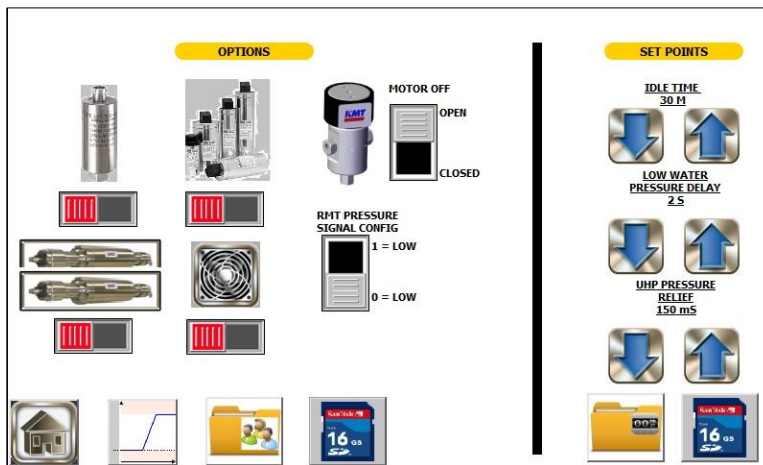
4.6 Machine Setup



The Customer Configuration Screen is a password-protected screen. It allows the customer to set operating parameters during the initial commissioning of the pump. It also allows the customer to set up optional modules purchased as upgrades for existing equipment.

Enter the username, user, and the password 111320 when the prompt displays.

Figure 4-9: Customer Configuration Screen



- IDLE TIME

Use the up or down arrows to set the desired idle time from 0-60 minutes in five (5) minute increments. The selected interval displays above the arrows. The default setting is ten (10) minutes.

Note: When the idle time is set at zero, the function is disabled.

- LOW WATER PRESSURE DELAY

Inlet cutting water pressure is monitored by a 30 psi pressure switch. If the inlet water falls below 30 psi for a certain time interval, the pump will shut down. The default setting is two (2) seconds.

Use the up and down arrows to select an interval between two (2) and five (5) seconds for shut down. The selected interval displays above the arrows.

- UHP PRESSURE RELIEF

When transferring from a high pressure to a low pressure, the dump valve will open to relieve pressure and then close.

Use the up and down arrows to select a time between zero and one (1) second to open the dump valve, release the pressure in the line and then close the dump valve. The time is set in 50 millisecond increments. The default setting is zero.

- DUMP VALVE AT MOTOR OFF

Press the switch to select open or closed to set the dump valve condition when the motor stops. The default is closed.

■ RMT PRESSURE SIGNAL CONFIG

Press the switch to select 1 or 0 to configure the remote pressure signal. Table 4-2, Remote Pressure Signal Configuration, illustrates the result of each selection.

Table 4-2
Remote Pressure Signal Configuration

Switch Setting	Remote Pressure Command	Pump Pressure
0	Low	Low
0	High	High
1	Low	High
1	High	Low



Press to save the settings to the accompanying folder. The contents of the folder represent the current or default settings and can be restored at any time by pressing the folder icon.



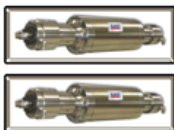
HIGH PRESSURE TRANSDUCER

Press the switch to indicate a high pressure transducer is installed on the unit. The switch will turn green.



POWER FACTOR CORRECTION

Press the switch if power factor correction is installed on the unit. The switch will turn green.



REDUNDANT INTENSIFIER

Press the switch if a redundant intensifier is installed on the unit. The switch will turn green.



OIL-TO-AIR OR COMBINATION COOLING

Press the switch if an oil-to-air or combination cooling system is installed on the unit. The switch will turn green.



Press to save the settings to the accompanying folder. The contents of the folder represent the current or default settings and can be restored at any time by pressing the folder icon.

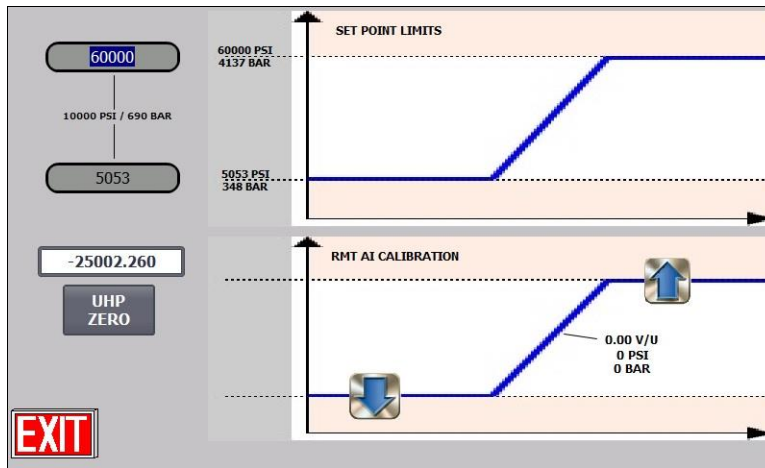


Press to display the Pressure Limit and Calibration Screen.

Pressure Limit and Calibration Screen

The Pressure Limit and Calibration Screen is used to set the maximum and minimum pressure limits and to calibrate the remote signal. All input signals are regulated through this screen before going to the pump.

Figure 4-10: Pressure Limit and Calibration Screen



Although the maximum pressure limit is 85,000 psi (5,860 bar) and the minimum pressure limit is 10,000 psi (689 bar), the limits can be changed as required.

1. Press the high limit icon to display the keypad. Enter the desired high limit and press ENTER. Pressure can be entered in either psi or bar.
2. Press the low limit icon to display the keypad. Enter the desired low limit and press ENTER.
3. The new setpoints display on the screen and become the maximum and minimum pressure limits for operation.

The remote calibration section is used to calibrate the high and low signal coming from the remote controls. For example, the machine is programmed to receive a signal from 0-10 volts. If the remote control is sending a 1.2-9.2 volt signal, the result will be a minimum pressure of 12,000 psi (827 bar) and a maximum of 78,200 psi (5,392 bar).

1. When the signal is received, press the up arrow to calibrate the maximum pressure limit, converting the 9.2 volt signal to 85,000 psi (5,860 bar).
2. Press the down arrow to calibrate the minimum pressure limit, converting the 1.2 volt signal to 10,000 psi (689 bar).

NOTE

These operations must be performed during commissioning and if the pressure changes.

In addition to setting pressure limits and calibrating the remote control signal, the pressure transducer must be calibrated.

1. Run the pump until the operating pressure and oil temperature stabilize.
2. Stop the pump and relieve all pressure from the system.
3. Press the UHP ZERO button to zero the pressure transducer.

NOTE

The transducer must be calibrated during commissioning and on a monthly basis thereafter.

Operator Configuration Screen



The Operator Configuration Screen allows the operator to set the display language and restore saved settings and parameters.

Figure 4-11: Operator Configuration Screen



LANGUAGE

Press the flag designating the desired language.



Press to restore the factory configuration settings.



Press to restore the operator selected settings and options to the last saved values.



Press to restore the operator selected operating parameters to the last saved values.



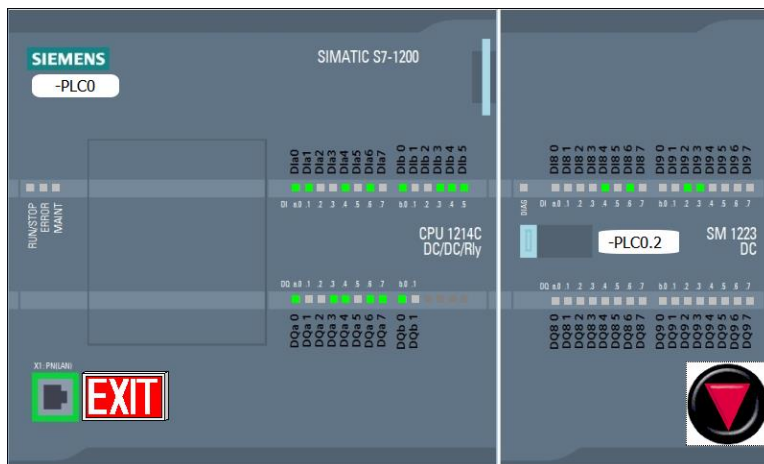
Press to restore the intensifier and pump information to the last saved values.



Press to display the PLC Screen.

The PLC Screen allows the operator to monitor the PLC inputs and outputs.

Figure 4-12: PLC Screen



4.7 Service and Maintenance

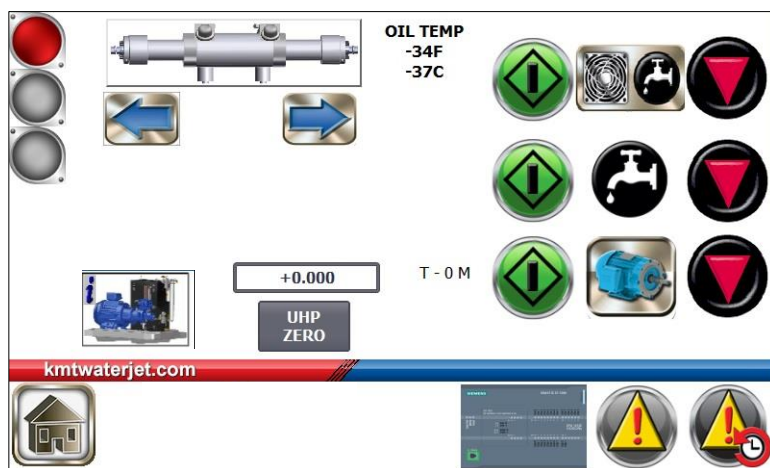


All maintenance and service activities are performed from the Main Service Screen. When selected, an automatic pump shut down is initiated. When the shutdown warning is issued, press OK to continue or press CANCEL to abort the request.

Only qualified personnel should perform maintenance on the machine.



Figure 4-13: Main Service Screen



When the left or right arrow is pressed, the piston on the selected end will extend, allowing full exposure to the plunger on the selected end when the unit is disassembled.

The unit must be completely assembled to use this function.



Press to display the General Pump Maintenance Data Screen.

Note: When this icon is pressed on the Intensifier Control Screen, the General Pump Data Screen displays. The General Pump Maintenance Data Screen is only available from the Main Service Screen.



Press the START button to turn the inlet cooling water on. This function can be used to test the cooling system.

On oil-to-water systems, the solenoid valve in the discharge cooling line will open and cooling water will flow to the heat exchanger. On oil-to-air systems, the fan will start.



Press the START button to turn the inlet cutting water on. This function can be used to purge the lines during commissioning or after maintenance.



Press the START button to start the motor. The motor will shut down after 10 minutes.



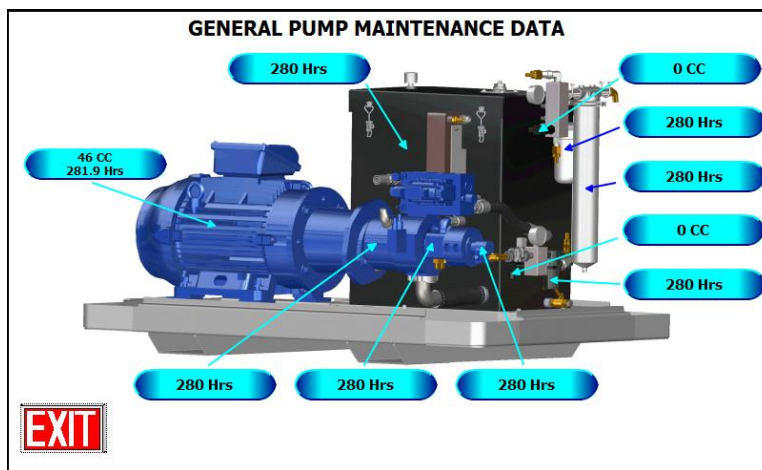
Press the UHP ZERO button to zero the pressure transducer. See Pressure Limit and Calibration Screen.

General Pump Maintenance Data Screen

The General Pump Maintenance Data Screen displays the hours and/or cycle count for maintenance and duty components that support the low pressure water, recirculation and hydraulic systems.

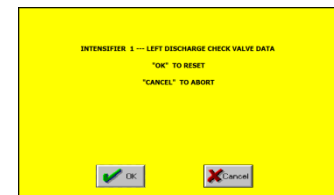
The indicator for the hydraulic oil filter and the hydraulic oil reservoir are color-coded to indicate when they are approaching the recommended replacement time, see Table 4-1, Indicator Status. The hydraulic oil filter should be replaced at 3,000 hours. The hydraulic oil should be replaced at intervals required to maintain ISO 4406 cleanliness level 18/15/13, not to exceed 6,000 hours. The oil should be replaced sooner if a fluid sample indicates contamination that cannot be rectified by filtering.

Figure 4-14: General Pump Maintenance Screen



When maintenance is performed, the operator can reset the hydraulic filter or reservoir hours by pressing the corresponding indicator.

When the confirmation warning is issued, press OK to continue or press CANCEL to abort the request.



4.8 Alarms

When an alarm condition occurs, the Alarm Screen will display over the current screen. The screen lists the type of alarm, the time and date it occurred. An 'I' in the status field indicates the alarm is active.



Pressing the ACKNOWLEDGE button will temporarily clear the screen. The status will change to 'I A' indicating the alarm has been acknowledged.

Figure 4-15: Alarm Screen

No.	Time	Date	Status	Text
20	2:33:54 PM	11/10/2014	I	REMOTE CONTROL STATION FAULT
12	2:33:54 PM	11/10/2014	I	LOCAL E-STOP ACTIVATED
11	2:33:54 PM	11/10/2014	I	QA3 TRIPPED, REMOTE SAFETY FUNCTION ACTIVATED,...
9	2:33:54 PM	11/10/2014	I	OIL LEVEL FAULT
31	2:31:13 PM	11/10/2014	I	COOLING FAN MOTOR OVER LOAD FAULT
30	2:31:13 PM	11/10/2014	I	COOLING FAN MOTOR OVERLOAD NOT OK WARNING
6	2:25:28 PM	11/10/2014	I	OIL TEMPERATURE COLD WARNING

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When the alarm condition is corrected, press the ALARM RESET button and the E-STOP RESET button, if applicable.



The status on the Alarm Screen will change to 'I A O' indicating the alarm has been reset.

The Alarm History Screen displays the last 3,000 shutdown faults indicating the time, date and type of alarm.

Figure 4-16: Alarm History Screen

No.	Time	Date	Status	Text
20	2:33:54...	11/10/2...	I	REMOTE CONTROL STATION FAULT
12	2:33:54...	11/10/2...	I	LOCAL E-STOP ACTIVATED
11	2:33:54...	11/10/2...	I	QA3 TRIPPED, REMOTE SAFETY FUNCTION ACTIVATED, INTERF...
9	2:33:54...	11/10/2...	I	OIL LEVEL FAULT
20	2:33:53...	11/10/2...	IO	REMOTE CONTROL STATION FAULT
12	2:33:53...	11/10/2...	IO	LOCAL E-STOP ACTIVATED
11	2:33:53...	11/10/2...	IO	QA3 TRIPPED, REMOTE SAFETY FUNCTION ACTIVATED, INTERF...
9	2:33:53...	11/10/2...	IO	OIL LEVEL FAULT
20	2:32:45...	11/10/2...	I	REMOTE CONTROL STATION FAULT
12	2:32:45...	11/10/2...	I	LOCAL E-STOP ACTIVATED
11	2:32:45...	11/10/2...	I	QA3 TRIPPED, REMOTE SAFETY FUNCTION ACTIVATED, INTERF...
9	2:32:45...	11/10/2...	I	OIL LEVEL FAULT
20	2:32:44...	11/10/2...	IO	REMOTE CONTROL STATION FAULT
12	2:32:44...	11/10/2...	IO	LOCAL E-STOP ACTIVATED
11	2:32:44...	11/10/2...	IO	QA3 TRIPPED, REMOTE SAFETY FUNCTION ACTIVATED, INTERF...
9	2:32:44...	11/10/2...	IO	OIL LEVEL FAULT

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Alarms are issued as faults, warnings or shutdowns. When a fault alarm occurs, shutdown is immediate. The motor stops, the dump valve opens and all high pressure and hydraulic pressure are relieved.

A warning alarm indicates a potential shutdown condition is being monitored. If the condition persists, shutdown will occur.

A shutdown alarm will result in a shutdown after a given time interval. The interval depends on the type of warning.

Table 4-3 lists all alarms along with the indication and possible remedies.

Table 4-3
Alarms

ID	Alarm	Indication and Comments	Possible Remedies
1	Low Water Inlet Pressure Switch Fault	A shutdown has occurred due to low inlet water pressure, less than 30 psi (2 bar).	Check water supply.
			Check water strainer.
2	Low Water Inlet Pressure Peak Count Fault	A shutdown has occurred due to inconsistent inlet water pressure, peaks in pressure falling below 30 psi (2 bar). The water pressure has fallen below 30 psi (2 bar) 10 times.	Check water supply.
			Check water strainer
3	Low Water Inlet Peak Count Warning	Inconsistent inlet water pressure, peaks in pressure falling below 30 psi (2 bar). A warning is issued when the water pressure falls below 30 psi (2 bar) eight times.	Check inlet water supply.
			Check plumbing to ensure it is sized properly.
			If the facility water pressure is below, or can fall below 35 psi (2.4 bar), a water pressure booster pump is required.
4	Low Inlet Water Pressure Warning	Cutting supply water pressure is inadequate for proper machine operation, less than 30 psi (2 bar). If the condition persists, shutdown will occur.	Check water supply.
			Check water strainer.
5	Booster Pressure Switch Fault	A shutdown has occurred due to low booster water pressure, less than 100psi (6.9 bar).	Check booster pump adjustment.
			Check condition of booster pump and replace if necessary.

Table 4-3
Alarms

ID	Alarm	Indication and Comments	Possible Remedies
6	Oil Temperature Cold Warning	Oil temperature has dropped below 68° F (20° C). If the condition persists, shutdown will occur. High pressure will not be generated while the oil is cold.	Start the hydraulic motor to warm the oil. When the oil has reached the appropriate temperature the motor will shut down.
7	Oil Temperature Hot Warning	High hydraulic oil temperature, in excess of 144° F (62° C). If the condition persists, shutdown will occur.	Check the cooling system.
8	Oil Hot Pending Shutdown	High hydraulic oil temperature, in excess of 144° F (62° C). If the condition persists, shutdown will occur.	Check the cooling system.
9	Oil Level Fault	Shutdown has occurred as a result of low hydraulic oil level.	Check the level gauge.
			Check for hydraulic leaks.
			Check the oil level switch.
10	Oil Hot Fault	Shutdown has occurred as a result of high hydraulic oil temperature. High pressure will not be generated while the oil is hot.	Fix the cooling system supply and start the hydraulic motor to cool the oil.
11	QA3 Tripped, Remote Safety Function Activated, Interface Plug Disconnected	The QA3 breaker has tripped.	Find and fix the cause of the trip then reset the breaker.
		The safety remote function is activated.	Reset the safety remote function.
		The interface plug is disconnected.	Connect the interface plug.
12	Local E-Stop Activated Fault	E-stop button on the pump has been activated, resulting in shutdown.	Pull the e-stop button out. Press the e-stop reset and fault reset buttons.
13	Local Safety Function Relay Fault	Wiring is damaged or loose.	Check wiring and replace or repair as needed.
		E-stop switch contacts are broken.	Replace the contacts.
		Defective safety relay.	Replace the safety relay.

Table 4-3
Alarms

ID	Alarm	Indication and Comments	Possible Remedies
14	Remote Start PB On Fault	Remote start command stayed on too long resulting in a shutdown. Command should be a momentary signal < 0.5s.	Check the software or hardware source of start command.
		Wiring has shorted.	Repair or replace the wiring.
		Start pushbutton is damaged.	Replace the pushbutton.
15	Local Start PB On Fault	Local start command stayed on too long resulting in a shutdown.	Train operators to not hold button on too long.
		HMI touch screen is defective.	Replace touch screen.
16	Safety Function Reset Dump Valve Pneumatic Pressure Switch (DVPPS) Fault	There is air pressure to the dump valve when it should be off.	Check the pneumatic valves for proper operation and/or bypassing.
		Defective dump valve pneumatic pressure switch	Replace the switch.
17	DVPPS Off Fault	There is air pressure to the dump valve when it should be off.	Check the pneumatic valves for proper operation and/or bypassing.
		Defective dump valve pneumatic pressure switch	Replace the switch
18	DVPPS On Fault	There is no air pressure to the dump valve when it should be on.	Check the pneumatic valve for proper operation.
		Defective dump valve pneumatic pressure switch	Replace the switch
19	Motor Overload Fault	The PLC monitors the motor overload relay and issues a fault when the overloads trip.	Check incoming voltage.
			Check overload setting.
			Check the motor amperage.
20	Remote Control Station Fault	Remote start, stop and fault reset buttons are not in the correct position for proper operation.	Check the wiring.
			Verify the remote interface plug is connected.

Table 4-3
Alarms

ID	Alarm	Indication and Comments	Possible Remedies
21	Cooling Fan Overload Fault	Overload has tripped on the cooling fan motor resulting in a shutdown. <i>Applies only to units equipped with an optional cooling system.</i>	Check incoming voltage.
			Check overload settings.
			Check motor amperage.
22	Cooling Fan Overload Warning	Overload has tripped on the cooling fan motor. If the condition persists, intensifier shutdown will occur. Warning is only issued during high pressure generation. <i>Applies only to units equipped with an optional cooling system.</i>	Check incoming voltage.
			Check overload settings.
			Check motor amperage.
23	Cooling Fan Not Operating Warning	Cooling fan motor failed to turn on for cooling. If the condition persists, intensifier shutdown will occur. Warning is only issued during high pressure generation. <i>Applies only to units equipped with an optional cooling system.</i>	Check incoming voltage.
			Check overload settings.
			Check motor amperage.
24	Idle Time Two Minute Shutdown Warning	Intensifier has run in a deadhead condition for the customer adjusted time limit (0-60 minutes). If the condition persists, shutdown will occur in two (2) minutes.	Cycle intensifier or adjust time limit.
25	Change Oil Filter Warning	Hydraulic oil filter requires replacement.	Change the oil filter and then reset the indicator
26	Cover Interlock SSW1 Open Warning	Cover for intensifier 1 is open. If the condition persists for two (2) minutes, shutdown will occur. <i>Applies only to units equipped with optional cover interlock.</i>	Close and lock the cover.
27	Cover Interlock SSW2 Open Warning	Cover for intensifier 2 is open. If the condition persists, shutdown will occur. <i>Applies only to units equipped with optional cover interlock.</i>	Close and lock the cover.



Table 4-3
Alarms

ID	Alarm	Indication and Comments	Possible Remedies
28	Safety Function Interlock Relay Timer Started Warning	Cover is open. If the condition persists for two (2) minutes, shutdown will occur in two minutes. <i>Applies only to units equipped with optional cover interlock.</i>	Close and lock the cover.
29	Safety Function Interlock Time Expired Fault	Shutdown has occurred as a result of an open cover. If the cover is closed, but it is not locked, the two (2) minute timer starts. <i>Applies only to units equipped with optional cover interlock.</i>	Close and lock the cover.
30	Cooling Fan Motor Overload Not OK Warning	The overload has tripped. If the condition persists, shutdown will occur.	
31	Cooling Fan Motor Overload Fault	The overload has tripped resulting in a shutdown.	
32	Left OS Warning	A left overstroke condition has occurred. Abnormally high stroke rate caused by an external or internal leak. Shutdown will occur if condition persists.	Check left high pressure seal. Check right discharge check valve. Check left inlet check valve.
33	Right OS Warning	A right overstroke condition has occurred. Abnormally high stroke rate caused by an external or internal leak. Shutdown will occur if condition persists.	Check right high pressure seal. Check left discharge check valve. Check right inlet check valve.

Table 4-3
Alarms

ID	Alarm	Indication and Comments	Possible Remedies
34	Intensifier OS Warning	<p>A topworks overstroke condition has occurred.</p> <p>Abnormally high stroke rate caused by an external or internal leak. Shutdown will occur if condition persists.</p> <p>An intensifier overstroke warning indicates the intensifier is stroking too fast in both directions.</p>	Check plumbing for leaks.
			Check high pressure orifice.
			Check incoming water pressure.
			Check inlet and discharge check valves.
35	Left OS Shutdown Pending	A left overstroke condition has occurred and shutdown will occur in 30 seconds.	Check left high pressure seal.
			Check right discharge check valve.
			Check left inlet check valve.
36	Right OS Shutdown Pending	A right overstroke condition has occurred and shutdown will occur in 30 seconds.	Check right high pressure seal.
			Check left discharge check valve.
			Check right inlet check valve.
37	Intensifier OS Shutdown Pending	<p>An intensifier overstroke condition has occurred and shutdown will occur in 30 seconds.</p> <p>If the machine is running near full capacity, it is possible an intensifier shutdown is actually caused by a left or right warning. This can be diagnosed further by reducing the operating pressure and monitoring all alarm occurrences on the Alarm Screen.</p> <p>If the machine is equipped with a pressure transducer, another level of overstroke protection is obtained by shutting down at the warning level if the pressure is less than 3,000 psi (207 bar).</p>	Check plumbing for leaks.
			Check high pressure orifice.
			Check incoming water pressure.
			Check inlet and discharge check valves.



Table 4-3
Alarms

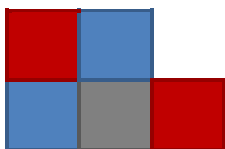
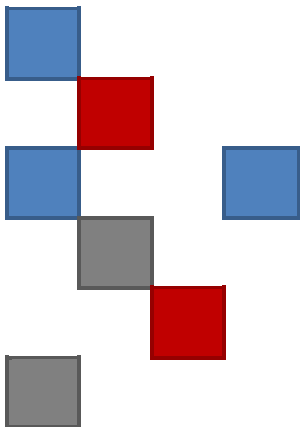
ID	Alarm	Indication and Comments	Possible Remedies
38	Left OS Shutdown Fault	Shutdown has occurred as a result of a left overstroke.	Check left high pressure seal.
			Check right discharge check valve.
			Check left inlet check valve.
39	Right OS Shutdown Fault	Shutdown has occurred as a result of a right overstroke.	Check right high pressure seal.
			Check left discharge check valve.
			Check right inlet check valve.
40	Intensifier OS Shutdown Fault	Shutdown has occurred as a result of an intensifier overstroke.	Check plumbing for leaks.
			Check high pressure orifice.
			Check incoming water pressure.
			Check inlet and discharge check valves.
41	Booster Pressure Warning	Booster pump output pressure is inadequate for proper machine operation, less than 100 psi (6.8 bar). If the condition persists, shutdown will occur.	Check booster pump adjustment.
			Check condition of booster pump and replace if necessary.

SECTION 5

LOW PRESSURE WATER SYSTEM

The Low Pressure Water System section details:

- Principles of operation and function of the system
- Routine maintenance procedures associated with the system

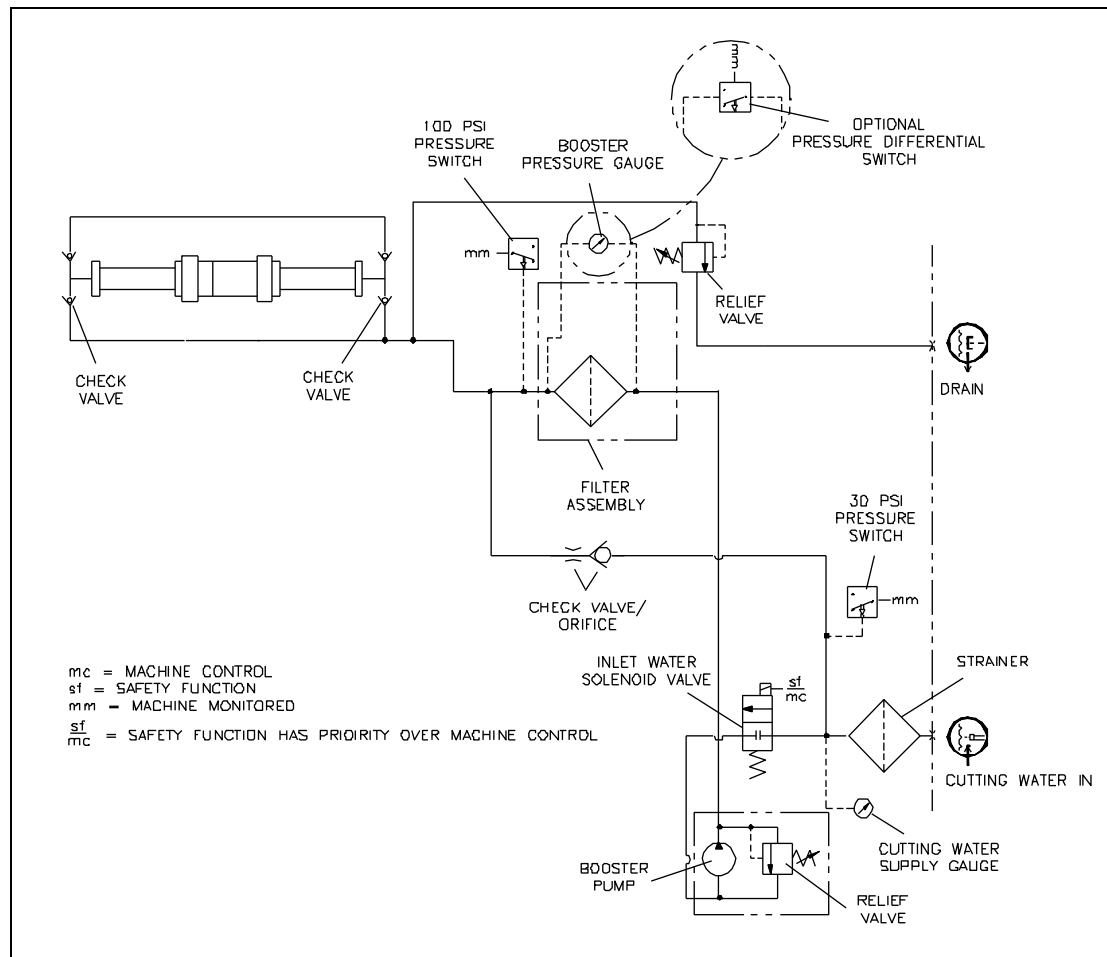


5.1 Overview

The SL-VI Pro III 60 utilizes two low pressure circuits: cutting water supply and cooling water supply. This section will discuss the cutting water supply circuit. See Section 6, Recirculation System, for a detailed explanation of the cooling water supply circuit.

The cutting water supply circuit supplies the intensifier with the required cutting water flow and pressure. System components include the strainer, inlet water solenoid valve, booster pump and the low pressure filter assembly. Pressure sensors, connected to the PLC, monitor out of tolerance conditions in the cutting water circuit and provide automatic shutdown protection.

Figure 5-1: Low Pressure Water System Schematic



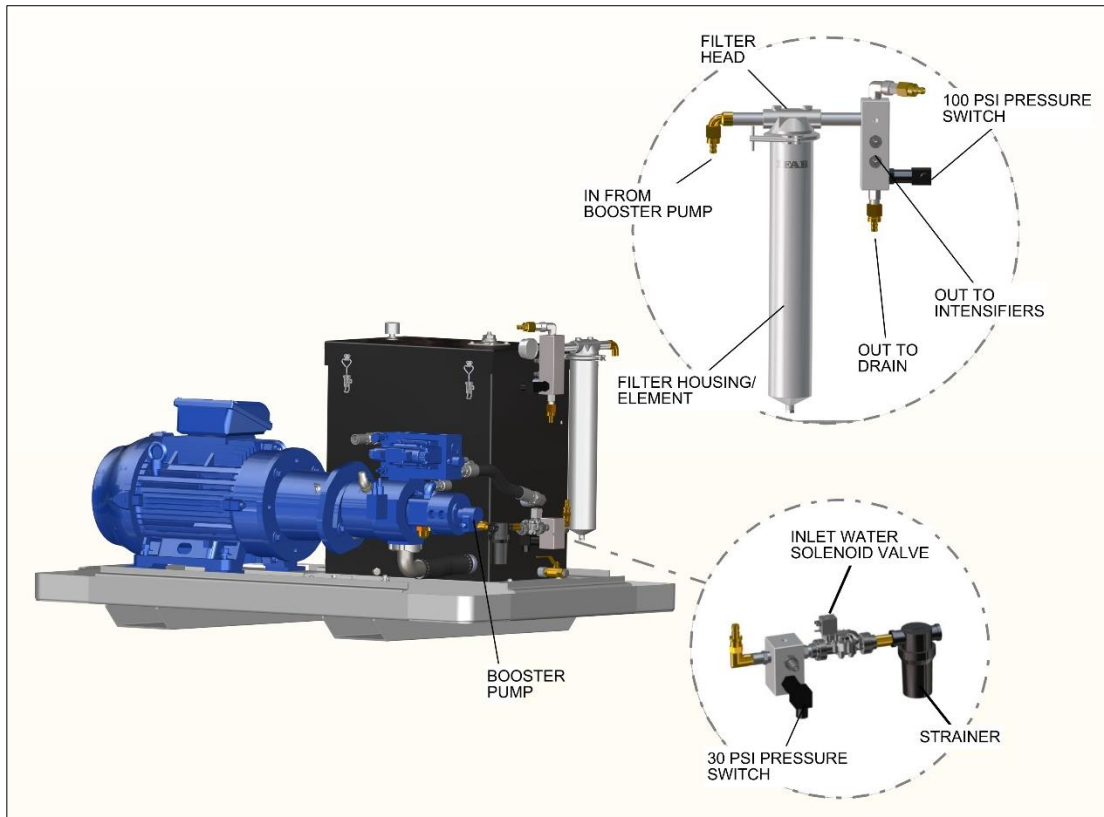
5.2 Cutting Water Supply

The quality of the inlet cutting water supply is one of the most important factors affecting component life and performance. Impurities in the water create grinding and corrosive effects on all components. See Section 11, Specifications, for details regarding water quality standards.

5.3 Operation

Cutting water is introduced through the 1/2-inch NPT connection on the bulkhead of the machine. Inlet cutting water pressure should be a minimum of 35 psi (2.4 bar) flowing, and can be monitored from the pressure gauge located on the front of the machine.

Figure 5-2: Low Pressure Water System



Cutting water passes through a strainer to remove debris before the water enters the normally closed, inlet water solenoid valve. When the motor is turned on, the solenoid valve opens and allows water to flow through the valve. The inlet water is monitored by a 30 psi pressure switch mounted on the inlet manifold. If the pressure drops below 30 psi (2 bar) the switch activates an automatic shutdown circuit in the PLC and the motor will not start. The inlet solenoid valve closes 15 seconds after the motor shuts off.

NOTE

The motor will not start if inlet cutting water pressure is below 30 psi (2 bar).

The booster pump increases the pressure up to a maximum of 180 psi (12.4 bar) to ensure proper supply to the intensifier assembly.

Pressurized water passes through the filter assembly where debris is removed to prevent contaminants from damaging the check valves and seals in the intensifier. The filter assembly consists of a filter head, housing and a 10 micron absolute filter.

As the water enters the outlet manifold, the discharge pressure is monitored by a 100 psi pressure switch. An automatic shutdown will occur if the pressure is below 100 psi (6.9 bar).

If the booster pump pressure exceeds 205 psi (14 bar) a relief valve opens allowing water to exit through the 1/2-inch drain connection on the bulkhead. It is still possible to operate the machine; however, excess water will continue to be released through the drain.

Discharge pressure is displayed on the pressure gauge on the front of the machine. The maximum gauge pressure should read approximately 180 psi (12.4 bar) while the machine is idling. When the pump is stroking, the water pressure range should remain between 150-180 psi (10.3-12.4 bar) during operation.

NOTE

While the intensifier assembly reverses direction, the boosted pressure will fluctuate slightly above and below the normal setting.

A relief valve built into the filter assembly prevents excessive discharge pressure and typically operates when the machine is in a deadhead condition. The booster pump is factory set to deliver 180 psi (12.4 bar) with an inlet pressure of 58 psi (4 bar). The pump may require adjustment to satisfy system requirements.

To reduce overheating during a deadhead condition, water is re-circulated through the orifice in the check valve, and routed back through the inlet of the booster pump.

From the outlet manifold, cutting water is routed to the inlet check valves in the sealing head on each end of the intensifier. If the machine is equipped with redundant intensifiers, the cutting water supply lines are manually connected to the active intensifier and manual hydraulic valves are opened or closed to direct the hydraulic flow to the active intensifier. Control is switched from one intensifier to the other from the control panel.

5.4 Service and Maintenance Procedures

To ensure water quality and supply to the high pressure system, the filter element, strainer and booster pump will require routine servicing and maintenance. The procedures for servicing these components are detailed below.

NOTE

Refer to Section 12, Parts List, for a complete listing of replacement parts.

Filter Assembly and Strainer Maintenance

The life of the filter element is directly related to the quality of the inlet water. The condition of the filter element can be monitored by observing the pressure gauge on the front of the machine. Document the pressure reading when the filter element is new. The element should be replaced when the pressure drops to 15 psi (1 bar) below the original value. When the filter element is replaced, the strainer should also be cleaned.

Use the following procedure to replace the filter element and clean the strainer.

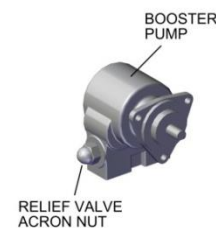
1. Turn the cutting water supply off.
2. Turn the v-clamp handle to loosen and remove the v-clamp.
3. Slide the filter housing away from the head and remove the old filter element.
4. Install the new element in the center of the housing.
5. Apply FML-2 grease to the o-ring in the filter head.
6. Position the housing in the filter head. Position the v-clamp and tighten the handle.
7. Unscrew and remove the strainer body. Remove and clean the mesh liner.
8. Ensure the gasket is positioned properly in the body, install the liner and screw the strainer body into the strainer head, hand tighten.
9. Turn the cutting water supply on.
10. Start the machine and verify satisfactory pressure readings.



Booster Pump Adjustment

If the discharge pressure from the booster pump stays below 150 psi (10.3 bar) while the intensifier is shifting, the relief valve on the booster pump should be adjusted.

1. Turn the cutting water supply on.
2. Start the machine and initiate normal, shifting operation.
3. Observe the discharge pressure from the booster pump. If the pressure stays below 150 psi (10.3 bar), continue with Step 4.
4. Stop the intensifier and access the adjustment screw in the acorn nut.
5. Use a flat screwdriver and turn the adjustment screw clockwise to increase the discharge pressure or counter-clockwise to decrease the pressure. Adjust the pressure to the highest desired pressure, within normal booster pump range.





If the adjustment screw is turned too far out (counter-clockwise) an internal spring and relief will fall down inside the pump. If this occurs, remove the pump and reinstall the parts to avoid component damage.

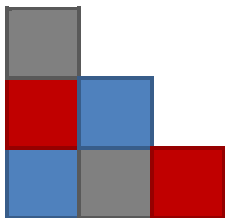
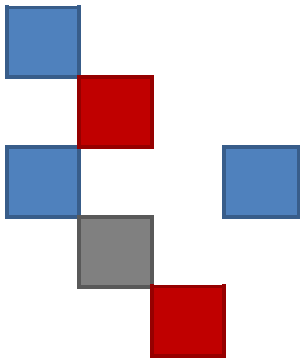
6. Resume normal operation and observe the booster discharge pressure. Peak pressure should be 180 psi (12.4 bar). If it is not, repeat the adjustment procedure.

SECTION 6

RECIRCULATION SYSTEM

The Recirculation System section details:

- Principles of operation and function of the system
- Principles of operation for systems equipped with optional cooling systems
- Routine maintenance procedures associated with the system

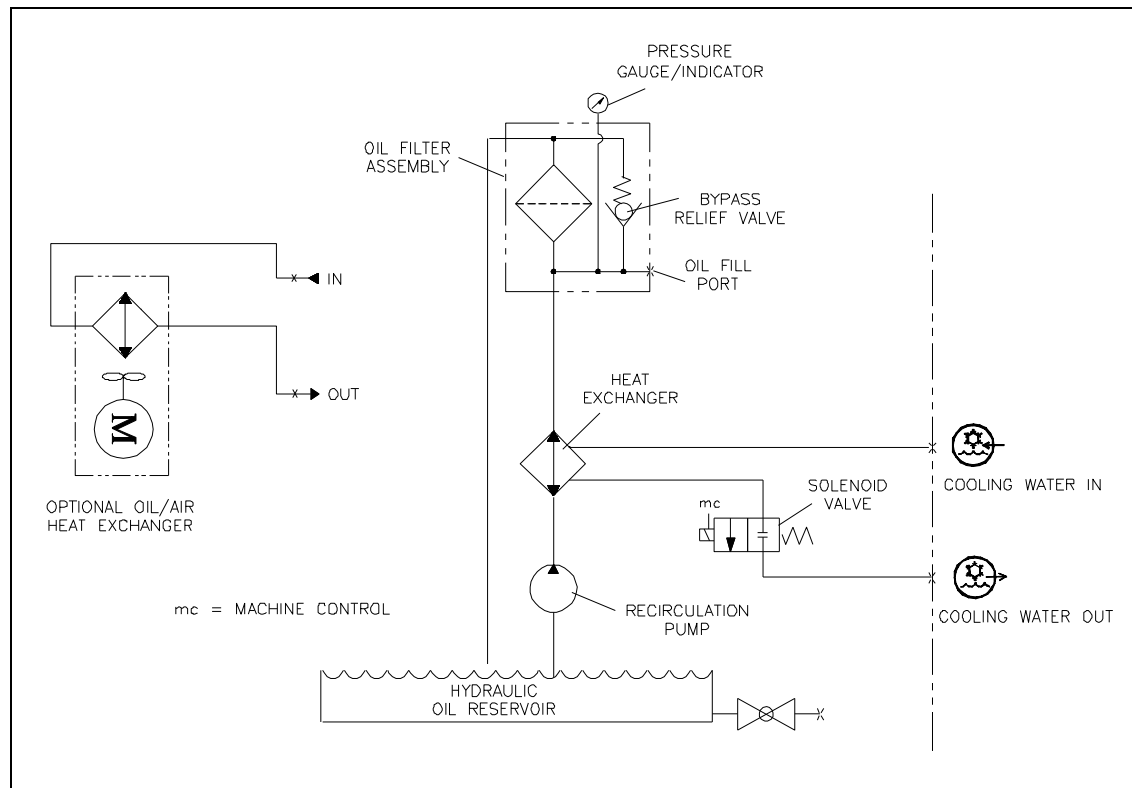


6.1 Overview

The oil recirculation circuit is a cooling and filtration system that provides properly conditioned oil to the main hydraulic system. Hydraulic oil is maintained at the proper operating temperature and condition by continuous recirculation.

System components include a solenoid valve (oil-to-water models), recirculation pump, heat exchanger, oil filter assembly and the hydraulic oil reservoir. A temperature sensor/low level switch, connected to the PLC, monitors temperature and oil level conditions in the hydraulic oil reservoir and provides automatic shutdown protection.

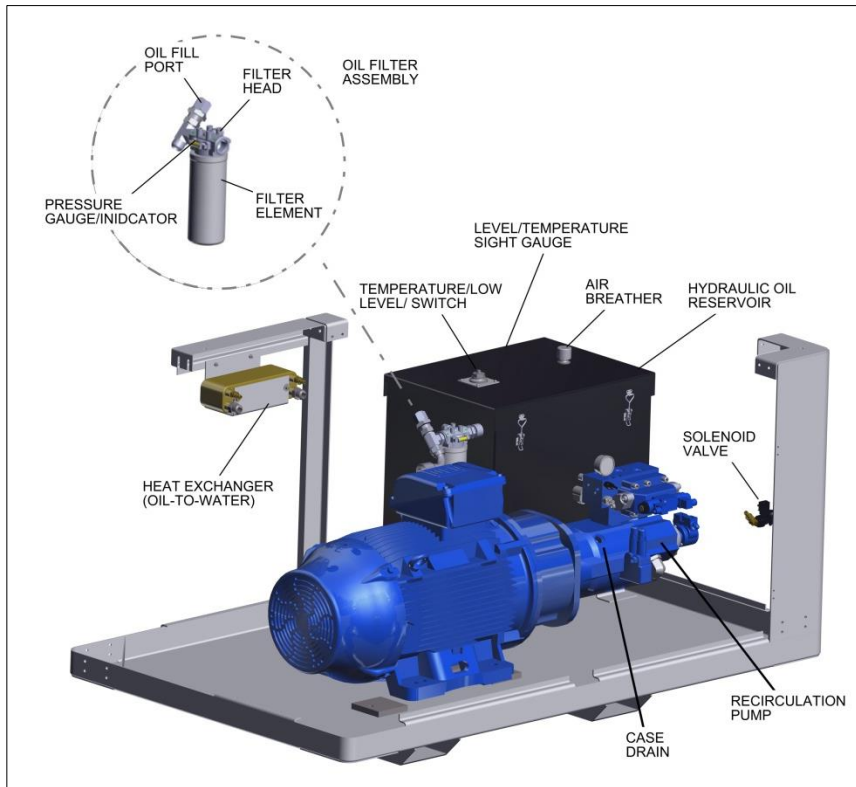
Figure 6-1: Recirculation System Schematic



6.2 Operation (Oil-to-Water Cooling System)

Cooling water is introduced through the 1/2-inch NPT connection on the bulkhead of the machine. A solenoid valve in the outlet line regulates the cooling water flow through the heat exchanger. Oil temperature is monitored from a dual scale level/temperature sight gauge on the side of the hydraulic oil reservoir.

Figure 6-2: Recirculation System (Oil-to-Water)



The recirculation pump pulls oil from the hydraulic oil reservoir and sends it to the heat exchanger. The oil-to-water heat exchanger controls heat build-up in the hydraulic oil. The plate style design allows cooling water and oil to flow side by side through alternating plates.

The cooled oil then passes through the filter element and returns to the reservoir. The cooling water either is discharged to the 1/2-inch NPT drain on the bulkhead or is routed to a customer supplied water chiller.

The hydraulic oil filter assembly consists of the filter head, a filter element, a differential pressure indicator, bypass relief valve and the oil fill port. Change the filter element when the indicator enters the red zone at normal operating temperature or after 3,000 hours whichever comes first.

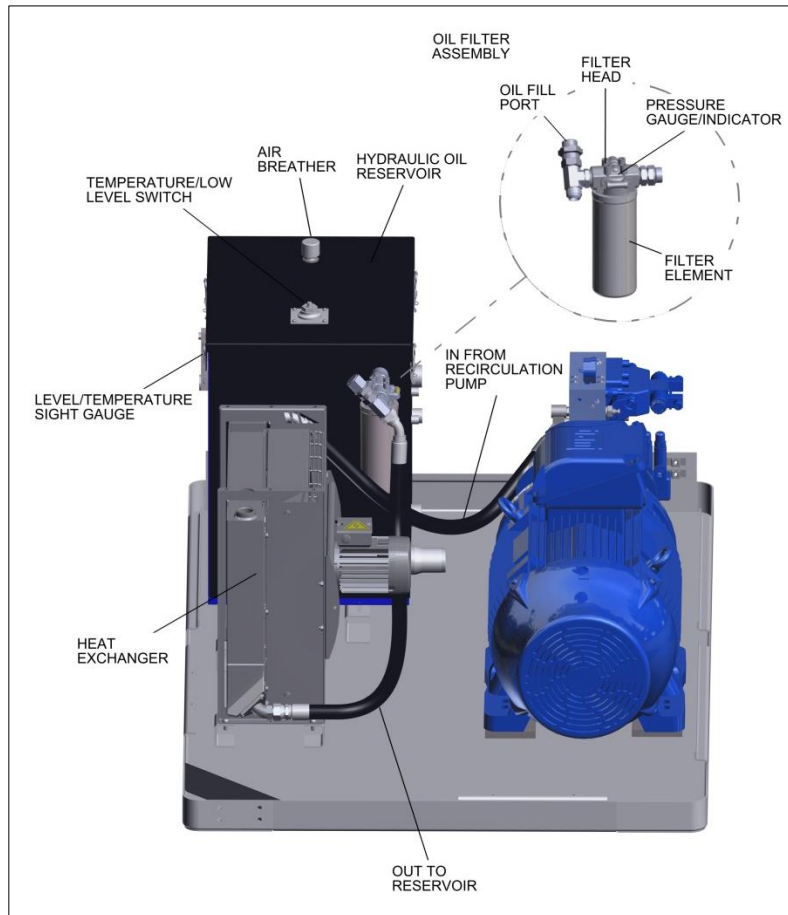
If the element is not replaced, and fills with debris, the bypass relief in the filter head will open to prevent over pressurization. The relief valve opens at 25 psi (1.7 bar). When the valve opens, the oil bypasses the filter and unfiltered oil is allowed to return to the reservoir.

The temperature sensor/low level switch monitors the oil temperature and level in the reservoir. An automatic shutdown will occur if the operating oil temperature exceeds 144° F (62° C). An automatic shutdown will also occur if the oil level falls below the specified volume in Section 11, Specifications.

6.3 Operation (Onboard Oil-to-Air Cooling System)

The recirculation pump pulls oil from the hydraulic oil reservoir and sends it to the heat exchanger. The temperature sensor mounted on the reservoir monitors the oil temperature and regulates the air flow to the heat exchanger through a signal to the PLC to initiate power to the fan. Oil temperature is monitored from a dual scale level/temperature sight gauge on the side of the reservoir.

Figure 6-3: Recirculation System (Oil-to-Air)



The cooled oil then passes through the filter element and returns to the reservoir.

The hydraulic oil filter assembly consists of the filter head, a filter element, a differential pressure indicator, bypass relief valve and the oil fill port. Change the filter element when the indicator enters the red zone at normal operating temperature or after 3,000 hours whichever comes first.

If the element is not replaced, and fills with debris, the bypass relief in the filter head will open to prevent over pressurization. The relief valve opens at 25 psi (1.7 bar). When the valve opens, the oil bypasses the filter and unfiltered oil is allowed to return to the reservoir.

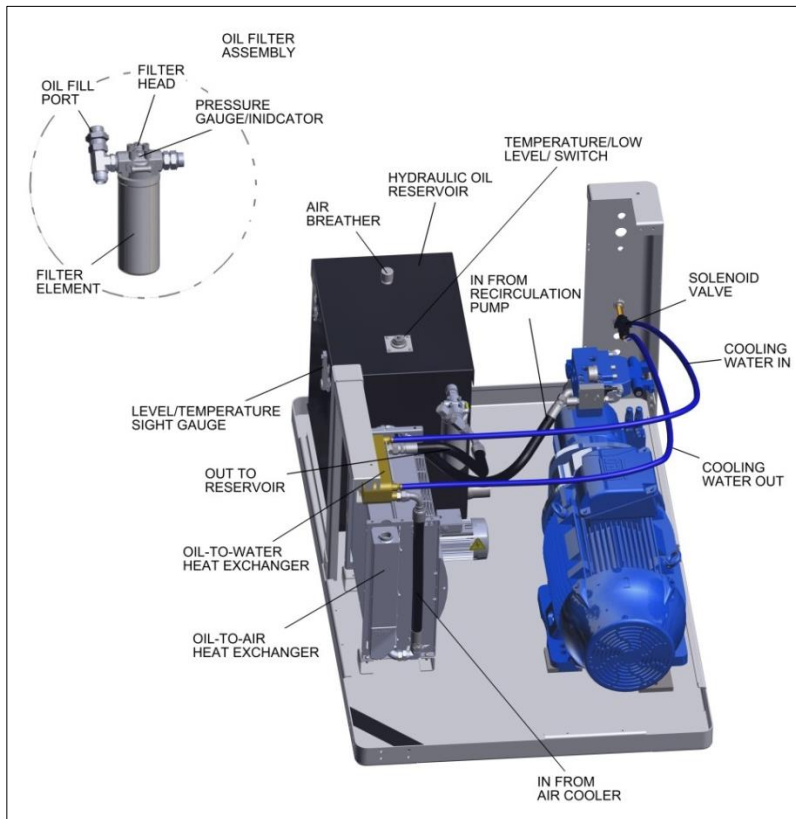
The temperature sensor/low level switch monitors the oil temperature and level in the reservoir. An automatic shutdown will occur if the operating oil temperature exceeds 144° F (62° C). An automatic shutdown will also occur if the oil level falls below the specified volume in Section 11, Specifications.

6.4 Operation (Onboard Water/Air Combination Cooling System)

The recirculation pump pulls oil from the hydraulic oil reservoir and sends it to the oil-to-air heat exchanger. The temperature sensor mounted on the reservoir monitors the oil temperature and regulates the air flow to the heat exchanger through a signal to the PLC to initiate power to the fan. Oil passes through the air cooling circuit and enters the oil-to-water heat exchanger.

Cooling water is introduced through the 1/2-inch NPT connection on the bulkhead of the machine. A solenoid valve in the outlet line regulates the cooling water flow through the water cooling circuit. Oil temperature is monitored from a dual scale level/temperature sight gauge on the side of the hydraulic oil reservoir.

Figure 6-4: Recirculation System (Combination Water/Air)



The cooled oil then passes through the filter element and returns to the reservoir. The cooling water either is discharged to the 1/2-inch NPT drain on the bulkhead or is routed to a customer supplied water chiller.

The hydraulic oil filter assembly consists of the filter head, a filter element, a differential pressure indicator, bypass relief valve and the oil fill port. Change the filter element when the indicator enters the red zone at normal operating temperature or after 3,000 hours whichever comes first.

If the element is not replaced, and fills with debris, the bypass relief in the filter head will open to prevent over pressurization. The relief valve opens at 25 psi (1.7 bar). When the valve opens, the oil bypasses the filter and unfiltered oil is allowed to return to the reservoir.

The temperature sensor/low level switch monitors the oil temperature and level in the reservoir. An automatic shutdown will occur if the operating oil temperature exceeds 144° F (62° C). An automatic shutdown will also occur if the oil level falls below the specified volume in Section 11, Specifications.

6.5 Service and Maintenance Procedures

To ensure the supply of properly conditioned oil to the main hydraulic system, the components will require routine servicing and maintenance. The procedures for servicing these components are detailed below.



NOTE

Refer to Section 12, Parts List, for a complete listing of replacement parts.

Hydraulic Oil Maintenance

The hydraulic oil should be changed at intervals required to maintain ISO 4406 cleanliness level 18/15/13, not to exceed 6,000 hours. The oil should be replaced sooner if a fluid sample indicates contamination that cannot be rectified by filtering.

An air breather and filter is located on the top of the reservoir. The air breather prevents dirt from being sucked into the reservoir when the oil level drops, and allows air to escape when the level rises. The air breather must not be used as a fill point. Oil **must only** be replaced at the fill port on the filter head.



Do not attempt to fill the reservoir from the air breather. The oil will not be filtered and will not conform to the cleanliness requirements of the system.

Figure 6-5: Hydraulic Oil Reservoir



Before proceeding, disconnect and lockout the main power supply and the electrical enclosure; and ensure that all high pressure water and hydraulic pressure has been bled from the system.



Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.



1. Drain the oil reservoir by connecting the inlet hose from an oil transfer pump to the drain valve on the reservoir.
2. Open the shut off valve on the drain and pump the used oil out to a container.
3. Close the shut off valve and remove the inlet hose from the drain valve.

NOTE

Oil from a new drum does not meet the cleanliness requirements of the hydraulic system. For this reason, it is important to use an oil transfer pump that will force oil through the return filter into the reservoir.

4. Remove the cap from the fill port on the oil filter.



To ensure cleanliness, the oil fill port **must** be used to pump oil into the reservoir. Filling at this point guarantees the hydraulic oil will pass through the oil filter before entering the reservoir.

5. Connect the discharge hose from the oil transfer pump to the fill port and pump the fresh oil into the reservoir.

NOTE

If 3/4-inch BSPP threads are required, install the adapter located on the inside of the frame. When filling is complete, remove the adapter and install the fill port cap.

6. Check the oil sight gauge on the reservoir to ensure proper fill level.
7. Remove the hose from the case drain on the main hydraulic pump to make sure the pump case fills with oil. With the hose removed, head pressure from the reservoir will force oil into the pump case.



Oil in the pump case provides internal lubrication for the main hydraulic pump. Failure to fill the pump case with oil will allow air to become trapped inside, damaging the pump.

8. Disconnect the discharge hose from the fill port and replace the fill port cap.
9. Follow the initial startup sequence in Section 4, Operation, to ensure the system is filled with oil.
10. Check the sight gauge again and follow the same procedure to add additional oil if necessary.

Pump Priming

Whenever the hydraulic reservoir is drained or the hydraulic pump is changed, bumping the electric motor is suggested. Bumping is defined as allowing the electric motor to start rotating, but stopping it before the motor gets up to full speed.

This procedure will ensure the hydraulic pump is full of oil and deter cavitation that will cause the hydraulic pump to fail prematurely.



Do not perform this procedure until the correct motor rotation and the presence of hydraulic oil in the hydraulic pump case drain line has been confirmed.

1. Disconnect the case drain to verify the presence of hydraulic oil.
2. Start the pump from the Main Service Screen, count two seconds and turn the pump off.
3. Repeat this process two times before allowing the hydraulic pump to create pressure.

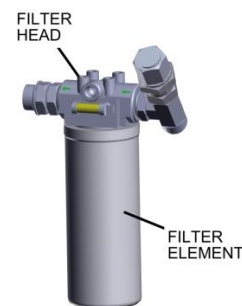
Oil Filter Maintenance

If it is not properly serviced, the filter element fills with debris and the oil will be forced through the relief valve, bypassing the filter. The bypass relief valve opens at 25 psi (1.7 bar). The filter element must be replaced when the pressure indicator is in the yellow zone or entering the red zone during normal operating conditions or after 3,000 hours whichever comes first.

NOTE

Normal operating conditions indicate the machine is running and the oil temperature has reached 120° F (48° C).

1. Use a filter wrench to unscrew the filter element from the filter head. Make sure the old gasket is removed with the element.
2. Lubricate the gasket on the new element with fresh oil.
3. Use the filter wrench to screw the new element onto the filter head and hand-tighten. Do not over tighten.
4. Start the machine and check for leaks.





NOTE

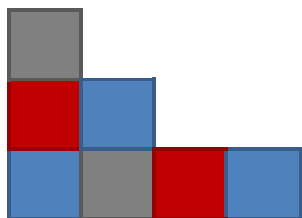
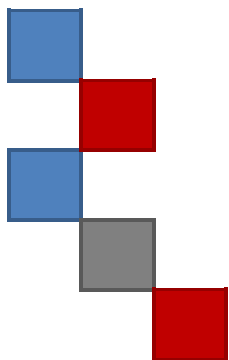
If the indicator is in the red zone after the filter is changed, check the operating condition of the gauge or indicator. These components may require replacement.

SECTION 7

HYDRAULIC SYSTEM

The Hydraulic System section details:

- Principles of operation and function of the system
- Routine maintenance procedures associated with the system

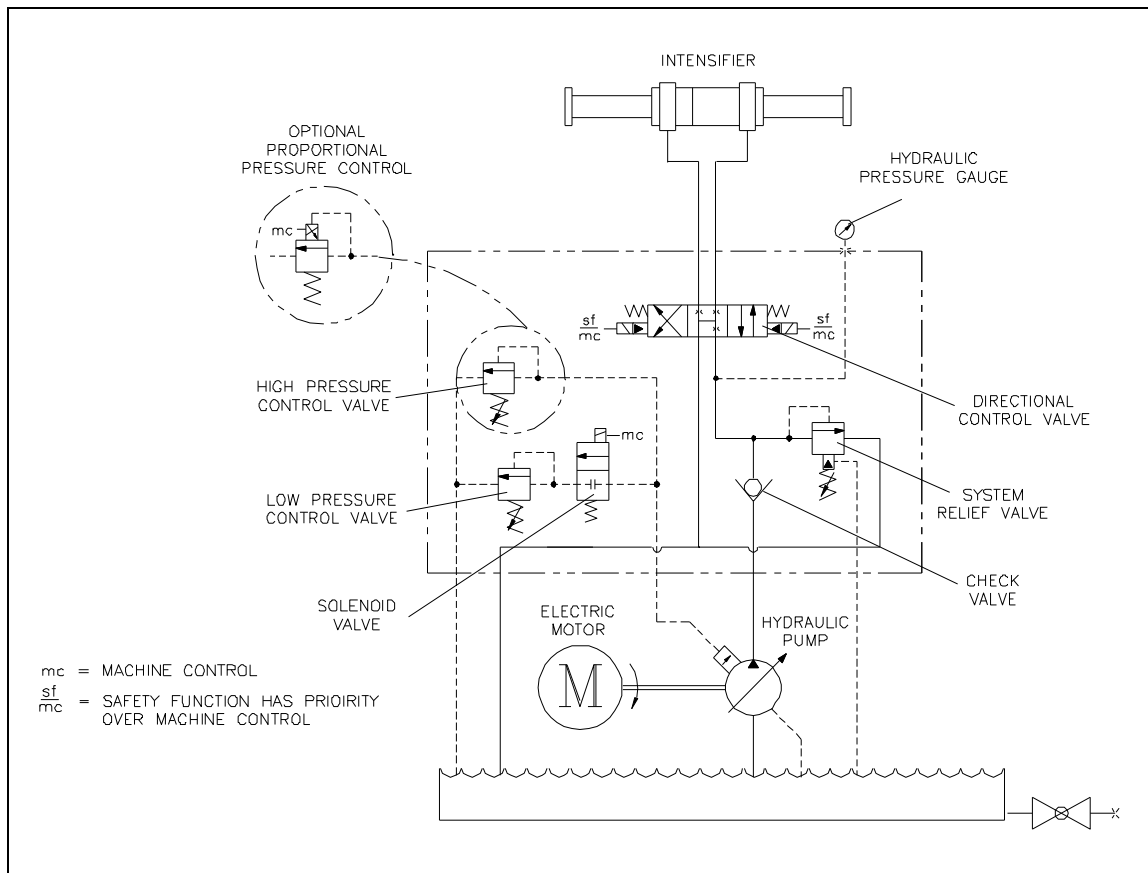


7.1 Overview

The main hydraulic power circuit supplies the intensifier assembly with the hydraulic oil required to produce high pressure water. High pressure cutting water is generated from the oil pressure in the hydraulic cylinder.

System components include the electric motor, hydraulic pump, 4-way directional control valve and the hydraulic manifold. The manifold houses the low pressure control valve, proportional pressure control valve, hydraulic gauge and the main system relief valve. The system relief valve monitors hydraulic oil pressure and provides system protection by limiting excess pressure.

Figure 7-1: Hydraulic System Schematic

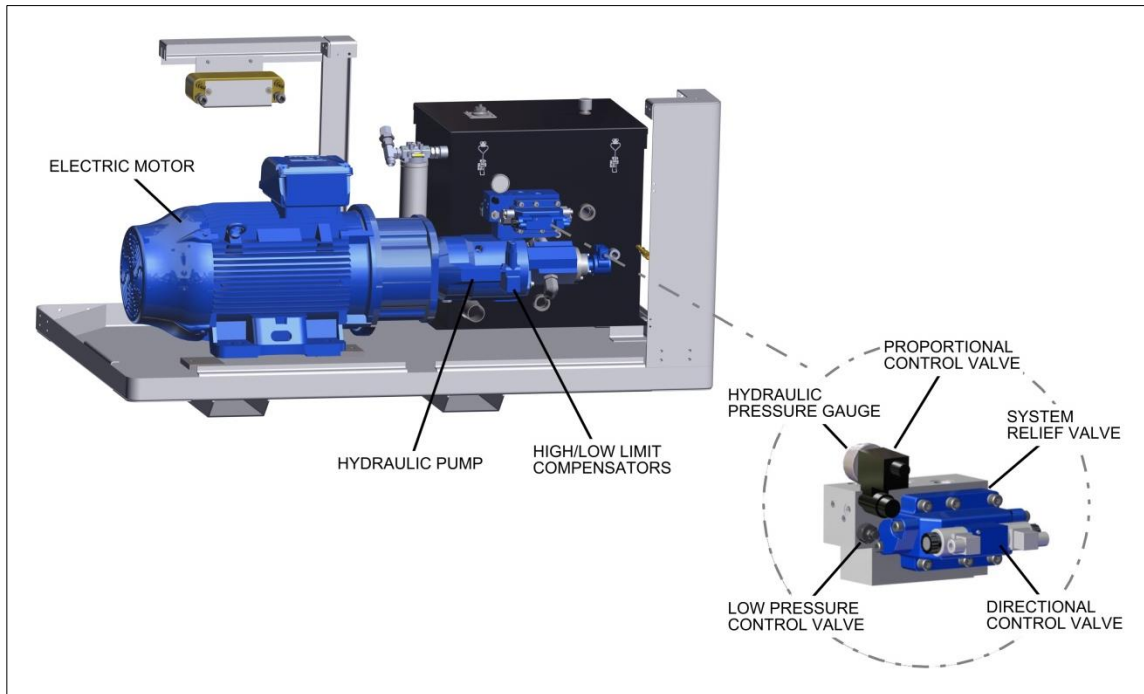


7.2 Operation

The electric motor drives three pumps mounted in tandem; the main hydraulic pump, the recirculation pump and the booster pump.

Hydraulic fluid from the reservoir is drawn into the inlet, low pressure side of the hydraulic pump. Oil delivered to the pump should be maintained at 110-120° F (43-49° C). Hydraulic fluid then enters the bottom of the manifold through an internal anti-rotation check valve. After a shutdown, the anti-rotation check valve prevents the pump from running backwards.

Figure 7-2: Hydraulic System



The main system relief valve provides system protection by monitoring the oil pressure entering the manifold. If the hydraulic pressure exceeds 2,610 psi (180 bar) the valve opens to limit the pressure. The valve is factory calibrated and is not serviceable. A drain line from the valve prevents oil from collecting behind the relief valve to ensure a constant pressure under all operating conditions.

The hydraulic system operates at high or low pressure settings up to the maximum flow capacity of the hydraulic pump. The high and low limit compensators mounted on the pump regulate the flow of hydraulic fluid to maintain constant operating pressures. Low operating pressures are set and adjusted at the low pressure control valve on the manifold. High pressure adjustments are made from the Dashboard on the control panel.



The high and low limit compensators regulate the flow of hydraulic fluid to the system by controlling the angle of the swashplate. If the oil is not properly maintained, the compensators can become blocked with debris. As a result, pump control will be lost and you will not be able to create hydraulic oil pressure.

The normally closed, two pressure solenoid valve is controlled by the operator's selection of high or low pressure. The valve is closed while operating in high pressure and is open during low pressure operation. A light on the solenoid connector indicates low pressure operation.

At startup, hydraulic pressure is automatically switched to low, limiting torque demand. The hydraulic pressure will automatically returns to the previously selected pressure setting.

A reference gauge on the top of the manifold displays hydraulic pressure to the intensifiers. When the intensifier shifts, it is normal for the pressure to quickly fall and then rise again.

The 4-way directional control valve directs pressurized oil to one end the hydraulic cylinder and returns fluid to the reservoir from the opposite end, causing the intensifier to stroke. A pilot valve that is electronically operated by two solenoids energized by the PLC controls the movement hydraulically. Indicators light up as each solenoid is energized.

The directional control valve sends flow to the hydraulic cylinder in one direction until the hydraulic piston activates the proximity switch at the end of the stroke. The activated switch sends a signal to the PLC to reverse the direction of flow. The piston then moves in the opposite direction until it activates the proximity switch at the opposite end of the stroke.

If the machine is equipped with redundant intensifiers, manual hydraulic valves are opened or closed to direct the hydraulic flow to either intensifier.

7.3 Service and Maintenance Procedures

The extreme duty cycles demanded of the hydraulic system make routine inspection and maintenance acutely important. Leaks must be detected and remedied as soon as possible.

The operating pressure settings must be checked daily, and the electric motor must be inspected at regular intervals. The procedures for servicing these components are detailed below.

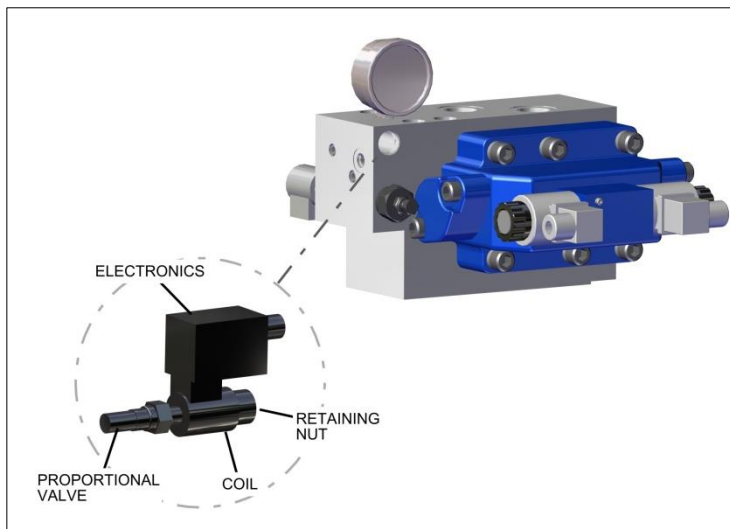
NOTE

Refer to Section 12, Parts List, for a complete listing of replacement parts.

Proportional Pressure Valve Maintenance

The screen in the proportional pressure valve can become blocked with debris resulting in erratic pressure fluctuations or the inability to reach or maintain the operating pressure.

Figure 7-3: Proportional Pressure Valve



1. Unscrew and remove the retaining nut on the proportional pressure valve.
2. Remove the coil and electronics from the valve.
3. Unscrew and remove the valve from the hydraulic manifold.
4. Use air or alcohol to clean the screen inside the valve.

NOTE

A blocked screen will appear black. Clean the screen until it is clear.

5. Screw the cleaned valve into the hydraulic manifold.
6. Replace the coil and electronics.
7. Replace the retaining nut.

