KMT Waterjet Systems

STREAMLINE HIGH PRESSURE WATERJET PUMP

OPERATION and SERVICE MANUAL

SL-IV 100 hp
200-208v/3/50-60

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NOTICE

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1 SL-IV 100hp Waterjet Pump General Information

The Streamline SL-IV 100hp Waterjet Pump, maintains the level of component reliability and ease of installation and maintenance that have made the KMT Waterjet Streamline waterjet pumps the standard of the industry for both water and Hydrobrasive™ applications.

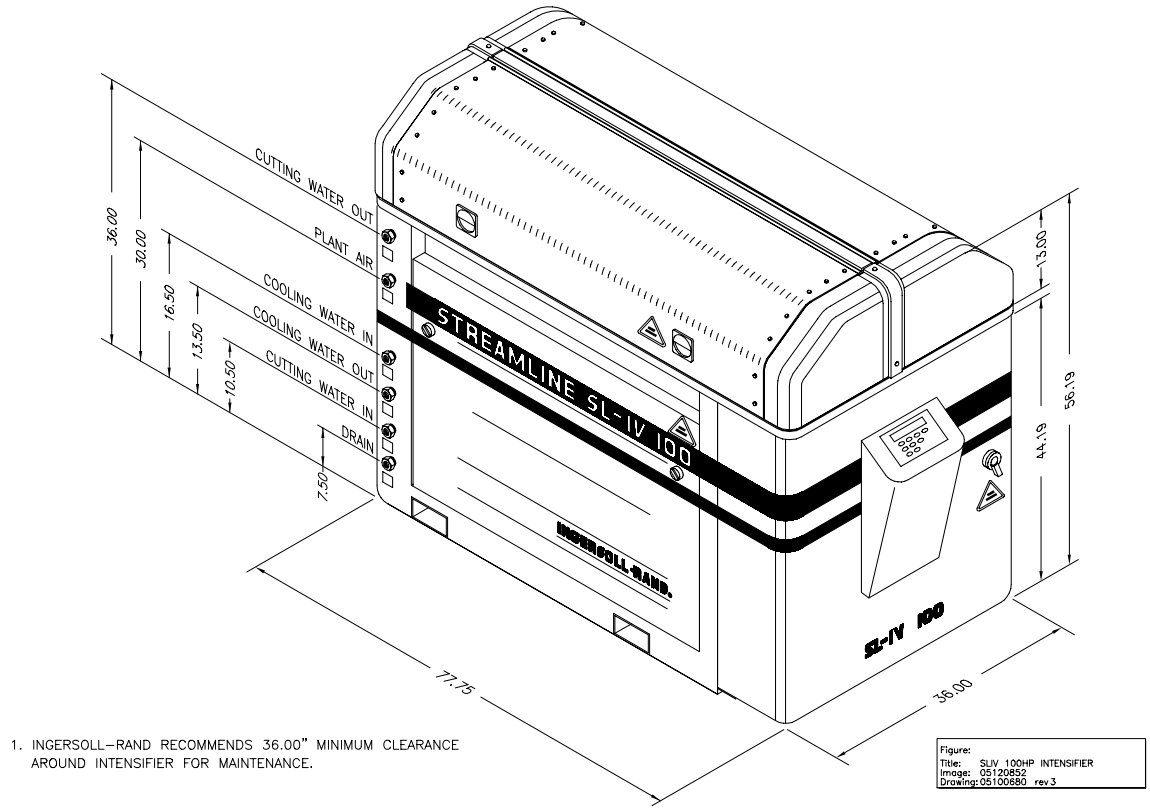
The SL-IV 100hp Waterjet Pump uses low pressure water, which meets certain quality requirements, and increases the pressure up to 3,800 bar (55,000 psi) for ultra-high–pressure waterjet cutting, hydrobrasive cutting, cleaning, surface preparation, etc.

This manual provides information for installation, operation, and maintenance of the SL-IV100hp Waterjet Pump.

1.1 Physical Description

The 100hp waterjet pump is equipped with two simultaneously operating hydraulic intensifiers, two high pressure attenuators, a motor/hydraulic pump assembly, an electric starter panel, control sensors, solenoids and logic, control interface panel, a low pressure water boost pump, and a low pressure water filter.

It is enclosed in a frame with the dimensions of 77.75” length, 36.0” width, and 56.19” height. The high pressure system is conveniently mounted on a drip pan. All service components are easily accessible from at least two sides simplifying maintenance. The entire high pressure system can be removed from the rest of the unit quickly for maintenance and serviceability.



1.1.1 Standard Equipment

Following is an overview of the standard equipment for the SL-IV100hp Waterjet Pump:

- Variable displacement, pressure compensated hydraulic pump
- Water pressure boost and filtration system with 10-micron double-length filter
- High efficiency heat exchanger in independent recirculation pump circuit
- Stand-alone unit with built-in Wye Delta motor starter
- High pressure safety dump valve
- Dual pressure compensator
- 2 High pressure attenuators
- Microprocessor control with diagnostic capability
- Water inlet shut-off valve
- Boost pump
- Separate water and oil drip pans
- Electrical remote control interface

1.2 Functional Description

The SL-IV100hp Waterjet Pump meets the automotive and industrial markets needs of low to high volume production of water jet pumps. The maximum HP water pressure is limited by a hydraulic relief valve that is certified and sealed by TUV. No HP rupture disk is required.

The HP intensifier is a reciprocating, double-ended hydraulic operated, electrically shifted hydraulic piston type. The HP intensifiers work in parallel, while the two HP attenuators reduce the routine fluctuations in the HP water pressure signal. The compression ratio is 20:1 with a maximum hydraulic pressure set at
3,100 psi.

The recirculation hydraulic loop for cooling and filtering oil runs continuously whenever the motor is running.

1.2.1 Functional Features

Following is a list of SL-IV100hp Waterjet Pump features:

- 4,150 bar (60,000 psi) design pressure
- 3,800 bar (55,000 psi) operating pressure
- Electronic reversing
- 24vdc safety control
- Standard high pressure water leak detection
- Standard dual pressure control facilitates hole piercing and kiss cut applications
- Exclusive long slow stroke
- Cartridge type hydraulic seal
- Low pressure water boost pump and filtration
- Reduced cooling water requirements
- Choice of English, German, Spanish, French, Swedish and Italian readouts as standard
- Meets CE requirements

1.3 Worldwide Product Support

The KMT waterjet Service Department serves the customer, by providing:

- Supervision of equipment installation, start up, and training for the number of days specified in the quotation, and per approved project. Additional time requested will be invoiced on a per diem basis, plus travel and normal living expenses.
- Field Services: on-site technical support is available on request. These services are invoiced on a per diem basis, plus travel, and normal living expenses.
- Technical Assistance: the Service Department is available for technical assistance by phone.
- Training: the Service Department conducts periodic training sessions at KMT Waterjet designated training locations. On-site training is also available.

1.3.1 Service Department

To contact the KMT Waterjet Service Department:

USA: Service Manager
KMT
Waterjet Systems
635 West 12th Street
Baxter Springs, KS 66713
USA
Phone:(620) 856–2151
Fax: (620) 856–5050

Europe: Technical Manager
KMT Waterjet Systems GmbH
Wasserstrahl–Schneidetechnik
Auf der Laukert 11
D–61231 Bad Nauheim
Germany
Phone:49–(0)6032–997–117
Fax: 49–(0)6032–997–270

1.3.2 Spare Parts

KMT waterjet maintains a well stocked Spare Parts Department staffed by well trained knowledgeable personnel. Emergency shipment is available.

Contact the Service Department of KMT Waterjet.

1.3.3 Questionnaire

The following equipment and service manual questionnaire will provide information to allow us to serve you better. Please complete them at your convenience and return to the applicable Service Department as shown above.

EQUIPMENT AND SERVICE MANUAL QUESTIONNAIRE

We have just installed a new SL-IV100hp Waterjet Pump at your location. We are interested in your initial impressions of the unit and its installation. Please take a few moments and answer the following questions.

1. General Appearance
   Was unit received in good condition? ☐ Yes ☐ No

   Comments: _____

2. Is the unit a convenient size? ☐ Yes ☐ No

3. Controls
   a. Are the controls user friendly? ☐ Yes ☐ No

   b. Is the unit easy to operate? ☐ Yes ☐ No

   Comments: _____

   _____

4. Performance
   a. Does the unit perform smoothly and meet your expectations? ☐ Yes ☐ No

   b. Does the unit run quietly? ☐ Yes ☐ No

   Comments: _____

   _____

5. Did installation and start-up go smoothly? ☐ Yes ☐ No

   Comments: _____

   _____

6. What feature(s) do you consider the most significant with this unit?
   Quiet Operation _____
   Appearance _____
   Performance (Operation) _____
   Repair/Maintenance _____

Other_____

7. What areas need improvement?
   Appearance _____
   Servicability _____
   Performance _____

   Other_____

Manual Organization

1. Does the table of contents help you find topics easily? ☐ Yes ☐ No

   Comments: _____

2. Is the information well organized? ☐ Yes ☐ No

   Comments: _____

3. Is the page layout suitable for the material being presented? ☐ Yes ☐ No

   Comments: _____

Graphics

1. How do you rate the quality and quantity of the photos/illustrations? ☐ Yes ☐ No

   Comments: _____

Text

1. Does the information in the manual adequately explain how to operate and service the equipment? ☐ Yes ☐ No

   Comments: _____

2. Are there paragraphs or procedures you feel need clarification? Please identify them by page number and add your comments. ☐ Yes ☐ No

   Comments: _____

3. Is there anything you would add or delete from the manual to make it more useful? ☐ Yes ☐ No

   Comments: _____

4. Is there any information that should receive more emphasis? ☐ Yes ☐ No

   Comments: _____

Name:_____ Title:_____

Company _____

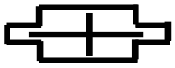
Address: _____

1.4 Safety

Safety procedures and safe practices must be followed during installation, operation, and maintenance of the waterjet pump. In this section we have provided label and sign descriptions used in this manual, as well as recommended safety procedures.

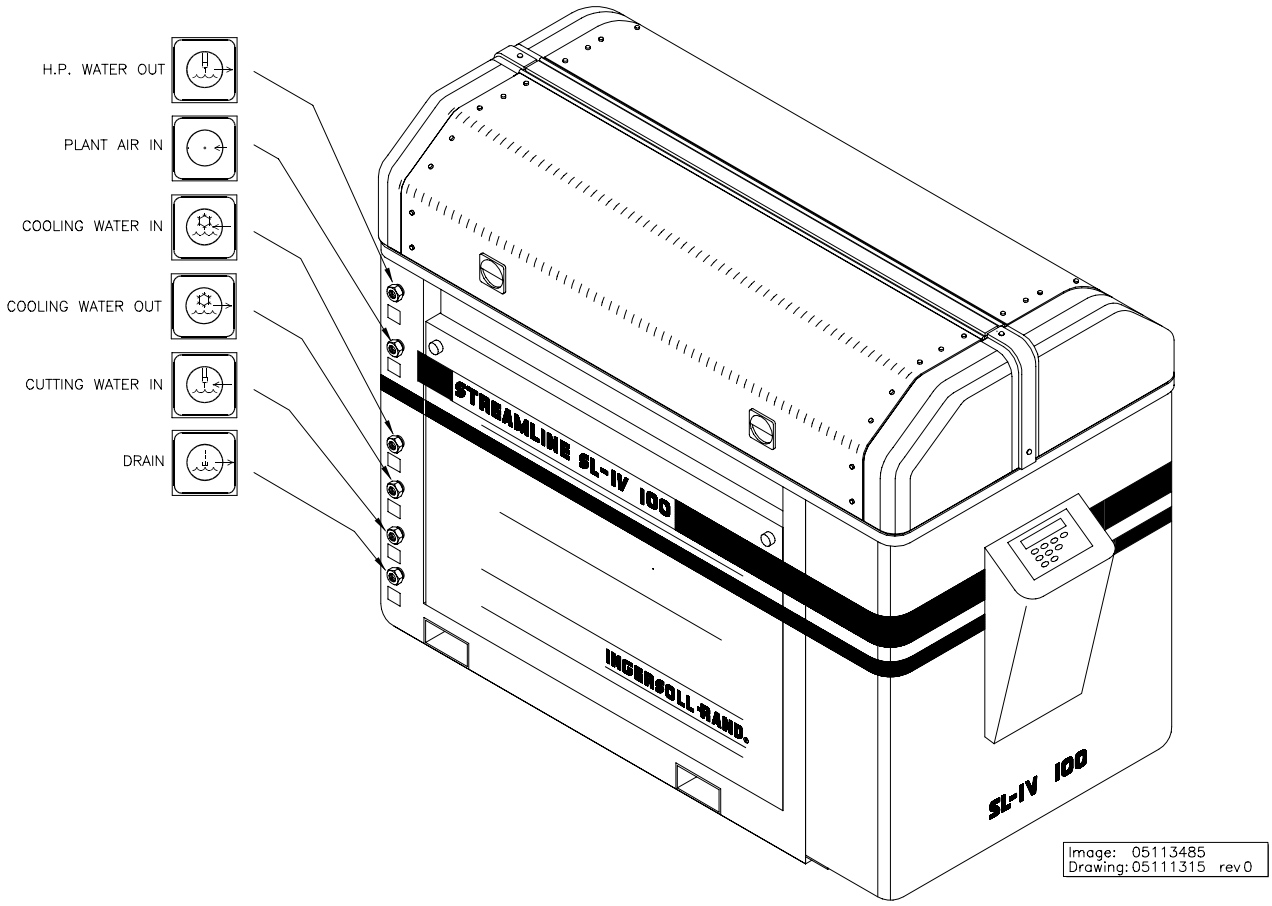
1.4.1 Labels and Abbreviations

The following describes hazard classifications of the waterjet pump.

CAUTION	Indicates the presence of a hazard, which can cause personal injury, or property damage if the caution instruction is ignored.
WARNING	Indicates the presence of a hazard, which can cause severe personal injury, death, or substantial property damage if the warning instruction is ignored.
	High pressure waterjet can cause eye injury. Wear eye protection when operating or working near machine.
	Hazardous noise can cause hearing loss. Wear ear protection when operating or working near machine.
	Hazardous voltage within can cause injury or death. Disconnect and lockout main power before opening cabinet.
!	Malfunction
	Hydraulic Intensifiers
	Pressure Control
	High Pressure
	Low Pressure
|	Start/Control Power On
	Stop
	Run

Rear of Waterjet Pump

- HP Water "OUT"
- Plant Air "IN"
- Cooling Water "IN"
- Cooling Water "OUT"
- Cutting Water "IN"
- Drain



1.4.2 Safety Procedures

Safety procedures must be observed while working on the pump, or any high pressure part of the installation. **Service should only be performed by qualified personnel.**

- The high pressure water, 3,800 bar (55,000 psi) in waterjet cutting systems should not be a cause for concern. Users must have due respect for these pressures and use proper SAFETY PROCEDURES and SAFE WORK HABITS.
- Everyone associated with the waterjet cutting system must realize that the force of the waterjet cutting stream can penetrate many dense or strong materials.
- Keep all untrained people away from the waterjet cutting area. Use barriers or partitions if needed.
- Safety glasses must be worn at all times in the waterjet cutting area.
- All **EMERGENCY STOP** buttons must be checked periodically. The normal operating position is pulled out.
- To check: turn on power and activate the **EMERGENCY STOP** buttons by pushing them in to see if the power goes off. Each device should be checked on a specified schedule. Each time the device is checked, it must function or be replaced before operating the system.
- Apply High Purity Goop (P/N 10084440) to all threaded high pressure connections. All tubing, fittings and bolted connections should be torqued to recommended values. Do NOT attempt to tighten or loosen a HP water fitting when the circuit is pressurized, see High Pressure (HP) Piping Safety.
- All high pressure leaks must be repaired immediately.
- Inspect all equipment on a scheduled basis.
- Before performing any maintenance on the unit, MECHANICALLY LOCK THE MAIN CONTROL POWER OFF, and assure the high pressure has been bled off.

Never do any work on the unit without making sure the electrical panel disconnect is locked out with a padlock in the OFF position.

Never work on any high pressure component, or loosen any high pressure fittings without first bleeding the system and assuring there is no high pressure water present.

Make sure the safety devices are operational. To panic stop the pump and bleed the high pressure, the EMERGENCY STOP buttons must be pushed in. The system pressure dump valves must be open.

Do not attempt to touch or be exposed to high pressure water. The high pressure water will penetrate all parts of human body without exception.

The liquid stream or material ejected by these extreme pressures can injure or kill.

1.4.3 High Pressure (HP) Piping Safety

High pressure piping must be installed without torsional or bending stresses. Proper supports and guides must be provided. 9/16" outside diameter HP tubing and fittings are recommended between the pump and the cutting station. This large tubing size will reduce vibration, strain and motion between the pump piping and the cutting area. The larger piping diameter also reduces pressure drop, and pressure pulsation.

Do not try to repair a leak in a HP water fitting when it is pressurized. Always shut off the power and bleed the HP water before doing maintenance on HP components. Weep holes are provided to release HP water if leakage occurs at a sealing surface. If a fitting is loosened with HP water present, a jet of HP water will exit the nearest weep hole with **possible hazardous results**.

Use extreme caution when handling high pressure equipment. Possible failure from fatigue cracking or over-pressurization can result in a hazardous high pressure leak, or component failure.

A flexible ¼" HP tube (whip) is frequently used on the cutting system to allow cutting nozzle movement. Supports and guides for the whip must be used, anti-vibration fittings and proper support must be provided to prevent failures from external loads (non-water related stresses).

When tightening or loosening HP connections, always use a supporting wrench to avoid bending forces or stress on the connection. Do not exceed recommended torque values

High pressure piping and fittings designed to 4,100 bar (60,000 psi) must always be used. Failure to do so may lead to catastrophic component failure, which can cause equipment damage, injury or even death.

1.4.4 Emergency Medical Treatment

An information card to aid treating a waterjet injury is included in the binder of each manual. The card is shown below. Contact the address shown for additional cards.

(Front Side)

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

(Back Side)

This person has been working with water jetting at pressures to 55,000 psi (374MPa, 3740 bar, 3867 Kg/cm^2) with a jet velocity of 3,000 fps (914 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.

2 Installation

The installation, start-up, operation, and maintenance of the SL-IV 100hp Waterjet Pump requires complete reading and study of this manual to understand the system in detail.

2.1 Installation Overview

- Read the manual and become familiar with the operation of each component and its nomenclature.
- Understand the complete system and its function before operating it.
- Safety procedures and safe practices must be followed during installation, operation, and maintenance of the SL-IV100hp Waterjet Pump.

2.1.1 Buyer Obligations

Equipment installation requires cooperation between the user and KMT Waterjet Systems. If on-site support is requested, the KMT Waterjet Service Department will require the following tasks be accomplished before arrival at the customer site.

- The waterjet cutting equipment should be uncrated, positioned and leveled, with electrical and fluid services brought to the unit.
- Provide and install power drops with fused disconnects sized to the equipment power requirements.
- Provide and install pneumatic drops with manual shutoff valves.
- Provide all mounting and support brackets and hardware for high pressure tubing runs.
- Provide and install water conditioning equipment necessary to meet water purity requirements. Provide and install manual shutoff valves.
- Provide and install necessary cooling water inlet/outlet, and drain water connections to the intensifier pump, and/or cutting equipment and manual shut-off valves.
- Provide suitably located and sized drains and proper disposal of waste water.
- Provide, install and connect wiring between the intensifier pumps, and the cutting station control system.
- KMT Waterjet supplies a pre-filled hydraulic system. If fluid is low or empty due to leakage during transit, the system must be filled per specifications.

2.1.2 Seller Obligations

If KMT Waterjet is requested, the following tasks will be the responsibility of the KMT Waterjet technician at installation.

- Insure site preparation is satisfactory.
- Remove internal strapping and blocking material.
- Insure that power is connected prior to equipment turn on.
- Insure that connections have been made for water and pneumatic service.
- Test motor rotation direction and correct if necessary.
- Check and test electrical signal connections between intensifier pump and cutting area.
- Power up and check out pump (and cutting station, if supplied by KMT Waterjet) for proper operation.
- Set boost pump discharge pressure.
- Install and test high pressure plumbing.
- Follow the standard test procedure to insure satisfactory performance.
- Train maintenance personnel in the performance of maintenance and repair procedures.
- Sign off the installation and testing on the KMT Waterjet standard acceptance document.

2.2 Installation Requirements (Utilities)

Environment: The SL-IV100hp Waterjet Pump must be installed indoors. Ambient conditions must not exceed maximum specifications.

Moving: The SL-IV100hp Waterjet Pump has provisions to be moved with a forklift. Check weight specifications.

The waterjet pump is top heavy. Avoid situations that could result in the equipment overturning

Electrical connections must be made by qualified personnel, and must meet national and local electrical codes.

2.2.1 Equipment Location/Environment

Space Requirements: There should be a minimum of 900mm (36 inches) clearance on all sides of the pump to facilitate service.

Electrical Wiring: Power supplied to the pump must be in accordance with national and local electrical codes. See specifications or requirements.

Control Wiring: Wiring for remote control of the pump must be in accordance with national and local electrical codes. The SL-IV100hp Waterjet Pump has a 24vdc electrical control system and has provisions for remote operation in the pump control panel.

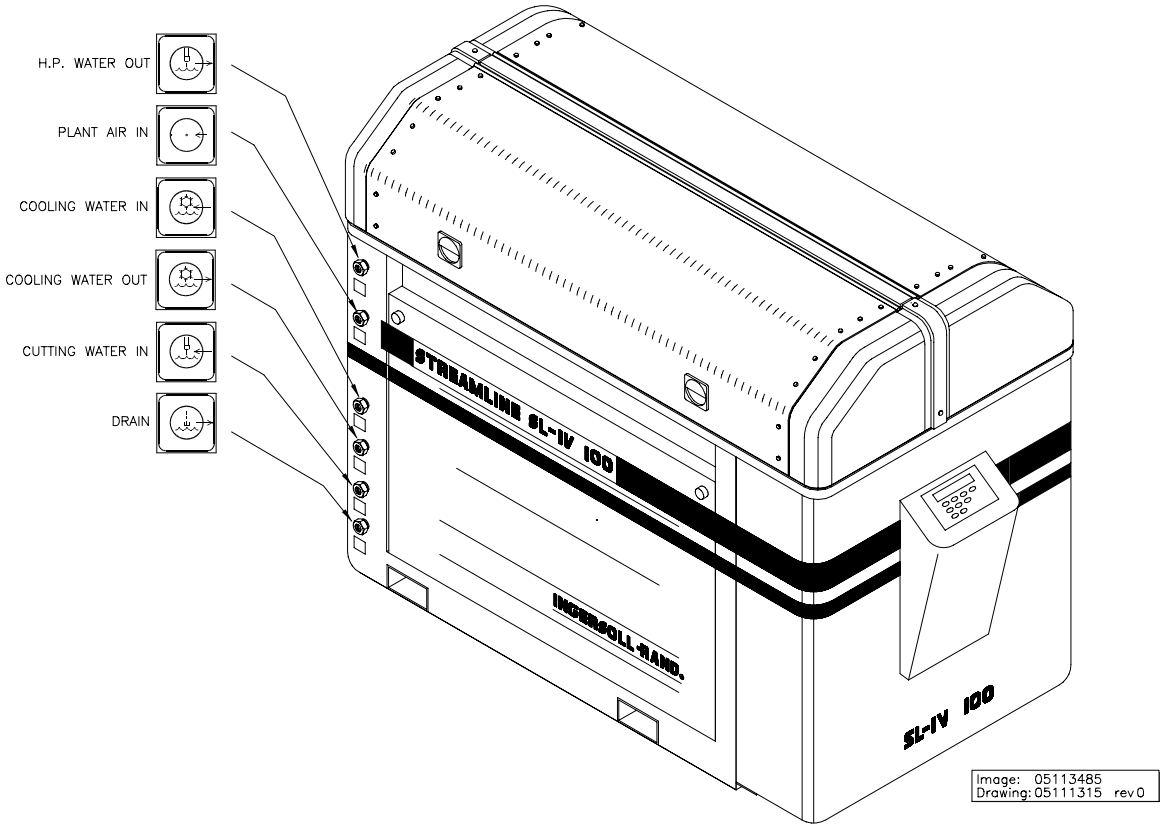
2.2.2 Service Connections

Cooling Water IN/OUT: Supply piping must be properly sized to handle the necessary flow, and pressure. Piping must meet national and local piping codes.

Cutting Water IN: Supply piping must be properly sized to handle the necessary flow and pressure. Piping must meet national and local piping codes.

HP Water OUT: Properly rated, sized, and well supported high pressure (HP) piping must be connected to the pump.

Drain: Cutting water released in the pump is discharged from the drain port and must be piped to an appropriate location (i.e. sewer line). Piping must meet national and local piping codes.

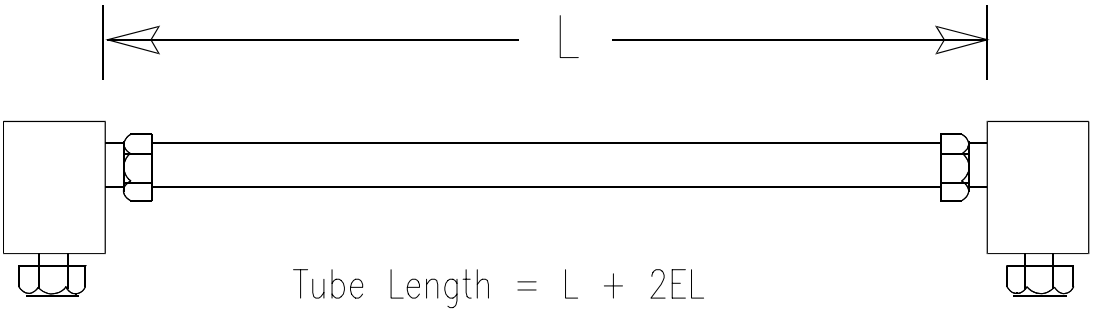


2.2.3 Tools and Equipment

HP Tube Coning and Threading Procedures

Determine Tube Length - Measure, the distance (L), between the fittings, then add two times the tube engagement length in the following table. Cut tubing to length and deburr.

WARNING High-pressure piping and fittings rated for 4,138 bar (60,000 psi) must be used. Failure to do so may cause component failure causing equipment damage, personal injury, or death.



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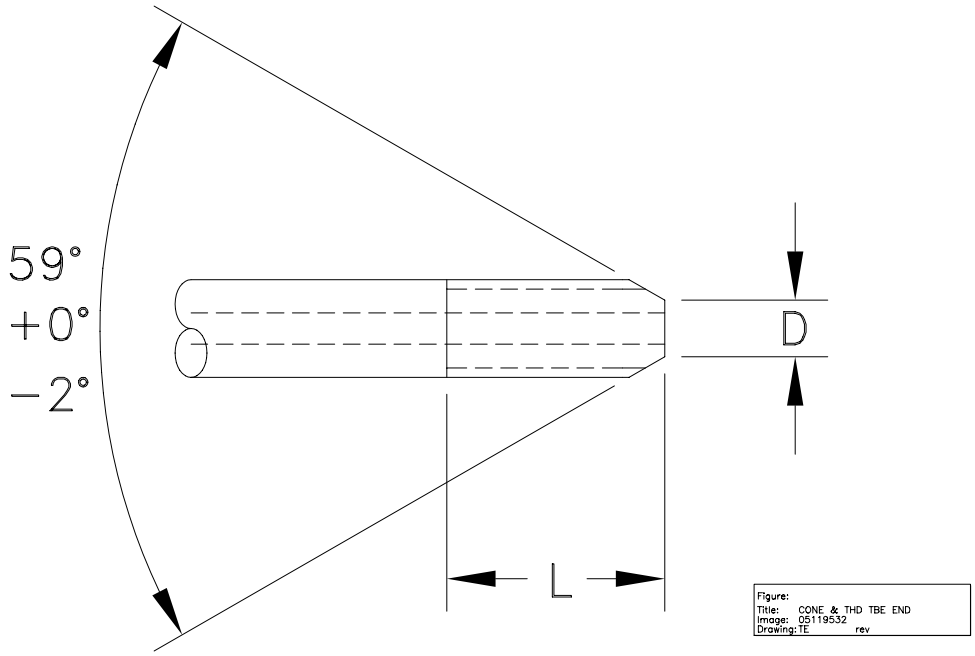
Drawing: HP TUBING rev --

Tube Engagement Length

HP Tube Diameter (inch)	Engagement Length (EL) mm (inch)
1/4"	12.7 (0.50)
3/8"	17.5 (0.69)
9/16"	21.3 (0.84)

Cone and Thread Tube

Cone and thread both ends of the tube per following diagram and procedure.

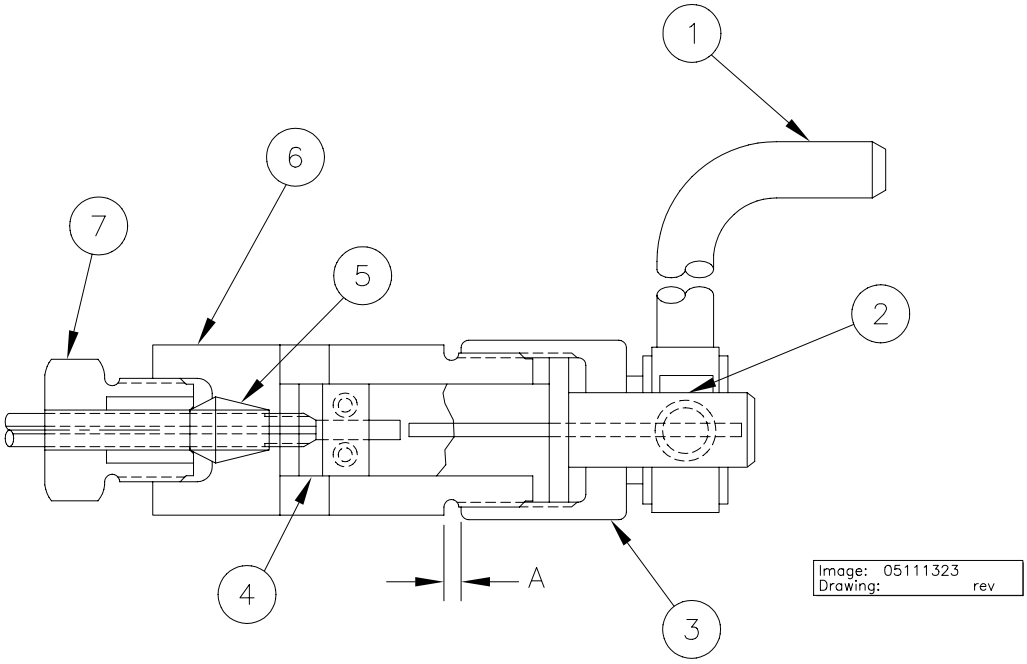


Cone and Thread Dimensions

O.D. Size mm (inch)	I.D. size mm (inch)	D (max) mm (inch)	L (max) mm (inch)	Thread NF-LH
6.35 (1/4")	2.11 (0.083)	3.58 (0.141)	14.3 (0.562)	(1/4"- 28)
9.52 (3/8")	3.18 (0.125)	5.56 (0.219)	19.1 (0.750)	(3/8"- 24)
14.27 (9/16")	4.78 (0.188)	7.14 (0.281)	23.8 (0.938)	(9/16"- 18)

To cone the tubing, use the following figure as reference.

Cone and Threading Tool



Item Description

(1) Cutter Handle (2) Cutter Support (3) Feed Nut
(4) Cutting Blades (5) Collet (6) Housing (7) Gland Nut

Tube Size (inch)	1/4”	3/8”	9/16”
A mm (inch)	3.30 (0.13)	4.07 (0.16)	7.11 (0.28)
Coning Tool (Part)	10079556	10097418	10079663
Threading Tool (Part)	10079697	10097434	10097442

Coning

- Place appropriate size coning tool in vise so that lubricant can flow to cutting blades (4).
- Set feed nut (3) location as shown in dimension A.
- Slide tubing through collet (5) until end contacts cutting blades (4) and tighten gland nut (7) just enough to slightly grip tubing.
- Turn feed nut (3) counterclockwise to back cutters away from tubing, and tighten gland nut (7) with wrench.
- Apply cutting oil through coning tool opening. A medium weight cutting oil having high sulfur content is recommended. Use cutting oil freely throughout the cutting operation.
- Turn feed nut (3) clockwise until cutting blades (4) contact end of tubing.
- Rotate cutter handle (1) in clockwise direction while simultaneously turning the feed nut (3) in a clockwise direction at a rate to assure that the cutting blades (4) are taking a light cut at all times.
- Continue rotating cutter handle until feed nut bottoms on housing (6), then rotate cutter handle several more revolutions to face-off end of cone.
- Unscrew feed nut (3), and remove the blade spindle (2) from the coning tool. Loosen the collet, slide the tubing (8) into the housing (6) until it extends approximately 100mm (4 inches) then retighten collet.

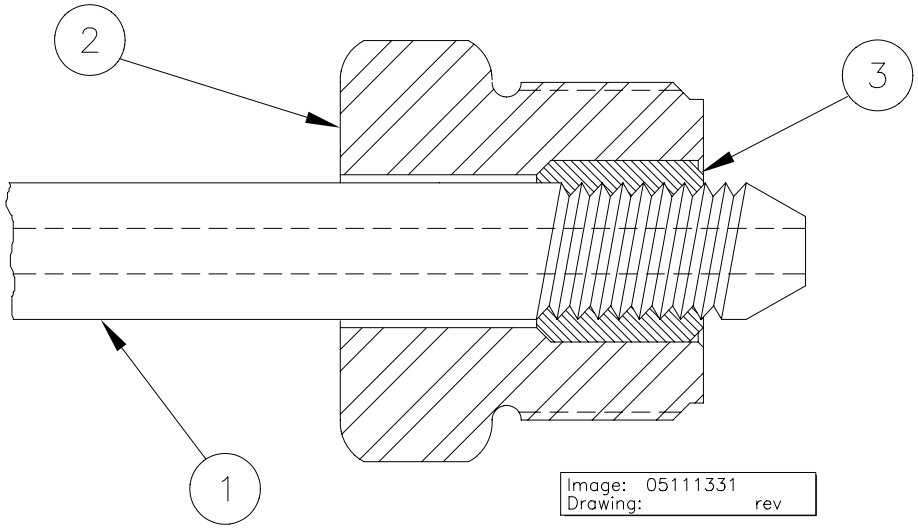
Threading

- Place appropriate size threading tool on coned end of tubing, apply pressure to start cutting action and rotate die holder counterclockwise until threads are cut per cone and thread dimension table.

HP Tube End Connection - Regular

The following type of connection is for general applications, where the only load on tubing is due to internal pressure.

1. Slip gland nut (2) on tubing (1) as shown and lubricate thread with High Purity Goop. Thread collar (3) on tubing until one to two threads are exposed between collar item (3) and tube cone.
2. Lubricate male threads of gland with High Purity Goop. Insert tubing in fitting, engage gland nut and tighten finger-tight.
3. Tighten gland to specified torque as given in the torque table specifications.

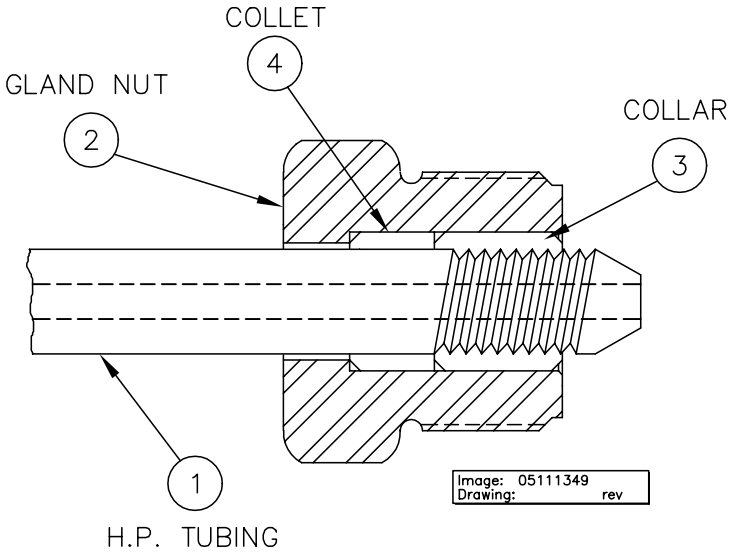


HP Tube End Connection – Anti-vibration

The following type of connection must be used when tubing is subjected to vibration, rotation, movement, and side loads (i.e. whip tubing). Lubricate threads as above.

WARNING Do not depend on end connection to take load alone. Proper piping support and guide must be provided.

1. Slip gland nut (2) and collet (4) on tubing (1), thread collar (3) until one to two threads are exposed between collar and tube cone.
2. Lubricate male threads of gland nut with High Purity Goop. Insert tubing in fitting, engage gland nut and finger tighten.
3. Tighten gland nut to the specified torque according to the table of Recommended Torque Values in this section.



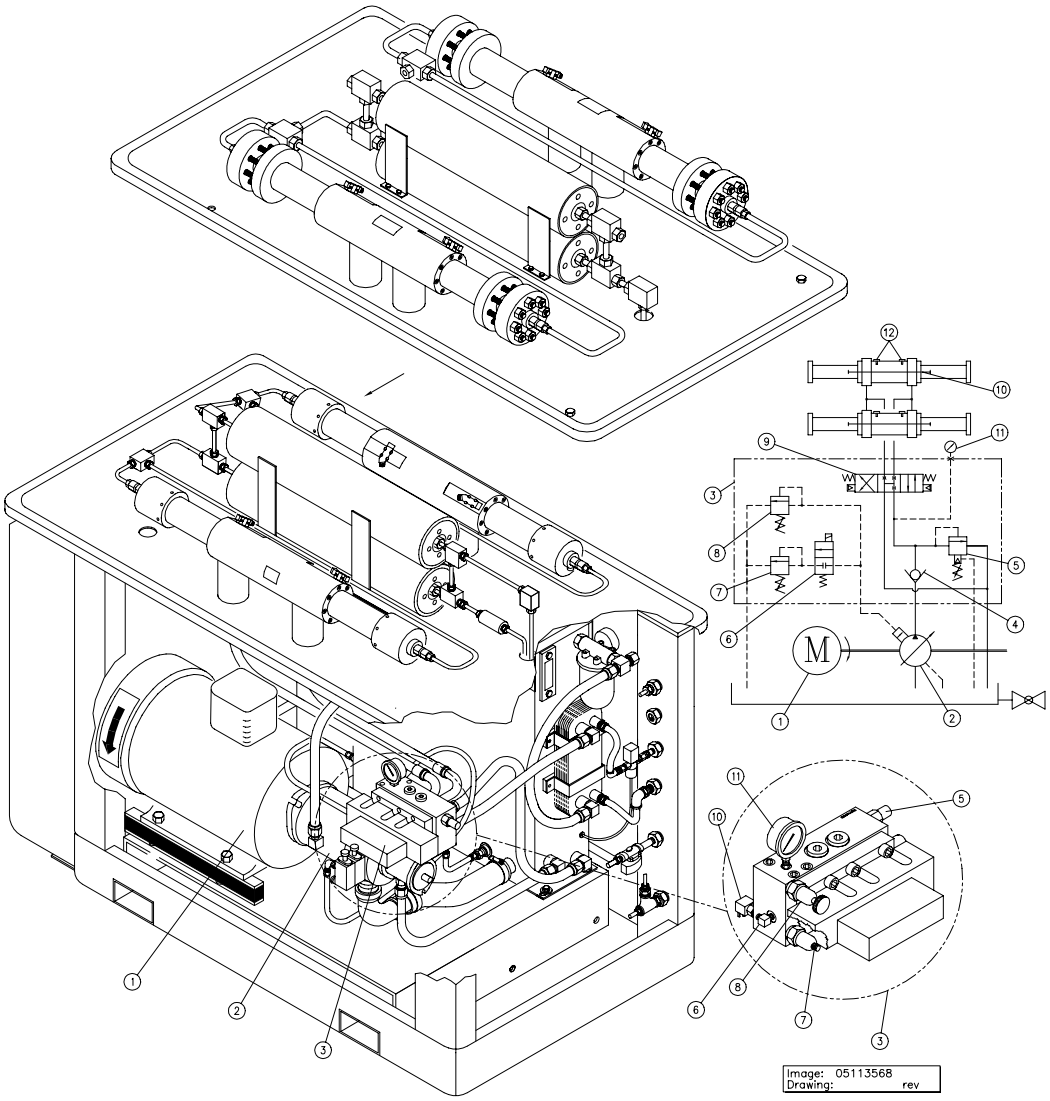
3 Operation

The SL-IV 100D Waterjet Pump is composed of the following systems:

- Low Pressure Water System
- High Pressure Water System
- Hydraulic System
- Recirculation System
- Electrical System (SLC 500 PLC w/2-line display)

3.1 Operation Overview

The following provides the component overview



Item Description

(1) Electric Motor	(2) Hydraulic Pump	(3) Manifold
(4) Check Valve	(5) Relief Valve	(6) Shutoff Valve
(7) LO Pressure Valve	(8) HI Pressure Valve	(9) Directional Control Valve
(10) Piston	(11) Pressure Gage	(12) Proximity Switch

3.2 Operator Console

Operator interface with the SL-IV 100D Waterjet Pump is through the operator's panel. The panel consists of the display keypad, emergency stop (E-Stop) palm button, and indicator lights. The keypad includes the start/stop function keys. The display shows the unit condition, hourmeter, and diagnostics.

All electrical power to the unit passes through the main disconnect, controlled by the panel disconnect handle on the enclosure.

The following shows the layout of buttons and lights of the operator's console for the waterjet pump.

3.2.1 Component Description

- **HI-LO Selector Switch (1):** Positions on this switch set low or high pressure. The positions are selected, depending on cutting requirements.
- **Keypad (3):** F1 to F8 functions.
- **LED (4):** Red LED on each function key indicates key is active.
- **CONTROL POWER ON (5):** White Lighted Pushbutton. After pulling out the E-STOP, press the CONTROL POWER ON button to power up the operator's console. When the white CONTROL POWER ON light is lit the 24vdc control power is ON, and the pump can be started.
- **Emergency Stop (E-STOP) (6):** Push in to stop pump. The E-STOP button causes the following actions:

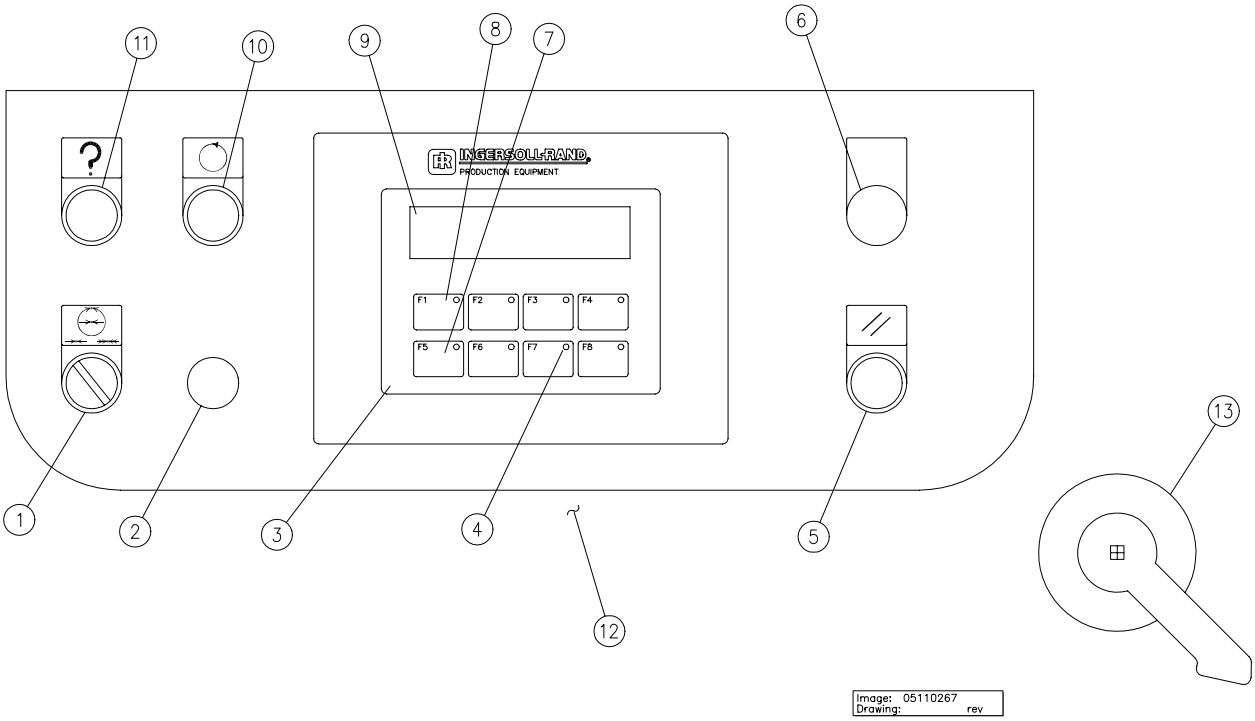
  Electrical control power is shut off and the electric motor, hydraulic pumps and intensifier assembly stop.

  The high pressure (HP) dump valve is opened. HP water is bled from the pump piping circuit.

  To reset the E-STOP button, pull out.

  For normal shutoff use the STOP (F5) button on keypad.
- **STOP (F5) (7):** Stops the pump in all but emergency stop situations. Pressing the STOP button shuts off electric motor and hydraulic pump. Electric control power (24vdc) stays on.
- **START (F1) (8):** Starts the pump, and generates high pressure.
- **Display (9):** Shows unit condition, hourmeter and diagnostics.
- **RUN (10):** Green light is ON when the pump is working normally.
- **PUMP PROBLEM (11):** Red light is ON when the pump stopped due to an abnormal condition. Blinking occurs during abnormal operation.

- **Panel Electrical Disconnect Handle (13):** Controls power to pump.
- **RESET (F6):** Must be pushed to re-open water supply valve after 2 minutes of non-use. Also, must be pushed before motor will re-start following a fault shutdown. The fault must be cleared before the reset will occur.
- **RECIRCULATION MODE (F2):** Starts the pump, but does not generate high pressure water. This mode allows quicker cooling of the hydraulic oil in the event of an over temperature shutdown. The pump will automatically turn off after ten minutes of recirculation mode.
- **LANGUAGE SELECTION (F8):** Selects the display language (English, Spanish, German, French, Italian, and Swedish).



3.2.2 Operating Procedures

The display on the operator's console provides information and diagnostics.

The following pages show start, stop and fault recovery procedures. The display messages are shown in a box representing the actual display.

The display language is set by pressing function key F8 (14); scroll by pressing F8 until necessary language (abbreviation displayed between brackets) is found.

START PROCEDURE

1. Pull EMERGENCY STOP (ES) PALMBUTTON (6).
2. Push CONTROL POWER ON button (5).
   CONTROL POWER ON button (5) light will be ON. Display (9) will be ON.
3. Display Messages:

   First

LDU L60 V 1.2
E2 SIZE = 8K

   5 Seconds Later

SLIV100-1 (ENG)
10.0 HRS

   F1 light (8) will go ON.
4. Push F1 (8) – motor starts and after a delay pump starts.
   F1 LED turns OFF
   F5 LED will be ON
   CONTROL POWER ON light will be ON
   RUN green light will be ON

   Message:

SLIV100-1 (ENG)
10.0 HRS

STOP PROCEDURE

From the following conditions, follow the procedure below to stop the unit:

F5 LED ON
RUN light ON
CONTROL POWER ON
Unit Running

1. Push F5, RUN light will go OFF
   F1 LED will go ON
   CONTROL POWER ON light will stay ON
   Unit will stop

2. Display Messages:

SLIV100-1 (ENG)
10.0 HRS

3.2.3 Remote Operation

The waterjet pump can also be started and stopped from a remote location. The following can be wired remotely:

- RUN (status light)
- "Malfunction" pump (status light)
- Start
- Stop
- HI/LO dual pressure control

Note: If the proportional pressure control is installed in place of the HI/LO hydraulic circuit proportional pressure control is available at the remote control location.

- Emergency stop

3.3 Initial Start-Up Procedure

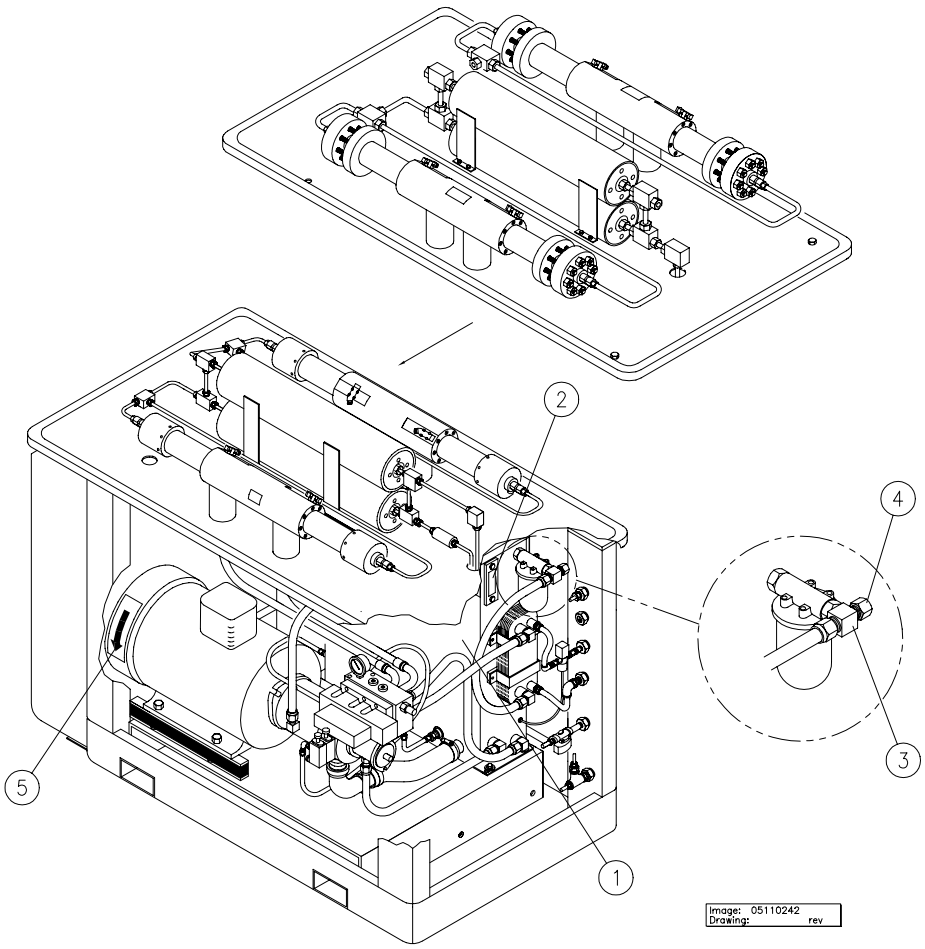
Make all connections for both electrical and water supply. Check the system for all correct connections before the unit is started for the first time. Assure safety standards have been observed. Following good safety practices will help you avoid injury and damage to the pump.

Become familiar with this operation section, and understand the electrical lights and switch functions before attempting to operate this unit.

3.3.1 Initial Pump Start Up Checks

The following checklist should be reviewed before turning on the unit.

- Verify all interface connections have been made.
- Verify all safety circuits are connected and operational.
- Make sure the oil tank (1) is full, check the sight glass (2) located on the side of the tank. If oil is needed, remove cap (4) and pump oil through fill port (3).



- Insure all cooling water valves, supply water valves, and high pressure valves are open.
- Check direction of motor rotation arrow (5).

CAUTION

Motor direction of rotation should be checked any time electrical maintenance/modification is performed on the motor starter wiring or on the service wiring to the pump.

Failure to verify correct motor rotation can result in costly damage to the hydraulic pump.

To Check Motor Direction

1. Remove the front cover from the pump and locate the motor rotation direction arrow (5). Two people are required for this procedure, one person to determine the motor fan rotation and the other person to jog the motor.

2. To jog motor, pull EMERGENCY STOP button on the control panel, and then press the CONTROL POWER ON button.

3. With one person checking the direction of rotation, the other person can jog START and STOP functions, F1 and F5, on keypad. Jog the motor by using both hands on the control panel, one finger on the STOP button ready to shut off the motor as soon as the START button is pushed. It should be possible to jog the motor in a START-STOP action that lasts less than one second.

   It may be necessary to use a flashlight and a mirror to view the fan blades inside the fan shroud.