Motor Maintenance

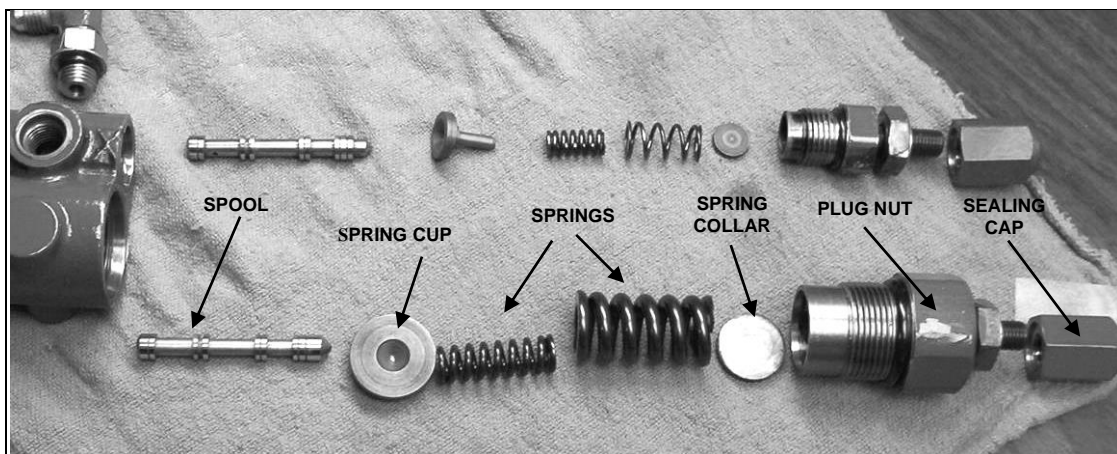
The motor should be inspected at regular intervals, approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear.

The zerk fittings, one at each end of the motor, must be greased at regular intervals. Refer to the motor data plate for the grease amount and interval.

Hydraulic Compensator Maintenance

The high and low limit compensators regulate the flow of hydraulic fluid to the system. The compensators can become blocked with debris resulting in loss of pump control.

Figure 7-4: Hydraulic Compensators



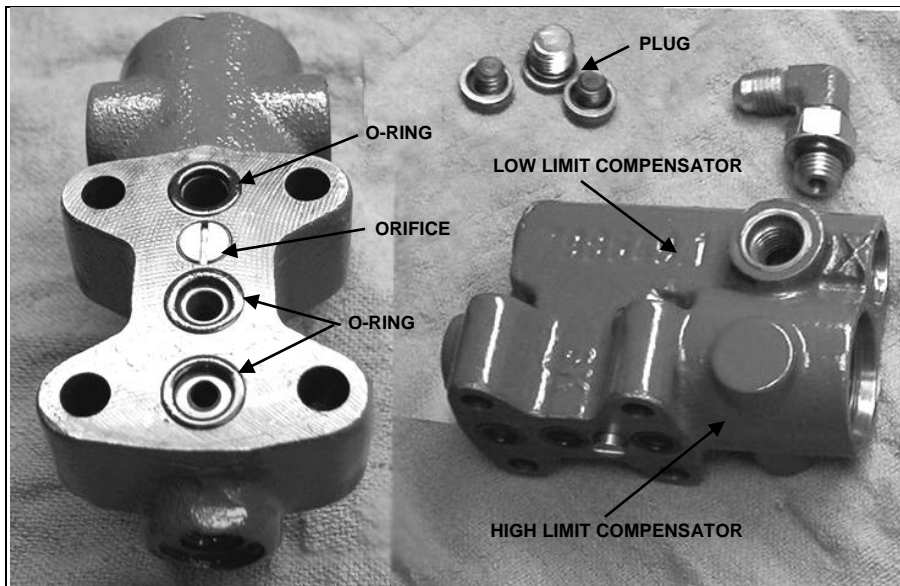


Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.



1. Remove the hydraulic hose from the low limit compensator.
2. Remove the four socket screws that attach the compensators to the pump.
3. Remove the compensators and then remove the three plugs and o-rings on the back of the housing.



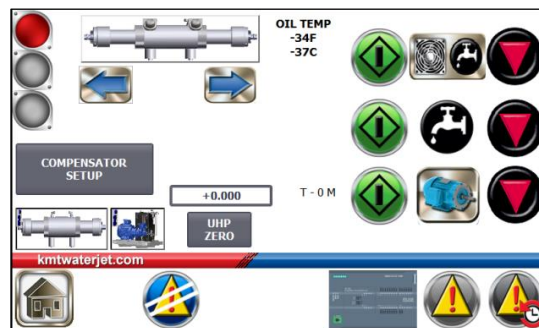
4. Disassemble the compensators one at a time by first removing the hexagon sealing cap.
5. Loosen the lock nut, and then remove the plug nut.
6. Disassemble the plug by removing the spring collar, springs, spring cup and spool.
7. Clean the housing and all components with clean fluid and carefully dry with air.
8. Check and clean the small internal passages in the spools.
9. Check and clean the orifices in both spools.
10. Assemble in the reverse order, ensuring that the screw slot on the orifice is aligned with the long axis of the body.



When the compensators are removed, the machine loses adjustment. The compensators must be reset before operation can begin.

Compensator Calibration

1. From the Home Screen, select the Main Service Screen.
2. Start the motor from the service screen.

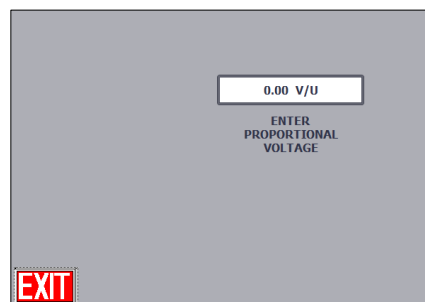


3. Press the COMPENSATOR SETUP button to display the login screen. Enter the user name and password and press OK.



If you do not have user account, contact the KMT Service group.

4. When the service screen displays, press the COMPENSATOR SETUP button again to display the Proportional Voltage Screen



5. Verify the proportional voltage reads 0.00V, if not enter 0.00
6. Proceed to the low pressure compensator located on the side of the hydraulic pump (the one furthest from the pump).



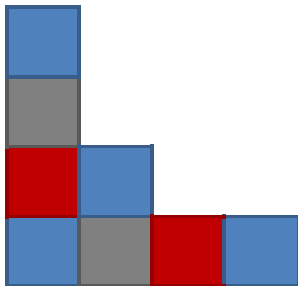
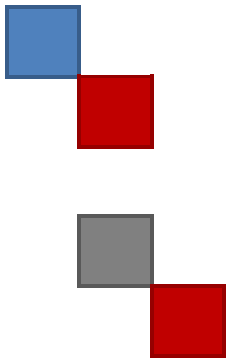
7. Loosen the retaining nut, adjust the hydraulic pressure to 250 psi (17 bar), and tighten the retaining nut, making sure the pressure does not change.
8. Enter 10.00 on the Proportional Voltage Screen.
9. Proceed to the high pressure compensator on the side of the hydraulic pump (the one closest to the pump).
10. Loosen the retaining nut, adjust the pressure to 2,350 psi (162 bar) and tighten the retaining nut, making sure the pressure does not change.
11. Check your settings by entering 0.00 on the Proportional Screen. Hydraulic pressure should read 250 psi (17 bar) on the hydraulic gauge, enter 10.0 and the gauge reading should be 2,350 psi (162 bar).
12. Press EXIT to return to the Main Service Screen.

SECTION 8

ELECTRICAL SYSTEM

The Electrical System section details:

- System operation
- Sensor and solenoid functions
- Routine maintenance procedures associated with the system



8.1 Overview

The SL-VI Pro III 60 is equipped with an integral motor starter and control circuitry, enclosed in the electrical panel. The operator controls the machine primarily through a touch-screen control panel that communicates with the programmable logic controller (PLC). A series of sensors/solenoids provide feedback and control to generate high pressure. The PLC programming performs the machine logic and diagnostic functions to ensure the safe generation of high pressure.

Major system components include the electric motor, control panel, high voltage and control components, and the wiring harness that connects the sensors and solenoids to the PLC.

NOTE

The Streamline SL-VI Pro III 60 meets the requirements of the EMC Directive 2004/108/EC. EMC characteristics may change when the SL-VI Pro III 60 is integrated with other electrical equipment. The finished installation, incorporating the SL-VI Pro III 60, should be tested against local EMC regulations.

SL-VI Pro III 60 models equipped with electronic controls incorporate the following:

1. Switch gear, high voltage hardware > 60VAC
 - Motor starter branch circuit
 - Motor controlled circuit breaker (MCCB) disconnect with LOTO capability
 - Line start or soft start (Wye-delta or electronic)
 - Motor overload protection
 - Optional cooling fan motor branch circuit
 - Combination motor starter, MCCB, overload protection with LOTO
 - Optional power factor correction capacities
 - Provide a reduction in KVA consumption
2. Control gear, low voltage hardware < 60VAC, designed to meet safety extra low voltage (SELV) requirements
 - Programmable logic controller (PLC)
 - Provides the machine logic for safe operation
 - Human machine interface (HMI)
 - Provides the interface for operator inputs and machine status
 - Storage of machine configuration and software backups
 - Sensors and solenoids
 - Provide inputs and outputs to safely generate high pressure
 - Safety function monitoring

E-stop functions to prevent or stop the generation of high pressure

Optional cover interlock system used to reduce exposure to high pressure

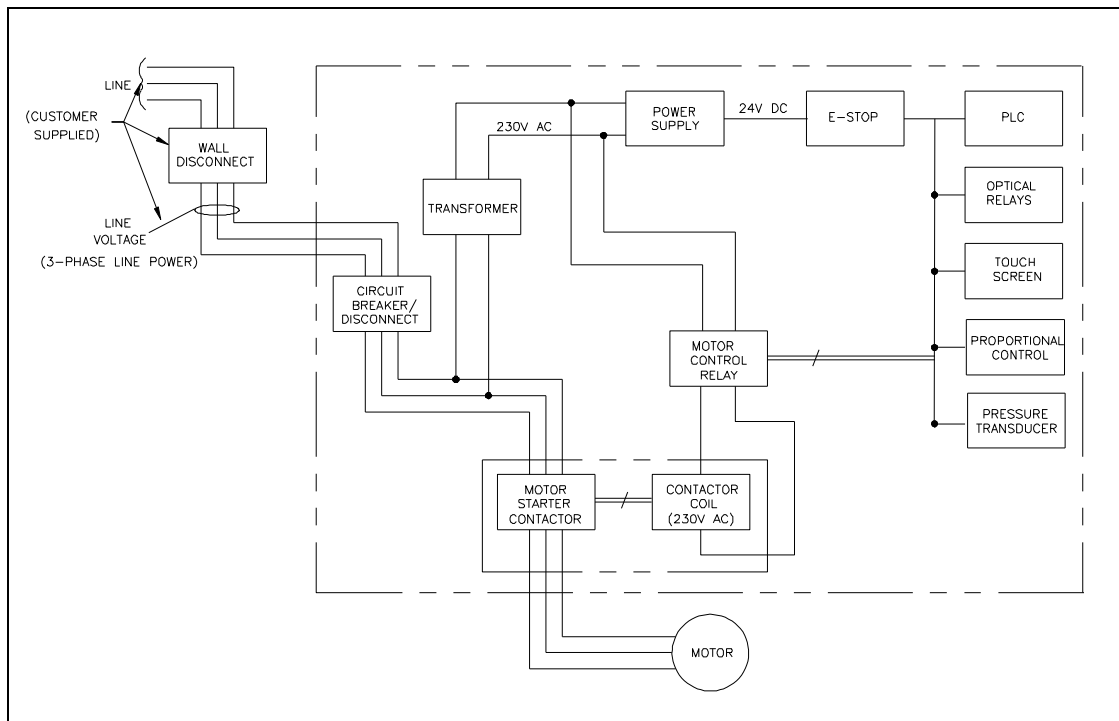
NOTE

The switch gear is protected by a plastic barrier with electrical separation of high voltage wiring from low voltage wiring.

8.2 Operation

Electrical supply is 3-phase, three wire plus ground (PE), connected to L1, L2 and L3 of the MCCB of the switch gear circuit and ground (PE) to the lug labeled PE. The power is then distributed in two directions, one to the motor control and one to the control gear.

Figure 8-1: Electrical Control Power



Some SL-VI Pro III 60 models will use a multi-tap step down transformer to supply the signal phase power required by the SELV DC power supply and the motor controls circuits.

When the START button is pressed, the motor control relay closes and control voltage is sent to the contactor coil(s). The coil(s) close, sending the incoming power to the motor. When the STOP button is pressed, the motor control relay opens, disconnecting power to the contactor coil(s), stopping the motor.

The motor is started by either contactors or a soft starter, solenoid operated by 230 volt AC or 24V DC control power.

Contactors are arranged in either a wye-delta or an across-the-line starter circuit. Wye-delta starter circuits are typically installed in all low voltage, high horsepower machines that require high current draw. Three, 3-phase contactors are used to start the motor slowly, minimizing the initial current draw. Across-the-line or full-voltage starting requires a single 3-phase contactor and is used on high voltage machines with low current draw.

Soft starters combine contactors, overload, timers and internal power/control wiring into a single device. They utilize a current limit starting method to greatly reduce mechanical and electrical shock to the system.

Switch Gear

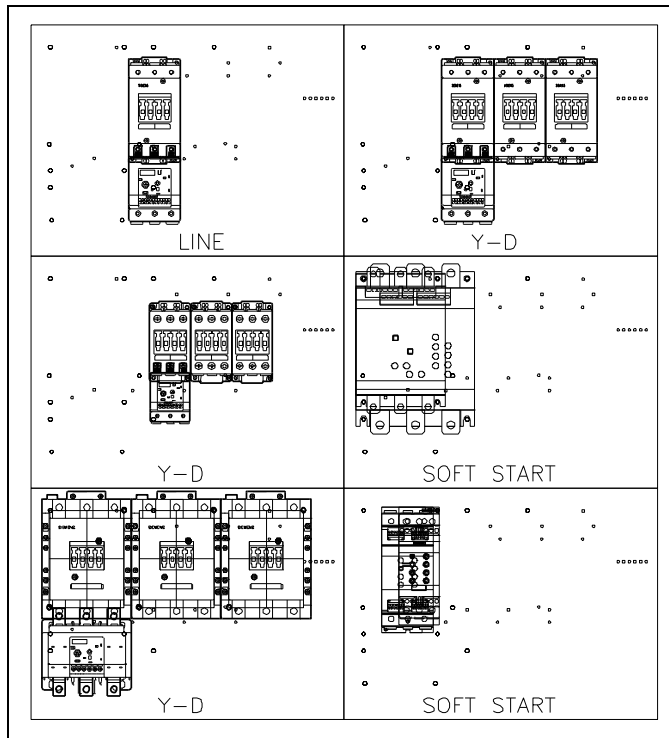
The switch gear contains the MCCB, motor control and motor overload protection. The MCCB is a motor rated circuit breaker that will allow high motor currents while starting. The MCCB provides the main disconnect location for the high pressure intensifier, it is a point of LOTO.

NOTE

Electrical energy will be present at the connection to the MCCB (L1, L2 and L3) when the LOTO is applied at the intensifier. Lock out and tag out upstream sources of electrical energy when required by governmental or company compliance.

Motor control/motor protection will be offered in two versions, line starter with external overload protection and soft-starter with internal overload protection. Line starters are available in applications when the motor full load amperage is less than 95A. Soft starter, either wye-delta or electronic, will be used when motor full load amperage is greater than 95A and in all European models. Line start may be replaced with a soft starter at the customer's request.

Figure 8-2: Motor Starter Details



The circuit breaker/door disconnect provides the primary over current protection for the machine. All power is automatically disconnected from the machine when the main disconnect on the enclosure door is opened. However, power is still present on the input side of the circuit breaker/door disconnect. The only way to isolate all power to the machine is to turn the customer installed main power disconnect off.

NOTE

See Section 2, Installation, regarding specifications for the customer installed main power disconnect.

In the electrical enclosure the high voltage components are isolated from the low voltage components. This provides an additional safety factor when maintenance is required.

Figure 8-3: Electrical Enclosure



Sensors and Solenoids

Warning and shutdown sensors monitor operating conditions, and electronically operated solenoids provide basic intensifier shift control. The harness cable connects these sensors and solenoids to the PLC.

Figure 8-4: Sensors and Solenoids

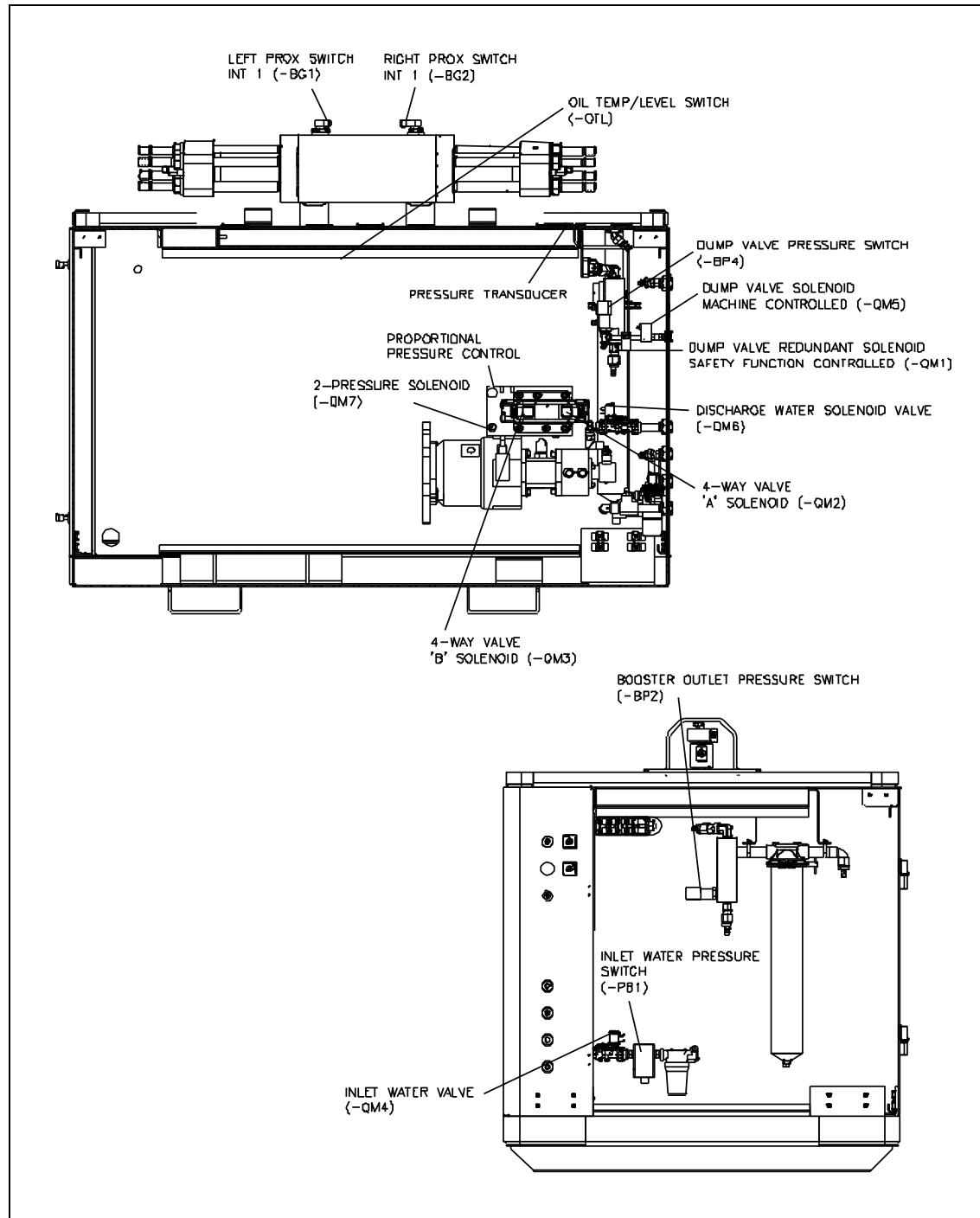


Table 8-1
Sensors and Solenoids

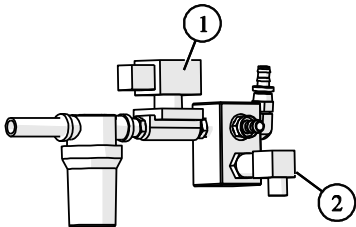
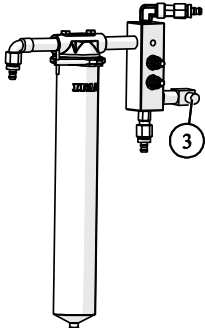
Component	Function
<i>Inlet Cutting Water</i>	
	<p>1 The normally closed, inlet water solenoid valve is located at the service bulkhead. When a start command is requested, the valve opens and the pressure switch closes, allowing the motor to start. If the valve opens and the pressure switch does not close, an alarm is issued and the motor will not start.</p> <p>When the motor is shut off or any alarm is present, the valve is closed. The valve can be opened in service mode to purge air from the system or to pressurize the system to look for leaks.</p>
	<p>2 The 30 psi pressure switch, mounted on the inlet manifold, monitors the inlet cutting water. If the pressure drops below 30 psi for the configured time interval, an alarm will shut down the intensifier, protecting the booster pump from damage due to insufficient supply water pressure.</p> <p>If the water pressure drops below 30 psi and then returns, it causes a low water pressure peak. If the machine counts eight low water pressure peaks a warning issued. Ten low water pressure peaks will result in an alarm that will shut down the intensifier.</p>
<i>Low Pressure Water Filter Assembly</i>	
	<p>3 To ensure adequate water pressure and supply to the intensifiers, the discharge pressure is monitored by a 100 psi pressure switch.</p> <p>When the booster pressure drops below 100psi a warning is issued for 40 seconds. If the pressure drops with in the first five seconds of the warning, an alarm will shut down the intensifier.</p>

Table 8-1
Sensors and Solenoids

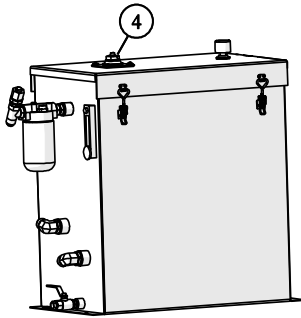
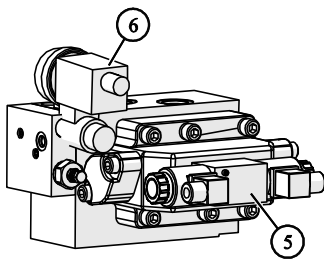
Component	Function
<p><i>Hydraulic Reservoir</i></p> 	<p>4 The temperature sensor/low level switch monitors the oil temperature and level in the reservoir. Although the float switch and the temperature sensor are combined in a single unit, they function independently.</p> <p>If the operating oil temperature exceeds 144° F (62° C) an automatic shutdown occurs. If the hydraulic fluid level falls below specifications, a low oil level shutdown occurs.</p> <p>If the oil temperature falls below 68° F (20° C) the intensifier will not stroke. The motor will run until the oil reaches the minimum operating temperature, and then the motor will shut down.</p> <p>If the oil temperature is out of operating range the intensifier will not generate high pressure. The hydraulic motor will start to cool or heat the oil as required.</p>
<p><i>Hydraulic Manifold</i></p> 	<p>5 The 4-way directional control valve shifts the hydraulics back and forth to the intensifier. A shift valve directs pressurized oil to one end of the hydraulic cylinder and returns fluid to the reservoir from the opposite end, causing the intensifier to stroke. The movement is controlled hydraulically by a pilot valve that is electronically operated by two solenoids, energized by the PLC. As power is directed from one solenoid to the other, LEDs are alternately illuminated.</p> <p>6 Proportional pressure control allows the operator to select or vary the hydraulic operating pressure from the control panel or from a remote console. An electronically controlled hydraulic cartridge valve, mounted on the hydraulic manifold, receives a signal from the PLC and automatically makes the operator selected adjustments.</p>

Table 8-1
Sensors and Solenoids

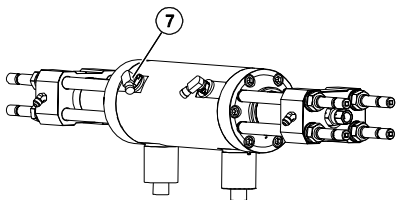
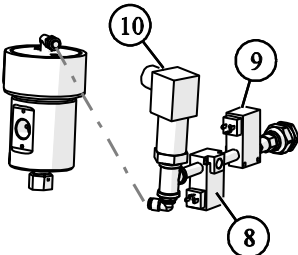
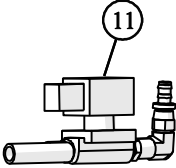
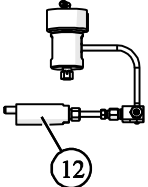
Component	Function
Hydraulic Cylinder	
	<p>7 As pressurized hydraulic oil is sent to one side of the hydraulic cylinder, it pushes against the piston, moving it in one direction until it activates the proximity switch at the end of the stroke. The hydraulic flow is then sent to the opposite side of the cylinder, and the piston reverses direction until it activates the proximity switch at the opposite end of the stroke.</p> <p>The green light on the proximity switch indicates there is power to the switch. The light turns yellow when the switch is activated. The proximity switches are magnetically activated by the presence of the metallic surface of the piston. When the switch is activated, it sends a signal to the PLC to change the flow of the directional control valve and reverse direction.</p>
High Pressure Dump Valve	
	<p>8/9 The normally open pneumatic dump valve is held closed by air pressure. When the air supply is interrupted from an emergency stop, the valve opens and allows water to flow through the valve. Pressure is released in the intensifier and the high pressure water stream exits through the drain.</p> <p>Redundant solenoid valves create a block and bleed system for the air pressure used to operate the dump valve. The first solenoid valve is machine controlled with a safety function override. The second solenoid is controlled by the safety function relay.</p> <p>10 A 30 psi pressure switch is used for testing and monitoring the safety function of the block and bleed system. If a failure is detected, a signal from the pressure switch prevents operation to continue.</p> <p>Together, the solenoids and the pressure switch provide redundancy and diversity to ensure all air pressure is removed from the high pressure dump valve when the e-stop button is pressed.</p>

Table 8-1
Sensors and Solenoids

Component	Function
<i>Discharge Cooling Water</i>	
	<p>11 A solenoid valve in the discharge cooling line regulates the cooling water flow through the heat exchanger. The valve is controlled by the PLC to maintain the hydraulic oil temperature within optimum operating range.</p>
<i>Pressure Transducer</i>	
	<p>12 The pressure transducer reads the output pressure from the attenuator in the high pressure system. A signal is sent to the PLC module that allows the operating pressure to be viewed from the control panel.</p>

Electrical Interface for Remote Control

Jumpers have been installed in the male connector on the remote interface plug for stand-alone operation. For remote control, remove the blocks with jumpers and use the new blocks supplied with the pump and wire the male connector according to Table 8-2 and 8-3 below.

Figure 8-5: Male Connector

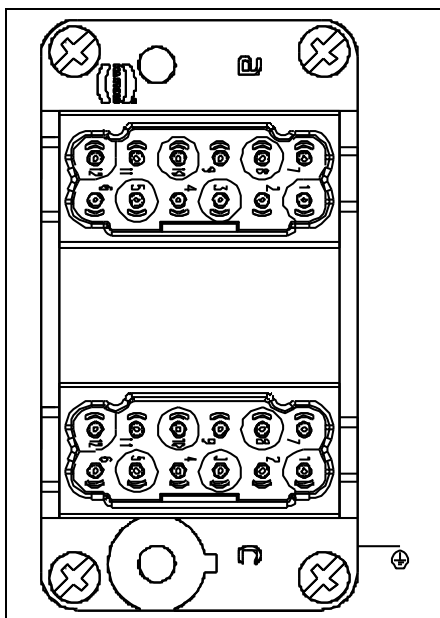




Table 8-2
Terminations for Remote Control
-XD1A

Pin	Signal Name	Wire Number (Factory Installed)
1	L+	Jumper to Pin 2
2	Stop	Jumper from Pin 1
3	Pressure Select	
4	Start	
5	Reset	
6	Stroke Pause	
7	Green Light	
8	Yellow Light	
9	Red Light	
10	-K0 Safety Function Offline	
11	White Light	
12	M	

Table 8-3
Terminations for Remote Control
-XD1C

Pin	Signal Name	Wire Number (Factory Installed)
1	-K0 Channel 1 Sensor Source	Jumper to Pin 3
2	-K0 Channel 2 Sensor Source	Jumper to Pin 4
3	-K0 Channel 1 Sensor Sink	Jumper from Pin 1
4	-K0 Channel 2 Sensor Sink	Jumper from Pin 2
5	Local 24VDC Source	Jumper to Pin 7
6	Remote 24VDC Source	
7	Local 24VDC SFC Return	Jumper from Pin 5
8	Remote 24VDC SFC Return	
9	-K0 Channel 1 Sensor Source Shield	
10	-K0 Channel 2 Sensor Source Shield	
11	-K0 Monitored Reset Loop Source	Jumper to Pin 12
12	-K0 Monitored Reset Loop Return	Jumper from Pin 11

8.3 Service and Maintenance Procedures

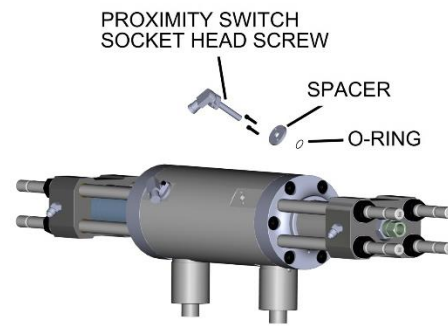
Electrical components require minimal service. The proximity switches on the hydraulic cylinder and the optical relay switches in the controls subassembly may require replacement.

NOTE

Refer to Section 12, Parts List for a complete listing of replacement parts.

Proximity Switch Maintenance

A proximity switch has failed and needs to be replaced if the LEDs do not change state, indicating they are not sensing the piston, if an LED flashes continuously, or if the appropriate input is not noted on the PLC processor annunciator light panel in the electrical enclosure.



1. Turn the machine off and observe the appropriate Lockout/Tagout procedures.



Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.



2. Remove the electrical cable from the failed proximity switch.
3. Remove the two socket head screws, the failed switch, spacer and the o-ring.
4. Install a new proximity switch by positioning the o-ring, spacer and the switch. Ensure the o-ring is correctly oriented.
5. Apply JL-M grease to the threads on the screws and tighten to 140-160 in-lbs (16-18 Nm).



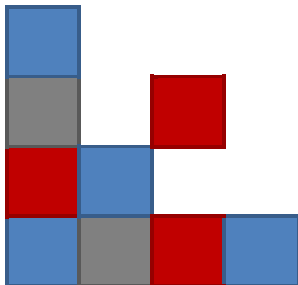
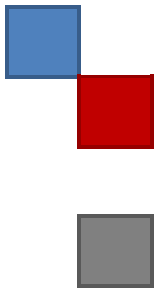
Ensure that the proximity switch is properly installed and secured prior to starting the machine. Failure to tighten the two hold down screws on each switch will result in the spray of hydraulic oil.

SECTION 9

ULTRA-HIGH PRESSURE WATER SYSTEM

The Ultra-High Pressure Water System section details:

- Principles of operation and function of the system
- System component overview
- Routine maintenance procedures associated with the system



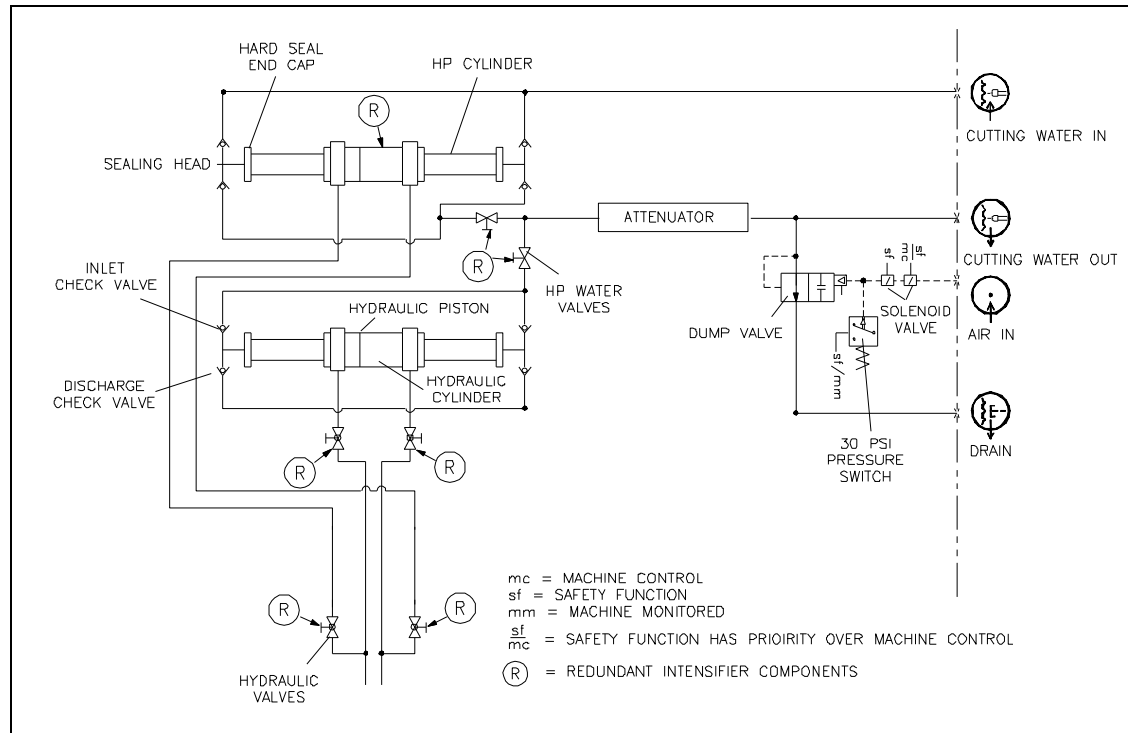
9.1 Overview

The ultra-high pressure water system is supported by both the cutting water supply circuit and the hydraulic circuit. Cutting water of sufficient flow and pressure is routed from the cutting water supply circuit to the intensifier where it is pressurized up to a maximum of 90,000 psi (6,200 bar) with the cutting head valve closed or 85,000 psi (5,860 bar) with the cutting head valve open.

The directional control valve in the hydraulic system creates the stroking action of the intensifier by sending pressurized hydraulic oil to one side of the hydraulic cylinder or the other. As the flow is sent to one side, hydraulic fluid is returned to the reservoir from the opposite side.

System components include a double-ended hydraulic cylinder; reciprocating piston assembly; ultra-high pressure cylinders on each end of the hydraulic cylinder; two plungers, sealing heads, a 1.6 liter capacity attenuator and a dump valve. Sophisticated check valves and seal assemblies ensure hydraulic oil, and the low pressure and high pressure water travel in the appropriate direction. Warning and shutdown sensors monitor strategic pressure, temperature and fluid levels to safeguard against component damage.

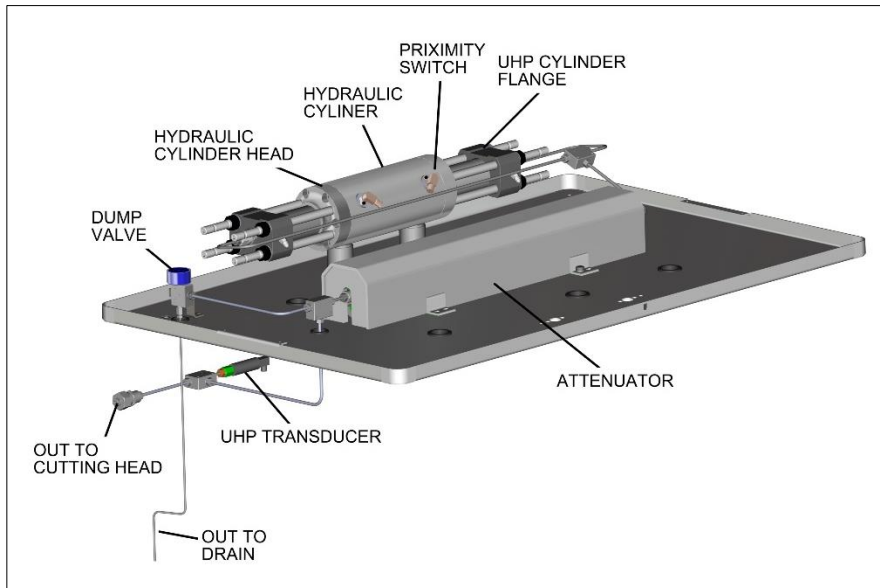
Figure 9-1: Ultra-High Pressure Water System Schematic



9.2 Operation

The directional control valve sends pressurized hydraulic oil to one side of the hydraulic cylinder. The pressurized oil pushes against the piston, moving it in one direction until it activates the proximity switch at the end of the stroke. The hydraulic flow is then sent to the opposite side of the cylinder, and the piston reverses direction until it activates the proximity switch at the opposite end of the stroke.

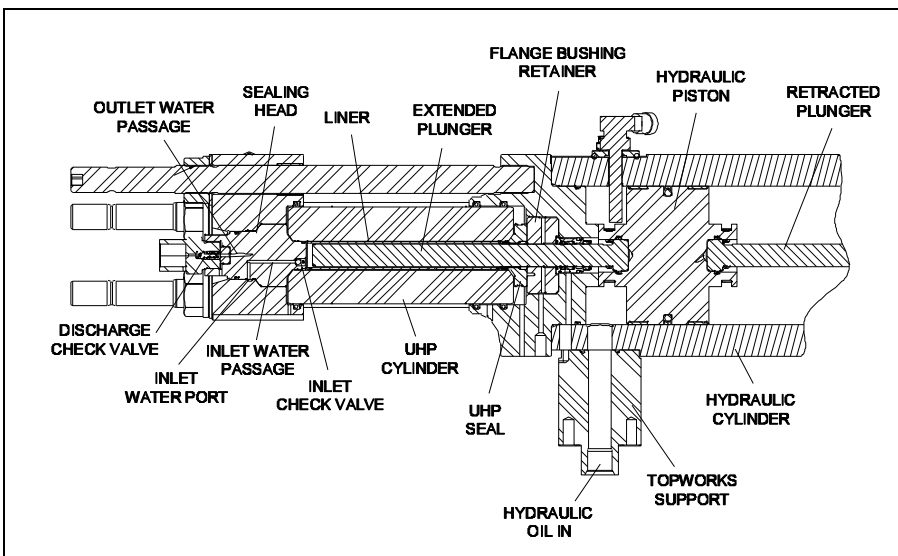
Figure 9-2: Ultra-High Pressure Water System



The green light on the proximity switch indicates there is power to the switch. The yellow light illuminates when the switch is activated. The proximity switches are magnetically activated by the presence of the metallic surface of the piston. When the switch is activated, it sends a signal to the PLC to change the flow of the directional control valve and reverse direction.

As the pressurized oil pushes the piston in one direction, the plunger on that end extends and pushes against the water in the high pressure cylinder, increasing the pressure up to 90,000 psi (6,200 bar) with the cutting head valve closed. When the piston reverses direction, the plunger retracts and the plunger in the opposite cylinder extends to deliver the high pressure water.

Figure 9-3: Ultra-High Pressure Cylinder



Low pressure water is routed through the inlet water ports to the inlet passages in the sealing heads. When the plunger retracts, the inlet check valve opens to allow water to fill the high pressure cylinder. When the plunger extends to create high pressure water, the inlet valve closes to seal the inlet passage and the discharge check valve opens to allow the high pressure water to exit the cylinder. As the plunger retracts, the discharge check valve closes.

The intensifier is a reciprocating pump. As the piston and plungers move from one side to the other, high pressure water exits one side of the intensifier as low pressure water fills the opposite side.

The high pressure water is then routed to the attenuator. The attenuator acts as a shock absorber to dampen pressure fluctuations and ensure a steady and consistent supply of water. From the attenuator, the high pressure water exits to the cutting head.

The dump valve releases the stored pressure in the intensifier and high pressure delivery lines. The high pressure dump valve assembly includes a normally open high pressure water valve and an electrically controlled air valve.

The normally open pneumatic dump valve is held closed by air pressure. When the air supply is interrupted and exhausted from an emergency stop, the valve opens and allows water to flow through the valve. Pressure is released in the intensifier and the high pressure water stream exits through the drain.

Redundant Intensifiers

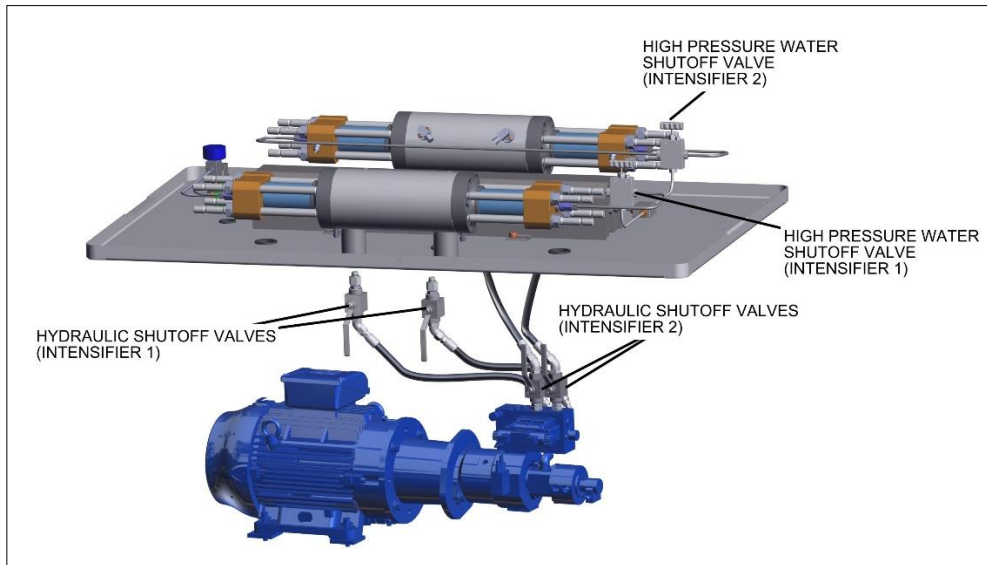
If the machine is equipped with redundant intensifiers, the cutting water supply lines are manually connected to the inlet water ports on the active intensifier. Manual hydraulic valves are opened or closed to direct the hydraulic flow to the active intensifier. Manual high pressure water valves are also opened or closed to direct the high pressure water flow from the active intensifier. Control is switched from one intensifier to the other from the Intensifier Control Screen on the control panel.



When a machine is equipped with redundant intensifiers, operation can continue on the secondary unit if the primary unit requires maintenance. However, maintenance **must not** be performed while the machine is in operation.

Maintenance **must never** be performed on any high pressure components while the machine is operating. All pressure must be relieved or blocked from the hydraulic and high pressure circuits and the electrical panel must be locked out before performing maintenance.

Figure 9-4: Redundant Intensifiers



The following example describes the procedure for changing from one intensifier to the other. In this example, intensifier 2 will become the active intensifier and intensifier 1 will become inactive.

1. Turn the machine off and make sure the emergency stop button is depressed.
2. Turn the cutting water supply off.
3. Disconnect the low pressure water supply lines from intensifier 1 and connect them to intensifier 2.
4. Remove the side cover to gain access to the hydraulic hand valves and close the two hydraulic shutoff valves to intensifier 1.
5. Close the high pressure water shutoff valve to intensifier 1.
6. Open the two hydraulic shutoff valves, and the high pressure water shutoff valve to intensifier 2.
7. Select intensifier 2 from the Intensifier Control Screen on the control display.
8. Turn the cutting water supply on and ensure all cooling water, water supply and cutting water valves are open.
9. Ensure all hydraulic and high pressure fittings, and the proximity switches are properly tightened on intensifier 2.
10. Start the machine in low pressure mode and inspect the hydraulic, high pressure fittings, valves and hoses for leaks.

9.3 System Components

The following figures illustrate the individual high pressure water system components.

Figure 9-5: System Components

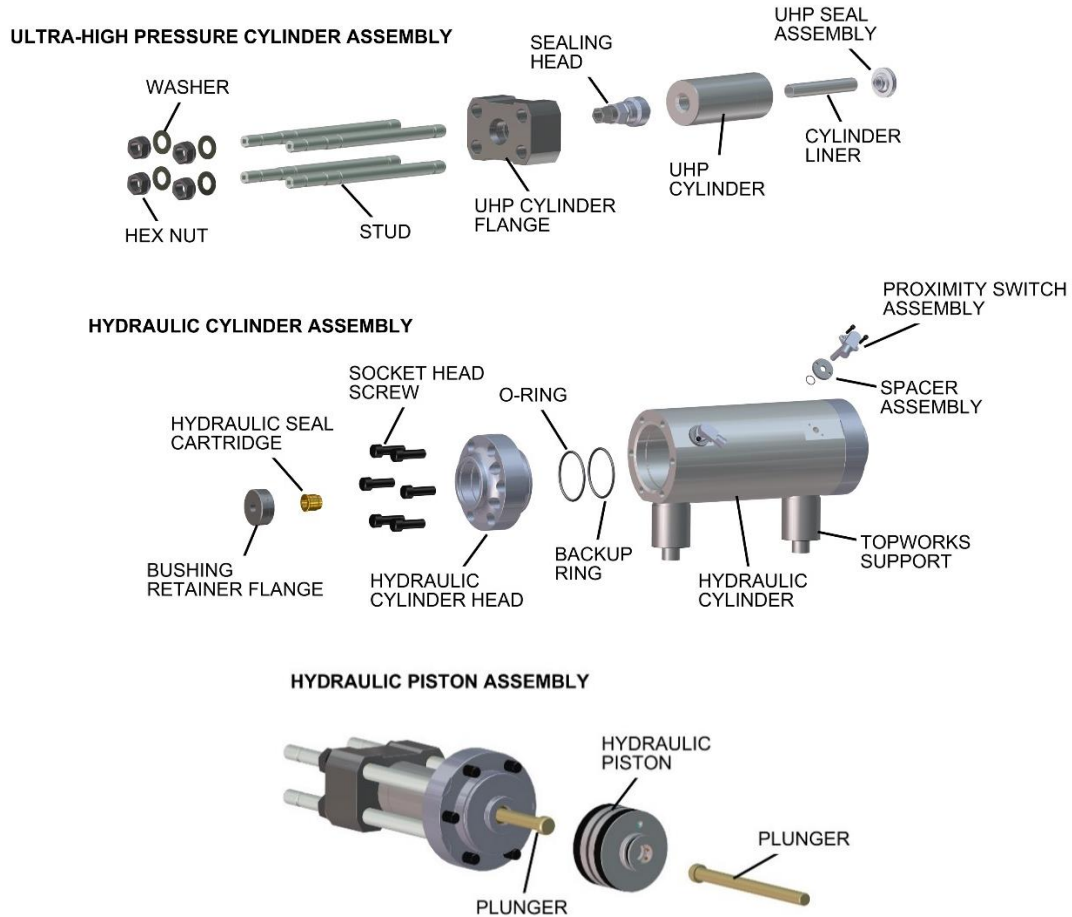


Table 9-1
Component Weights

UHP Cylinder Flange	22 lb. (9.9 kg)
UHP Cylinder Flange and Sealing Head	25 lb. (11.3 kg)
UHP Cylinder	20.5 lb. (9.2 kg)
Hydraulic Cylinder Head	25.5 lb. (11.5 kg)

9.4 Service and Maintenance Overview

Never perform any type of maintenance on the high pressure water system while it is pressurized. Always turn the power off and bleed the high pressure water before servicing. Pressing the emergency stop button turns the control power off to the intensifier, and bleeds high pressure water through the dump valve.

Improper assembly can lead to the premature failure of components. Follow maintenance procedures carefully; components must be properly cleaned prior to assembly and tightened to the correct torque specifications.

Some high pressure components are not serviceable at the customer level, others require precise refinishing. KMT Waterjet Systems offers maintenance and refinishing services for these components.

NOTE

Refer to Section 12, Parts List for a complete listing of replacement parts.

Specialized Maintenance Tools

KMT Waterjet has designed tools to facilitate the removal and installation of specialized system components. These tools are illustrated in Figure 9-6, Specialized Maintenance Tools and their respective part numbers are listing in Table 9-2.

Figure 9-6: Specialized Maintenance Tools

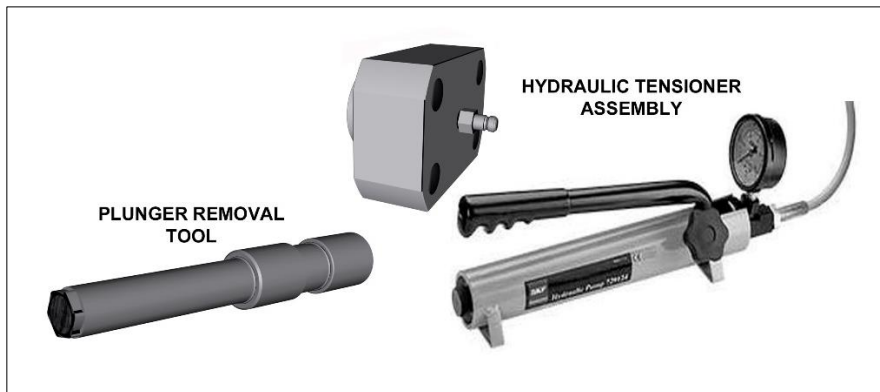


Table 9-2
Specialized Maintenance Tools
Ultra-High Pressure Water System

	Part Number
Plunger Removal Tool	20477460
Hydraulic Tensioner Assembly (includes hydraulic hand pump and hose)	20476132



Torque Specifications

Table 9-3 and Figure 9-7, Torque Specifications, detail the torque specifications and tightening sequences for the high pressure components and connections.

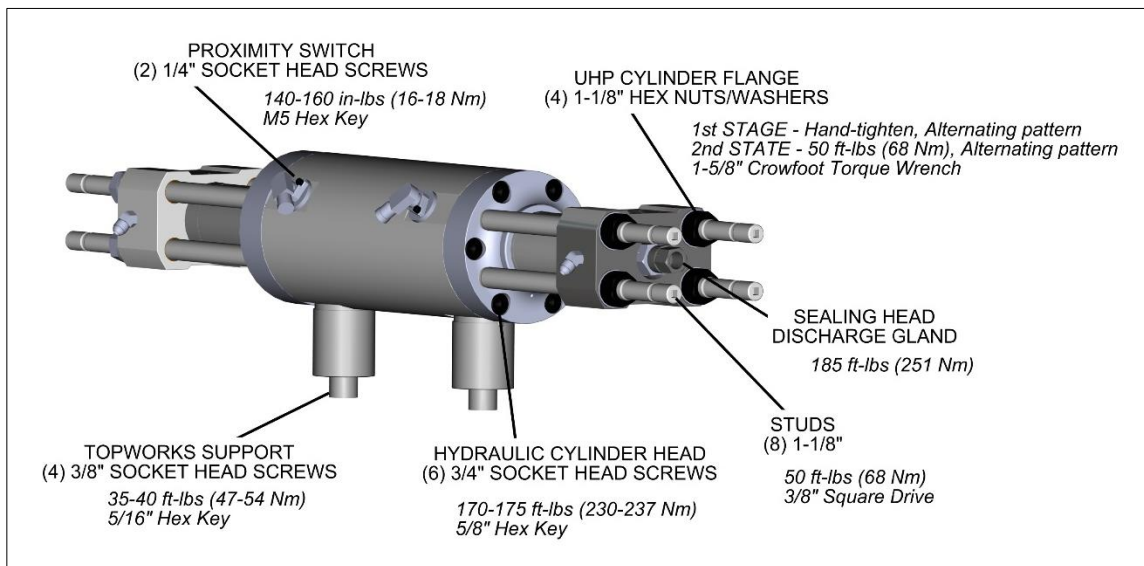
Table 9-3
Torque Specifications
Ultra-High Pressure Water System

UHP Cylinder Flange	
Hex Nuts	4 (1-1/8") each
1st Stage	Hand-tighten, alternating pattern
2nd Stage	50 ft-lbs (68 Nm), alternating pattern
Crowfoot Torque Wrench	1-5/8-inch
Studs	
Stud	8 (1-1/8") each
Torque	50 ft-lbs (68 Nm)
Square Drive	3/8-inch
Hydraulic Cylinder Head	
Socket Head Screws	6 (3/4") each
Torque	170-175 ft-lbs (230-237 Nm)
Hex Key	5/8-inch
Proximity Switch	
Socket Head Screws	2 (1/4") each
Torque	140-160 in-lbs (16-18 Nm)
Hex Key	M5
Topworks Support	
Socket Head Screws	4 (3/8") each
Torque	35-40 ft-lbs (47-54 Nm)
Hex Key	5/16-inch
Sealing Head	
Discharge Gland	185 ft-lbs (251 Nm)
Pneumatic Control Valve	
3/8-inch UHP Gland	75 ft-lbs (102 Nm)
1/4-inch UHP Gland	35 ft-lbs (47 Nm)
Pneumatic Actuator	5 ft-lbs (7 Nm)
1/4-inch UHP Adapter	70 ft-lbs (95 Nm)

Table 9-3
Torque Specifications
Ultra-High Pressure Water System

Ultra-High Pressure Fittings	
1/4-inch HP Gland Nut	35 ft-lbs (47 Nm)
3/8-inch HP Gland Nut	75 ft-lbs (102 Nm)
9/16-inch HP Gland Nut	160 ft-lbs (217 Nm)

Figure 9-7: Torque Specifications



9.5 High and Low Pressure Water Piping

Before performing any maintenance on the high pressure components, it is necessary to remove the high and low pressure water piping. Use the following procedure to remove and install the piping.



Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.



1. Turn the cutting water supply off.
2. Loosen and remove the high pressure gland fitting connected to the discharge high pressure check valve. Move the tubing to clear the work area.
3. Loosen and remove the low pressure piping connected to the inlet water port on the high pressure cylinder flange.
4. Loosen and remove the drain line connection on the hydraulic cylinder head.
5. When the required maintenance has been completed and the components reassembled, connect the low pressure water piping to the inlet water port on the cylinder flange and the drain line to the hydraulic cylinder head.
6. Apply Pure Goop to the threads on the high pressure gland fitting. Before installing the high pressure fitting, ensure proper collar position, 1-1/2 to 2-1/2 threads should be exposed. Install and tighten the fitting to the torque specifications in Table 9-3.
7. Turn the cutting water supply on and check for low pressure leaks.
8. Remove the cutting orifice and start the machine. Operate in low pressure mode to flush the high pressure passages.
9. Install the orifice and operate at high pressure to check for leaks.

9.6 Ultra-High Pressure (UHP) Cylinder

The ultra-high pressure cylinder and associated components must be removed to service the plunger, ultra-high pressure seals, hydraulic piston and hydraulic seal cartridge.

Ultra-High Pressure Cylinder Removal

Prior to removing electrical power or any high or low pressure piping, start the machine from the Main Service Screen on the control panel.

Press and hold the right or left arrow until the proximity switch on the end to be serviced illuminates. The plunger will extend in the selected direction, allowing full exposure when the unit is disassembled.

1. Turn the machine off and observe the appropriate Lockout/Tagout procedures.



Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

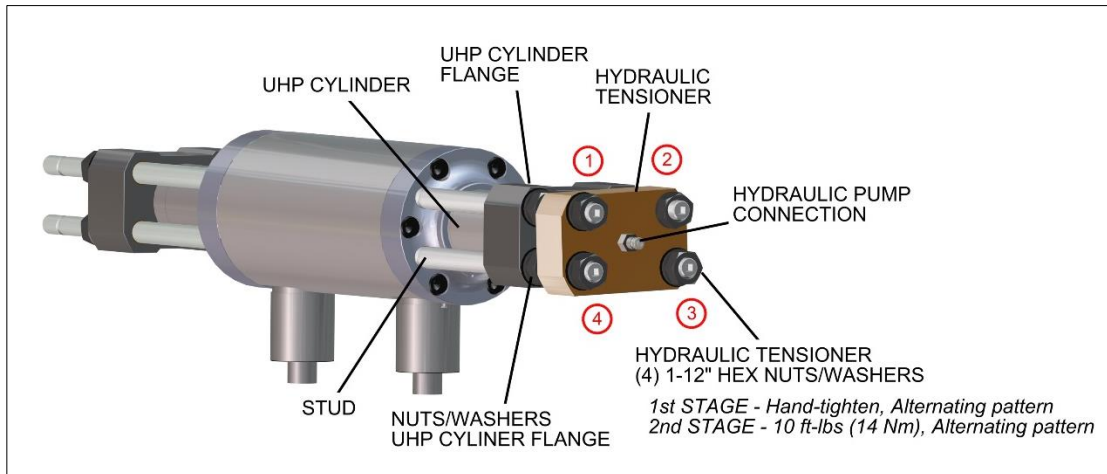
Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.



2. Disconnect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.
3. Position the hydraulic tensioner on the end of the studs and install the tensioner washers and nuts. Hand-tighten the nuts in an alternating pattern, 1, 3, 2 and 4. Then torque the nuts in the same alternating pattern to 10 ft-lbs (14 Nm).
4. Install the quick connect hose from the hydraulic hand pump to the tensioner. Tighten the pressure relief valve knob and pump until the pressure gauge needle reads exactly 80 MPa [11,603 psi] (800 bar). This will ensure the proper pre-load force is applied to the four studs.



Figure 9-8: Ultra-High Pressure Cylinder Removal



5. Use a 1-5/8" crowfoot to loosen the nuts on the ultra-high pressure cylinder flange. Unscrew the nuts as far as possible, leaving a minimum of 1/4" clearance between the nut and the cylinder flange.
6. Turn the hand relief valve on the hydraulic hand pump counter-clockwise to relieve the pressure and disconnect the pump. Ensure the pressure gauge reads 0 MPa (0 psi) before disconnecting the pump.
7. Remove the washers and nuts on the hydraulic tensioner and remove the tensioner.
8. Remove the cylinder flange nuts and washers from the studs.
9. Pull the UHP cylinder flange over the studs to remove the flange and sealing head together. See Table 9-1, Component Weights.
10. Pull and remove the UHP cylinder from the hydraulic cylinder head using one of the following methods. See Table 9-1, Component Weights.
 - a. Rotate the cylinder by hand while simultaneously pulling the cylinder from the hydraulic cylinder head.



During removal, use both hands to support the weight of the cylinder. Use adequate cushioning to prevent injury to your hands and damage to the outer locating diameter on each end of the cylinder.

- b. Rock the cylinder side to side or up and down while simultaneously pulling the cylinder from of the hydraulic head.

NOTE

Two of the four studs can be removed to aid in the removal and installation of the UHP cylinder. If the studs are removed, ensure they are properly reinstalled and torqued to 50 ft-lbs (68 Nm) each..

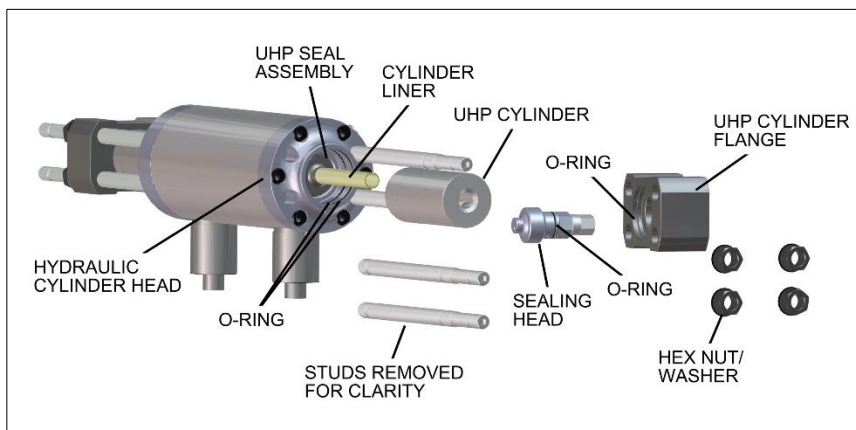
Ultra-High Pressure Cylinder Installation

1. Verify the ultra-high pressure cylinder bore and outer locating diameter at each end have been adequately cleaned. Use isopropyl alcohol and a clean, lint free cloth.
2. Verify the high pressure seal is installed over the plunger and seated against the bushing retainer flange.
3. Verify the plunger is clean. Use isopropyl alcohol and a clean, lint free cloth.
4. Ensure the stainless liner bore and outer diameter are clean. Install the liner over the plunger.
5. Apply a thin film of FML-2 grease to the two o-rings in the hydraulic cylinder head bore.
6. With the UHP cylinder in a parallel position to the studs, slide the seal end of the cylinder over the plunger and into the hydraulic cylinder head until light contact is made with the UHP seal. Facing the sealing head end of the cylinder, use both hands to push the cylinder straight in to make sure the cylinder has bottomed out.



The seal end of the UHP cylinder must be installed toward the hydraulic cylinder. The opposite, sealing head, end of the cylinder is laser marked indicating 'this face out'.

Figure 9-9: Ultra-High Pressure Cylinder Installation



7. If the studs were removed during the process, reapply Pure Goop to the front threads if necessary and install the studs into the hydraulic cylinder head. Use a 3/8" square drive torque wrench to torque each of the studs to 50 ft-lbs (68 Nm).
8. Verify that the sealing head and UHP cylinder flange have been adequately cleaned.
9. Apply a light film of FML-2 grease to the o-ring on the sealing head and the o-ring in the UHP cylinder flange.
10. Slide the sealing head into the bore of the UHP cylinder flange until it bottoms out.
11. While holding the UHP cylinder up with one hand, install the sealing head and UHP cylinder flange over the studs until the cylinder slides into the cylinder flange and bottoms out.



The cylinder must be held in a horizontal position until the o-ring in the high pressure cylinder flange slides over the high pressure cylinder.

Failure to do so may result in the front nose of the sealing head scratching or damaging the sealing chamfer surface on the cylinder.

12. Apply Pure Goop to the middle threads on the studs and install the washers and hex nuts. Hand-tighten in an alternating pattern until they are snug against the cylinder flange.
13. Position the hydraulic tensioner on the end of the studs, install the washers and nuts and hand-tighten until they are snug against the tensioner. Using a 1-5/8" crowfoot, torque the four nuts to 10 ft-lbs (14 bar) in an alternating pattern.
14. Install the quick-connect hose from the hydraulic hand pump to the tensioner. Turn the hand relief valve on the pump clockwise to ensure the valve is fully closed.
15. Pump the hand pump until the pressure gauge reads exactly 80 MPa [11,603 psi] (800 bar).
16. Using a 1-5/8" crowfoot, torque the cylinder flange nuts to 50 ft-lbs (68 Nm) in an alternating pattern.
17. Turn the hand relief valve counter-clockwise to release pressure from hydraulic hand pump. Remove the quick connect hose, nuts and washers on the tensioner and then remove the hydraulic tensioner.
18. Connect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.
19. Start the machine in low pressure mode to flush air from the high pressure components and to check for obvious leaks. After 5-10 strokes, switch to high pressure operation and check for leaks.

If leaks are detected, turn the machine off and remedy the problem. When the problem has been remedied, repeat the start up procedure, moving from low to high pressure soon after the intensifier starts pumping water. There is no further need to flush air from the system.



Proper pre-load force on the studs is essential to prevent the sealing head and the UHP seal assembly from leaking between the cylinder mating/sealing surfaces. If water leaks between the metal-to-metal sealing surface of the sealing head, and/or the seal assembly, and the UHP cylinder and scratches or jetting marks are visible, replace the components.

If repeated leaks are observed, ensure 80 MPa [11,603 psi] (800 bar) of pre-load pressure is being applied by the hydraulic hand pump. If the leaking persists, calibrate or replace the hydraulic gauge on the hand pump (P/N 7219000129).

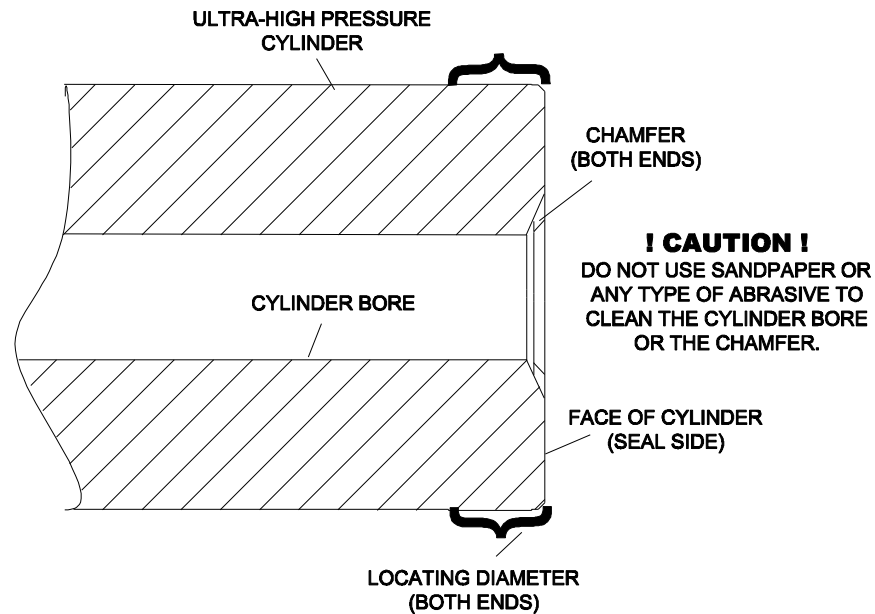
Ultra-High Pressure Cylinder Maintenance

The seal area in the ultra-high pressure cylinder bore should be inspected and cleaned each time the ultra-high pressure seal assembly is replaced.

1. Clean the bore and the chamfer at each end of the ultra-high pressure cylinder using isopropyl alcohol and a clean, lint free cloth.
2. Clean the outer locating diameter of the cylinder with a non-abrasive scouring pad and isopropyl alcohol to prevent any kind of buildup.



The movement of the stainless steel liner inside the cylinder bore can result in a small length of frosted surface on each end of the cylinder. This is a normal part of cylinder wear.

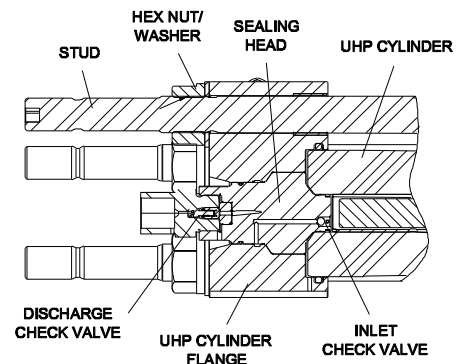


Do not use sandpaper or any type of abrasive to clean the cylinder bore or the chamfer.

9.7 Sealing Head

The sealing head is sealed to the outboard end of the UHP cylinder by a metal-to-metal seal. The studs in the UHP cylinder flange hold the sealing head against the end of the cylinder.

The inlet and discharge check valves in the sealing head ensure the low pressure and high pressure water only travels in the appropriate direction.



High Pressure Discharge Check Valve

The high pressure discharge check valves should be serviced on a regular, preventive maintenance schedule. The discharge check valve can be serviced with the sealing head either installed or removed from the high pressure cylinder.

1. Turn the machine off and observe the appropriate Lockout/Tagout procedures.

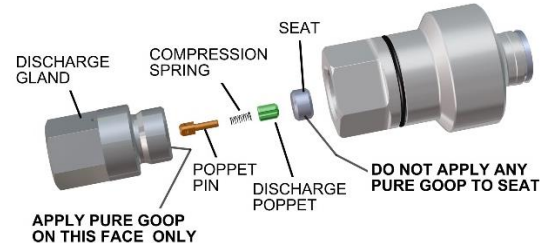


Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.



2. Disconnect the high pressure water piping, following the procedure, High and Low Pressure Water Piping.
3. Use two wrenches to remove the discharge gland nut. The poppet pin, spring and discharge poppet will normally remain in the gland nut when it is removed. Remove the components from the gland nut.
4. Use a pick tool to remove the seat from the sealing head.



Do not apply any Pure Goop on the seat.

5. Inspect the poppet pin for wear and replace the pin if worn.
6. Inspect both faces of the seat for damage or cracking. A cracked or damaged seat must be replaced.

NOTE

Replace the seat, spring and discharge poppet as a set. If one component requires replacement, replace all components.

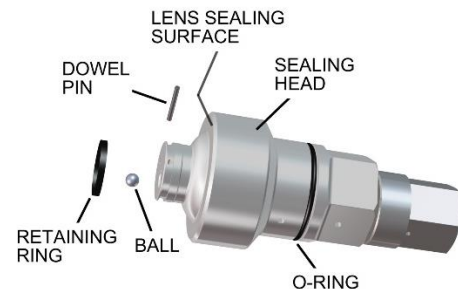
7. Install the seat. **Do not** apply Pure Goop near the central bore of the seat or on the flat sealing faces of the discharge poppet. Apply a thin film of Pure Goop only on the front face of the discharge gland. Wipe any excess goop off. Any amount of goop between the seat and the discharge poppet can cause the components to stick during operation.
8. Install the poppet pin and the spring, and then install the poppet valve into the discharge gland. Make sure the large end of the spring is against the poppet.
9. Apply Pure Goop to the threads on the discharge gland and thread the gland into the sealing head. Hand-tighten until there is a 0.20 inch (5 mm) gap between the gland and the sealing head. No threads should show. If the gap exceeds 0.20 inch (5 mm), the poppet or seat has slipped out of position. The parts must be removed, inspected and re-assembled.
10. Tighten the discharge gland to the torque specifications in Table 9-3.

Low Pressure Inlet Check Valve

Service the inlet check valves on a regular, preventive maintenance schedule. The high pressure cylinder flange must be removed to service the inlet check valve.

Follow the applicable steps in the procedure, Ultra-High Pressure Cylinder. When the cylinder flange has been removed, proceed with Step 1 below.

1. Remove the sealing head from the flange.
2. Remove the retaining ring, dowel pin and ball.
3. Remove the o-ring from the body.
4. Inspect the sealing head for scratches or wear on the contact surface and the ball seating surface. If defects are detected on the sealing head contact surface, the surface must be refinished. See the procedure, Sealing Head Maintenance.



5. If defects are detected on the ball or dowel pin, replace the ball and/or dowel pin. If defects are detected on the ball seating surface it may be possible to refinish the surface, depending on the severity of the defects. See the procedure, Sealing Head Maintenance.

If the surface cannot be properly refinished the sealing head must be replaced.

NOTE

Refinishing the surface on a regular schedule, prior to the detection of defects, will prolong the life of the sealing head.

6. If no defects are detected on the ball, dowel pin or seating surface, replace the existing ball and the dowel pin.

NOTE

Replace the dowel pin every 500 hours or sooner if the pin shows signs of wear or defects.