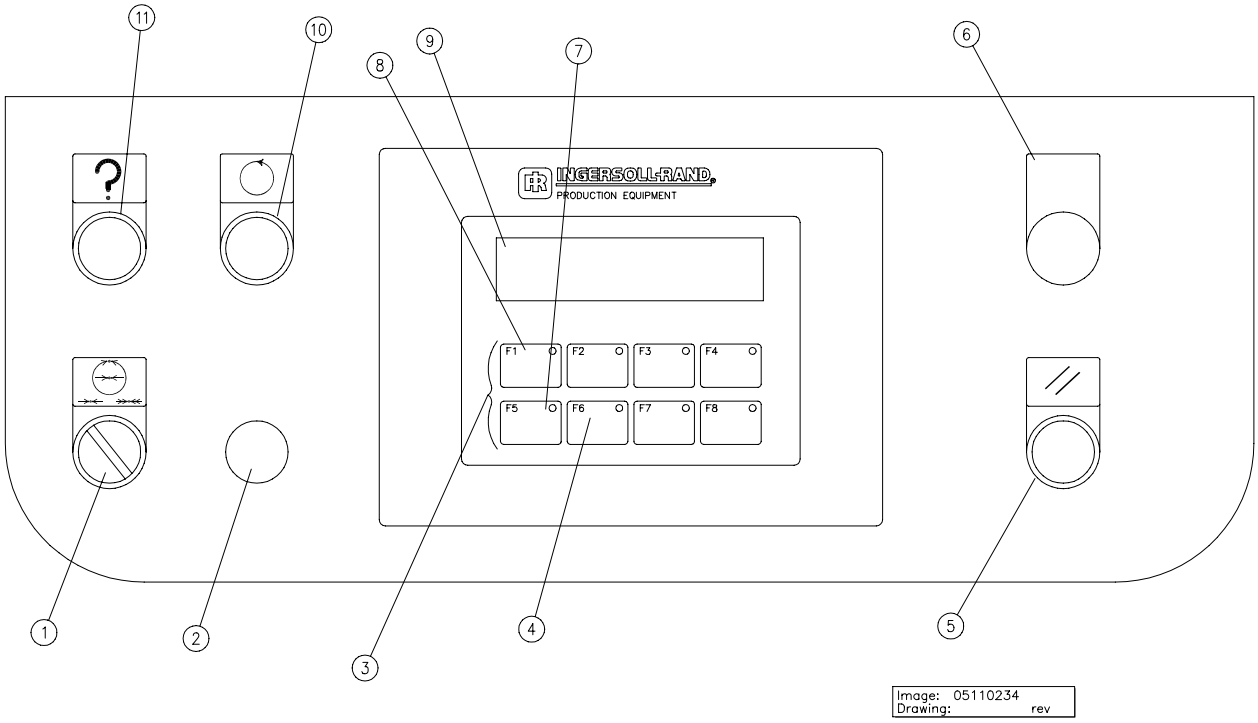
   If the motor rotates in the wrong direction, swap a pair of wires at the starter panel's main disconnect, not at the motor or starter contactors, and then recheck the rotation.

4. After verifying motor rotation, replace side covers

3.3.2 Pump Operation

Perform the following steps before operating the pump.

1. Utilities Check:
   Cutting Water – **ON**
   Cooling Water – **ON**
   Main Electrical Power – **ON**
   Plant Air – **ON**
2. Install an orifice in the cutting head and close the nozzle control valve. Insure all safety equipment is installed and working. Set selector switch (1) to LOW pressure setting.



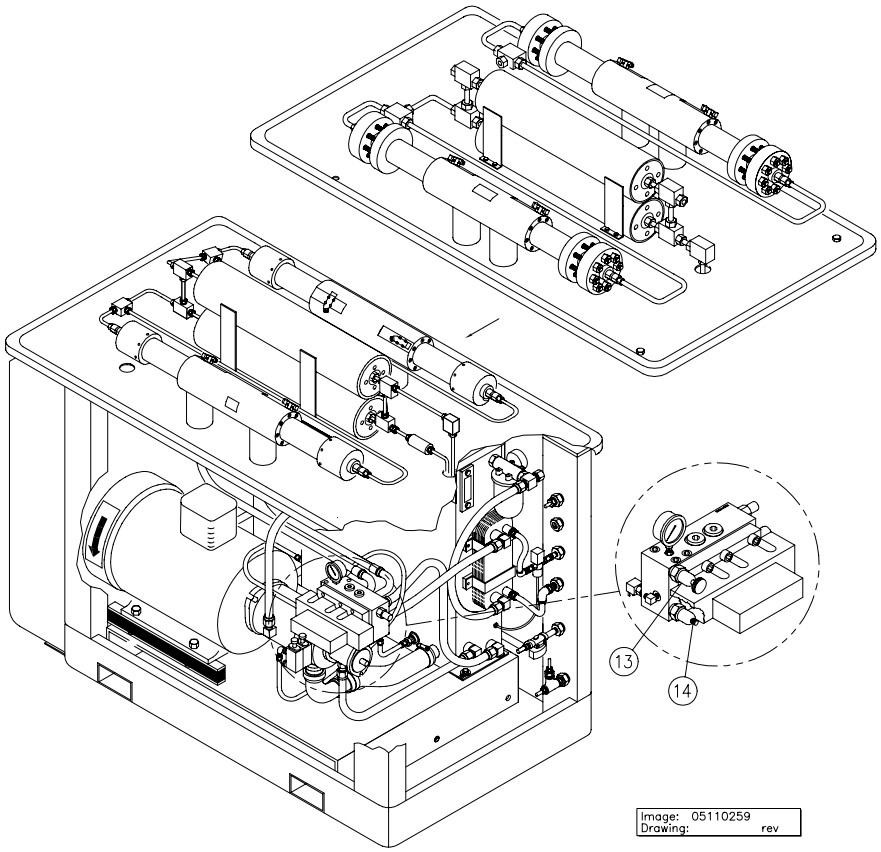
3. Pull out EMERGENCY STOP (E-STOP) palm button (6).
4. Press CONTROL POWER ON pushbutton (5) to power up unit. The CONTROL POWER ON pushbutton should be lit. The digital display window (9) will be operational.
5. Press START F1, (8) on keypad pushbutton to start pump. The intensifier assembly will stroke and stop when the HP lines are filled.
   The pump will maintain a constant HP water signal even though the nozzle is closed and no water is circulating. This is called standby or deadheaded condition.

CAUTION

A long standby period can cause the water booster pump to overheat. If the temperature reaches the high limit the pump will stop.

6. Check for any leaks throughout the installation.
7. Remove front cover and locate the HI (13) and LO (14) pressure control valves. They are factory set to deliver high pressure water at 3,100 bar (45,000 psi) and 690 bar (10,000 psi). Turning clockwise increases pressure, counterclockwise to decrease.

Note: If equipped with proportional pressure control, use the continuously variable pressure control feature to adjust hydraulic and HP water pressure.



8. After the oil is warmed above 30°C (86°F), turn the HI pressure control valve (13) counterclockwise all the way out, reducing the high pressure setting to its minimum.

CAUTION

To assure proper oil viscosity and lubrication of the hydraulic system, always operate the unit at a hydraulic oil pressure of less than 70 bar (1,000 psi) until the oil temperature is at least 30°C (86°F).

9. Set selector switch to HI pressure setting.
10. Open nozzle control valve, the intensifier assembly will start stroking again. Turn HI pressure control valve (13) clockwise until reaching 1,034 bar (15,000 psi). Check for leaks.

11. Continue increasing pressure by 345 bar (5,000 psi) steps, checking for leaks every time, until reaching desired operating pressure.
12. With HI-LO selector switch change pressure two or three times to assure proper operation.
13. If other than factory LO setting required, set selector switch to LO, adjust LO pressure control valve (14). Clockwise to increase pressure, counterclockwise to decrease.
14. To stop pump, press STOP, F5, (7) button. It is recommended to bleed out the pressure through the nozzle.
15. Check emergency stop and remote controls.
16. The pump is ready for normal operation

3.4 Shutdown Procedure

NOTE

Relieve high pressure anytime the unit is stopped, by opening the cutting valve.

3.4.1 Normal Shutdown Procedure

Press the STOP, F5, (7) button. The hydraulic power unit will shutdown but control power (24vdc) to the PLC will remain on.

3.4.2 Emergency Shutdown Procedure

An emergency stop is handled by pressing the EMERGENCY (E-STOP) palmbutton. This immediately shuts off all electrical power and vents the high pressure through the dump valve, out to drain.

3.4.3 Remote E-Stop Provisions

An emergency stop can be performed at a remote work station through wiring connections provided on the pump starter/control panel. This control option is useful when the operator is controlling the motion of a machine (robot, cutting box, X-Y motion table, etc.) without leaving the work station.

3.5 Fault Messages Overview

The pump will shutdown as a result of the following conditions. Correct problems as shown on the second line of display. The second line of the display will guide the operator through basic troubleshooting in order to eliminate the problem as described.

3.5.1 Water Supply Valve Reset

1. After 2 minutes of non-use, the water supply valve will automatically close and the pump will not start.
2. The display will read: Push F6 to Reset
3. Push F6, wait 5 seconds, and then push F1 and follow the start procedure.

3.5.2 High Oil Temperature Shutdown

1. MALFUNCTION red light (11) will blink indicating that the oil has overheated and will shutdown due to high oil temperature.

2. After 60 seconds of over temperature the following will occur:
   - MALFUNCTION light will be ON steady
   - F1 LED will be ON
   - F6 LED will be ON
   - Unit will shut down.

3. The display sequence will read:

   COOLING WATER?

   ADJUST MODULATOR

   PUSH F2 TO COOL

   PUSH F6 TO RESET

OIL TEMP HIGH
COOLING WATER?

4. To correct the condition follow the display sequence:
   - Find the reason for the overheat and correct it.
   - Push F2 to cool and the pump will start.
   - The following message will appear:

     RECIR MODE

     PUSH F5 TO STOP

5. After temperature returns to normal the following occurs:
   - MALFUNCTION light will be OFF
   - F5 LED will be ON
   - F6 LED will be ON

6. To resume normal operation:
   - Push F6 to clear the messages
   - Push F5 and the unit will shutdown
   - Push F1 and follow the START procedure

3.5.3 Low Oil Level Shutdown

1. The unit will shut down immediately and the following occurs due to low oil level:
   - RUN green light will go OFF
   - MALFUNCTION red light will go ON
   - F1 will be ON
   - F6 will be ON
2. The display sequence will read:

   CHECK LEVEL GAGE
   PUSH F6 TO RESET

OIL LEVEL LOW
CHECK LEVEL GAGE

3. To correct the condition do the following:
   - Fill to proper level
   - Observe all safety procedures
   - Check for cause of low level, leaks, etc.
   - Make required repairs
4. After problem is corrected the following occurs:
   - Push F6 to clear the messages.
   - MALFUNCTION red light should go OFF
   - F1 LED will be ON
   - F6 LED will go OFF
5. Push F1 and follow the START procedure to resume normal operation.

3.5.4 High Booster Temperature Shutdown

The unit will shutdown after 30 seconds of over temperature.

1. The RUN green light will go OFF and the MALFUNCTION red light will go ON when the booster temperature is too high.
2. The display sequence will read:

   LONG STALL?
   INLET WATER?
   PUSH F6 TO RESET

BOOSTER TEMP HIGH
LONG STALL?

3. To correct the condition open the nozzle valve to allow cutting water to flow and let the unit cool down. Check the low pressure water (inlet water).
4. After the problem is corrected the following occurs:
   - MALFUNCTION Red light should be OFF
   - F1 LED will be ON
   - F6 LED will be ON
5. To resume normal operation:
   - Push F6 and the messages will clear
   - The F1 LED will be on and all others will be OFF
   - Push F1 and follow the START procedure

3.5.5 High Pressure Leak Warning

The high pressure leak warning will occur for at least 60 seconds before the unit shutdowns. It is possible for the unit to run indefinitely with a high pressure leak warning

1. The following will occur as a warning to the operator of the unit's condition:
   - MALFUNCTION red light blinking
   - RUN green light ON
   - F5 LED ON
2. The unit will shutdown:
   - Run green light goes OFF
   - MALFUNCTION red light ON steady
   - F1 LED will go ON
   - F6 LED will go ON
3. The display sequence will read:

   CHECK H.P. CHECK VALVES

   CHECK H.P. SEALS

   CHECK ORIFICE

   CHECK FITTING

   CHECK TUBING

   PUSH F6 TO RESET

H.P. WATER LEAK
CHECK H.P. CHECK VALVES

4. Correct the condition by checking the items on the display.
5. After the condition is corrected, the following occurs:
   - Push F6 to clear messages
   - MALFUNCTION red light should go OFF
   - F1 LED will be ON
   - F6 LED will go ON
6. To resume normal operation:
   - F1 LED will be ON and all others will be OFF
   - Push F1 and follow the START procedure

3.5.6 Cutting Water Supply

F3 is the toggle for the cutting water supply. With F3 turned ON, cutting water supply automatically shuts off, five (5) minutes after the electric motor is shut off. The cutting water supply must be reset by pushing F6 before the motor will start. With F3 selected in the OFF mode, cutting water pressure will continue to be available to the pump, even if the electric motor is not running.

3.5.7 Idle Shutdown

F4 is the toggle for the idle Shutdown. With F4 selected ON the pump will automatically shut down after thirty (30) minutes of running idle. With F4 toggled OFF, the pump will continue to run indefinitely.

3.5.8 High Pressure Water Transducer

The high-pressure water transducer provides a display of the operating pressure to the nearest 1000 PSI (50 bar). It is also used to issue over pressure warning and trapped high-pressure warning messages. If the pressure display shows something other than 0 PSI when the system is at 0 PSI, pushing F7 will recalibrate the transducer.

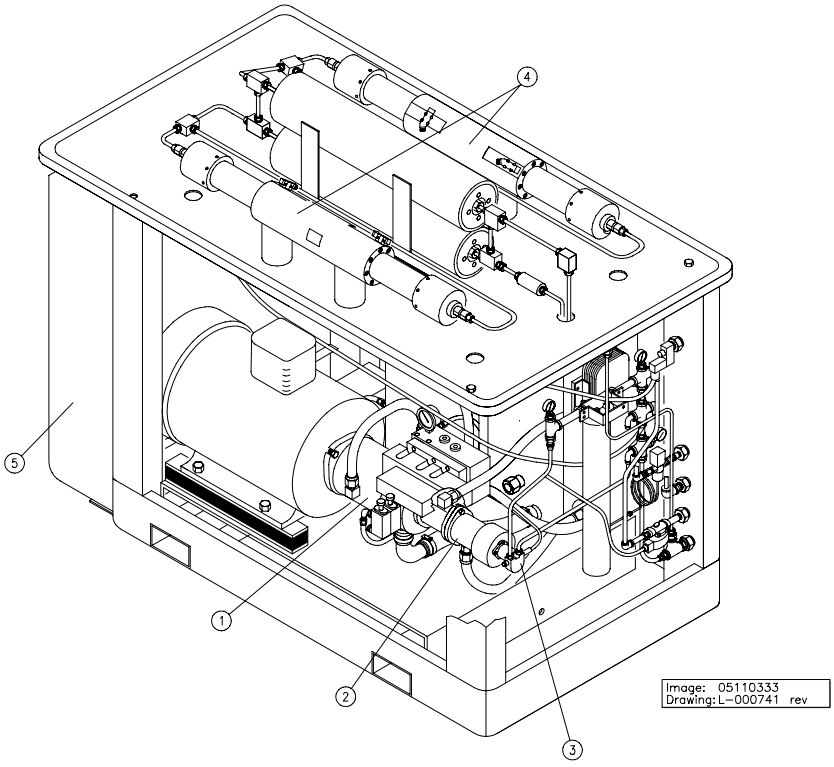
4 Maintenance

This section provides an overview of "Scheduled Maintenance" and "Preventive Maintenance". In addition, maintenance of the five systems is necessary and is described in their respective sections. Refer to the following sections for detailed information on the operator console and systems maintenance:

- Operator Console, Section 3
- Low Pressure Water, Section 6
- High Pressure Water, Section 7
- Electrical System, Section 8
- Hydraulic System, Section 9
- Recirculation System, Section 10

The following is an overview of the primary components and their location.

- **Hydraulic Pump** – including electric motor, and hydraulic valve manifold block. The pump is a variable displacement, axial piston and pressure compensated type.
- **Recirculation Pump** – including a fixed displacement gear – type pump, oil to water heat exchanger, hydraulic return line – type filter, and related hydraulic hoses and fittings. The gear pump mounts to the back of the variable piston pump, which has a through shaft.
- **Boost Pump** – includes a stainless steel vane – type pump with pressure adjustment and high temperature switch, low pressure water filter, bypass relief valve, and associated water tubing and fittings. The boost pump is mounted to the back of the hydraulic gear pump, which has a through shaft.
- **Intensifier Assembly** – includes two high pressure (HP) attenuators, two hydraulic intensifier assemblies, a HP dump valve and associated HP piping with fittings.



Item Description

(1) Hydraulic Pump (2) Recirculation Pump (3) Boost Pump

(4) Intensifier Assembly (5) Control Panel

4.1 Scheduled Maintenance

Check Description	Item to be Checked	Major Component	As Req'd	Per Shift	Weekly	Monthly	3-Month	6-Month	Yearly[1]
Fluid Level & Leak Checks	Oil Level	Hydraulic Oil Tank		X					R
	Oil Sample	Hydraulic System				F			
	Hydraulic Cartridge Seals	Hydraulic Cylinder	X	X					
	Plunger Seals	HP Cylinder	X	X					
	Sealing Head	HP Cylinder	X	X					
Pressure & Flow Checks	Water Supply Pressure	Low Pressure Filter Assembly	X	X					
	Intensifier Discharge Pressure	HP Piping	X						
	Hydraulic Pump Pressure	Hydraulic Pump		X					
Temperature Checks	Plunger Seal	HP Cylinder	X	X					
	HP Check Valve	Port Sealing Head	X	X					
	Cooling Water Inlet/Outlet	Oil/Water Heat Exchanger	X			F			
Lubrication & Filter Checks	Motor Bearings Lube	Hydraulic Power Unit	X					R	
	Hydraulic Filter	Hydraulic Oil Tank	X	X				R	
Vibrations-Rotating Equip.	Electric Motor					F			L
	Hydraulic Pump					F			
Splined Shaft Service	Motor/Pump Connection	Motor-Female Spline Piston Pump-Male Spline							L[2]
System Cleaning & Inspections	Hydraulic Pump					F			
	HP Tubing, Valves, & Fittings					F			
	Hydraulic Manifolds	Hydraulic Intensifier				F			
	Control Panel	Electrical Enclosure				F			
	Gage Calibration	Hydraulic Pump & HP Piping				F			
Control Lights			X						

Key:

F: Information
X: To be observed
R: To be replaced
L: To be lubricated

[1]Yearly or 4,000 hours, whichever comes first.
[2]See Section 9.3.3 concerning spline lubrication recommendations.

4.2 General Maintenance

Proper maintenance is important for reliable and consistent performance. Preventive maintenance reduces unscheduled downtime, and extends component life.

High pressure water will cut almost anything it contacts. Any leaks must be repaired immediately to prevent damage or serious personal injury.

Maintenance Guidelines

- Regular inspection of equipment is recommended.
- Keep equipment and surrounding areas clean.
- Check pressures, temperatures, and look for leaks.
- Make repairs immediately.
- A maintenance record should be kept.

Work Area

- Maintain a clean work area for repair and maintenance of the waterjet pump.
- Use a clean work bench in a dust and dirt free work area.
- Use lint-free material for wipe cloths.
- When blowing off parts with compressed air, use only clean, dry air. When flushing parts with a solvent, use only clean, filtered fluid.
- Always use original Ingersoll-Rand replacement parts, for consistent performance, reliability, safety, and to protect equipment warranty.

Safety Recommendations

- Carefully read the Safety Guidelines in Section 1, of this manual.
- Lock out all electrical power.
- Close all incoming supply valves and open all drain valves.
- Close the nozzle valves and manifold valves. When the power is shut off, the safety dump valve will open and bleed off high pressure water stored in the discharge piping.
- Provide suitable receptacles, pans, trays, etc. to catch and retain fluids to avoid a hazardous work area.
- DOUBLE CHECK to insure that all pressure is relieved from the system before proceeding.

Binding and Interference

When assembling close tolerance machine parts, use extreme care in aligning them for assembly. Do not force the parts together. If parts bind during assembly, separate them and try again until they are successfully mated.

NOTE

It should never be necessary to force an assembly together.

Plunger material is strong, but brittle. Avoid dropping, sharp blows, or heavy bending loads when working with these expensive parts.

Make sure all parts are clean, free of burrs, metal particles, dirt, dust, etc. Use High Purity Goop (Part 10084440), when assembling any high pressure fitting.

After servicing any high pressure components, flush the high pressure water system by operating the waterjet pump for a short period with the nozzle valve open and no orifice in place. Next, shut down the waterjet pump, install an orifice, and slowly increase the discharge water pressure in stages. Check all high pressure connections for leaks.

Unusual requirements should be referred to the Technical Services group at KMT Waterjet.

To contact the KMT Waterjet Spare Parts Department:

USA: Parts Department
KMT Waterjet Systems
635 West 12th Street
Baxter Springs, KS 66713 USA
Phone: (620)856-2151
Fax: (620)856-5050

Europe: Spare Parts Manager
KMT Waterjet Systems GmbH
Wasserstrahl-Schneidetechnik
Auf der Laukert 11
D-61231 Bad Nauheim Germany
Phone: 49-(0)6032-997-115
Fax: 49-(0)6032-997-271

4.3 4.4 Service Log Data

Maintaining a book of Service Log Sheets such as shown in the following pages can be a useful method for ordering spare parts, and for tracking maintenance trends on the SL-IV high pressure intensifier pump. Each part replaced should be noted with the following information: date, person, operating hours, and parts replaced. The Service Log data sheet and part identification illustrations provide a simple means of noting the part(s) service/ replaced. Identify the part(s) serviced or replaced in Figure 4-3 then mark the box under the number corresponding to that part's balloon number in the figure. If there are special conditions that might relate to that part's service history, write comments to the side or add to the bottom or separate sheets of paper. Note that if there are two intensifiers on the pump (redundant option) then indicate which intensifier (I or II) in the column labeled "Intensifier". Note that intensifier I is located to the front when standing such that the control panel is to one's left and the plumbing connections are to the right rear of the pump. Also note which HP cylinder is being serviced: Cylinder A is closest to the electrical control panel.

Service life of certain HP components can be analyzed using the Service Log sheets. Subtracting operating hours between part changes provides service life information. If questions arise concerning service history, then the Service Log sheets can be faxed to the KMT Waterjet service office. Having a mutually – understood form of recording service history (that is, the Service Log sheets) is an advantage when drawing the attention of KMT Waterjet service personnel to the particular service problem.