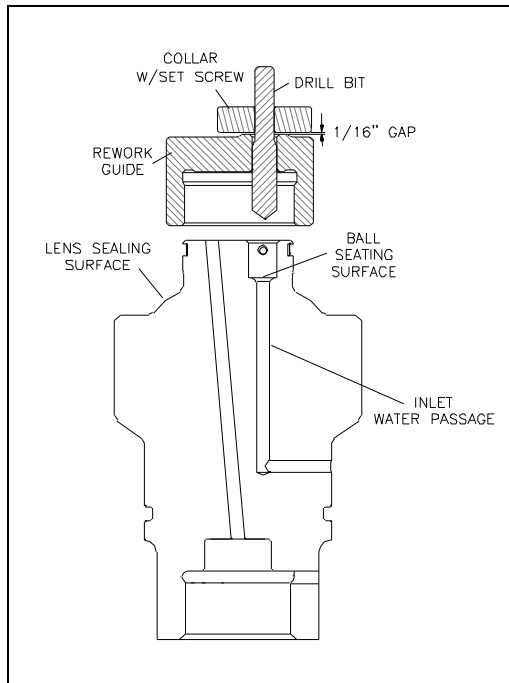
7. Install the retaining ring.
8. Inspect the assembled unit to ensure the ball moves freely.
9. Apply FML-2 grease to the new o-ring and install.

Sealing Head Maintenance

The sealing head should be inspected for scratches, excessive sealing damage or erosion marking on the high pressure cylinder contact surface, and on the ball seating surface. If defects are detected on the contact surface, the surface must be refinished. If defects are detected on the ball seating surface, the sealing head can be refinished.

1. Do not use sandpaper or any type of abrasive to clean the lens sealing surface. If water-jetting marks are visible on the surface, it may not be possible to field clean the surface sufficiently for the sealing head to reseal under pressure. If so, replace the sealing head. Contact KMT Waterjet for information about rebuilding the sealing head.
2. Inspect the edges of the inlet water passage in the ball seating surface. The passage should be cylindrical with smooth edges. Over time the edges become jagged. It may be possible to refinish the surface, depending on the severity of the defects.

Figure 9-10: Ball Seating Surface Rework



3. Position the drill bit (inlet check valve rework kit P/N 72121395) in the bore until it bottoms out against the seating surface.
4. Slide the rework guide over the bit and push it down over the end of the sealing head.
5. Position the collar on the drill bit until there is a 1/16" gap between the collar and the guide. Tighten the set screw.
6. Use a power drill and carefully drill the bore.
7. Remove the guide with the drill bit and clean the bore with dry air and alcohol. Use a plastic or brass bristle brush to deburr the bore. **No not** use a steel or wire brush.
8. If additional refinishing is required, repeat the process.

9.8 Ultra-High Pressure Seal Assembly

The following procedure should be used to replace the ultra-high pressure seal assembly.

Prior to removing electrical power or any high or low pressure piping, start the machine from the Main Service Screen on the control panel.

Press and hold the right or left arrow until the proximity switch on the end to be serviced illuminates. The plunger will extend in the selected direction, allowing full exposure when the unit is disassembled.



Do not apply any lube or grease to any surface of the UHP seal assembly.

1. Turn the machine off and observe the appropriate Lockout/Tagout procedures.



Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.



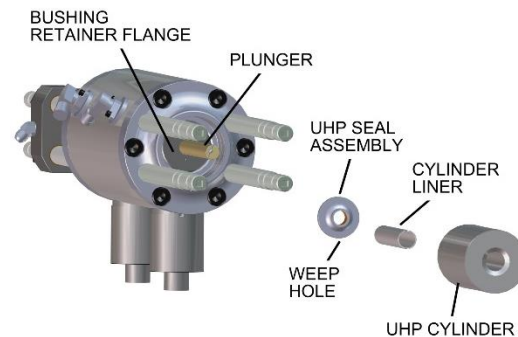
2. Disconnect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.
3. Remove the UHP cylinder, following the procedure, Ultra-High Pressure Cylinder Removal detailed earlier in this section.
4. Remove the cylinder liner from the bore of the UHP cylinder and inspect for possible heat or wear damage. If scratches are detected on the tabs on the ends of the liner, the liner can be reworked.
5. Slide the UHP seal assembly off the plunger. If the seal cannot be removed in this manner, position two flat screwdrivers approximately 180° apart in the groove around the seal to pry it out.

6. Clean and inspect the UHP cylinder bore and chamfer for unusual wear, cracks or pitting. If seal debris is present, follow the procedure, Ultra-High Pressure Cylinder Maintenance.
7. Inspect the plunger surface for flaws. Rotate the plunger 360 degrees by hand while viewing light reflection on the surface to detect any dullness, streaks, pits or other defects. Run a fingernail perpendicular to the direction of the suspected flaws to determine the severity of defects. If a fingernail snags on a scratch it is deep and may require replacement to prevent low UHP seal life in the future. If seal debris or oil are present on the plunger, clean it with isopropyl alcohol and a clean, lint free cloth.



Do not use sandpaper or any type of abrasive to clean or polish the plunger surface. This will damage the surface finish and likely result in low UHP seal life in the future.

8. Thoroughly clean the bore of the hydraulic cylinder head.
9. Ensure the new seal assembly is free of fingerprints and dust. Clean with isopropyl alcohol and a lint free cloth is necessary.
10. **Do not apply any lubrication to the seal assembly or the UHP cylinder chamfer.** Ensure the weep hole is in the 6 o'clock position and slide the seal assembly onto the plunger until contact is made with the bushing retainer flange.



Proper orientation of the high pressure seal is critical.



Do not apply any grease directly on the seal components or the UHP cylinder.

11. Slide the cylinder liner inside the cylinder and slide the cylinder and liner over the plunger.

12. Install the ultra-high pressure cylinder and associated components, following the procedure, Ultra-High Pressure Cylinder Installation.
13. Reconnect the high and low pressure water piping and turn the low pressure water supply on.

9.9 Hydraulic Seal Cartridge and Plunger Removal

Use the following procedure to remove the hydraulic seal cartridge and the plunger.

Prior to removing electrical power or any high or low pressure piping, start the machine from the Main Service Screen on the control panel.

Press and hold the right or left arrow until the proximity switch on the end to be serviced illuminates. The plunger will extend in the selected direction, allowing full exposure when the unit is disassembled.

1. Turn the machine off and observe the appropriate Lockout/Tagout procedures.



Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.



2. Disconnect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.
3. Remove the proximity switch on the end of the hydraulic cylinder to be serviced. This will allow the hydraulic oil to drain back to the reservoir, minimizing oil spillage. It will take approximately five minutes for the oil to drain.
4. Remove the UHP cylinder and associated components, following the procedure, Ultra-High Pressure Cylinder Removal.
5. Remove the UHP seal assembly.
6. Remove the bushing retainer flange and clean the surfaces, weep holes and grooves. Check the retainer flange for cracks.
7. Apply hydraulic oil to the o-ring and replace the proximity switch by positioning the spacer and the switch. Apply JL-M grease to the threads on the socket head screws and tighten, following the torque specifications in Table 9-3.

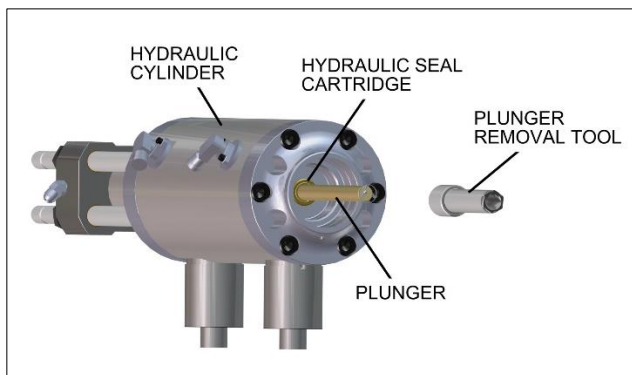


Reinstall the proximity switch as soon as practical. Removal of the switch presents the potential of an oil spray hazard.

Ensure that the proximity switch is properly installed and secured prior to starting the machine. Failure to tighten the two hold down screws on each switch will result in the spray of hydraulic oil.

8. Remove the collet from the plunger removal tool. Thread the large end of the tool onto the hydraulic seal cartridge and pull the cartridge out, over the plunger.

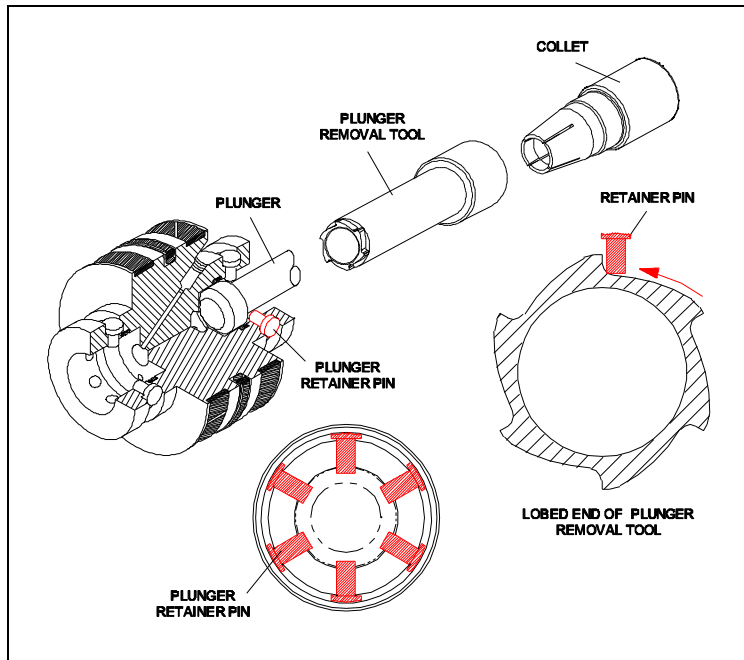
Figure 9-11: Hydraulic Seal Cartridge Removal



9. With the cartridge removed, remove the plunger with the hydraulic cylinder head in place. Six retainer pins hold the plunger in position. The pins close around the plunger button to retain the plunger, and retract to release the plunger.

Clean the plunger and the ID of the collet with alcohol or a similar solvent. Partially thread the collet into the plunger removal tool and slide the removal tool over the plunger with the lobed end toward the plunger button. Note the orientation of the retainer pins on the plunger button. Align the lobes on the tool with the retainer pins as shown below. Tighten the collet and rotate the tool slightly, causing the pins to retract and release the plunger. Remove the plunger from the hydraulic piston.

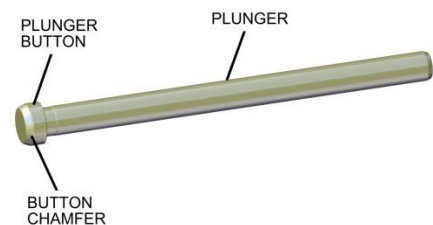
Figure 9-12: Plunger Retainer Pins



Plunger Maintenance

Plunger surfaces can become streaked with longitudinal scratches or flaws, and discolored or dull in appearance. If any of these conditions become severe, the high pressure seal assembly and possibly the hydraulic seal cartridge will leak.

Remove accumulation of debris on the surface of the plunger by polishing in a radial direction with 600-grit sandpaper. However, plunger surface flaws usually cannot be repaired on site. The plunger can be returned to KMT Waterjet for reconditioning.



Plunger Installation

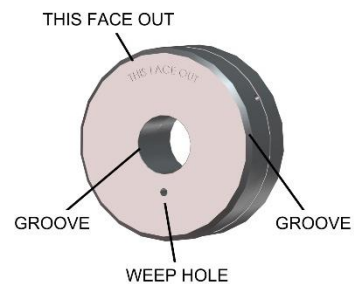
To install the plunger, apply hydraulic oil to the plunger button and slide the plunger removal tool over the plunger with the lobed end toward the plunger button to help center the plunger in the hydraulic cylinder head. Position the plunger in the button socket of the piston and force the plunger into place by hand. Use a flashlight to verify that all six pins are equally extended to grip the plunger button.

Hydraulic Seal Cartridge Installation

Use the following procedure to replace the hydraulic seal cartridge



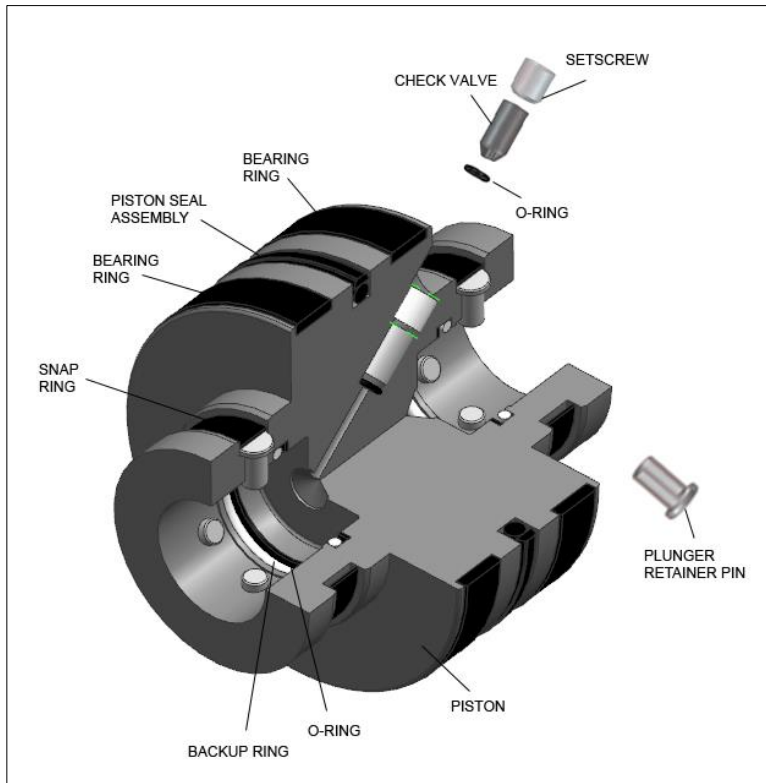
1. Apply hydraulic oil to the exposed surfaces of the seals and slide the hydraulic seal cartridge over the plunger, into the cavity of the hydraulic cylinder head.
2. Clean the plunger with isopropyl alcohol and a lint free cloth.
3. Thoroughly clean the bushing retainer flange, including the cross-drilled weep holes and internal and external grooves. Install the retainer flange ensuring the laser marked side is positioned toward the high pressure cylinder and the weep hole is in the 6 o'clock position.
4. Install the high pressure seal assembly. Clean the seal and the plunger with isopropyl alcohol and a lint free cloth.
5. Install the UHP cylinder and associated components, following the procedure, Ultra-High Pressure Cylinder Installation.
6. Connect the high and low pressure water piping and turn the low pressure water supply on.



9.10 Hydraulic Piston

Two bearing rings provide wear contact between the piston and the inside diameter of the hydraulic cylinder. On each end of the piston, six retainer pins hold the plunger in position. A flat snap ring holds the plunger retainer pins in place. Two internal check valves vent unwanted hydraulic pressure from one side of the piston to the other, preventing pressure from building behind the plunger button.

Figure 9-13: Hydraulic Piston



Hydraulic Piston Removal

Use the following procedure to remove the hydraulic piston.

1. Turn the machine off and observe the appropriate Lockout/Tagout procedures.



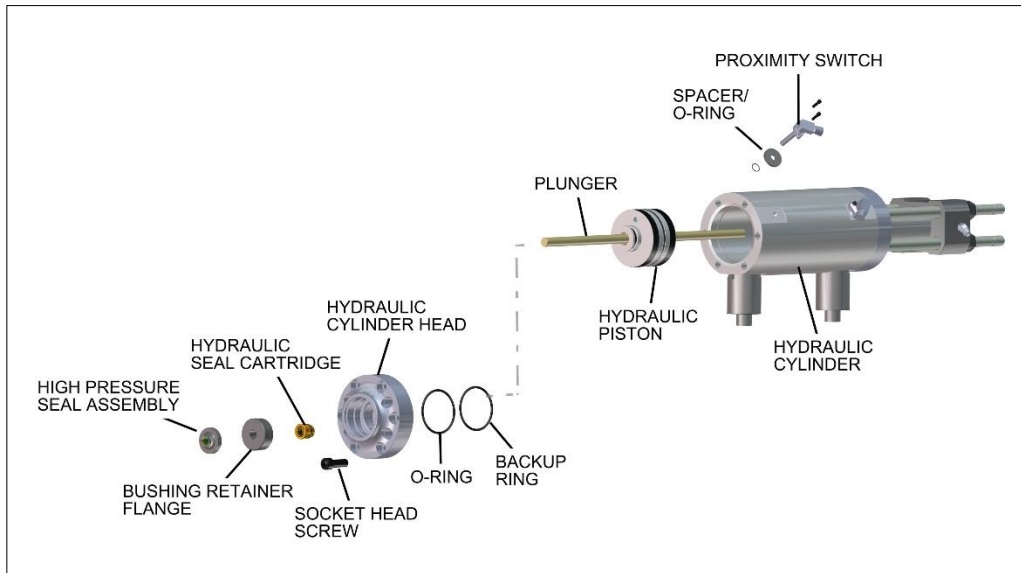
Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.

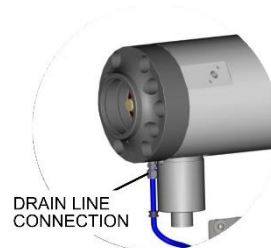


2. Disconnect the high and low pressure water piping from both ends of the intensifier, following the procedure, High and Low Pressure Water Piping.
3. Remove the UHP cylinder and associated components on each end of the intensifier, following the procedure, Ultra-High Pressure Cylinder Removal.

Figure 9-14: Hydraulic Piston Removal



4. Remove both of the proximity switches to prevent interference and to allow the hydraulic oil to drain back to the reservoir, minimizing oil spillage. It will take approximately five minutes for the oil to drain.
5. Remove the high pressure seal assembly, bushing retainer flange and the hydraulic seal cartridge from both hydraulic cylinder heads. It is not necessary to remove the plunger.
6. Verify the drain line has been removed from the hydraulic cylinder head.
7. Loosen and remove the socket head screws in one of the hydraulic cylinder heads.
8. Remove the hydraulic cylinder head with the o-ring and backup ring. See Table 9-1, Component Weights.
9. Grasp the plunger firmly and pull the piston out of the hydraulic cylinder.



Bearing Rings and Seal Assembly

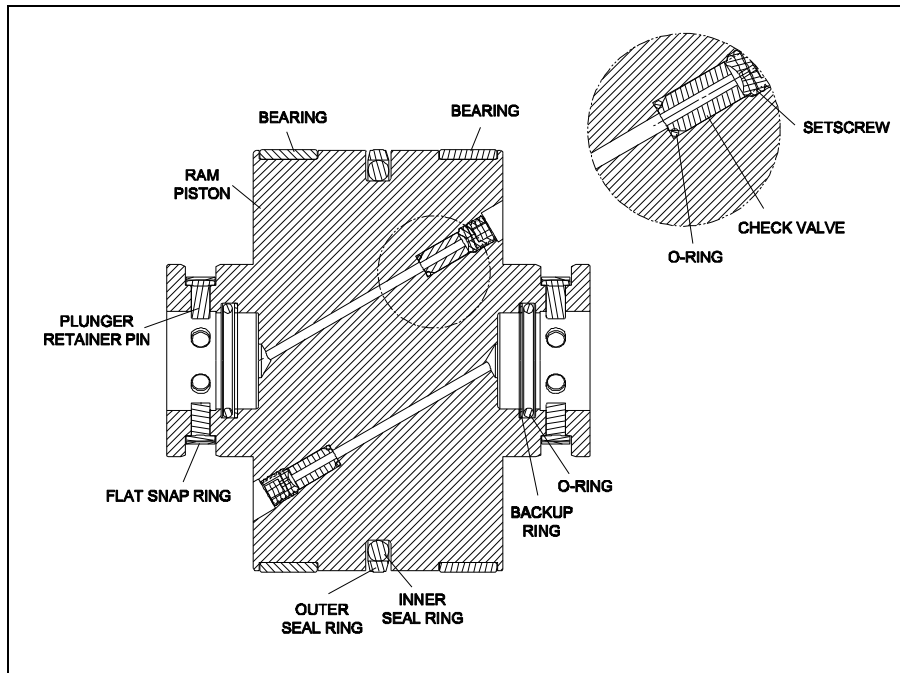
1. Remove the plungers from the hydraulic piston.
2. Use a smooth, dull-edged blade made from brass or similar soft metal material to remove the two bearing rings and the seal assembly.

NOTE

Do not scratch the surfaces of the piston seal groove. Scratches on the sides or bottom of the groove can result in hydraulic leaks.

3. Inspect the bottom of the seal grooves for marks, scratches and residue buildup. Clean and/or repair the groove surfaces as required.
4. Apply FML-2 grease to the new bearing rings and install the rings.
5. The piston seal assembly consists of an inner o-ring and an outer seal ring. Apply FML-2 grease to both rings. Use the smooth, dull-edged blade to install the inner o-ring, ensuring the o-ring is not twisted after installation. Slide the outer seal ring over the metal edges and ease it into position over the o-ring.

Figure 9-15: Bearing Rings and Seal Assembly



Plunger Button Sockets, Seals and Retainer Pins

1. Remove the flat snap rings and plunger retainer pins on both ends of the piston.
2. Inspect the snap rings and the pins for unusual wear or deformation. Clean and inspect the pin holes for unusual wear, deformation or enlargement.
3. Remove the plunger button o-ring and backup ring from each plunger socket. Take care not to scratch or damage the seal groove surfaces.
4. Clean and inspect the seal grooves for residue buildup or surface marks that could cause seal leaks.
5. Inspect the plunger button sockets for unusual wear.

NOTE

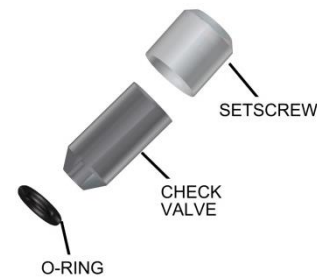
Due to the high contact force between the piston and the plunger, the plunger may make an impression in the bottom of the socket. This compression mark or indentation is normal.

6. Apply FML-2 grease to new plunger button backup rings and o-rings. Install the rings in the internal groove in the plunger socket. If the backup ring is not installed the plunger can be forced out of the plunger socket.
7. Install the retainer pins, verifying that each pin moves freely without excess side play in the pin holes.
8. Install the flat snap ring over the pins.
9. Install the plungers and check the snap-in feature of the plunger attachment. Use the plunger removal tool to ensure the pins retract to release the plunger, and close to retain the plunger in a uniform manner.

Internal Check Valves

It is not necessary to service the internal check valves unless a problem is suspected. If the check valves or the internal passages in the piston require service, plunger button, seal and pin servicing is also recommended.

1. Loosen the setscrew and remove the check valves and o-rings. Clean the internal passages.
2. Apply FML-2 grease to a new o-ring and install the o-ring in the check valve passage. Use a blunt, pencil-like instrument to position it in the bottom of the passage.
3. Clean and install a new check valve with the chamfered end toward the o-ring.
4. Sparingly apply Loctite, threadlocker adhesive to the setscrew. Thread the screw over the check valve cartridge and tighten.



NOTE

Excess threadlocker adhesive can clog the check valve or block the internal passage. To avoid excess adhesive, position the setscrew on an Allen wrench and apply the adhesive. Hold the screw horizontal on a paper towel and rotate the screw to remove excess adhesive.

Hydraulic Piston Installation

1. Ensure that the hydraulic cylinder bore is free of grit or contamination.
2. Lubricate the bearing rings and seal assembly, and lightly lubricate 2-3 inches of the hydraulic cylinder bore with hydraulic oil.
3. Install the piston into the hydraulic cylinder bore. If necessary, use a plastic head hammer to drive the piston into position between the holes for the proximity switches.

4. Install the plungers and check the snap-in feature of the plunger attachment. Use the plunger removal tool to ensure the pins retract to release the plunger, and close to retain the plunger in a uniform manner.
5. Verify the proper positioning of the o-ring and backup ring in the groove on both hydraulic cylinder heads, and that they are sufficiently lubricated with hydraulic oil.
6. Position the cylinder heads on the ends of the hydraulic cylinder. Apply JL-M grease to the threads on the socket head screws. Install the screws in each hydraulic cylinder head and tighten, following the torque specifications in Table 9-3. See Table 9-1, Component Weights.
7. Replace the hydraulic seal cartridge, bushing retainer flange and high pressure seal assembly in both hydraulic cylinder heads.
8. Apply hydraulic oil to the o-rings and replace the proximity switches by positioning the o-rings, spacers and the switches. Apply JL-M grease to the threads on the socket head screws and tighten, following the torque specifications in Table 9-3.



Ensure the proximity switches are properly installed and secured prior to starting the motor. Failure to tighten the two hold down screws on each switch will result in the spray of hydraulic oil.

9. Connect the drain line on the hydraulic cylinder head.
10. Install the UHP cylinders and associate components, following the procedure, Ultra-High Pressure Cylinder Installation.
11. Connect the high and low pressure water piping, and turn the low pressure water supply on.

9.11 Hydraulic Cylinder Maintenance

The inside diameter surface of the hydraulic cylinder should be inspected for wear grooves and surface finish whenever the hydraulic cylinder heads are removed. Excessive grooving is indicative of piston seal wear.

9.12 High Pressure Attenuator

The high pressure attenuator is not serviceable at the customer level. KMT Waterjet Systems tests the seals in the attenuator at pressures exceeding normal operating pressure, making disassembly difficult. If the attenuator develops a high pressure water leak, it should be replaced.

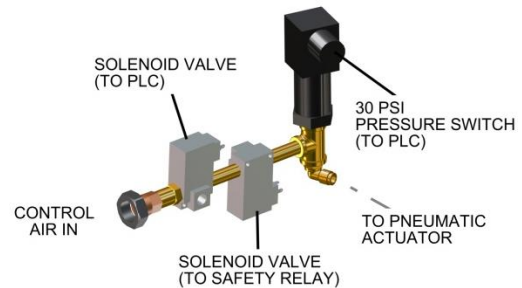
9.13 Ultra-High Pressure Dump Valve

The ultra-high pressure dump valve assembly includes a normally open high pressure water valve and a solenoid operated air valve. Redundant solenoid valves create a block and bleed system for the air pressure used to operate the dump valve. The first solenoid valve is machine controlled with a safety function override. The second solenoid is controlled by the safety function relay.

A 30 psi pressure switch is used for testing and monitoring the safety function of the block and bleed system. If a failure is detected, a signal from the pressure switch prevents operation to continue.

Together, the solenoids and the pressure switch provide redundancy and diversity to ensure all air pressure is removed from the high pressure dump valve when the e-stop button is pressed.

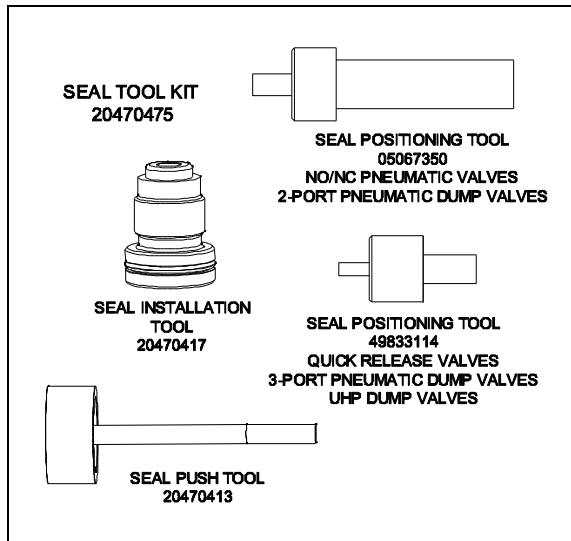
The following procedure is recommended for servicing the ultra-high pressure dump valve. Failure to follow these procedures will cause damage to the stem, valve seat, or both.



The high pressure dump valve is designed to instantly release high pressure from the system. **Proper maintenance is imperative** to prevent potential personal injury.

Figure 9-16, Pneumatic Valve Seal Tools, illustrates the special tools recommended for this procedure.

Figure 9-16: Pneumatic Valve Seal Tools



Pneumatic Control Dump Valve

For reliable operation, always replace the valve seat, seal assembly, brass backup ring and stem at the same time. The SST backup ring can be reused.

Before proceeding, disconnect and lockout the main power supply and the electrical enclosure; and ensure that all high pressure water and hydraulic pressure has been bled from the system.

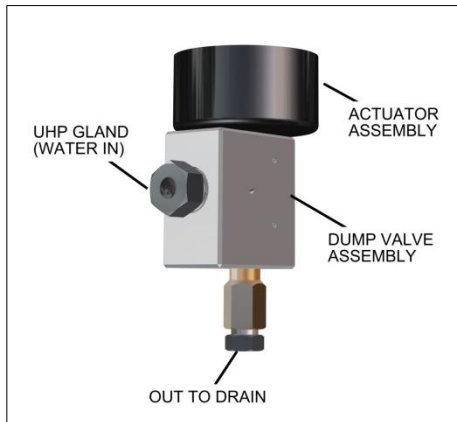


Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before performing maintenance.

Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before performing maintenance.



Figure 9-17: UHP Dump Valve



1. Turn the air supply off.
2. Remove the air supply hose from the valve assembly.
3. Loosen and remove the high pressure gland connections and the drain connection.
4. Remove the valve and actuator assembly from the machine.
5. Loosen the cylinder head on the actuator.
Unscrew and remove the actuator from the valve body.
6. Unscrew the UHP adapter and remove the adapter and valve seat.
7. Remove the stem, SST backup ring and brass backup ring from the valve body.
8. Remove the seal assembly by pushing it with the seal push tool (P/N 20470413). The assembly must be pushed out through the actuator port in the top of the valve body.
9. Discard the stem, brass backup ring, seal assembly and valve seat.
10. Clean and inspect the valve body, being careful not to damage or scratch the bore.

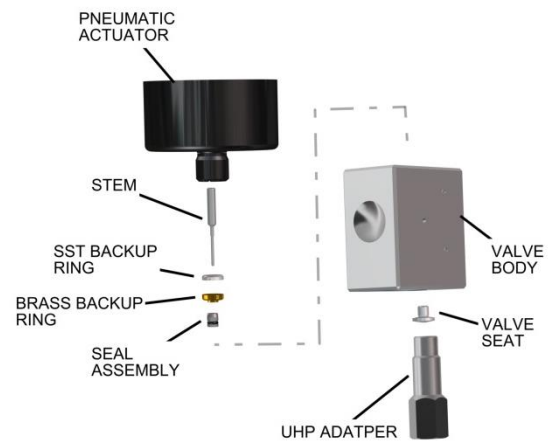
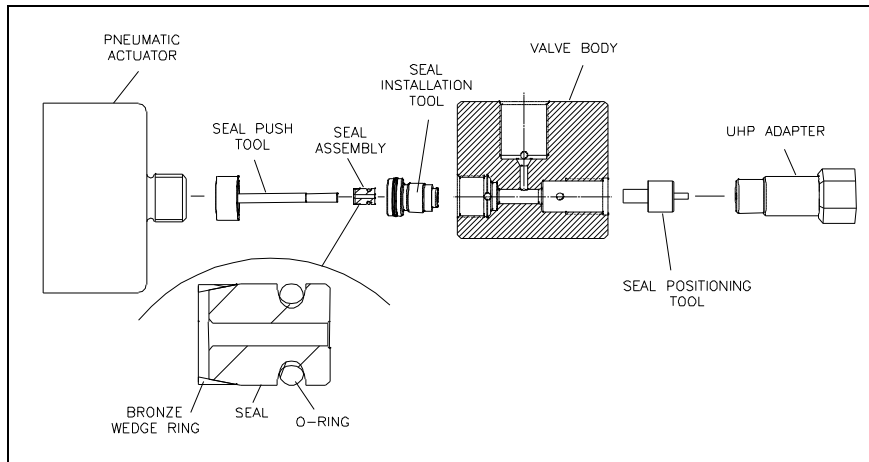


Figure 9-18: Valve Seal Installation

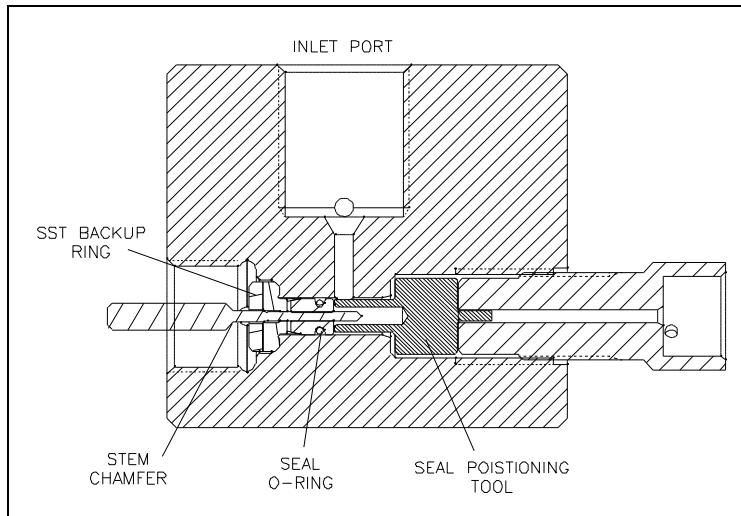


11. Place the seal positioning tool into the end of the valve body as shown above. Thread the UHP adapter into the valve body until light contact is made with the positioning tool. Tighten finger-tight only.
12. Apply Pure Goop anti-seize compound to the threads on the seal installation tool. Screw the seal installation tool into the threads of the valve body. Tighten finger-tight only.
13. Lubricate the seal and the o-ring with FML-2 food grade grease. Insert the seal and o-ring, with the bronze wedge ring, into the seal installation tool. Insert the o-ring end of the seal first so the tapered end of the seal (wedge ring end) faces the actuator. The tapered end of the seal must face the actuator. See Figure 9-18, Valve Seal Installation.
14. Use the seal push tool to push the seal assembly into the bore of the valve body until the seal makes light contact with the positioning tool.
15. Remove the push tool and the installation tool from the valve body.
16. Install the existing SST backup ring and a new brass backup ring on a new stem. The vee groove on the SST backup ring must face toward the brass backup ring. The small OD of the brass backup ring must face toward the seal assembly.
17. Apply FML-2 grease to the tip of the stem and insert the stem with the backup rings into the top of the valve body so the stem enters the ID of the seal assembly. **Insert the stem until the chamfer on the stem is seated against the SST backup ring.** See Figure 9-19, Valve Stem Placement.



Do not push the o-ring on the seal assembly past the inlet port on the valve body. This will damage the seal o-ring.

Figure 9-19: Valve Stem Placement



18. Remove the UHP adapter and the seal positioning tool.
19. Apply Pure Goop anti-seize compound to the threads of the actuator and carefully thread it into the valve body, guiding the stem head into the hole in the actuator. Turn the actuator clockwise until resistance is felt. Reverse the actuator 1/4-turn, and give it a quick spin clockwise to seat it. Hand-tighten only, 5 ft-lbs (7 Nm).
20. Apply Pure Goop anti-seize compound to all surfaces, except the ID, of a new valve seat. Install the seat into the opposite end of the valve body, inserting the small OD first.
21. Apply anti-seize compound to the threads on the UHP adapter. Install the adapter and torque to 70 ft-lbs (95 Nm).
22. Apply anti-seize compound to the threads on 1/4-inch gland. Replace the gland and collar, and torque to 35 ft-lbs (47 Nm).
23. Apply anti-seize compound to the threads on the 3/8-inch high pressure gland. Install the collar and the gland and torque to 75 ft-lbs (102 Nm).
24. Install the air supply hose and the electrical connection to the solenoid valve. Turn the air pressure to the actuator on and test the valve for leaks and proper operation.

Pneumatic Actuator

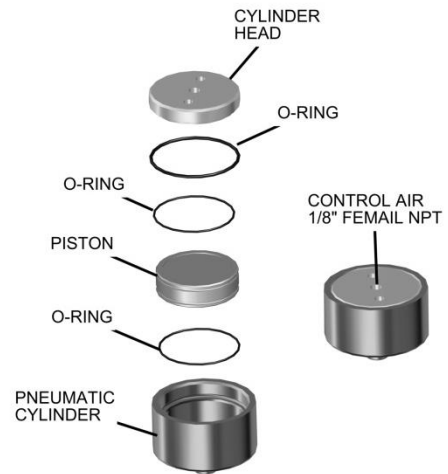
Use the following procedure to service the pneumatic actuator.

1. Unscrew and remove the cylinder head using a strap wrench and a pin spanner. Remove the piston from the cylinder.



Do not install the pneumatic cylinder in a vise to remove the cylinder head. This may distort the body and seize the piston, preventing proper operation.

2. Remove the o-ring on the cylinder head.
Apply FML-2 grease to a new o-ring and install.
3. Remove the two o-rings on the piston. Apply FML-2 grease to two new o-rings and install.
4. Install the piston in the pneumatic cylinder.
Apply anti-seize compound to the threads on the cylinder head and screw it into the pneumatic cylinder.



9.14 Weep Holes

Any high pressure seal or connection will eventually fail and begin to leak. Weep holes are located at every threaded and non-threaded high pressure connection to provide a vent for internal leaks. Water or oil dripping from a weep hole, unless a component is designed to leak a specific amount, indicates one or more internal components are beginning to fail.

Table 9-4 lists the location of the weep hole, the possible source of the leak and the corrective action required.

Table 9-4
Weep Holes
Ultra-High Pressure Water System

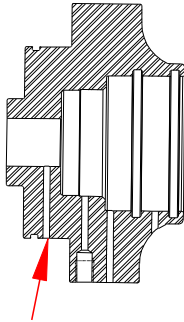
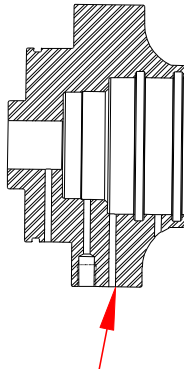
Location	Indication	Comments
Hydraulic Cylinder Head		
<p>Hydraulic oil leaking from the weep hole in the hydraulic cylinder head</p> 	<p>Failed hydraulic seal cartridge</p>	<p>Replace the seal cartridge. If the leak persists, check the plunger for linear scratches or scoring.</p> <p>Depending on the life and condition of the UHP seal, it could be reused.</p>
<p>Water leaking from the weep hole in the hydraulic cylinder head</p> 	<p>Metal-to-metal seal between the high pressure seal assembly and the high pressure cylinder has failed</p> <p>The leak may present as small or heavy drips, with or without steam</p>	<p>Stop the pump immediately. If jetting or score marks are present, replace the UHP pressure seal assembly immediately.</p> <p>Check for jetting or score marks on the cylinder chamfer. If present, replace the UHP cylinder.</p> <p>It may be possible to refurbish the cylinder chamfer. Return to KMT for evaluation.</p> <p>It may not be possible to refurbish the sealing head lens sealing surface.</p>

Table 9-4
Weep Holes
Ultra-High Pressure Water System

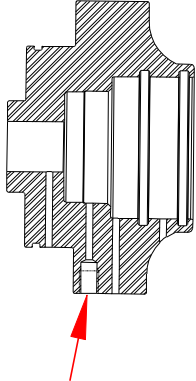
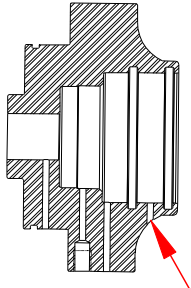
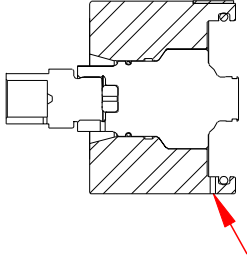
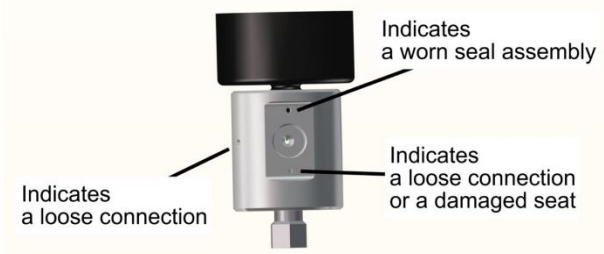
Location	Indication	Comments
<p>Water leaking from the weep hole in the hydraulic cylinder head</p> 	<p>Low pressure water leaking from the plastic seal in the UHP seal assembly</p>	<p>No immediate action is required unless the pump shuts down due to an overstroke. Start the pump to verify the UHP seal leak is the cause of the overstroke shutdown. If so, the UHP seal may require replacement.</p> <p>It is normal for the UHP seal to occasionally leak low pressure water after every stroke. This condition may continue to persist for hundreds of operating hours before the seal eventually fails.</p> <p><i>Water leaking from this weep hole is routed to the contaminated waste drain.</i></p>
<p>Water leaking from the weep hole in the hydraulic cylinder head</p> 	<p>In the event of a UHP cylinder failure at a location between the two o-rings, water will leak from this weep hole.</p>	<p>The UHP cylinder may be cracked.</p> <p>Check the o-rings for damage and replace if necessary. The o-rings are critical for the alignment of the UHP cylinder.</p>



Table 9-4
Weep Holes
Ultra-High Pressure Water System

Location	Indication	Comments
Sealing Head Water leaking from the weep hole in the sealing head		
	Seat in the discharge check valve is not sealing properly	Make sure the discharge gland is tightened to the proper torque specification.
		Inspect the seat, sealing head and discharge gland for cracks.
	Internal crack in sealing head	Replace the sealing head. <i>A cracked sealing head can result in water leaking from the high pressure outlet passage to the low pressure inlet passages.</i> <i>The sealing head body can become extremely hot.</i>
	Improper torque on discharge gland	Tighten the gland to the proper torque specification.
Water leaking from the weep hole in the discharge gland	Erosion or scratches on the contact surface of the sealing head, or on the gland nut where the seat makes contact	Polish the surfaces following the procedure, Sealing Head Maintenance.
	High pressure piping gland is not tight and is not sealing properly	Tighten the gland to the proper torque specification.
		Check the number of exposed threads past the collar on the high pressure piping. Only 1-1/2 to 2-1/2 threads should be exposed.
		Check high pressure piping for damage, cracks or deformation.
		Inspect the gland for deformation of the threads.
	Damaged sealing head gland	Check the gland for cracks due to fatigue. If cracks are detected, replace the gland.

Table 9-4
Weep Holes
Ultra-High Pressure Water System

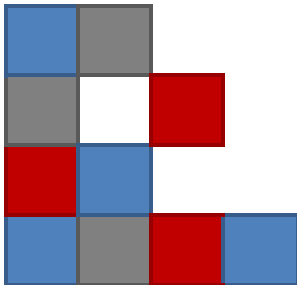
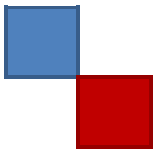
Location	Indication	Comments
UHP Cylinder Flange Water leaking from the weep hole in the UHP cylinder flange 	Metal-to-metal leak between the sealing head and the UHP cylinder chamfer	<p>Stop the pump immediately. If jetting or score marks are present, replace the sealing head assembly immediately.</p> <p>Check for jetting or score marks on the cylinder chamfer. If present, replace the UHP cylinder.</p> <p>It may be possible to refurbish the cylinder chamfer. Return to KMT for evaluation.</p> <p>Replace the aligning o-ring in the UHP cylinder if damaged.</p>
Dump Valve Water leaking from the weep holes in the dump valve		

SECTION 10

TROUBLESHOOTING

The Troubleshooting section contains:

- Guide for diagnosing problems
- Information for repairing the equipment





10.1 Overview

The troubleshooting guide will help identify the probable cause of a system malfunction and assist in providing corrective action. The following symptoms are discussed in this section:

1. Inlet water pressure is falling below 30 psi (2 bar) during stroke condition
2. Outlet booster pump pressure is falling below 100 psi (6.8 bar)
3. Water is leaking around the v-clamp on the filter head
4. High oil temperature resulting in shutdown
5. Low oil level resulting in shutdown
6. Hydraulic pressure but no high pressure water pressure
7. Erratic fluctuations in the operating pressure, or inability to reach or maintain set pressure
8. No hydraulic oil pressure
9. Pump shaft will not turn
10. Pump will not start
11. Console display and lights do not illuminate
12. Pump quits running
13. No control power
14. Red light on operator's console is on
15. Hot surfaces on the high pressure cylinder components
16. Low cutting water pressure
17. Hydraulic oil leaking from the weep hole in the hydraulic cylinder head
18. Water leaking from the weep hole in the hydraulic cylinder head
19. Water leaking from the weep hole in the hydraulic cylinder head
20. Water leaking from the weep hole in the hydraulic cylinder head
21. Water leaking from the weep hole in the sealing head
22. Water leaking from the weep hole in the sealing head gland nut
23. Water leaking from the weep hole in the UHP cylinder flange
24. Water leaking from the weep holes in the dump valve



10.2 Troubleshooting Guide

Listen to the machine and observe it in operation. Learn to recognize the normal sounds and operating conditions of the system. Carefully define the symptom of the problem. Locate the symptom on the troubleshooting guide that most closely corresponds to the problem.

If the symptoms in the guide do not correspond to the malfunction, or if the problem is not resolved by the recommended corrective action, contact the KMT Customer Service Department for assistance.

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

	Malfunction	Indication	Comments
1.	Inlet water pressure is falling below 30 psi (2 bar) during stroke condition	Supply water pressure or flow is low	Check for restrictions or other demands on the utility.
		Inlet solenoid valve is malfunctioning	Replace the inlet solenoid valve.
		Pressure switch is bad	Replace the pressure switch.
2.	Outlet booster pump pressure is falling below 100 psi (6.8 bar)	Supply water pressure is low	Check for restrictions or other demands on the utility.
		Filter element is dirty	Replace the filter element.
		Mesh liner in the strainer is clogged	Clean the liner in the strainer.
		Booster pump needs to be adjusted, or replaced	Booster pump should be adjusted to 150 psi (10.2 bar) when deadheaded.
		Pressure switch is bad	Replace the pressure switch.
3.	Water is leaking around the v-clamp on the filter head	O-ring that closes the passage has deteriorated, been cut or is not positioned correctly	Replace or reposition the o-ring.

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

Malfunction	Indication	Comments
4.	High oil temperature resulting in shutdown	Oil-to-Water Models
		Cooling water flow is restricted
		Check cooling water source for proper temperature and flow rate.
		Solenoid valve in outlet line is malfunctioning
		Replace the solenoid valve.
		Scale build up in the heat exchanger has restricted the flow
		The heat exchanger will need to be flushed or replaced. <i>A water pressure differential of more than 35 psi (2.4 bar) may indicate restriction.</i>
		Oil temperature sensor is not operating properly
		Replace the sensor.
		Oil-to-Air Models
5.	Low oil level resulting in shutdown	Oil temperature sensor is not operating properly
		Replace the sensor.
		No power to cooler fan motor
		Check power supply to fan motor.
		Check the circuit breaker.
		Restricted air flow to cooler
5.	Low oil level resulting in shutdown	<i>There should be 36 inches (1 meter) clear space in front of the cover.</i>
		Ambient temperature is greater than 104° F
		<i>The air cooler will not be able to maintain oil temperature at ambient temperatures above 104° F</i>
5.	Low oil level resulting in shutdown	Oil level is low due to leaks
		Check the level gauge.
		Check for hydraulic leaks.
5.	Low oil level resulting in shutdown	Level switch is malfunctioning
		Check or replace the level switch.

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

Malfunction		Indication	Comments
6.	Hydraulic pressure but no high pressure water pressure	Proximity switch failure	From the Maintenance Screen on the control panel, jog the intensifier left and right and verify that the red light comes on at both proximity switches.
		I/O relay failure	From the Maintenance Screen on the control panel, jog the intensifier left and right and verify that the green light comes on at both directional valve solenoids.
		Coil failure on the directional control valve	Check the resistance of the coils on the directional valve with a multi- meter. The resistance should be between 18 and 20 ohms.
		PLC failure	If there are inputs from the proximity switches, but no outputs, contact the KMT Customer Service Department for a logic review and verification of PLC failure.

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

	Malfunction	Indication	Comments
7.	Erratic fluctuations in the operating pressure, or inability to reach or maintain set pressure	The screen in the proportional pressure valve is blocked with debris	Remove the valve and clean the screen following the maintenance procedure in Section 7, Hydraulic System.
		Large, worn or damaged orifice	Make sure the orifice does not exceed the capacity of the pump.
			Make sure the orifice is in good working condition. Verify the jewel is installed in the orifice mount.
		Check valve leakage	Inspect the discharge check valves in the sealing heads.
			Inspect the inlet check valves in the sealing heads.
		Seal leakage	Inspect the high pressure seal on the plunger.
			Inspect the sealing head-to-cylinder sealing surfaces.
		Hydraulic control malfunction	Check the operation of the hydraulic relief valve.
			Verify the directional control valve is shifting properly.
			Check the operation of the proximity switches.
8.	No hydraulic oil pressure	The high and low limit compensators on the hydraulic pump are blocked with debris and are not controlling the swashplate	Disassemble the compensators, clean and inspect the components following the maintenance procedure in Section 7, Hydraulic System.
		Incorrect motor rotation	Check the motor rotation.
9.	Pump shaft will not turn	The flexible coupling has failed	Replace the flexible coupling.
		The hydraulic pump has seized	Replace the hydraulic pump.

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

Malfunction		Indication	Comments
10.	Pump will not start	Emergency stop button is depressed	Pull the e-stop button out and reset safety function relay.
			Check all remote safety function relays and reset.
		A protection fault has been activated	Check the display panel for fault messages.
		Motor overload relay has been tripped	Identify the source of the overload and remedy the problem. Reset the overload relay.
		Inlet water valve is turned off	Turn the water valve on.
11.	Console display and e-stop light does not illuminate	Control power has been interrupted	Check to verify the remote interface plug is connected.
			Check the input and output of the 24 volt DC power supply.
		Main power is disconnected	Check the main power and verify that the main power disconnect is on.
12.	Pump quits running	Unsafe operation has been detected	Check the display panel for fault messages.
		Electrical power has been interrupted	Check the power supply circuit for a tripped breaker.
			Check the input and output of the 24 volt DC power supply.
			Verify that power is available at the main power source.
		Motor overload relay has been tripped	Identify the source of the overload and remedy the problem. Reset the overload relay.

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

	Malfunction	Indication	Comments
13.	No control power	Circuit breaker has been tripped	Check the input and output of all circuit breakers.
		Safety function relay has been tripped	Check all safety function relays and reset.
		Remote interface plug is disconnected	Connect remote interface plug.
14.	Red light on operator's console is on	An alarm condition has occurred	Check the display panel for fault messages. <i>Refer to Section 4, Operation, for additional information regarding warning and alarm conditions and recovery procedures.</i>
15.	Hot surfaces on the high pressure cylinder components	Leaking discharge check valve	Inspect the condition of the seat, poppet valve, spring, poppet pin and sealing head surface on the discharge end of the sealing heads.
		Leaking inlet check valve	Inspect the condition of the ball, dowel pin and seat and replace if necessary.
		Damaged sealing head	Check the cone flange surface of the sealing head for scratches or mechanical damage and replace if necessary.
		Damaged high pressure cylinder	Check the high pressure cylinder for cracks.

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

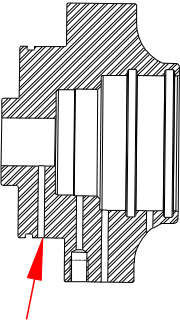
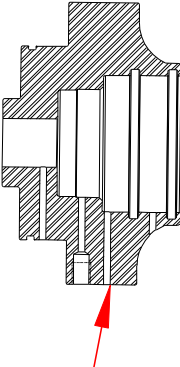
	Malfunction	Indication	Comments
16.	Low discharge water pressure	Low hydraulic pressure setting	If operating in low pressure, switch to high pressure operation and check the hydraulic pressure setting.
			Clean the hydraulic relief or proportional pressure control valve.
		Collapsed element in the high pressure line filter	Clean the compensators on the hydraulic pump. Check the element in the high pressure line filter, if applicable.
17.	Hydraulic oil leaking from the weep hole in the hydraulic cylinder head 	Failed hydraulic seal cartridge	Replace the seal cartridge. If the leak persists, check the plunger for linear scratches or scoring. Depending on the life and condition of the UHP seal, it could be reused.
18.	Water leaking from the weep hole in the hydraulic cylinder head 	Metal-to-metal seal between the high pressure seal assembly and the high pressure cylinder has failed The leak may present as small or heavy drips, with or without steam	Stop the pump immediately. If jetting or score marks are present, replace the UHP pressure seal assembly immediately. Check for jetting or score marks on the cylinder chamfer. If present, replace the UHP cylinder. It may be possible to refurbish the cylinder chamfer. Return to KMT for evaluation.

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

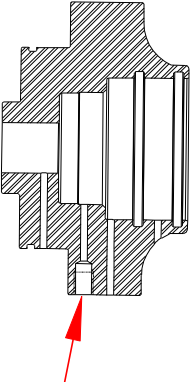
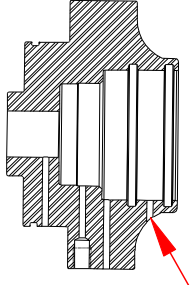
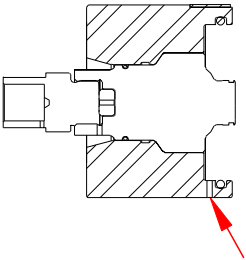
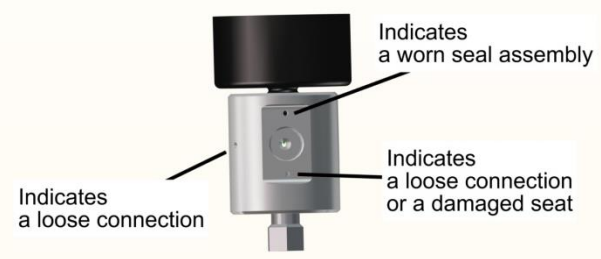
	Malfunction	Indication	Comments
19.	<p>Water leaking from the weep hole in the hydraulic cylinder head</p> 	<p>Low pressure water leaking from the plastic seal in the high pressure seal assembly</p>	<p>No immediate action is required unless the pump shuts down due to an overstroke. Start the pump to verify the leak is the cause of the overstroke shutdown. If so, the UHP seal may require replacement.</p> <p>It is normal for the UHP seal to occasionally leak low pressure water after every stroke. This condition may continue for hundreds of operating hours before seal failure.</p> <p><i>Water leaking from this weep hole is routed to the contaminated waste drain.</i></p>
20.	<p>Water leaking from the weep hole in the hydraulic cylinder head</p> 	<p>If pressure builds up between the two o-rings on the hydraulic cylinder head, water will leak from this weep hole.</p>	<p>The UHP cylinder may be cracked.</p> <p>The o-rings may have failed.</p>

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

Malfunction		Indication	Comments
21.	Water leaking from the weep hole in the sealing head	Seat in the discharge check valve is not sealing properly	Make sure the gland nut is tightened to the proper torque specification.
			Inspect the seat, sealing head and gland nut for scratches, erosion or cracks.
		Improper torque on gland nut	Tighten the gland nut to the proper torque specification.
		Internal crack in sealing head	Replace the sealing head. <i>A cracked sealing head can result in water leaking from the high pressure outlet passages to the low pressure inlet passages.</i> <i>The sealing head body can become extremely hot.</i>
		Erosion or scratches on the contact surface of the sealing head, or on the gland nut where the seat makes contact	Polish the surfaces following the procedure, Sealing Head Maintenance, detailed in Section 9, High Pressure Water System.
22.	Water leaking from the weep hole in the sealing head gland nut	High pressure piping gland nut is not tight and is not sealing properly	Tighten the gland nut to the proper torque specification.
		Improper high pressure piping connection	Check the number of exposed threads past the collar on the high pressure piping. Only 1-1/2 to 2-1/2 threads should be exposed.
			Check high pressure piping for damage, cracks or deformation.
			Inspect the gland nut for deformation of the threads.
		Damaged sealing head gland nut	Check the gland nut for cracks due to fatigue. If cracks are detected, replace the gland nut.

Table 10-1
SL-VI Pro 60 III Troubleshooting Guide

	Malfunction	Indication	Comments
23.	<p>Water leaking from the weep hole in the UHP cylinder flange</p> 	<p>Metal-to-metal leak between the sealing head and the UHP cylinder chamfer</p>	<p>Stop the pump immediately. If jetting or score marks are present, replace the sealing head assembly immediately.</p> <p>Check for jetting or score marks on the cylinder chamfer. If present, replace the UHP cylinder.</p> <p>It may be possible to refurbish the cylinder chamfer. Return to KMT for evaluation.</p>
24.	<p>Water leaking from the weep holes in the dump valve</p>		

10.3 Soft Starter

Table 10-2
Soft Starter Troubleshooting Guide









		Indication	Remedy
Warning			
1.	Impermissible I_e CLASS setting (control voltage present, no start command) <i>Device</i>  (green) <i>State/Bypassed/Failure</i>  (red)  (green)  (green)	The rated operational current I_e set for the motor (control voltage present, no start command) exceeds the associated, maximum permissible setting current referred to the selected CLASS setting.	Check the rated operational current set for the motor, select a lower CLASS setting, or calculate the soft starter with a size allowance. As long as the soft starter is not controlled IN (0->1), this is only a status signal. However, it becomes a fault signal if the start command is applied.
2.	Start inhibited, device too hot <i>Device</i>  (yellow) <i>State/Bypassed/Failure</i>  (red)	The acknowledgment and the motor start are inhibited for a defined time by the inherent device protection following an overload trip, to allow the soft starter to cool down. Possible causes: <ul style="list-style-type: none"> ▪ Too many starts ▪ Motor ramp-up time too long ▪ Ambient temperature in switching device's environment too high ▪ Minimum installation clearances not complied with 	The device cannot be started until the temperature of the thyristor or the heat sink has cooled down enough to guarantee sufficient reserve for a successful startup. The time until restarting is allowed can vary but is a minimum of 30 seconds. Rectify the causes and possibly retrofit the optional fan, if applicable.
Fault			
3.	Impermissible electronics supply voltage <i>Device</i>  (red) <i>State/Bypassed/Failure</i>  (red)	The control supply voltage does not correspond to the soft starter's rated voltage.	Check the control supply voltage; could be caused by a power failure, voltage dip, or incorrect control supply voltage. Use a stabilized power supply unit if due to mains fluctuations.

Table 10-2
Soft Starter Troubleshooting Guide













		Indication	Remedy
4.	<p>Impermissible I_e CLASS setting and IN (0->1) (control voltage present, IN start command changes from 0 to 1)</p> <p><i>Device</i>  (green)</p> <p><i>State/Bypassed/Failure</i>  (red)</p>	<p>The rated operational current I_e set for the motor (control voltage present, start command present) exceeds the associated, maximum permissible setting current referred to the selected CLASS setting.</p>	<p>Check the rated operational current set for the motor, select a lower CLASS setting, or calculate the soft starter with a size allowance.</p>
5.	<p>Motor protection tripping Overload relay/thermistor</p> <p><i>Device</i>  (green)</p> <p><i>State/Bypassed/Failure</i>  (red)</p>	<p>The thermal motor model has tripped. After an overload trip, restarting is inhibited until the recovery time has elapsed.</p> <p>Overload relay tripping time is 60 seconds.</p> <p>Thermistor tripping time equals the time for the temperature sensor (thermistor) in the motor to cool down.</p>	<ul style="list-style-type: none"> Check whether the motor's rated operational current I_e is set correctly. Change the CLASS setting Possibly reduce the switching frequency. Deactivate the motor protection (CLASS OFF). Check the motor and the application.
6.	<p>Thermistor protection: wire breakage/short-circuit (optional)</p> <p><i>Device</i>  (green)</p> <p><i>State/Bypassed/Failure</i>  (red)</p>	<p>Temperature sensor at terminals T11/T12/T22 is short-circuited or defective, a cable is not connected, or no sensor is connected.</p>	<p>Check the temperature sensor and the wiring.</p>
7.	<p>Thermal overload on the device</p> <p><i>Device</i>  (yellow)</p> <p><i>State/Bypassed/Failure</i>  (red)</p>	<p>Overload trip of the thermal model for the power unit.</p> <p>Possible causes:</p> <ul style="list-style-type: none"> Too many starts Motor ramp-up time too long Ambient temperature in switching device's environment too high Minimum installation clearances not complied with 	<p>Wait until the device has cooled down again, possibly increase the current limiting value set for starting, or reduce the switching frequency (too many consecutive starts). Possibly retrofit the optional fan, if applicable.</p> <p>Check the load and the motor, check whether the ambient temperature in the soft starter's environment is too high (derating above 40 °C).</p>

Table 10-2
Soft Starter Troubleshooting Guide

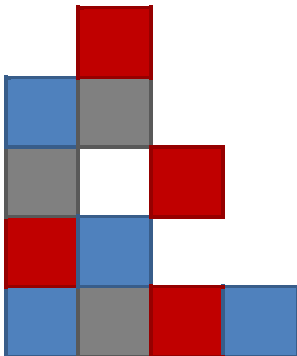
		Indication	Remedy
8.	Missing load voltage, phase failure/missing load	Phase L1/L2/L3 is missing or fails/collapses when the motor is operating.	Connect L1/L2/L3 or correct the voltage dip.
	<i>Device</i>  (yellow)	Tripped as a result of a dip in the permissible rated operational voltage > 15 % for > 100 ms during the startup process or > 200 ms in bypass mode.	
	<i>State/Bypassed/Failure</i>  (red)		
		The motor that is connected is too small and the fault occurs as soon as it is switched to bypass mode.	Set the correct rated operational current for the connected motor or set it to the minimum value (if the motor current is less than 10% of the set I_e , the motor cannot be operated with this starter).
		Motor phase T1/T2/T3 is not connected.	Connect the motor properly (e.g. jumpers in the motor terminal box, repair switch closed etc.)
9.	Device fault	Soft starter is defective.	Contact KMT for technical assistance.
	<i>Device</i>  (red)		
	<i>State/Bypassed/Failure</i>  (red)		

SECTION 11

SPECIFICATIONS

The Specifications section provides:

- Equipment specifications
- Water quality standards and treatment guidelines
- Horsepower requirements for orifice sizes



11.1 Overview

Comprehensive listings of specifications for the SL-VI Pro III 60 are provided in this section.

Table 11-1
SL-VI Pro III 60

Model	Motor Horsepower Rating	
	HP	Kw
SL-VI Pro 60	60	45

11.2 Installation Specifications

Environment

Installation location	Indoors
Air borne dust/contaminants	Minimal
Ambient temperature	
Minimum storage	36° F (2° C)
Continuous duty	40° F (5° C) to 86° F (30° C)
Intermittent duty	40° F (5° C) to 104° F (40° C)
Maximum relative humidity* (at maximum operating temperature)	95%
<p>*Note: When the relative humidity is above 50%, the oil in the reservoir should be checked frequently for water content.</p>	

EMC Standards

The SL-VI has been tested and conforms to the following EMC standards:

- EN 55011 Conducted Emissions, Group 1, Class A
- EN 55011 Radiated Emissions, Group 1, Class A
- EN 6100-4-2 ESD immunity
- EN 61000-4-3 Radiated field immunity
- EN 61000-4-4 EFT/BURST immunity
- EN 61000-4-5 Surge immunity
- EN 61000-4-6 Conducted RF immunity
- EN 61000-4-8 PF Magnetic field immunity
- EN 61000-4-11 Voltage dips, fluctuation and interruptions



The detailed test and results are available on request.

Electromagnetic Radiation

The SL-VI is compliant to EN6100-64 (Emissions) and EN6100-6-2 (Immunity) standards of EMC Directive 2004/108/EC.

Sound Level Range

(Sound levels will vary with pump location, environment and equipment options.)

Sound level [dB(A)]	83-94
---------------------	-------

Equipment Dimensions and Weights

Length	Width	Height	Weight
82.50" (2,095 mm)	51.82" (1,320 mm)	57.58" (1,508 mm)	4,380 lbs (1,987 kg)

Redundant Models (same dimensions as above)

	4,695 lbs (2,130 kg)
--	----------------------

Service Connections

		Connection	Height
A	Drain	1/2" NPT	11.61" (295 mm)
B	Cutting Water In	1/2" NPT	14.61" (371 mm)
C	Cooling Water In	1/2" NPT	17.61" (447 mm)
	Hydraulic Oil Out (oil-to-air models)	3/4" JIC	17.61" (447 mm)
D	Cooling Water Out	1/2" NPT	20.61" (523 mm)
	Hydraulic Oil In (oil-to-air models)	3/4" JIC	20.61" (523 mm)
E	Plant Air In	1/4" NPT	30.61" (777 mm)
F	Cutting Water Out	9/16" HP	33.61" (854 mm)
G	Contaminated Waste Drain	1/2" NPT	36.61" (929 mm)

All service connections are made on the bulkhead of the machine. The intensifier requires two incoming water sources, cooling water and cutting water; two drain lines, cooling water and wastewater; a high pressure discharge line, and an air supply line.

Plant Air

The facility compressed air connection should provide clean, dry air regulated to 85 psi (5.9 bar). Air usage is minimal, normally less than 1 scf/min.

The following table provides specifications for each ISO air quality classification. KMT recommends adherence to Quality Class 4.

Table 11-2
ISO Air Quality Classifications

ISO Quality Class	Maximum Particle Size (microns)	Maximum Pressure Dew Point (water @ 100 psi)	Maximum Oil Content (Mg/m ³)
1	0.1	-94° F (-60° C)	0.01
2	1	-40° F (-40° C)	0.1
3	5	-4° F (-20° C)	1
4	15	+38° F (+3° C)	5
5	40	+45° F (+7° C)	25
6	--	+50° F (+10° C)	--

11.3 Water Specifications

Cutting Water Supply (Low Pressure Water System)

Maximum consumption [gpm (L/min)]	4.0 @ 60 Hz (15.0 @ 50 Hz)
Minimum inlet water pressure	35 psi (2.4 bar) flowing
Maximum inlet water pressure	80 psi (5.5 bar)
Maximum outlet water pressure	180 psi (12.4 bar)
Booster pump factory set inlet pressure	58 psi (4 bar)
Booster pump factory set outlet pressure	180 psi (12.4 bar)
Optimum inlet water temperature	65° F (18° C)
Maximum inlet water temperature	85° F (29° C)
Low inlet water pressure	30 psi (2 bar)
Low booster pressure	100 psi (6.9 bar)



Cooling Water Supply (Recirculation System)

Reservoir capacity	55.8 gal (211 L)
Low oil level shutdown	41.0 gal (155 L)
Maximum consumption at 75° F (24° C)	4.0 gpm (15.1) L/min
Total heat rejection (BTU/HR)	36,500
Minimum operating oil temperature	68° F (20° C)
Optimum operating oil temperature	120° F (65° C)
Hot oil shutdown (maximum operating oil temperature)	144° F (62° C)
Minimum inlet cooling water pressure (oil-to-water models)	35 psi (2.4 bar)
Maximum inlet cooling water pressure (oil-to-water models)	100 psi (6.9 bar)
Oil filtration rating (Beta filtration rating)	$\beta_{10} \geq 100^*$
Fluid cleanliness rating (ISO fluid cleanliness rating)	17/14**
Nominal recirculation pressure	30 psi (2 bar)

Recommended oil type

General service	Conoco Phillips Megaflow AW 46 Mobil DTE 10 Excel 46
Food service	Fuchs Cassida FM 46 Mobil DTE FM 46 Chevron Lubricating Oil FM 46

* **Note:** For each particle per milliliter downstream of the filter greater than 10 microns, there are 100 particles per milliliter larger than 10 microns upstream of the filter.

****Note:** Indicates ISO 4406 range numbers for maximum permissible number of particles per milliliter, greater than 5 and 15 microns.

17 <1,300 particles per milliliter, >5 microns

14 <160 particles per milliliter, >15 microns

Water Quality Standards

The quality of the inlet cutting water supply is one of the most important factors affecting component life and performance. Water treatment requirements can be determined by a water analysis.



Due to its aggressive nature, KMT does not recommend using deionized water in our pumps.

The cutting water supply must meet the following standards. A high concentration of dissolved solids, especially calcium, silica and chlorides will affect high pressure component life.

Table 11-3
Water Quality Standards

Constituent (mg/l or ppm)	Minimum Requirement	Best
Alkalinity	25	10
Calcium	5	0.5
Chloride	15	1
Free Chlorine	1	0.05
Iron	0.1	0.01
Magnesium as Mg	0.1	0.1
Manganese as Mn	0.1	0.1
Nitrate	25	10
Silica	10	1
Sodium	10	1
Sulfate	25	1
TDS*	100	35**
Total Hardness	10	1
pH	6.5-8.5	6.5-8.5
Turbidity (NTU)	5	1

* **Note:** Total dissolved solids

****Note:** Do not reduce the TDS beyond this amount or the water will be too aggressive.

Table 11-4
Water Impurities

Constituent	Chemical Formula	Comments
Alkalinity	Bicarbonate (HCO_3) Carbonate (CO_3) Hydrate (OH), expressed as CaCO_3	Acid neutralizing capacity of water. Foaming and carryover of solids, causes embrittlement of steel, can produce CO_2 , a source of corrosion.
Calcium	Ca	When dissolved makes water hard; contributes to the formation of scale.
Chloride	Cl	Adds to solid content and increases corrosive character of water; in relative percentage presence with oxygen induces stress corrosion cracking.
Free Chlorine	Cl_2	Oxidizing agent; can attack elastomeric seals and damage reverse osmosis (RO) membranes.
Iron	Fe^{++} (ferrous) Fe^{+++} (ferric)	Discolors water or precipitation; source of scale and erosion.
Magnesium as Mg		When dissolved makes water hard; contributes to the formation of scale.
Manganese as Mn	Mn^{++}	Discolors water or precipitation; source of scale and erosion.
Nitrate	NO_3	Adds to solid content; effect is not generally significant industrially.
Silica	SiO_2	Causes scale
Sodium	Na	Found naturally; introduced to water in the ion exchange water softening process.
Sulfate	SO_4	Adds to solid content; combines with calcium to form calcium sulfate scale.
TDS		Measure of the total amount of dissolved matter in water.
Total Hardness	CaCO_3	Sum of all hardness constituents in water; typically expressed as their equivalent concentration of calcium carbonate; primarily due to calcium and magnesium in solution, but may include small amounts of metal. Carbonate hardness is usually due to magnesium and calcium bicarbonate; non-carbonate hardness is due to sulfates and chlorides.
pH		Intensity of the acidic or alkaline solids in water; pH scale runs from 0, highly acidic, to 14, highly alkaline; with 7 being neutral.

11.4 Electrical Specifications

Electrical System

Motor type	TEFC (Totally Enclosed Fan Cooled)
Controls	
Voltage	24 volts DC
Power supply	5 amps DC

NOTE

See nameplate for machine specific ampacity and power voltage requirements.

11.5 Hydraulic and Ultra-High Pressure Water System Specifications

Hydraulic System

Maximum continuous operating pressure	2,210 psi (152 bar)
Main system relief valve	2,610 psi (180 bar)

Ultra-High Pressure Water System

Plunger diameter [inches (mm)]	0.875" (22 mm)
Piston diameter [inches (mm)]	5.50" (139.7 mm)
Intensification ratio	38.5:1
Maximum flow rate	
60,000 psi (4,137 bar)	1.10 gpm @ 60 Hz (4.16 L/min @ 50 Hz)
85,000 psi (5,860 bar)	0.73 gpm @ 60 Hz (2.76 L/min @ 50 Hz)
Minimum outlet pressure	10,000 psi (827 bar)
Maximum outlet pressure with cutting head valve open	85,000 psi (5,860 bar)
Maximum outlet pressure with cutting head valve closed	90,000 psi (6,200 bar)



Ultra-High Pressure Water System

Pneumatic Control Valve

Maximum water pressure	90,000 psi (6,200 bar)
Minimum air pressure	85 psi (5.9 bar)
Maximum air pressure	100 psi (6.9 bar)
Maximum flow rate	1.0 cfm (0.028) m ³ /min

Orifice Capacity

Table 11-5
Single Orifice Diameter

Model	Motor Horsepower Rating		Maximum Operating Pressure	Maximum Single Orifice Diameter (at full pressure)
	HP	Kw		
SL-VI Pro III 60	60	45	85,000 psi (5,860 bar)*	0.011" @ 60 Hz (0.279 mm @ 50 Hz)

**Note:* Maximum pressure with cutting head valve open.

11.6 Torque Specifications

Measurements are made with lubricated components and a certified, calibrated torque wrench. Inconsistencies in wrench settings, lubrication and technique may not produce a leak free seal. If leakage occurs, the torque can be increased to seal the components. However, **do not exceed the recommended torque value by more than 15 percent**. If leakage persists, there is a component problem.



Excessive torque can cause component damage or failure, resulting in potential hazards to equipment and personnel.

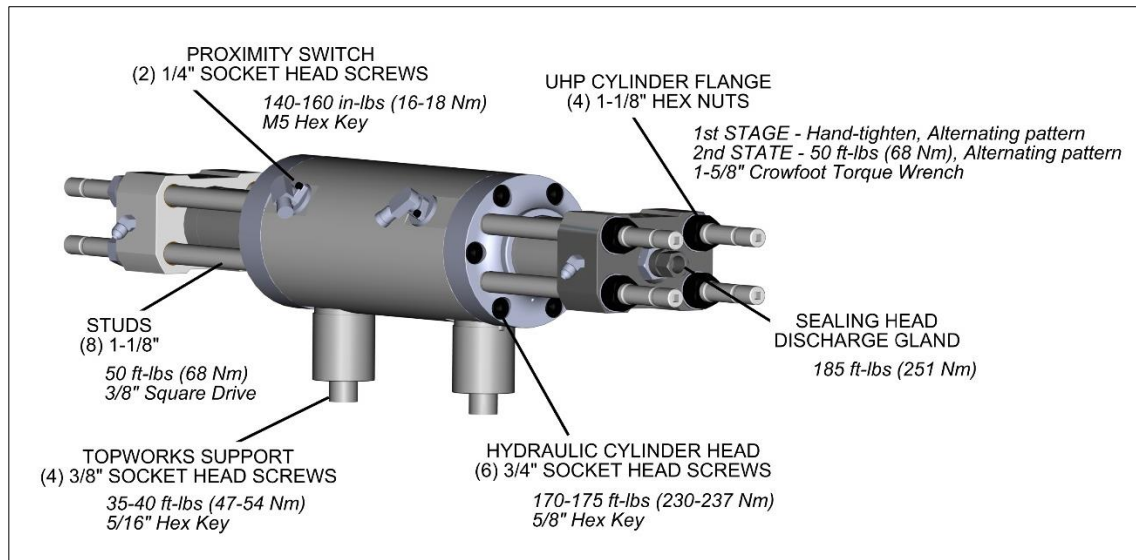
Table 11-6
Torque Specifications
Ultra-High Pressure Water System

UHP Cylinder Flange	
Hex Nuts	4 (1-1/8") each
1st Stage	Hand-tighten, alternating pattern
2nd Stage	50 ft-lbs (68 Nm), alternating pattern
Crowfoot Torque Wrench	1-5/8-inch
Studs	
Stud	8 (1-1/8") each
Torque	50 ft-lbs (68 Nm)
Square Drive	3/8-inch
Hydraulic Cylinder Head	
Socket Head Screws	6 (3/4") each
Torque	170-175 ft-lbs (230-237 Nm)
Hex Key	5/8-inch
Proximity Switch	
Socket Head Screws	2 (1/4") each
Torque	140-160 in-lbs (16-18 Nm)
Hex Key	M5

Table 11-6
Torque Specifications
Ultra-High Pressure Water System

Topworks Support	
Socket Head Screws	4 (3/8") each
Torque	35-40 ft-lbs (47-54 Nm)
Hex Key	5/16-inch
Sealing Head	
Discharge Gland	185 ft-lbs (251 Nm)
Pneumatic Control Valve	
3/8-inch UHP Gland	75 ft-lbs (102 Nm)
1/4-inch UHP Gland	35 ft-lbs (47 Nm)
Pneumatic Actuator	5 ft-lbs (7 Nm)
1/4-inch UHP Adapter	70 ft-lbs (95 Nm)
Ultra-High Pressure Fittings	
1/4-inch HP Gland Nut	35 ft-lbs (47 Nm)
3/8-inch HP Gland Nut	75 ft-lbs (102 Nm)
9/16-inch HP Gland Nut	160 ft-lbs (217 Nm)

Figure 11-1: Torque Specifications

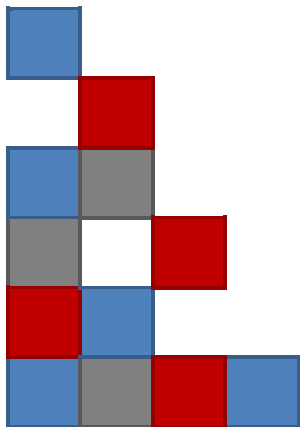


SECTION 12

PARTS LIST

The Parts List details:

- Standard parts and optional modules
- Maintenance and installation tools
- Equipment accessories



12.1 Overview

This section contains a comprehensive list of all standard and optional parts for the SL-VI Pro III 60 horsepower, maintenance tools, installation and equipment accessories. To facilitate the ordering of replacement parts, item numbers in each table correspond to the identifying numbers in the accompanying figures.

Use the following information to contact the Customer Service Department at KMT Waterjet Systems.

USA

Customer Service Department
KMT Waterjet Systems
PO Box 231
635 West 12th Street
Baxter Springs, KS 66713-0231
USA

Phone (800) 826-9274
Fax (620) 856-2242
Email wj.service@kmtwaterjet.com
wj.parts@kmtwaterjet.com

Europe

Spare Parts Manager
KMT Waterjet Systems GmbH
Hohe Strasse 4-6
D-61231 Bad Nauheim
Germany

Phone +49-6032-997-0
Fax +49-6032-997-270
Email order.spares@kmt-waterjet.com

12.2 Index

Part lists are arranged in the following sequence:

Parts List Index

Table	Description	Part Number	Page	Table	Description	Part Number	Page
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12-2	Intensifier Assembly	72170165	12-7	12-19	Electrical Configuration, Line Start	72171147	12-42
12-3	Hydraulic Seal Cartridge	05130091	12-9	12-20	Electrical Kit, Hardware	72157578	12-44
12-4	Sealing Head Assembly	72170157	12-10	12-21	Electrical Kit, Circuit Breaker	72155173	12-46
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12-6	Pneumatic Valve/Actuator Assembly	20468634	12-13	12-23	Electrical Kit, High Voltage Controls	72155348	12-49
12-7	Ultra-High Pressure Water Assembly	72186207	12-15	12-24	Electrical Kit, Motor Starter	72155223	12-51
12-8	Bulkhead Pipe Assembly	72186225	12-18	12-25	Power Factor Correction Kit	72166221	12-52
12-9	Low Pressure Water Filter Assembly	72155629	12-22	12-26	Proportional Pressure Control	72182629	12-54
12-10	Hydraulic Power Package	72182795	12-24	12-27	Redundant Kit	72186365	12-56
12-11	D08 Manifold Assembly	72159791	12-26				
12-12	Hydraulic Manifold Assembly	72112043	12-26				
12-13	Hydraulic Hose Connections	72159197	12-29				
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12-17	Combination Heat Exchanger Kit	72158362	12-38				

Parts List Index

Table	Description	Part Number	Page	Table	Description	Part Number	Page
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12-31	Indexed Focusing Tubes		12-61	12-38	Integrated Wear Insert/Orifice Assemblies		12-71
12-32	Diamond Orifice		12-62	12-39	UHP Valve/Actuator Assembly, NC	20480359	12-72
12-33	UHP Pressure Filter Assemblies		12-63	12-40	UHP Valve/Actuator Assembly, NO	20478997	12-73
12-34	UHP Pressure Swivel Pro Assemblies		12-64	12-41	UHP Pressure Fitting and Valve Assemblies		12-74

Table 12-1
SL-VI Pro III 60 Horsepower Intensifier Unit

Item	Part Number	Description
1	72186207	Ultra-High Pressure Water Assembly
2	72183019	Electrical Assembly (Optional)
3	72186225	Bulkhead Pipe Assembly
4	72183328	Reservoir Assembly
5	72182795	Hydraulic Power Package
6	72159197	Hydraulic Hose Connections
7	72185965	Cover Assembly (Optional)
8	72158536	Door Kit (Optional)
9	72186365	Redundant Kit (Optional)

Figure 12-1: SL-VI Pro III 60 Horsepower Intensifier Unit

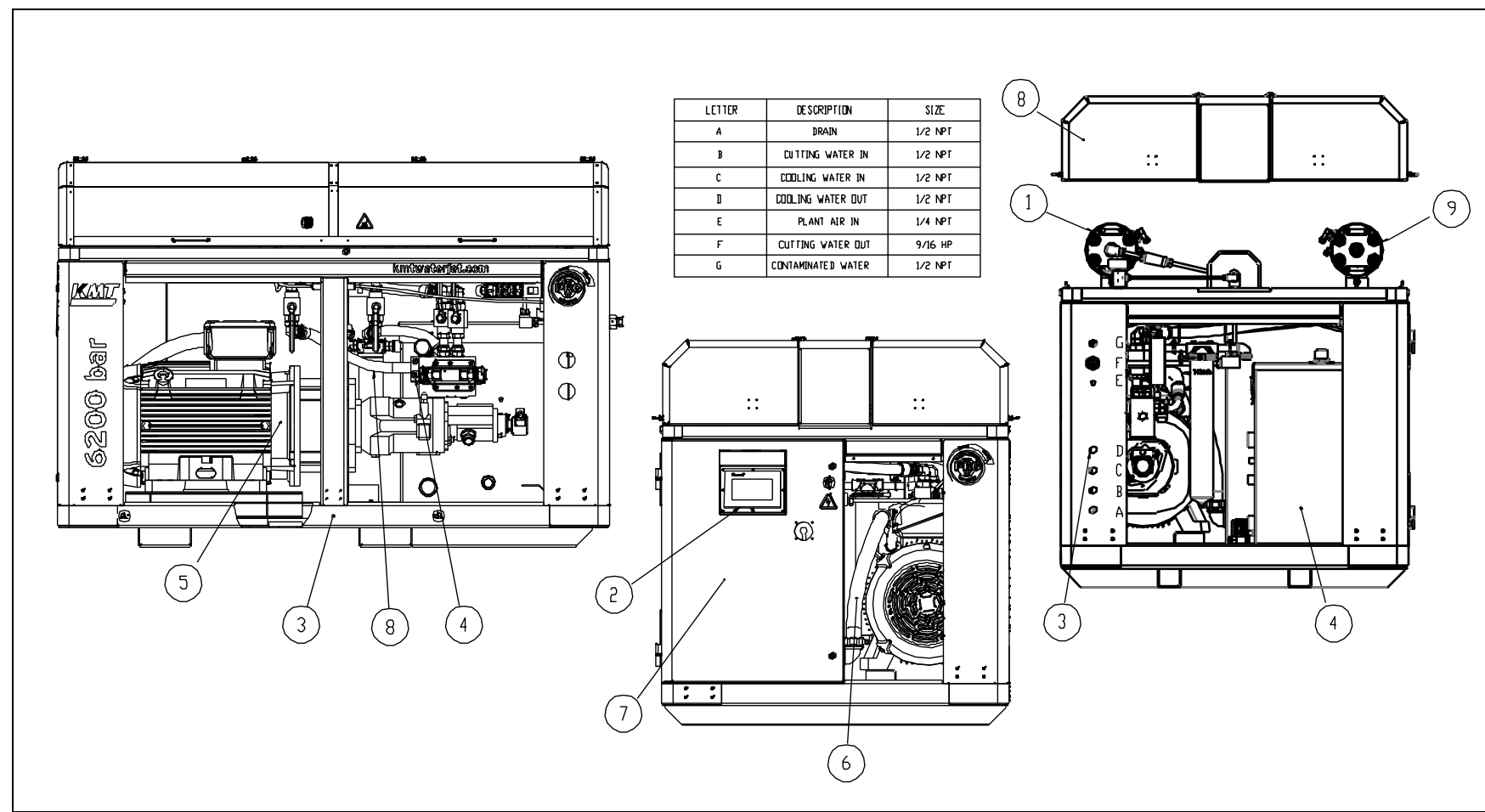


Table 12-2
Intensifier Assembly
72170165

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	05146592	Gasket, Topworks Support	2	14	72162253	Plunger	2
2	20476377	Support, Topworks	2	15	05130091	Hydraulic Seal Cartridge	2
3	10118206	O-Ring, 1.31 x 1.56 x .13	2	16	72175989	Bushing Retainer Flange	2
4	05144514	Hydraulic Cylinder	1	17	72158494	UHP Seal Assembly	2
5	05098991	Socket Head Screw, 3/8-16 x 3-3/4	8	18	72166738	UHP Cylinder	2
6	95688743	Lock Washer, .38	8	19	72163802	Liner	2
7	72101190	Piston Assembly	1	20	20474325	Stud, 1-1/8-12 x 18.31	8
8	10074771	O-Ring, 5.25 x 5.50 x .13	2	21	72170157	Sealing Head Assembly	2
9	05120092	Backup Ring, 5.25 x 5.50 x .13	2	22	72178493	Flange Assembly	2
10	72175997	Hydraulic Cylinder Head	2	23	20464590	Flat Washer, 1.13	8
11	05097886	Socket Head Screw, 3/4-16 x 2-1/4	12	24	20461761	Hex Nut, 1-1/8-12	8
12	05144183	Spacer Assembly, Proximity Switch	2	25	20489339	Adapter, JIC/Pipe, .50 x .38	1
	05144191	O-Ring, .69 x .88 x .09		26	72176756	O-Ring, 3.88 x 4.25 x .19	6
13	72141569	Kit, Proximity Switch	2				
	72134224	Proximity Switch					
	95119012	Socket Head Screw, 1/4-20 x 1					

Figure 12-2: Intensifier Assembly

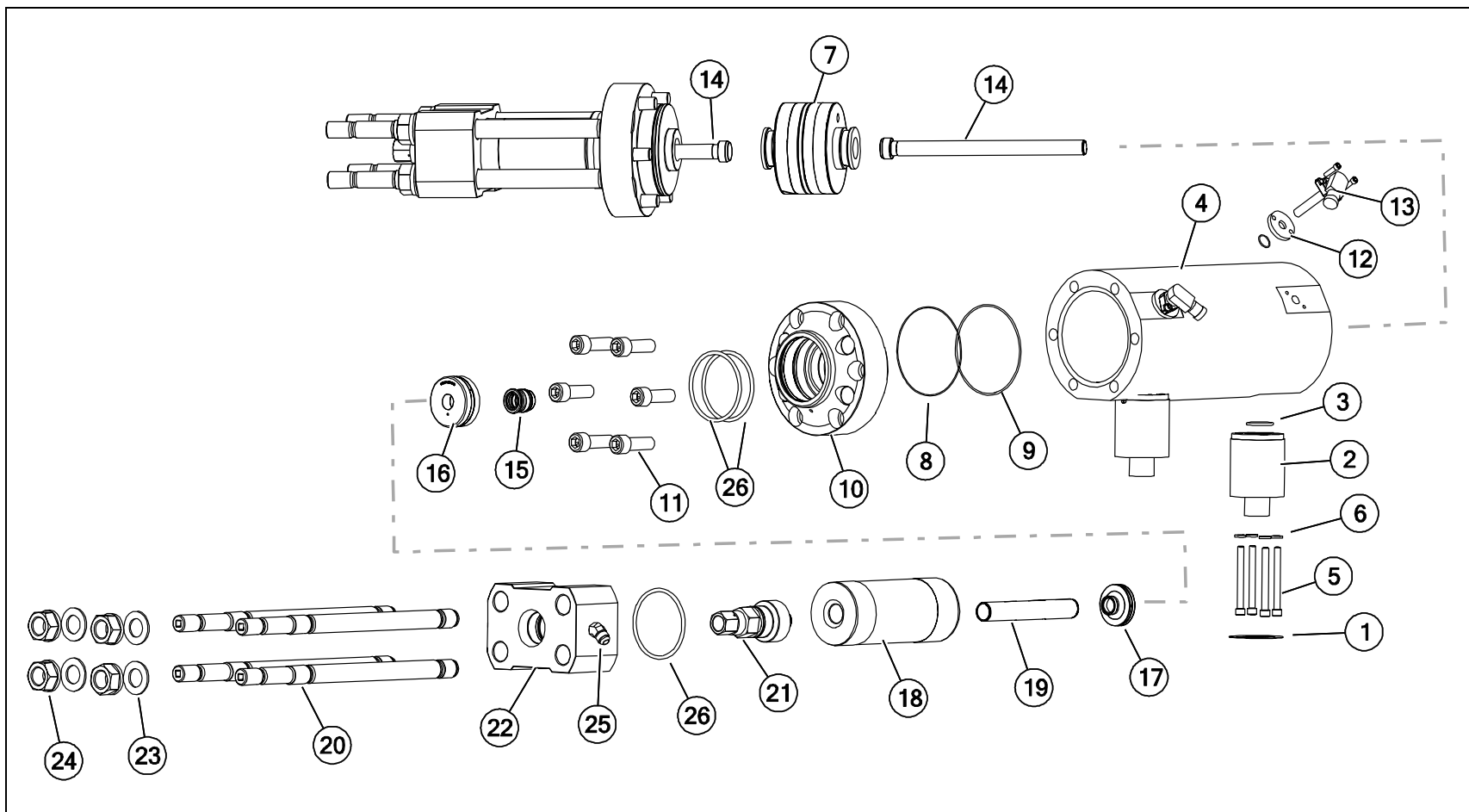


Table 12-3
Hydraulic Seal Cartridge
05130091

Item	Part Number	Description	Quantity
1	05130109	Seal Bushing	1
2	05015060	Packing Ring	2
3	10193522	O-Ring, 1.19 x 1.38 x .09	1
4	05050760	Backup Ring	1
5	05129481	O-Ring, 1.0 x 1.13 x .06	1
6	05013024	O-Ring, 1.25 x 1.38 x .06	1
7	05129515	Backup Ring	1
8	05027255	Packing Seal	1
80084759		Rebuild Kit	
		Includes Items 2-8	

Figure 12-3: Hydraulic Seal Cartridge

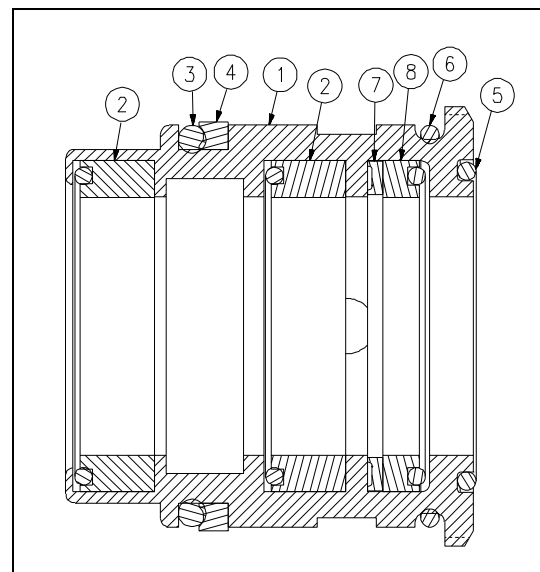
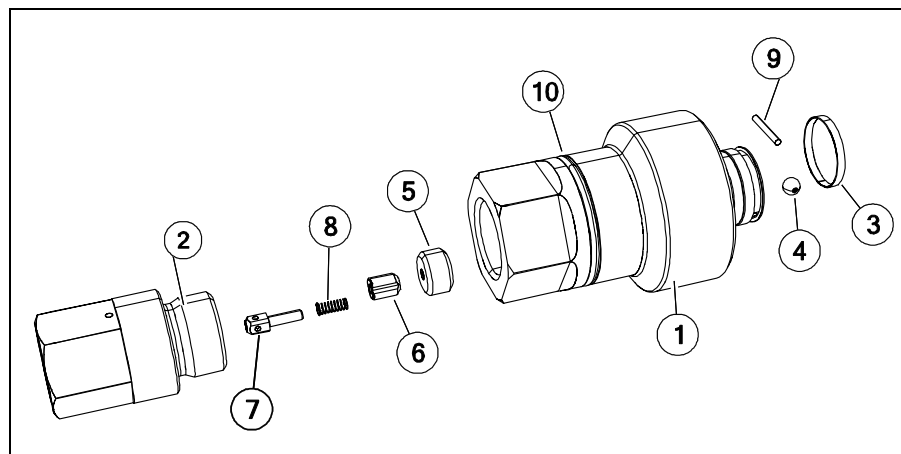


Table 12-4
Sealing Head Assembly
72170157

Item	Part Number	Description	Quantity
1	72165539	Sealing Head	1
2	20481660	Gland	1
3	20492123	Retaining Ring	1
4	10085371	Ball	1
5	72101570	Seat	1
6	05116561	Discharge Poppet	1
7	05116751	Poppet Pin	1
8	05147863	Compression Spring	1
9	20492131	Dowel Pin	1
10	10146082	O-Ring, 1.69 x 1.88 x .09	1

Figure 12-4: Sealing Head Assembly



72117819 Spare Parts Kit

Includes items 4, 5, 6, 7, 8 and 9

72135447 Spare Parts Kit

Includes items 5, 6, 7 and 8

Table 12-5
Hydraulic Piston Assembly
72101190

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72101205	Ram Piston, 5.50	1	6	05049994	Backup Ring, 1.50 x 1.75	2
2	05074380	Clevis Pin	12	7	05087713	O-Ring, 1.25 x 1.50 x .13	2
3	05049887	Setscrew	2	8	05120118	Seal Assembly	1
4	10148757	Check Valve Assembly	2	9	05120100	Bearing	2
5	05088364	Retaining Ring	2				

72168337 Spare Parts Kit

Includes items 4, 5, 6, 7, 8 and 9

Figure 12-5: Hydraulic Piston Assembly

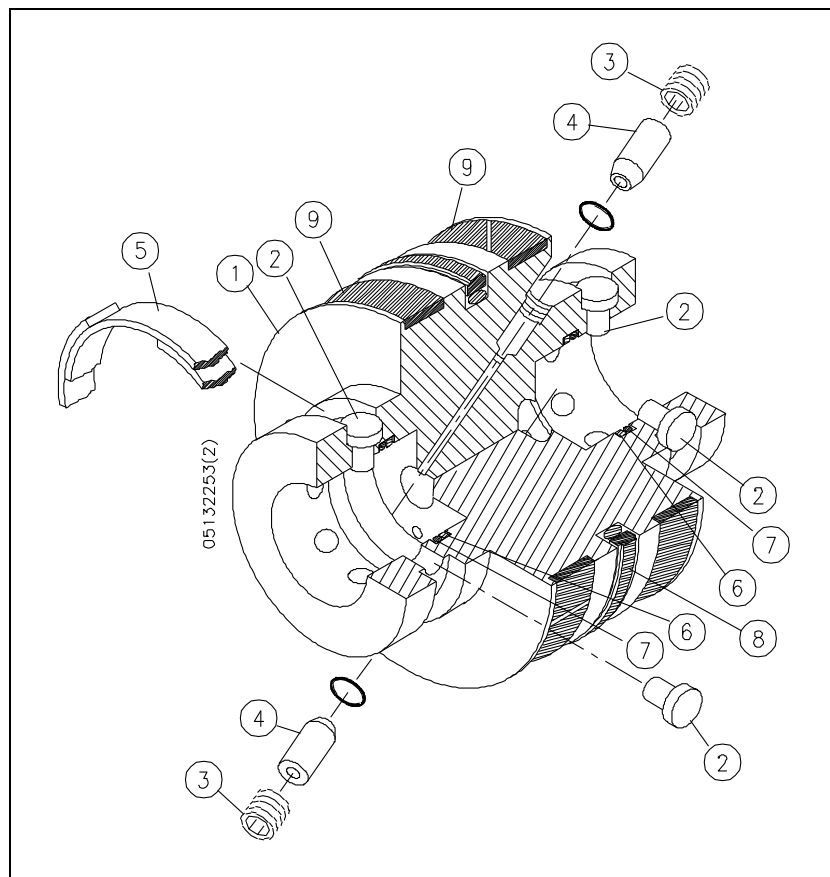


Table 12-6
Pneumatic Valve/Actuator Assembly, Normally Open
20468634

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	20468617	Valve Body	1	9	10074714	O-Ring, 2.44 x 2.63 x .09	1
2	10178697	Valve Seat	1	10	10074565	O-Ring, 2.25 x 2.38 x .06	2
3	20451557	UHP Adapter	1	11	BV501184	Piston	1
4	72112069	Seal Assembly	1	12	20452965	UHP Collar, .38	1
5	20475874	Backup Ring, Bronze	1	13	20452956	UHP Gland, .38	1
6	20475878	Valve Stem	1	14	20452959	UHP Collar, .25	1
7	20468601	Pneumatic Cylinder	1	15	20452962	UHP Gland, .25	1
8	BV601184	Cylinder Head	1	16	20475882	Backup Ring, SST	1

20477518 Spare Parts Kit

Includes items 2, 4, 5, 6, 9, 10 and 16

Figure 12-6: Pneumatic Valve/Actuator Assembly, Normally Open

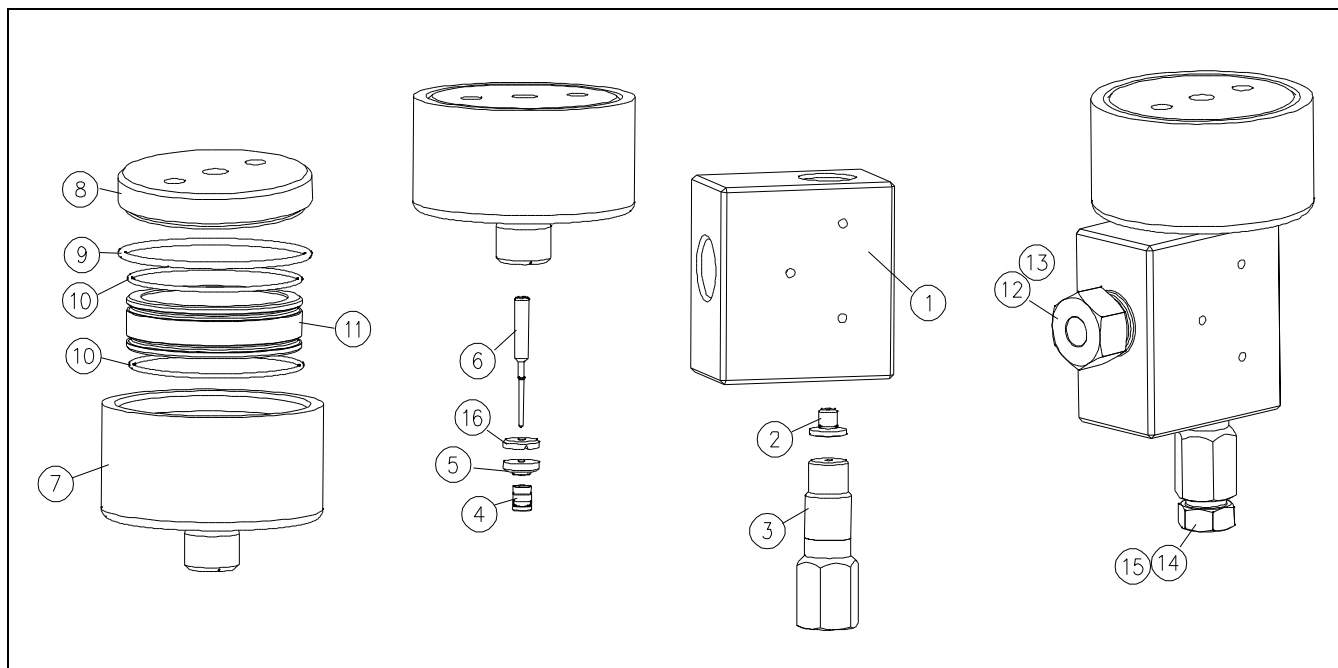


Table 12-7
Ultra-High Pressure Water Assembly
72186207

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	20478834	Attenuator Assembly, 1.6L	1	19	20478653	UHP Tube, .38 x 5.0	1
2	95383790	Socket Head Screw, 1/2-13 x 1	4	20	20468634	Pneumatic Valve/Actuator Assembly	1
3	95413696	Lock Washer, .50	4	21	20464737	Coupling, Bulkhead, UHP, .38 x .38	1
4	20452956	UHP Gland, .38	2	22	72175565	UHP Tube, Bent, .25	1
5	20452965	UHP Collar, .38	4	23	10083897	Ferrule, Hose, .25	10
6	20480175	Attenuator Housing	1	24	10186153	Flexible Conduit, .38	150.0"
7	05144837	Spacer, Attenuator Bracket	4	26	72158122	Socket Head Screw, 1/4-28 x 5/8	2
8	95660957	Flat Washer, .38	8	27	95838314	Lock Washer, .25	2
9	95670972	Lock Washer, .38	8	28	95391322	Flat Washer, .25	2
10	95375473	Socket Head Screw, 3/8-16 x 1	8	29	49831480	Grommet, 3.0	7
11	72158312	UHP Tube, Bent, .38	1	30	20419432	Grommet, 2.25	2
12	72131795	UHP Tube, Bent, .38	1	32	72160706	UHP Tube, .38 x 11.10	1
13	72131788	UHP Tube, Bent, .38	1	33	72160914	Pressure Transducer	1
14	72158403	UHP Tube, Bent, .38	1	34	20468830	UHP Tube, .38 x 4.81	1
15	72158411	UHP Tube, Bent, .38	1	35	10067205	Cable Connector, .50	1
16	20491892	Cup Seal	1	37	72120528	Resistor	1
17	20455812	Tee Assembly, UHP, .38	3	38	72158140	Kit, Screen Ground	1
18	72170165	Intensifier Topworks	1	39	10083012	Lock Nut, .50	1

Table 12-7
Ultra-High Pressure Water Assembly
72186207

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
40	10082857	Gasket Assembly, .50	1	44	72170474	Foam Strip	16.0"
41	05143631	Cable, #18	130.0"	45	49898729	Flat Washer, M12	4
42	10078715	HP Collar, .38	1	46	10112662	Neoprene	48.0"
43	10078129	HP Gland, .38	1	47	72169600	Gland Assembly, .38	2

Figure 12-7: Ultra-High Pressure Water Assembly

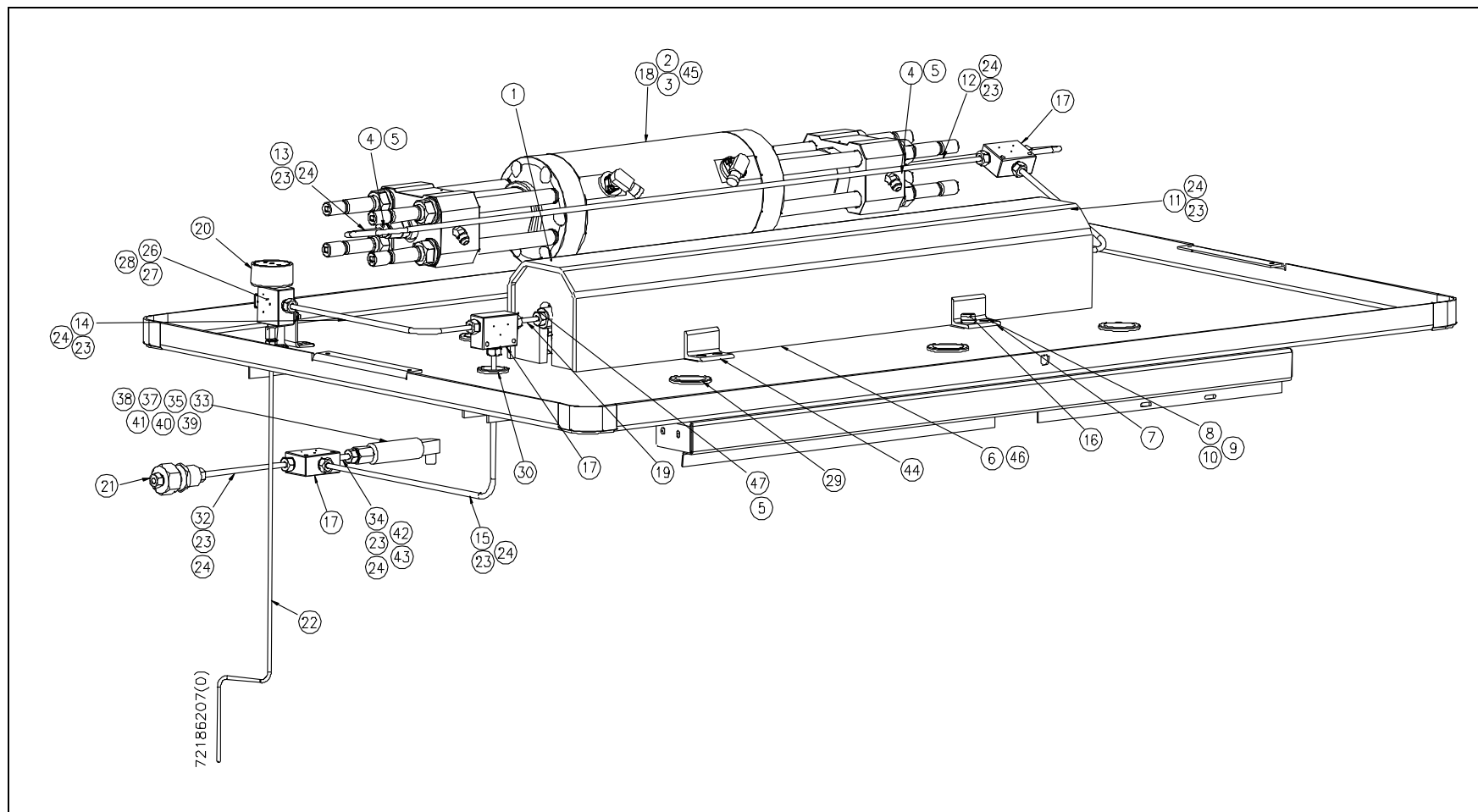


Table 12-8
Bulkhead Pipe Assembly
72186225

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	05024815	Solenoid Valve	1	20	72155629	Filter Subassembly	1
2	10127801	Pipe Nipple, .50 x 3.0	1	21	10189025	Adapter, Hose/JIC, .50 x .50	5
3	49887011	Adapter, JIC/Pipe, .50 x .50	2	22	05111406	Adapter, JIC/Pipe, .50 .25	2
5	10077055	Coupling, Bulkhead, Pipe, .94 x .25	1	23	10189025	Adapter, Hose/JIC, .50 x .50	2
6	10078335	Coupling, Pipe, .25 x .13	1	24	05135645	Adapter, Hose/Pipe, .50 x .50	3
7	20453730	Check Valve Assembly	1	25	49833882	Adapter, Hose/ORB, .50 x .50	1
8	49888035	Solenoid Valve	1	27	49895303	Adapter, JIC/Pipe, .50 x .50	1
9	72149291	Adapter, Tube/Pipe, .25 x .13	1	28	20421272	Hose, Push-on, .50	200.0"
10	05140751	Pressure Switch, 30 psi	2	29	10125359	Pipe Nipple, .13 x 2.0	2
11	05139506	Pressure Gauge, 0-200 psi	1	30	72156810	Solenoid Valve	1
12	10127298	Elbow, Pipe, .50 x .50	1	31	72156834	Tee, Pipe/Pipe, .25 x .13	1
13	10073823	Tee, .50 x .50	1	32	72156842	Adapter, Tube/Pipe, .25 x .25	1
14	49834328	Adapter, Pipe/Tube, .50 x .25	1	33	05074067	Pipe Nipple, .50 x 3.0	1
15	20412815	Filter, Strainer	1	35	10079903	Poly Tube, .25	35.0"
16	20413789	Manifold, Inlet	1	36	10097624	Button Head Screw, 1/4-20 x 1/2	4
17	10100436	Coupling, Pipe, .50 x .50	2	37	95838314	Lock Washer, .25	4
18	49886922	Bushing, Bulkhead, Pipe, .50 x .50	3	38	95391322	Flat Washer, .25	6
19	10070092	Jam Nut, 1-14	3	39	20456703	Decal, Contaminated Water	1

Table 12-8
Bulkhead Pipe Assembly
72186225

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
40	10150456	Decal, HP Water Out	1	52	72172538	Adapter, Pipe/Tube, .50 x .38	2
41	05071808	Decal, Plant Air	1	53	10187714	Tee, Pipe, .50	1
42	10150464	Decal, HP Water In	1	54	72119552	Adapter, Tube/Pipe, .38 x .25	2
43	10150449	Decal, Drain	1	55	72114076	Grommet	2
44	10192425	Hose Barb, .50 x .50	3	56	20419359	Manifold, Air	1
45	72124013	Pressure Gauge, 0-400 psi	1	57	72178885	Bracket, Manifold	1
46	80087828	Adapter, Hose/Pipe, .25 x .25	1	58	05031620	Socket Head Screw, 10-32 x 1-3/4	2
47	49830722	Adapter, Hose/Pipe, .25 x .25	2	59	95367207	Flat Washer, #10	4
48	61126172	Hose, Push-on, .25	50.0"	60	95367728	Lock Washer, #10	2
49	49830490	Decal, Boosted Pressure	1	61	10069961	Hex Nut, #10-32	2
50	49830482	Decal, Pressure In	1	62	95473997	Hex Nut, 1/4-20	2
51	05060207	Pipe Nipple, .50 x 5.0	1	63	20419424	Poly Tube, .38	72.0"

Figure 12-8: Bulkhead Pipe Assembly

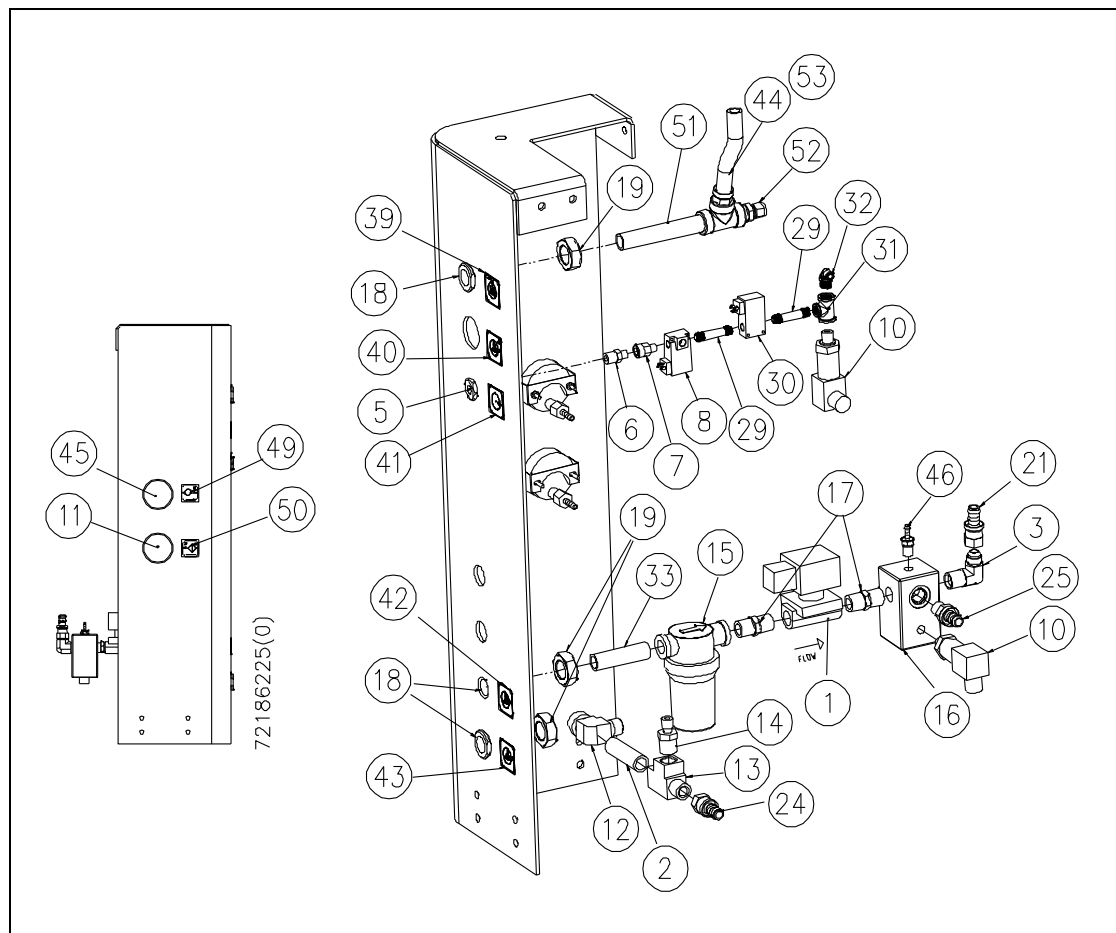


Figure 12-8: Bulkhead Pipe Assembly

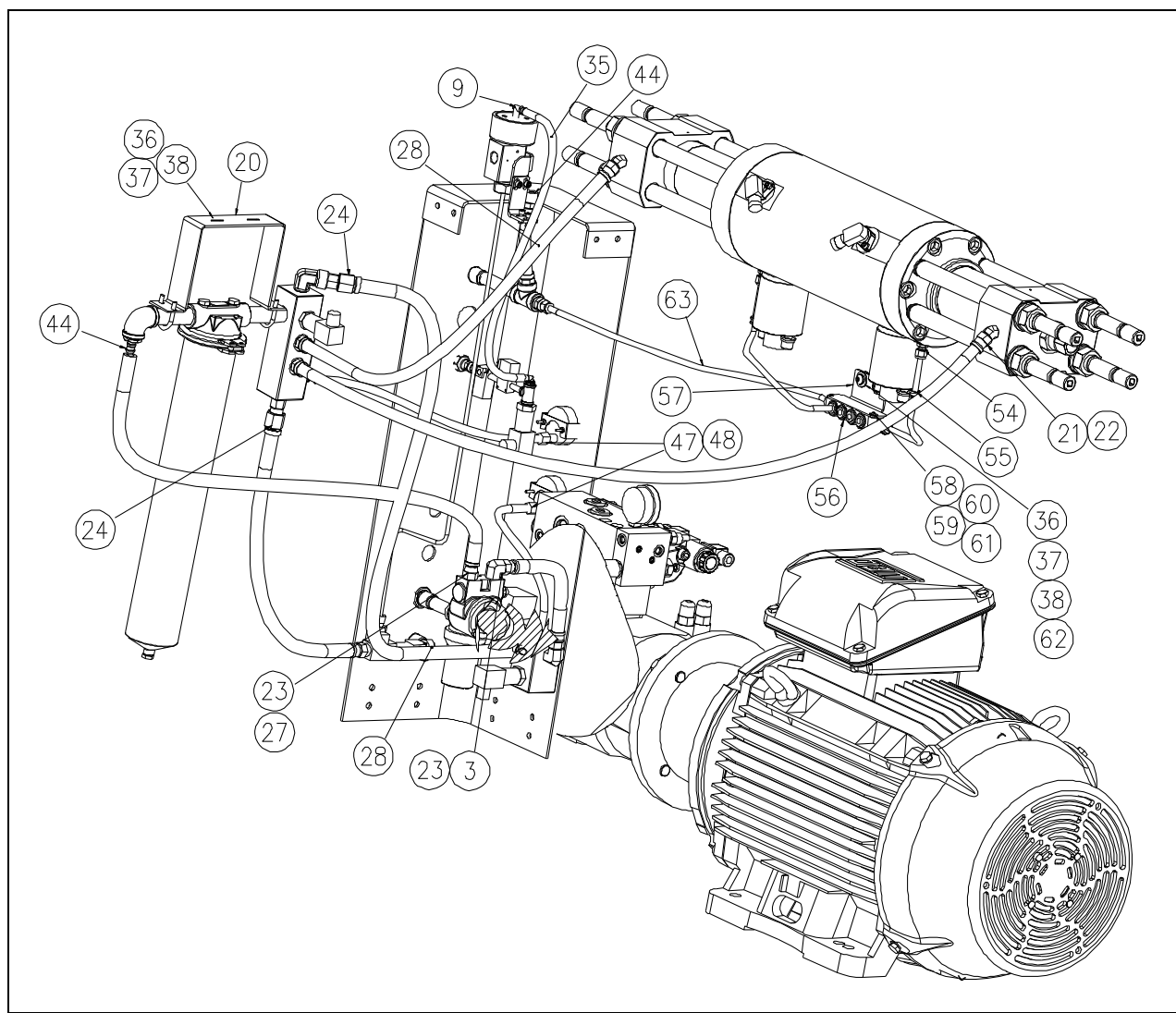


Table 12-9
Low Pressure Water Filter Assembly
72155629

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72155272	Filter Housing Assembly	1	10	72131267	Pressure Switch, 100 psi	1
2	49838386	Pipe Nipple, .75 x 4.0	2	11	10187730	Elbow, Pipe, .75 x .75	1
3	49833882	Adapter, Hose/ORB, .50 x .50	2	12	80087828	Adapter, Hose/Pipe, .25 x .25	1
4	05072798	Relief Valve Assembly	1	13	20442221	Hex Nut, 1/4-20	4
5	72152951	Bracket, Filter Mount	1	15	72125264	Filter Element	1
6	10083384	U-Bolt, .75	2	16	95391322	Flat Washer, .25	4
7	20413848	Manifold, LP Water Outlet	1	17	95838314	Lock Washer, .25	4
8	10119253	Elbow- Pipe, .50 x .50	1	18	10103448	Bushing, Pipe, .75 x .50	1
9	05135652	Check Valve Assembly	1	22	72179002	Tag, Install Filter	1

Figure 12-9: Low Pressure Water Filter Assembly

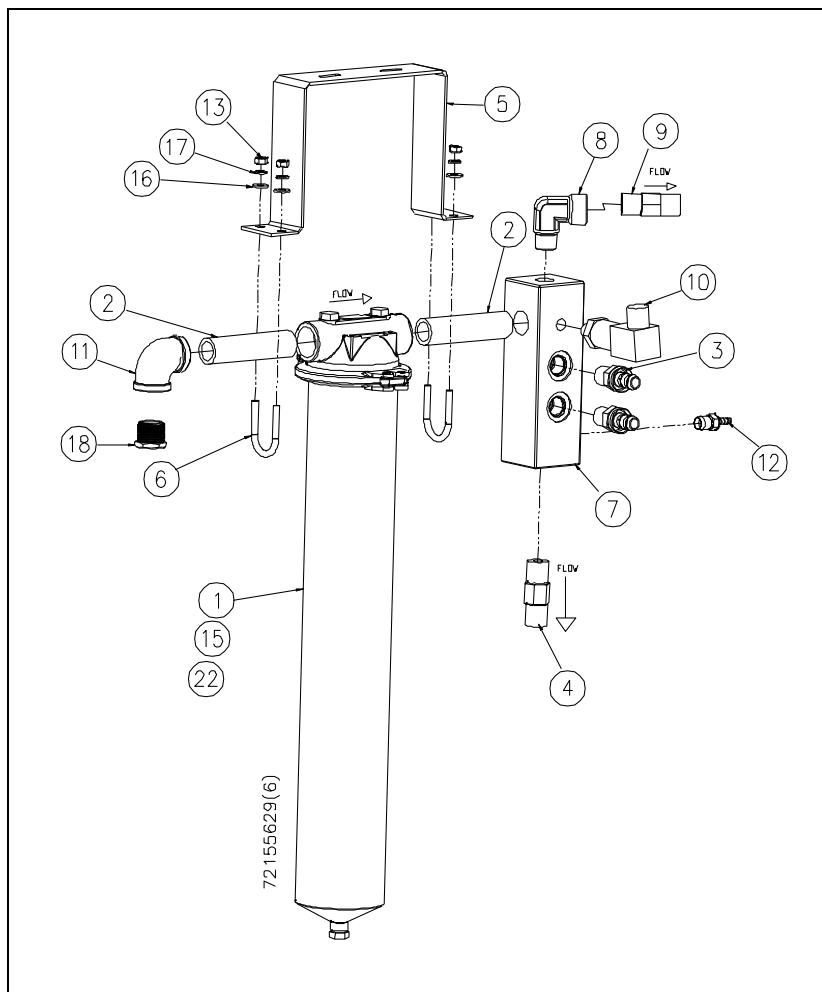


Table 12-10
Hydraulic Power Package
72182795

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	61125453	Hex Head Screw, 3/4-10 x 2-1/4	4	20	05103429	Spline Shaft	1
2	95688735	Lock Washer, .75	8	21	05103411	Adapter, Water Pump	1
3	72153521	Electric Motor, 60 HP	1	22	05103395	Shaft Coupling	1
4	10082022	Flange, Motor/Pump	1	23	20481206	Water Pump	1
5	05103239	Piston Pump	1	24	95838314	Lock Washer, .25	3
6	10192961	Socket Head Screw, M12 x 1.75 x 30MM	2	25	95572897	Socket Head Screw, 1/4-20 x 5/8	3
7	10069763	Flat Washer, .50	2	26	95750394	Lock Washer, .38	2
8	72159791	Manifold Assembly, D08	1	27	05041033	Socket Head Screw, 3/8-16 x 1-1/4	2
9	80086150	Adapter, ORB/JIC, 1.0 x 1.0	1	28	95897294	Hex Head Screw, 5/8-11 x 1-1/2	4
10	05091301	Hydraulic Pump	1	29	95688719	Lock Washer, .63	4
11	10091510	Arrow Decal	1	30	80087513	Flat Washer, .63	4
12	05103247	Socket Head Screw, 1/2-13 x 6	4	31	20469936	Relief Valve Assembly, 180 Bar	1
13	95688750	Lock Washer, .50	4	32	95897286	Hex Head Screw, 5/8-11 x 3	4
14	49882087	O-Ring, 1.88 x 2.13 x .13	1	33	95688719	Lock Washer, .63	4
16	05085758	Adapter, ORB/JIC, .38 x .25	1	34	80087513	Flat Washer, .63	4
17	10118057	Plug, ORB, .75	1	35	20484771	Motor Mount	4
19	72158528	Coupling, Flexible Drive	1	Ref 1	05112727	O-Ring, 104MM x 3MM	--
				Ref 2	49891195	O-Ring, 2.75 x 3.0 x .13	--

Figure 12-10: Hydraulic Power Package

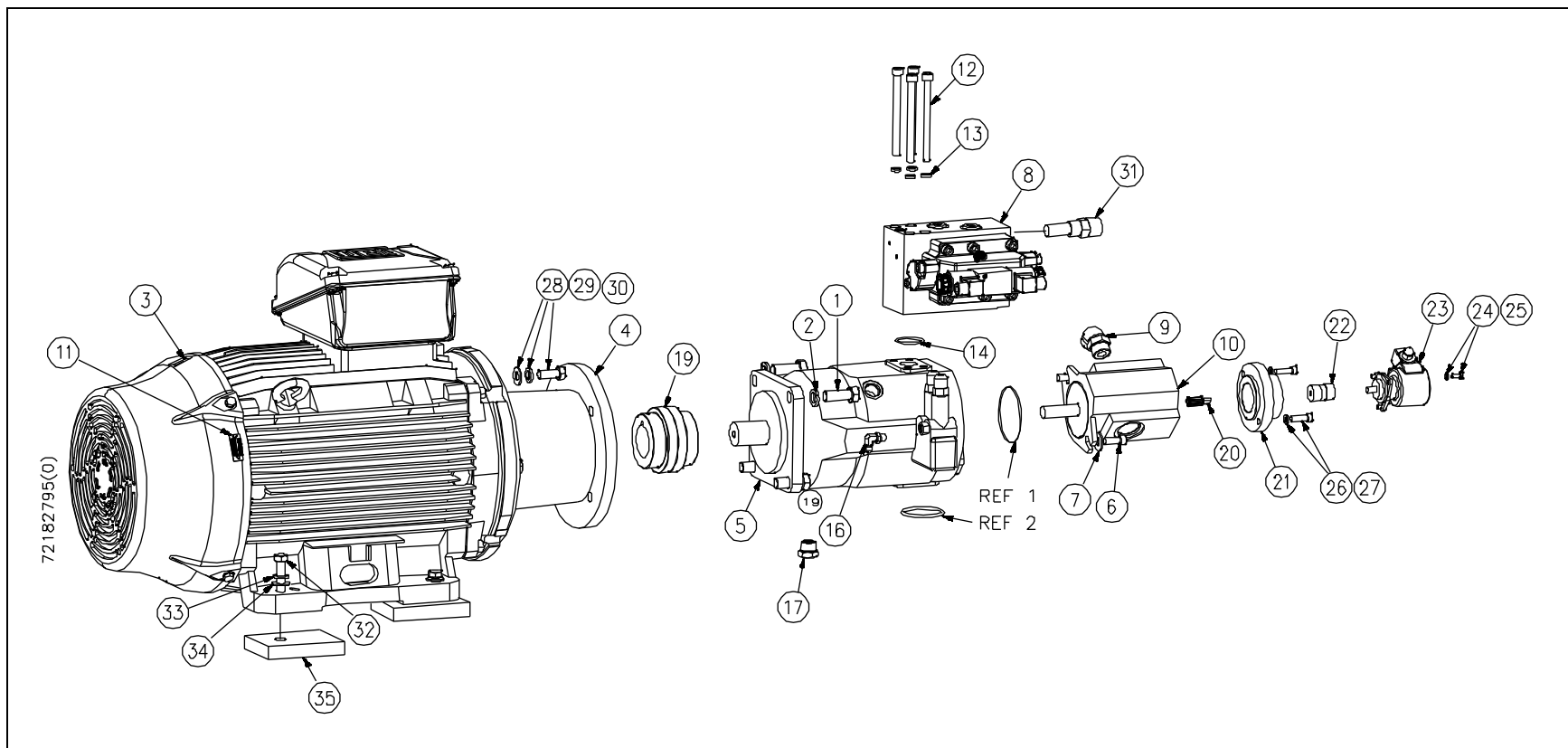


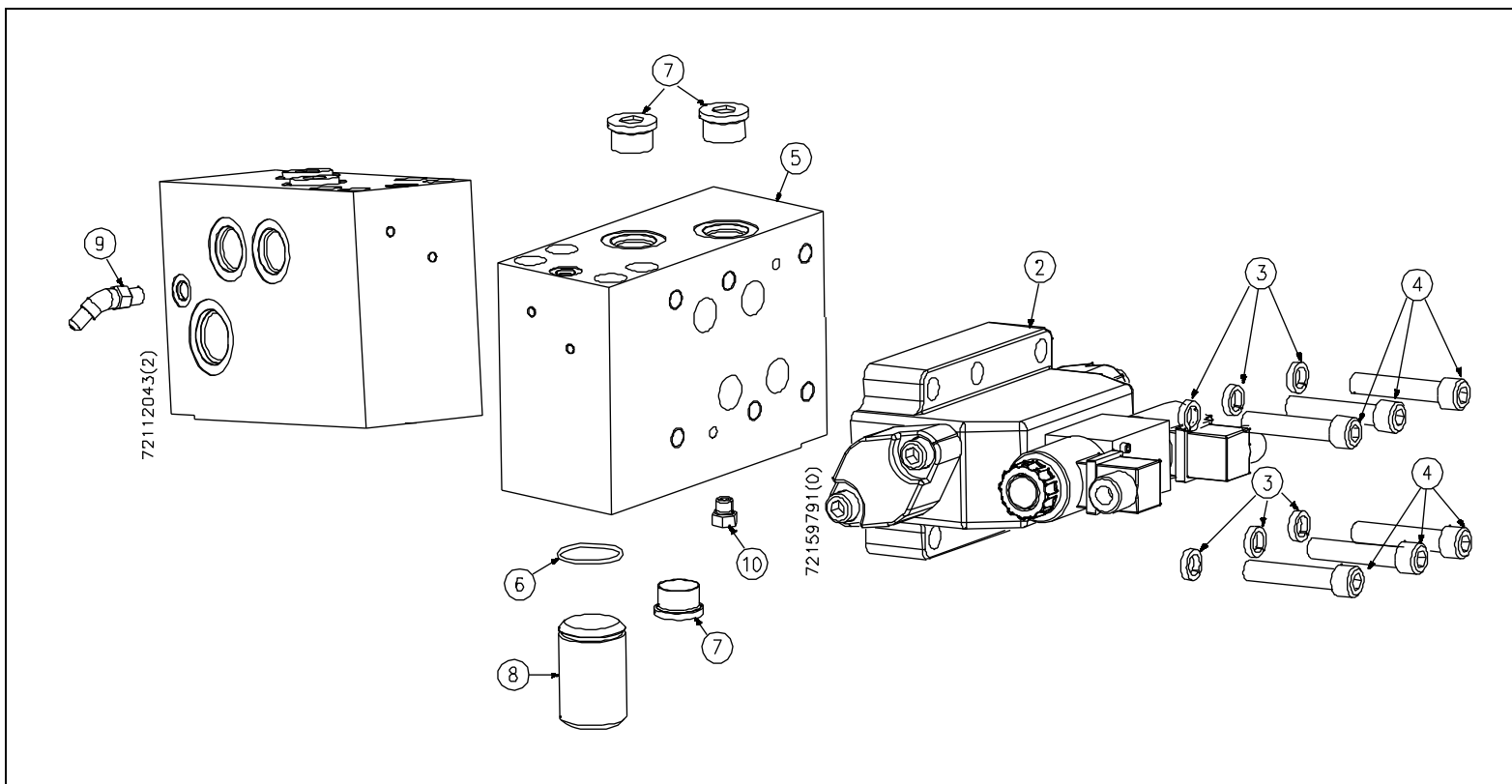
Table 12-11
D08 Manifold Assembly
72159791

Item	Part Number	Description	Quantity
1	72112043	Hydraulic Manifold Assembly	1
2	20437206	Directional Control Valve	1
3	95688750	Lock Washer, .50	6
4	95055059	Socket Head Screw, 1/2-13 x 2-1/2	6

Table 12-12
Hydraulic Manifold Assembly
72112043

Item	Part Number	Description	Quantity
5	72112035	Manifold	1
6	10187417	O-Ring, 1.50 x 1.69 x .09	1
7	05071055	Plug, ORB, .75	3
8	05103189	Check Valve Assembly	1
9	10144749	Adapter, JIC/ORB, .25 x .25	1
10	49889769	Plug, ORB, .25	1

Figure 12-11: Hydraulic Manifold Assembly



Item	Part Number	Description	Quantity
Directional Control Valve			
Ref 1	20436066	Hydraulic Valve, D08	1
Ref 2	20436058	Electric Valve, D03	1
Ref 3	20437172	Hydraulic Orifice, .063	1
Ref 4	20453037	R-Ring, 9.81MM x 1.5MM x 1.78MM	4
Ref 5	20498816	R-Ring, 2.78MM x 2.6MM x 3MM	4
Ref 6	20498808	R-Ring, 19MM x 3MM x 3MM	2
Ref 7	20470852	Seal Nut	2
Ref 8	20470848	Solenoid, D08	2
Ref 9	20476884	Socket Head Screw, M12 x 1.75 x 40MM	4
Ref 10	20475976	Seal, End Cap, D08 Valve	2
Ref 11	72122865	End Cap, D08	2
72110500	R-Ring Kit	Includes reference items 5, 6 and 10	

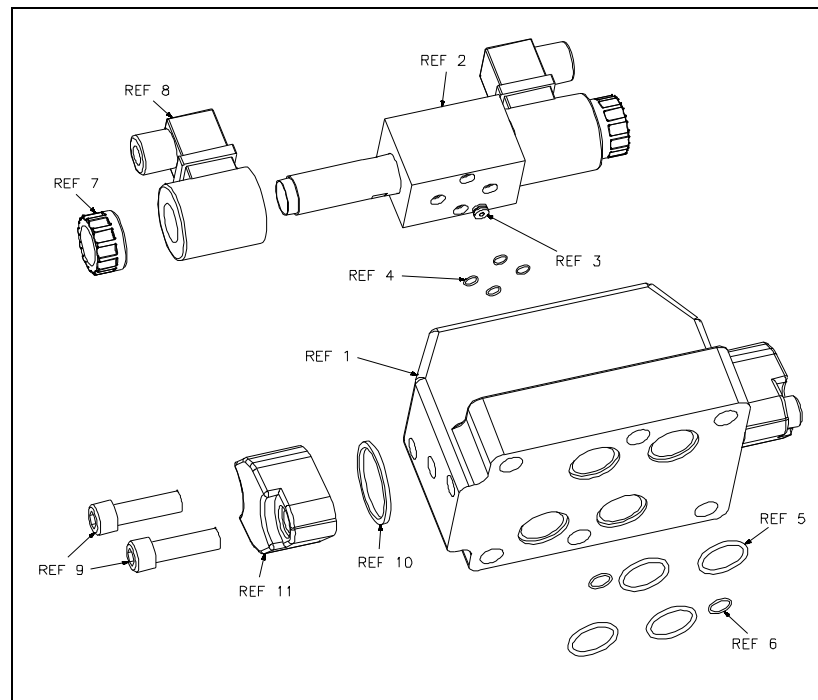


Table 12-13
Hydraulic Hose Connections
72159197

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	49872245	Split Flange Kit, 2.50	1	14	49876089	Adapter, JIC/ORB, .25 x .25	2
2	05106984	Adapter, Flange/Hose, 2.50 x 2.50	1	15	05085758	Adapter, ORB/JIC, .38 x .25	1
3	49879471	Adapter, JIC/ORB, 1.25 x 1.25	1	16	80079684	Adapter, FSOR/ORB, 1.0 x .75	2
4	10144749	Adapter, JIC/ORB, .25 x .25	2	17	10142644	Adapter, JIC/ORB, .25 x .25	1
5	05073168	Adapter, JIC/ORB, .75 x .75	1	18	10117083	Hydraulic Hose Assembly, .75 x 45.0	1
6	72159213	Hydraulic Hose Assembly, 1.25 x 14.50	1	19	72153679	Hydraulic Hose Assembly, .25 x 17.0	1
7	72106005	Hydraulic Hose Assembly, Suction/Return	1	20	72159304	Hydraulic Hose Assembly, .25 x 25.0	1
8	80085889	Hydraulic Hose Assembly, .25 x 20.0	1	21	72159296	Hydraulic Hose Assembly, 1.0 x 33.0	2
9	10091163	Adapter, JIC/ORB, .75 x .75	1	22	72158065	Hydraulic Hose, Suction/Return	11.0"
10	20427442	Adapter, JIC/ORB, 1.25 x 1.0	1	23	72158031	Hose Clamp	4
11	20427111	Adapter, JIC/ORB, 1.25 x 1.25	1	24	80079809	Adapter, FSOR/ORB, 1.0 x .75	2
12	10099760	Adapter, JIC/ORB, 1.25 x 1.25	1				

Figure 12-12: Hydraulic Hose Connections

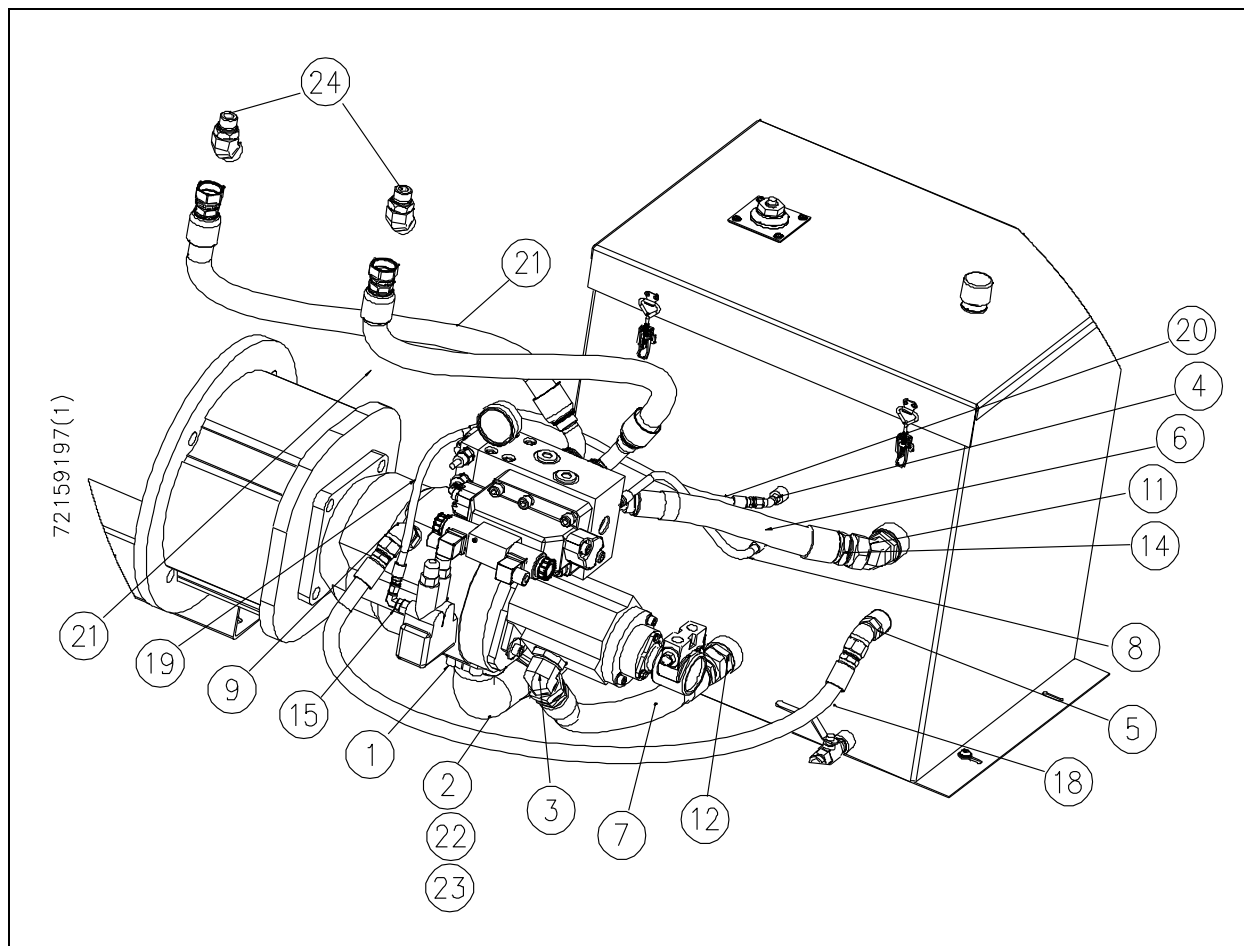


Figure 12-13: Hydraulic Hose Connections

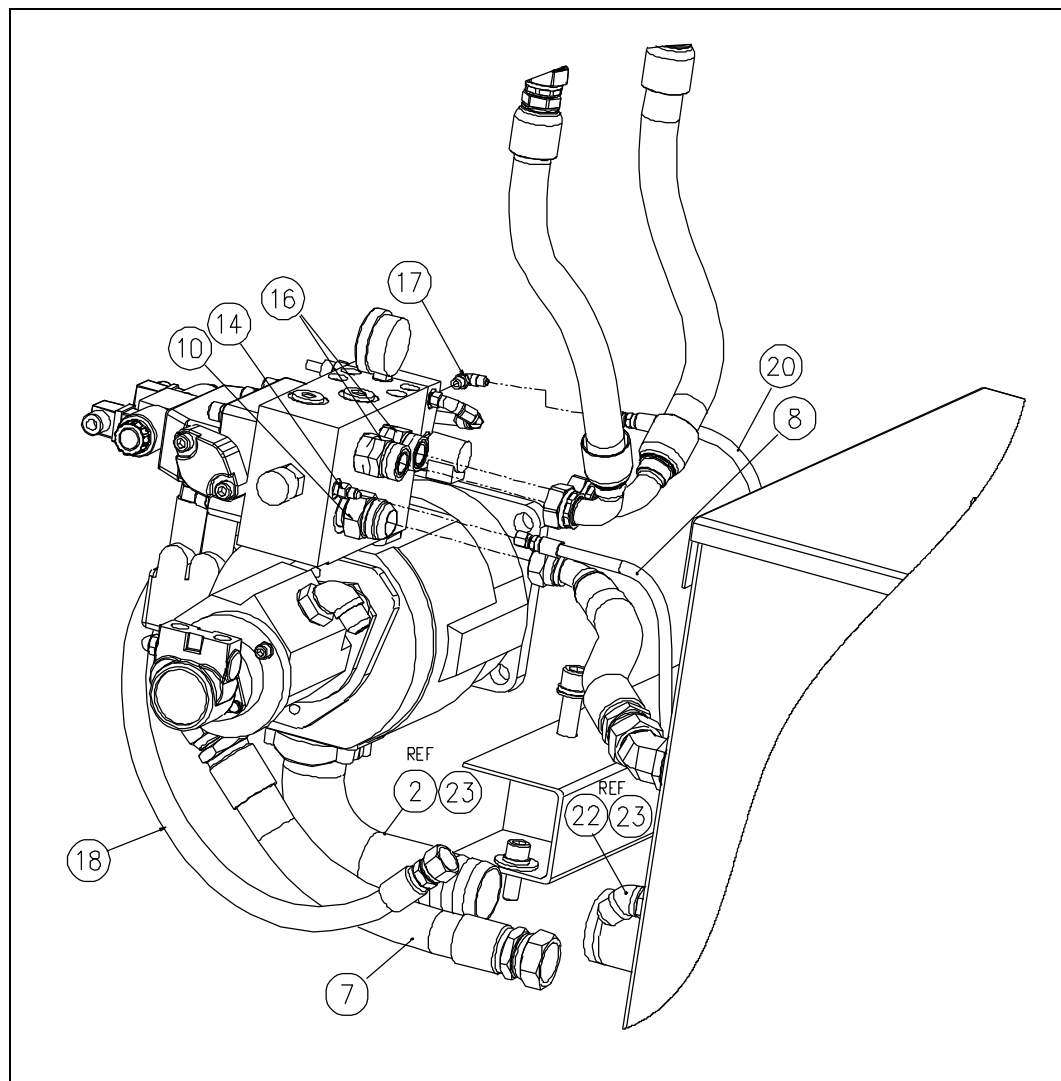


Table 12-14
Reservoir Assembly
72183328

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72156199	Reservoir Weldment	1	14	72157620	Tee, JIC/ORB, 1.0 x 1.0	1
2	72154512	Lid, Reservoir	1	15	05069976	Cap, JIC Swivel, .75	1
3	05025176	Plug, ORB, .50	1	16	72157635	Adapter, BSPP/JIC, 1.0 x 1.0	1
4	72145376	Temperature/Level Sensor	1	17	05131941	Coupling, ORB, 1.0 x 1.0	1
5	05079967	Gasket	1	18	95897948	Button Head Screw, 10-24 x 1/2	4
6	05092739	Air Breather	1	19	95367728	Lock Washer, #10	4
7	20423326	Ball Valve Assembly	1	20	95367207	Flat Washer, #10	4
8	20451474	Level/Temperature Gauge	1	21	10082071	Pipe Plug, .38, not shown	1
9	72138699	Cover, Reservoir	1	24	72173285	Bushing, JIC, 1.0 x .75	1
10	05006291	Diffuser	1	25	05091954	Button Head Screw, 3/8-16 x 1	4
11	72118430	Gasket, Edge Trim	94.0"	26	95660957	Flat Washer, .38	8
12	05103809	Hydraulic Filter Head	1	27	95670972	Lock Washer, .38	4
13	05104187	Filter Element	1	28	95484382	Hex Nut, 3/8-16	4