Cutting Conditions (Circle One): Pure water / Abrasive	Operating Pressure: _____________bar/psi	No. of Orifices & Orifice Size: _____ each x ______ mm/inch	SL-IV Service Log Page ____

Date/Person	Hours	1	2	3	4	TW	CYL	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Remarks
							A																			
							B																			
							A																			
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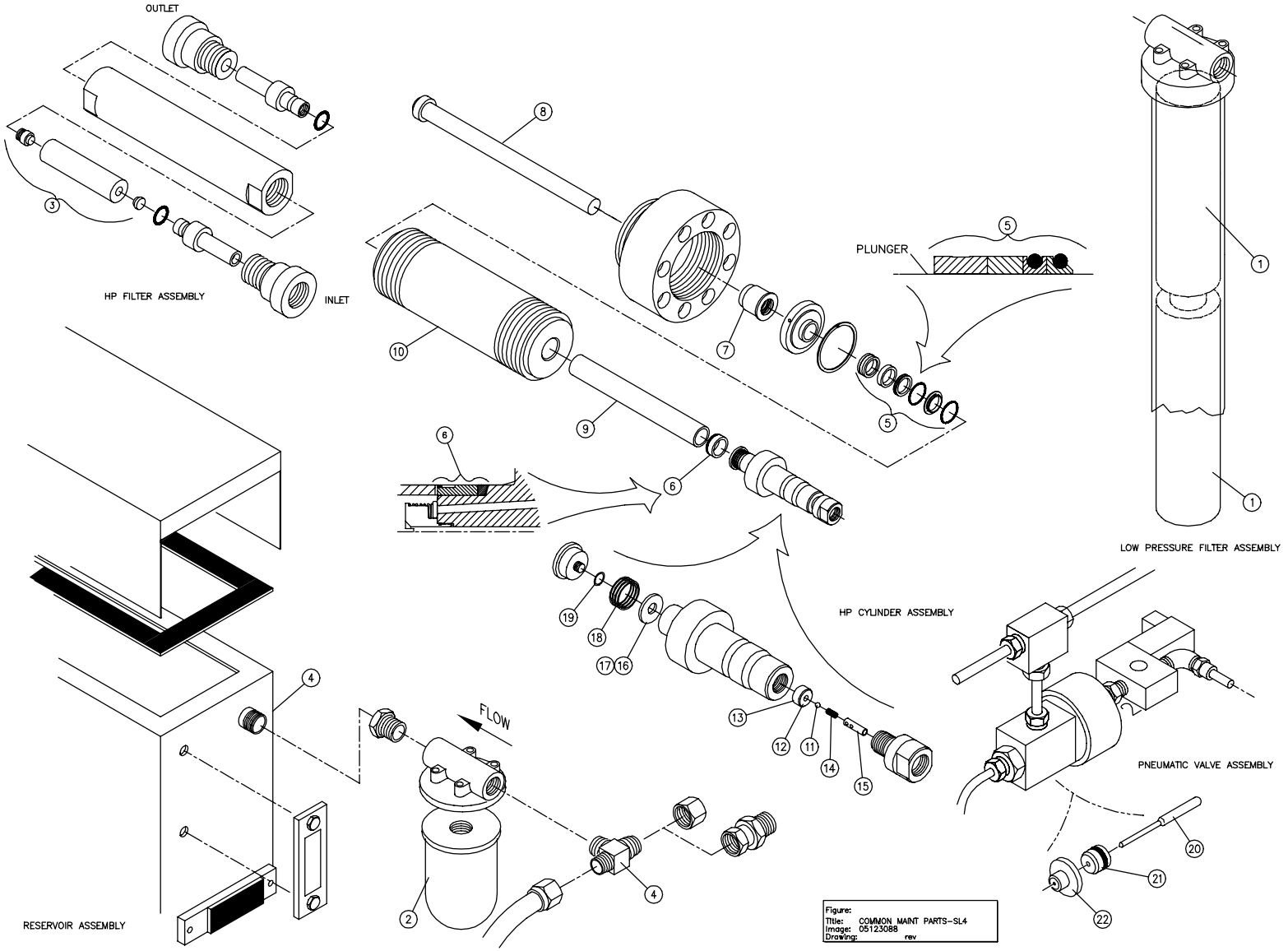
Ref. No.	Part No. (CCN)	4.3.1 PART DESCRIPTION
1	10106722	Filter Element, Low Pressure Water, 2 each x 10 microns
2	05049698	Filter Element, Hydraulic Oil
3		Filter Element, High Pressure Water, ¼ HP, 3/8 HP, or 9/16 HP
4	05022702	Hydraulic Oil Change
5	05112487	Seal, HP Plunger (StreamLIFE)
6	10110393	Seal, HP Discharge (Sealing Head)
7	05009030	Seal, Hydraulic, Plunger Cartridge
8	05108113	Plunger, Ceramic
9	05109624	Liner, HP Cylinder
10	05059712	Cylinder, HP
11	10086288	Ball, HP Check Valve
12	10107902	Seat, HP Check Valve (Wear out first side, then reverse and use opposite side)
13	10107902	Seat, HP Check Valve (Wear out second side, then replace)
14	05022017	Spring, HP Check Valve
15	05012331	Guide Sleeve, HP Check Valve
16	10107894	Poppet, LP Water Inlet Check Valve (Wear out first side, then reverse to use opposite side)
17	10107894	Poppet, LP Water Inlet Check Valve (Wear out second side, then replace poppet)
18	49884562	Spring, Poppet LP Inlet Check Valve
19	05049853	O-ring, LP Inlet Check Valve
20	49865843	Stem, HP Dump Valve
21	10178978	Seal Assy, HP Dump Valve
22	10178697	Seat, Replaceable, HP Dump Valve


OUTLET
HP FILTER ASSEMBLY
INLET
PLUNGER
LOW PRESSURE FILTER ASSEMBLY
HP CYLINDER ASSEMBLY
PNEUMATIC VALVE ASSEMBLY
RESERVOIR ASSEMBLY
FLOW
Figure:
Title: COMMON MAINT PARTS-SL4
Image: 05123088
Drawing: rev

Section 5 TROUBLESHOOTING

SL-IV Pump Will Not Start

Condition & Possible Causes	*Corrective Action*
E-STOP Button Depressed	Pull out E-STOP button. Push CONTROL POWER ON button – white light on CONTROL POWER ON button should illuminate.
Power Disconnected	Check that main power is present. Check that main power disconnect is ON.
Control Power Interrupted	Check power supply circuit protection (tripped breaker). Check power supply (24vdc) input and output.
Protection Activated	Check LOW OIL LEVEL, HIGH OIL TEMPERATURE, LEAK CONDITION, or HIGH TEMPERATURE BOOSTER PUMP (bold letters indicate display messages)
Motor Overload Relay Tripped	Find reason for overload. Reset overload relay.
Inlet Water Valve Turned Off	Reset water valve by pressing F6

Console Display and Lights Fail to Illuminate

E-STOP Button Depressed	Pull out E-STOP button. Push CONTROL POWER ON button - white light on CONTROL POWER ON button should illuminate.
Main Power Disconnected	Check main power.
Door Unlatched (locked out)	Check that the door disconnect switch is properly engaged.
Control Power Not Available	Check power supply circuit protection (tripped breaker). Check power supply (24vdc) input and output.

Pump Quit Running

Unsafe Operation Detected	Check fault indication on operator's console and correct: LOW OIL LEVEL, HIGH OIL TEMPERATURE, LEAK CONDITION, or HIGH TEMPERATURE BOOSTER PUMP.
Electrical Power Interruption	**Check power supply circuit protection (tripped breaker). Check power supply (24vdc) input and output.** **Check that main power is available.**
Motor Overload Relay Tripped	Find reason for overload. Reset overload relay.

No Control Power (24vdc)

Circuit Breaker Tripped	Check input circuit breaker of power supply. Check output circuit breaker (24vdc) of power supply.
Power Supply Fault	Check power supply input and output voltages.

Red Flashing Light, Message On Operator's Console

Condition and Possible Causes	*Corrective Action*
LEAK	Check for HP piping leaks Check for HP seal leak Check for HP check valve leaks Check for HP valve leaks Check for sufficient water supply Check for dump valve closure or seal leakage. Check orifices condition, and proper diameters.
OIL TEMP	Verify hydraulic oil tank temperature is above 62^0C (144^0F). Check cooling water flow to heat exchanger. Adjust water modulating valve.
OIL LEVEL	Check hydraulic oil level on the reservoir sight glass. Check for and correct hydraulic oil leak, add oil to tank.
BOOSTER PUMP	Check booster pump temperature if above 53^0C (128^0F). Check cutting flow to/from booster pump. Check water bypass orifice. Excessive time in deadheaded condition.

HP Water Signal Abnormal Fluctuation

Orifice Large/ Worn/ Damaged	Check that orifices do not exceed capacity of pump. Check that orifices are in good working order. Verify that stone is not missing.
Check Piping Leaks	Check system components for leaks including dump valve condition.
Check Valve Leakage	Inspect pump discharge HP check valves. Inspect pump inlet low pressure (LP) check valves.
Check Seal Leakage	Inspect plunger, sealing head seals.
Hydraulic Control Malfunction	Check hydraulic valves operation. Verify proper shifting of 4-way reversing valve. Verify proper proximity switch operation.

Hot Surfaces On HP Cylinder Components

HP Discharge Check Leaking	Inspect check valve seat, poppet, spring, and guide condition.
LP Inlet Check Valve Leaking	Inspect check valve poppet, spring, seat, and sealing head.
Sealing Head or Plunger	Check plunger and sealing head seal leak and repair. Inspect seal head body for crack in the bottom of the inlet water groove.
Damaged HP Cylinder	Check cylinder inside diameter for damage. Polish if required.

Oil or Water Leaks from HP Cylinder Weep Holes

Condition and Possible Causes	*Corrective Action*
Oil Leak HP Intensifier	Check hydraulic cylinder O-ring leakage. Check proximity switch area for oil leakage. Remove, inspect, replace or clean hydraulic seal (cartridge).
Water Leak at HP Plunger Seal	Replace seal assembly. Check plunger and follower if leak exceeds about 1 drop in 10 strokes. Check for scratches, circumferential or longitudinal grooves, or material build up on inside diameter of HP cylinder. Polish ID of cylinder if required. **Plunger should be returned to KMT Waterjet if polishing is needed.**
Water Leak at Sealing Head Seal	Check seal assembly. Check for scratches on inside diameter of HP cylinder. Polish if required. Check for scratches in area of sealing head seal. Polish if required.

Hot Hydraulic Oil

Restricted or No Cooling Flow	Check cooling water flow to and from heat exchanger. Check setting of water modulating valve. Check water pressure differential across heat exchanger, 2.75 bar (40 psi) minimum required for flow through the exchanger. Check operation of water modulating valve.
Water Modulating Valve Set High	Check and adjust setting of cooling water valve. - Compressing spring slows water flow and increases temp, de-compressing spring increases water flow and lowers oil temp.
Heat Exchanger Clogged	Flush heat exchanger, improve quality of cooling water.

Low Cutting Water Pressure

Low Hydraulic Pressure Setting	If in LO, turn pressure switch to HI. Check hydraulic pump pressure setting.
Restricted or No Cutting Water Supply	Check cutting water supply flow and pressure
Water Filter Clogged	Check pressure differential at filter gages, and replace elements if exceeds 1 bar (15 psi) while the pump is operating.
Air Trapped	Bleed air from cutting water plumbing.

HP Check Valves Leak

If there are no visible HP water leaks, but there are higher temperatures on HP cylinder or sealing head, this is an indication of a HP or LP check valve leak. Use corrective action listed at right:

1. Disconnect the proximity switch cables of the opposite (normal) HP cylinders.
2. With the cutting nozzle valve open, start pump at low pressure; the pistons will move and stop at the opposite (normal) HP cylinders.
3. Stop pump, assure all pressure is bled, block system by closing cutting valves.
4. Start pump, switch hydraulic pump to HI pressure.
5. Assure there are no external water leaks.
6. Reconnect the proximity switch cables. The pistons will reverse:
   - If the plunger moves (the problem side proximity switch light will turn ON), it means inlet check valve problem.
   - If the plunger does not move, it means a HP discharge check valve problem.

Normal Temperature, but Check Valve Problem

Since the HP check valves are interconnected, to determine which of the four inlet check valves or four discharge check valves is causing the problem, follow these procedures.

Check inlet HP check valve	1. Follow the procedure outlined in "HP Check Valves Leak". 2. A bad inlet check valve will be indicated by a piston moving after the proximity switch cables are reconnected.
Check discharge HP check valve after completing inlet check.	1. Re-install all HP plumbing and proximity switch cables 2. Start pump, switch to HI, and then close nozzle valve. 3. Stop pump and watch high pressure gage. 4. If the pressure drops, one of the four discharge check valves is leaking. 5. Determine which valve is leaking by inspection. Look for erosion or uneven wear on the poppet or seat.

6 Low Pressure Water System

The SL-IV100hp Waterjet Pump is equipped with two low pressure circuits:

- Cutting water supply for HP intensifier assembly
- Cooling water supply for the oil-to-water heat exchanger

The low pressure water system supplies the pump with the following:

- Water of sufficient cleanliness and pressure to the inlets of the four (4) HP cylinders (both hydraulic intensifiers)
- Cooling water of sufficient flow rate and low temperature to the oil-to-water heat exchanger.

6.1 Oil Cooling Water Supply

The oil cooling water supply circuit includes the water modulating valve.

The maximum flow rate of the cooling water is 4.5 gpm (40 psi min inlet pressure, at 70^0 Fahrenheit maximum inlet temperature) with drain or outflow of same capacity.

6.2 Cutting Water Supply

The cutting water supply includes the following:

- Low pressure water filter
- Inlet water shutoff valve (solenoid operated)
- Boost pump along with sensors and pressure controls

The low pressure water fittings are stainless steel with rubber hoses connecting the low pressure water components. The boost pump housing is also stainless steel and is protected by the low pressure water filter.

The low pressure cutting water circuit allows the water to pass through the low pressure filter prior to entering the boost pump to prevent debris from damaging the pump.

However, when the low pressure water filter gets loaded up with dirt/contaminants, the water pressure exiting this filter may be too low to supply the boost pump. The low pressure water filter is equipped with pressure gages to indicate the condition of the filter element.

Quick disconnects are provided at all of the HP cylinder inlet check valve/sealing head ports for ease of maintenance, preventing low pressure water from spraying out when this connection is broken. The cutting water supply circuit is automatically shut off after the motor has been off for 2 minutes. To reset the water supply valve, press F6.

6.2.1 Normal Operating Condition

During normal operation, the low pressure water system maintains the following conditions:

- Filter pressure drop (gage reading 4 minus 6) not more than 1 bar (15 psi)
- Boost pump discharge pressure gage reading 8.0-8.3 bar (115-120 psi)

NOTE

While the intensifier assembly reverses direction, the boost pressure will fluctuate slightly above and below the normal setting. Pressure fluctuation greater than 2 bar (30 psi) may indicate inadequate water supply to unit, or poor boost pump performance.

6.2.2 Operation

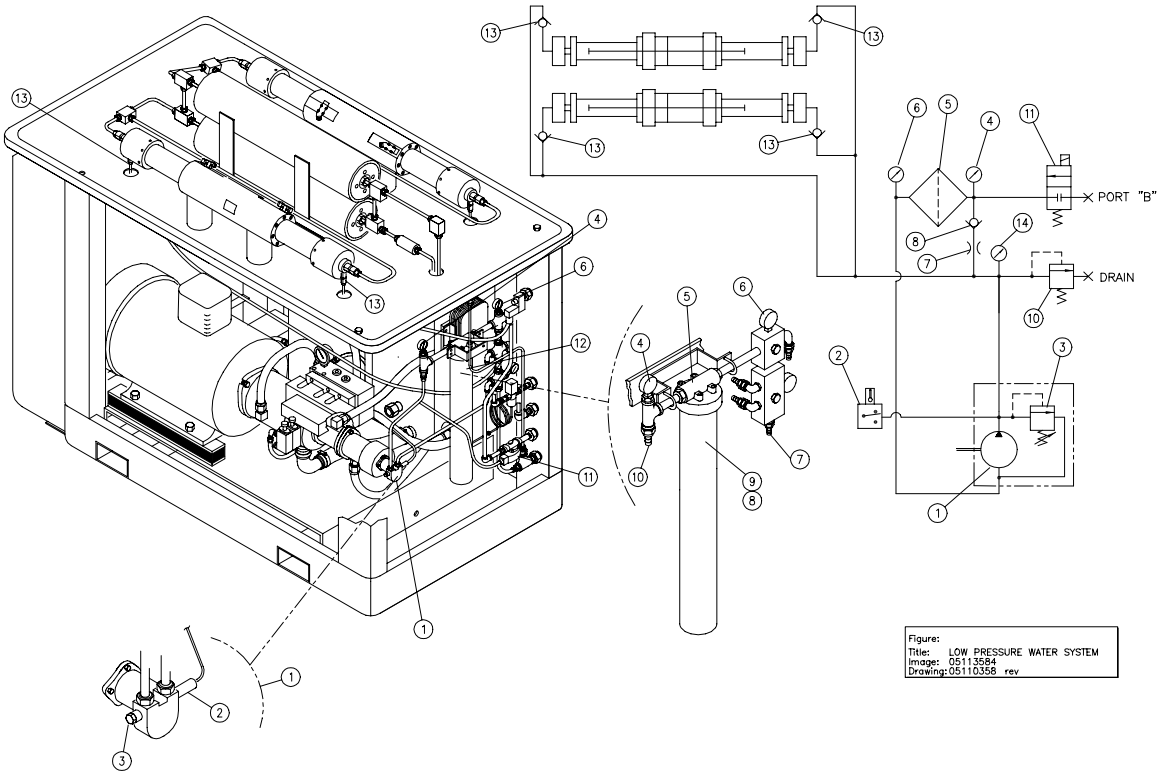
The cutting water enters the pump through port "B". When the CONTROL POWER ON button on the operator control panel is activated, solenoid valve (11) opens allowing water to flow to the inlet of the boost pump (1). The boost pump increases the inlet pressure to 8 bar (120 psi) to assure proper supply to both intensifier assemblies. If the motor does not run for 2 minutes, the solenoid valve (11) will shut off. To re-open the valve, press F6.

NOTE

The boost pump (1) is factory set to deliver 8 bar (120 psi) with an inlet pressure at port "B" of 4 bar (58 psi). The pump may require adjustment if local inlet pressure is different, because discharge pressure depends on inlet pressure. Inlet pressure is affected by filter condition, as well as local water supply conditions.

The water flows through the low pressure water supply filter (5) and then enters the boost pump. The filter gages (4 and 6) indicate the condition of the filter. A difference of 1 bar (15 psi) indicates a dirty filter element that should be replaced.

The boost pump is connected with hoses to the inlet of both hydraulic intensifiers with quick connect fittings (13).



6.2.3 Boost Pump Pressure Adjustment

Adjustment must be made with the pump turned off and the inlet water turned off.

The boost pump pressure relief valve (3) is adjusted by turning with a flat blade screwdriver. Turn clockwise to increase pressure or counterclockwise to decrease pressure. The relief valve adjusting screw is accessed by removing the acorn nut on the side of the pump.

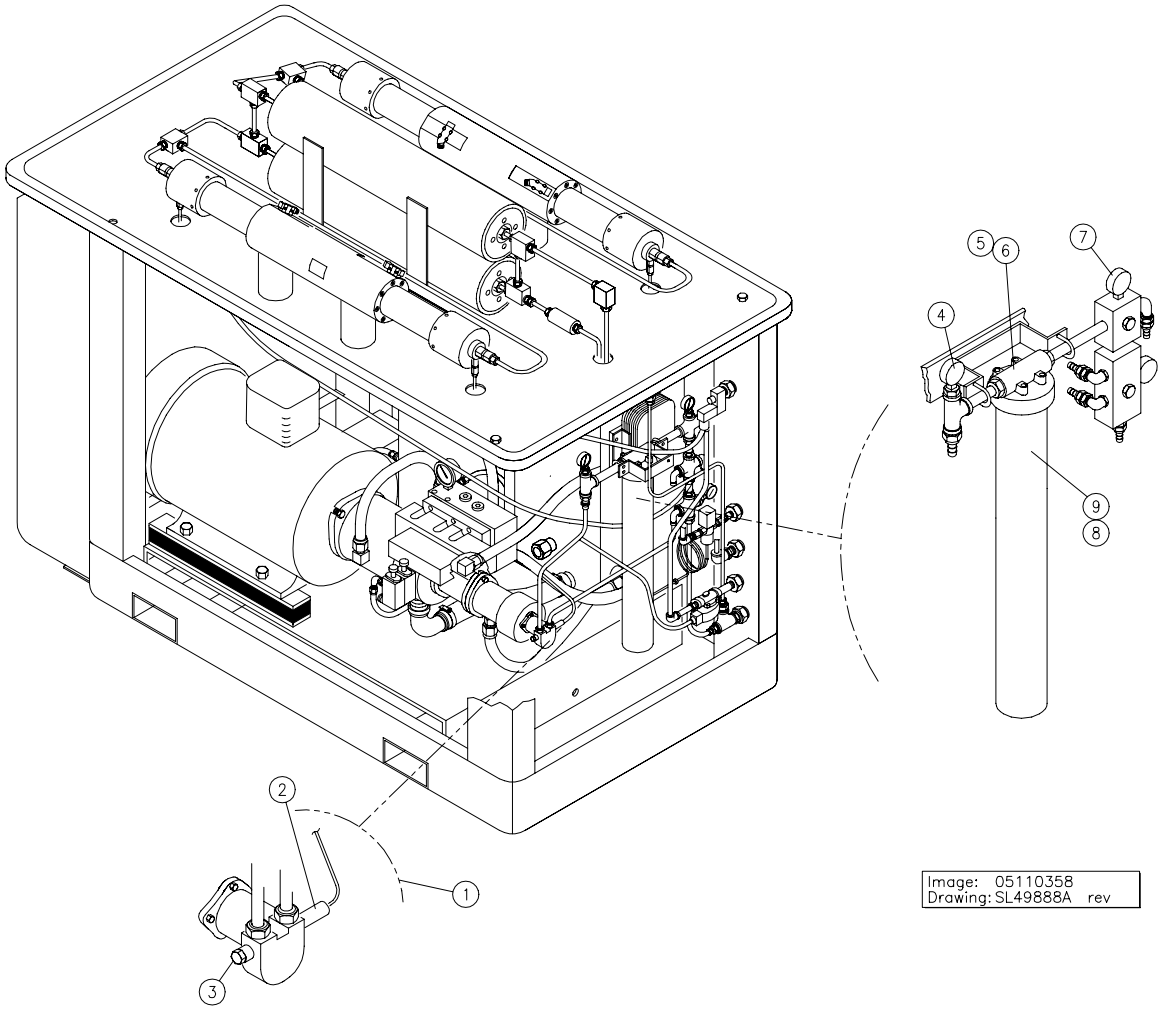
6.2.4 Low Pressure System Protection

System pressurization over 8.6 bar (125 psi) is prevented by the relief valve (10). Pump overheating due to lack of water, or long deadheaded conditions, is prevented by the temperature switch (2) on the boost pump (1), which turns the pump off. To reduce boost pump overheating while deadheaded, water is recirculated through orifice (7) and backflow check valve (8) to the boost pump inlet.

Control		Pressure Adjustment		Pressure Settings Bar (psi)	
		Increase	Decrease	Maximum	Minimum
Boost Pressure	3	Clockwise	Counterclockwise	8.3 (120)	8.0 (115)
Boost Relief	10	Fixed	Fixed	9.0 (130)	8.6 (125)

6.3 Maintenance Overview

In order to maintain necessary fluid pressure for the pump and to keep the water clean for proper operation it is necessary to replace the water filter and/or adjust the boost pump. The guidelines for servicing these parts are described below.



Item Description

(1) Boost Pump (2) Temperature Sensor (3) Pressure Control Valve
(4) Pressure Gage (5) Bleed Valve (6) Filter Head
(7) Pressure Gage (8) Filter Housing (9) Filter Element

6.3.1 Water Filter Service

Replace filter elements when there is a 1 bar (15 psi) pressure differential between gages (4) and (6):

Components:	Bleed Valve Element Head Housing
Recommended Tools:	Supplied filter thread/unthread tool (to turn housing) Container (to capture some water spill) Rags
Parts:	Elements for water: 10 micron (quantity 2) Polymer mixture: 40 micron (quantity 2)

Water Filter Element Replacement Procedure

1. Turn off cutting water supply
2. Press bleed valve to relieve trapped pressure
3. Unscrew housing from head. Remove element.
4. Install new elements in housing. Screw housing into head.
5. Open cutting water supply.
6. Press bleed valve to remove trapped air.
7. Start waterjet pump. Verify satisfactory pressure readings.

6.3.2 Boost Pump

If boost pressure, as read on the boost pump discharge pressure gage is not 8.0-8.3 bar (115-120 psi), the boost pump needs to be adjusted.

Components: (1) Boost pump
(3) Pressure control knob

Recommended Tools: Flat screwdriver (To turn pressure control knob)
Container (To capture some water spill)
Rags

Parts: None required

Boost Pump Adjustment Procedure

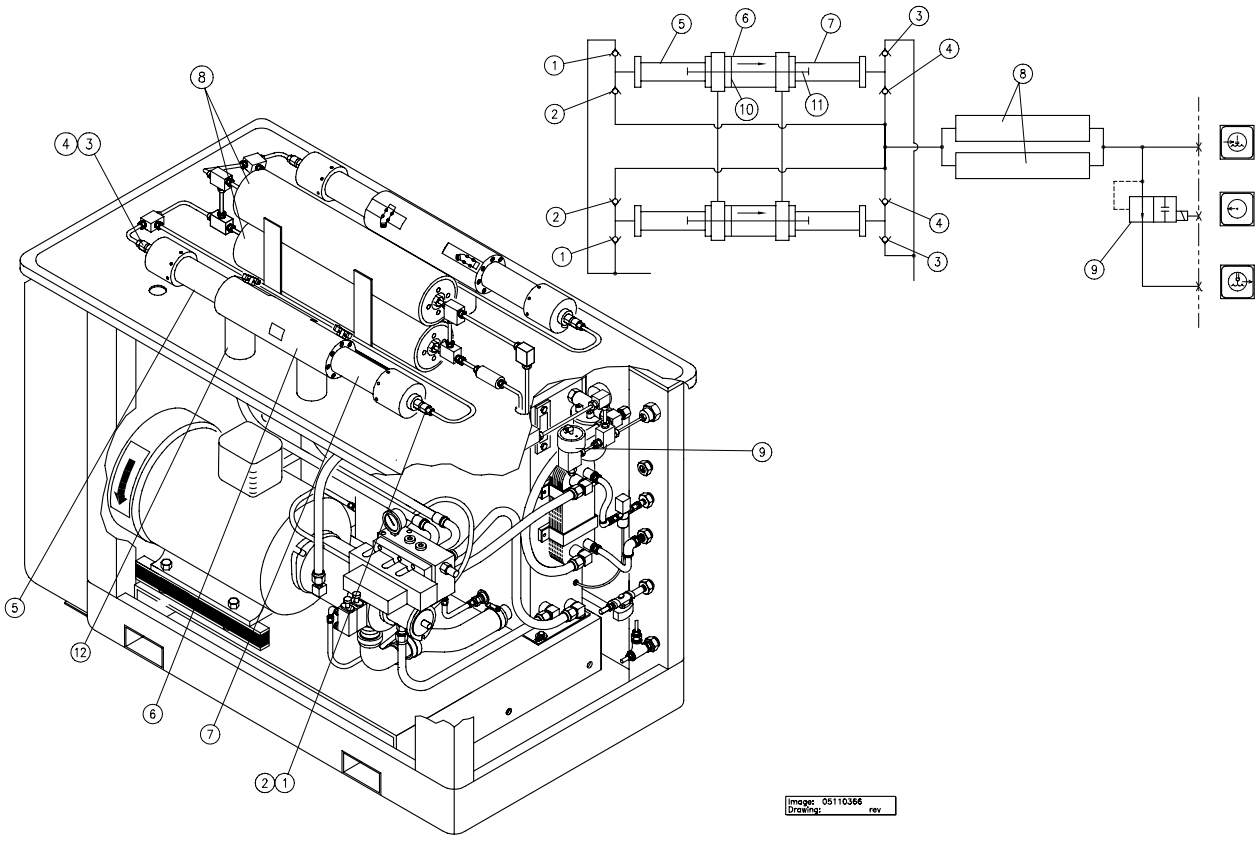
1. Turn on cutting water supply
2. Start waterjet pump and observe boost discharge pressure
3. Stop waterjet pump and press E-Stop button.
4. Remove acorn nut from the side of the boost pump and turn screw clockwise to increase pressure or counter-clockwise to decrease pressure.
5. Replace acorn nut, restart waterjet pump and observe boost discharge pressure.
6. Repeat steps 4 and 5 if necessary.

7 High Pressure (HP) Water

The high pressure (HP) water system takes the relatively low pressure water inlet to up to 3,800 bar (55,000 psi) at 2.0 1/min, 0.53gpm with an orifice diameter of 0.28 mm (0.011”).

7.1 Components

The high pressure water components include the hydraulic intensifier, HP attenuators, HP dump valve and HP piping.

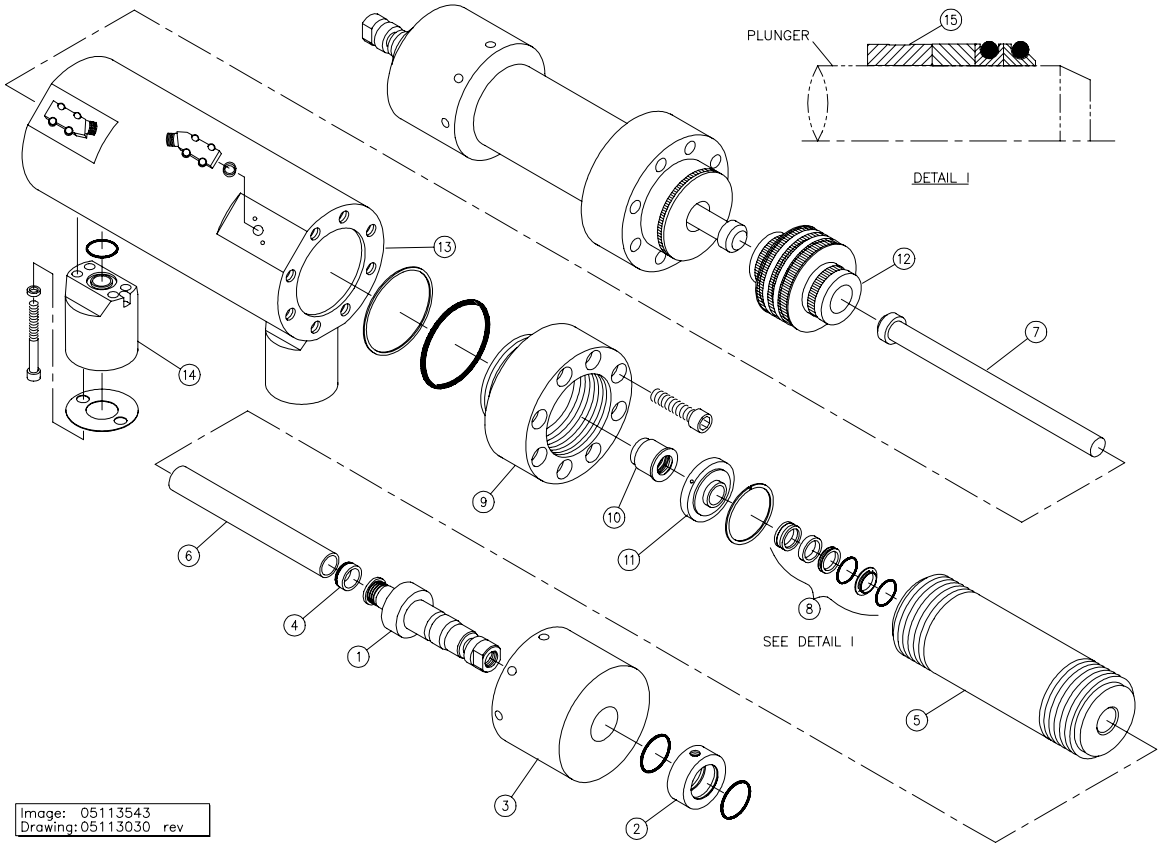


Item Description

(1) Inlet Check Valve	(2) Discharge Check Valve	(3 Inlet Check Valve)
(4) Discharge Check Valve	(5) HP Cylinder	(6) Hydraulic Cylinder
(7) HP Cylinder	(8) Attenuator	(9) Dump Valve
(10) Piston	(11) Plunger	(12) Stem

7.2 Intensifier Disassembly and Reassembly

Detailed instructions are provided on disassembly and reassembly of the hydraulic intensifier, including HP seal maintenance. A discussion of detailed inspection and repair for individual HP subassemblies is also provided. HP attenuators are discussed but no disassembly procedures are included since attenuators are not serviceable by the customer.



Item Description

(1) Sealing Head	(2) Collar	(3) Head Nut
(4) Head Seal	(5) Cylinder Body	(6) Cylinder Liner
(7) Plunger	(8) Plunger Seal	(9) Cylinder Head
(10) Hydraulic Cartridge Seal	(11) Flange	(12) Piston
(13) Cylinder	(14) Stem	(15) Follower

7.2.1 HP & LP Water Piping

Disconnect from/Reconnect to Waterjet Pump

Before performing maintenance on the waterjet pump observe motor starter lock out/tag out procedures.

1. With 13/16" open wrench loosen and remove HP Piping attached to discharge HP check valve. Move tubing to clear work area.
2. For servicing discharge HP check valve on the intensifier assembly, refer to Section 7.3.1."Discharge HP Check Valve".
3. The sealing head can be removed with the discharge HP check valve attached. Remove the low pressure water quick disconnect and gently pry the collar off the sealing head.
4. With the HP piping and the low pressure cutting water plumbing disconnected, the following operations can be performed:
   - Sealing head can be removed from the HP cylinder
   - HP cylinder can be removed from hydraulic cylinder head
   - HP seals (sealing head and plunger) can be serviced

After the pump has been reassembled, then the HP water piping, quick disconnect and collar are reinstalled as follows:

5. Slide inlet water collar over sealing head until it rests against the head nut. Connect LP inlet water quick disconnect to collar.
6. Install the HP water piping. Tighten HP connections using a 13/16" crowfoot wrench. Use a 30mm (1-3/16") wrench for back-up on the sealing head, and a 1" wrench for back-up on the elbow. Turn on cutting water supply and check for low pressure leaks.

Check that all proximity switches are properly installed prior to starting the motor.

7. Start the waterjet pump. Operate at low pressure (without a cutting orifice) to flush the HP passages, then operate at high pressure to check for leaks.

7.2.2 HP Sealing Head

Remove from/Install in Waterjet Pump

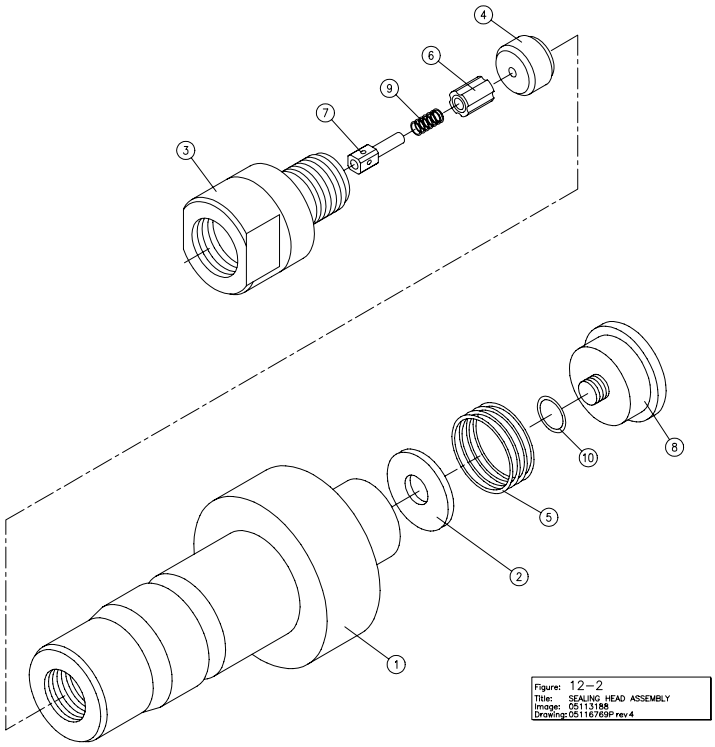
1. Remove low pressure and HP piping from sealing head using procedure in Section 7.2.1.

2. With pin spanner wrench located on head nut to turn counterclockwise, and cylinder wrench installed on cylinder to hold in opposite direction of rotation; break the head nut loose. Tapping the pin spanner wrench with plastic hammer may be required.

3. Unscrew head nut until it is flush with the water inlet groove on the sealing head. With a screwdriver in the groove, and supported by the head nut, gently pry the sealing head out as far as possible; continue repeating the process until the sealing head is loose from the cylinder. Continue unscrewing the head nut and remove nut from HP cylinder.

NOTE

Parts are heavy; avoid dropping.



Item Description

(1) Sealing Head	(2) Inlet Poppet	(3) Gland Nut
(4) Poppet Seat	(5) Inlet Spring	(6) Poppet
(7) Guide Pin	(8) Poppet Retainer	(9) Discharge Spring
(10) O-Ring		

4. Remove the sealing head. Using the seal removal tool, remove the HP seal components remaining in the HP cylinder outboard end. Remove the cylinder bore liner.

5. The HP cylinder can now be to be removed for further tear down, or the sealing head and it's HP seal can be serviced. *Note that a fully assembled spare sealing head greatly reduces pump down-time.*

6. Prior to installing a new sealing head HP seal, the following tasks should be accomplished, as necessary:
   - Inspect and service inlet check valve
   - Inspect and polish sealing head seal surfaces
   - Inspect and polish HP cylinder outboard bore surface

7. Wipe the bore liner clean, then install it into the HP cylinder.

8. Lightly grease the sealing head seal components with food grade grease before installing. Slide the seal assembly onto the boss of the sealing head. The tan, hard plastic back-up ring must shoulder against the seal shoulder. The ring is chamfered and must be installed against the chamfered shoulder of the sealing head. The HP seal must be installed with the O-ring facing the inlet HP check valve.

9. Lightly lubricate the inside of the HP cylinder outboard end with food grade grease. Ensure threads are clean and undamaged. Lubricate cylinder threads with High Purity Goop.

10. Fit the sealing head assembly and head nut together. While holding the sealing head assembly securely against the head nut, thread nut onto the HP cylinder. Avoid knocking the end of the seal head against the HP cylinder to prevent damage to the inlet check valve and to seals or sealing surfaces.

11. As the head nut threads onto the HP cylinder and the sealing head begins to resist turning, tap the sealing head outboard end with a plastic hammer until the sealing head seats against the end of the HP cylinder.

NOTE

It is important to avoid rotating the sealing head relative to the HP cylinder, as this may cause premature HP seal leaks.

12. The head nut can be threaded by hand onto the HP cylinder. Turn the head nut until it bottoms out. Then tighten the head nut with the spanner wrench, finishing with a single, light tap on the wrench handle. Any torque greater than this could cause problems with loosening the head nut during subsequent disassembly.

7.2.3 HP Cylinder

Remove from/Install in Waterjet Pump

The HP cylinder can be unthreaded from the cylinder head either with or without its head nut and sealing head assembled to it. We recommend the following procedure since the combined parts make up a rather heavy assembly that is difficult to handle.

1. Remove sealing head from HP cylinder by following procedures outlined in Section 7.2.2.

2. Unthread the HP cylinder from its hydraulic cylinder head using the special cylinder wrench. Support the weight of the cylinder until it completely clears the plunger. The cylinder is heavy and may damage the plunger or cause injury if it is not supported.

3. With the HP cylinder removed the plunger HP seal can be serviced and the complete cylinder can be inspected and polished as described in Section 7.3.4. Remove the plunger HP seal and seal follower from the HP cylinder using the special aluminum seal removal tool. Be careful not to scratch the bore of the HP cylinder.

4. Remove cartridge retainer flange from hydraulic cylinder head by first removing retaining ring using a flat blade screwdriver. Wipe and clean surfaces, weep holes, and grooves in cartridge retainer flange. Check retainer flange for cracks.

5. Prior to installing a new plunger HP seal, the following tasks should be accomplished, as necessary:

    - Inspect plunger's exposed surface for scratches, surface discoloration, or unusual contact markings. Remove and replace plunger
    - Inspect and polish HP cylinder bore surface.

6. Reinstall the cartridge retainer flange with its retaining (snap) ring. Before assembly, lightly lubricate the follower and the seal assembly with food grade grease. Slide plunger seal follower over plunger. Install plunger HP seal assembly over plunger in the following order:

   - Solid plastic backup ring against follower
   - U-shaped seal and O-ring against backup ring
   - J-shaped seal body and O-ring against U-shaped seal body. The open side of the J-seal should face outboard (toward the sealing head).

7. Inspect the HP cylinder threads and apply High Purity Goop to the threads and shoulder guides, then screw the HP cylinder into the hydraulic cylinder head. Be sure to support the weight of the HP cylinder. As the HP plunger seal goes into the cylinder, the cylinder will become difficult to rotate. Use the special cylinder wrench to assist, as necessary.

8. Tighten the HP cylinder hand tight with the cylinder wrench, and then tap the cylinder wrench with the hand's palm to tighten.

9. Install bore liner into HP cylinder. The sealing head can now be installed onto the HP cylinder (Section 7.2.2).

7.2.4 Hydraulic Seal Cartridge & Plunger

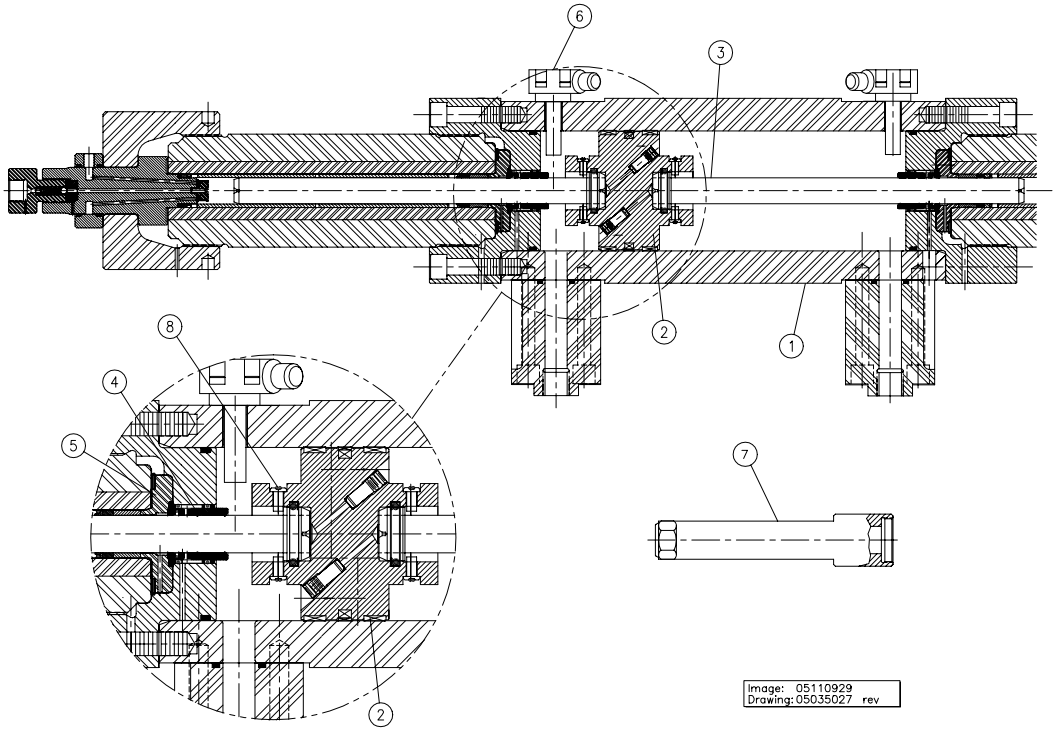
Remove/Install

With the HP cylinder removed from the hydraulic cylinder head (Section 7.2.3), the following items become accessible:

- Cartridge retainer flange
- Hydraulic seal cartridge
- Plunger
- Hydraulic cylinder head
- Hydraulic piston and cylinder

1. Remove the proximity switch on the side of waterjet pump to allow hydraulic oil to drain to the tank. This procedure takes about 5 minutes and will minimize oil spillage.

2. To remove the hydraulic seal cartridge, use a screwdriver to remove the internal retaining (snap) ring that holds in the cartridge retainer flange. Remove cartridge retainer flange.



Item Description

(1) Hydraulic Cylinder	(2) Piston	(3) Plunger
(4) Cartridge Seal	(5) Flange	(6) Proximity Switch
(7) Plunger Tool	(8) Retaining Pins	

3. Using cartridge/plunger removal tool threaded to the seal cartridge, pull the cartridge outward over the plunger. Seals in the hydraulic cartridge can be removed and replaced, or the entire cartridge can be replaced. It is recommended that at least one spare cartridge be kept on hand, ready to install. See Section 7.3.6 for servicing hydraulic seal cartridge.

4. With the cartridge removed, the plunger can be removed with the cylinder head in place. Slide the cartridge/plunger removal tool over the plunger, with the hex-shaped smaller end toward the plunger button. Note orientation of plunger button retainer pins (6 each), and then align hex flats of tool with pins. Force tool by hand under pins, then rotate tool slightly to cause pins to retract enough to release plunger. Plunger can now be extracted from hydraulic piston. See Section 7.3.5 for servicing the plunger.

5. To install new plunger, slip cartridge/plunger removal tool over plunger; hex end toward plunger button, to help center plunger in cylinder head. Position plunger in mating pocket of piston, then force into place by hand. Using a flashlight, verify that all 6 pins are equally extended to grip plunger button.

6. Lubricate exposed surfaces of seals in hydraulic seal cartridge with food grade grease and slide cartridge over plunger into cylinder head cavity.

7. Thoroughly clean cartridge retainer flange, including cross-drilled weep holes. Install flange and internal retaining ring, making sure that the retaining ring seats fully inside its groove.

8. HP cylinder and sealing head are now able to be assembled to the waterjet pump per Sections 7.2.3 and 7.2.2.

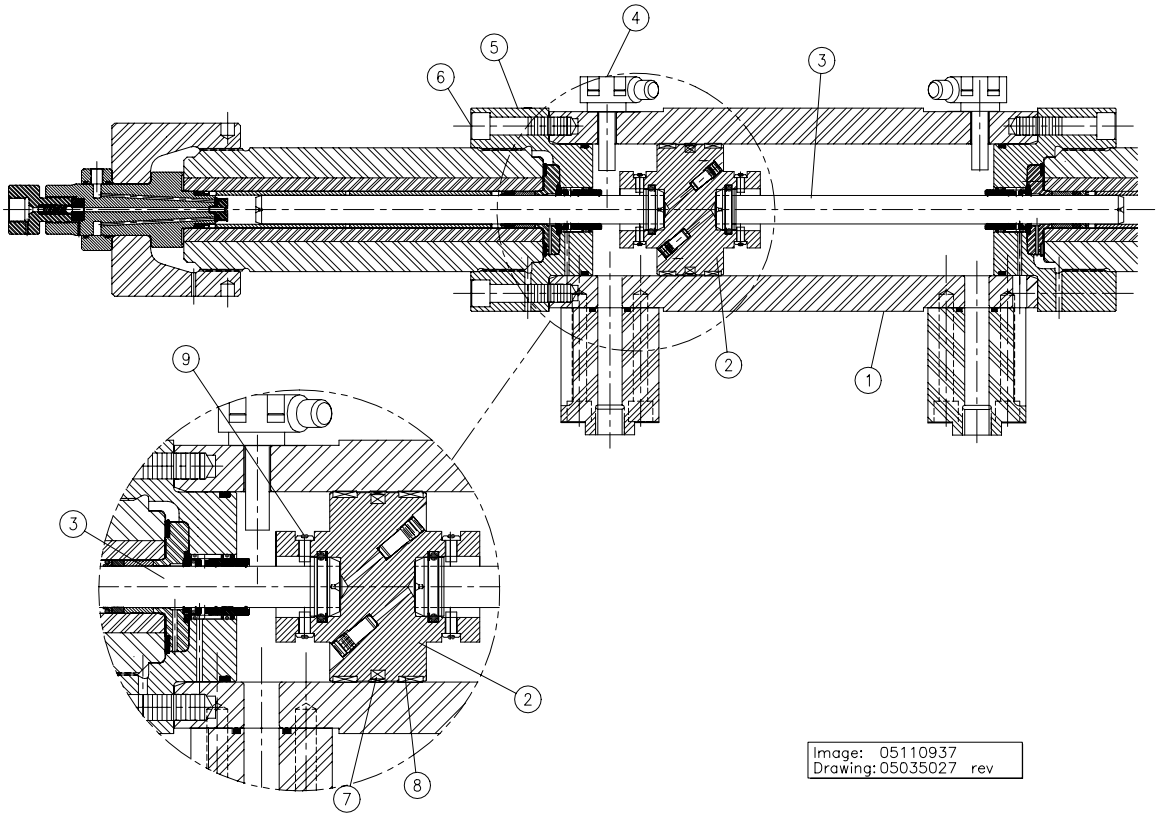
7.2.5 Hydraulic Cylinder Head and Hydraulic Piston

Disassembly

1. Remove sealing head and HP cylinder using procedures in Sections 7.2.2 and 7.2.3.

2. Remove proximity switch at cylinder end to be serviced. If both cylinder heads and/or the hydraulic piston are to be removed, both proximity switches must be removed.

3. Remove hydraulic seal cartridge (Section 7.2.4). Seal cartridge removal is recommended to avoid sliding cylinder head over plunger. The plunger need not be removed at this stage.



Item Description

(1) Hydraulic Cylinder	(2) Piston	(3) Plunger
(4) Proximity Switch	(5) Cylinder Head	(6) Cap Screw
(7) Seal Assembly	(8) Glide Ring	(9) Retainer Pin

4. Loosen and remove 6 each socket head cap screws retaining cylinder head to hydraulic cylinder. The cylinder head and its O-ring can be removed. The proximity switch mounting flats provide a small lip for loosening the cylinder head.

5. To remove the hydraulic piston from the hydraulic cylinder, remove both cylinder heads. The piston must be driven from the cylinder bore due to the seal squeeze and friction. Use a plastic head hammer to avoid striking the assembly with a metal object. See Section 7.3.7 for servicing the hydraulic piston.

6. Reassemble the hydraulic cylinder by reversing the above steps.

7.3 Intensifier Subassemblies Inspection and Repair

The inspection and repair of the following subassemblies will be discussed:

- Discharge HP Check Valve, Section 7.3.1
- Inlet Check Valve, Section 7.3.2
- Sealing Head, Section 7.3.3
- HP Cylinder, Section 7.3.4
- Plunger, Section 7.3.5
- Hydraulic Seal Cartridge, Section 7.3.6
- Hydraulic Piston, Section 7.3.7
- Hydraulic Cylinder, Section 7.3.8

7.3.1 Discharge HP Check Valve

The HP discharge check valve can be serviced with the sealing head either installed in or removed from its intensifier HP cylinder.

1. Remove the gland nut from the sealing head using two 30mm (1 3/16") wrenches.

2. When the gland nut is removed, the spring guide, spring and poppet will normally stay in the gland nut. The valve seat is removed with a magnet. Inspect the seat for damage or cracking. A cracked seat should be replaced. The seat is symmetrical, and can be installed with either face toward the poppet. When reinstalling the seat, apply a thin film of High Purity Goop to both faces. Install the seat into the sealing head with the best surface facing the poppet.

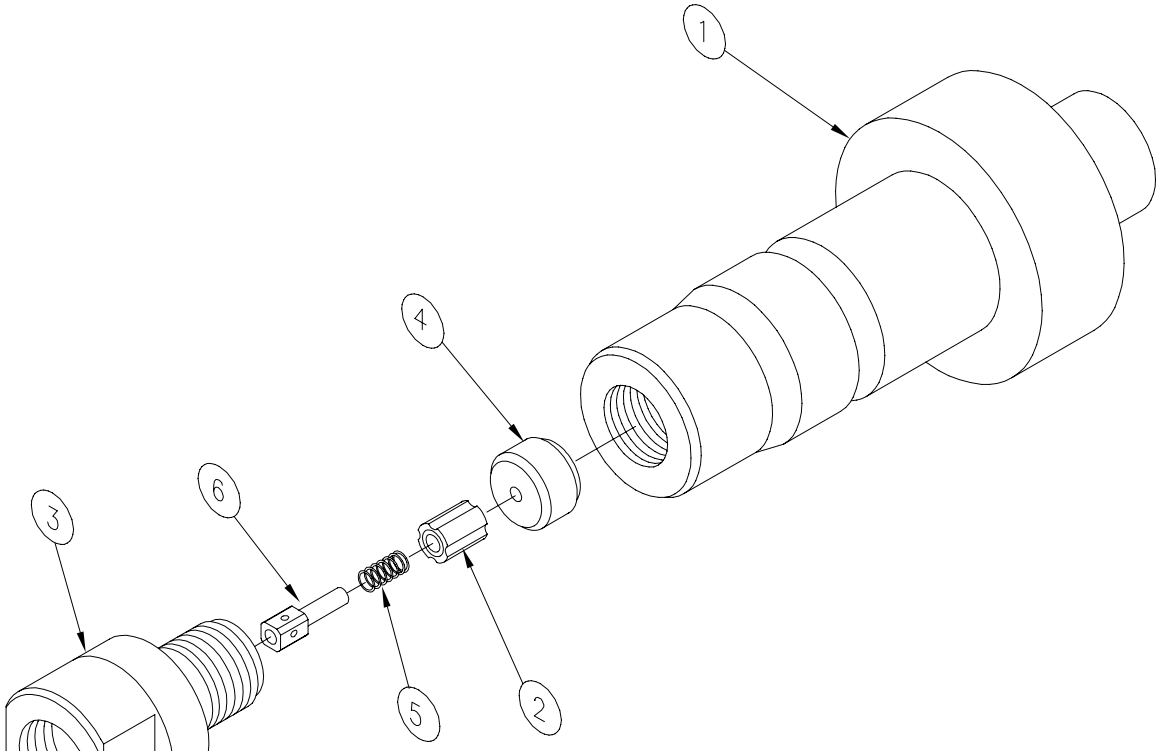


Figure:
Title: SEALING HEAD ASSEMBLY
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Drawing: 05116769P rev 4

Item Description

(1) Sealing Head	(2) Poppet	(3) Gland Nut
(4) Poppet Seat	(5) Spring	(6) Guide Pin

3. Inspect the poppet, spring, and guide for wear. Replace the spring and guide if worn. Replace the poppet ball if it has dull appearance.

4. Apply a thin film of High Purity Goop to the sealing face of the gland nut. Install the guide, spring, and poppet into the gland nut. These parts should be installed dry, ie, without grease.