Figure 12-13: Reservoir Assembly

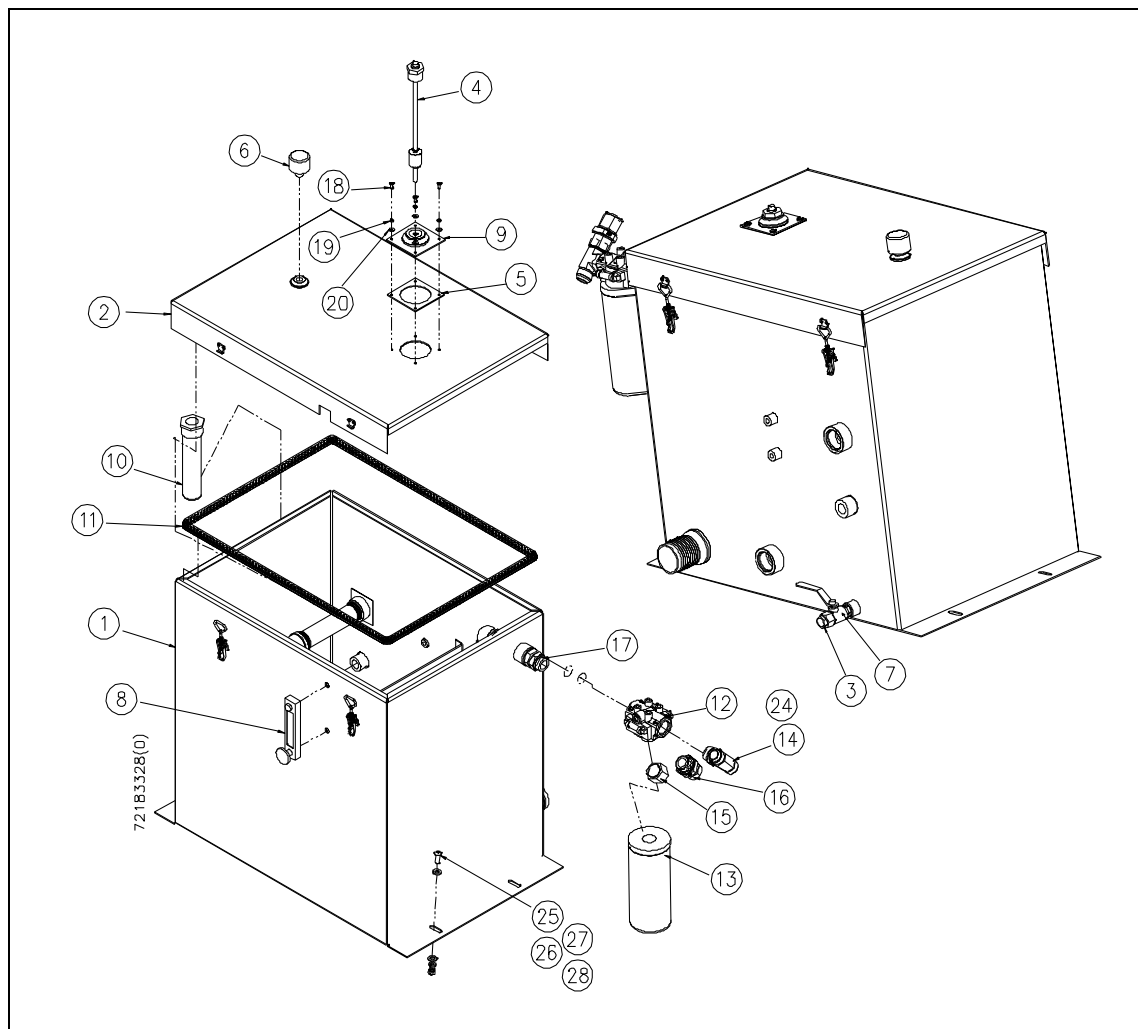


Table 12-15
Oil/Water Heat Exchanger Kit
72158354

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72158296	Bracket, Heat Exchanger	1	14	10079713	Hose Barb, .50 x .50	2
2	05145941	Heat Exchanger	1	15	61126172	Hose, Push-on, .25	200.0"
3	10097657	Button Head Screw, 1/4-20 x 3/4	2	16	72158520	Hydraulic Hose Assembly, 1.0 x 60.0	1
4	95838314	Lock Washer, .25	2	17	72158502	Hydraulic Hose Assembly, 1.0 x 27.0	1
5	10070092	Jam Nut, 1-14	2	18	05064407	Adapter, JIC/ORB, 1.0 x .75	2
6	49886922	Bushing, Bulkhead, Pipe, .50 x .50	2	19	10070191	Hex Nut, M8	4
7	10173805	Adapter, Hose/JIC, .50 x .50	2	20	10069672	Lock Washer, M8	2
8	10127801	Pipe Nipple, .50 x 3.0	1	21	72158742	Sound Insulation	1
9	49890239	Solenoid Valve	1	22	72136158	Connector, DIN Form A	1
10	05107875	Adapter, JIC/Pipe, .50 x .50	2	23	72135884	Cable Assembly	1
11	10150472	Decal, Cool In	1	24	72135843	Coupler, Cable, not shown	1
12	10150480	Decal, Cool Out	1	26	72158692	Sound Insulation, not shown	1
				27	95391322	Flat Washer, .25	2

Figure 12-14: Oil/Water Heat Exchanger Kit

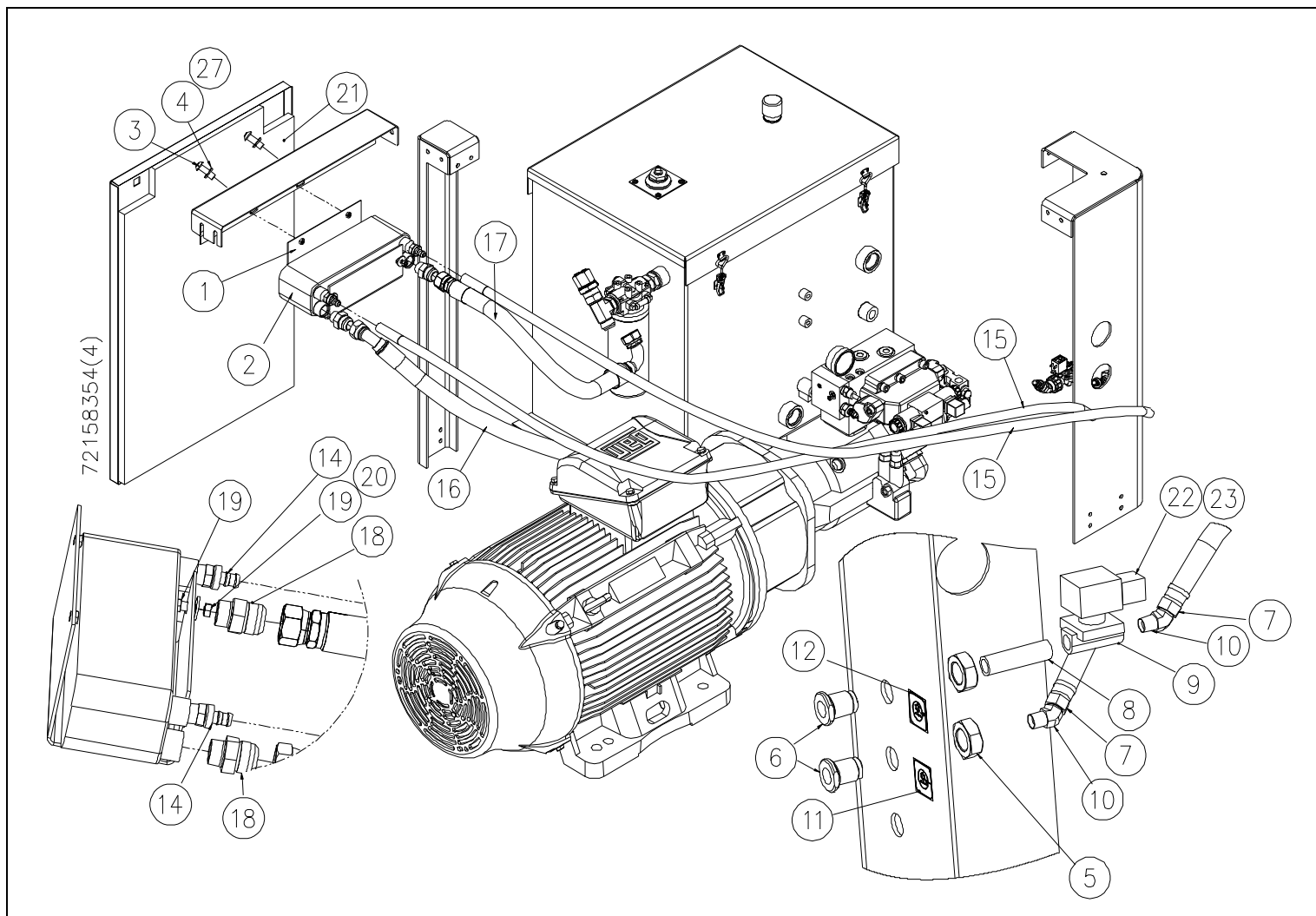


Table 12-16
Oil/Air Heat Exchanger Kit
72158346

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72154744	Heat Exchanger, Electric	1	9	72155124	Motor/Starter Protector	1
2	72158388	Hydraulic Hose Assembly, 1.0 x 44.0	1	10	72155033	Auxiliary Contact, 1 NC/1 NO	1
3	72158395	Hydraulic Hose Assembly, 1.0 x 38.0	1	11	72146220	Auxiliary Contact, 1 NO/1 NC	1
4	05091954	Button Head Screw, 3/8-16 x 1	4	12	05001698	Cable, #14	120.0"
5	95670972	Lock Washer, .38	4	13	49887813	Connector, Cable, .50	1
6	72134109	Caplug	2	14	10083012	Lock Nut, .50	1
7	05114962	Decal, Electrical Hazard	1	15	10082857	Gasket Assembly	1
8	05114970	Decal, Burn Hazard	2	16	20480801	Decal, Energy	6

Figure 12-15: Oil/Air Heat Exchanger Kit

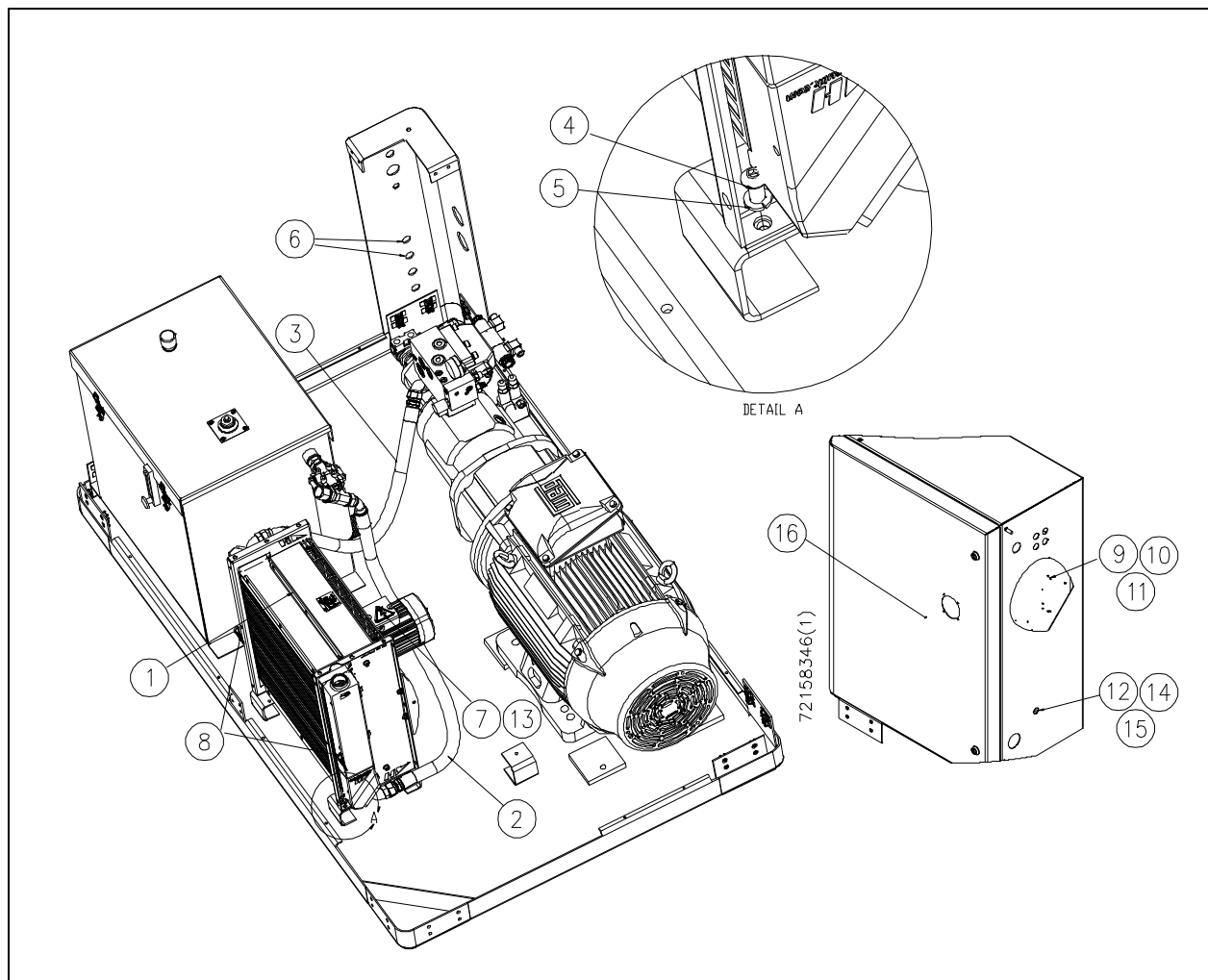


Table 12-17
Combination Heat Exchanger Kit
72158362

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72154744	Heat Exchanger, Air/Water	1	19	10070191	Hex Nut, M8	4
2	72158395	Hydraulic Hose Assembly, 1.0 x 38.0	1	20	10069672	Lock Washer, M8	2
3	05091954	Button Head Screw, 3/8-16 x 1	4	21	61126172	Hose, Push-on, .25	200.0"
4	95670972	Lock Washer, .38	4	22	72158437	Hydraulic Hose Assembly, 1.0 x 28.50	2
5	72158296	Bracket, Heat Exchanger	1	23	20428934	Elbow, JIC, 1.0 x 1.0	1
6	05145941	Heat Exchanger, Oil/Water	1	24	72155150	Motor Starter/Protector	1
7	10097657	Button Head Screw, 1/4-20 x 3/4	2	25	05114970	Decal, Burn Hazard	2
8	95838314	Lock Washer, .25	2	26	05114962	Decal, Electrical Hazard	1
9	10070092	Jam Nut, 1-14	2	27	72136158	Connector, DIN, Form A	1
10	49886922	Bushing, Bulkhead, Pipe, .50 x .50	2	28	72135884	Cable Assembly, 5 Socket	1
11	10173805	Adapter, Hose/JIC, .50 x .50	2	29	20480801	Decal, Energy	6
12	10127801	Pipe Nipple, .50 x 3.0	1	30	72155033	Auxiliary Contact, 1 NC/1 NO	1
13	49890239	Solenoid Valve	1	31	72146220	Auxiliary Contact, 1 NO/1 NC	1
14	05107875	Adapter, JIC/Pipe, .50 x .50	2	32	05001698	Cable, #14	120.0"
15	10150472	Decal, Cool In	1	33	49887813	Connector, Cable, .50	1
16	10150480	Decal, Cool Out	1	34	10083012	Lock Nut, .50	1
17	10079713	Hose Barb, .50 x .50	2	35	10082857	Gasket Assembly	1
18	05064407	Adapter, JIC/ORB, 1.0 x .75	2	36	72135843	Coupler, Cable	1

Figure 12-16: Combination Heat Exchanger Kit

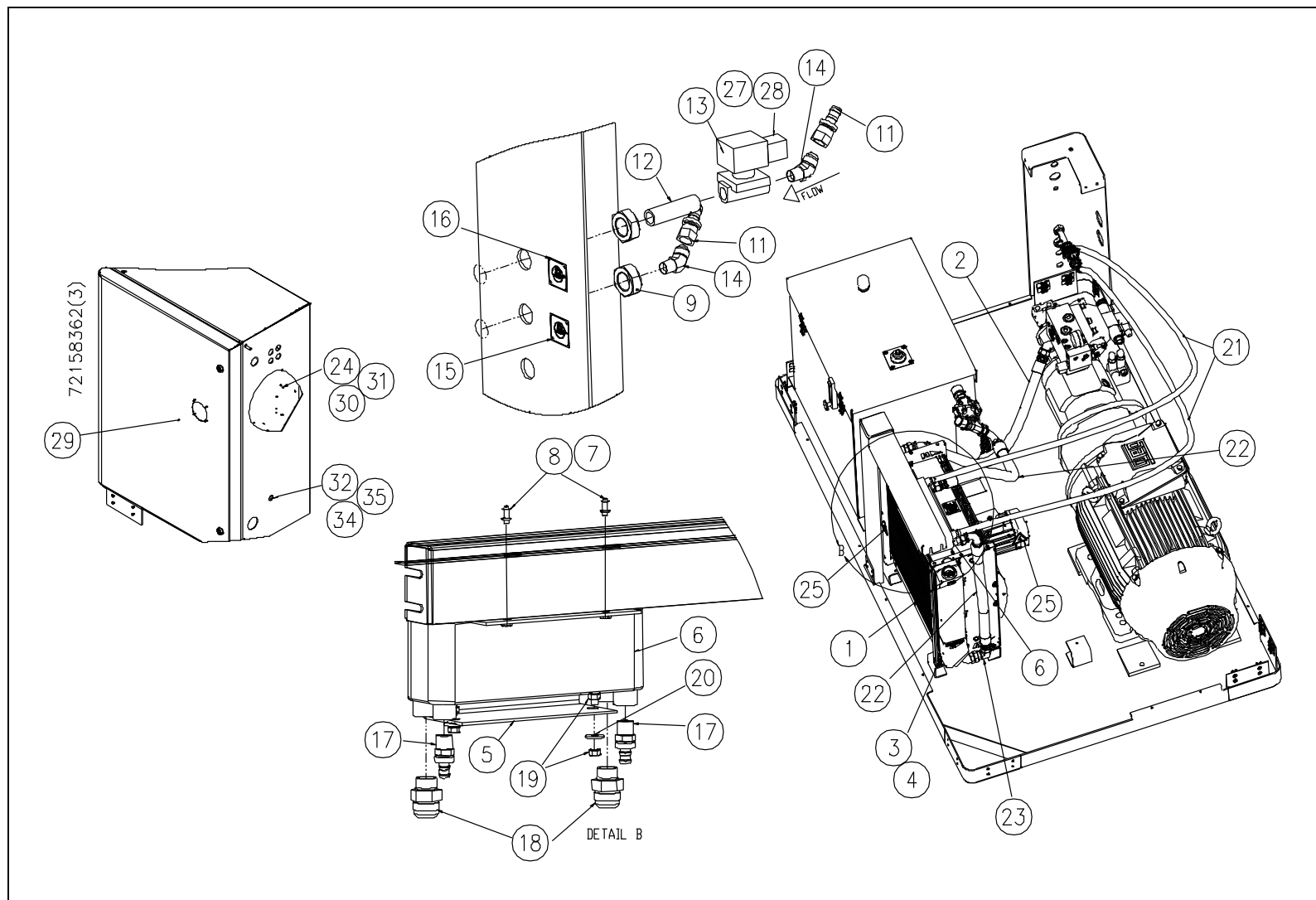


Table 12-18
Electrical Assembly, Line Start
72183019

Item	Part Number	Description	Quantity
1	72171147	Electrical Configuration	1
2	72158015	Cover, High Voltage	1
4	72161280	Motor Cable Assembly	1
5	72186433	Adapter Plate, Controller	1
6	72186440	Adapter Plate	1
7	10076032	Button Head Screw, 10-32 x 1/2	8
8	95367728	Lock Washer, #10	8
9	72171530	Hourmeter, Optional (S models only)	--

Figure 12-17: Electrical Assembly, Line Start

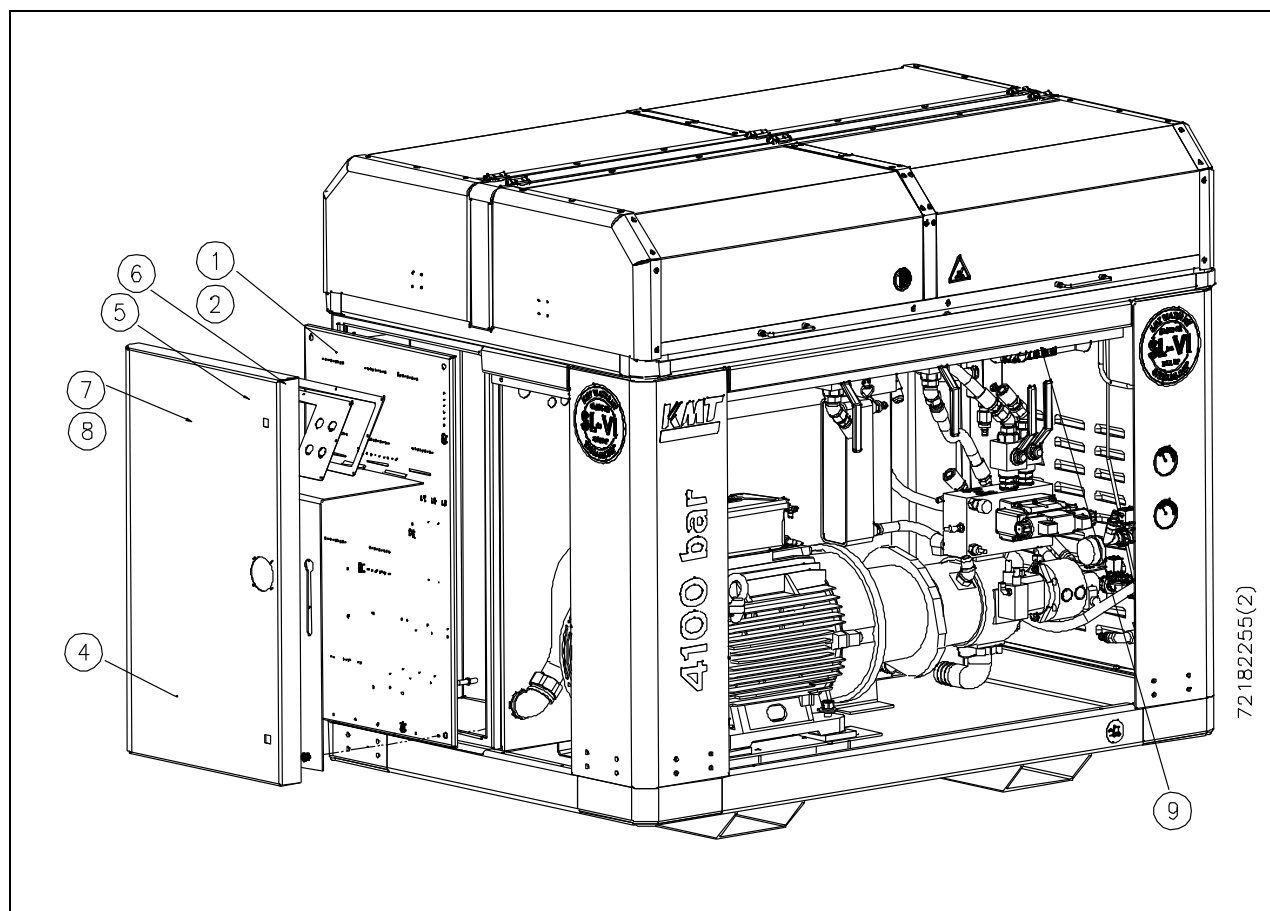


Table 12-19
Electrical Configuration, Line Start
72171147

Item	Part Number	Description	Quantity
1	72157578	Electrical Kit, Hardware	1
2	72155173	Electrical Kit, Circuit Breaker	1
3	72155421	Electrical Kit, Low Voltage Controls	1
4	72155348	Electrical Kit, High Voltage Controls	1
5	72155223	Electrical Kit, Motor Starter	1
6	10152668	Wire, #2, Black	72.0"

Figure 12-18: Electrical Configuration, Line Start

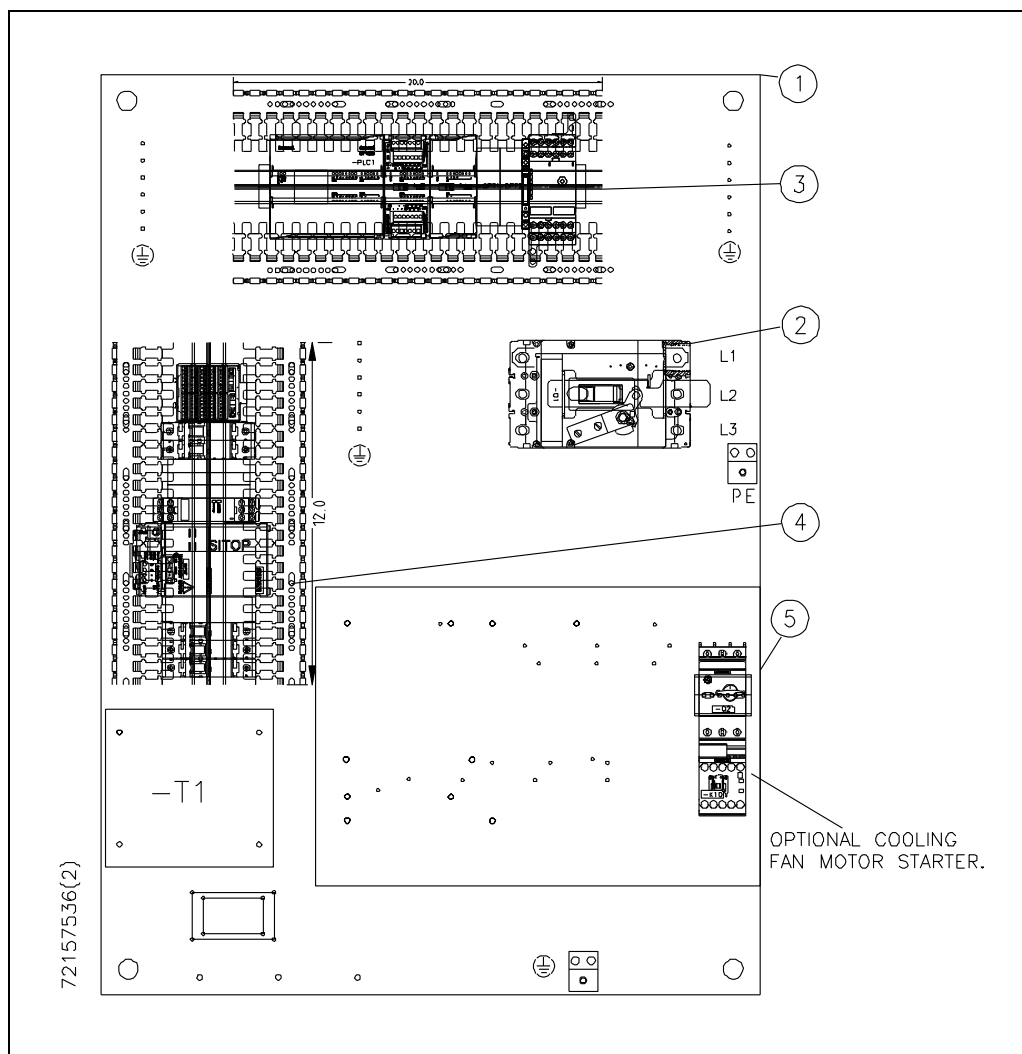


Table 12-20
Electrical Kit, Hardware
72157578

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72136298	Wiring Duct	0.416	14	10125912	Cable Tie, .87	0.2
2	72136207	Pan Head Screw, 10-16 x 5/8	8	15	10120921	Mount, Cable Tie	6
3	72109797	DIN Rail	0.38	16	10098770	Flexible Conduit, 1.0	10.0"
4	10170132	Rivet	10	17	10094563	Connector, Flexible Conduit	2
5	20430277	Ground Lug, #14-1/0	2	18	72162461	Nut, 3/8-16	2
6	95175758	Hex Head Screw, 1/4-20 x 5/8	10	20	05133707	Bushing, Conduit, 1.0 x 1.0	2
7	10069748	Flat Washer, .25	12	21	72136504	Plug Connector	1
8	10157659	Lock Washer, .25	10	22	72157643	Panel Insert	1
9	10073500	Pan Head Screw, 8-32 x 3/4	14	23	72171621	Cable Connector, .50	1
10	10114627	Flat Washer, #8	16	24	10082857	Gasket Assembly, .50	1
11	10069607	Lock Washer, #8	14	25	10083012	Lock Nut, .50	1
12	10159143	Ring Terminal, #8	6				
13	10125920	Cable Tie, 1.88	0.2				

Figure 12-19: Electrical Kit, Hardware

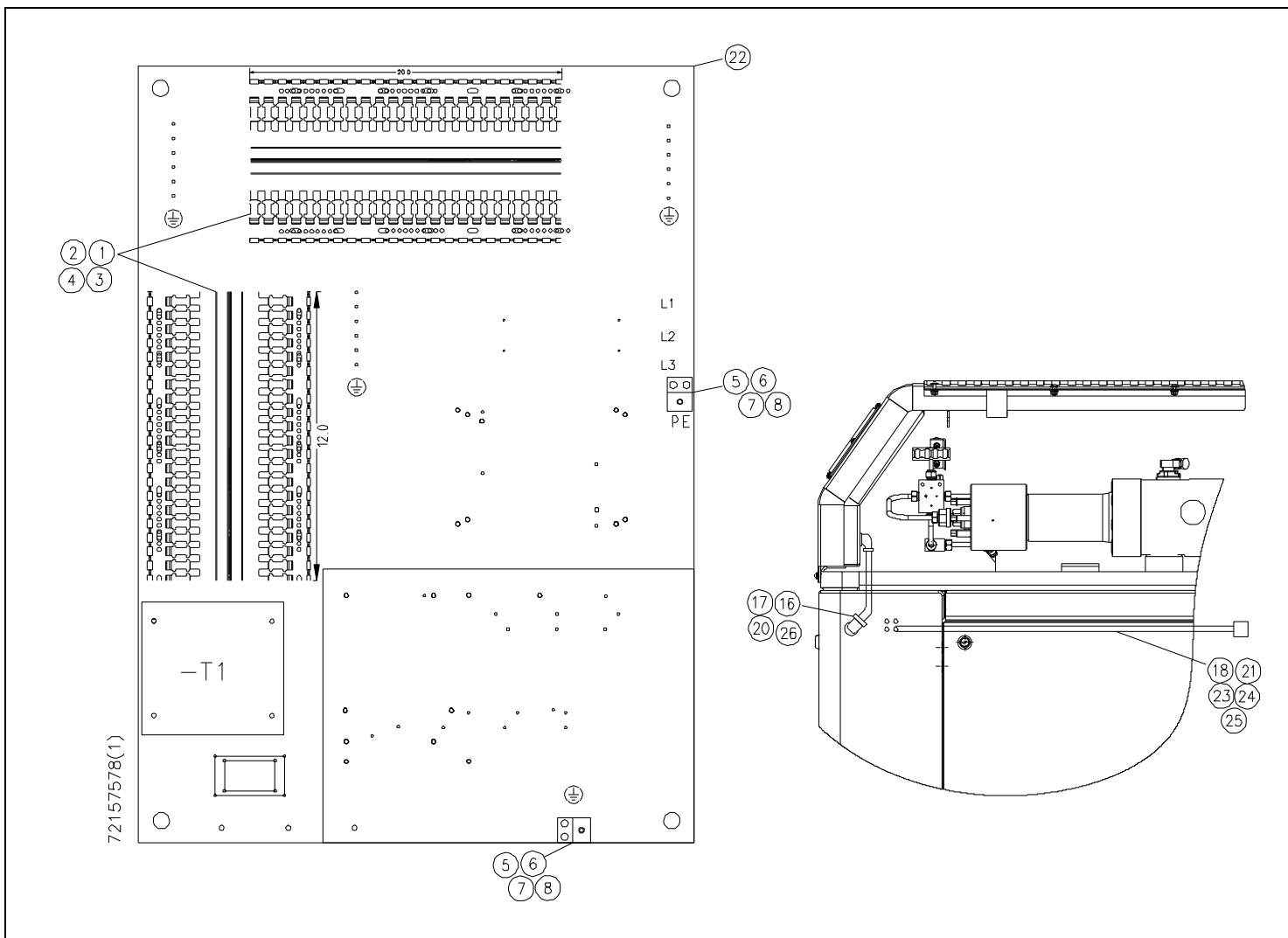


Table 12-21
Electrical Kit, Circuit Breaker
72155173

Item	Part Number	Description	Quantity
1	72154843	Circuit Breaker, 100A	1
2	72154835	Rotary Drive, Circuit Breaker	1
3	72157726	Terminal Cover	1

Table 12-22
Electrical Kit, Low Voltage Controls
72155421

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72144153	Program Controller	1	15	72149366	Connector, Dummy Module	2
2	72169075	Digital Card, I/O	1	16	72149374	Connector, Locking Element	0.2
3	72135299	Safety Relay, 24VDC	1	17	72149341	Connector, Side Entry	1
4	72140163	Module, Operator to Coupler Module	2	18	72149359	Connector, Single Lever Lock	1
5	72135166	Display	1	19	72149424	Connector, Cable Clamp	1
6	72135653	Legend Plate, E-Stop	1	20	72130028	Cable, Ethernet	1
7	72109664	Pushbutton, E-Stop	1	21	72155371	Plug, Remote Interface	1
8	72122907	Contact Block	1	22	72169210	Plug, Remote Interface	1
9	72144244	Contact Block	2	23	72155496	Plug Cover	2
10	72120528	Resistor	1	24	72155603	Memory Card	1
11	72149408	Connector, Quick Lock, Female	2	25	20420563	End Anchor	4
12	72149416	Connector, Quick Lock, Male	4	26	72109755	Interface Relay	1
13	72149400	Connector, Hinged Frame	1	27	72109690	Adapter, Contact Block	1
14	72149382	Connector, Hinged Frame	1				

Figure 12-20: Electrical Kit, Low Voltage Controls

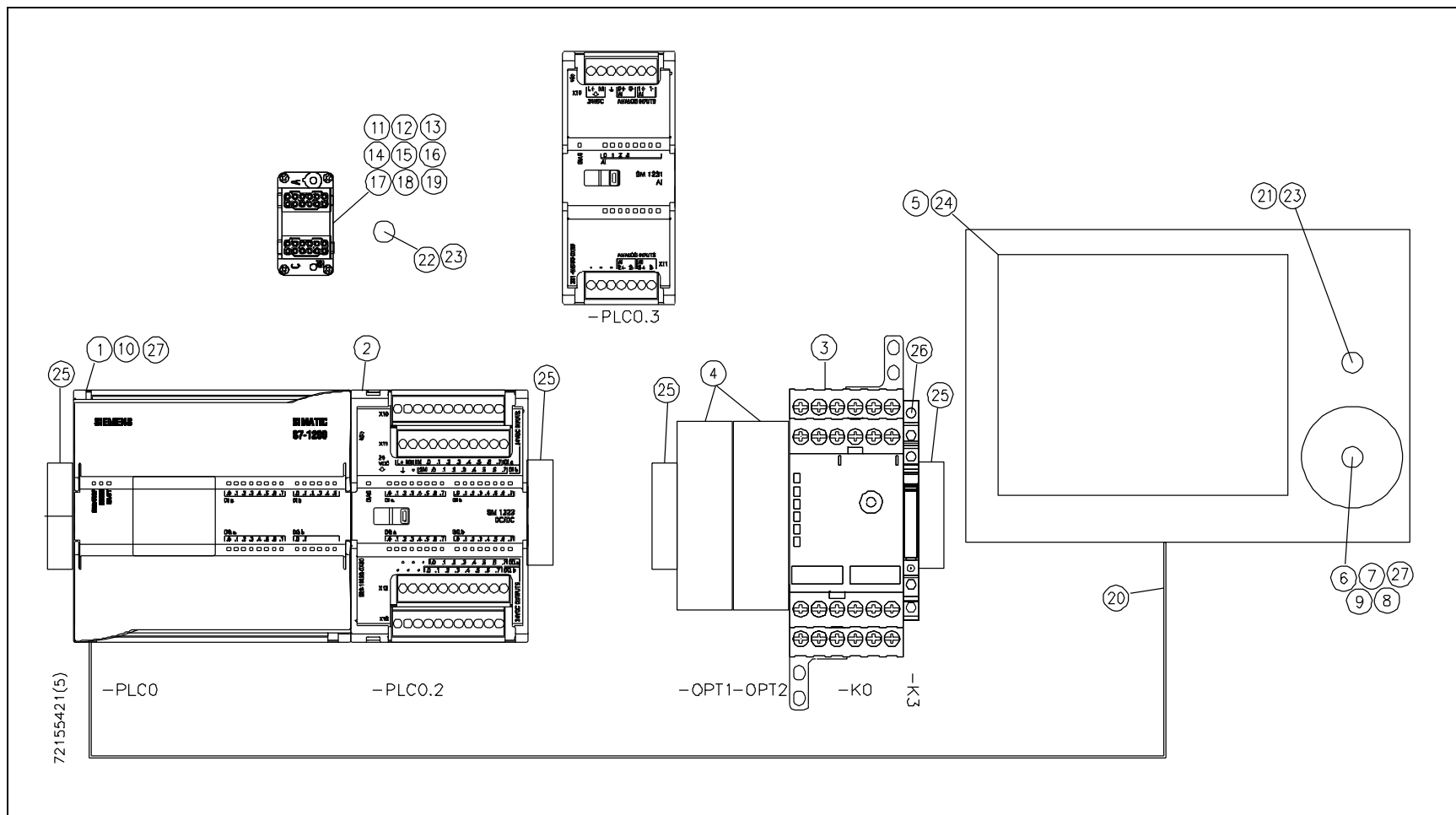


Table 12-23
Electrical Kit, High Voltage Controls
72155348

Item	Part Number	Description	Quantity
1	72137199	Circuit Breaker, 6A	1
2	20489290	Power Supply	1
3	72144236	Circuit Breaker, 2A	1
4	72135348	Circuit Breaker, 4A	1
5	72154960	Terminal Block	1
6	72144179	Safety Expansion Relay	1
7	20420563	End Anchor	2

Figure 12-21: Electrical Kit, High Voltage Controls

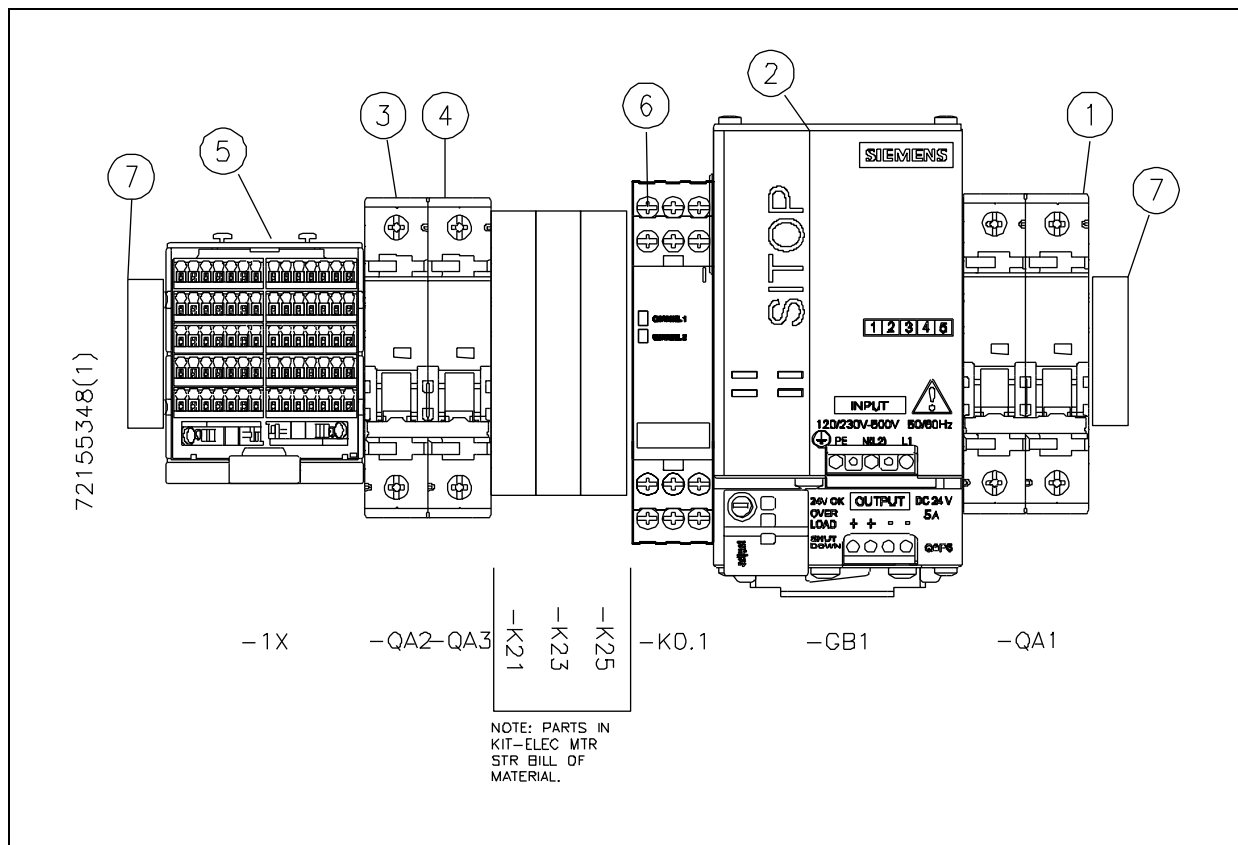


Table 12-24
Electrical Kit, Motor Starter
72155223

Item	Part Number	Description	Quantity
1	72154819	Contactator	3
2	72155199	Interface Relay	1
3	72154793	Overload Relay	1
4	72154918	Block, Auxiliary Contact	1
5	72154926	Block, Auxiliary Contact	1

Table 12-25
Power Factor Correction Kit
72166221

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72161530	Capacitor, 22.5 KVAR	1	11	10069607	Lock Washer, #8	3
2	72161546	Capacitor, 10 KVAR	1	12	75155199	Interface Relay	1
3	72163444	Bracket, Capacitor	1	13	20420563	End Anchor	2
4	80089873	Button Head Screw, 1/4-20 x 1	3	14	72146566	Wire, #18, Brown	72.0"
5	95648150	Lock Washer, .25	3	15	72109945	Wire, #18, Blue	60.0"
6	10069748	Flat Washer, .25	3	16	72161437	Wire, #6, Black	72.0"
7	72161587	Contactor, Capacitor Switch	1	17	05020078	Wire, #8, Black	72.0"
8	10073500	Pan Head Screw, 8-32 x 3/4	3	18	10170371	Connector, Crimp Pin, #18	10
9	72109797	DIN Rail	.08	19	10170355	Connector, Crimp Pin, #6	6
10	10114627	Flat Washer, #8	3	20	05141692	Connector, Crimp Ferrule, #8	12

Figure 12-22: Power Factor Correction

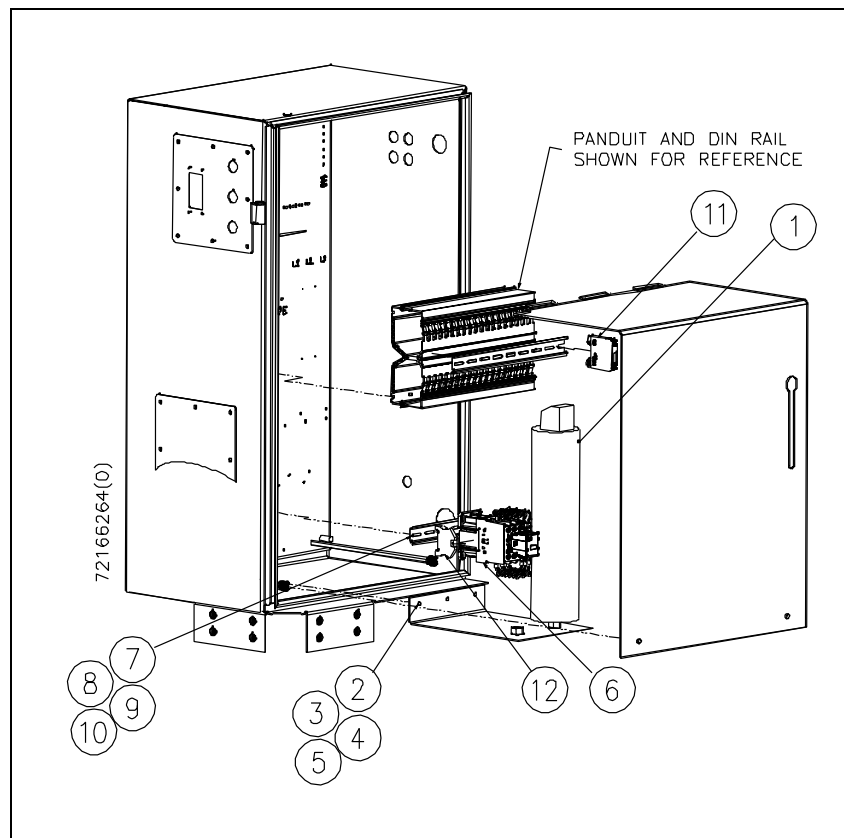
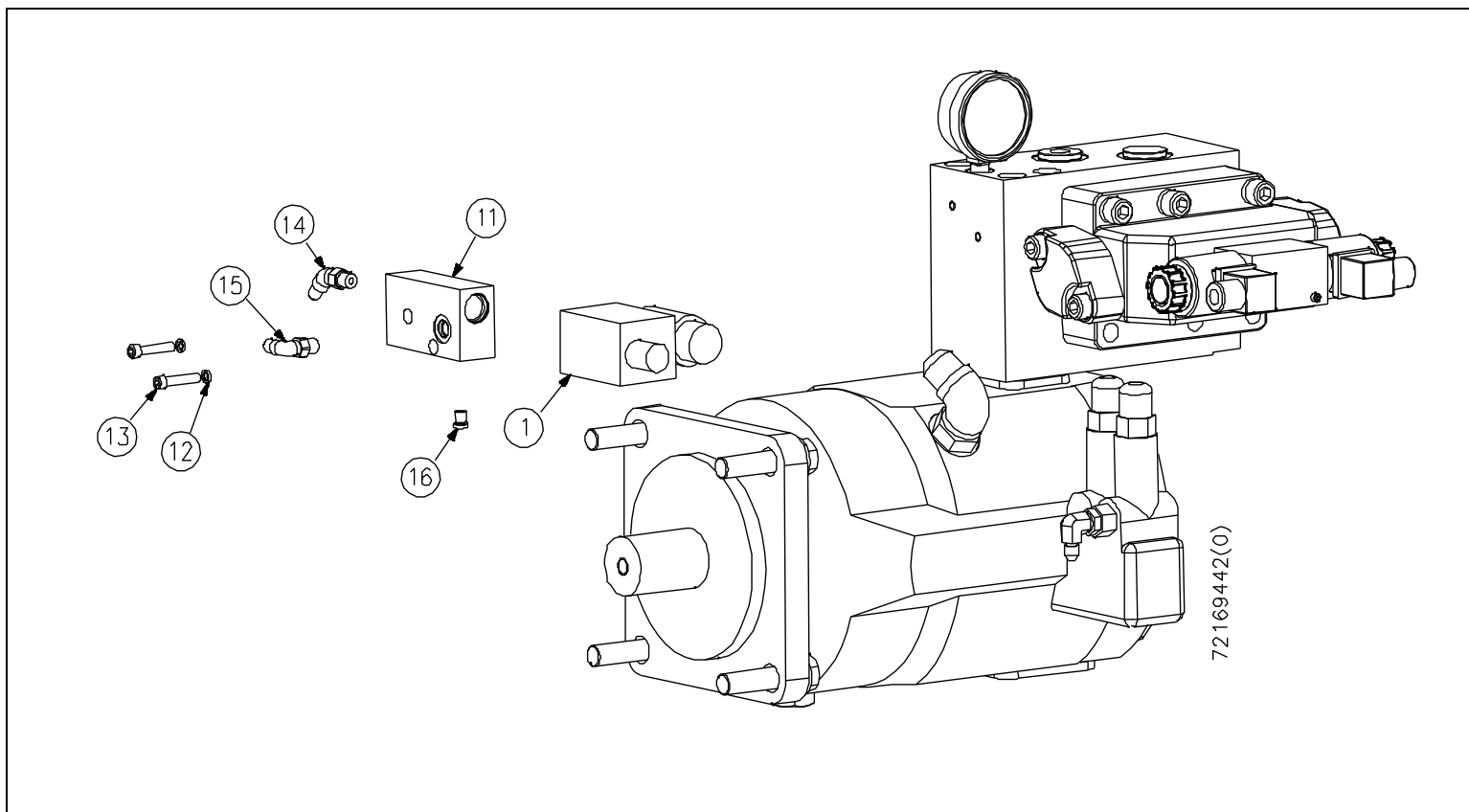


Table 12-26
Proportional Pressure Control Kit
72182629

Item	Part Number	Description	Quantity
1	80071087	Proportional Control Valve	1
2	49867104	Cable, #18	120.0"
3	10067205	Connector, Cable, .50	1
4	72109945	Wire #18, Blue	50.0"
5	61172607	Connector, Crimp Ferrule, #18	10
6	72135405	Analog Card	1
7	10083012	Lock Nut, .50	1
8	10082857	Gasket Assembly	1
9	72158140	Screen Grounding Kit	1
10	72146566	Wire, #18, Brown	50.0"
11	72111845	Pilot Manifold	1
12	10069581	Lock Washer, .25	2
13	10144376	Socket Head Screw, 1/4-20 x 1-1/4	2
14	10144749	Adapter, JIC/ORB, .25 x .25	1
15	10142644	Adapter, JIC/ORB, .25 x .25	1
16	05055017	Plug, ORB, .13	1
17	72166538	Project Logic	1

Figure 12-23: Proportional Pressure Control Kit



72169442(0)

Table 12-27
Redundant Kit
72186365

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	72170165	Intensifier Topworks	1	17	80079692	Adapter, FSOR/ORB, 1.0 x 1.0	4
2	95413696	Lock Washer, .50	4	18	80079551	2-Way Ball Valve Assembly	4
3	95383790	Socket Head Screw, 1/2-13 x 1	4	20	80079684	Adapter, FSOR/ORB, 1.0 x .75	4
4	20452956	UHP Gland, .38	2	22	72158461	Hydraulic Hose Assembly, 1.0 x 39.13	2
5	20452965	UHP Collar, .38	2	25	72136124	Cable Assembly, 4 Socket	1
6	20496008	UHP Tube, .38 x 5.19	1	26	20465070	Connector, Cable, .50	1
7	72163028	3-Way Valve Assembly	2	27	10083012	Lock Nut, .50	1
8	72169800	UHP Tube, Bent, .38	2	28	10082857	Gasket Assembly, Flexible Conduit, .50	1
10	72131795	UHP Tube, Bent, .38	1	29	72171665	Cable, Pigtail	1
11	10083897	Ferrule, Hose, .25	14	30	05076096	Decal, Intensifier I	1
12	10186153	Conduit, Flexible, .38	140.0"	31	05076104	Decal, Intensifier II	1
13	72131788	UHP Tube, Bent, .38	1	32	20451641	Latch Pin	4
15	80079817	Adapter, FSOR/ORB, 1.0 x 1.0	4	33	72119552	Adapter, Tube/Pipe, .38 x .25	2
16	80079874	Adapter, FSOR/ORB, 1.0 x .75	2	34	20419424	Poly Tube, .38	96.0"

Figure 12-24: Redundant Kit

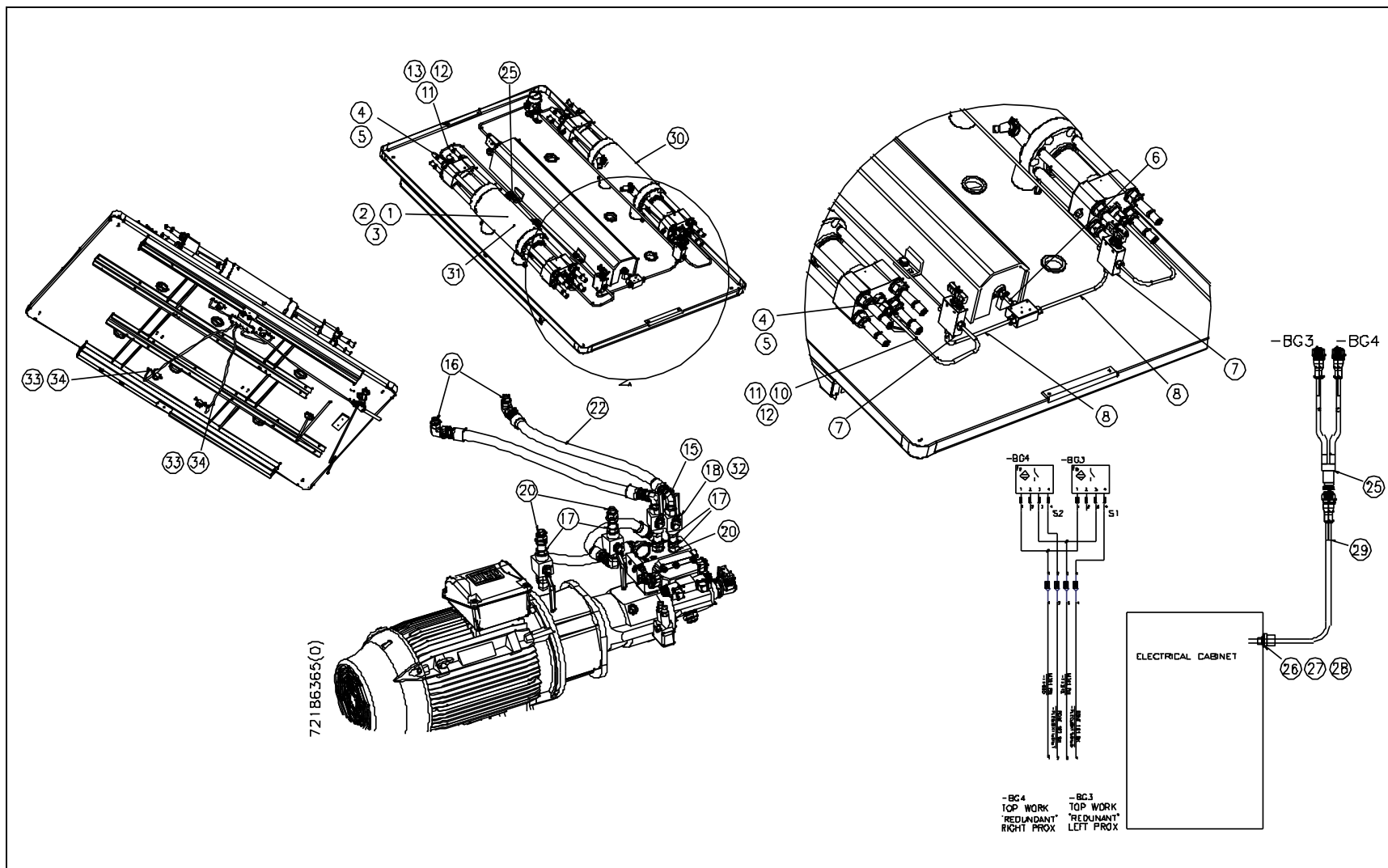


Table 12-28
High Pressure Tube Coning Tools

Item	Part Number	Description
	05109897	Power Coning Tool Assembly, .25
	05109889	Power Coning Tool Assembly, .38
	05109871	Power Coning Tool Assembly, .56
1	05108808	Blade, .25
	05108824	Blade, .38
	05108816	Blade, .56
2	05109814	Retainer, .25
	05109822	Retainer,.38
	05109830	Retainer, .56
	05120472	Cone and Thread Lubricant, 4 oz.

Figure 12-25: High Pressure Coning Tools

Power Coning Tool Assembly

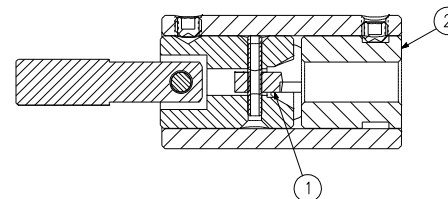
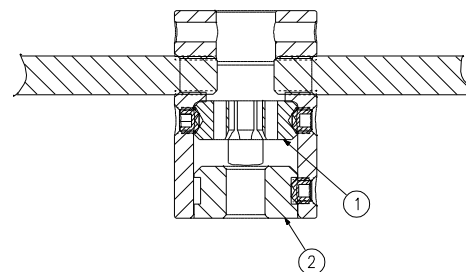


Table 12-29
High Pressure Tube Threading Tools

Item	Part Number	Description
	05108865	Hand Threading Tool Assembly, .25
	05108873	Hand Threading Tool Assembly, .38
	05108881	Hand Threading Tool Assembly, .56
	05122742	Power Threading Tool Assembly, .25
	05120258	Power Threading Tool Assembly, .38
	05122759	Power Threading Tool Assembly .56
1	05108899	1/4-20 Threading Die
	05108915	3/8-16 Threading Die
	10078301	9/16-18 Threading Die
2	05108741	Retainer, .25
	05108758	Retainer, .38
	05108766	Retainer, .56
	05108782	Tube Vise, .25
	05108790	Tube Vise, .38
	05108774	Tube Vise, .56
7	20437825	Tube Vise, .75
	20440071	Tube Vise, 1.0

Figure 12-26: High Pressure Threading Tools

Hand Threading Tool Assembly



Power Threading Tool Assembly

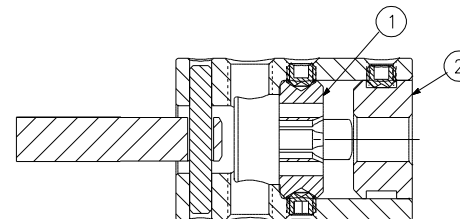


Table 12-30
Maintenance Tools and Lubricants

Item	Part Number	Description
Maintenance Tools		
1	20477460	Plunger Removal Tool
2	20476132	Hydraulic Tensioner Assembly (includes hydraulic hand pump)
	7219000129	Hydraulic Gauge
20470475 Seal Tool Kit, Pneumatic Control Valves		
1	20470417	Seal Installation Tool
2	05067350	Seal Positioning Tool, NO/NC Valves, 2-Port Dump Valve
3	49833114	Seal Positioning Tool, Quick Release Valve, 3-Port Dump Valve
4	20470413	Seal Push Tool
Lubricants		
	10084440	Pure Goop Thread Lubricant, 1.0 oz.
	10087385	FML-2 Grease, 14.5 oz.
	49832199	JL-M Thread Lubricant, 16 oz.
	80082191	JL-M Thread Lubricant, 15 ML
	20487868	Threadlocker Adhesive

Figure 12-27: Maintenance Tools and Lubricants

Maintenance Tools



Seal Tool Kit, Pneumatic Control Valves

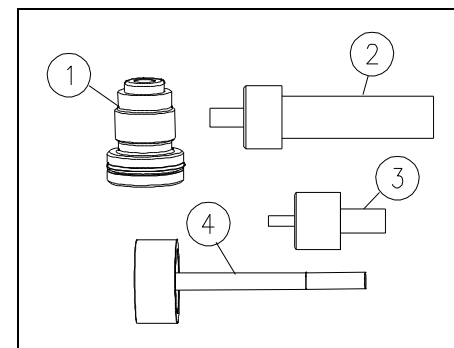


Table 12-31
Indexed Focusing Tubes

Part Number	Description	
20477366	R-500	0.030" (0.762 mm) x 3.00" (76.2 mm)
20477375	R-500	0.030" (0.762 mm)x 3.50" (88.9 mm)
20477378	R-500	0.030" (0.762 mm)x 3.75" (95.3 mm)
20477382	R-500	0.030" (0.762 mm)x 4.00" (101.6 mm)
20490776	R-500	0.033" (0.838 mm)x 3.00" (76.2 mm)
20490760	R-500	0.033" (0.838 mm)x 4.00" (101.6 mm)
20486133	R-500	0.040" (1.016 mm) x 3.00" (76.2 mm)
20486166	R-500	0.040" (1.016 mm) x 4.00" (101.6 mm)
20477386	R-500	0.043" (1.092 mm) x 3.00" (76.2 mm)
20477395	R-500	0.043" (1.092 mm) x 4.00" (101.6 mm)
20486151	R-500	0.045" (1.143 mm) x 3.00" (76.2 mm)
20486158	R-500	0.045" (1.143 mm) x 4.00" (101.6 mm)
20490794	R-500	0.048" (1.219 mm) x 3.00" (76.2 mm)
20490768	R-500	0.048" (1.219 mm) x 4.00" (101.6 mm)

Figure 12-28: Indexed Focusing Tubes

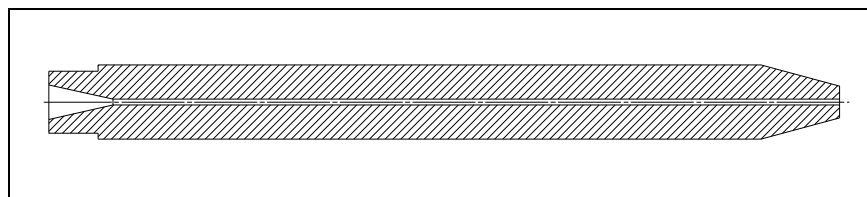


Table 12-32
Diamond Orifice

Part Number	Description	Part Number	Description	Part Number	Description
20481704	0.004" (0.102 mm)	20481711	0.011" (0.279 mm)	20481718	0.018" (0.457 mm)
20481705	0.005" (0.127 mm)	20481712	0.012" (0.305 mm)	20481719	0.019" (0.483 mm)
20481706	0.006" (0.152 mm)	20481713	0.013" (0.330 mm)	20481720	0.020" (0.508 mm)
20481707	0.007" (0.178 mm)	20481714	0.014" (0.356 mm)	20481721	0.021" (0.533 mm)
20481708	0.008" (0.203 mm)	20481715	0.015" (0.381 mm)	20481722	0.022" (0.559 mm)
20481709	0.009" (0.229 mm)	20481716	0.016" (0.406 mm)		
20481710	0.010" (0.254 mm)	20481717	0.017" (0.432 mm)		

Figure 12-29: Diamond Orifice

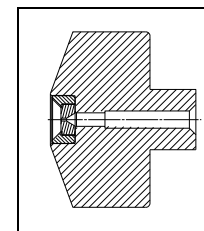
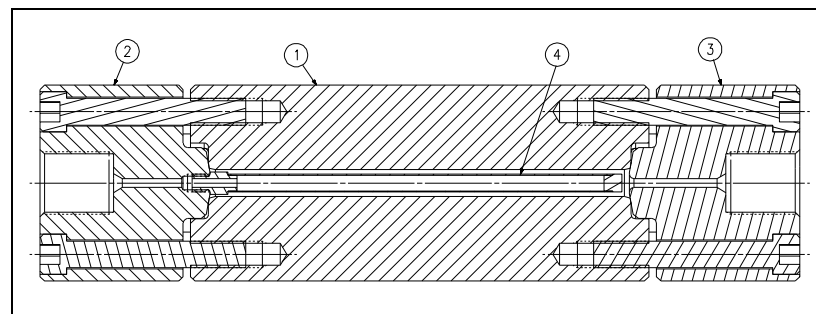


Table 12-33
Ultra-High Pressure Water Filter Assemblies

Item	Part Number	Description	Quantity
	20475916	Inline Water Filter, .38	
1	20475920	Filter Body	1
2	20475923	Sealing Head, Inlet	1
3	20475927	Sealing Head, Outlet	1
4	20453553	Filter Element	1
5	20453646	Socket Head Screw	12
	20452965	UHP Collar, .38	2
	20452956	UHP Gland, .38	2
	20475944	Inline Water Filter, .56	
1	20475920	Filter Body	1
2	20475931	Sealing Head, Inlet	1
3	20475940	Sealing Head, Outlet	1
4	20453553	Filter Element	1
5	20453646	Socket Head Screw	12
	20453124	UHP Collar, .56	2
	20453121	UHP Gland, .56	2

Figure 12-30: Ultra-High Pressure Water Filter Assemblies

UHP Inline Water Filter, .38



UHP Inline Water Filter, .56

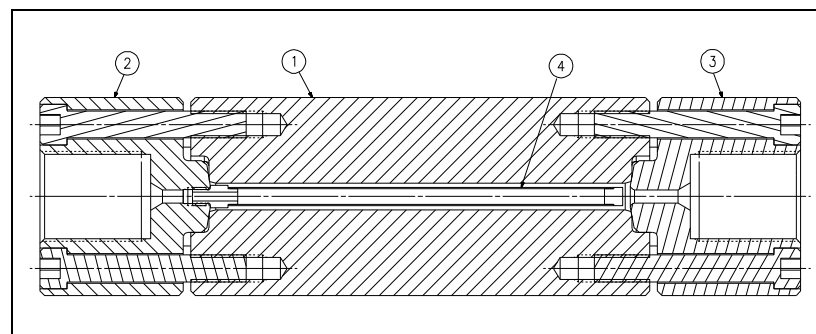


Table 12-34
Ultra-High Pressure Swivel Pro Assemblies

Item	Part Number	Description	Quantity
	20477623	UHP Swivel Pro, Straight, .25, F/F	
1	20486952	Spindle	1
2	20486976	Swivel Body	1
3	20486968	Swivel Housing	1
4	20486984	Seal Retainer	1
5	20487002	Seal Assembly	1
6	20475956	Thrust Bearing	1
7	20487051	Bushing	1
8	20487059	Collar	1
9	10074938	O-Ring	1
10	20477717	Setscrew	1
11	20477574	Grease Fitting	1
	20488720	Tool Kit	
	10067189	NLGI-2 Swivel Grease	20487902 Seal Installation Tool
	10087385	FML-2 Grease	20487884 Seal Push Tool
	20487868	Loctite 242	20487910 Pin Spanner Wrench
	10084440	Pure Goop	20487918 1/4-20 Bottoming Tap

Figure 12-31: Ultra-High Pressure Swivel Pro Assemblies
UHP Pro Swivel Assembly, Straight, F/F Connection, .25