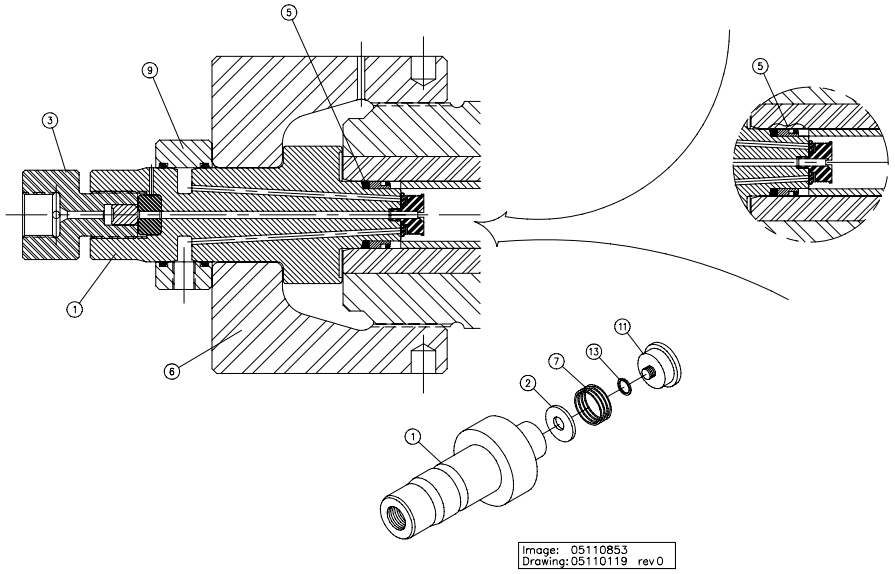
5. Apply High Purity Goop to the gland nut threads. Install the gland nut into the sealing head. The gland nut should be hand tightened until there is a gap of 5mm (0.20") between the gland nut and sealing head. No threads should show. If the gap exceeds 5mm (0.20"), then the poppet has slipped out of place, and the parts must be removed, inspected and reassembled.

6. Using a 30mm (1-3/16") crowfoot/torque wrench combination, torque the gland nut to 88 Nm (65 ft-lbs.).

7. Reconnect high pressure and low pressure piping, collar and quick disconnects per Section 7.2.1. Operate waterjet pump to verify HP fittings do not leak, and that the HP water signal is normal (indicative of normal check valve operation).

7.3.2 Inlet Check Valve

1. Use a ½" flat bladed screwdriver to unscrew the poppet retainer from the sealing head. The inlet check valve is disassembled.
2. Inspect and refinish the sealing head face seal surface per instructions in Section 7.3.3.
3. Inspect both surfaces of the flat washer shaped poppet. If one surface is marred, and the opposite surface is not, the poppet may be reversed with the best surface facing the sealing head. If both sides are worn, replace poppet.
4. Insure the poppet retainer threads, and the mating threads in the port sealing head are clean and dry. Install small O-ring over threads.
5. Assemble the inlet poppet, spring, and retainer to the sealing head using a ½" flat blade screwdriver.
6. Inspect the assembled unit to insure the following:
   - The poppet moves freely.
   - The spring is fully guided on the poppet retainer.
   - The spring end is 90° from the retainer's screwdriver slot.
   - The poppet retainer is shouldered against the sealing head.
   - O-ring is sandwiched between poppet and body.



Item Description

(1) Sealing Head	(2) Poppet	(3) Gland Nut
(5) Head Seal	(6) Head Nut	(7) Suction Spring
(9) Collar	(11) Retainer	(13) O-Ring

7.3.3 Sealing Head

The sealing head should be inspected for scratches and wear on two surfaces:

- HP seal contact surface
- Inlet HP check valve poppet contact surface

In addition, the sealing head inlet water groove should be examined for cracking.

1. Inspect the poppet sealing surface of the sealing head for pits, scratches, or jetting erosion. If the sealing head is not absolutely smooth, it must be refinished. Using a piece of plate glass (not window glass) on a sturdy table, place a piece of 400 grit wet/dry sandpaper atop the plate of glass which provides the absolutely flat surface necessary for the polishing process. Using even, deliberate strokes, polish the sealing head until smooth. Rotate the head about 10-15 degrees every stroke. Be careful not to tilt or tip the head while polishing it as to not scrape the part.

2. When the sealing head is flat and smooth, perform a final polish with 600 grit wet/dry sandpaper. A mirror finish is required. Ingersoll-Rand offers a refinishing service.

7.3.4 HP Cylinder

1. At a workbench, use the seal removal tool to prevent scratching the cylinder bore sealing surface. Use a pulling action to remove the sealing head HP seal.

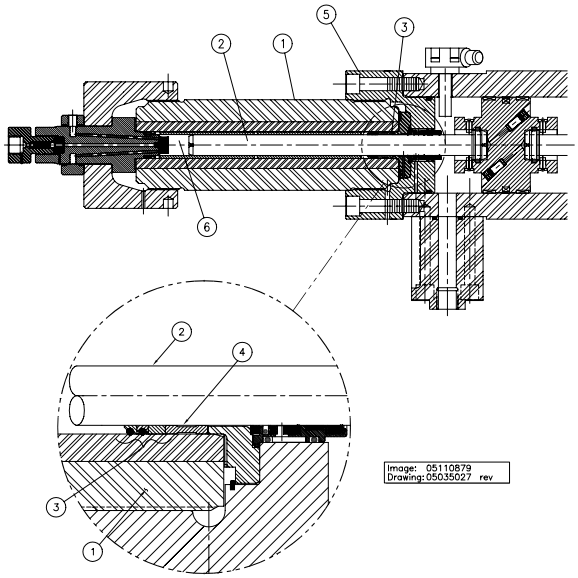
2. Remove the bore liner. Use a plastic-faced hammer and the seal removal tool to drive out the plunger HP seal and follower. Be careful not to scratch the bore of the cylinder or damage the cylinder threads.

3. Clean sealing areas of HP cylinder inside diameter and inspect cylinder for rings, scratches, pits, residue build-up and other potential leak paths. Seal material or residue can build up forming a ring, and running a fingernail across it, will cause it to appear as a surface flaw. It is usually necessary to clean the area before performing an inspection.

4. Use 600 grit wet/dry sandpaper to polish HP cylinder inside diameter where the seal will locate. Polish only in a circumferential motion. Do not polish or drag the sandpaper along the length of the cylinder. Hold the sandpaper on the end of your finger, and move in a cylindrical wiping motion in the bore of the HP cylinder. Wipe residue from cylinder inside diameter and re-inspect for surface defects.

NOTE

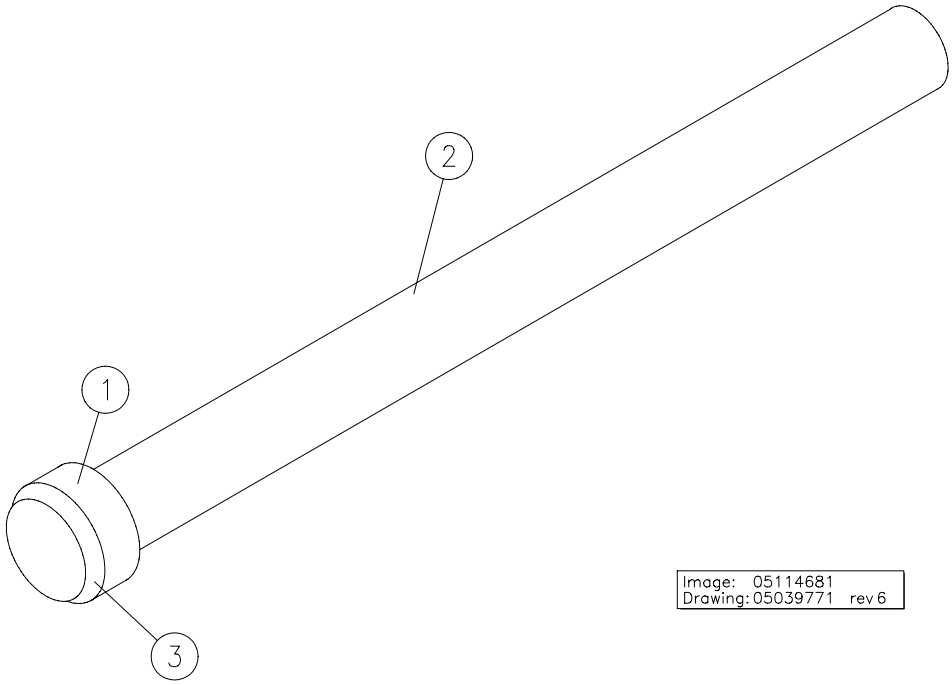
The HP cylinder ends often show a “step” between inner and outer sleeves where the inner sleeve extends beyond the outer by a small amount. This is normal and does not indicate a flaw in the cylinder.



Item	Description	
(1) Cylinder Body	(2) Plunger	(3) Plunger Seal Follower
(5) Cylinder Head	(6) Liner	

7.3.5 Plunger

Plunger surfaces can become streaked with longitudinal scratches or flaws, the surface can become discolored or dull in appearance, or the outboard end can become smeared with stainless steel due to contact with the bore liner. If any of these conditions become severe, the plunger HP seal and possibly the hydraulic seals will leak excessively. Some surface flaws can be polished and repaired on site, while others must be polished using the reconditioning service offered by KMT Waterjet.



Item	Description		
(1) Plunger Button	(2) Plunger	(3) Button Chamfer	

7.3.6 Hydraulic Seal Cartridge

1. Carefully remove worn seals and O-rings from cartridge by pushing them with a dowel or similar object. Remove seals positioned close to the open ends first, working toward the interior. Examine seals for unusual wear, deformation or cuts. Note any unusual buildups of solid material or debris causing possible leak paths.
2. Examine the cartridge body (1) surfaces for scratches, signs of metal-to-metal contact, deformation or other unusual wear.

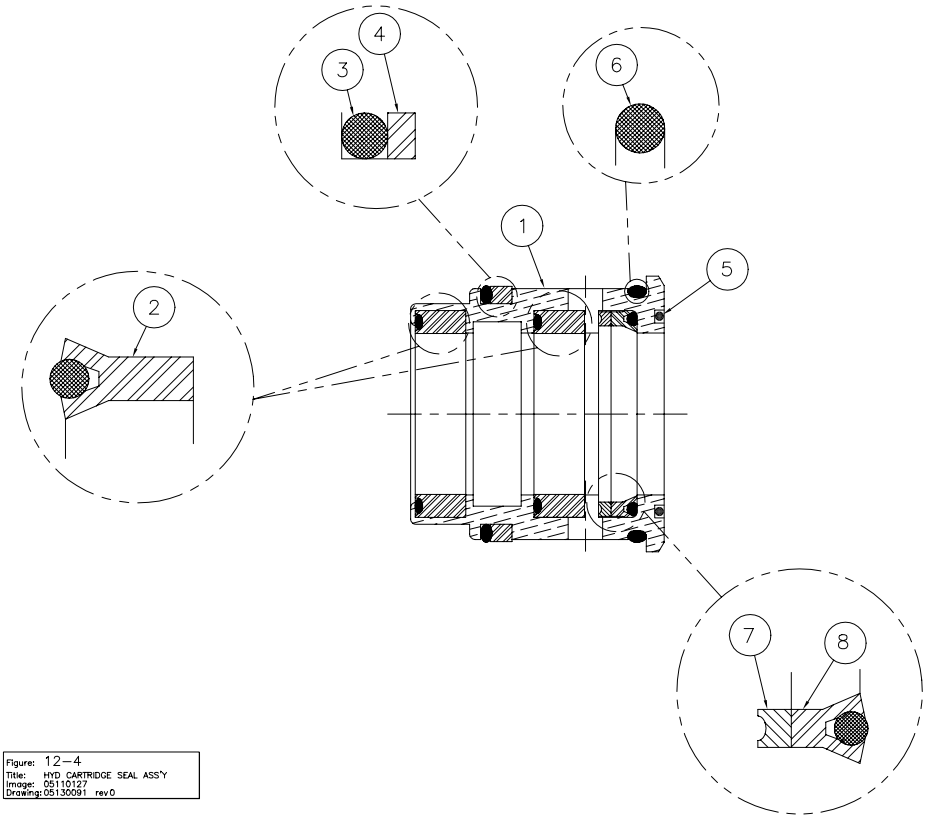


Figure: 12-4
Title: HYD CARTRIDGE SEAL ASS'Y
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Item Description

(1) Cartridge Body	(2) U-cup Seal	(3) O-Ring
(4) Back-Up Ring	(5) O-ring	(6) O-Ring
(7) Back-Up Ring	(8) U-cup Seal	

NOTE

It is important to examine the inside diameter surfaces of cartridge seal grooves for scratches, especially any scratches in the axial direction that might offer a leak path. Use caution during seal removal and installation to avoid scratching these surfaces. Do not use metal screwdrivers, wires, etc. to remove inside diameter seals. Plastic or wood should be used for seal removal and installation.

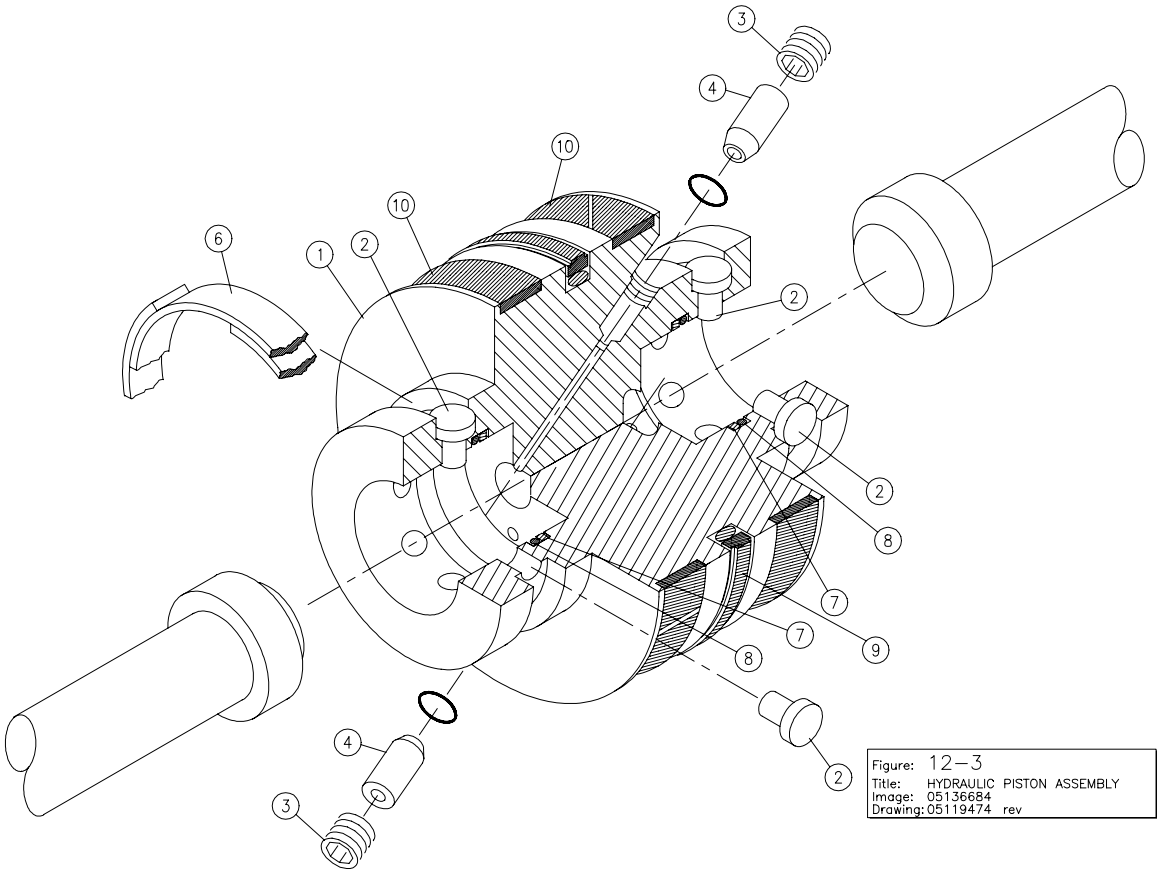
3. During seal installation, orient U-cup packing seals (2) (8) so that they match figure above.

4. Apply food grade grease to seals and cartridge seal components to aid in installation and seal seating. Use installation tool, if available, for installation of U-cup seals (2) (8). Verify that U-cup O-rings are in place in their respective U-cup seals after installation.

7.3.7 Hydraulic Piston

The hydraulic piston contains a seal assembly, glide rings that contact the cylinder bore, pins and elastic bands to retain the two plungers, and check valves to vent possible leaking hydraulic fluid internal to the piston assembly.

1. Replace piston hydraulic seal and glide rings (2 each) by removing these components with the help of a smooth, dull-edged blade made from brass or similar soft (relative to steel) material. Note that scratches to the seal groove sides and/or bottom can result in an oil leak path. Care should be taken to avoid scratches.



Item Description

(1) Piston
(2) Pin
(3) Set Screw
(4) Check Valve
(5) Threadlocking Adhesive
(6) Elastic Band
(7) Back-up Ring
(8) O-ring
(9) Seal Assembly
(10) Bearing Ring

2. Clean and inspect the seal groove and glide ring grooves (2 each) for unusual scratches, residue buildup, etc. Inspect outside diameter surfaces of piston for signs of contact with cylinder walls. If other than superficial damage has occurred, the piston should be replaced. Install the 2-part piston seal in the center groove. Install the square cross-sectioned backup ring in the groove, taking care to see that this ring lies flat against the groove bottom. Install the seal over the backup ring using the dull-bladed tool.

CAUTION

If this ring is allowed to twist, and not lie flat against the groove bottom, it can cause uneven wear and premature failure of the seal.

3. To install glide rings, spread each ring at its split, and then position these rings in their respective grooves.

4. Disassemble plunger retainer pins and button seals then clean grooves and holes. Inspect plunger cavities (2 each) for unusual wear, scratches, etc. The bottom of this cavity will normally show the impression of the plunger on it due to the high contact forces between piston and plunger.

5. Install new backup ring and O-ring in each internal groove in each plunger pocket. Failure to install backup ring can result in plunger being forced out of plunger pocket.

6. Inspect elastic pin retaining band for cuts, material flaws or other signs of weakness. Install pins (6 each) around plunger pocket. Position elastic band over pins. Repeat for other plunger pocket.

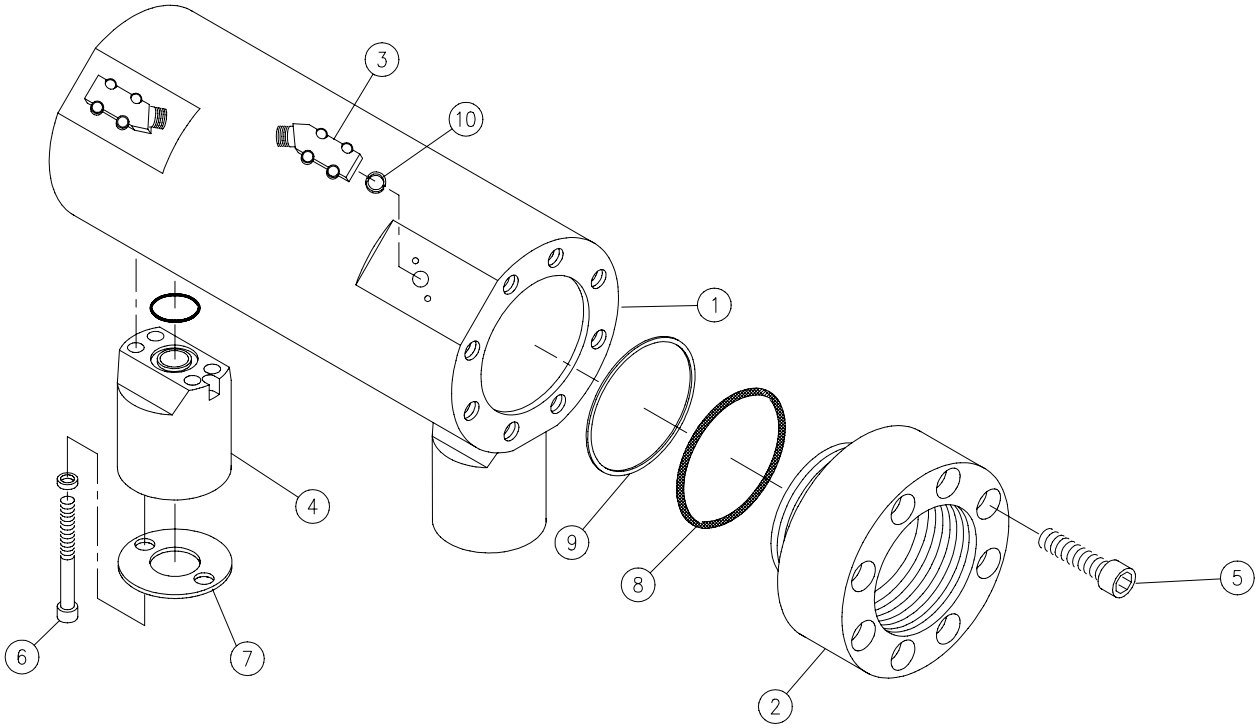
7. Check valves (2 each) or cross-drill plug removal may be necessary. Re-install using thread locking compound applied sparingly on the plug threads. Excess compound may clog a check valve or block a drilled passageway. To avoid excess compound, position the plug or retainer on its Allen wrench, apply thread locking compound, then hold the plug/retainer horizontal on a paper towel while rotating the plug/retainer to wipe off excess thread locking compound.

8. Install O-ring in check valve cavity, positioning in hole bottom with pencil-like blunt instrument. Install check valve with chamfered end toward O-ring. Coat retainer with thread locking compound. Then, thread retainer over check valve cartridge. Allow 24 hours for thread locking compound to set.

9. Install plugs in cross- drilled passages by applying thread locking compound to plug threads. Then thread plugs (2 each per hole), with the second plug acting to lock in the first. Allow 24 hours for thread locking compound to set.

7.3.8 Hydraulic Cylinder

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 on this bore is indicative of piston seal wear.



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Item Description

(1) Hydraulic Cylinder
(2) Cylinder Head
(3) Proximity Switch
(4) Mount Stem
(5) Socket Head Cap Screw
(6) Socket Head Cap Screw
(7) Gasket
(8) Back-up Ring
(9) O-ring
(10) Spacer

7.4 HP Dump Valve

The dump valve assembly includes a normally open HP water valve, plus a solenoid operated air valve for the air actuator on the dump valve.

7.5 HP Attenuators

There is no servicing of the HP attenuators at the customer level. The seals in the HP attenuators are tested at KMT Waterjet to high pressure in excess of operating pressure making disassembly difficult. In the event of a HP water leak of a HP attenuator, the attenuator should be replaced. The defective attenuator should be returned to KMT Waterjet Systems for replacement or servicing.

8 Electrical System

The electrical system contains all functions necessary for turnkey operation. This includes the control and starter panel, intensifier reversal circuit, diagnostics, malfunction warning and protection.

The electrical enclosure and the display, buttons, lights, and electrical harnesses into and out of this enclosure can be exposed to occasional water spray and dust per NEMA-12 standards.

8.1 Electrical Overview

There is only one 100hp electric motor on the SL-IV100hp Waterjet Pump. The control voltage of 24vdc is furnished by the built-in power supply drawing its power from the motor's AC circuit.

8.1.1 Motor Starter Circuit

The SL-IV100hp Waterjet Pump is powered by a standard Wye-delta starter circuit. The built in starter circuit includes the following:

- Manual disconnect with door handle interlock
- Over current protection
- Thermal overload devices.
- The hydraulic circuit is selected to low pressure to allow the motor to achieve full speed for approximately 5 seconds.
- The motor is also provided with terminal blocks for wire termination

8.1.2 Control Circuits and Logic

The operator controls the waterjet pump primarily through the digital display panel. The digital interface (display) communicates with the PLC controller located inside the electrical enclosure.

In order to prevent costly damage to the pump, automatic shutdown logic and diagnostic messages are displayed to the operator as to the cause of the impending shutdown. Some of the inputs that trigger automatic shutdown:

- Low hydraulic reservoir level
- High hydraulic oil temperature
- High boost pump temperature
- HP intensifiers cycling out-of-tolerance condition

For more information on these conditions and recovery procedures, refer to Section 3, Operation, of this manual.

The following terminal blocks are provided in order to interface with the remote operator's station

- Start
- Stop
- Emergency Stop (E-Stop)
- Pump RUN indicator light
- Pump malfunction light

8.1.3 Operation

During normal operation, the control panel shows operating messages and the RUN green light will be lit. After pulling the EMERGENCY STOP and CONTROL POWER ON pushbutton is pressed:

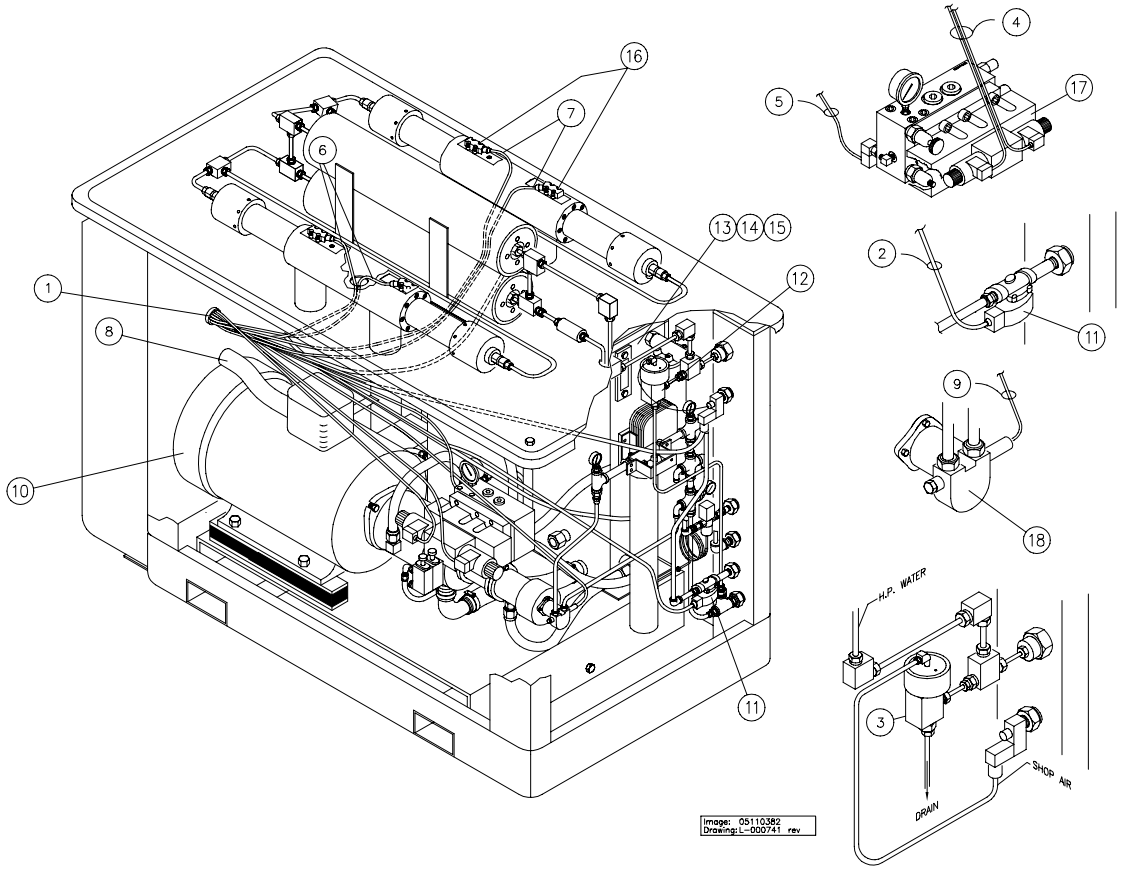
The control power is turned ON.