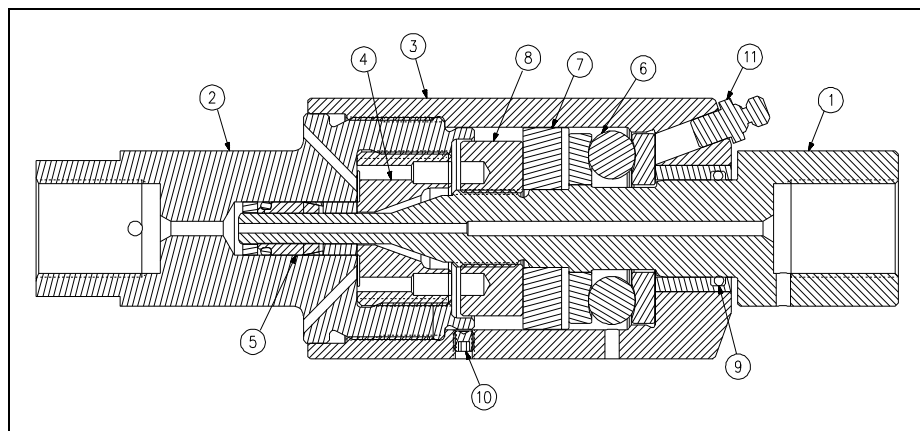


Table 12-34
Ultra-High Pressure Swivel Pro Assemblies

Item	Part Number	Description	Quantity
	20491098	UHP Swivel Pro, 90D, .25, F/F	
1	20486952	Spindle	1
2	20490859	Swivel Body	1
3	20486968	Swivel Housing	1
4	20486984	Seal Retainer	1
5	20487002	Seal Assembly	1
6	20475956	Thrust Bearing	1
7	20487051	Bushing	1
8	20487059	Collar	1
9	10074938	O-Ring	1
10	20477717	Setscrew	1
11	20477574	Grease Fitting	1

UHP Swivel Pro Assembly, 90D, F/F Connection, .25

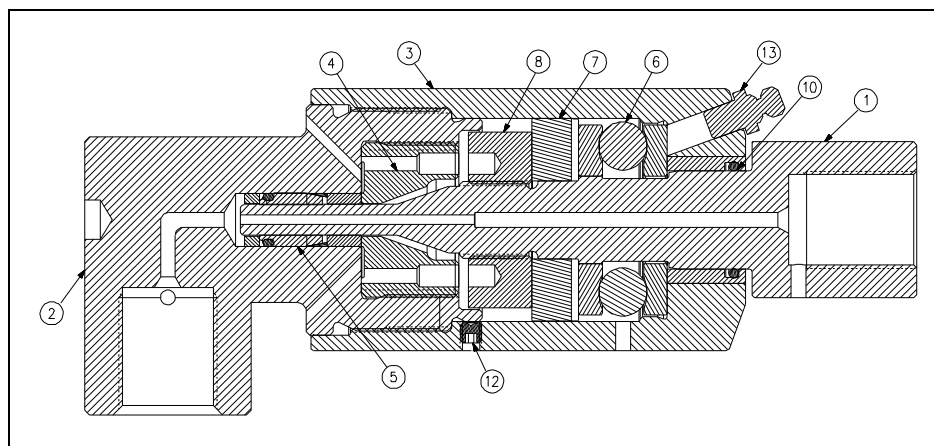


Table 12-34
Ultra-High Pressure Swivel Pro Assemblies

Item	Part Number	Description	Quantity
	20490851	UHP Swivel Pro, Straight, .25, F/M	
1	20490843	Spindle	1
2	20486976	Swivel Body	1
3	20486968	Swivel Housing	1
4	20486984	Seal Retainer	1
5	20487002	Seal Assembly	1
6	20475956	Thrust Bearing	1
7	20487051	Bushing	1
8	20487059	Collar	1
9	10074938	O-Ring	1
10	20477717	Setscrew	1
11	20477574	Grease Fitting	1

UHP Swivel Pro Assembly, Straight, F/M Connection, .25

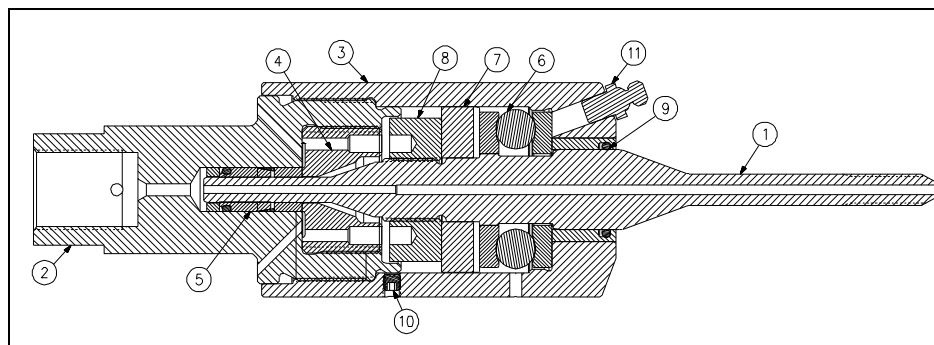


Table 12-34
Ultra-High Pressure Swivel Pro Assemblies

Item	Part Number	Description	Quantity
	72108129	UHP Swivel Pro, 90D, .25, F/M	
1	20490843	Spindle	1
2	20490859	Swivel Body	1
3	20486968	Swivel Housing	1
4	20486984	Seal Retainer	1
5	20487002	Seal Assembly	1
6	20475956	Thrust Bearing	1
7	20487051	Bushing	1
8	20487059	Collar	1
9	10074938	O-Ring	1
10	20477717	Setscrew	1
11	20477574	Grease Fitting	1
	72129713	Swivel Rebuild Kit	
	20487002	Seal Assembly	10087385 FML-2 Grease
	20475956	Thrust Bearing	20487868 Loctite 242
	10074938	O-Ring	10084440 Pure Goop
	20477717	Setscrew	10149045 Emery Cloth, 600 Grit
	20487051	Bushing	

UHP Swivel Pro Assembly, 90D, F/M Connection, .25

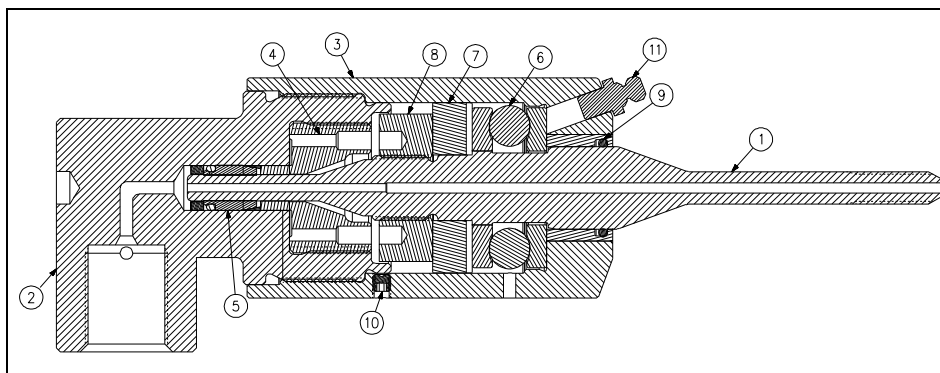


Table 12-35
Nozzle Tubes

Part Number	Description
	For use with Short Stop Filter
20487241	3.50" (88.90 mm)
20487249	4.50" (114.30 mm)
20487257	5.75" (146.05 mm)
20497106	6.25" (158.75 mm)
20487265	7.50" (190.50 mm)
20487273	9.75" (247.65 mm)
20480993	Nozzle Nut, .75

Figure 12-32: .75 Nozzle Tube

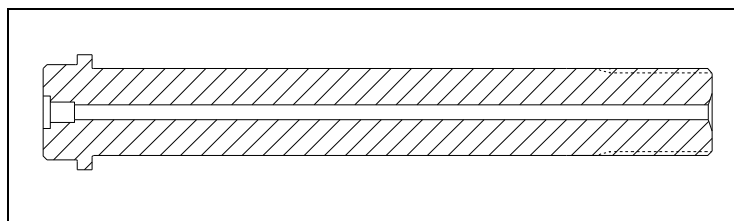


Table 12-36
IDE Pro Abrasive Nozzle Assembly
Without Short Stop Filter

Part Number	Description
20481405	IDE Pro Assembly, .005
20481407	IDE Pro Assembly, .007
20481408	IDE Pro Assembly, .008
20481409	IDE Pro Assembly, .009
20481410	IDE Pro Assembly, .010
20481411	IDE Pro Assembly, .011
20481412	IDE Pro Assembly, .012
20481413	IDE Pro Assembly, .013
20481414	IDE Pro Assembly, .014
20481415	IDE Pro Assembly, .015
20481416	IDE Pro Assembly, .016
20481418	IDE Pro Assembly, .018

Table 12-37
Autoline™ Pro Abrasive Nozzle Assembly
20480707

Item	Part Number	Description	Quantity
1	20480732	Cap	1
2	20480715	Body Assembly	1
3	20453964	Abrasive Feed Tube Assembly	1
4	20453973	Abrasive Feed Adapter	1
5	20453976	Retainer Knob	1
6	05138821	O-Ring	1
7	05142286	O-Ring	1
8	05087168	Guard	1
	49885361	Plastic Feed Hose	

Figure 12-33: Autoline™ Pro Abrasive Nozzle Assembly

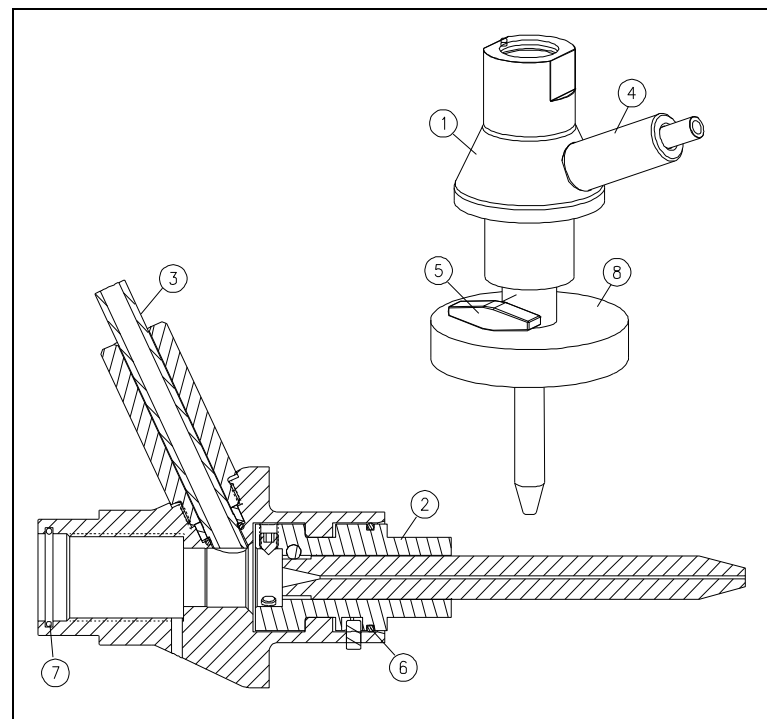
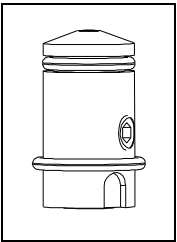


Table 12-38
Integrated Wear Insert/Orifice Assemblies

Part Number	Orifice Size	Part Number	Orifice Size	
20496204	0.004	20496214	0.014	<p><i>Figure 12-34: Wear Inset/Orifice Assembly</i></p> 
20496205	0.005	20496215	0.015	
20496206	0.006	20496216	0.016	
20496207	0.007	20496217	0.017	
20496208	0.008	20496218	0.018	
20496209	0.009	20496219	0.019	
20496210	0.010	20496220	0.020	
20496211	0.011	20496221	0.021	
20496212	0.012	20496222	0.022	
20496213	0.013			

20479589 Spare Parts Kit

20433398	Setscrew, 8-32	2
05142286	O-Ring, .75 x .88 x .06	2
20445476	O-Ring, .31 x .44 x .06	3
05138821	O-Ring, .69 x .81 x .06	2
05077078	O-Ring, .38 x .50 x .06	2

Table 12-39
UHP Valve/Actuator Assembly, Normally Closed
20480359

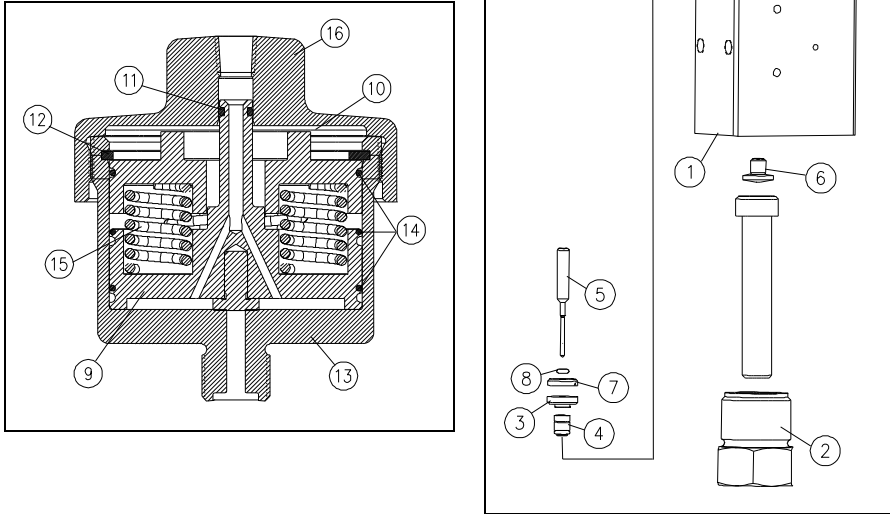
Item	Part Number	Description	Quantity	
1	20475871	Valve Body	1	<p>Figure 12-35: UHP Valve/Actuator Assembly, NC</p> 
2	20454351	HP Gland	1	
3	20475874	Bronze Backup Ring	1	
4	72112069	Seal Assembly	1	
5	20475878	Valve Stem	1	
6	10178697	Valve Seat	1	
7	20475882	SST Backup Ring	1	
8	49895584	O-Ring	1	
	20474154	Actuator Assembly		
9	20468022	Piston	1	<p>20477521 Repair Kit, Normally Closed Valve Includes Items 3, 4, 5, 6, 7, 8 and 11</p> <p>72175708 Actuator Rebuild Kit Includes Items 11, 14 and 15</p>
10	20411554	Cylinder Cap	1	
11	10150233	O-Ring	1	
12	10177772	Retaining Ring	1	
13	20467522	Pneumatic Cylinder	1	
14	10177806	O-Ring	3	
15	05054119	Compression Spring	1	
16	20467518	Cover	1	

Table 12-40
UHP Valve/Actuator Assembly, Normally Open
20478997

Item	Part Number	Description	Quantity
1	20475871	Valve Body	1
2	20454351	HP Gland	1
3	20475874	Bronze Backup Ring	1
4	72112069	Seal Assembly	1
5	20475878	Valve Stem	1
6	10178697	Valve Seat	1
7	20475882	SST Backup Ring	1
20479022 Actuator Assembly			
8	20468601	Pneumatic Cylinder	1
9	BV601184	Cylinder Head	1
10	10074714	O-Ring	1
11	10074565	O-Ring	2
12	BV501184	Piston	1
20477518 Repair Kit, Normally Open Valve			
Includes Items 3, 4, 5, 6, 7, 10 and 11			

Figure 12-36: UHP Valve/Actuator Assembly, NO

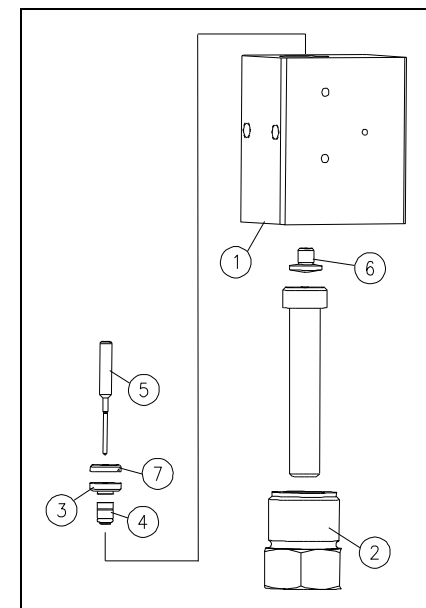
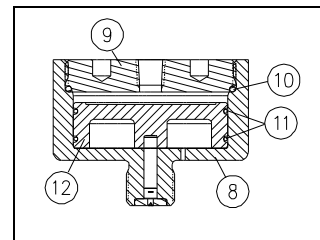


Table 12-41
Ultra-High Pressure Fitting and Valve Assemblies

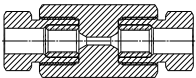
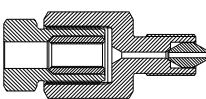
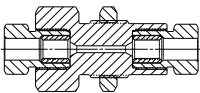
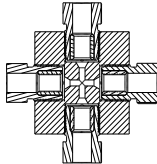
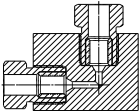
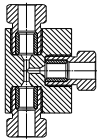
Part Number	Description		Part Number	Description	
		UHP Coupling			UHP Bushing
20477023	Coupling, .25 x .25, F/F		72133175	Bushing, .38 x .25, F/M	
20477738	Coupling, .25 x .38, F/F		72133224	Bushing, .38 x .25, M/F	
20477730	Coupling, .25 x .56, F/F		72133183	Bushing, .56 x .25, F/M	
20477660	Coupling, .38 x .38, F/F		72133232	Bushing, .56 x .25, M/F	
20477709	Coupling, .38 x .56, F/F		72133209	Bushing, .56 x .38, F/M	
20477685	Coupling, .56 x .56, F/F		72133250	Bushing, .56 x .38, M/F	
		UHP Bulkhead Coupling			UHP Cross
20464737	Bulkhead Coupling, .38 x .38, F/F		20452971	Cross, .25	
20453271	Bulkhead Coupling, .38 x .56, F/F		20452968	Cross, .38	
20455413	Bulkhead Coupling, .56 x .56, F/F		20453115	Cross, .56	
		UHP Elbow			UHP Tee
20455821	Elbow, .25 x .25, 90D		20455824	Tee, .25	
20455809	Elbow, .38 x .38, 90D		20455812	Tee, .38	
20455377	Elbow, .56 x .56, 90D		20455374	Tee, .56	

Table 12-41
Ultra-High Pressure Fitting and Valve Assemblies

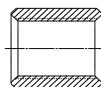
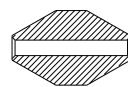
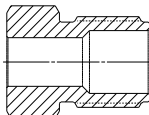

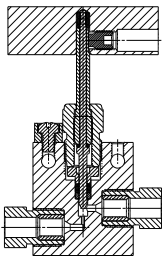
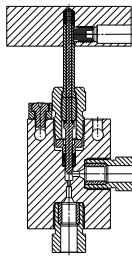
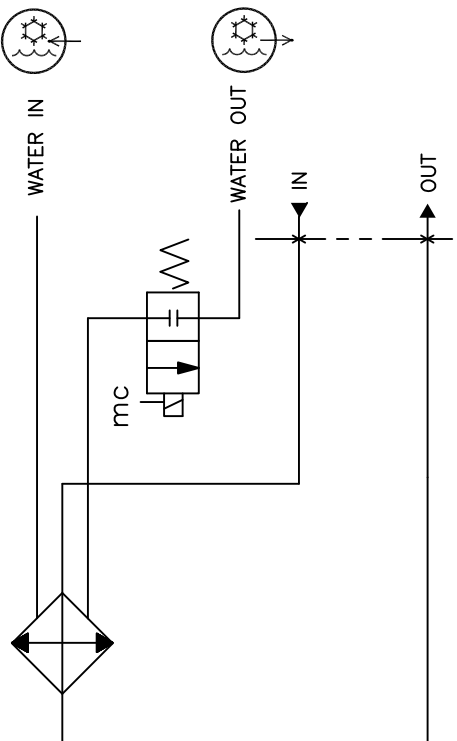
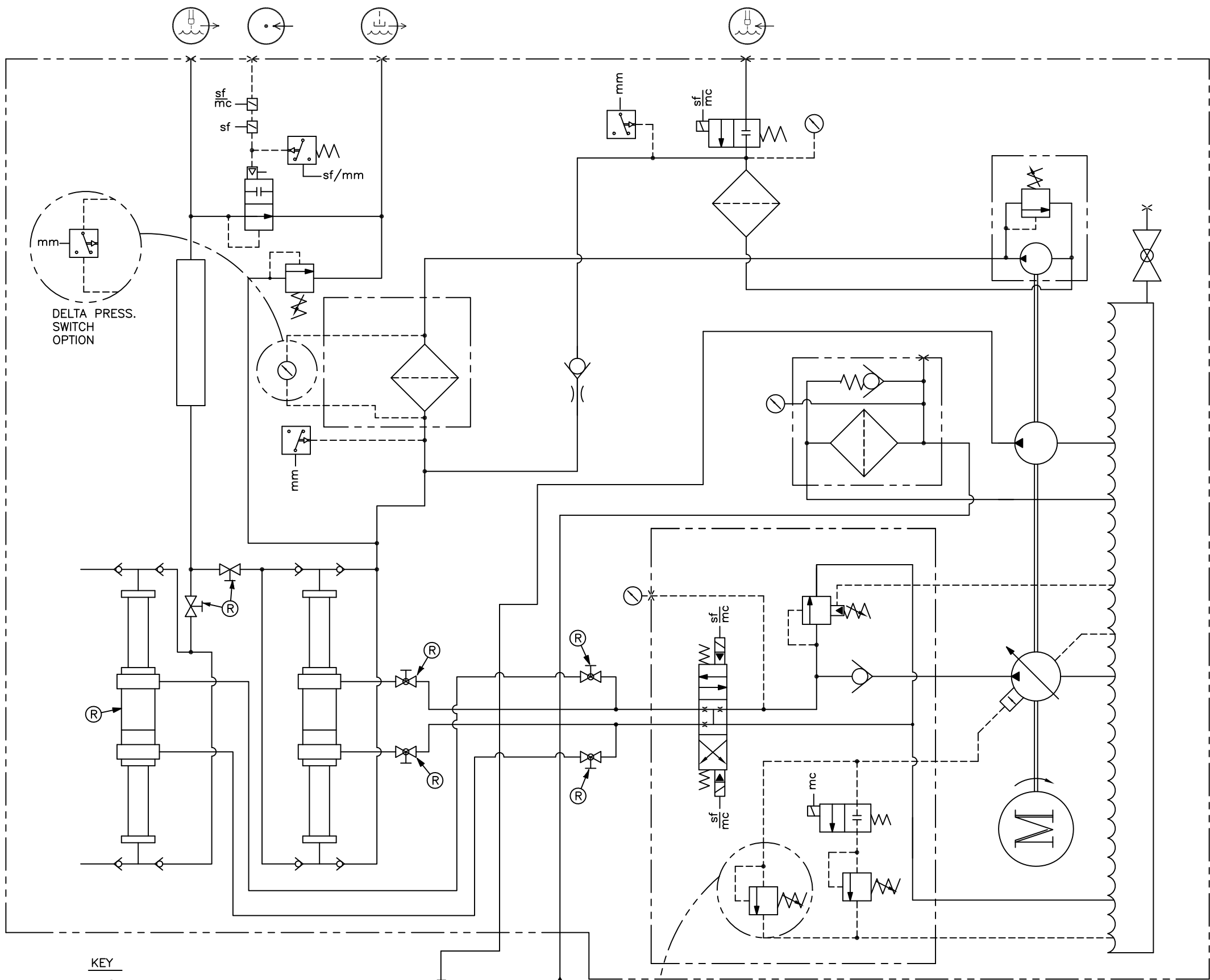
Part			Part		
Number	Description		Number	Description	
UHP Collar			UHP Adapter Cone		
20452959	Collar, .25		72133266	Adapter Cone, .25	
20452965	Collar, .38		72122072	Adapter Cone, .38	
20453124	Collar, .56		72133349	Adapter Cone, .56	
UHP Gland			UHP Plug		
20452962	Gland, .25		20453130	Plug, .25	
20452956	Gland, .38		20453136	Plug, .38	
20453121	Gland, .56		20453127	Plug, .56	

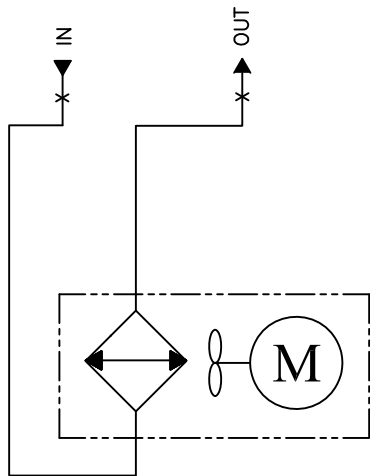
Table 12-41
Ultra-High Pressure Fitting and Valve Assemblies

Part Number	Description		Part Number	Description	
		2-Way Straight Valve			2-Way Angle Valve
20467981	2 Way Straight, .25		20468610	2 Way Angle, .25	
20468568	2 Way Straight, .35		20468593	2 Way Angle, .38	
20468014	2 Way Straight, .56		20477836	2 Way Angle, .56	

REVISIONS			
NO	DESCRIPTION	DATE	APPROVED
-	----	----	----



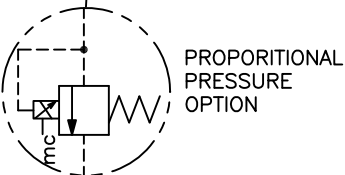
OPTION (1)
OIL/WATER HEAT EXCHANGER



OPTION (2)
OIL/AIR HEAT EXCHANGER

- KEY
- Ⓡ = REDUNDANT INTENSIFIER COMPONENTS (OPTION)
 - mc = MACHINE CONTROL
 - sf = SAFETY FUNCTION
 - sf mc = SAFETY FUNCTION HAS PRIORITY OVER MACHINE CONTROL
 - mm = MACHINE MONITORED

OPTIONS

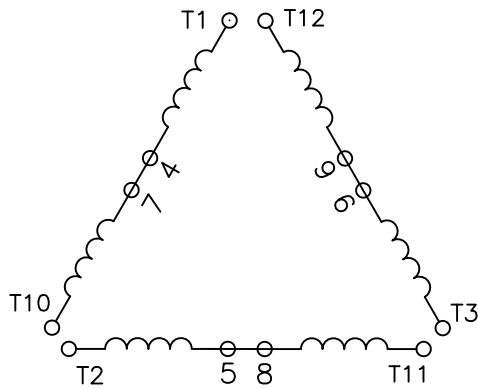


PROPORTIONAL
PRESSURE
OPTION

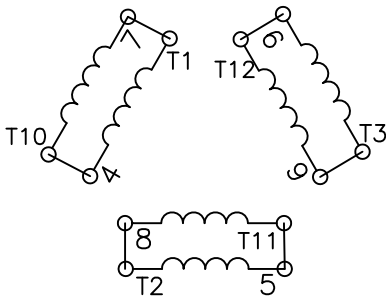
Copyright © 2003 KMT Waterjet Systems All Rights Reserved	PROPRIETARY NOTICE	STANDARD TOLERANCES	GD&T TO ASME Y14.5M 1994		TITLE SCHEMATIC-HYDRAULIC SLVI PMP W/OPTIONS	ACAD
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TITLE BLOCK REVISION: 2				SHEET 1 OF 1		

REVISIONS			
NO	DESCRIPTION	CHECKED	APPROVED
1	REMOVED -Q2, ADDED -Q3 ECR 1585	9/10/14	J.D.S.
2	ECR 1056 FERR/CRIMP/TEST	10/10/14	J.D.S.
4	DELETED NOTE #3 PER ECR 1802	10/29/15	J.D.S.
5	ADDED RE-WRITTEN NOTE #3 PER ECR_3137	1/18/16	J.D.S.
6	REVISED NOTE #4 ECR 3209	2/18/16	J.D.S.

NOTE 1: MOTOR TERMINATIONS



HIGH VOLTAGE TERMINATION



LOW VOLTAGE TERMINATION

NOTE 2:

SET OVERLOAD ACCORDING TO HP/KW
iΔA CURRENT VALUE.
(SEE TABLE 1, SHEET 4)

NOTE 3:

JUMPERS INSTALLED IN REMOTE
CONNECTOR. IF REMOTE FUNCTIONS
ARE TO BE USED, REPLACE
CONNECTOR BLOCKS WITH SUPPLIED
EMPTY BLOCKS.

NOTE 4:

SEE DWG 72182130 (SHEET 23 OF
THE DWG PACKAGE) FOR DETAIL OF
REMOTE CONNECTIONS.

NOTE 5:

EXCEPTED CIRCUIT. NOT DISCONNECTED
BY LOCAL DISCONNECT. WIRE TO BE
ORANGE (OR).

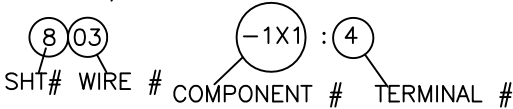
NOTE 6:

1. ALL 3φ WIRE WILL HAVE FERRULES,
AND MAINTAIN IP20 INSULATION
REMOVAL LENGTH.
2. INSULATION THHN OR MTW.
3. ALL 3φ WIRE WILL HAVE LABELING
FOLLOWING THE FORMAT IN NOTE 7:5.
4. FERRULES SHALL MEET DIN EN:46228, CRIMPING TOOLS SHALL MEET
DIN EN:60352-2, SAMPLE TESTING OF CRIMPING PROCESS SHALL MEET
DIN EN:60999 PART 1.

NOTE 7:

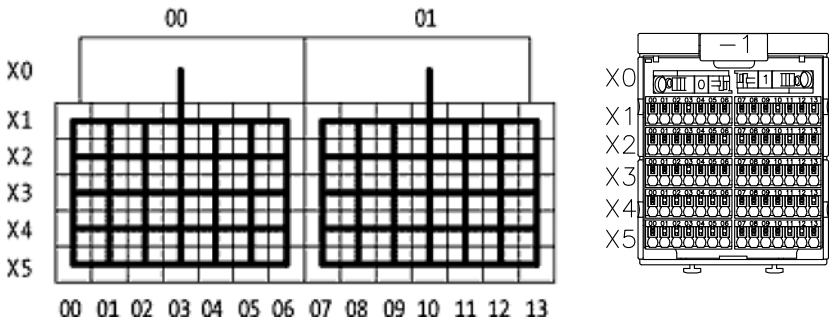
1. DC SUPPLY IS A 2-WIRE EARTHED
DESIGN.
2. DC CONTROL WIRE WILL BE 18 AWG
(1.0 mm²) MTW UNLESS MARKED
DIFFERENTLY.
3. DC POSITIVE WIRES WILL BE BROWN
(BN)
4. DC NEUTRAL WIRES WILL BE BLUE
(BU).
5. ALL WIRES WILL HAVE FERRULES
AND LABELS FOLLOWING THIS FORMAT:
xxxx/-XX.X:XX.

EXAMPLE:
803/-1X1:4



REVISIONS			
NO	DESCRIPTION	CHECKED	APPROVED
1	FIRST BUILD ECR REF ECR 875	9/10/14 J.D.S.	---
6	DELETED NOTE #4. 4.0 WAS 3.5 80% WAS 100% ECR 3209	2/18/16	J.D.S.

NOTE 8: TERMINAL BLOCK DESIGNATIONS



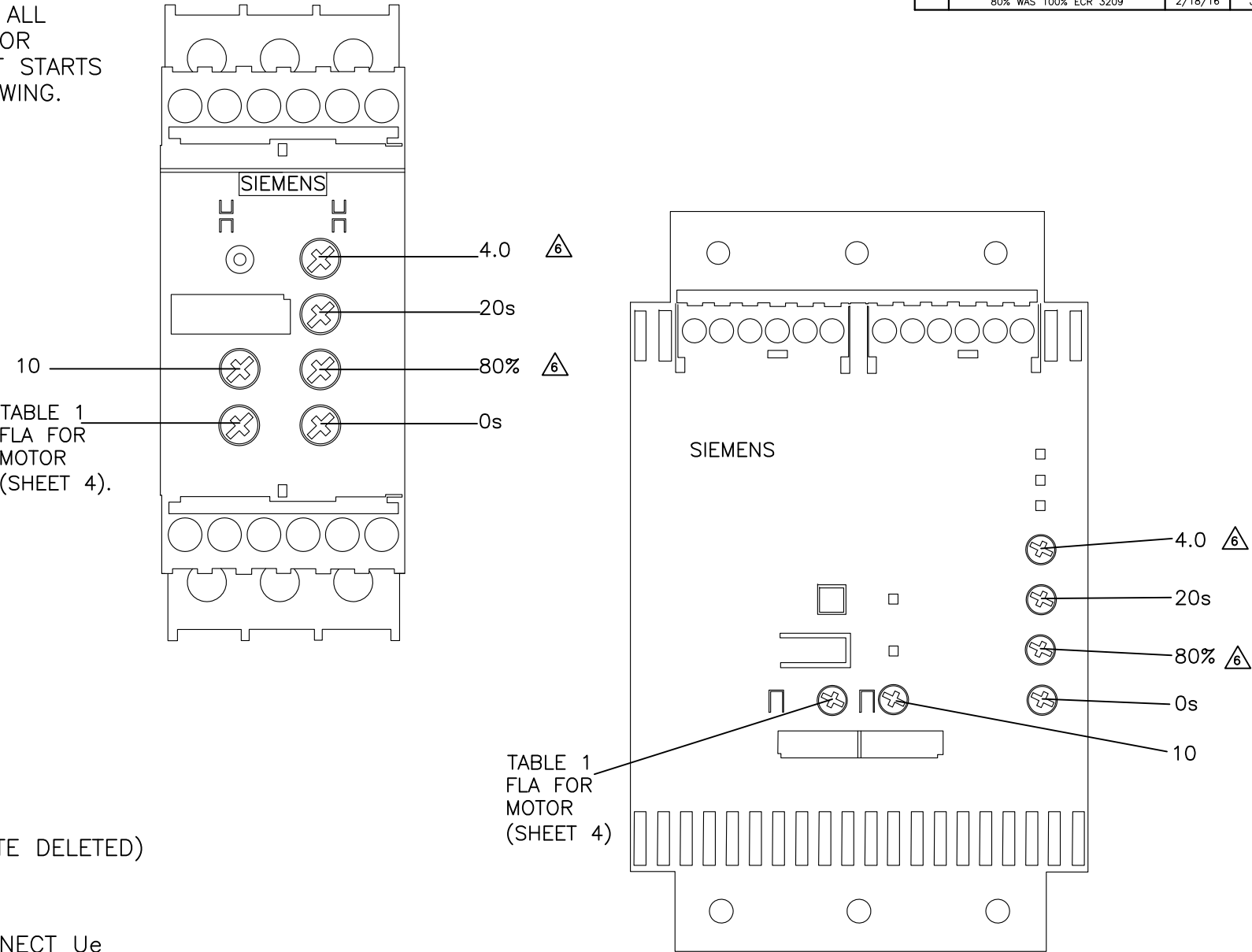
- NOTE 9:
1. PROTECTIVE CONDUCTORS WILL BE BICOLOR GN/YE, MIN SIZE 18 AWG (1.0 mm²).
 2. ALL LUGS, RING TERMINALS, AND DIN RAIL THAT ARE MOUNTED TO METAL INSERT MUST USE ANTI-CORRISION COMPOUND (NOALOX).
 3. ALL PROTECTIVE CONDUCTOR TERMINATIONS WILL BE: ONE WIRE, ONE TERMINATING POINT.
 4. ENCLOSURE SUB-PLATE IS PART OF THE PROTECTIVE BONDING CIRCUIT. IEC 60204-1:8.2.1

- NOTE 10:
1. SAFETY FUNCTION RELAY CONTACTS RATED AT 230VAC 4A, 24VDC 6A.

NOTE 11: CROSS REFERENCE NUMBERS PREFIXED WITH SENSOR SCHEMATIC 72156290D.

NOTE 12:
2 CONDUCTOR 18 AWG (1.0 mm²) 95% SHIELDED CABLE, WITH RD OUTER SHEATH MAX LENGTH 800M TOTAL. EXTERNAL OF PROTECTIVE ENCLOSURES SAFETY FUNCTION CABLES REQUIRES CROSS CHANNEL FAULT DETECTION IN CASE OF DAMAGE TO CABLING.

NOTE 13: SET ALL PARAMETERS FOR 3RW40XX SOFT STARTS TO THE FOLLOWING.

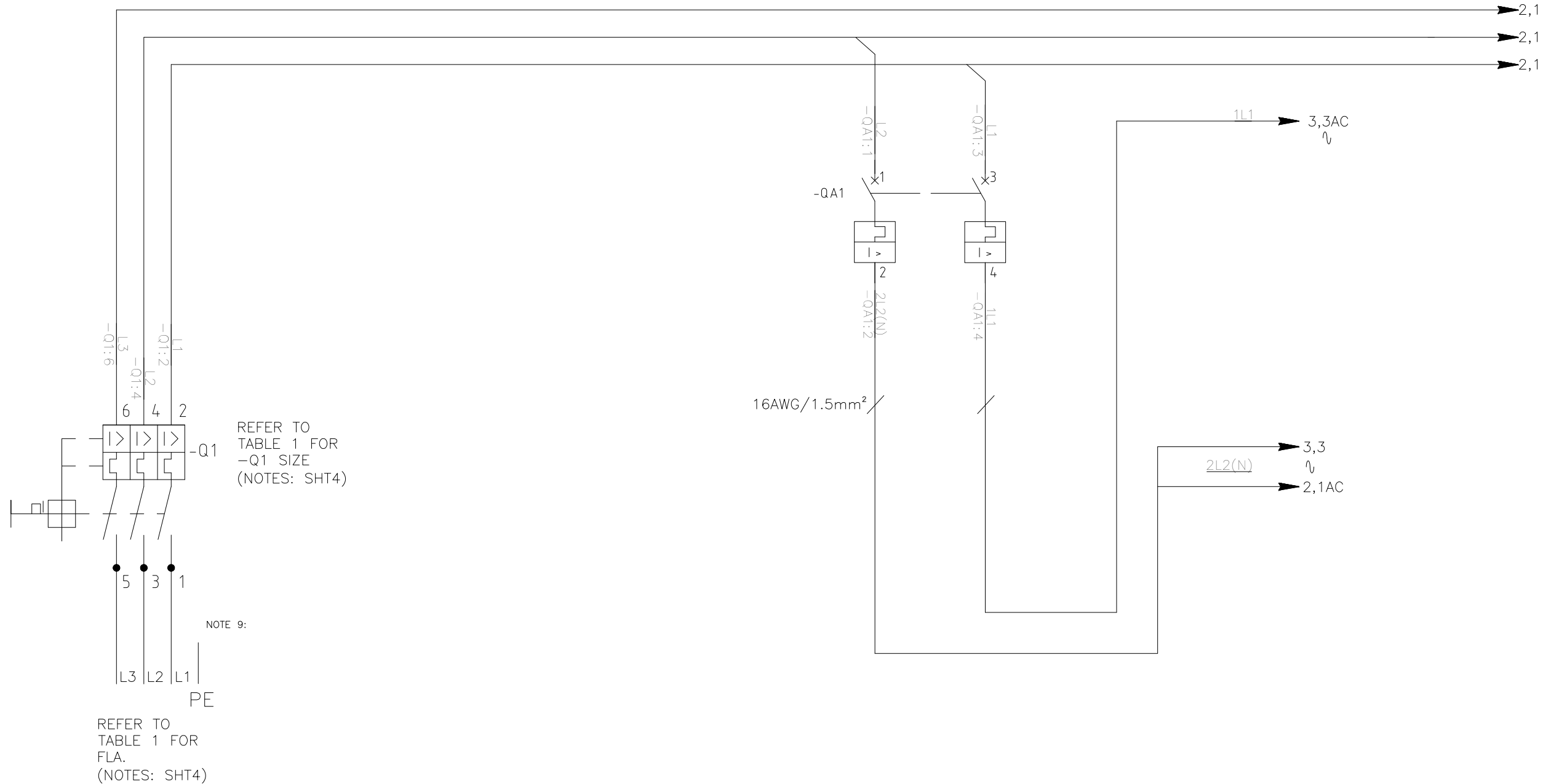


NOTE 14: (NOTE DELETED)

NOTE 15: CONNECT U_e SPECIFIED BY THE COIL of -K20 OR -G2.

NOTE 16: TRANSFORMER TERMINATIONS
PRIMARY VOLTAGE
H6 = 550 / 575 / 600 VAC
H5 = 440 / 460 / 480 VAC
H4 = 380 / 400 / 415 VAC
H3 = 220 / 230 / 240 VAC
H2 = -- / 200 / 208 VAC

REVISIONS			
NO	DESCRIPTION	DATE	APPROVED
1	ECR 875 FIRST BUILD	9-10-14	J.D.S.
2	CLARIFICATION ECR_3209	2-15-16	J.D.S.

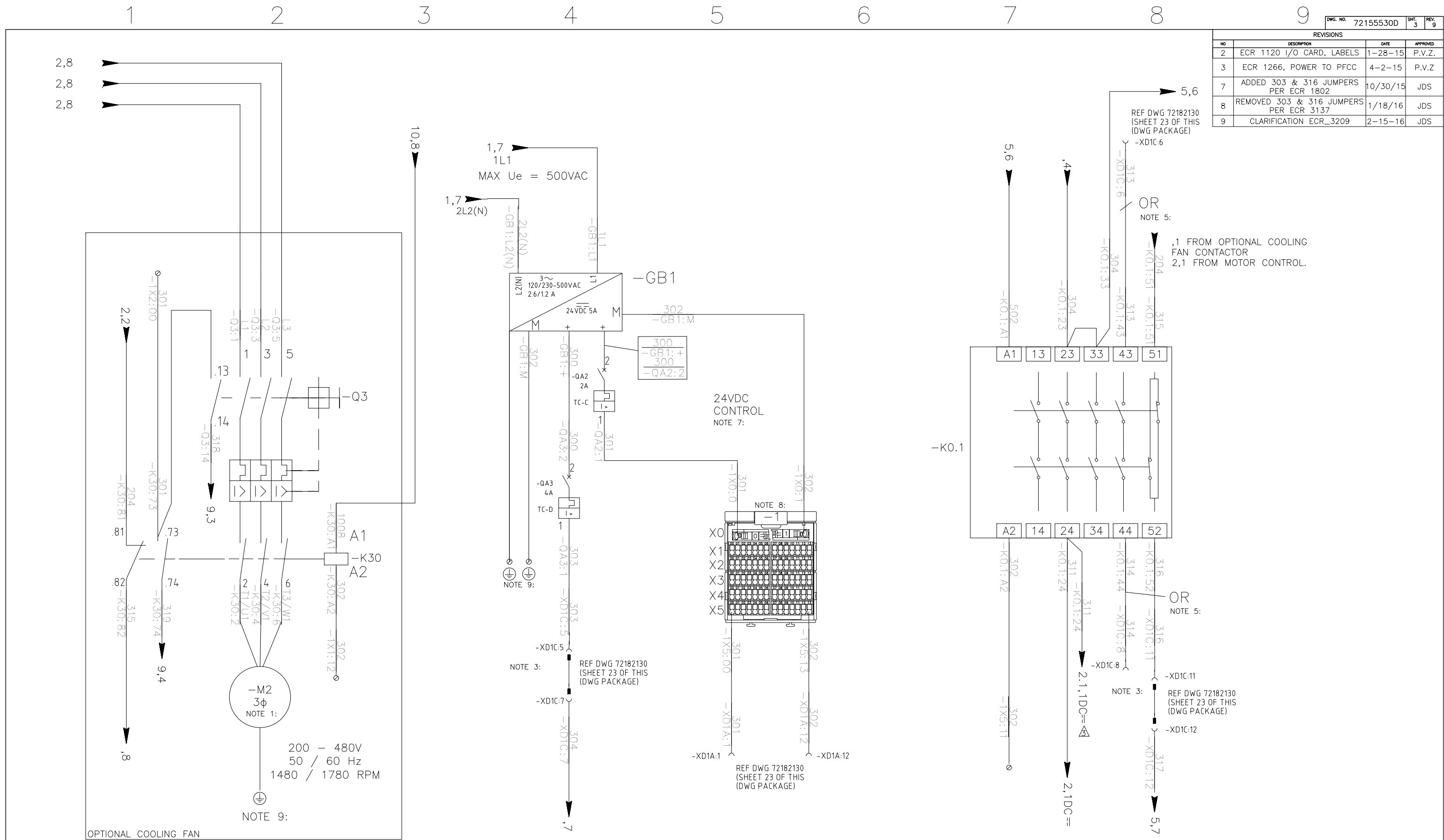


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					SCALE: —	TITLE BLOCK REVISION: 2	SHEET 1 OF 15

—

NEXT ASSEMBLY

		DWG. NO.	72155530D	SMT.	3	REV.	9
REVISIONS							
NO	DESCRIPTION	DATE		APPROVED			
2	ECR 1120 I/O CARD, LABELS	1-28-15		P.V.Z.			
3	ECR 1266, POWER TO PFCC	4-2-15		P.V.Z			
7	ADDED 303 & 316 JUMPERS PER ECR 1802	10/30/15		JDS			
8	REMOVED 303 & 316 JUMPERS PER ECR 3137	1/18/16		JDS			
9	CLARIFICATION ECR_3209	2-15-16		JDS			



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DWG</td></tr><tr><td>MATERIAL</td><td>DRAWN BY & DATE</td></tr><tr><td>—</td><td>PVZ 4/4/14</td></tr><tr><td>HEAT TREAT</td><td>CHECKED BY & DATE</td></tr><tr><td>—</td><td></td></tr><tr><td>HARDNESS</td><td>ENG. APPROVAL & DATE</td></tr><tr><td>—</td><td>JDS 4/16/14</td></tr></table>	ALL DIMENSIONS IN INCHES [mm]	REF. DWG	MATERIAL	DRAWN BY & DATE	—	PVZ 4/4/14	HEAT TREAT	CHECKED BY & DATE	—		HARDNESS	ENG. APPROVAL & DATE	—	JDS 4/16/14	<div><div><div><div><div><div></div><div></div><div></div><div></div><div></div><div></div></div><div></div><div></div><div></div><div></div><div></div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> 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ALL DIMENSIONS IN INCHES [mm]	REF. DWG																	
MATERIAL	DRAWN BY & DATE																	
—	PVZ 4/4/14																	
HEAT TREAT	CHECKED BY & DATE																	
—																		
HARDNESS	ENG. APPROVAL & DATE																	
—	JDS 4/16/14																	

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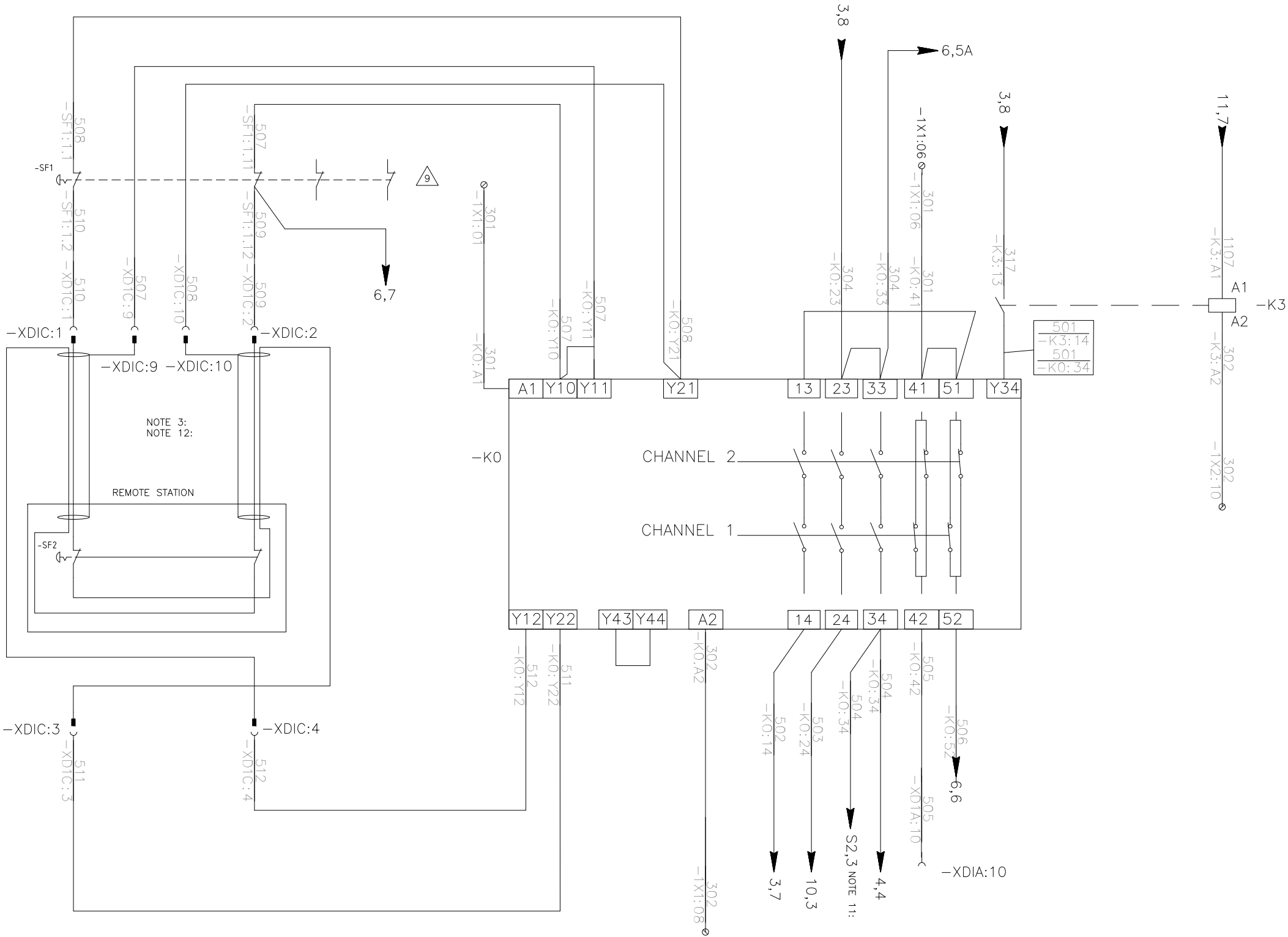
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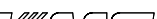

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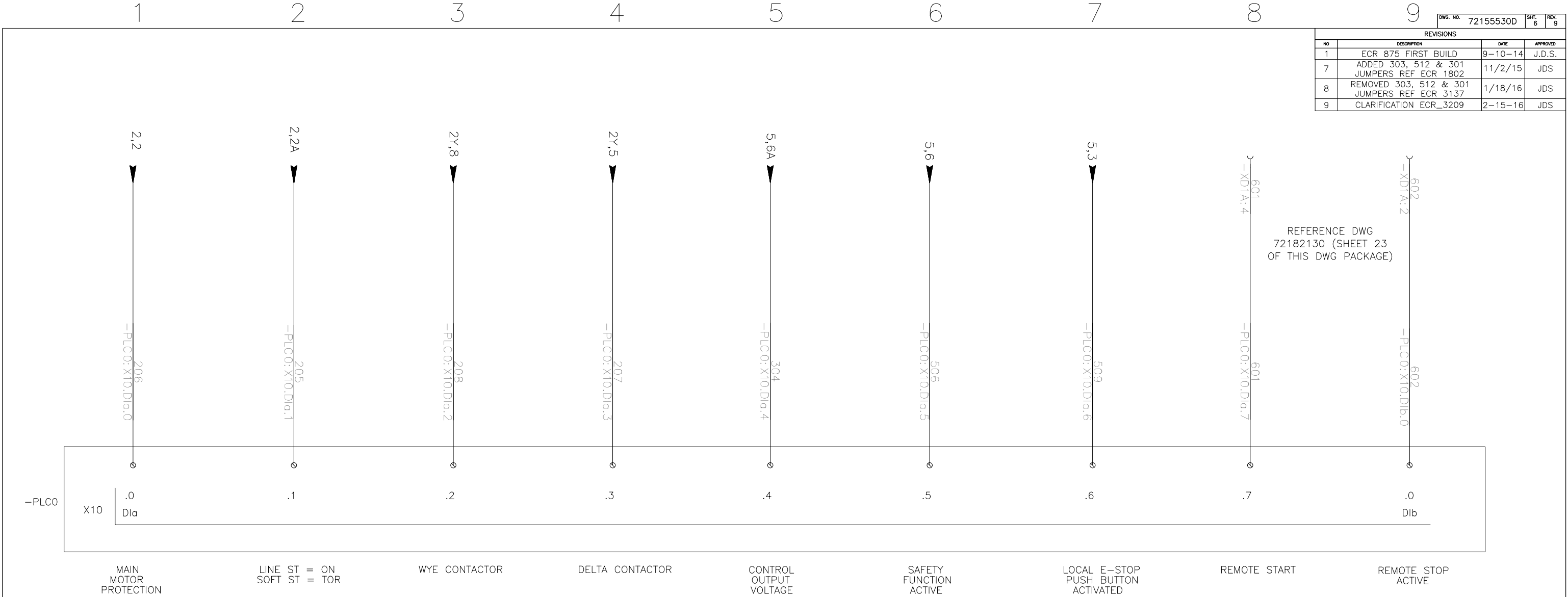
REVISIONS			
NO	DESCRIPTION	DATE	APPROVED
1	ECR 875 FIRST BUILD	9-10-14	J.D.S.
3	ECR 1266, REMOVED COVER SFR FROM THIS SHT,	4-2-15	P.V.Z
6	ECR 1739, REWIRED SFR TO ALLOW RESET FROM REMOTE	9-30-15	P.V.Z
7	ADDED JUMPERS 510, 512 & 316 PER ECR 1802	10/30/15	JDS
8	REMOVED JUMPERS 510, 512 & 316 PER ECR 3137	1/18/16	JDS
9	DELETED -PF1, ADDED CONTACTS TO -SF1 ECR_3209	2-15-16	JDS



2-CHANNEL E-STOP
(REF DWG 72182130)
(SHEET 23 OF THIS DWG PACKAGE)

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NEXT ASSEMBLY

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WARNING ! The export or reexport of this drawing or a product produced by this drawing is subject to U.S. Export Administration regulations and other applicable governmental restrictions or regulations.	This document contains confidential and trade secret information, is the property of KMT Waterjet Systems, and is given to the receiver in confidence. The receiver by reception and retention of the document accepts the document in confidence and agrees that, except as authorized in writing by KMT Waterjet Systems, it will (1) not use the document on any copy thereof or the confidential or the trade secret information therein; (2) not copy the document; (3) not disclose to others either the document or the confidential or trade secret information therein; and (4) upon completion of the need to retain the document, or upon demand return the document, all copies thereof, and all material copied therefrom.	UNLESS OTHERWISE NOTED: ALL DIAMETERS ON COMMON CENTERLINE COAXIAL TO .005 BREAK SHARP EDGES AND CORNERS .015 SURFACE FINISH — ✓ <u>STANDARD TOLERANCES</u> X.X = ±.063 X.XX = ±.015 X.XXX = ±.005 ANGLE = ±2°	ALL DIMENSIONS IN INCHES [mm]	REF. DWG	DRAWN BY & DATE PVZ 4/4/14	 DWG. NO. 72155530D	SCHEM—ELEC SLVI	REV. 9
		MATERIAL —	CHECKED BY & DATE	HEAT TREAT —				
		HARDNESS —	ENG. APPROVAL & DATE JDS 4/16/14	THIRD ANGLE PROJECTION				
		SCALE: —		TITLE BLOCK REVISION: 2				



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ALL DIAMETERS ON COMMON CENTERLINE COAXIAL TO .005
BREAK SHARP EDGES AND CORNERS .015
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STANDARD TOLERANCES
X.X = ±.063
X.XX = ±.015
X.XXX = ±.005
ANGLE = ±2°

GD&T TO ASME Y14.5M 1994

ALL DIMENSIONS IN INCHES [mm]

MATERIAL -

HEAT TREAT -


HARDNESS -

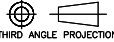
REF. DWG

DRAWN BY & DATE
PVZ
4/4/14

CHECKED BY & DATE

ENG. APPROVAL & DATE
JDS
4/16/14



THIRD ANGLE PROJECTION

SCALE: -

TITLE

SCHEM-ELEC SLVI

DWG. NO.
72155530D

REV.
9

TITLE BLOCK REVISION: 2

SHEET 6 OF 15

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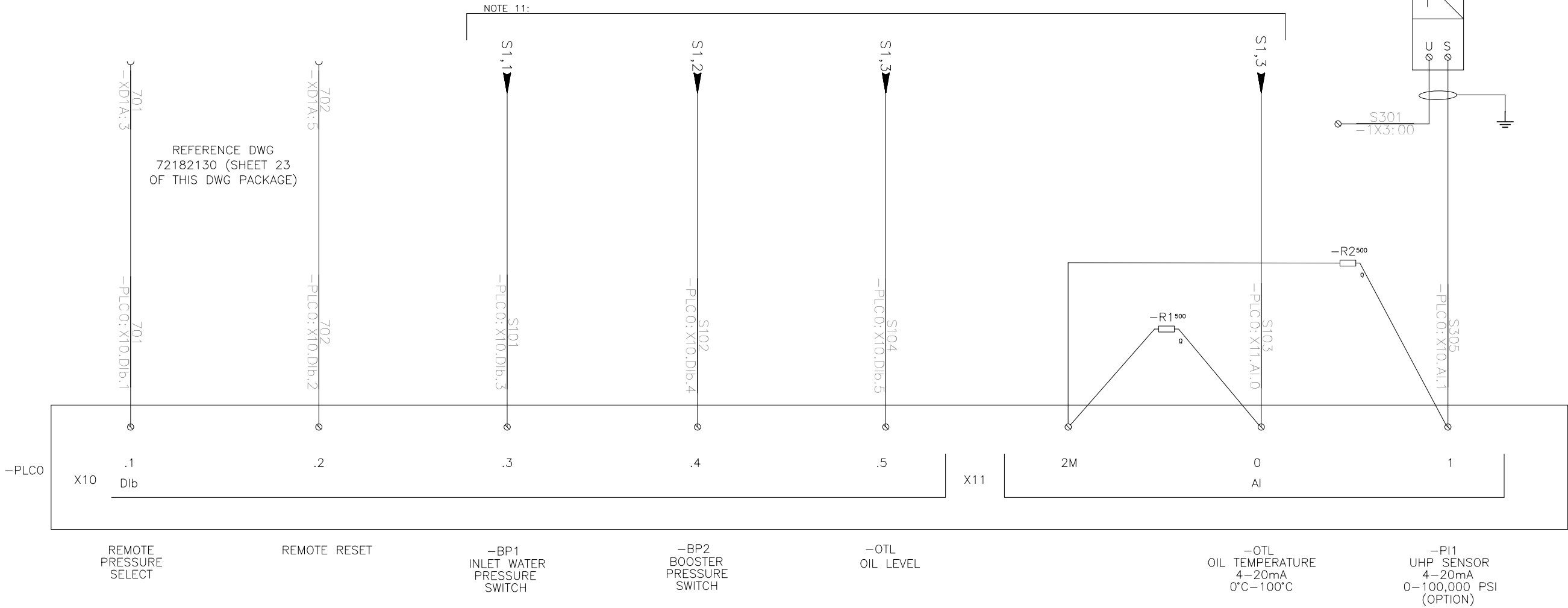
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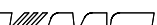
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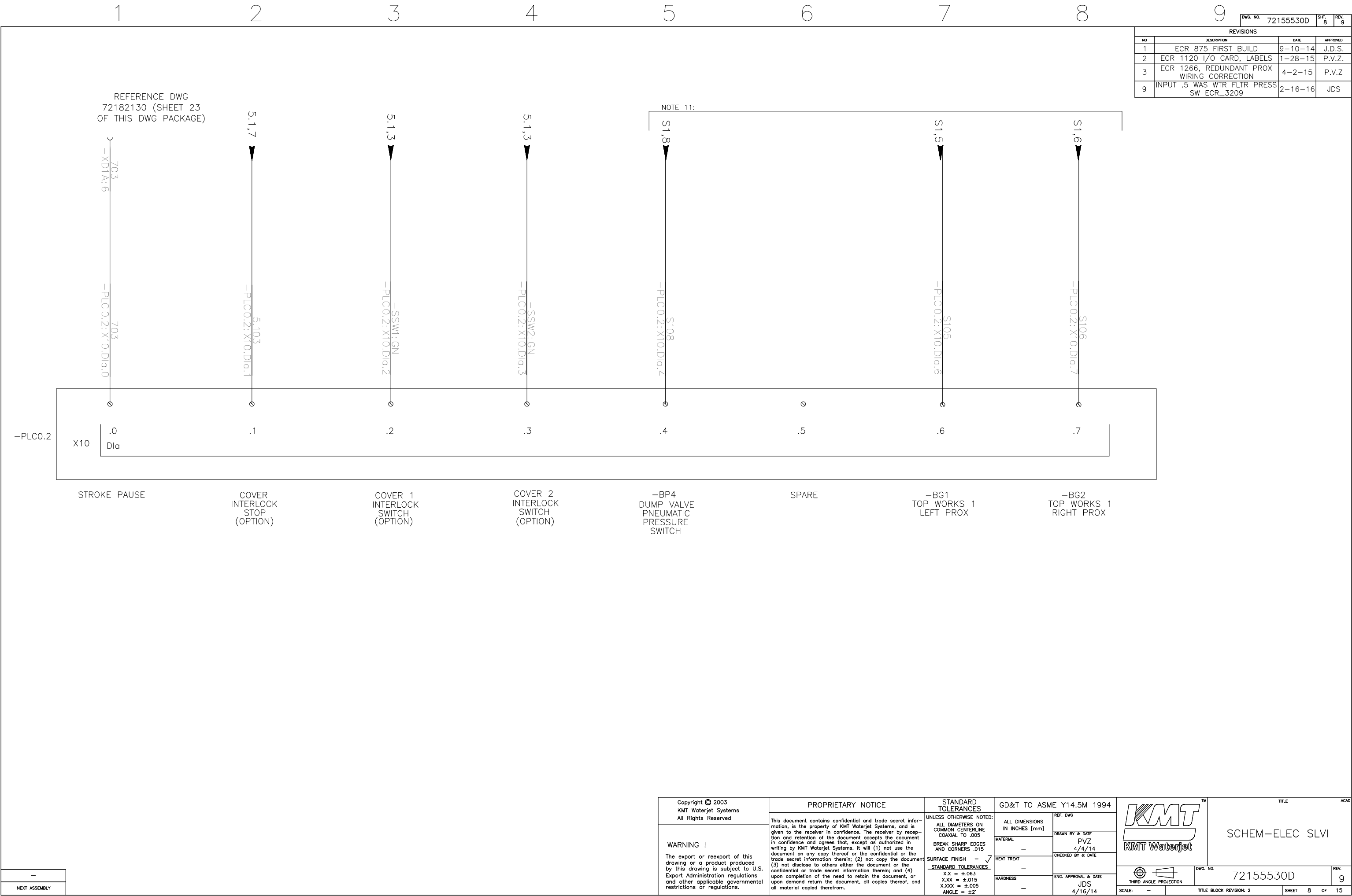
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REVISIONS			
NO	DESCRIPTION	DATE	APPROVED
1	ECR 875 FIRST BUILD	9-10-14	J.D.S.
2	ECR 1120 I/O CARD, LABELS	1-28-15	P.V.Z.
3	ECR 1266, RECONFIG SFR TO PROVIDE A STOP COMMAND	4-2-15	P.V.Z.
9	CLARIFICATION ECR_3209	2-15-16	JDS

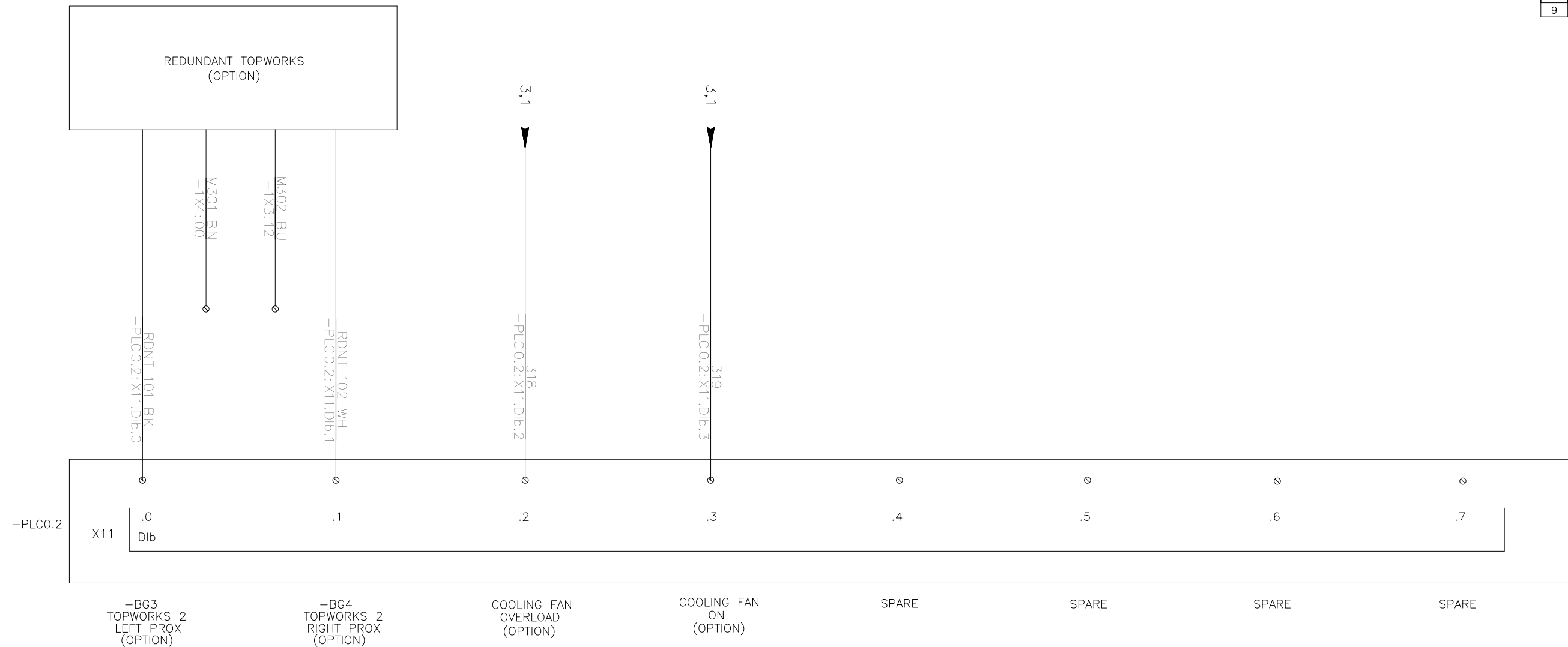


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NEXT ASSEMBLY

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		THIRD ANGLE PROJECTION				SCALE: —	TITLE BLOCK REVISION: 2	SHEET 7 OF 15

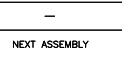


REVISIONS			
NO	DESCRIPTION	DATE	APPROVED
2	ECR 1120 I/O CARD, LABELS	1-28-15	P.V.Z.
9	CLARIFICATION ECR_3209	2-16-16	JDS



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WARNING ! The export or reexport of this drawing or a product produced by this drawing is subject to U.S. Export Administration regulations and other applicable governmental restrictions or regulations.	This document contains confidential and trade secret information, is the property of KMT Waterjet Systems, and is given to the receiver in confidence. The receiver by reception and retention of the document accepts the document in confidence and agrees that, except as authorized in writing by KMT Waterjet Systems, it will (1) not use the document on any copy thereof or the confidential or the trade secret information therein; (2) not copy the document; (3) not disclose to others either the document or the confidential or trade secret information therein; and (4) upon completion of the need to retain the document, or upon demand return the document, all copies thereof, and all material copied therefrom.	UNLESS OTHERWISE NOTED: ALL DIAMETERS ON COMMON CENTERLINE COAXIAL TO .005 BREAK SHARP EDGES AND CORNERS .015 SURFACE FINISH - <input checked="" type="checkbox"/> <u>STANDARD TOLERANCES</u> X.X = ±.013 X.XXX = ±.005 ANGLE = ±2°	ALL DIMENSIONS IN INCHES [mm] MATERIAL — HEAT TREAT — HARDNESS —	REF. DWG DRAWN BY & DATE PVZ 4/4/14 CHECKED BY & DATE ENG. APPROVAL & DATE JDS 4/16/14	
					SCALE: — TITLE BLOCK REVISION: 2 SHEET 9 OF 15

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NEXT ASSEMBLY



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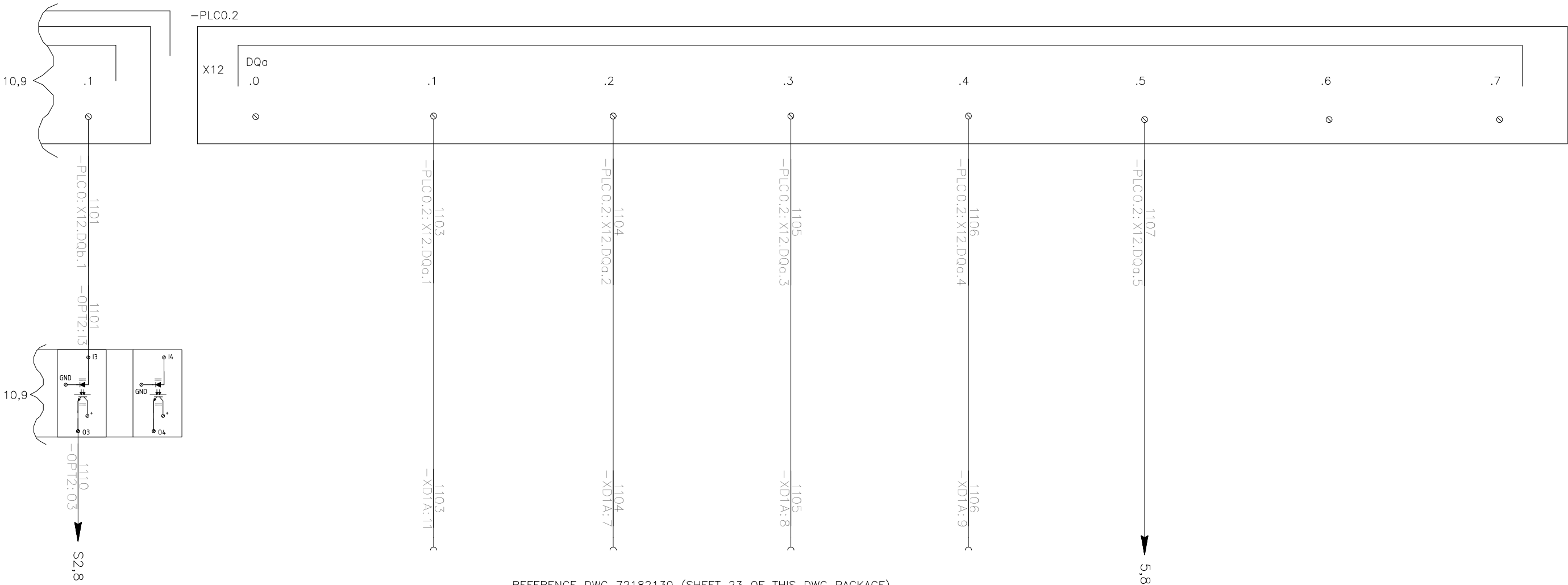
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DWG. NO. 72155530D				SHT. 11	REV. 9
REVISIONS					
NO	DESCRIPTION	DATE	APPROVED		
2	ECR 1120 I/O CARD, LABELS	1-28-15	P.V.Z.		
9	CLARIFICATION ECR_3209	2-16-16	JDS		



NOTE 11:

DUAL
PRESSURE
VALVE

SPARE

REMOTE
WHITE
LIGHT

REMOTE
GREEN
LIGHT

REMOTE
YELLOW
LIGHT

REMOTE
RD
LIGHT

SAFETY
FUNCTION
RESET RELAY

SPARE

SPARE

REFERENCE DWG 72182130 (SHEET 23 OF THIS DWG PACKAGE)

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NEXT ASSEMBLY

Copyright © 2003 KMT Waterjet Systems All Rights Reserved	PROPRIETARY NOTICE	STANDARD TOLERANCES	GD&T TO ASME Y14.5M 1994			TITLE SCHEM—ELEC SLVI	ACAD
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DWG. NO.		72155530D	SHT.	12	REV.	9
REVISIONS						
NO	DESCRIPTION			DATE	APPROVED	
2	ECR 1120 I/O CARD, LABELS			1-28-15	P.V.Z.	
9	CLARIFICATION ECR_3209			2-16-16	JDS	

—PLC0.2



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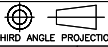
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NEXT ASSEMBLY

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		SCALE: —		TITLE BLOCK REVISION: 2		SHEET 12 OF 15	

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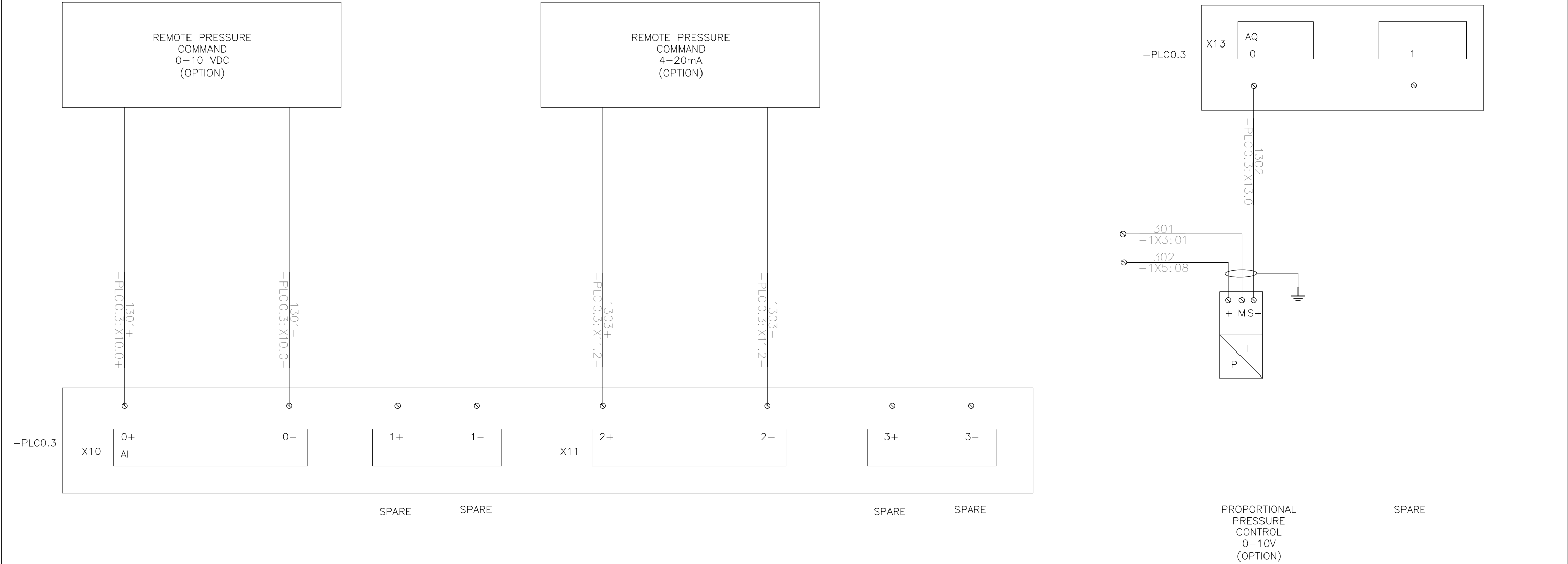
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DWG. NO.	72155530D	SHT.	13	REV.	9
REVISIONS					
NO	DESCRIPTION	DATE	APPROVED		
2	ECR 1120 I/O CARD, LABELS	1-28-15	P.V.Z.		
3	ECR 1266 REMOVED PUMP 2 PROPORTIONAL VALVE, ADDED CURRENT INPUT FOR CUSTOMER REMOTE INPUT OPTION.	4-7-15	P.V.Z.		
9	CLARIFICATION ECR_3209	2-17-16	JDS		

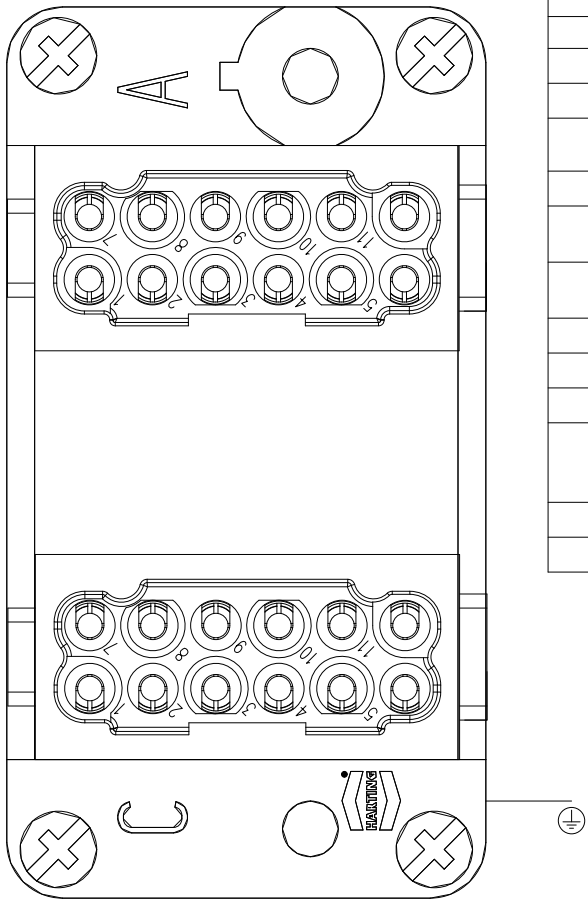


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NEXT ASSEMBLY

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		THIRD ANGLE PROJECTION		DWG. NO.		72155530D	REV.	9
		THIRD ANGLE PROJECTION		DWG. NO.		72155530D	REV.	9
THIRD ANGLE PROJECTION		DWG. NO.	72155530D	REV.	9	TITLE BLOCK REVISION: 2		SHEET 13 OF 15

REVISONS			
NO	DESCRIPTION	DATE	APPROVED
1	ECR 875 FIRST BUILD	9-10-14	J.D.S.
2	ECR 1120 I/O CARD, LABELS	1-28-15	P.V.Z.
5	INVERTED CONNECTOR TO MATCH HARDWARE, ECR1585	8-10-15	P.V.Z.