The cutting water inlet valve (11) solenoid is powered on and opens. It will remain on for 2 minutes or until the motor is started, whichever occurs first. If the 2 minutes elapses before the motor is started, the solenoid must be re-opened by pressing F6.

The high pressure dump valve (3) is powered on and closes.

NOTE

The high-pressure dump valve will not close if the air supply is OFF.



After pressing the F1 key:

- The motor starter in the control panel is activated and the motor (10) starts.
- The hydraulic HI-LO solenoid valve (5) shifts to LOW pressure to allow for minimum load on the motor during start up. After a few seconds, the pressure shifts to the operator's switch setting.
- The intensifier assembly starts operating. Reversal position is sensed by proximity switches (16), which send signals to the PLC inside the control panel. The PLC activates the opposite solenoid on the pump reversing valve (17).

8.2 Maintenance Overview

Electrical components require minimum attention and service. The components that require service are the proximity switches on the intensifier assembly, and the optical relay switch in the control panel.

8.2.1 Proximity Switch Service

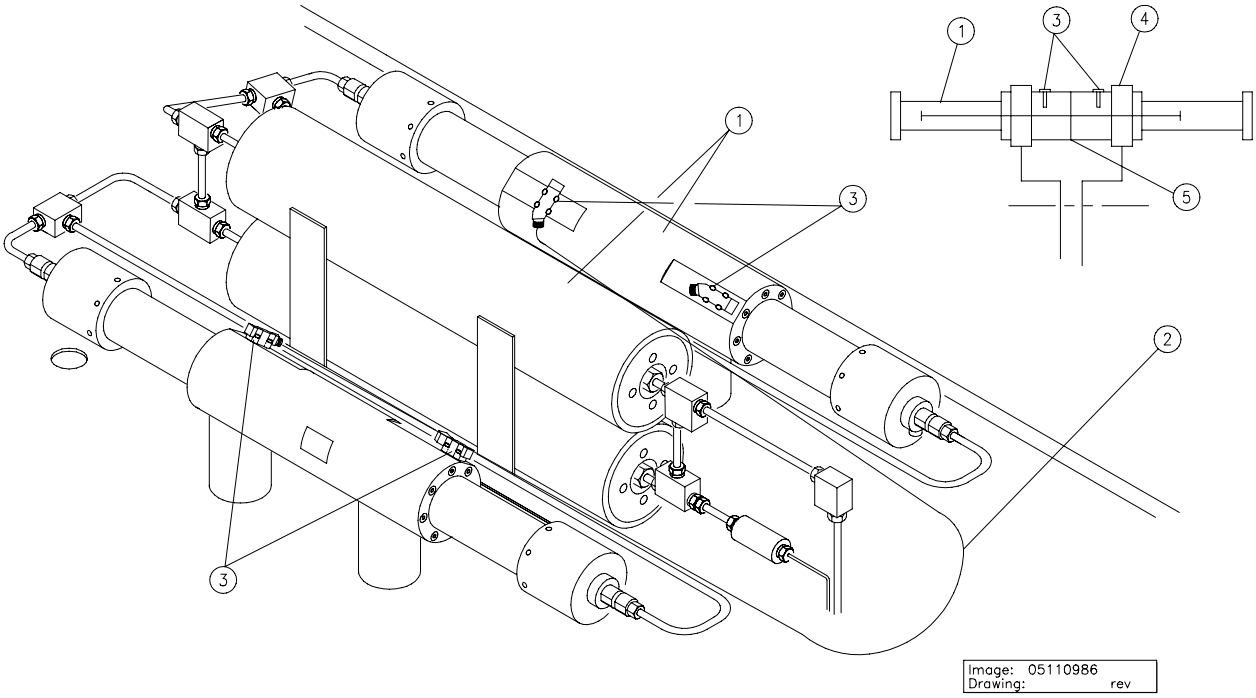
If the pump quits pumping water, the proximity switch may need to be replaced. Check the LED lights on the switch.

Symptoms of a failed proximity switch are (1) the LED lights do not change state (indicating not sensing the piston) or (2) the LED lights are continuously flashing. Replace the switch when failure occurs.

Components:
(1) Intensifier Assembly
(2) Electrical Harness
(3) Proximity Switch
(4) Hydraulic Cylinder
(5) Piston

Recommended Tools:
Allen (hex) Wrench, M5
Torque Wrench
Rags

Parts:
Proximity Switch



Replace Proximity Switch

1. Turn off waterjet pump, disconnect and LOCKOUT electric power.
2. Disconnect cable.
3. Unscrew bolts, remove proximity switch.
4. Install new switch. Install bolts.
5. Torque bolts to 16-18 Nm (140-160 in-lbs.).

8.2.2 Optical Relay Switch Service

If the pump quits operating, the optical relay switch may need to be replaced:

- Verify input to the proximity switch
- Check output to the optical relay
- Replace switch upon failure

Components: Control panel
Optical Relay Switch
Screw

Recommended Tools: Flat screwdriver, 3mm (1/8 inch)

Parts: Optical Relay Switch

Replace Optical Relay Switch

1. Turn off waterjet pump, disconnect and LOCKOUT electric power.
2. Open control panel.
3. Unscrew optical relay switch mounting bolts, remove and replace.

9 Hydraulic System

The hydraulic system drives the intensifier assembly to produce HP water. The system is composed of a variable displacement pressure compensated piston pump, driven by a motor.

The hydraulic system is designed to provide sufficient hydraulic oil flow at sufficient pressure to supply the two intensifiers, at their specified maximum output conditions of flow and pressure. Refer to Section 11, Specifications.

The waterjet pump "slow start" feature includes the hydraulic and the electrical start circuits. Hydraulic pressure is automatically switched to low during startup, working with the Wye-Delta motor start circuit to reduce motor load. After a few seconds (time enough for the motor to reach full speed) hydraulic pressure is automatically switched to the operator's switch setting.

9.1 Overview

The hydraulic system includes two hydraulic circuits each with its own pump:

- Main hydraulic power circuit which uses the piston pump (discussed in this section), and the
- Recirculation system which uses a gear pump mounted in tandem with the piston pump (discussed in Section 10, Recirculation System).

A single pump and directional control valve (DCV) are used to control both intensifier hydraulic cylinders. The hydraulic manifold, which includes the solenoid–operated DCV, is mounted on the pump discharge port. The hydraulic system also includes plumbing to connect pump, tank and intensifier cylinders.

9.1.1 Features

In addition to "slow start", other features of the hydraulic system are listed below:

- **Hydraulic 4-way valve –** directional control valve (DCV)–solenoid–operated. Used for HP cylinder shifting.
- **Closed coupled motor/hydraulic pump –** pump mounts directly to the motor, saving approximately 8-10 inches of length on the overall pump/motor assembly, reducing footprint of the waterjet pump package. The pump is directly coupled to the motor rather than a conventional standalone housing and shaft coupling assembly.
- **Reference hydraulic gage –** used for adjusting pressures in the HI/LO relief valves. Displays hydraulic pressure, as well as water pressure in multiple units directly at the pressure adjustment knob.
- **Built in hydraulic oil drip pan –** allows for the spills to be contained within the machine while addressing environmental issues of mixing water and oil.
- **Remote dual pressure control –** allows for flexibility at the cutting nozzle in pressure adjustments for certain pure water/abrasive applications.
- **Pressure adjustment control –** allows for infinite pressure settings though out the entire pressure range for flexibility.

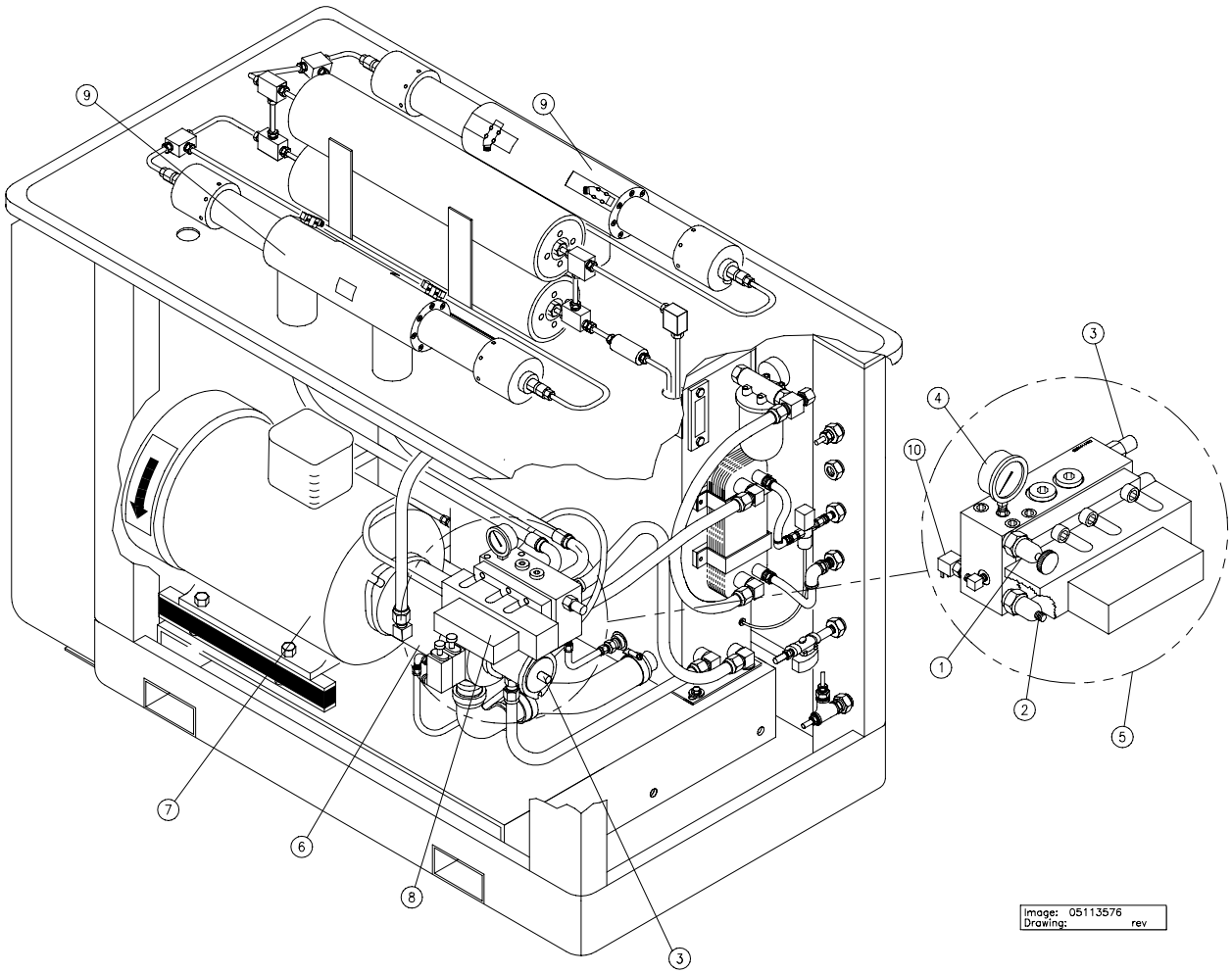
9.1.2 Components

Following are the hydraulic system components:

(1) HI pressure control (2) LO pressure control (3) Fixed relief valve
(4) Gage (5) Manifold (6) Pump
(7) Motor (8) Directional Control Valve (9) Hydraulic Cylinder
(10) Hi-Lo Solenoid Valve

NOTE

The main pump is direct-mounted to the motor. The main pump control includes hi and lo preset pressures. The operator is able to switch between pressures at the operator's console.



9.2 Operation

The hydraulic system operates at HI or LO pressure settings up to the maximum flow capacity of the variable displacement piston pump. Upon selecting HI or LO, the operator is able to adjust the HI or LO pressure controls within the respective adjustment ranges.

The electric motor (7) drives the variable displacement, pressure compensated pump (6). The hydraulic manifold (5) is mounted on the pump discharge. The flow from the pump passes through check valve to the directional control valve (8), and the directional control valve sends the flow to the hydraulic cylinders (9) in one direction until the piston activates the proximity switch at the end of the stroke. The activated proximity switch sends an electrical signal to the programmable controller (PLC). This PLC in turn activates the directional control valve (8) to change flow and to reverse direction of movement of piston until activating the opposite end-of-stroke proximity switch.

Although one DCV supplies hydraulic power to two intensifier hydraulic cylinders arranged in parallel, these cylinders operate at approximately the same cycle rate due to logic built into the PLC (see Section 8, Electrical System).

9.2.1 Hydraulic Pressure Adjustment

A variable displacement pressure compensated feature maintains constant operating pressures even under variable flow demands. Dual pressure control is standard. Switching high to low pressure may be done at the control panel (or remotely) with the HI-LO switch that activates the solenoid valve (11). The HI pressure is set by adjusting the knob and the LO pressure is adjusted using a wrench on that relief cartridge (2). Turning the knob/adjusting the screw clockwise increases pressure.

NOTE

In order to remote select the pressure, the HI-LO switch should be set to the “HI” position.

9.2.2 Hydraulic System Pressure Protection

Besides the HI-LOW Pressure Control Valves, the hydraulic system pressure is limited by the main relief valve (3). The operating hydraulic pressure is indicated by hydraulic gage (4).

Control	Valve	Pressure Adjustment		Hyd. Pressure Bar (psi)	
		Increase	Decrease	Maximum	Minimum
High Pressure	1	Clockwise	Counterclockwise	207 (3,000)	1.7 (25)
Low Pressure	2	Clockwise	Counterclockwise	103 (1,500)	1.7 (25)
Main Relief	3	Fixed	Fixed	234 (3,400)	

NOTE

Do not adjust the HI pressure control to pressures greater than 3,000 psi. Doing so will cause the main relief to open limiting hydraulic pressure to 3,400 psi. Also due to excessive opening of the main relief valve will result in significant wasted heating of the hydraulic oil, and the decrease of water flow performance.

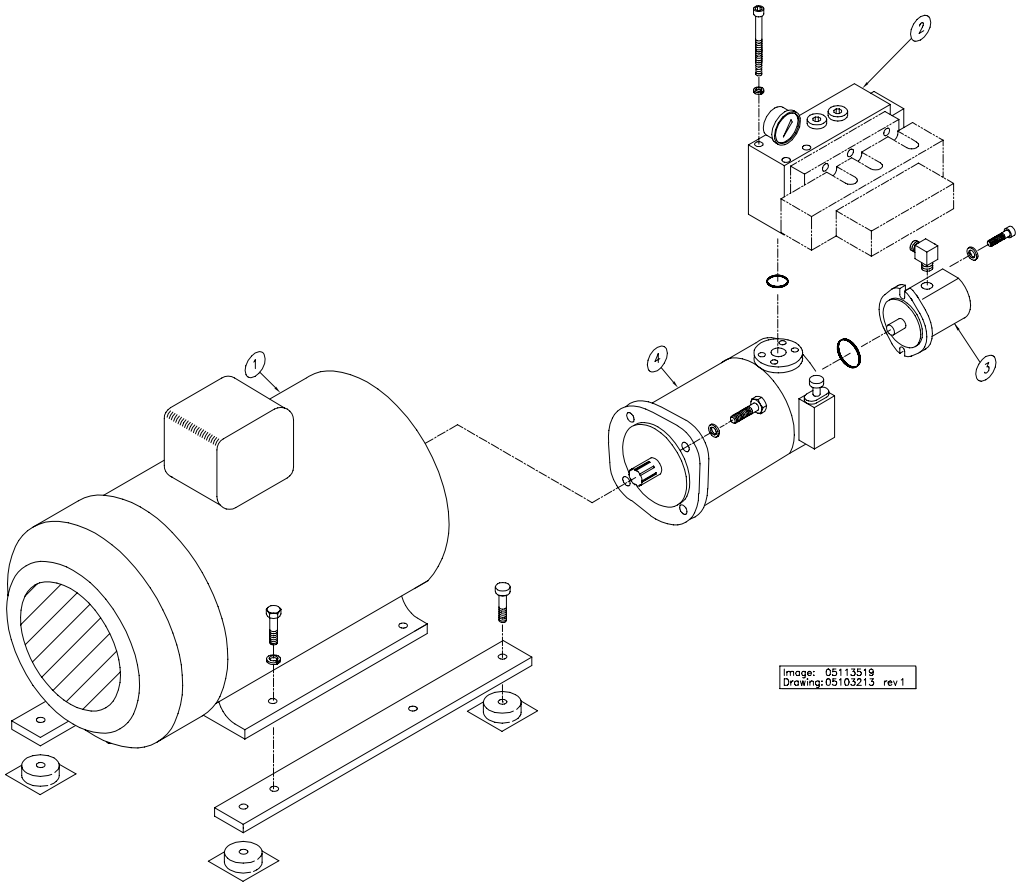
9.3 Motor/Hydraulic Service Maintenance

The hydraulic oil filter should be checked daily and replaced when the visual indicator is in the red zone. The hydraulic oil should be replaced every 2000 hours or yearly, whichever occurs first. For hydraulic oil and filter maintenance, see Section 10, Recirculation System.

The hydraulic system components that require periodic maintenance are the motor and the manifold. The motor needs to be serviced every 5000 hours of use. The operating pressure settings of the manifold needs to be checked daily and adjusted if necessary.

Recommended Tools: Manual Grease Gun
Open End Wrench 14mm (9/16")
Rags

Parts: Bearing Grease, SRI #2 or equivalent



Item Description

(1) Motor (2) Manifold (3) Recirculation Pump
(4) Hydraulic Pump

9.3.1 Motor Service

1. Locate the two zerk fittings, they are located at each end of the motor, remove their plastic caps.
2. Apply one or two strokes of grease. Replace caps on zerk fittings.
3. Run motor a few minutes.

9.3.2 Manifold Service

1. Check operating pressure.
2. If pressure adjustment is necessary:
3. Adjust high pressure control valve. Turn locking nut counterclockwise, then turn the knob clockwise to increase pressure, counterclockwise to decrease.
4. Adjust low pressure control valve. Turn locking nut counterclockwise with open end wrench. Turn the hex clockwise to increase pressure, and counterclockwise to decrease. Lock in place with nut.

9.3.3 Motor/ Pump Coupling – Spline Lubrication—

(Recommended Annual Service Procedure)

Special Tools and Supplies:

- Optimal Spline Lubricant- (P/N 10184802)
- Cleaning Solvent
- Miscellaneous Wooden Blocks
- Shop Rags
- Spare Shaft Seal—(See Table Below)

Shaft Seal Part No's -- Hydraulic Pumps		
Model/ kW (hp)	Piston Pump Displacement (cc's/rev)	Shaft Seal – Part No.
SL4/22 (30) & S30-OEM	45	05096011
SL4/37 (50)	71	05088083
SL4/75 (100)	140	49831159

1 Lock out electrical power to prevent inadvertent motor start

2 Unbolt motor vibration mounts from frame base plate (4 ea socket head cap screws).

3 Support hydraulic pump assembly while leaving all hose connections undisturbed. Use wooden blocks to support pump/ manifold assembly.

4 Remove bolts attaching piston main pump to electric motor.

5 Slide electric motor away from hydraulic pump package, revealing spline coupling.

Note: Additional clearance and access to the motor and pump splines can be had by pushing the pump assembly to the right. The main pump suction hose will limit movement to approximately 1-inch. It should not be necessary to disconnect any hydraulic hoses for this procedure.

Note: If additional clearance is required to separate motor and pump, unbolt electrical panel from the pump frame (SL-IV/30/50/100hp). Remove 4 ea ½-in. nuts from studs holding electrical panel to end of frame. Move electrical panel 4-8 inches away from frame. Disconnecting of motor lead wires should not be necessary to perform this procedure. Note that wire ties holding the electrical control harness to the top pan should be removed to allow the electrical control panel.

6 Wipe residue from motor internal spline and from male pump splines. Avoid damage to shaft seal on hydraulic pump.

7 Inspect splines for unusual wear. Consult with KMT Waterjet Service if spline wear appears beyond limits.

8 Note presence of hydraulic oil or evidence of hydraulic leak in shaft cavity. If hydraulic leak is indicated, replace shaft seal.

9 Lubricate internal and male spline wear surfaces with Optimal grease. Cover mating spline surfaces sufficient to assure all metal- to- metal contact surfaces are lubricated.

10 Move motor and pump assembly together to re-engage splines. Install hex head cap screws through holes/slots in pump flange into motor face.

11 Reinstall motor mount socket head cap screws (4 ea).

12 Reinstall electrical panel to end of frame (if applicable).

13 Start motor, apply full HP water pressure, noting any unusual sounds from motor / pump assembly.

14 (Spline lube procedure complete)

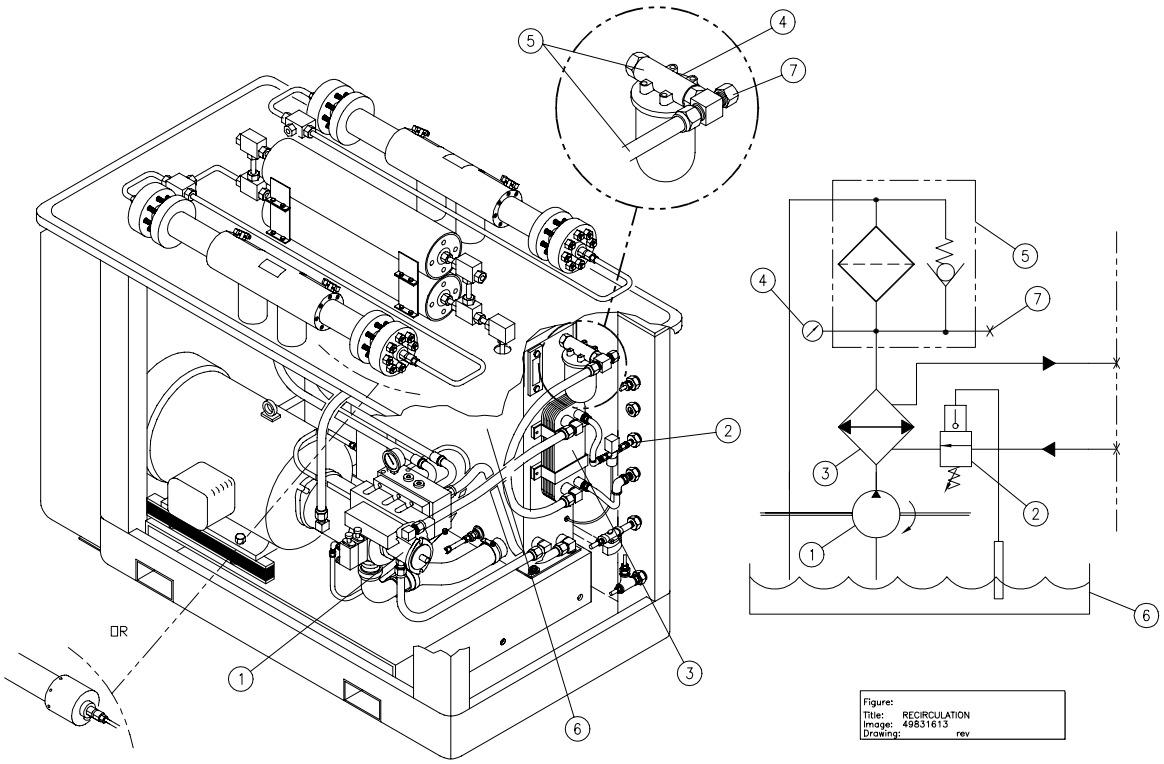
10 Recirculation System

The recirculation system keeps the hydraulic oil at operating temperature while using the minimum amount of cooling water flow. The system also provides the necessary oil conditioning and filtration to maintain oil cleanliness. The conditioning of the hydraulic oil includes cooling it, cleaning it, and together with the hydraulic tank, removing air bubbles entrained in the oil due to agitation and turbulent flow in the main pump circuit.

10.1 Components

The cooling and filtration system (recirculation system) is equipped with the following:

- **Recirculation pump** (gear-type)–which receives oil from the oil tank
- **Heat exchanger** - cooling water is controlled by the water modulating valve
- **Oil filter assembly** - includes an indicator to show the filter element condition. It also includes a bypass or relief valve, should the filter element become entirely clogged with dirt/contaminants.



Item Description

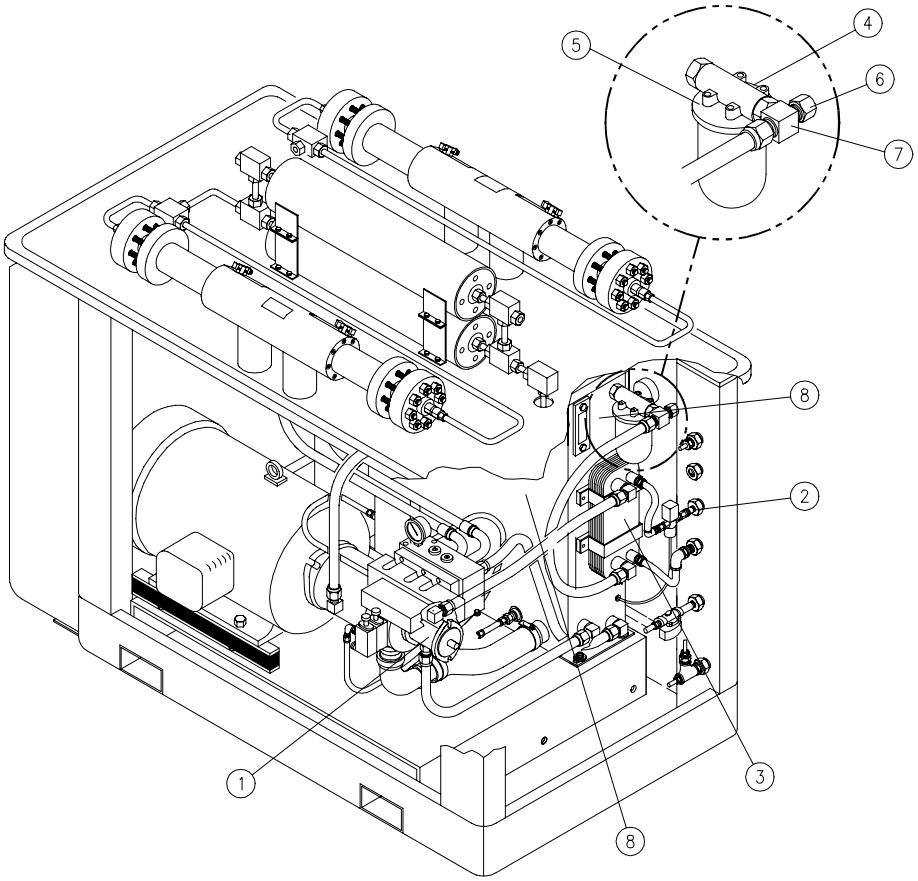
(1) Recirculation Pump
(2) Water Modulating Valve
(3) Heat Exchanger
(4) Visual Indicator
(5) Oil Filter
(6) Oil Fill Port
(7) Oil Fill
(8) Hydraulic Oil Tank

10.2 Operation

The recirculation pump (1) takes oil from the tank (6) and pumps it to the oil to water heat exchanger (3), then to the oil filter (5) and back to the tank.