FEMALE
BULKHEAD
CONNECTOR




-XD1A		
PIN	SIGNAL NAME	WIRE NUMBER
1	L+	301/-XD1A:1
2	STOP	602/-XD1A:2
3	PRESSURE SELECT	701/-XD1A:3
4	START	601/-XD1A:4
5	RESET	702/-XD1A:5
6	STROKE PAUSE	703/-PL0.2:X10. Dia.0
7	GN LIGHT	1104/-XD1A:7
8	YE LIGHT	1105/-XD1A:8
9	RD LIGHT	1106/-XD1A:9
10	-KO SAFETY FUNCTION OFFLINE	505/-XD1A:10
11	WH LIGHT	1103/-XD1A:11
12	M	302/-XD1A:12

-XD1B		
PIN	SIGNAL NAME	WIRE NUMBER

-XD1C		
PIN	SIGNAL NAME	WIRE NUMBER
1	-KO CH 1 SENSOR SOURCE	510/-XD1C:1
2	-KO CH 2 SENSOR SOURCE	509/-XD1C:2
3	-KO CH1 SENSOR RETURN	511/-XD1C:3
4	-KO CH 2 SENSOR RETURN	512/-XD1C:4
5	LOCAL 24VDC SOURCE	303/-XD1C:5
6	REMOTE 24VDC SOURCE	313/-XD1C:6
7	LOCAL 24VDC SFEC RETURN	304/-XD1C:7
8	REMOTE 24VDC SFEC RETURN	314/-XD1C:8
9	-KO CH 1 SENSOR SOURCE SHIELD	507/-XD1C:9
10	-KO CH2 SENSOR SOURCE SHIELD	508/-XD1C:10
11	-KO MONITORED RESET LOOP SOURCE	316/-XD1C:11
12	-KO MONITORED RESET LOOP RETURN	317/-XD1C:12

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NEXT ASSEMBLY

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		ALL DIMENSIONS IN INCHES [mm]	DRAWN BY & DATE					THIRD ANGLE PROJECTION	TITLE BLOCK REVISION: 2	SHEET 14 OF 15
		MATERIAL	CHECKED BY & DATE							
		BREAK SHARP EDGES AND CORNERS .015	—	PVZ 4/4/14						
		SURFACE FINISH — ✓	HEAT TREAT	—						
		STANDARD TOLERANCES	HARDNESS	—						
		X.X = ±.063 X.XX = ±.015 X.XXX = ±.005 ANGLE = ±2°		ENG. APPROVAL & DATE JDS 4/16/14	72155530D	9				

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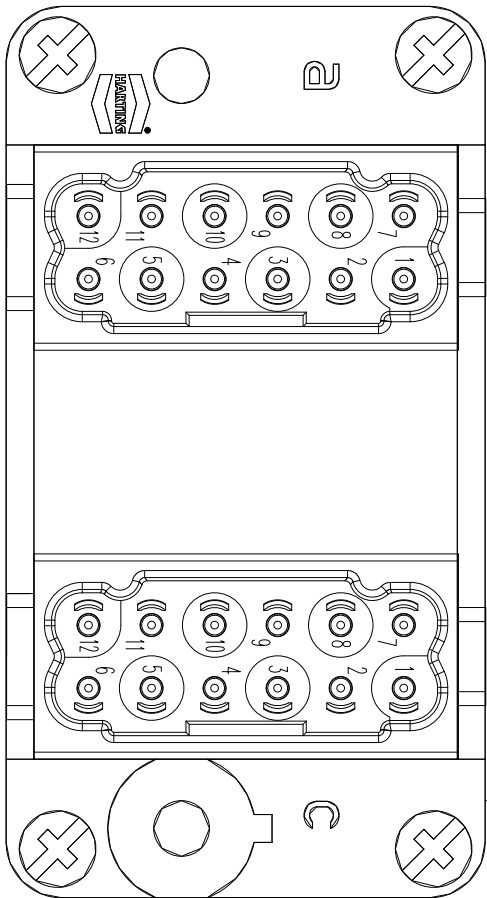
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MALE BULKHEAD CONNECTOR



-XD1A		
PIN	SIGNAL NAME	WIRE NUMBER
1	L+	JUMPER TO PIN 2
2	STOP	JUMPER FROM PIN 1
3	PRESSURE SELECT	
4	START	
5	RESET	
6	STROKE PAUSE	
7	GN LIGHT	
8	YE LIGHT	
9	RD LIGHT	
10	-KO SAFETY FUNCTION OFFLINE	
11	WH LIGHT	
12	M	

-XD1B		
PIN	SIGNAL NAME	WIRE NUMBER

-XD1C		
PIN	SIGNAL NAME	WIRE NUMBER
1	-KO CH 1 SENSOR SOURCE	JUMPER TO PIN 3
2	-KO CH 2 SENSOR SOURCE	JUMPER TO PIN 4
3	-KO CH1 SENSOR SINK	JUMPER FROM PIN 1
4	-KO CH 2 SENSOR SINK	JUMPER FROM PIN 2
5	LOCAL 24VDC SOURCE	JUMPER TO PIN 7
6	REMOTE 24VDC SOURCE	
7	LOCAL 24VDC SFC RETURN	JUMPER FROM PIN 5
8	REMOTE 24VDC SFC RETURN	
9	-KO CH 1 SENSOR SOURCE SHIELD	
10	-KO CH2 SENSOR SOURCE SHIELD	
11	-KO MONITORED RESET LOOP SOURCE	JUMPER TO PIN 12
12	-KO MONITORED RESET LOOP RETURN	JUMPER FROM PIN 11

CONNECTION INSTRUCTIONS

1. USE 16 TO 23 AWG STRANDED WIRE.
2. STRIP INSULATION 7/16".
3. DO NOT TWIST STRANDS OR ATTACH FERRULES.
4. INSERT SINGLE WIRE INTO TERMINAL.
5. PUSH LOCKING TAB IN WITH A SMALL SCREWDRIVER.
6. IF WIRE REMOVAL BECOMES NECESSARY, PRY LOCKING TAB UP, DO NOT TWIST.

TERMINATIONS FOR -XD1C CONNECTOR:

1. FOR STAND ALONE OPERATION, LEAVE JUMPERS IN MALE CONNECTOR. TO USE ANY OF THE REMOTE FUNCTIONS, REMOVE THE JUMPURED CONNECTION BLOCKS AND USE SUPPLIED EMPTY BLOCKS.
2. E-STOP PB OR REMOTE PB BOX CONNECTING LOCAL SAFETY FUNCTION SENSOR CIRCUIT (SFSC) CONNECT DUAL CHANNEL E-STOP PUSH BUTTON, PREFERENCE: MOUNTED MONITORED CONTACT SWITCHES.
 1. CHANNEL 1 NC SWITCH .11 TO -XD1C:1, NC SWITCH .12 TO -XD1C:3.
 2. CHANNEL 2 NC SWITCH .21 TO -XD1C:2, NC SWITCH .22 TO -XD1C:4.
 3. INSERT JUMPERS FROM -XD1C:5 TO -XD1C:7 AND FROM -XD1C:11 TO -XD1C:12.
 4. SHIELDS FOR THE SFSC CONNECTION CABLES TO -XD1C: 9, AND -XD1C:10
3. INTERFACING TWO SAFETY FUNCTION RELAYS(SFR).

CONNECTION OF PUMP SAFETY CONTROL VOLTAGE TO REMOTE SFR ENABLE CIRCUIT, (24VDC @ 4AMPS, MIN 18AWG 1.0MM² WIRE)

 1. INSERT JUMPERS FROM -XD1C:1 TO -XD1C:3 AND FROM -XD1C:2 TO -XD1C:4.
 2. CONNECT -XD1C:5 TO REMOTE SFR ENABLE CIRCUIT. (SEE NOTE 4B)
 3. REMOTE SFR TO -XD1C:7. (SEE NOTE 4B)

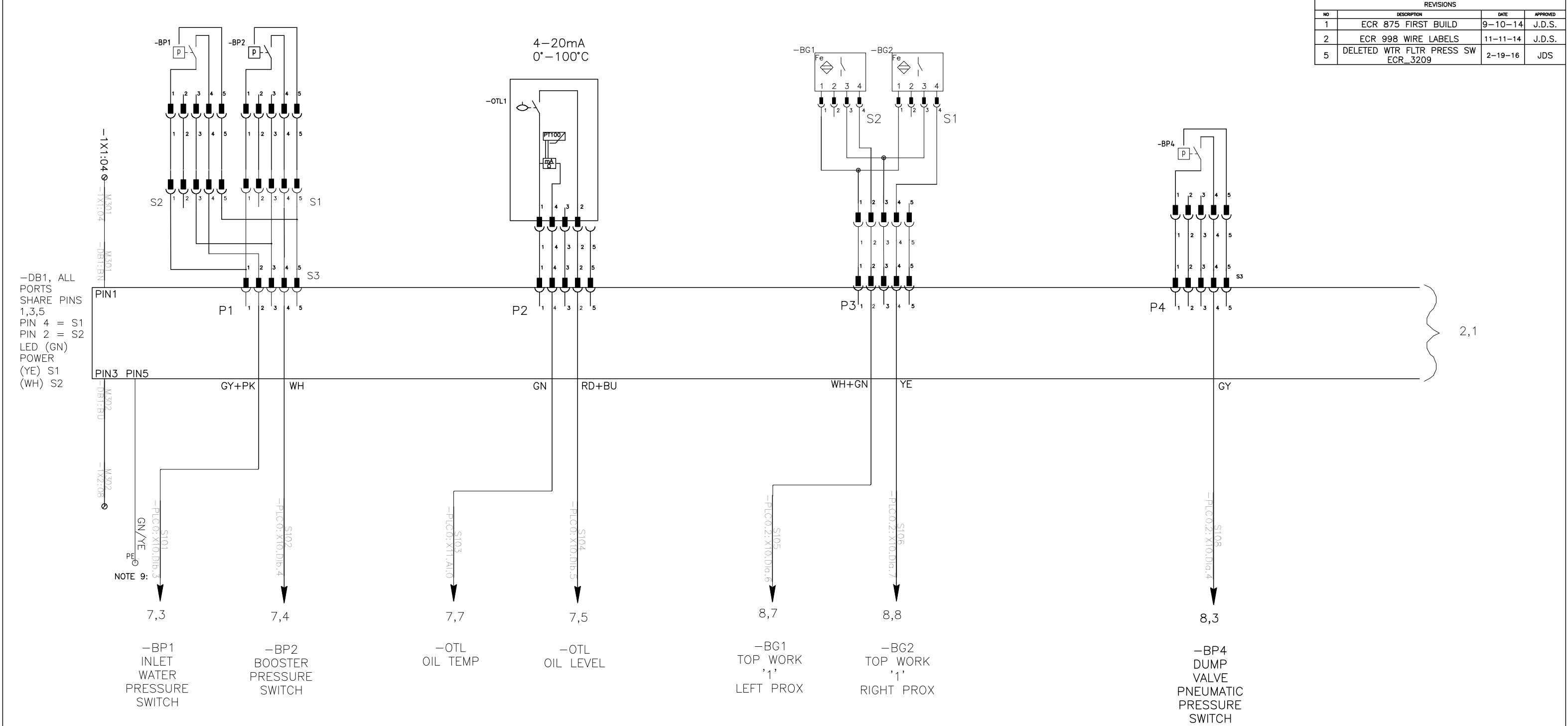
CONNECTION OF REMOTE SAFETY CONTROL VOLTAGE TO PUMP SFR ENABLE CIRCUIT; (24VDC @ 4AMPS MAX).

 1. SOURCE OF THE REMOTE DC CONTROL VOLTAGE TO -XD1C:6. (SEE NOTE 4C)
 2. RETURN OF THE REMOTE DC CONTROL VOLTAGE TO -XD1C:8. (SEE NOTE 4C)

PUMP CONTROLLED SAFETY CONTACTOR IN REMOTE SAFETY FUNCTION CIRCUIT, THE MONITORED RESET LOOP MUST BE CONNECTED TO SAFETY CONTACTOR N/C CONTACTS.

 1. SOURCE OF MONITORED RESET LOOP; -XD1C:11 TO SAFETY CONTACTOR N/C .11
 2. RETURN OF MONITORED RESET LOOP; SAFETY CONTACTOR N/C .12 TO -XD1C:12

REVISIONS			
NO	DESCRIPTION	DATE	APPROVED
1	ECR 875 FIRST BUILD	9-10-14	J.D.S.
2	ECR 998 WIRE LABELS	11-11-14	J.D.S.
5	DELETED WTR FLTR PRESS SW ECR_3209	2-19-16	JDS



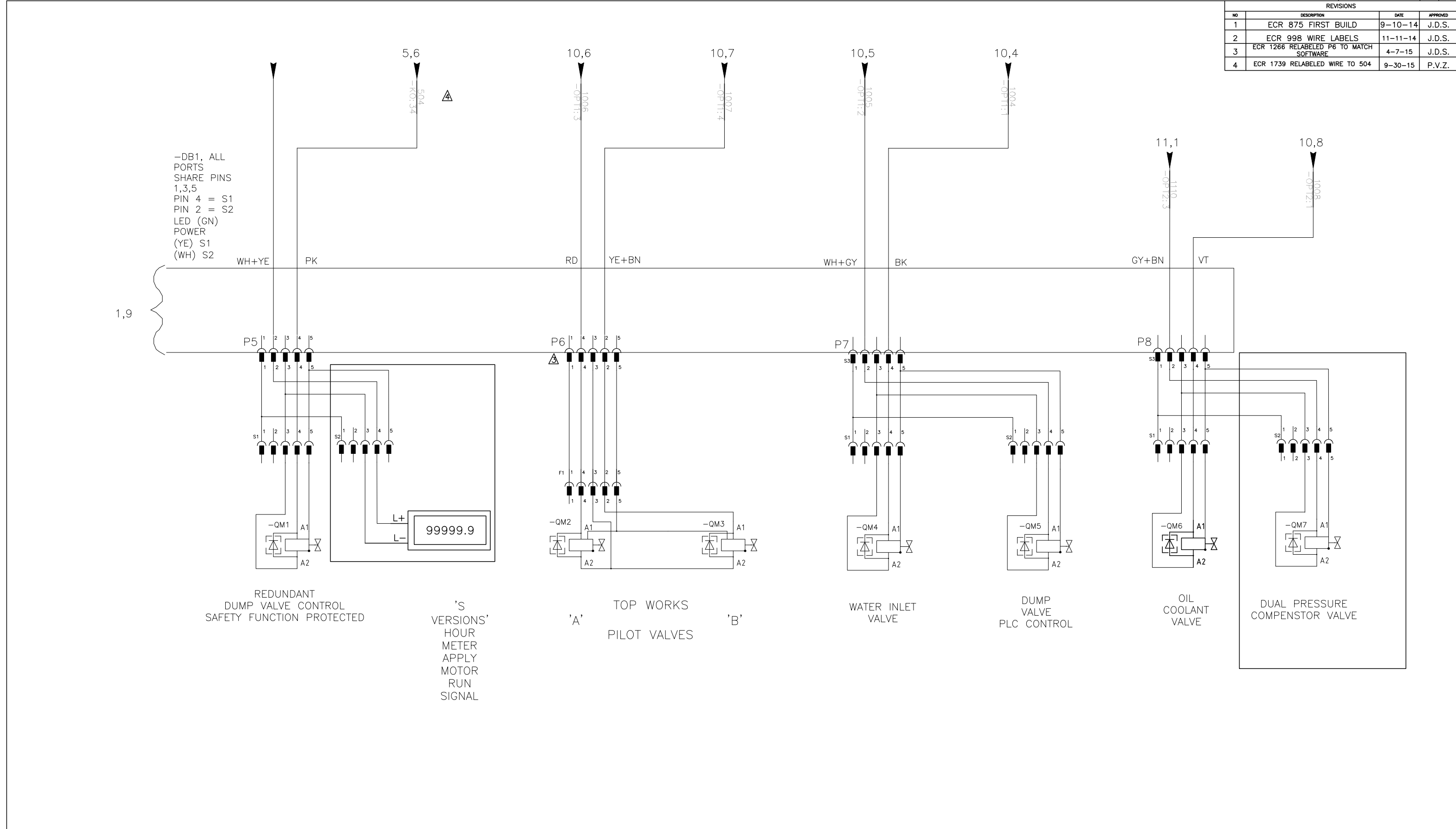
NOTE:

1. CROSS REFERENCE NUMBERS REFER TO MAIN ELECTRICAL SCHEMATIC.

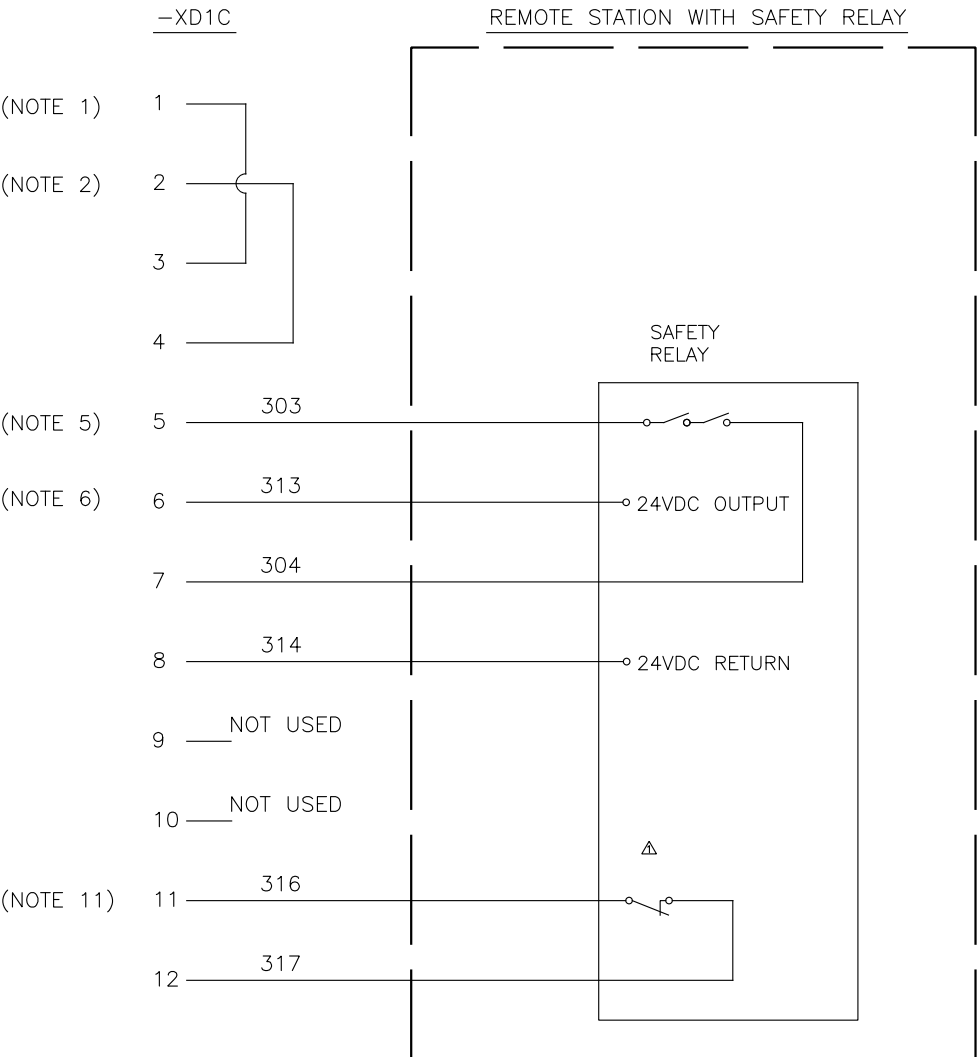
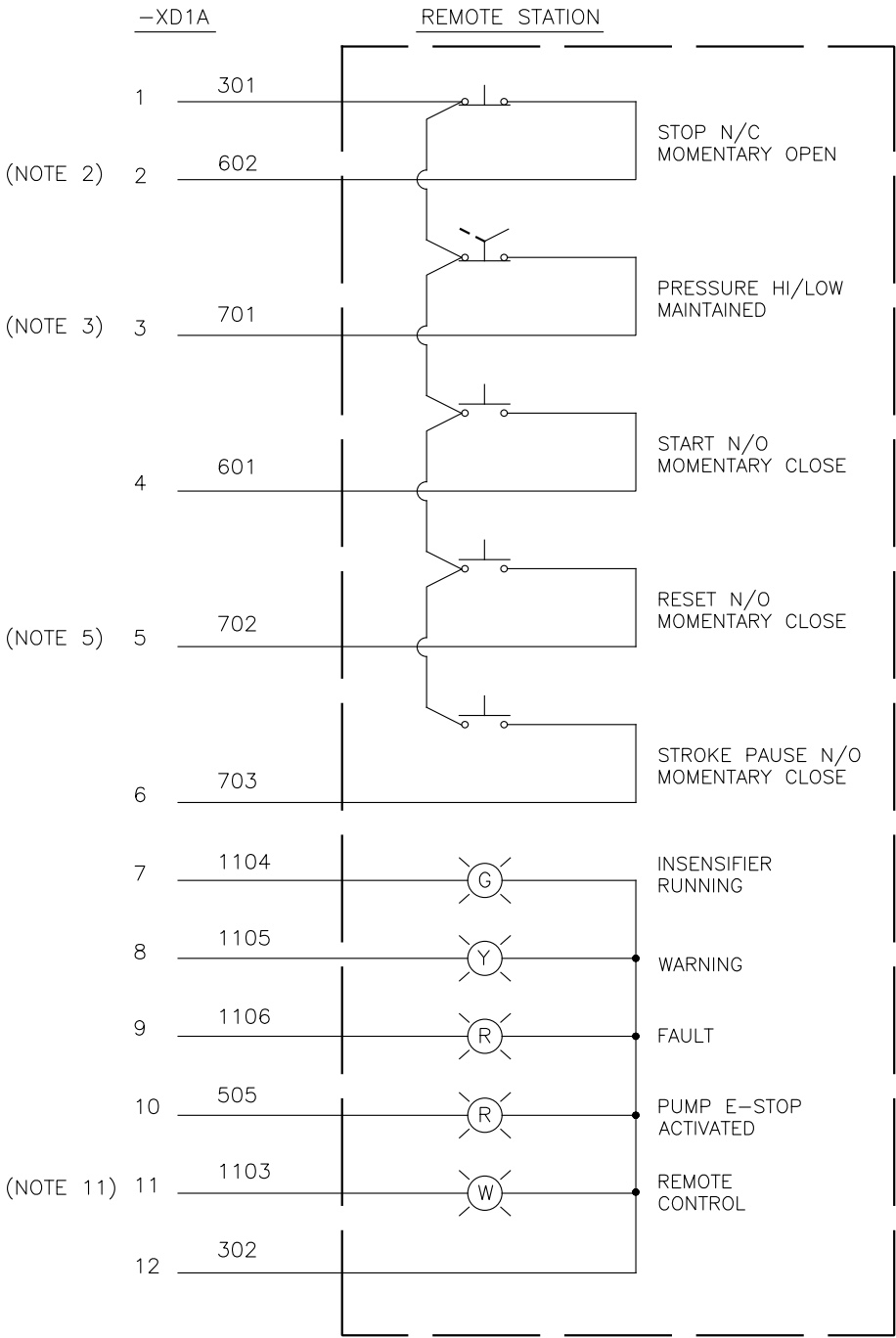
NOTE 9:

- PROTECTIVE CONDUCTORS WIRE WILL BE BICOLOR GN/YE, MIN SIZE 18AWG(1.0mm²).
- ALL LUGS, RING TERMINALS, AND DIN RAIL ARE TO BE MOUNTED WITH ANTI-CORROSION COMPOUND.
- ALL PROTECTIVE CONDUCTOR TERMINATIONS WILL BE: ONE WIRE, ONE TERMINATING POINT.
- ENCLOSURE SUB-PLATE IS PART OF THE PROTECTIVE BONDING CIRCUIT. IEC 60204-1:8.2.1

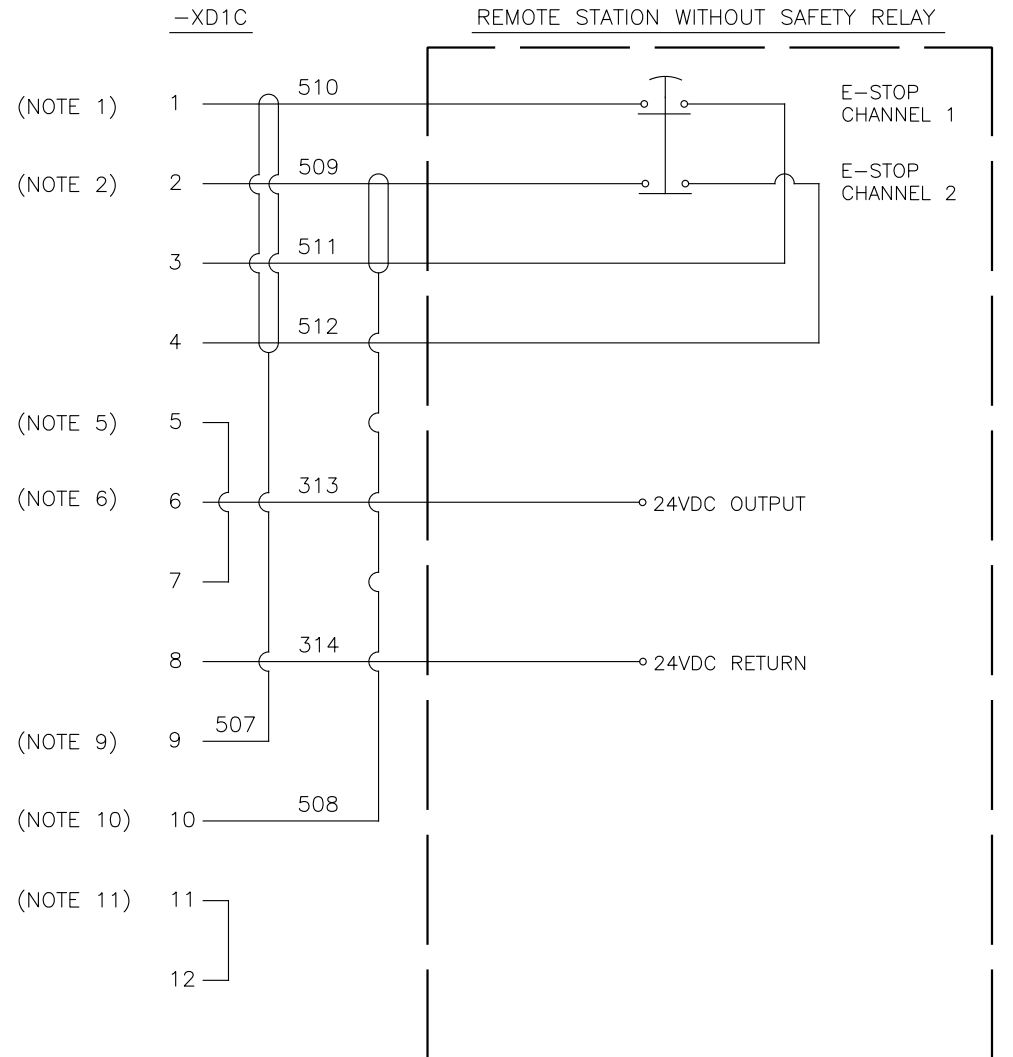
REVISIONS			
NO	DESCRIPTION	DATE	APPROVED
1	ECR 875 FIRST BUILD	9-10-14	J.D.S.
2	ECR 998 WIRE LABELS	11-11-14	J.D.S.
3	ECR 1266 RELABELED P6 TO MATCH SOFTWARE	4-7-15	J.D.S.
4	ECR 1739 RELABELED WIRE TO 504	9-30-15	P.V.Z.



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			ENG. APPROVAL & DATE J.D.S 4/17/14		THIRD ANGLE PROJECTION	DWG. NO. 72156290D		
			SCALE: —		TITLE BLOCK REVISION: 2	SHEET 2 OF 2		



- NOTES:
- JUMPER PIN 1 TO PIN 3.
 - JUMPER PIN 2 TO PIN 4.
 - REMOVE PIN 5 TO PIN 7 JUMPER TO USE REMOTE SAFETY RELAY TO INTERRUPT CONTROL POWER TO MOTOR STARTER.
 - USE PINS 6 (24V +) AND 8 (24V -) TO HAVE PUMP SAFETY RELAY IN SERIES WITH REMOTE STATION SAFETY RELAY COIL.
 - WHEN PUMP SAFETY RELAY IS TRIPPED, REMOTE SAFETY CIRCUIT WILL TRIP.
 - REMOVE PIN 11 TO PIN 12 JUMPER TO CONNECT REMOTE STATION SAFETY RELAY N.C. CONTACT IN SERIES WITH PUMP SAFETY RELAY RESET CIRCUIT.

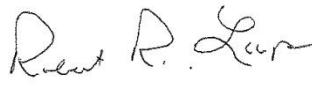



- NOTES:
- REMOVE PIN 1 TO PIN 3 JUMPER TO USE REMOTE E-STOP CHANNEL 1.
 - REMOVE PIN 2 TO PIN 4 JUMPER TO USE REMOTE E-STOP CHANNEL 2.
 - JUMPER PIN 5 TO PIN 7.
 - USE PINS 6 (REMOTE STATION 24V +) AND 8 TO HAVE PUMP SAFETY RELAY IN SERIES WITH REMOTE STATION E-STOP CIRCUIT. WHEN PUMP SAFETY RELAY IS TRIPPED, REMOTE STATION SAFETY CIRCUIT WILL BE OPEN.
 - OPTIONAL MONITORING OF REMOTE E-STOP CABLE SHIELD DETECTS DAMAGE TO THE CABLE.
 - OPTIONAL MONITORING OF REMOTE E-STOP CABLE SHIELD DETECTS DAMAGE TO THE CABLE.
 - JUMPER PIN 11 TO PIN 12.

- NOTES:
- REMOVE PIN 1 TO PIN 2 JUMPER TO USE REMOTE STOP.
 - REMOTE HI/LOW CONTROL CAN BE CONFIGURED AT THE PUMP HMI TO USE CLOSED CONTACT = HI OR CLOSED CONTACT = LOW.
 - WILL ONLY RESET A REMOTE STATION E-STOP.
 - WHITE LIGHT FLASHES WHEN PUMP IS IN REMOTE CONTROL MODE BUT MOTOR IS NOT READY TO START. WHITE LIGHT IS SOLID WHEN PUMP IS IN REMOTE CONTROL MODE AND MOTOR IS READY TO START.

Technology International Incorporated



Safety of Machinery – Electrical Equipment of Machines: Part 1 – General Requirements	
<p>Completed by:</p> <p>Robert R. Loop, A.S., B.S.</p> <p>Senior Consultant - Safety</p> <p>Technology International, Inc. (I²T)</p> <p>Satellite Office – Princeton, AL</p> <p>W www.techintl.com</p> <p>T ☎ (800) 810-9000 (Richmond, VA Office)</p> <p>F ☎ : 256-776-9847 C ☎ : 256-599-6124</p> <p>O ☎ 256-776-9847, E rloop@techintl.com</p>	<p>Signature:</p> 
Date of Issue	20 JAN 15
Testing Laboratory	Technology International Inc.
Address	11311 Business Centre Drive Suite A Richmond VA 23236 USA
Testing Location	635 W. 12 th Street Baxter Springs, KS 66713 USA
Manufacturer	KMT Waterjet Systems, Inc.
Address	Same as Testing Location
Standard	EN 60204-1:2006 EHSR 2006/42/EC
Test procedure	Test as Described in Document
Deviations	None
Non-standard test method	None
Type of test object	Water Intensifier
Trademark/Logo	
Model/type reference	SL6
Serial Number	001 assigned for test purposes
<p>Notes:</p>	



DECLARATION OF CONFORMITY
in accordance to directive 2006/42/EC on machinery

KMT Waterjet Systems
635 West 12th Street
Baxter Springs, KS 66713
USA

declares, that the STREAMLINE™ high pressure pump:

Model: _____ **Serial** _____ **Part Number:** _____
Number: _____

to which this declaration relates, **meets the essential health and safety requirements** and is in conformity with the relevant EU Directives listed below using the relevant section of the following EU standards:

Machine Directive 2006/42EG Annex 1

Council Directive of 17 May, 2006 on the approximation of laws of the member States relating to machinery.

EN ISO 12100:2010	Safety of Machinery-General Principles for Design-Risk Assessment and Risk Reduction
EN 60204-1:2006	Safety of Machinery-Electrical Equipment of Machines
EN ISO 4413:2010	Hydraulic Fluid Power-General Rules and Safety Requirements for Systems and their Components
EN ISO 13849-1:2008	Safety of Machinery-Safety related parts of control systems

EMC Directive 2004/108CE

EN 61000-6-4	Emission standard for industrial environments
EN 61000-6-2	Immunity standard for industrial environments


ECO Design of Energy Related Products 2009/125/EC

Electric Motors	Commission Regulation (EU) No 4/2014
-----------------	--------------------------------------

Authorized person within the European Community to compile the technical file:

Wolfgang Emrich, Hohe Strasse 4-6, 61231 Bad Nauheim Germany

Baxter Springs KS USA 2/10/16
(Place and Date of Issue)



(Compliance Engineer)

- ☒ Original Version of Declaration of Conformity
☐ Translated Version of Declaration of Conformity



DECLARATION OF INCORPORATION
in accordance to directive 2006/42/EC on machinery

KMT GmbH – KMT Waterjet Systems
Hohe Strasse 4-6
61231 Bad Nauheim
Germany

declares, that the intensifier with high pressure attenuator and hydraulic relief valve:

Model: _____ **Serial Number:** _____ **Part Number:** _____

to which this declaration relates, **meets the essential health and safety requirements** as a partly completed machinery.

The partly completed machinery must not be put into service until the relevant machinery into which it is to be incorporated has been declared in conformity with the essential requirements of the Machinery Directive 2006/42/EC.

The partly completed machinery conforms with the relevant EU Directives listed below using the relevant section of the following EU standards and other normative documents:

Machine Directive 2006/42EG Annex 1

Council Directive of 17 May, 2006 on the approximation of laws of the member States relating to machinery.

EN ISO 12100 Safety of Machinery-General Principles for Design-Risk Assessment and Risk Reduction

EMC Directive 2004/108CE

EN 61000-6-4 Emission standard for industrial environments

EN 61000-6-2 Immunity standard for industrial environments

ECO Design of Energy Related Products 2009/125/EC

Electric Motors Commission Regulation (EU) No 4/2014

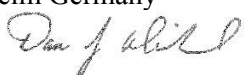
Once this equipment is integrated into the complete machine, the following steps need to be followed to ensure the complete machine conforms to the required EU standards:

1. Test the complete machine against EMC Directive 2004/108/EC and any local EMC regulations.
2. Complete a risk assessment to EN ISO 12100.
3. Check for other Directives and local regulatory requirements that may apply.
4. EN 60204-2:2006 Safety of Machinery-Electrical Equipment of Machines
5. EN ISO 13849-1:2008 Safety of Machinery-Safety related parts of control systems

Authorized person within the European Community to compile the technical file:

Wolfgang Emrich, Hohe Strasse 4-6, 61231 Bad Nauheim Germany

Baxter Springs KS USA 2/9/16
(Place and Date of Issue)



(Compliance Engineer)

- ☒ Original Version of Declaration of Incorporation
☐ Translated Version of Declaration of Incorporation



MATERIAL SAFETY DATA SHEET

PURE GOOP™

November 2003

1. PRODUCT IDENTIFICATION

PURE GOOP: Thread lubricant

Manufactured by:
Swagelok Company
29500 Solon Road
Solon, Ohio USA 44139
Tel: (440) 248-4600
Fax: (440) 349-5970

Emergency Contact:
Chemtrec (800) 424-9300

2. INGREDIENTS

Ingredients	CAS #	WT%	PEL
Polychlorotrifluoroethylene	9002-83-9	75-85	Not Available
Polytetrafluoroethylene	9002-84-0	15-20	Not Available
Amorphous Silica	7631-86-9	1-5	Not Available

3. HEALTH HAZARD INFORMATION

- European Community Danger Group:..... None
- Special Hazards for man or environment: None
- LD₅₀/LC₅₀ Not Available

Routes of Entry

Skin Contact	Skin Absorption	Eye Contact	Inhalation	Ingestion
No	No	Yes	Yes	Yes

4. FIRST AID MEASURES

- If inhaled (Overexposure): If person is affected by fumes, remove person to fresh air. Seek medical attention.
- After contact with skin (Overexposure): Wash thoroughly with soap and water. If severe irritation develops, seek medical attention.
- After contact with eyes: Rinse thoroughly with water for 15 minutes, seek medical attention. Do not rub eyes.
- If swallowed: Seek medical attention.
- Medical information: Unlikely to cause ill effects. Inhaling fumes of decomposition products can cause temporary influenza-like symptoms which are described as "polymer fume fever". Symptoms include fever, cough, and malaise.

5. FIRE FIGHTING MEASURES



MATERIAL SAFETY DATA SHEET

PURE GOOP™

November 2003

- Suitable extinguishing agents: Carbon dioxide, foam, agent suitable for environment.
- Not suitable for safety reasons: None known.
- Special dangers caused by substance preparation itself, by combustion products or gases formed: May decompose above 500°F/260°C to produce organo-chlorine compounds, organo-fluorine compounds, hydrogen fluoride, and chlorine gas.
- Additional information: None.

Auto ignition	UEL	LEL	Sensitivities
Not Applicable	Not Available	Not Available	Not Available

6. ACCIDENTAL RELEASE MEASURES

- Measures for protection of people: Put on necessary protective equipment. Eye and hand protection as needed.
- Measures for protection of the environment: None required.
- Cleaning measures: Use absorbent material and suitable cleaner.
- Additional information: None.

7. HANDLING AND STORAGE

- Safety information: None.
- Information on protection from fire: May decompose above 500°F/260°C to produce organo-chlorine compounds, organo-fluorine compounds, hydrogen fluoride, and chlorine gas.
- Additional information: Store in a cool, dry place for optimal product performance.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

- Precautionary measures to protect employees: None required.
- Respiratory protection: None required.
- Hand protection: Rubber gloves are recommended to minimize exposure.
- Eye protection: Safety glasses or goggles are recommended to minimize exposure.
- Skin protection: Wash hands after use.



MATERIAL SAFETY DATA SHEET

PURE GOOP™

November 2003

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance Opaque-white	Odor Neutral	pH Not Applicable	Density 2.1 gm/cm ³	Vapor Pressure <0.01mm Hg
Boiling Point Not Available	Melting Point Not Available	Flash Point Not Available	Flammability Not Available	Explosive Not Applicable

10. STABILITY AND REACTIVITY

- Conditions to avoid: May decompose above 500°F/260°C to produce organo-chlorine or compounds, organo-fluorine compounds, hydrogen fluoride, and chlorine gas.
- Materials to avoid: Sodium, potassium, barium, calcium, finely divided zinc, aluminum, magnesium, and beryllium. Avoid aluminum-threaded connections where galling and seizure may initiate a reaction. Reacts with amines, liquid fluorine, and liquid chlorine trifluoride.
- Hazardous decomposition products: See Sections 4 and 5.

11. TOXICOLOGICAL INFORMATION

- Acute toxic properties: None known.
- Health effects: See Sections 4 and 5.
- Additional health effects: None known.

Sensitization	Teratogenicity	Reproductive Toxicity	Mutagenicity	Synergistic Products	Carcinogenicity
Not Available	Not Available	Not Available	Not Available	Not Available	Listed ingredients are not suspected carcinogens according to NTP, and IARC

12. ECOLOGICAL INFORMATION

- Mobility: Paste-like viscosity.
- Degradability: Not established.
- Accumulation: No known adverse bioaccumulation or biomagnification effects.
- Short / Long term effects on ecotoxicity: No known ecological effects.



MATERIAL SAFETY DATA SHEET

PURE GOOP™

November 2003

13. DISPOSAL CONSIDERATIONS

- Appropriate methods of disposal: Unused product not considered a hazardous waste in the United States. Dispose of in a responsible manner.
- European Community(EC) considerations: Use appropriate waste codes based on ingredients.

14. TRANSPORT INFORMATION

- Transport precautions: Consult applicable regulations when transporting this product
- Additional information: None.

15. REGULATORY INFORMATION

- EC regulations: This product has been classified under CHIP-96 guidelines based on chemical content.
- US/Canadian regulation listings: SARA 313 - NO, TSCA - YES, Canada's Controlled Products - NO
- EC Relevant risk: None.
- EC Relevant safety: S: 37/39 - Wear suitable gloves and eye/face protection.
S:20 - When using do not eat or drink.
- Additional information: Consult country codes for specific requirements.

16. OTHER INFORMATION

- Further information contact: Your Swagelok Distributor or the contacts listed in Section 1 of this sheet.
- Sources of information used to compile document: Properties of individual ingredients were used to compile this document. This Material Safety Data Sheet was designed to give the distributors and users of PURE GOOP information to handle and use the product in a responsible manner.

Preparation Data		
Environmental and Safety Department	(440) 349-5955	November 2003

Revision Date: 12/10/2004

Issue date: 12/13/2004

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product name: Loctite(R) 222 Threadlocker Low Strength
Product Use: Sealant
Company address:
Henkel Canada, Inc.
2255 Meadowpine Boulevard
Mississauga, Ontario L5N 7P2

Item No. : 21464
Region: Canada
Contact Information:
Telephone: 905.814.6511
Emergency telephone: 905.814.6511
Internet: www.loctite.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>Hazardous components</u>	<u>%</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>OTHER</u>
Polyglycol dimethacrylate 25852-47-5	30-60	None	None	None
Polyglycol oleate 9004-96-0	30-60	None	None	None
Silica, amorphous, treated 68909-20-6	5-10	10 mg/m ³ (Inhal)	20mppcf	6 mg/m ³
Saccharin 81-07-2	1-5	None	None	None
Propylene glycol 57-55-6	1-5	None	None	None
Cumene hydroperoxide 80-15-9	1-5	None	None	1 ppm (6 mg/m ³) Skin (WEEL)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Physical state: Liquid
Color: Purple
Odor: Mild
WHMIS hazard class: D.2.B

WARNING: CAUSES EYE IRRITATION.
MAY CAUSE ALLERGIC SKIN REACTION.
MAY CAUSE SKIN IRRITATION.
MAY CAUSE RESPIRATORY TRACT IRRITATION.

Relevant routes of exposure: Skin, Inhalation, Eyes

Potential Health Effects

Inhalation: May cause respiratory tract irritation.
Skin contact: May cause allergic skin reaction. May cause skin irritation.
Eye contact: Contact with eyes will cause irritation.
Ingestion: Not expected to be harmful by ingestion.

Existing conditions aggravated by exposure: Eye, skin, and respiratory disorders.

See Section 11 for additional toxicological information.

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Product name: Loctite(R) 222 Threadlocker Low Strength

4. FIRST AID MEASURES

Inhalation:	Remove to fresh air. If symptoms develop and persist, get medical attention.
Skin contact:	Wash with soap and water. Remove contaminated clothing and shoes. Wash clothing before reuse. Get medical attention if symptoms occur.
Eye contact:	Flush with copious amounts of water, preferably, lukewarm water for at least 15 minutes, holding eyelids open all the time. Get medical attention.
Ingestion:	Do not induce vomiting. Keep individual calm. Obtain medical attention.

5. FIRE-FIGHTING MEASURES

Flash point:	Greater than 93°C (200°F) Tagliabue closed cup
Autoignition temperature:	Not available
Flammable/Explosive limits-lower %:	Not available
Flammable/Explosive limits-upper %:	Not available
Extinguishing media:	Foam, dry chemical or carbon dioxide.
Special fire fighting procedures:	Wear self-contained breathing apparatus and full protective clothing, such as turn-out gear.
Unusual fire or explosion hazards:	None
Hazardous combustion products:	Oxides of carbon. Oxides of sulfur. Oxides of nitrogen. Irritating organic vapors.
Sensitivity to mechanical impact:	Not available.
Sensitivity to static discharge:	Not available.

6. ACCIDENTAL RELEASE MEASURES

Environmental precautions:	Prevent product from entering drains or open waters.
Clean-up methods:	Soak up with inert absorbent. Store in a partly filled, closed container until disposal.

7. HANDLING AND STORAGE

Handling:	Avoid contact with eyes, skin and clothing. Avoid breathing vapor and mist. Wash thoroughly after handling. Use only with adequate ventilation.
Storage:	For safe storage, store at or below 38°C (100°F). Keep in a cool, well ventilated area away from heat, sparks and open flame. Keep container tightly closed until ready for use.
Incompatible products:	Refer to Section 10.

For information on product shelf life contact Loctite Canada Customer Service at (905) 814-6511.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls:	No specific ventilation requirements noted, but forced ventilation may still be required if concentrations exceed occupational exposure limits.
Respiratory protection:	Use NIOSH approved respirator if there is potential to exceed exposure limit(s).

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Product name: Loctite(R) 222 Threadlocker Low Strength

Skin protection: Use impermeable gloves and protective clothing as necessary to prevent skin contact. Neoprene gloves. Butyl rubber gloves. Natural rubber gloves.

Eye/face protection: Safety goggles or safety glasses with side shields.

See Section 2 for exposure limits.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Liquid
Color: Purple
Odor: Mild
Odor Threshold: Not available
Vapor pressure: Less than 5 mm Hg at 27°C (80°F)
pH: Not applicable
Boiling point/range: Greater than 149°C (300°F)
Melting point/range: Not available
Specific gravity: 1.08 at 20°C (68°F)
Vapor density: Not available
Evaporation rate: Not available
Solubility in water: Slight
Partition coefficient (n-octanol/water): Not available
VOC content: 11.8%; 127 grams/liter (EPA Method 24)

10. STABILITY AND REACTIVITY

Stability: Stable.

Hazardous polymerization: Will not occur.

Hazardous decomposition products: Oxides of carbon. Oxides of sulfur. Oxides of nitrogen. Irritating organic vapors.

Incompatibility: Strong oxidizers.

Conditions to avoid: See "Handling and Storage" (Section 7) and "Incompatibility" (Section 10).

11. TOXICOLOGICAL INFORMATION

Product toxicity data: Acute oral LD50 greater than 10, 000 mg/kg (rat). Acute dermal LD50 greater than 5000 mg/kg (rabbit).

Toxicologically synergistic products: Not available.

Refer to the following for Irritancy of Product, Sensitization to Product, Carcinogenicity, Reproductive Toxicity, Teratogenicity, and Mutagenicity.

Ingredient Toxicity Data & Carcinogen Status

Hazardous components	LD50s & LC50s (NIOSH) :	Other LD50s and LC50s:	NTP Carcinogen	IARC Carcinogen	OSHA Carcinogen	ACGIH - Carcinogens
Polyglycol dimethacrylate 25852-47-5	None	None	No	No	No	No
Polyglycol oleate 9004-96-0	Oral LD50 (Mouse) > 25 g/kg	None	No	No	No	No
Silica, amorphous, treated 68909-20-6	None	None	No	No	No	No
Saccharin 81-07-2	Oral LD50 (Mouse) = 17 g/kg	None	No	No	No	No

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Product name: Loctite(R) 222 Threadlocker Low Strength

Propylene glycol 57-55-6	Oral LD50 (Rat) = 20 g/kg Dermal LD50 (Rabbit) = 20800 mg/kg Oral LD50 (Mouse) = 22 g/kg	None	No	No	No	No
Cumene hydroperoxide 80-15-9	Inhalation LC50 (Mouse) = 200 ppm Inhalation LC50 (Rat) = 220 ppm Oral LD50 (Rat) = 382 mg/kg	None	No	No	No	No

Literature Referenced Target Organ & Other Health Effects

Hazardous components	Health Effects/Target Organs
Polyglycol dimethacrylate 25852-47-5	Allergen, Irritant
Polyglycol oleate 9004-96-0	Irritant
Silica, amorphous, treated 68909-20-6	No Target Organs
Saccharin 81-07-2	No Target Organs
Propylene glycol 57-55-6	Irritant
Cumene hydroperoxide 80-15-9	Allergen, Central nervous system, Corrosive, Irritant, Mutagen

12. ECOLOGICAL INFORMATION

Ecological information: Not available

13. DISPOSAL CONSIDERATIONS

Information provided is for unused product only.

Recommended method of disposal: Dispose of in accordance with federal and local regulations.

14. TRANSPORT INFORMATION

Canada Transportation of Dangerous Goods - Ground:

Proper shipping name: Unrestricted
Hazard class or division: None
Identification number: None
Packing group: None

International Air Transportation (ICAO/IATA):

Proper shipping name: Unrestricted
Hazard class or division: None
Identification number: None
Packing group: None

WaterTransportation (IMO/IMDG):

Proper shipping name: Unrestricted
Hazard class or division: None
Identification number: None
Packing group: None
Marine pollutant: None

Item No. : 21464

Product name: Loctite(R) 222 Threadlocker Low Strength

15. REGULATORY INFORMATION

Canada Regulatory Information

CEPA DSL/NDL Status: All components are listed on or are exempt from listing on the Domestic Substances List.

United States Regulatory Information

TSCA 8 (b) Inventory Status: All components are listed or are exempt from listing on the Toxic Substances Control Act Inventory.

16. OTHER INFORMATION

This material safety data sheet contains changes from the previous version in sections: New Material Safety Data Sheet format.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Product Regulations.

Prepared by: Kyra Kozak Woods, Health and Regulatory Affairs Specialist

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JL-M MATERIAL SAFETY DATA SHEET

SECTION 1 – PRODUCT IDENTIFICATION				
Product Name: JL-M Lubricant Revised: 03/07/03 Prepared by: C. Semerod Emergency Information: (412) 279-1149		Manufacturer's Name: Superbolt, Inc. Manufacturer's Address: 1000 Gregg Street Carnegie, PA 15106 Manufacturer's Phone #: (412) 279-1149		
SECTION 2 – HAZARDOUS INGREDIENTS				
CHEMICAL NAME:	CAS NO.:	OSHA PEL:	ACGIH TLV:	(STEL)
Molybdenum Disulfide	1317-33-5	10 mg/m3	10 mg/m3	N/A
Silica, Fused	60676-86-0	0.1 mg/m3	0.1 mg/m3	N/A
Graphite	7782-42-5		2 mg/m3	N/A
Silica, Crystalline	14808-60-7		0.1 mg/m3	N/A
Lubricating Oils, Petroleum, Hydrotreated, Spent	64742-58-1	5 mg/m3*	5 mg/m3*	10mg/m3*
Residual Oils (Petroleum), Solvent Dewaxed	64742-62-7	5 mg/m3*	5 mg/m3*	10 mg/m3*
Solvent-Refined Heavy Paraffinic Distillate (Petroleum)	64741-88-4	5 mg/m3*	5 mg/m3*	10 mg/m3*
Solvent –Dewaxed Hydrotreated Heavy Paraffinic Distillate (Petroleum)	64742-65-0	5 mg/m3*	5 mg/m3*	10 mg/m3*
Hydrotreated Heavy Paraffinic Distillate (Petroleum)	64742-54-7	5 mg/m3*	5 mg/m3*	10 mg/m3*
Proprietary Additives Mixture (<1%) (*) Designates limits set by OSHA and the ACGIH for oil mist. This product is sold in a paste form so misting should not occur.				
SECTION 3 – PHYSICAL DATA		SECTION 4 – FIRE AND EXPLOSION DATA		
Appearance and Odor: Dark Grey Paste, Mild Petroleum Boiling Point: > 500 degrees F % Volatile: 0% Vapor Density: > 1 (Air = 1) Evaporation Rate: < 1 (Ether = 1) Specific Gravity: 4.8 (Water = 1) Vapor Pressure: Essentially 0 (mm Hg) Solubility in Water: Insoluble pH: N/A		Flash Point: 338 degrees F Lower Explosive Limit: N/A Upper Explosive Limit: N/A Extinguishing Media: Carbon Dioxide, Regular Foam, Dry Chemical Special Fire Fighting Procedures: Fire may produce dense smoke, firefighters should wear self contained breathing apparatus. Use water to cool fire exposed containers. Unusual Fire & Explosion Hazards: Decomposition and combustion by-products may be toxic. Heated containers may rupture or explode.		
SECTION 5 – REACTIVITY DATA		SECTION 6 – STORAGE & HANDLING		
Stability: Stable Hazardous Polymerization: Will not occur. Incompatibility: Avoid contact with oxidizing agents, heat, sparks or flame. Hazardous Combustion By-Products: Carbon Monoxide, Sulfur Dioxide, Aldehydes, and Nitrogen Oxides Hazardous Decomposition: Thermal decomposition may yield methacrylate monomers.		Handling Precautions: Use good personal hygiene practices. Clean contaminated clothing and protective equipment before reuse. Storage Precautions: Store in a cool dry location. Keep container tightly closed when not in use and during transport. Keep away from open sparks or flames.		
SECTION 7 – HEALTH HAZARDS				
Effects of Overexposure: Skin: May Cause Irritation Eyes: Eye Irritant. May cause redness and Blurred vision. Ingestion: Not Expected Inhalation: Not Expected (Chronic respiratory diseases may be aggravated by dust exposure.) NFPA CODES: Health: 1 Flammability: 1 Reactivity: 0 Carcinogenicity: Silica is a suspected carcinogen in a respirable form by the IARC and NTP however, not by the ACGIH or OSHA.		First Aid Procedures: Skin: Remove contaminated clothing from irritated area. Flush exposed area with mild soap and water. Seek medical attention if irritation persists. Eyes: Flush eyes with large quantities of water, holding eyelids open. Seek medical attention if irritation persists. Ingestion: Do not induce vomiting. If spontaneous vomiting occurs, keep head below hips to avoid aspiration into the lungs. Seek immediate medical attention. Inhalation: Remove to fresh air. Obtain medical attention if necessary.		
SECTION 8 – SPECIAL PROTECTION		SECTION 9 – SPILL AND DISPOSAL PROCEDURES		
Eye Protection: Safety Glasses or Face Shield Protective Gloves: Recommended Respiratory Protection: Avoid breathing dust, use an approved respirator if levels exceed OSHA limits. Ventilation: Local ventilation to maintain levels within OSHA limits.		Spill Procedures: Scrape or wipe up any spilled material. Wear proper protective equipment when cleaning up a spill. Disposal Procedures: Dispose of in accordance with any applicable federal, state, or local laws.		

The information in this MSDS was obtained from sources which we believe are reliable. However, the information is provided without any representation or warranty, expressed or implied, regarding the accuracy or correctness. The conditions or methods of handling, storage, use and disposal of the product are beyond our control. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage, or expense arising out of or in any way connected with the handling, storage, use or disposal of the product.



LUBRIPLATE®

MATERIAL SAFETY DATA SHEET

Section 1

PRODUCT NAME OR NUMBER:

LUBRIPLATE Super FML-0, FML-1, FML-2

GENERIC/CHEMICAL NAME:

Petroleum Lubricating Grease

Manufacturer's Name:

Fiske Brothers Refining Co.

Address:

1500 Oakdale Ave., Toledo, Ohio 43605 - 129 Lockwood St., Newark, NJ 07105

FORMULA:

Calcium Soap, USP Mineral Oil and Additives

NSF Registration No's:

125742, 125740, 125741

Emergency Telephone Number:

1-800-255-3924 - CHEM-TEL (24 hour)

Telephone Number for Information:

419-691-2491 - Toledo Office

Section 2 - Hazardous Ingredients/Identity Information

<u>Hazardous Components</u>	<u>OSHA PEL</u>	<u>ACGIH TLV</u>	<u>Other Limits Recommended</u>	<u>% (optional)</u>
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Non-hazardous

Hazardous Material Identification System (HMIS):

Health - 1,

Flammability - 1,

Reactivity - 0

Not a Controlled Product under (WHMIS) - Canada**Special Protection: See Section 9**

Section 3 - Health Hazard Data

Threshold Limit Value: 5 mg/m³ for oil mist in air. OSHA Regulation 29 CFR 1910.1000

Effects of Overexposure: Prolonged or repeated skin contact may cause skin irritation. Product contacting the eyes may cause eye irritation. Human health risks vary from person to person. As a precaution, exposure to liquids, vapors, mists and fumes should be minimized. This product has a low order of acute oral toxicity, but minute amounts aspirated into the lungs during ingestion may cause mild to severe pulmonary injury.

Carcinogenicity: NTP? No

IARC Monographs? No

OSHA Regulated? No

Section 4 - Emergency and First Aid Procedures

EYE CONTACT: Flush with clear water for 15 minutes or until irritation subsides. If irritation persists, consult a physician.

SKIN CONTACT: Remove any contaminated clothing and wash with soap and warm water. If injected by high pressure under skin, regardless of the appearance or its size, contact a physician IMMEDIATELY. Delay may cause loss of affected part of the body.

INHALATION: Vapor pressure is very low and inhalation at room temperature is not a problem. If overcome by vapor from hot product, immediately remove from exposure and call a physician.

INGESTION: If ingested, call a physician immediately. Do not induce vomiting.

Section 5 - Fire and Explosion Hazard Data

Flash Point (Method Used): COC - 435°F **Flammable Limits:** LEL 0.9% UEL 7.0%**Extinguishing Media:** Foam, Dry Chemical, Carbon Dioxide or Water Spray (Fog)

Special Fire Fighting Procedures: Cool exposed containers with water. Use air-supplied breathing equipment for enclosed or confined spaces.

Unusual Fire and Explosion Hazards: Do not store or mix with strong oxidants. Empty containers retain residue. Do not cut, drill, grind, or weld, as they may explode.

Section 6 - Physical/Chemical Characteristics

Boiling Point:	>550°F	Specific Gravity (H₂O = 1):	0.90 - 0.91
Vapor Pressure (mm Hg.):	<0.01	Melting Point:	Semi-solid
Vapor Density (AIR = 1):	>5	Evaporation Rate: (Butyl Acetate = 1)	<0.01
Solubility in Water:	Negligible		
Appearance and Odor:	Smooth, white grease with mineral oil odor.		

Section 7 - Reactivity Data

Stability:	Unstable Stable X	Conditions to Avoid:	N/A
Incompatibility (Materials to Avoid):	Avoid contact with strong oxidants like liquid chlorine, concentrated oxygen.		
Hazardous Decomposition or Byproducts:	May form SO ₂ . If incomplete combustion, Carbon Monoxide.		
Hazardous Polymerization:	May Occur Will Not Occur X	Conditions to Avoid:	N/A

Section 8 - Spill or Leak Procedures

Steps to be taken in case material is released or spilled:

Scrape up grease, wash remainder with suitable petroleum solvent or add absorbent. Keep petroleum products out of sewers and watercourses. Advise authorities if product has entered or may enter sewers and watercourses.

Waste disposal method:

Assure conformity with applicable disposal regulations. Dispose of absorbed material at an approved waste disposal facility or site.

SARA/TITLE III, Section 313 Status - Zinc Compounds - <6%

Section 9 - Special Protection Information

Respiratory Protection (Specify type):		Normally not needed		
Ventilation	Local Exhaust:	Used to capture fumes and vapors	Special:	N/A
	Mechanical (General)		Other:	N/A
Protective Gloves:		Use oil-resistant gloves, if needed.		
		Eye Protection:	If chance of eye contact, wear goggles.	
Other Protective Equipment:		Use oil-resistant apron, if needed.		

Section 10 - Special Precautions

Precautions to be taken in handling and storing:

Keep containers closed when not in use. Do not handle or store near heat, sparks, flame, or strong oxidants.

Other Precautions:

Remove oil-soaked clothing and laundry before reuse. Cleanse skin thoroughly after contact.

The above information is furnished without warranty, expressed or implied, except that it is accurate to the best knowledge of Fiske Brothers Refining Company. The data on these sheets relates only to the specific material designated herein. Fiske Brothers Refining Company assumes no legal responsibility for use or reliance upon this data.



Hydraulic AW (All Grades)

Material Safety Data Sheet

1. Product and Company Identification

Product Name:	Hydraulic AW (All Grades)
MSDS Number:	778830
Synonyms:	Hydraulic AW 32 Hydraulic AW 46 Hydraulic AW 68 Hydraulic AW 100
Intended Use:	Hydraulic Fluid
Manufacturer/Supplier:	ConocoPhillips Lubricants 600 N. Dairy Ashford, 2W900 Houston, Texas 77079-1175
Emergency Health and Safety Number:	Chemtrec: 800-424-9300 (24 Hours)
Customer Service:	U.S.: 800-822-6457 or International: +1-83-2486-3363
Technical Information:	800-766-0050
MSDS Information:	Internet: http://w3.conocophillips.com/NetMSDS/

2. Hazards Identification

Emergency Overview

This material is not considered hazardous according to OSHA criteria.

NFPA



Appearance: Clear and bright

Physical Form: Liquid

Odor: Petroleum

Potential Health Effects

Eye: Contact may cause mild eye irritation including stinging, watering, and redness.

Skin: Contact may cause mild skin irritation including redness and a burning sensation. Prolonged or repeated contact can defat the skin, causing drying and cracking of the skin, and possibly dermatitis (inflammation). No harmful effects from skin absorption are expected.

Inhalation (Breathing): No information available on acute toxicity.

Ingestion (Swallowing): No harmful effects expected from ingestion.

Signs and Symptoms: Effects of overexposure may include irritation of the digestive tract, nausea and diarrhea. Inhalation of oil mist or vapors at elevated temperatures may cause respiratory irritation.

Pre-Existing Medical Conditions: Conditions which may be aggravated by exposure include skin disorders.

See Section 11 for additional Toxicity Information.

3. Composition / Information on Ingredients

Component	CASRN	Concentration*
Lubricant Base Oil (Petroleum)	VARIOUS	>99
Additives	PROPRIETARY	<1

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First Aid Measures

Eye Contact: If irritation or redness develops from exposure, flush eyes with clean water. If symptoms persist, seek medical attention.

Skin Contact: Remove contaminated shoes and clothing and cleanse affected area(s) thoroughly by washing with mild soap and water or a waterless hand cleaner. If irritation or redness develops and persists, seek medical attention.

Inhalation (Breathing): If respiratory symptoms develop, move victim away from source of exposure and into fresh air in a position comfortable for breathing. If symptoms persist, seek medical attention.

Ingestion (Swallowing): First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

Notes to Physician: High-pressure hydrocarbon injection injuries may produce substantial necrosis of underlying tissue despite an innocuous appearing external wound. These injuries often require extensive emergency surgical debridement and all injuries should be evaluated by a specialist in order to assess the extent of injury. Early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

Acute aspirations of large amounts of oil-laden material may produce a serious aspiration pneumonia. Patients who aspirate these oils should be followed for the development of long-term sequelae. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities.

5. Fire-Fighting Measures

NFPA 704 Hazard Class

Health: 0 **Flammability:** 1 **Instability:** 0 (0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)

Unusual Fire & Explosion Hazards: This material may burn, but will not ignite readily. If container is not properly cooled, it can rupture in the heat of a fire.

Extinguishing Media: Dry chemical, carbon dioxide, foam, or water spray is recommended. Water or foam may cause frothing of materials heated above 212°F / 100°C. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces.

Fire Fighting Instructions: For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8).

Isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely. Avoid spreading burning liquid with water used for cooling purposes.

Hazardous Combustion Products: Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of sulfur, nitrogen or phosphorus may also be formed.

See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

6. Accidental Release Measures

Personal Precautions: This material may burn, but will not ignite readily. Keep all sources of ignition away from spill/release. The use of explosion-proof electrical equipment is recommended. Stay upwind and away from spill/release. Notify persons and shipping down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8).

Environmental Precautions: Stop spill/release if it can be done safely. Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems, and natural waterways. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on the surface of the water, may require notification of the National Response Center (phone number 800-424-8802).

Methods for Containment and Clean-Up: Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents).

7. Handling and Storage

Precautions for safe handling: Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment.

High pressure injection of hydrocarbon fuels, hydraulic oils or greases under the skin may have serious consequences even though no symptoms or injury may be apparent. This can happen accidentally when using high pressure equipment such as high pressure grease guns, fuel injection apparatus or from pinhole leaks in tubing of high pressure hydraulic oil equipment.

Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Do not wear contaminated clothing or shoes.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. "Empty" drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

Conditions for safe storage: Use and store this material in cool, dry, well-ventilated area away from heat and all sources of ignition. Keep container(s) tightly closed. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage. Storage temperatures above 113°F may lead to thermal decomposition, resulting in the generation of hydrogen sulfide and other sulfur containing gases.

8. Exposure Controls / Personal Protection

Component	US-ACGIH	OSHA	Other
Lubricant Base Oil (Petroleum)	TWA: 5mg/m ³ STEL: 10 mg/m ³ as Oil Mist, if generated	TWA: 5 mg/m ³ as Oil Mist, if generated	---

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

Engineering controls: If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

Eye/Face Protection: The use of eye protection that meets or exceeds ANSI Z.87.1 is recommended to protect against potential eye contact, irritation, or injury. Depending on conditions of use, a face shield may be necessary.

Skin/Hand Protection: The use of gloves impervious to the specific material handled is advised to prevent skin contact. Users should check with manufacturers to confirm the breakthrough performance of their products. Suggested protective materials: Nitrile.

Respiratory Protection: Where there is potential for airborne exposure above the exposure limit a NIOSH certified air purifying respirator equipped with R or P95 filters may be used.

A respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use. Air purifying respirators provide limited protection and cannot be used in atmospheres that exceed the maximum use concentration (as directed by regulation or the manufacturer's instructions), in oxygen deficient (less than 19.5 percent oxygen) situations, or under conditions that are immediately dangerous to life and health (IDLH).

Suggestions provided in this section for exposure control and specific types of protective equipment are based on readily available information. Users should consult with the specific manufacturer to confirm the performance of their protective equipment. Specific situations may require consultation with industrial hygiene, safety, or engineering professionals.

9. Physical and Chemical Properties

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm). Data represent typical values and are not intended to be specifications.

Appearance:	Clear and bright
Physical Form:	Liquid
Odor:	Petroleum
Odor Threshold:	No data
pH:	Not applicable
Vapor Pressure:	<1 mm Hg
Vapor Density (air=1):	>1
Boiling Point/Range:	No data
Melting/Freezing Point:	<15.8°F / <-9°C
Pour Point:	<15.8°F / <-9°C
Solubility in Water:	Insoluble
Partition Coefficient (n-octanol/water) (Kow):	No data
Specific Gravity:	0.87 - 0.89 @ 60°F (15.6°C)
Bulk Density:	7.2 - 7.4 lbs/gal
Viscosity:	5.2 - 10.5 cSt @ 100°C; 30 - 110 cSt @ 40°C
Evaporation Rate (nBuAc=1):	No data
Flash Point:	>320°F / >160°C
Test Method:	Pensky-Martens Closed Cup (PMCC), ASTM D93, EPA 1010
LEL (vol % in air):	No data
UEL (vol % in air):	No data
Autoignition Temperature:	No data

10. Stability and Reactivity

Stability: Stable under normal ambient and anticipated conditions of use.

Conditions to Avoid: Extended exposure to high temperatures can cause decomposition.

Materials to Avoid (Incompatible Materials): Avoid contact with oxidizing agents and reducing agents.

Hazardous Decomposition Products: Not anticipated under normal conditions of use.

Hazardous Polymerization: Not known to occur.

11. Toxicological Information

Chronic Toxicity:

Lubricant Base Oil (Petroleum)

Carcinogenicity: The petroleum base oils contained in this product have been highly refined by a variety of processes including severe hydrocracking/hydroprocessing to reduce aromatics and improve performance characteristics. All of the oils meet the IP-346 criteria of less than 3 percent PAH's and are not considered carcinogens by NTP, IARC, or OSHA.

Acute Toxicity:

Component	Oral LD50	Dermal LD50	Inhalation LC50
Lubricant Base Oil (Petroleum)	>5 g/kg	>2 g/kg	No data

12. Ecological Information

Ecotoxicity: Experimental studies show that acute aquatic toxicity values are greater than 1000 mg/l. These values are consistent with the predicted aquatic toxicity of these substances based on their hydrocarbon compositions.

Mobility: Volatilization to air is not expected to be a significant fate process due to the low vapor pressure of this material. In water, base oils will float and spread over the surface at a rate dependent upon viscosity. There will be significant removal of hydrocarbons from the water by sediment adsorption. In soil and sediment, hydrocarbon components will show low mobility with adsorption to sediments being the predominant physical process. The main fate process is expected to be slow biodegradation of base oil components in soil and sediment.

Persistence and degradability: The hydrocarbons in this material are not readily biodegradable, but since they can be degraded by microorganisms, they are regarded as inherently biodegradable.

Bioaccumulation Potential: Log Kow values measured for the hydrocarbon components of this material range from 4 to over 6, and therefore regarded as having the potential to bioaccumulate. In practice, metabolic processes may reduce bioconcentration.

13. Disposal Considerations

The generator of a waste is always responsible for making proper hazardous waste determinations and needs to consider state and local requirements in addition to federal regulations.

This material, if discarded as produced, would not be a federally regulated RCRA "listed" hazardous waste and is not believed to exhibit characteristics of hazardous waste. See Sections 7 and 8 for information on handling, storage and personal protection and Section 9 for physical/chemical properties. It is possible that the material as produced contains constituents which are not required to be listed in the MSDS but could affect the hazardous waste determination. Additionally, use which results in chemical or physical change of this material could subject it to regulation as a hazardous waste.

This material under most intended uses would become "Used Oil" due to contamination by physical or chemical impurities. Whenever possible, Recycle Used Oil in accordance with applicable federal and state or local regulations. Container contents should be completely used and containers should be emptied prior to discard.

14. Transportation Information

U.S. Department of Transportation (DOT)

Shipping Description:

Not regulated

Note:

If shipped by land in a packaging having a capacity of 3,500 gallons or more, the provisions of 49 CFR, Part 130 apply. (Contains oil)

International Maritime Dangerous Goods (IMDG)

Shipping Description:

Not regulated

Note:

U.S. DOT compliance requirements may apply. See 49 CFR 171.22, 23 & 25.

International Civil Aviation Org. / International Air Transport Assoc. (ICAO/IATA)

UN/ID #:

Not regulated

Note:

U.S. DOT compliance requirements may apply. See 49 CFR 171.22, 23 & 24.

	LTD. QTY	Passenger Aircraft	Cargo Aircraft Only
Packaging Instruction #:	---	---	---
Max. Net Qty. Per Package:	---	---	---

15. Regulatory Information

CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds):

This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

CERCLA/SARA - Section 311/312 (Title III Hazard Categories)

Acute Health:	No
Chronic Health:	No
Fire Hazard:	No
Pressure Hazard:	No
Reactive Hazard:	No

CERCLA/SARA - Section 313 and 40 CFR 372:

This material contains the following chemicals subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR 372:

Component	Concentration*	de minimis
Zinc Compound(s)	<1.5	1.0%

EPA (CERCLA) Reportable Quantity (in pounds):

This material does not contain any chemicals with CERCLA Reportable Quantities.

California Proposition 65:

This material does not contain any chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

Canadian Regulations:

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the Regulations.

WHMIS Hazard Class
None

National Chemical Inventories:

All components are either listed on the US TSCA Inventory, or are not regulated under TSCA.

All components are either on the DSL, or are exempt from DSL listing requirements.

U.S. Export Control Classification Number: EAR99

16. Other Information

Date of Issue: 27-Jan-2009
Status: Final
Revised Sections or Basis for Revision: Product Name / Synonyms (Section 1)
Physical Properties (Section 9)
Regulatory information (Section 15)
MSDS Number: 778830

Guide to Abbreviations:

ACGIH = American Conference of Governmental Industrial Hygienists; CASRN = Chemical Abstracts Service Registry Number; CEILING = Ceiling Limit (15 minutes); CERCLA = The Comprehensive Environmental Response, Compensation, and Liability Act; EPA = Environmental Protection Agency; IARC = International Agency for Research on Cancer; LEL = Lower Explosive Limit; NE = Not Established; NFPA = National Fire Protection Association; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = Permissible Exposure Limit (OSHA); SARA = Superfund Amendments and Reauthorization Act; STEL = Short Term Exposure Limit (15 minutes); TLV = Threshold Limit Value (ACGIH); TWA = Time Weighted Average (8 hours); UEL = Upper Explosive Limit; WHMIS = Worker Hazardous Materials Information System (Canada)

Disclaimer of Expressed and implied Warranties:

The information presented in this Material Safety Data Sheet is based on data believed to be accurate as of the date this Material Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

PRODUCT IDENTIFICATION: . . : GERALYN AW 68

MANUFACTURER IDENTIFICATION

```

Company Name. . . . . : FUCHS LUBRICANTS CO.
Address . . . . . : 17050 LATHROP AVE.
                   HARVEY           IL  60426
Telephone . . . . . : 708-333-8900
Emergency Contact . . . : Regulatory Compliance Department
Emergency Telephone . . : 708-333-8900 (8am - 5pm CST, M-F)
                   800-255-3924 (24 Hours)

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MSDS PRINT DATE : 07/26/2007

* EMERGENCY OVERVIEW

This product is a liquid that is insoluble in water. Direct eye contact may cause minor, short term irritation. Short term skin exposure is not expected to be irritating. Inhalation and ingestion are not anticipated routes of exposure during normal conditions of use.

* HMIS Rating: Health- 1 Flammability- 1 Reactivity- 0 PPE- X

SECTION 2 - COMPONENT DATA

Components listed in this section may contribute to the potential hazards associated with exposure to the concentrate. The product may contain additional non-hazardous or trade-secret components.

Mineral Oil	Cas#: proprietary	Percent: > 90
Exposure Limit:		
ACGIH TLV:	5 mg/m3 (as mist)	
ACGIH STEL:	10 mg/m3 (as mist)	
OSHA PEL:	5 mg/m3 (as mist)	

- Carcinogenic Components: This product contains no carcinogens.

SECTION 3 - HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS and SYMPTOMS from SHORT TERM/ACUTE EXPOSURE:

- EYE EXPOSURE -

This product is not expected to cause eye irritation under normal conditions of use. Symptoms of slight eye irritation may result when direct contact occurs, or when exposed to high mist levels in poorly ventilated areas.

- SKIN EXPOSURE -

Short term skin contact is not expected to cause skin irritation. Prolonged or repeated direct exposure to the skin may result in



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symptoms of irritation and redness. In severe cases, prolonged or repeated contact may result in dermatitis accompanied by symptoms of irritation, itching, dryness, cracking and/or inflammation.

- INHALATION -

This product has low volatility and so is not expected to cause respiratory tract irritation during normal conditions of use. Exposure to high mist levels in poorly ventilated areas may cause upper respiratory tract irritation and difficulty breathing.

- INGESTION -

Ingestion may cause slight stomach irritation and discomfort.

POTENTIAL CHRONIC HEALTH EFFECTS:

No further data known.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

No further data known.

CARCINOGENICITY:

This product is not listed as a known or suspected carcinogen by IARC, OSHA, or the NTP.

SECTION 4 - FIRST AID MEASURES

EYE CONTACT:

Upon direct eye contact, hold eyelids open and flush with a steady, gentle stream of water for at least 15 minutes. If irritation is due to exposure to mist or vapors, remove the individual to fresh air. If irritation persists, flush the eyes with clean water until the irritation subsides. If symptoms persist, contact a physician.

SKIN CONTACT:

Remove product from the skin by washing with a mild soap and water. Contaminated clothing should be removed to prevent prolonged exposure. If symptoms of exposure persist, contact a physician.

INHALATION:

Inhalation is not an expected route of exposure. If respiratory irritation or distress occurs, remove the employee to fresh air. Contact a physician or other medical professional if irritation or distress persists.

INGESTION:

If small amounts are ingested, first aid measures are not likely to be necessary. If larger amounts are ingested or if symptoms of ingestion occur, dilute stomach contents with two glasses of water or milk. (NOTE: Do NOT give anything by mouth to an unconscious person.) Do not induce



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vomiting without medical supervision. If vomiting occurs spontaneously keep airway clear. If symptoms of ingestion persist, seek medical attention.

NOTE TO PHYSICIAN:

No further data known.

SECTION 5 - FIRE FIGHTING MEASURES

FIRE AND EXPLOSIVE PROPERTIES:

Flashpoint	:	445.0	CF	COC
Flammability Limits	:	LEL		-N/A
		UEL		-N/A

EXTINGUISHING MEDIA:

In accordance with NFPA guidance, dry chemical, foam, or CO2 fire extinguishers are all acceptable. Note that while water fog extinguishers are also acceptable, do NOT apply a direct stream of water onto burning product because it may cause spreading and increase fire intensity.

UNUSUAL FIRE & EXPLOSION HAZARDS:

No further data known.

FIRE-FIGHTING PROCEDURES AND EQUIPMENT:

Emergency responders in the danger area should wear bunker gear and self-contained breathing apparatus for fires beyond the incipient stage. See Section 8 of the MSDS for other PPE to be worn as conditions warrant.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

CLEAN-UP MEASURES:

Important: As with any spill or leak, before responding ensure that you are familiar with the potential hazards and recommendations of the MSDS. Appropriate personal protective equipment must be worn. See Section 8 of this MSDS for PPE recommendations.

If possible, safely contain the spill with dikes or other spill response equipment appropriate for petroleum or organic material releases. Take measures to prevent spreading of product. Note that while product will ignite it will not readily burn. However, as a precaution eliminate ignition sources. Prevent from entering sewers or waterways. Large volumes may be transferred to an appropriate container for proper disposal. Small volumes or residues may be soaked up with absorbents. Spill response materials should be collected for proper disposal.

SECTION 7 - HANDLING AND STORAGE

HANDLING:



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As with any industrial chemical, handle the product in a manner that minimizes exposure to practicable levels. Prior to handling, consult Section 8 of this MSDS to evaluate personal protective equipment needs. Open containers slowly to relieve any pressure. Follow all other standard industrial hygiene practices.

Empty containers may contain product residue. All safety precautions taken when handling this product should also be taken when handling empty drums and containers. Keep containers closed when not in use.

Product residue in empty containers is combustible but will not readily burn. NOTE however, that excessive heating or cutting of empty containers may create an ignition source sufficient to start a fire and in extreme cases, cause an explosion.

STORAGE:

Protect product quality by storing indoors and away from extreme temperatures. Close all containers when not in use.

SPECIAL COMMENTS:

No further data known.

SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION

PERSONAL PROTECTIVE EQUIPMENT:

Selection of personal protective equipment should be based upon the anticipated exposure and made in accordance with OSHA's Personal Protective Equipment Standard found in 29 CFR 1910 Subpart I. The following information may be used to assist in PPE selection.

- EYE PROTECTION -

Wear eye protection appropriate to prevent eye exposure. Where splashing is not likely, chemical safety glasses with side shields are recommended. Where splashing may occur, chemical goggles or full face shield is recommended.

- SKIN PROTECTION -

Gloves are not normally needed during normal conditions of use. If health effects are experienced, oil or chemical resistant gloves such as butyl or nitrile are recommended.

Where splashing or soaking is likely, wear oil or chemical resistant clothing to prevent exposure.

- RESPIRATORY PROTECTION -

A respirator may be worn to reduce exposure to vapors, dust, or mist. Select a NIOSH/MSHA approved respirator appropriate for the type and physical character of the airborne material. A self-contained breathing



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apparatus is recommended in all situations where airborne contaminant concentration has not been confirmed to be below safe levels. Respirator use should comply with the OSHA Respirator Protection Standard found in 29 CFR 1910.134.

ENGINEERING CONTROLS:

Normal general ventilation is expected to be adequate. It is recommended that ventilation be designed in all instances to maintain airborne concentrations at lowest practicable levels. Ventilation should at a minimum, prevent airborne concentrations from exceeding any exposure limits listed in Section 2 of this MSDS.

The user may wish to refer to 29 CFR 1910.1000(d)(2) and the ACGIH "Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices" (Appendix C) for the determination of exposure limits of mixtures. An industrial hygienist or similar professional may be consulted to confirm that the calculated exposure limits apply.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Physical Appearance	: Water white
Odor	: Mild petroleum
Physical State	: Liquid
Water Solubility	: Insoluble
Specific Gravity	: .868

SECTION 10 - STABILITY AND REACTIVITY

INCOMPATIBILITIES:

This product is incompatible with strong oxidizing agents.

DECOMPOSITION PRODUCTS MAY INCLUDE:

Thermal decomposition products are dependent on combustion conditions. A complex mixture of airborne solid, liquid, particulates and gasses may evolve when the material burns. Combustion byproducts may include:

- oxides of carbon,
- incompletely burned hydrocarbons as fumes and smoke.

CONDITIONS TO AVOID:

Avoid contact with incompatible materials and exposure to extreme temperatures.

POLYMERIZATION:

This product is not expected to polymerize.

STABILITY:



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This product is stable.

SECTION 11 - TOXICOLOGICAL INFORMATION

EYE EFFECTS:

No further toxicological data known.

SKIN EFFECTS:

No further toxicological data known.

ORAL EFFECTS:

No further toxicological data known.

INHALATION EFFECTS:

No further toxicological data known.

OTHER:

No further data known.

SECTION 12 - ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION:

This product has not been evaluated for ecotoxicity. As with any industrial chemical, exposure to the environment should be prevented and minimized wherever possible.

ENVIRONMENTAL FATE:

The degree of biodegradability and persistence of this product has not been determined.

SECTION 13 - DISPOSAL CONSIDERATIONS

WASTE DISPOSAL:

Ensure that collection, transport, treatment, and disposal of waste product, containers and rinsate complies with all applicable laws and regulations. Note that use, mixture, processing, or contamination of the product may cause the material to be classified as a hazardous waste. It is the responsibility of the product user or owner to determine at the time of disposal, whether the product is regulated as a hazardous waste.

SECTION 14 - TRANSPORT INFORMATION

DOT HAZARDOUS MATERIAL INFORMATION:

* Not otherwise DOT regulated.

SECTION 15 - REGULATORY INFORMATION

FEDERAL REGULATIONS:



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SARA 313:

This product contains NONE of the substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Clean Water Act / Oil Pollution Act:

This product contains mineral oil and is subject to regulation by Section 311 of the Clean Water Act and the Oil Pollution Act. Releases of the product into or leading to surface waters must be reported to the National Response Center at 1-800-424-8802.

CERCLA Reportable Quantity:

Any components listed below have been assigned a reportable quantity (RQ) by the Federal EPA. Releases of the product into the environment that exceed the RQ for a particular component must be reported to the National Response Center at 1-800-424-8802.

Component	RQ
* - * - * - * - * - * - * - * - * - * - * - *	

Toxic Substances Control Act:

The components of this product are listed on the TSCA Inventory.

Ozone Depleting Substances:

This product contains no ozone depleting substances as defined by the Clean Air Act.

Hazardous Air Pollutants:

Any components listed below are defined by the Federal EPA as hazardous air pollutants.

Component	
* - * - * - * - * - * - * - * - * - * - * - *	

STATE REGULATIONS:

This product contains mineral oil, and as used, may be regulated by state used oil regulations. Check with the appropriate state agency to determine whether such a regulation exists.

No further data known.

SECTION 16 - OTHER INFORMATION

Prepared by : Corporate Regulatory Compliance
 Date of issue : 07/26/2007
 Last Revision Date : 11/01/2006
 C4302368

FUCHS LUBRICANTS CO.



PRODUCT NAME: GERALYN AW 68

NOTICE: This MSDS provides a good faith representation of information believed to be accurate as of the last revision date. This document does not create any express or implied product warranties. Since conditions of use are beyond the control of Fuchs Lubricants Co., all risks associated with product use are assumed by the user.

Revision Date: 04/12/2006

Issue date: 04/12/2006

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product name: 242® Threadlocker
Product type: Anaerobic Sealant
Company address:
Henkel Corporation
1001 Trout Brook Crossing
Rocky Hill, Connecticut 06067

Item No. : 24231
Region: United States
Contact Information:
Telephone: 860.571.5100
Emergency telephone: 860.571.5100
Internet: www.loctite.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous components	%	ACGIH TLV	OSHA PEL	OTHER
Polyglycol dimethacrylate 25852-47-5	60-100	None	None	None
Polyglycol oleate 9004-96-0	10-30	None	None	None
Saccharin 81-07-2	1-5	None	None	None
Silica, amorphous, fumed, crystalline-free 112945-52-5	1-5	6 mg/m ³ TWA	10 mg/m ³ TWA	3 mg/m ³ TWA respirable dust
Cumene hydroperoxide 80-15-9	1-5	None	None	1 ppm (6 mg/m ³) Skin (WEEL), 1ppm, skin TWA, (WEEL)
Propylene glycol 57-55-6	1-5	None	None	10 mg/m ³ TWA, (WEEL)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

HMIS:

Physical state: Liquid
Color: Blue
Odor: Mild

HEALTH: 2*
FLAMMABILITY: 1
PHYSICAL HAZARD: 1
Personal Protection: See Section 8

WARNING: CAUSES EYE IRRITATION.
MAY CAUSE SKIN IRRITATION.
MAY CAUSE ALLERGIC SKIN REACTION.
MAY CAUSE RESPIRATORY TRACT IRRITATION.

Relevant routes of exposure: Skin, Inhalation, Eyes

Potential Health Effects

Inhalation: May cause respiratory tract irritation.
Skin contact: May cause allergic skin reaction. May cause skin irritation.
Eye contact: Contact with eyes will cause irritation.
Ingestion: Not expected to be harmful by ingestion.

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Existing conditions aggravated by exposure:

Eye, skin, and respiratory disorders.

See Section 11 for additional toxicological information.

4. FIRST AID MEASURES

Inhalation:	Remove to fresh air. If symptoms develop and persist, get medical attention.
Skin contact:	Wash with soap and water. Remove contaminated clothing and shoes. Wash clothing before reuse. Get medical attention if symptoms occur.
Eye contact:	Flush with copious amounts of water, preferably, lukewarm water for at least 15 minutes, holding eyelids open all the time. Get medical attention.
Ingestion:	Do not induce vomiting. Keep individual calm. Obtain medical attention.

5. FIRE-FIGHTING MEASURES

Flash point:	Greater than 93°C (200°F) Tagliabue closed cup
Autoignition temperature:	Not available
Flammable/Explosive limits-lower %:	2.6 % (propylene glycol)
Flammable/Explosive limits-upper %:	12.5 % (propylene glycol)
Extinguishing media:	Foam, dry chemical or carbon dioxide.
Special fire fighting procedures:	None
Unusual fire or explosion hazards:	None
Hazardous combustion products:	Oxides of carbon. Oxides of sulfur. Oxides of nitrogen. Irritating organic vapors.

6. ACCIDENTAL RELEASE MEASURES

Environmental precautions:	Prevent product from entering drains or open waters.
Clean-up methods:	Soak up with inert absorbent. Store in a partly filled, closed container until disposal.

7. HANDLING AND STORAGE

Handling:	Avoid contact with eyes, skin and clothing. Avoid breathing vapor and mist. Wash thoroughly after handling.
Storage:	For safe storage, store at or below 38°C (100°F). Keep in a cool, well ventilated area away from heat, sparks and open flame. Keep container tightly closed until ready for use.
Incompatible products:	Refer to Section 10.

For information on product shelf life contact Henkel Customer Service at (800) 243-4874.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls:	No specific ventilation requirements noted, but forced ventilation may still be required if concentrations exceed occupational exposure limits.
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Respiratory protection: Use NIOSH approved respirator if there is potential to exceed exposure limit(s).

Skin protection: Use impermeable gloves and protective clothing as necessary to prevent skin contact. Neoprene gloves. Butyl rubber gloves. Natural rubber gloves.

Eye/face protection: Safety goggles or safety glasses with side shields.

See Section 2 for exposure limits.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Liquid
Color: Blue
Odor: Mild
Vapor pressure: Less than 5 mm Hg at 27°C (80°F)
pH: Not applicable
Boiling point/range: Greater than 149°C (300°F)
Melting point/range: Not available
Specific gravity: 1.1 at 23.9°C (75°F)
Vapor density: Not available
Evaporation rate: Not available
Solubility in water: Slight
Partition coefficient (n-octanol/water): Not available
VOC content: 4.48%; 49.3 grams/liter (EPA Method 24)

10. STABILITY AND REACTIVITY

Stability: Stable.

Hazardous polymerization: Will not occur.

Hazardous decomposition products: Oxides of carbon. Oxides of sulfur. Oxides of nitrogen. Irritating organic vapors.

Incompatibility: Strong oxidizers. Free radical initiators. Strong reducing agents. Alkalis. Oxygen scavengers. Other polymerization initiators. Copper. Iron. Zinc. Aluminum. Rust.

Conditions to avoid: See "Handling and Storage" (Section 7) and "Incompatibility" (Section 10).

11. TOXICOLOGICAL INFORMATION

Product toxicity data: Acute oral LD50 greater than 10,000 mg/kg (rat). Acute dermal LD50 greater than 5000 mg/kg (rabbit).

Carcinogen Status

Hazardous components	NTP Carcinogen	IARC Carcinogen	OSHA Carcinogen
Polyglycol dimethacrylate 25852-47-5	No	No	No
Polyglycol oleate 9004-96-0	No	No	No
Saccharin 81-07-2	No	No	No
Silica, amorphous, fumed, crystalline-free 112945-52-5	No	No	No
Cumene hydroperoxide 80-15-9	No	No	No
Propylene glycol 57-55-6	No	No	No

Literature Referenced Target Organ & Other Health Effects

Item No. : 24231

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Product name: 242® Threadlocker

Hazardous components	Health Effects/Target Organs
Polyglycol dimethacrylate 25852-47-5	Allergen, Irritant
Polyglycol oleate 9004-96-0	Irritant
Saccharin 81-07-2	No Target Organs
Silica, amorphous, fumed, crystalline-free 112945-52-5	Nuisance dust
Cumene hydroperoxide 80-15-9	Allergen, Central nervous system, Corrosive, Irritant, Mutagen
Propylene glycol 57-55-6	Irritant

12. ECOLOGICAL INFORMATION

Ecological information: Not available

13. DISPOSAL CONSIDERATIONS

Information provided is for unused product only.

Recommended method of disposal: Dispose of according to Federal, State and local governmental regulations.

EPA hazardous waste number: Not a RCRA hazardous waste.

14. TRANSPORT INFORMATION

U.S. Department of Transportation Ground (49 CFR):

Proper shipping name: Unrestricted
Hazard class or division: None
Identification number: None
Packing group: None

International Air Transportation (ICAO/IATA):

Proper shipping name: Unrestricted
Hazard class or division: None
Identification number: None
Packing group: None

WaterTransportation (IMO/IMDG):

Proper shipping name: Unrestricted
Hazard class or division: None
Identification number: None
Packing group: None
Marine pollutant: None

15. REGULATORY INFORMATION

United States Regulatory Information

TSCA 8 (b) Inventory Status:	All components are listed or are exempt from listing on the Toxic Substances Control Act Inventory.
TSCA 12 (b) Export Notification:	4-Methoxyphenol (150-76-5).
CERCLA/SARA Section 302 EHS:	None above reporting de minimus.
CERCLA/SARA Section 311/312:	Immediate Health Hazard, Delayed Health Hazard
CERCLA/SARA 313:	This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 (40 CFR 372). Cumene hydroperoxide (CAS# 80-15-9) .
California Proposition 65:	This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

Canada Regulatory Information

CEPA DSL/NDL Status:	All components are listed on or are exempt from listing on the Domestic Substances List.
WHMIS hazard class:	D.2.B

16. OTHER INFORMATION

This material safety data sheet contains changes from the previous version in sections: 15

Prepared by: Kyra Kozak Woods, Product Safety and Regulatory Affairs Specialist

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Revision Date: 04/01/2004

Issue date: 04/01/2004

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product name: Loctite(R) 7649 Primer N
Product type: Accelerator
Company address:
Henkel Corporation
1001 Trout Brook Crossing
Rocky Hill, Connecticut 06067

Item number: 19269
Region: United States
Contact Information:
Telephone: 860.571.5100
Emergency telephone: 860.571.5100
Internet: www.loctite.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>Hazardous components</u>	<u>%</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>OTHER</u>
Acetone 67-64-1	60-100	500 ppm TWA 750 ppm STEL	1000 ppm TWA 2400 mg/m ³ TWA	None
2-Ethylhexanoic acid 149-57-5	0.1-1	5 mg/m ³ TWA	None	None

3. HAZARDS IDENTIFICATION**EMERGENCY OVERVIEW****HMIS:**

Physical state: Liquid
Color: Green
Odor: Acetone

HEALTH: 2*
FLAMMABILITY: 3
PHYSICAL HAZARD: 0
Personal Protection: See Section 8

DANGER: FLAMMABLE LIQUID AND VAPOR.
CAUSES EYE AND SKIN IRRITATION.
MAY CAUSE RESPIRATORY TRACT IRRITATION.

Relevant routes of exposure: Inhalation, Skin contact, Eye contact, Ingestion

Potential Health Effects

Inhalation: Harmful if inhaled. Vapors and mists will irritate nose and throat and possibly eyes. May cause respiratory tract irritation. Headache, dizziness, nausea, and loss of coordination are indications of excessive exposure to vapors or spray mists.

Skin contact: May cause skin irritation. Solvent action can dry and defat the skin, causing the skin to crack, leading to dermatitis.

Eye contact: Vapors may irritate eyes. Contact with eyes will cause irritation.

Ingestion: Harmful if swallowed.

Existing conditions aggravated by exposure: Eye, skin, and respiratory disorders.

See Section 11 for additional toxicological information.

Item number: 19269

Product name: Loctite(R) 7649 Primer N

4. FIRST AID MEASURES

Inhalation:	Remove to fresh air. If discomfort persists seek medical attention.
Skin contact:	Wash with soap and water.
Eye contact:	Flush with copious amounts of water, preferably, lukewarm water for at least 15 minutes, holding eyelids open all the time.
Ingestion:	If conscious, drink plenty of water. Do not induce vomiting. Keep individual calm. Obtain medical attention.

5. FIRE-FIGHTING MEASURES

Flash point:	-20°C (-4°F) (estimated)
Autoignition temperature:	465°C (869°F)
Flammable/Explosive limits-lower %:	2.6 %
Flammable/Explosive limits-upper %:	13 %
Extinguishing media:	Foam, dry chemical or carbon dioxide.
Special fire fighting procedures:	None
Unusual fire or explosion hazards:	Vapors may accumulate in low or confined areas, travel considerable distance to source of ignition, and flash back.
Hazardous combustion products:	Oxides of carbon. Oxides of nitrogen. Irritating organic vapors.

6. ACCIDENTAL RELEASE MEASURES

Environmental precautions:	Prevent product from entering drains or open waters.
Clean-up methods:	Remove all ignition sources. Ensure adequate ventilation. Soak up with inert absorbent. Store in a closed container until ready for disposal.

7. HANDLING AND STORAGE

Handling:	Avoid contact with eyes, skin and clothing. Avoid breathing vapor and mist. Wash thoroughly after handling. During use and until all vapors are gone: Keep area ventilated - do not smoke; extinguish all flames, pilot lights, and heaters; turn off stoves, electrical tools and appliances, and any other sources of ignition.
Storage:	Store away from heat, sparks, flames, or other sources of ignition. For safe storage, store at or below 49°C (120°F).
Incompatible products:	Refer to Section 10.

For information on product shelf life contact Henkel Customer Service at (800) 243-4874.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls:	Use local ventilation if general ventilation is insufficient to maintain vapor concentration below established exposure limits.
Respiratory protection:	Use NIOSH approved respirator if there is potential to exceed exposure limit(s).

Item number: 19269

Product name: Loctite(R) 7649 Primer N

Skin protection: Chemical resistant, impermeable gloves.

Eye/face protection: Safety goggles or safety glasses with side shields.

See Section 2 for exposure limits.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Liquid
Color: Green
Odor: Acetone
Vapor pressure: 172 mmHg at 20 °C (68 °F)
pH: Not applicable
Boiling point/range: 56°C (133°F)
Melting point/range: Not available
Specific gravity: 0.7936
Vapor density: 2.0
Evaporation rate: 1.9 (Ether = 1)
Solubility in water: Completely miscible
Partition coefficient (n-octanol/water): Not available
VOC content: 1.48%; 11.7 grams/liter (EPA Method 24)

10. STABILITY AND REACTIVITY

Stability: Stable.

Hazardous polymerization: Will not occur.

Hazardous decomposition products: Oxides of carbon. Oxides of nitrogen. Irritating organic vapors.

Incompatibility: Strong oxidizers.

Conditions to avoid: See "Handling and Storage" (Section 7) and "Incompatibility" (Section 10).

11. TOXICOLOGICAL INFORMATION

Carcinogen Status

Hazardous components	NTP Carcinogen	IARC Carcinogen	OSHA Carcinogen
Acetone	No	No	No
2-Ethylhexanoic acid	No	No	No

Literature Referenced Target Organ & Other Health Effects

Hazardous components	Health Effects/Target Organs
Acetone	Blood, Central nervous system, Irritant, Reproductive
2-Ethylhexanoic acid	Developmental, Eyes, Irritant, Liver, Reproductive

12. ECOLOGICAL INFORMATION

Ecological information: Not available

13. DISPOSAL CONSIDERATIONS

Information provided is for unused product only.

Recommended method of disposal: Dispose of according to Federal, State and local governmental regulations.

EPA hazardous waste number: D001: Ignitable.

Item number: 19269

Product name: Loctite(R) 7649 Primer N

14. TRANSPORT INFORMATION

U.S. Department of Transportation Ground (49 CFR):

Proper shipping name: Acetone
Hazard class or division: 3
Identification number: UN 1090
Packing group: II
Exceptions: Consumer Commodity ORM-D (Not more than 1 Liter)

International Air Transportation (ICAO/IATA):

Proper shipping name: Acetone
Hazard class or division: 3
Identification number: UN 1090
Packing group: II
Exceptions: Consumer Commodity ID8000 (Not more than 500 ml)

WaterTransportation (IMO/MDG):

Proper shipping name: Acetone
Hazard class or division: 3
Identification number: UN 1090
Packing group: II
Exceptions: Dangerous goods in limited quantities of class 3 (Not more than 1 liter(s))
Marine pollutant: None

15. REGULATORY INFORMATION

United States Regulatory Information

TSCA 8 (b) Inventory Status: All components are listed or are exempt from listing on the Toxic Substances Control Act Inventory.
TSCA 12 (b) Export Notification: Acetone (CAS# 67-64-1).

CERCLA/SARA Section 302 EHS: None.
CERCLA/SARA Section 311/312: Immediate Health Hazard, Delayed Health Hazard, Fire
CERCLA/SARA 313: None above reporting de minimus.

California Proposition 65: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm. Nickel (CAS# 7440-02-0). Cobalt (CAS# 7440-48-4). Formaldehyde (CAS# 50-00-0). Acetaldehyde (CAS# 75-07-0). Benzene (CAS# 71-43-2).

Canada Regulatory Information

CEPA DSL/NDL Status: All components are listed on or are exempt from listing on the Domestic Substances List.
WHMIS hazard class: B.2, D.2.A, D.2.B

16. OTHER INFORMATION

This material safety data sheet contains changes from the previous version in sections: Expanded chemical information in Section 2 and related sections.

Prepared by: Kyra Kozak Woods, Health and Regulatory Affairs Specialist

DISCLAIMER: The data contained herein are furnished for information only and are believed to be reliable. However, Henkel Corporation does not assume responsibility for any results obtained by persons over whose methods Henkel Corporation has no control. It is the user's responsibility to determine the suitability of Henkel's products or any production methods mentioned herein for a particular purpose, and to adopt such precautions as may be advisable for the protection of property and persons against any hazards that may be involved in the handling and use of any of Henkel Corporation's products. In light of the foregoing, Henkel Corporation specifically disclaims all warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, arising from sale or use of Henkel Corporation's products. Henkel Corporation further disclaims any liability for consequential or incidental damages of any kind, including lost profits.

Item number: 19269

Product name: Loctite(R) 7649 Primer N

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MATERIAL SAFETY DATA SHEET

QUICK TAP

SECTION 1:

IDENTIFICATION

Company Name:	QUALICHEM, INC.
Address:	P.O. BOX 926 SALEM, VA 24153
Phone No.	(540) 375-6700
Fax No.	(540) 375-3880
Emergency Phone No.	CHEM-TEL 800-255-3924
Date Prepared:	9/14/10
Date Revised:	3/28/12

SECTION 2:

INGREDIENTS

<u>MATERIAL</u>	<u>CAS NO.</u>	<u>%</u>
ALKANES, CHLORO	61788-76-9	5-10

SECTION 3:

HEALTH HAZARDS

Ingestion:	MAY CAUSE IRRITATION OF THE DIGESTIVE SYSTEM.
Inhalation:	NOT A LIKELY ROUTE OF EXPOSURE. MAY CAUSE IRRITATION.
Skin Contact:	MAY CAUSE IRRITATION.
Eye Contact:	MAY CAUSE IRRITATION.
Other Information:	NONE KNOWN.

SECTION 4:

FIRST AID

Ingestion:	DRINK SEVERAL GLASSES OF WATER TO DILUTE. DO NOT INDUCE VOMITING. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. GET MEDICAL ATTENTION.
Inhalation:	REMOVE VICTIM TO FRESH AIR. GET MEDICAL ATTENTION IF SYMPTOMS PERSIST.
Skin Contact:	WASH WITH PLAIN WATER OR SOAP AND WATER.
Eye Contact:	IMMEDIATELY FLUSH WITH CLEAR WATER FOR 15 MINUTES AND GET MEDICAL ATTENTION IF IRRITATION PERSISTS.
Notes to Physician:	NONE KNOWN. TREAT SYMPTOMS WITH SUPPORTIVE MEASURES.

SECTION 5:

FIRE AND EXPLOSION HAZARD DATA

Flash Point/Method:	>200°C/ C.C.
Lower Limit in Air:	ND
Upper Limit in Air:	ND
Extinguishing Media:	FOAM, DRY CHEMICAL, CO2, WATER SPRAY OR FOG.
Procedures:	SELF-CONTAINED BREATHING APPARATUS SHOULD BE USED IN CONFINED AREAS. COOL EXPOSED CONTAINERS WITH WATER. AVOID BREATHING SMOKE, VAPOR OR FUMES.
Unusual Hazards:	NONE
Combustion Products:	OXIDES OF CARBON AND SULFUR MAY BE PRODUCED

SECTION 6:

ACCIDENTAL RELEASE MEASURES

Personal Precautions:	WEAR PERSONAL PROTECTIVE EQUIPMENT AS SPECIFIED IN SECTION 8. SPILLED MATERIAL CAN BE VERY SLIPPERY.
Procedures for Clean-up:	SMALL SPILLS - ABSORB IN SAWDUST OR ANY AVAILABLE ABSORBANT, PLACE RESIDUE IN SUITABLE CONTAINER FOR DISPOSAL. LARGE SPILLS - DIKE OR OTHERWISE CONTAIN LIQUID. ABSORB IN SAWDUST OR ANY AVAILABLE ABSORBANT, PLACE RESIDUE IN A SEALED, LIQUID-PROOF CONTAINER FOR DISPOSAL. CLEAN CONTAMINATED SURFACES WITH WATER OR AQUEOUS CLEANING AGENTS. OBEY ALL FEDERAL, STATE OR LOCAL REGULATIONS.
Prohibited Materials:	NONE

MATERIAL SAFETY DATA SHEET

QUICK TAP

SECTION 7:

HANDLING AND STORAGE

Handling:	AVOID EYE AND SKIN CONTACT. DO NOT TAKE INTERNALLY. USE WITH ADEQUATE VENTILATION.
Storage:	KEEP OUT OF REACH OF CHILDREN. STORE IN A COOL, DRY PLACE. KEEP CONTAINERS TIGHTLY CLOSED WHEN NOT IN USE.

SECTION 8:

EXPOSURE CONTROLS/PERSONAL PROTECTION

Precautionary Measures:	STANDARD INDUSTRIAL HANDLING PRECAUTIONS. WASH THOROUGHLY AFTER HANDLING CHEMICALS.
Engineering Controls:	USE WITH ADEQUATE VENTILATION.
Control Limits:	NONE.
Equipment for Personal Protection:	WEAR CHEMICAL SAFETY GLASSES OR GOGGLES, PROTECTIVE GLOVES, AND STANDARD PROTECTIVE CLOTHING WHEN HANDLING THE CONCENTRATE. EYEWASH STATION IN AREA OF USE.

SECTION 9:

PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	CLEAR, LIGHT AMBER LIQUID.
Odor:	MILD FATTY
pH (5% in DI water):	NA
Specific Gravity:	0.90-0.92
Density:	7.59 lbs./gal.
Solubility in Water:	INSOLUBLE
Boiling Point:	>600°F
Percent Volatile:	0
Vapor Pressure (mmHg):	N.D.
Vapor Density:	N.D. BUT HEAVIER THAN AIR
Evaporation Rate:	(water=1): <1

SECTION 10:

STABILITY AND REACTIVITY

Stability:	STABLE
Conditions to Avoid:	NONE
Hazardous Polymerization:	STABLE
Incompatibility:	STRONG OXIDIZING AGENTS, ACIDS OR ALKALIES.
Hazardous Decomposition Products:	OXIDES OF CARBON AND SULFUR WILL BE PRODUCED BY COMBUSTION.

SECTION 11:

TOXICOLOGICAL INFORMATION

Materials and Tests:	NO TOXICITY STUDIES HAVE BEEN CONDUCTED ON THIS PRODUCT.
Carcinogenicity:	NO COMPONENT OF THIS PRODUCT IS LISTED AS A CARCINOGEN BY IARC, NTP, OR ACGIH.
Sensitization:	NOT A SENSITIZER.
Mutagenicity:	NO COMPONENT OF THIS PRODUCT IS CLASSIFIED AS A MUTAGEN.
Teratogenicity:	NO COMPONENT OF THIS PRODUCT IS CLASSIFIED AS A TERATOGEN

SECTION 12:

ECOLOGICAL INFORMATION

Ecotoxicity:	NO TOXICITY TESTING HAS BEEN PERFORMED ON THIS PRODUCT.
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SECTION 13:

DISPOSAL CONSIDERATIONS

General Considerations:	THIS PRODUCT WOULD NOT BE CONSIDERED AS A HAZARDOUS WASTE.
Procedures:	DISPOSAL BY USE PREFERRED. DISPOSE OF THIS PRODUCT FOLLOWING ALL FEDERAL, STATE, OR LOCAL REGULATIONS.

MATERIAL SAFETY DATA SHEET

QUICK TAP

SECTION 14:

TRANSPORT INFORMATION

Shipping Name:	NOT REGULATED.
----------------	----------------

SECTION 15:

REGULATORY INFORMATION

<u>Regulation</u>	<u>Material</u>	<u>RQ</u>	<u>Max. %</u>
CERCLA (40 CFR302.4):	NONE		
SARA 302 (Sect. 355, Appendix A):	<u>Material</u>	<u>TPQ</u>	<u>Max. %</u>
SARA 311/312:	<u>Categories</u>	<u>Hazards</u>	
	NONE		
SARA 313 (40 CFR 372.45):	<u>Material</u>		<u>Max. %</u>
	NONE		
CWA (40 CFR 401.15):	NONE		
RCRA (40 CFR 261):	NONE		
Notes:	THIS PRODUCT NOT A HAZARDOUS WASTE PER RCRA REGULATIONS.		
OSHA (29 CFR 1910.1200):	ALL COMPONENTS LISTED UNDER THIS STANDARD ARE SHOWN IN SECTION 2 OF THIS MSDS.		
WHMIS (Canada):	CLASS D-2B: MATERIAL CAUSING OTHER TOXIC EFFECTS (TOXIC). THIS PRODUCT HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CONTROLLED PRODUCTS REGULATIONS AND THE MSDS CONTAINS ALL THE INFORMATION REQUIRED BY THE CONTROLLED PRODUCTS REGULATIONS.		
Inventories:	ALL INGREDIENTS IN THIS PRODUCT ARE LISTED IN TSCA AND DSL (CANADA) INVENTORIES.		

SPECIAL STATE REGULATIONS

<u>STATE</u>	<u>INGREDIENT</u>	<u>%</u>	<u>REGULATORY DESIGNATION</u>
NONE			

SECTION 16 OTHER INFORMATION

SUGGESTED HAZARD RATINGS

<u>NFPA*</u>	<u>HAZARD</u>	<u>HMIS*</u>
1	HEALTH (Blue)	1
1	FIRE (Red)	1
0	REACTIVITY (Yellow)	0
	PERSONAL PROTECTION	B
	SPECIAL HAZARDS	

*Notes: 0 = Insignificant; 1 = Slight; 2 = Moderate; 3 = High; 4 = Extreme

The data contained in this Material Safety Data Sheet has been prepared based upon an evaluation of the ingredients in the product, their concentration in the product and potential interactions. The information is offered in good faith and is believed to be accurate. It is furnished to the customer who is urged to study it carefully to become aware of hazards, if any, in the storage, handling, use and disposal of the product; and to ensure his employees are properly informed and advised of all safety precautions required. The information is furnished for compliance with the "Occupational Safety and Health Act" of 1970, the "Hazards Communication Act" of 1983 as well as various other Federal, State and Local regulations. Use or dissemination of all or part of this information for any other purpose is prohibited by law.

Revision 1.4

DATE PRINTED: September 24, 2013

PAGE No. 3



Safety Data Sheet according to (EC) No 1907/2006

Page 1 of 14

LOCTITE 248

sds no. : 153639
V004.1

Revision: 02.05.2013
printing date: 26.02.2014

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

LOCTITE 248

1.2. Relevant identified uses of the substance or mixture and uses advised against

Intended use:

Anaerobic

1.3. Details of the supplier of the safety data sheet

Henkel Ireland
Operations and Research Limited
Tallaght Business Park
Dublin 24

Ireland

Phone: +353 (14046444)

Fax-no.: +353 (14519926)

ua-productsafety.uk@uk.henkel.com

1.4. Emergency telephone number

24 Hours Emergency Tel: +44 (0)1442 278497

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (DPD):

Xi - Irritant

R36/37 Irritating to eyes and respiratory system.

2.2. Label elements

Label elements (DPD):

Xi - Irritant



Risk phrases:

R36/37 Irritating to eyes and respiratory system.

Safety phrases:

S25 Avoid contact with eyes.

S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

S51 Use only in well-ventilated areas.

Additional labeling:

For consumer use only: S2 Keep out of the reach of children

S46 If swallowed, seek medical advice immediately and show this container or label.

2.3. Other hazards

None if used properly.

SECTION 3: Composition/information on ingredients

General chemical description:

Methacrylate resin based threadlocker

Declaration of the ingredients according to CLP (EC) No 1272/2008:

Hazardous components CAS-No.	EC Number REACH-Reg No.	content	Classification
Polyamide wax~	477-310-1 01-0000019941-65	>= 10- < 25 %	Chronic hazards to the aquatic environment 4 H413
Ethane-1,2-diol 107-21-1	203-473-3 01-2119456816-28	> 1- < 3 %	Acute toxicity 4; Oral H302
Cumene hydroperoxide 80-15-9	201-254-7	> 1- < 2,5 %	Acute toxicity 4; Dermal H312 Specific target organ toxicity - repeated exposure 2 H373 Acute toxicity 3; Inhalation H331 Acute toxicity 4; Oral H302 Organic peroxides E H242 Chronic hazards to the aquatic environment 2 H411 Skin corrosion 1B H314
1-Methyl-2-pyrrolidone 872-50-4	212-828-1 01-2119472430-46	> 0,1- < 0,5 %	Toxic to reproduction 1B H360D Serious eye irritation 2 H319 Specific target organ toxicity - single exposure 3 H335 Skin irritation 2 H315
Cumene 98-82-8	202-704-5	> 0,1- < 0,5 %	Flammable liquids 3 H226 Aspiration hazard 1 H304 Specific target organ toxicity - single exposure 3 H335 Chronic hazards to the aquatic environment 2 H411

For full text of the H - statements and other abbreviations see section 16 "Other information".
Substances without classification may have community workplace exposure limits available.

Declaration of ingredients according to DPD (EC) No 1999/45:

Hazardous components CAS-No.	EC Number REACH-Reg No.	content	Classification
Polyamide wax~	477-310-1 01-0000019941-65	>= 10 - < 25 %	R53
Ethane-1,2-diol 107-21-1	203-473-3 01-2119456816-28	> 1 - < 3 %	Xn - Harmful; R22
Cumene hydroperoxide 80-15-9	201-254-7	> 1 - < 2,5 %	T - Toxic; R23 Xn - Harmful; R21/22, R48/20/22 O - Oxidizing; R7 C - Corrosive; R34 N - Dangerous for the environment; R51/53
1-Methyl-2-pyrrolidone 872-50-4	212-828-1 01-2119472430-46	> 0,1 - < 0,5 %	Toxic for reproduction - category 2.; R61 Xi - Irritant; R36/37/38
Cumene 98-82-8	202-704-5	> 0,1 - < 0,5 %	R10 Xn - Harmful; R65 Xi - Irritant; R37 N - Dangerous for the environment; R51/53

For full text of the R-Phrases indicated by codes see section 16 'Other Information'.
Substances without classification may have community workplace exposure limits available.

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation:

Move to fresh air. If symptoms persist, seek medical advice.

Skin contact:

Rinse with running water and soap.

Obtain medical attention if irritation persists.

Eye contact:

Rinse immediately with plenty of running water (for 10 minutes), seek medical attention from a specialist.

Ingestion:

Rinse mouth, drink 1-2 glasses of water, do not induce vomiting, consult a doctor.

4.2. Most important symptoms and effects, both acute and delayed

EYE: Irritation, conjunctivitis.

RESPIRATORY: Irritation, coughing, shortness of breath, chest tightness.

4.3. Indication of any immediate medical attention and special treatment needed

See section: Description of first aid measures

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media:

Carbon dioxide, foam, powder

Extinguishing media which must not be used for safety reasons:

None known

5.2. Special hazards arising from the substance or mixture

Trace amounts of toxic and/or irritating fumes may be released and the use of breathing apparatus is recommended.

5.3. Advice for firefighters

Wear self-contained breathing apparatus and full protective clothing, such as turn-out gear.

Additional information:

In case of fire, keep containers cool with water spray.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Avoid skin and eye contact.

6.2. Environmental precautions

Waste disposal with the approval of the responsible local authority.

Do not let product enter drains.

6.3. Methods and material for containment and cleaning up

For small spills wipe up with paper towel and place in container for disposal.

For large spills absorb onto inert absorbent material and place in sealed container for disposal.

6.4. Reference to other sections

See advice in chapter 8

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Use only in well-ventilated areas.

Avoid skin and eye contact.

Prolonged or repeated skin contact should be avoided to minimise any risk of sensitisation.

Hygiene measures:

Good industrial hygiene practices should be observed.

Do not eat, drink or smoke while working.

Wash hands before work breaks and after finishing work.

7.2. Conditions for safe storage, including any incompatibilities

Store in original containers at 8-21°C (46.4-69.8°F) and do not return residual materials to containers as contamination may reduce the shelf life of the bulk product.

7.3. Specific end use(s)

Anaerobic

SECTION 8: Exposure controls/personal protection**8.1. Control parameters****Occupational Exposure Limits**

Valid for

Great Britain

Ingredient	ppm	mg/m ³	Type	Category	Remarks
ETHANE-1,2-DIOL, PARTICULATE 107-21-1		10	Time Weighted Average (TWA):		EH40 WEL
ETHANE-1,2-DIOL, VAPOUR 107-21-1	20	52	Time Weighted Average (TWA):		EH40 WEL
ETHANE-1,2-DIOL, PARTICULATE 107-21-1			Skin designation:	Can be absorbed through the skin.	EH40 WEL
ETHANE-1,2-DIOL, VAPOUR 107-21-1			Skin designation:	Can be absorbed through the skin.	EH40 WEL
ETHANE-1,2-DIOL, VAPOUR 107-21-1	40	104	Short Term Exposure Limit (STEL):		EH40 WEL
ETHYLENE GLYCOL 107-21-1	20	52	Time Weighted Average (TWA):	Indicative	ECTLV
ETHYLENE GLYCOL 107-21-1	40	104	Short Term Exposure Limit (STEL):	Indicative	ECTLV
N-METHYL-2-PYRROLIDONE 872-50-4	20	80	Short Term Exposure Limit (STEL):		EH40 WEL
N-METHYL-2-PYRROLIDONE 872-50-4	10	40	Time Weighted Average (TWA):		EH40 WEL
N-METHYL-2-PYRROLIDONE 872-50-4			Skin designation:	Can be absorbed through the skin.	ECTLV
N-METHYL-2-PYRROLIDONE 872-50-4	20	80	Short Term Exposure Limit (STEL):	Indicative	ECTLV
N-METHYL-2-PYRROLIDONE 872-50-4	10	40	Time Weighted Average (TWA):	Indicative	ECTLV
CUMENE 98-82-8			Skin designation:	Can be absorbed through the skin.	EH40 WEL
CUMENE 98-82-8	50	250	Short Term Exposure Limit (STEL):		EH40 WEL
CUMENE 98-82-8	25	125	Time Weighted Average (TWA):		EH40 WEL
CUMENE 98-82-8	50	250	Short Term Exposure Limit (STEL):	Indicative	ECTLV
CUMENE 98-82-8	20	100	Time Weighted Average (TWA):	Indicative	ECTLV

Predicted No-Effect Concentration (PNEC):

Name on list	Environmental Compartment	Exposure period	Value				Remarks
			mg/l	ppm	mg/kg	others	
Ethane-1,2-diol 107-21-1	aqua (freshwater)					10 mg/L	
Ethane-1,2-diol 107-21-1	aqua (marine water)					1 mg/L	
Ethane-1,2-diol 107-21-1	sediment (freshwater)				20,9 mg/kg		
Ethane-1,2-diol 107-21-1	STP					199,5 mg/L	
Ethane-1,2-diol 107-21-1	aqua (intermittent releases)					10 mg/L	
Ethane-1,2-diol 107-21-1	soil				1,53 mg/kg		
1-Methyl-2-pyrrolidone 872-50-4	aqua (freshwater)					0,25 mg/L	
1-Methyl-2-pyrrolidone 872-50-4	aqua (marine water)					0,025 mg/L	
1-Methyl-2-pyrrolidone 872-50-4	aqua (intermittent releases)					5 mg/L	
1-Methyl-2-pyrrolidone 872-50-4	sediment (freshwater)				0,805 mg/kg		
1-Methyl-2-pyrrolidone 872-50-4	soil				0,138 mg/kg		
1-Methyl-2-pyrrolidone 872-50-4	STP					10 mg/L	
1-Methyl-2-pyrrolidone 872-50-4	oral				0,00167 mg/kg		
1-Methyl-2-pyrrolidone 872-50-4	sediment (marine water)				0,0805 mg/kg		

Derived No-Effect Level (DNEL):

Name on list	Application Area	Route of Exposure	Health Effect	Exposure Time	Value	Remarks
Ethane-1,2-diol 107-21-1	worker	dermal	Long term exposure - systemic effects		106 mg/kg bw/day	
Ethane-1,2-diol 107-21-1	worker	inhalation	Long term exposure - local effects		35 mg/m3	
Ethane-1,2-diol 107-21-1	general population	dermal	Long term exposure - systemic effects		53 mg/kg bw/day	
Ethane-1,2-diol 107-21-1	general population	inhalation	Long term exposure - local effects		7 mg/m3	
1-Methyl-2-pyrrolidone 872-50-4	worker	dermal	Acute/short term exposure - systemic effects		208 mg/kg bw/day	
1-Methyl-2-pyrrolidone 872-50-4	worker	inhalation	Acute/short term exposure - systemic effects		80 mg/m3	
1-Methyl-2-pyrrolidone 872-50-4	worker	dermal	Long term exposure - systemic effects		19,8 mg/kg bw/day	
1-Methyl-2-pyrrolidone 872-50-4	worker	inhalation	Long term exposure - systemic effects		40 mg/m3	
1-Methyl-2-pyrrolidone 872-50-4	general population	dermal	Acute/short term exposure - systemic effects		125 mg/kg bw/day	
1-Methyl-2-pyrrolidone 872-50-4	general population	inhalation	Acute/short term exposure - systemic effects		80 mg/m3	
1-Methyl-2-pyrrolidone 872-50-4	general population	oral	Acute/short term exposure - systemic effects		26 mg/kg bw/day	
1-Methyl-2-pyrrolidone 872-50-4	general population	dermal	Long term exposure - systemic effects		11,9 mg/kg bw/day	
1-Methyl-2-pyrrolidone 872-50-4	general population	inhalation	Long term exposure - systemic effects		12,5 mg/m3	
1-Methyl-2-pyrrolidone 872-50-4	general population	oral	Long term exposure - systemic effects		6,3 mg/kg bw/day	

Biological Exposure Indices:

None

8.2. Exposure controls:**Respiratory protection:**

Use only in well-ventilated areas.

Hand protection:

Chemical-resistant protective gloves (EN 374).

Suitable materials for short-term contact or splashes (recommended: at least protection index 2, corresponding to > 30 minutes permeation time as per EN 374):

nitrile rubber (NBR; ≥ 0.4 mm thickness)

Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374):

nitrile rubber (NBR; ≥ 0.4 mm thickness)

This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced.

Eye protection:
Wear protective glasses.

Skin protection:
Wear suitable protective clothing.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	solid blue
Odor	characteristic
Odour threshold	No data available / Not applicable
pH	not applicable
Initial boiling point	> 150,0 °C (> 302 °F)
Flash point	> 100 °C (> 212 °F)
Decomposition temperature	No data available / Not applicable
Vapour pressure (25,0 °C (77 °F))	< 6,66 mbar
Density ()	1,1000 g/cm3
Bulk density	No data available / Not applicable
Viscosity	No data available / Not applicable
Viscosity (kinematic)	No data available / Not applicable
Explosive properties	No data available / Not applicable
Solubility (qualitative) (Solvent: Water)	Slight
Solubility (qualitative) (Solvent: Acetone)	Not determined
Solidification temperature	No data available / Not applicable
Melting point	No data available / Not applicable
Flammability	No data available / Not applicable
Auto-ignition temperature	No data available / Not applicable
Explosive limits	No data available / Not applicable
Partition coefficient: n-octanol/water	No data available / Not applicable
Evaporation rate	No data available / Not applicable
Vapor density	No data available / Not applicable
Oxidising properties	No data available / Not applicable

9.2. Other information

No data available / Not applicable

SECTION 10: Stability and reactivity

10.1. Reactivity

Strong oxidizing agents.
Free radical initiators.

10.2. Chemical stability

Stable under recommended storage conditions.

10.3. Possibility of hazardous reactions

See section reactivity

10.4. Conditions to avoid

No decomposition if used according to specifications.

10.5. Incompatible materials

None if used properly.

10.6. Hazardous decomposition products

Oxides of carbon.

SECTION 11: Toxicological information**11.1. Information on toxicological effects****General toxicological information:**

The preparation is classified based on the conventional method outlined in Article 6(1)(a) of Directive 1999/45/EC. Relevant available health/ecological information for the substances listed under Section 3 is provided in the following.

Oral toxicity:

May cause irritation to the digestive tract.

Inhalative toxicity:

Irritating to respiratory system

Skin irritation:

Although it is not a common sensitizer there may be a risk of sensitization on prolonged or repeated contact with damaged skin

Eye irritation:

Irritating to eyes.

Acute oral toxicity:

Hazardous components CAS-No.	Value type	Value	Route of application	Exposure time	Species	Method
Ethane-1,2-diol 107-21-1	LD50	> 2.000 mg/kg	oral		rat	EU Method B.1 (Acute Toxicity (Oral))
Cumene hydroperoxide 80-15-9	LD50	550 mg/kg	oral		rat	
1-Methyl-2-pyrrolidone 872-50-4	LD50	5.010 mg/kg	oral		rat	

Acute inhalative toxicity:

Hazardous components CAS-No.	Value type	Value	Route of application	Exposure time	Species	Method
1-Methyl-2-pyrrolidone 872-50-4	LC50	> 5,1 mg/l	inhalation	4 h	rat	OECD Guideline 403 (Acute Inhalation Toxicity)

Skin corrosion/irritation:

Hazardous components CAS-No.	Result	Exposure time	Species	Method
Cumene hydroperoxide 80-15-9	corrosive		rabbit	
1-Methyl-2-pyrrolidone 872-50-4	moderately irritating		human	
1-Methyl-2-pyrrolidone 872-50-4	slightly irritating		rabbit	

Serious eye damage/irritation:

Hazardous components CAS-No.	Result	Exposure time	Species	Method
1-Methyl-2-pyrrolidone 872-50-4	irritating		rabbit	

Germ cell mutagenicity:

Hazardous components CAS-No.	Result	Type of study / Route of administration	Metabolic activation / Exposure time	Species	Method
Ethane-1,2-diol 107-21-1	negative	bacterial reverse mutation assay (e.g Ames test)	with and without		
Cumene hydroperoxide 80-15-9	positive	bacterial reverse mutation assay (e.g Ames test)	without		OECD Guideline 471 (Bacterial Reverse Mutation Assay)
Cumene hydroperoxide 80-15-9	negative	dermal		mouse	

Repeated dose toxicity

Hazardous components CAS-No.	Result	Route of application	Exposure time / Frequency of treatment	Species	Method
1-Methyl-2-pyrrolidone 872-50-4	NOAEL=0,5 mg/l	inhalation	90 days 6 hrs/day, 5 days/wk	rat	OECD Guideline 413 (Subchronic Inhalation Toxicity: 90-Day)

SECTION 12: Ecological information**General ecological information:**

The preparation is classified based on the conventional method outlined in Article 6(1)(a) of Directive 1999/45/EC. Relevant available health/ecological information for the substances listed under Section 3 is provided in the following.

In the cured state contribution of this product to Environmental Hazards is insignificant in comparison to articles in which it is used.

12.1. Toxicity**Ecotoxicity:**

Do not empty into drains / surface water / ground water.

Hazardous components CAS-No.	Value type	Value	Acute Toxicity Study	Exposure time	Species	Method
Ethane-1,2-diol 107-21-1	NOEC	15.380 mg/l	Fish	28 d	Oryzias latipes	OECD Guideline 204 (Fish, Prolonged Toxicity Test: 14-day Study)
	LC50	72.860 mg/l	Fish	96 h	Pimephales promelas	OECD Guideline 203 (Fish, Acute Toxicity Test)
Ethane-1,2-diol 107-21-1	EC50	34.400 mg/l	Daphnia	48 h	Ceriodaphnia sp.	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)
Ethane-1,2-diol 107-21-1	EC50	> 20.000 mg/l	Algae		Microcystis aeruginosa	OECD Guideline 201 (Alga, Growth Inhibition Test)
Ethane-1,2-diol 107-21-1	NOEC	8.590 mg/l	chronic Daphnia	7 d	Ceriodaphnia sp.	OECD 211 (Daphnia magna, Reproduction Test)
Cumene hydroperoxide 80-15-9	LC50	3,9 mg/l	Fish	96 h	Oncorhynchus mykiss	OECD Guideline 203 (Fish, Acute Toxicity Test)
Cumene hydroperoxide 80-15-9	EC50	18 mg/l	Daphnia	48 h	Daphnia magna	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)
Cumene hydroperoxide 80-15-9	ErC50	3,1 mg/l	Algae	72 h	Pseudokirchnerella subcapitata	OECD Guideline 201 (Alga, Growth Inhibition Test)
1-Methyl-2-pyrrolidone 872-50-4	LC50	4.000 mg/l	Fish	96 h	Leuciscus idus	
1-Methyl-2-pyrrolidone 872-50-4	EC50	4.897 mg/l	Daphnia	48 h	Daphnia magna	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)
1-Methyl-2-pyrrolidone 872-50-4	EC50	> 500 mg/l	Algae	72 h	Scenedesmus subspicatus (new name: Desmodesmus subspicatus)	
Cumene 98-82-8	LC50	4,8 mg/l	Fish	96 h	Oncorhynchus mykiss	OECD Guideline 203 (Fish, Acute Toxicity Test)
Cumene 98-82-8	EC50	4 mg/l	Daphnia	48 h	Daphnia magna	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)
Cumene 98-82-8	EC50	2,6 mg/l	Algae	72 h	Selenastrum capricornutum (new name: Pseudokirchnerella subcapitata)	OECD Guideline 201 (Alga, Growth Inhibition Test)

12.2. Persistence and degradability

Persistence and Biodegradability:

The product is not biodegradable.

Hazardous components CAS-No.	Result	Route of application	Degradability	Method
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Polyamide wax~		no data	24 %	
Ethane-1,2-diol 107-21-1	readily biodegradable	aerobic	83 - 96 %	OECD Guideline 301 C (Ready Biodegradability: Modified MITI Test (I))
Cumene hydroperoxide 80-15-9			18 %	OECD Guideline 301 E (Ready biodegradability: Modified OECD Screening Test)
1-Methyl-2-pyrrolidone 872-50-4		aerobic	99 %	OECD Guideline 301 E (Ready biodegradability: Modified OECD Screening Test)
Cumene 98-82-8		aerobic	86 %	

12.3. Bioaccumulative potential / 12.4. Mobility in soil**Mobility:**

Cured adhesives are immobile.

Bioaccumulative potential:

No data available.

Hazardous components CAS-No.	LogKow	Bioconcentration factor (BCF)	Exposure time	Species	Temperature	Method
Polyamide wax~	> 6,5				22 °C	OECD Guideline 117 (Partition Coefficient (n-octanol / water), HPLC Method)
Ethane-1,2-diol 107-21-1	-1,36					
Cumene hydroperoxide 80-15-9		9,1		calculation		OECD Guideline 305 (Bioconcentration: Flow-through Fish Test)
Cumene hydroperoxide 80-15-9	2,16					
1-Methyl-2-pyrrolidone 872-50-4	-0,11					
Cumene 98-82-8		35,5		Carassius auratus		OECD Guideline 305 (Bioconcentration: Flow-through Fish Test)
Cumene 98-82-8	3,55				23 °C	OECD Guideline 107 (Partition Coefficient (n-octanol / water), Shake Flask Method)

12.5. Results of PBT and vPvB assessment

Hazardous components CAS-No.	PBT/vPvB
Polyamide wax~	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
Ethane-1,2-diol 107-21-1	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
1-Methyl-2-pyrrolidone 872-50-4	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.

12.6. Other adverse effects

No data available.

SECTION 13: Disposal considerations**13.1. Waste treatment methods**

Product disposal:

Dispose of in accordance with local and national regulations.

Contribution of this product to waste is very insignificant in comparison to article in which it is used

Disposal of uncleaned packages:

After use, tubes, cartons and bottles containing residual product should be disposed of as chemically contaminated waste in an authorised legal land fill site or incinerated.

Disposal must be made according to official regulations.

Waste code

08 04 09 waste adhesives and sealants containing organic solvents and other dangerous substances

SECTION 14: Transport information

14.1. UN number

Not hazardous according to RID, ADR, ADNR, IMDG, IATA-DGR.

14.2. UN proper shipping name

Not hazardous according to RID, ADR, ADNR, IMDG, IATA-DGR.

14.3. Transport hazard class(es)

Not hazardous according to RID, ADR, ADNR, IMDG, IATA-DGR.

14.4. Packaging group

Not hazardous according to RID, ADR, ADNR, IMDG, IATA-DGR.

14.5. Environmental hazards

Not hazardous according to RID, ADR, ADNR, IMDG, IATA-DGR.

14.6. Special precautions for user

Not hazardous according to RID, ADR, ADNR, IMDG, IATA-DGR.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

not applicable

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

VOC content < 3 %
(1999/13/EC)

15.2. Chemical safety assessment

A chemical safety assessment has not been carried out.

SECTION 16: Other information

The labelling of the product is indicated in Section 2. The full text of all abbreviations indicated by codes in this safety data sheet are as follows:

R10 Flammable.
R21/22 Harmful in contact with skin and if swallowed.
R22 Harmful if swallowed.
R23 Toxic by inhalation.
R34 Causes burns.
R36/37/38 Irritating to eyes, respiratory system and skin.
R37 Irritating to respiratory system.
R48/20/22 Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed.
R51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R53 May cause long-term adverse effects in the aquatic environment.
R61 May cause harm to the unborn child.
R65 Harmful: may cause lung damage if swallowed.
R7 May cause fire.
H226 Flammable liquid and vapor.
H242 Heating may cause a fire.
H302 Harmful if swallowed.
H304 May be fatal if swallowed and enters airways.
H312 Harmful in contact with skin.
H314 Causes severe skin burns and eye damage.
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H331 Toxic if inhaled.
H335 May cause respiratory irritation.
H360D May damage the unborn child.
H373 May cause damage to organs through prolonged or repeated exposure.
H411 Toxic to aquatic life with long lasting effects.
H413 May cause long lasting harmful effects to aquatic life.

Further information:

This information is based on our current level of knowledge and relates to the product in the state in which it is delivered. It is intended to describe our products from the point of view of safety requirements and is not intended to guarantee any particular properties.