The visual indicator (4) indicates when the filter element needs replacement. It should be read when both the water jet pump is running and the oil temperature is approximately 115°F. If the indicator shows yellow or just started into the red zone, then it is time to change the filter element.

Oil fill port must be used when pumping oil into tank to assure cleanliness. By filling at this point, the hydraulic oil must pass through the hydraulic filter to get to the hydraulic tank, guaranteeing that the oil into the tank gets at least one pass through a pretty good filter.



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Operating Temperature Adjustment

The operating temperature is adjusted by turning the water modulating valve (2) adjusting knob with a flat blade screwdriver. Clockwise increases the oil temperature.

The water modulating valve regulates the cooling flow that enters at port "D" to the heat exchanger (3) and then discharges through port "C" to the drain.

The operating oil temperature is factory set at 46°C (115°F) based on the temperature and flow of cooling water at the factory. Field adjustment may be necessary.

10.3 System Pressure Protection

System pressurization over 4.2 bar (60 psi) is prevented by relief valve (8) located on filter head (5).

Control	**Valve**	**Adjustment**		**Setting**	
		Increase	**Decrease**	**Maximum**	**Minimum**
Oil Temperature	2	Clockwise	Counter-clockwise	52°C (125° F)	41°C (110°F)
Oil Pressure	8	Fixed	Fixed	4.2 bar (60 psi)	3.8 bar (55 psi)

10.4 Maintenance Overview

During normal operating condition, the oil will be maintained at the correct operating temperature.

In order to get the best value from the hydraulic system (including the recirculation system) one should change the filter element when it indicates that it is time. The hydraulic oil should be changed after 2,000 hours or 1 year of service (whichever comes first) or whenever a fluid sample indicates that it is contaminated and beyond being fixed by simply operating the filter.

Parts: Hydraulic Oil:
General service, use Mobil #DTE Heavy Medium, No. 021029 (Part 05022702)
Food service, use AMOCO #FG68EL (Part 49835762)
Oil with additives such as zinc diophosphate for antiwear are not recommended because of reaction with water.

Tools: Open End Wrench, 1-1/4”
Rags
Container to collect oil
Oil transfer pump with ¾” hoses. Inlet hose with ½” male pipe connector, and pump discharge hose with ¾” female JIC connector.

Oil Filter

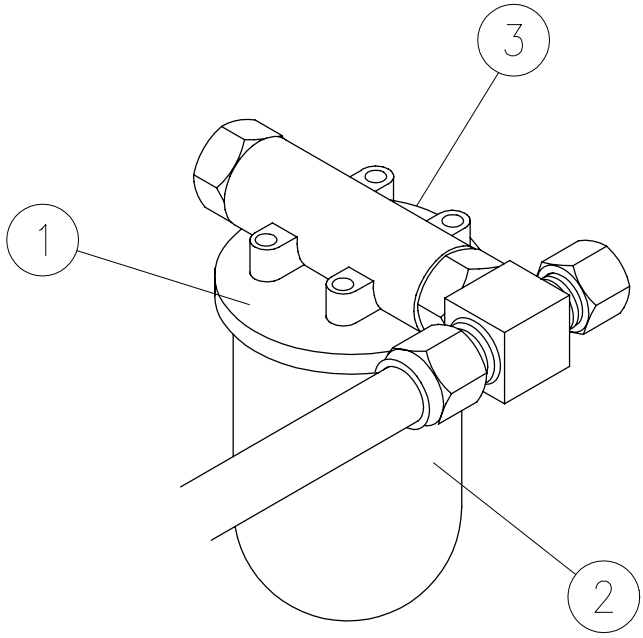
If the visual indicator (slide bar) is in the yellow zone or entering the red zone, this is an indication that the oil filter needs to be replaced.

Components: (1) Oil Filter Head
(2) Element
(3) Visual Indicator

Parts: Element
Tools: Filter Wrench
Rags
Container to collect oil spills

Replace Oil Filter

1. Unscrew element from filter head with the filter wrench.
2. Oil gasket of new element.
3. Screw new element on head.
4. Start pump and check for leaks.



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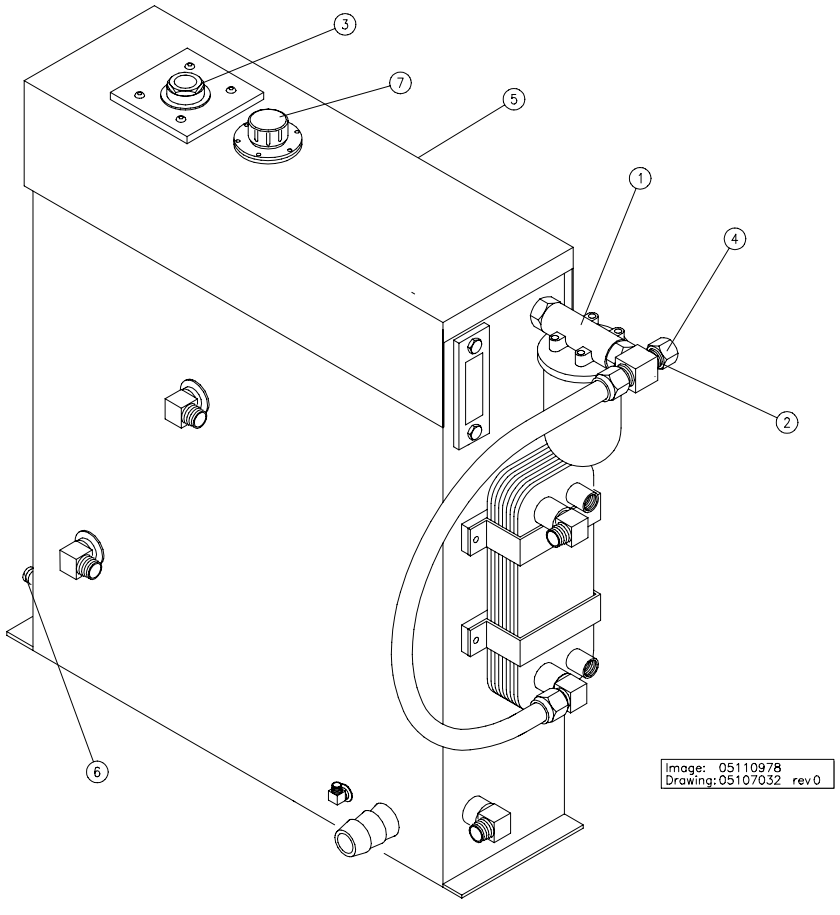
Oil Tank

The oil tank is equipped with the following:

- Visual temperature and level indicator
- Air breather and filter that prevents dirt from being sucked into the tank whenever the oil level drops, then allows air to escape when the level rises
- Drain valve, and
- Fill components.

The fill components consists of the Oil Filter Head, Fill Port, and the Fill Port Cap.

WARNING The breather is not a fill component, and must not be used as a fill point.



Item Description

(1) Filter Assembly

(2) Oil Fill Port

(3) Temperature Sensor

(4) Oil Fill Port Cap

(5) Oil Tank Cover

(6) Shut-Off Valve

(7) Breather

Replace Hydraulic Oil

1. Drain the tank, by connecting the inlet hose of the oil transfer pump to the drain valve. Open valve and pump oil to container.
2. Close hand valve, remove oil transfer pump inlet hose from hand valve.

NOTE

Never assume a new drum of oil is free of damaging contaminants. Typically, oil from a new drum does not meet the hydraulic system cleanliness requirements. For this reason it is important to use the oil transfer pump, which forces oil through the return filter into the tank.

3. Remove cap from fill port.
4. Connect oil transfer pump discharge to fill port. This will assure clean filtered oil is pumped into the tank.

CAUTION

Oil must be filtered through an equivalent filter such as a 10 micron filter element or see filter element in figure 12 in section 12. Failure to do so will cause damage to the primary hydraulic components, voiding the warranty.

5. Check oil sight gage to assure proper fill level. Remove hose, cap fill port.
6. Remove the plug of the main hydraulic pump case and make sure the case fills with oil. With the plug removed, head pressure from the tank (reservoir) will force oil into the pump case.
7. Run pump following initial start-up procedure. This will assure the system is filled.
8. Check oil sight gage. Add oil if necessary.
9. Disconnect oil transfer pump discharge hose, install fill port cap.

CAUTION

Failure to fill the pump case with oil will damage the pump due to air becoming trapped inside.

11 Specifications

Following are the specifications for the SL-IV 100D Waterjet Pump. Included are the specifications for the equipment, torque, cutting water, cooling water, and the maximum quantity of orifices that can be supported.

11.1 Equipment Specifications

Installation location	Indoors	
-Air borne dust/contaminants	Min	
Ambient temperature		
-Minimum storage	2(36)	°C(°F)
-Minimum operating	5(40)	°C(°F)
-Maximum operating [1]	40(104)	°C(°F)
Maximum Relative Humidity[2]		
-At Maximum Operating Temp.	95%	
Electrical[3] Motor Size	75 (100)	Kw (hp)
-Motor type[4]	TEFC	
Voltage / Service Amps	400/3/50/150 415/3/50/150 480/3/60/150 575/3/60/150	Volts/Phase/Hertz/Amps
Controls		
-Voltage	24	volts, DC
-Power Supply	10	amps, DC
-Safety shutdown switch settings		
High oil temperature	62(144)	°C(°F)
Low oil level	140(37)	l (gal).
Boost pump overheat	53(128)	°C(°F)
Hydraulic System		
-Oil tank capacity	170(45)	l (gal)
-Recommended oil type		
Regular applications		

[1] Based on motor nameplate data, oil temperature must be maintained within operating specifications.
[2] When relative humidity is above 50%, frequently check oil in tank for water content. Installation of an air desiccant trap/filter on the oil tank breather is a good practice.
[3] Totally enclosed fan cooled.
[4] Not all motor voltages are readily available, check with factory for availability

Food applications	Mobil, DTE Heavy Medium, # 021029 (KMT# 05022702) AMOCO #FG68EL (KMT# 10192524)	
-Hydraulic oil operation		
Minimum temperature	15(60)	°C(°F)
Maximum temperature	65(150)	°C(°F)
Optimum temperature	46(115)	°C(°F)
Hot oil shutdown	62(144)	°C(°F)
Oil filtration	$\beta_{10} \geq 75$	
-Hydraulic Pump Type	Piston	
Displacement	Variable	
Pressure	Compensated	
Flow rate	203(53)	l/min(gpm)
-Hydraulic Hi-Lo Settings (factory)		
Lo pressure	34(500)	bar(psi)
Hi pressure	172(2500)	bar(psi)
-Hydraulic oil cooling		
Total heat rejection	13(18)	kW(hp)
Cooling fluid requirements at inlet fluid temperature	18(65)	°C(°F)
Maximum cooling flow	17(4.5)	l/min(gpm)
Maximum inlet pressure	6.9(100)	bar(psi)
Pressure drop	30(2)	bar(psi)
Cutting Water "IN"		
-Minimum inlet pressure	2.4(35)	bar(psi)
-Maximum inlet pressure	7(100)	bar(psi)
-Maximum outlet pressure	8.3(120)	bar(psi)
-Maximum inlet temperature	29(85)	°C(°F)
-Optimum inlet temperature	18(65)	°C(°F)
-Factory Boost Pump Settings		
Inlet Pressure	4(58)	bar(psi)
Outlet Pressure Set at[5]	8.3(120)	bar(psi)
Cutting Water Out		
-Maximum flow rate	7.6(2.0)	l/min(gpm)
-Minimum outlet pressure	345(5,000)	bar(psi)
-Maximum cont. outlet pressure	3800(55,000)	bar(psi)
Compressed Air		
-Flow rate maximum	0.028(1.0)	m^3/min(cfm)
-Inlet pressure range	5-6(75-85)	bar(psi)
Service Connections		
-Cutting water in	1/2" NPT	

[5] Boost pump discharge pressure is dependent on inlet pressure.

-Cutting water out	9/16"	60,000 psi HP fitting
-Cooling water in	1/2" NPT	
-Cooling water out	1/2" NPT	
-Plant air in	1/4" NPT	
-Cutting water drain	1/2" NPT	
-Oil tank drain valve	1/2" NPT	
-Oil tank fill port	3/4" male JIC	

11.2 Torque Specifications

Recommended Torque Values–Hydraulic Intensifier and HP Connections

WARNING Do not exceed torque values, excess torque can cause component damage or failure with potential hazards to equipment and personnel.

Item	**Torque** Nm(Ft-Lb)	**Wrench** mm(inch)
Hydraulic Intensifier		
Hydraulic Cylinder		
End bell bolt	200(145)	M12 hex
Proximity switch	17(13)	M5 hex
Seal Head		
Gland Nut	88(65)	30 (1-3/16) Crowfoot
HP Tubing Nut	67(50)	(13/16) Crowfoot
Pneumatic Valve		
3/8" Inlet	67(50)	(13/16) Crowfoot
1/4" Outlet	34(25)	(5/8) Crowfoot
H P Fitting Gland Nuts		
1/4" Nut	34(25)	(5/8) Crowfoot
3/8" Nut	67(50)	(13/16) Crowfoot
9/16" Nut	149(110)	(1-3/16) Crowfoot

NOTE

Measurements are made with lubricated components and a calibrated torque wrench. Inconsistencies in wrench settings, lubrication, and technique, may not produce a leak tight seal. If leakage persists, increase the torque until the components seal, do not exceed a value 15% greater than shown. If leakage persists there is a component problem. **EXCESSIVE TORQUE MAY DAMAGE OR REDUCE THE LIFE OF COMPONENTS.**

Use of an antiseize thread lubricant, like High Purity Goop (P/N 10084440) is highly recommended for tightening of stainless steel HP water fittings.

A torque wrench kit is available from (P/N 49895436).

11.3 Cutting Water Specifications

The cutting water supply to the waterjet pump must meet the following specifications. High concentration of dissolved solids, especially calcium, silica, and chlorides, will affect high pressure component life. A water analysis will indicate the type of water treatment necessary.

Water Quality Parameters	Minimum Requirement	Better	Best
Alkalinity (mg/l)	50	25	10
Calcium (mg/l)	25	5	0.5
Carbon Dioxide (mg/l)	0	0	0
Chloride as Cl (mg/l)	100	15	1
Free Chlorine (mg/l)	1	1	0.05
Iron as Fe (mg/l)	0.2	0.1	0.01
Manganese as Mn (mg/l)	0.1	0.1	0.1
Magnesium as Mg (mg/l)	0.5	0.1	0.1
Nitrate (mg/l)	25	25	10
Oxygen (mg/l)	2	1	0.1
pH Value	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
Silica (mg/l)	15	10	1
Sodium (mg/l)	50	10	1
Sulfate (mg/l)	25	25	1
Total Dissolved Solids (mg/l)	200	100	5*
Total Hardness as CaCO3 (mg/l)	25	10	1
Turbidity (NTU)	5	6	1

* Do not reduce beyond this amount or the water will become too aggressive.

11.4 Cooling Water Specifications

Depending on the type of cooling system (closed recirculation, once through, etc.), the following common problems can be experienced:

Closed recirculation:
Corrosion
Fouling

Once through:
Corrosion
Fouling
Scale
Microbiological

Scale control is the most common problem, and is the result of insoluble matter deposited on the heat transfer surface. Calcium carbonate is the primary cause of scale when calcium bicarbonate breaks down. As the temperature of the water increases it becomes less able to hold carbonates in suspension.

To predict the tendency of scale formation, the Langelier's saturation index can be used as a guide.

Saturation Index = pH-pHs where pHs is calculated at saturation with calcium carbonate.

A positive index indicates a tendency to deposit calcium carbonate, the higher the positive value, the higher the scale formation. A zero index corresponds to water that is in equilibrium with respect to calcium carbonate.

11.5 Orifice Support Capacity

The SL-IV100hp Waterjet Pump supplies high pressure (HP) water up to 3,800 bar (55,000 psi). The following table shows size, ratings, and maximum quantity of orifices that can be supported.

Rated power kW(hp)	Pressure Bar (Psi)	Flow lpm (gpm)	Qty	Orifice Diameter mm (inch)
75(100)	3,800 (55,000)	7.6 (2.0)	1	0.51 (0.020)
60(80)	3,800 (55,000)	6.1 (1.6)	1	0.46 (0.018)
75(100)	3,800 (55,000)	7.6 (2.0)	2	0.36 (0.014)
53(70)	3,800 (55,000)	5.3 (1.4)	2	0.30 (0.012)
75(100)	3,800 (55,000)	7.6 (2.0)	4	0.25 (0.010)
75(100)	3,800 (55,000)	7.6 (2.0)	8	0.18 (0.007)
75(100)	3,800 (55,000)	7.6 (2.0)	16	0.13 (0.005)

PARTS LISTS
For:

SL-IV /100 hp
High Pressure Waterjet Pump
Version 2.0
200-208v / 3ϕ / 50-60 Hz

To contact the KMT Waterjet Spare Parts Department:

USA Parts Department
KMT
Waterjet Systems
635 West 12th Street / POB 231
Baxter Springs, KS 66713-0231
USA
Phone: (620) 856–2151
Fax: (620) 856–5050

Europe: Spare Parts Manager
KMT Waterjet Systems GmbH
Wasserstrahl–Schneidetechnik
Auf der Laukert 11
D–61231 Bad Nauheim
Germany
Phone: 49–(0)6032–997–115
Fax: 49–(0)6032–997–271

SECTION 12 PARTS LISTS
100 hp SL-IV

12.1 General

This section contains parts lists for service procedures and part identification, along with electrical and plumbing schematics of the SL-IV 100 hp high pressure (HP) Waterjet Pump. The reader can use these parts lists to identify the part on a drawing, then find the part number and part description corresponding to the drawing balloon number. Replacement parts can be ordered with this part number information.

12.2 Part Nomenclature

The following abbreviations and numerical sizes are used for part descriptions in these parts lists:

Table 12-1 Part Description Abbreviations and Nominal Size Guide

Item	Description	Item	Description
Assy	Assembly	mm sq.	Square millimeters
1/4, 9/16, 3/4	Nominal sizes in fractions of an inch, e.g., 1/2 NPT ~ 0.50-inch national pipe thread, or 9/16 HP tube ~ 0.56-inch OD HP tubing or tube fitting	JIC	37-degree flared, threaded hydraulic fitting, JIC standard, typically used on hydraulic hose end connections.
Hyd	Hydraulic	Dia	Diameter
ID or OD	Inside diameter or outside diameter	Deg	Degree
psi or ksi	Pounds per square inch or thousands of pounds per square inch	-4,-8,-12	Hydraulic fitting nominal size, in 1/16 th's of an inch, e.g., 1/2 OD tube ~ -8
HP and hp	HP: High Pressure, hp: horsepower	NO or NC	Normally open or normally closed
SAE O-ring	O-ring threaded port style, SAE standard		

Figure 12-1. INTENSIFIER ASSEMBLY-05119169

ITEM No.	QTY.	PART No.	DESCRIPTION
1	2	05059712	Body, Cylinder, HP, 1.13-in. ID
2	2	05119151	Plunger, Ceramic
3	2	05116769	Head Assembly, Sealing
4	2	05034772	Head, Cylinder
5	2	05133145	Seal Kit, StreamLIFE, (includes packing follower)
6	2	10110393	Seal Assembly, Sealing Head
7	2	05059688	Nut, Retaining, Sealing Head
8	2	05130091	Seal Assy, Plunger, Cartridge, Hyd
9	2	05007786	Flange, Retaining, Bushing
11	2	05132246	Liner, HP Cylinder
12	4	10074904	O-ring
13	2	10110401	Collar, LP Water, Sealing Head
14	2	05034798	Ring, Retaining
15	1	05034764	Cylinder, Hyd
16	2	10075000	O-ring
17	2	05034855	Ring, Backup
18	16	05034780	Cap Screw, Socket Head, M14x60, Grade 12.9
19	2	05127584	Switch, Proximity, 20-250 VAC/VDC
20	4	10183572	Cap Screw, Socket Head, M6x1x22mm, 316/304 Stainless
21	1	05132253	Piston Assy, Hyd
23	2	05049812	Stem, Mounting, Hyd Cylinder
25	8	05079652	Cap Screw, Socket head, M10 x 1.5 x 85mm, Grade 12.6
26	8	05061486	Washer, Lock, High Collar, M10, Stainless
27	2	10074409	O-ring
28	2	05065172	Spacer, Proximity Switch
29	2	05081872	Gasket, Drip Pan, Upper
30	*	10148674	Special Tool, HP Seal Removal (Not Shown)
31	*	05066139	Special Tool, Wrench, HP Cylinder (Not Shown)
32	*	05004924	Special Tool, Plunger Removal

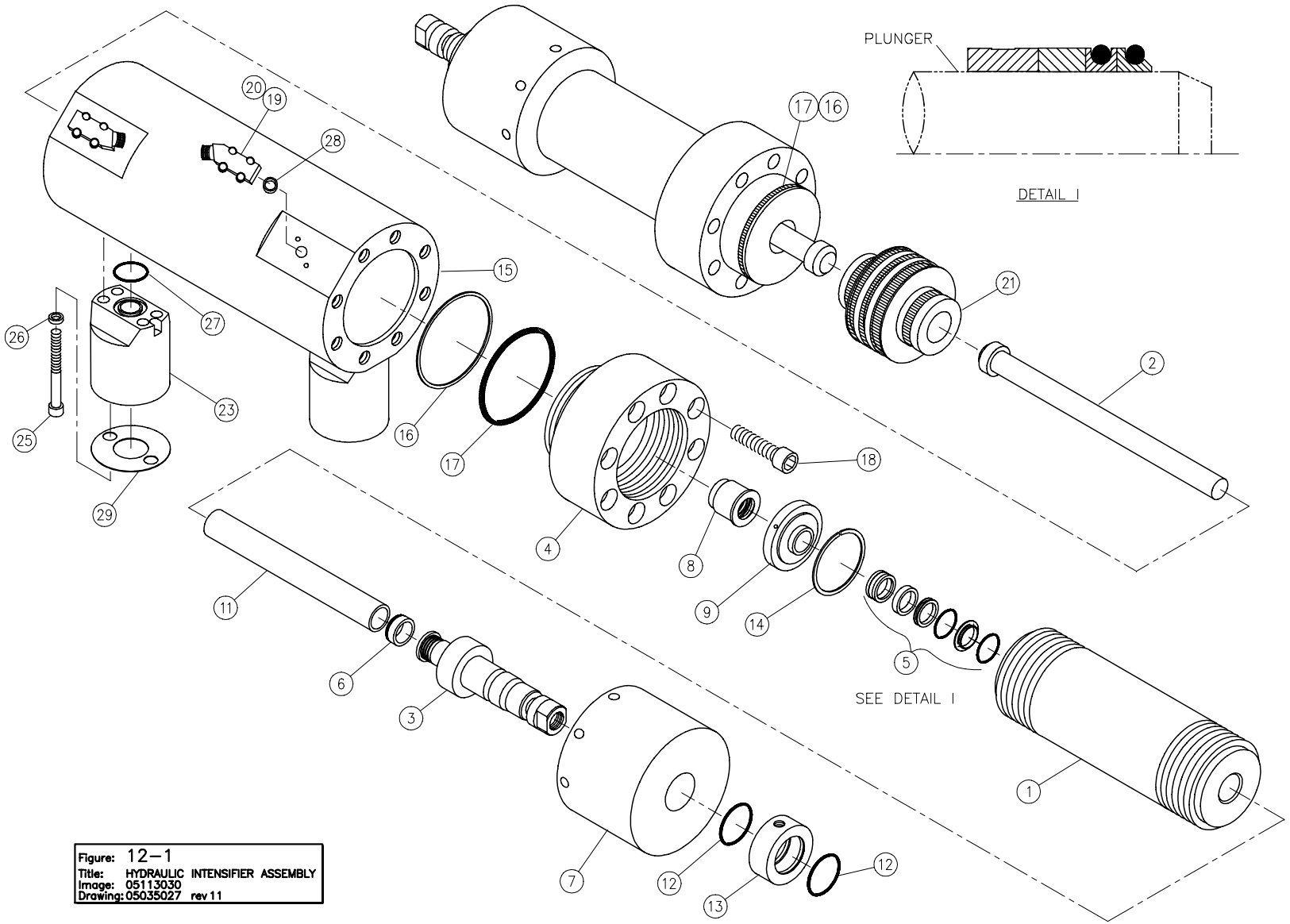


Figure: 12–1
Title: HYDRAULIC INTENSIFIER ASSEMBLY
Image: 05113030
Drawing: 05035027 rev 11

Figure 12-2. SEALING HEAD ASSEMBLY 05116769

ITEM No.	QTY	PART No.	DESCRIPTION
1	1	10106417	Body, Sealing Head
2	1	10107894	Poppet, Inlet, Cutting Water
3	1	05116777	Gland, HP, Sealing Head
4	1	05112768	Seat, HP, Sealing Head
5	1	49884562	Spring, Compression
6	1	05116561	Poppet, Valve, HP Check
7	1	05116751	Pin, Guide
8	1	10118552	Retainer, Poppet
9	1	AV500260	Spring, Compression
10	1	05049853	O-Ring

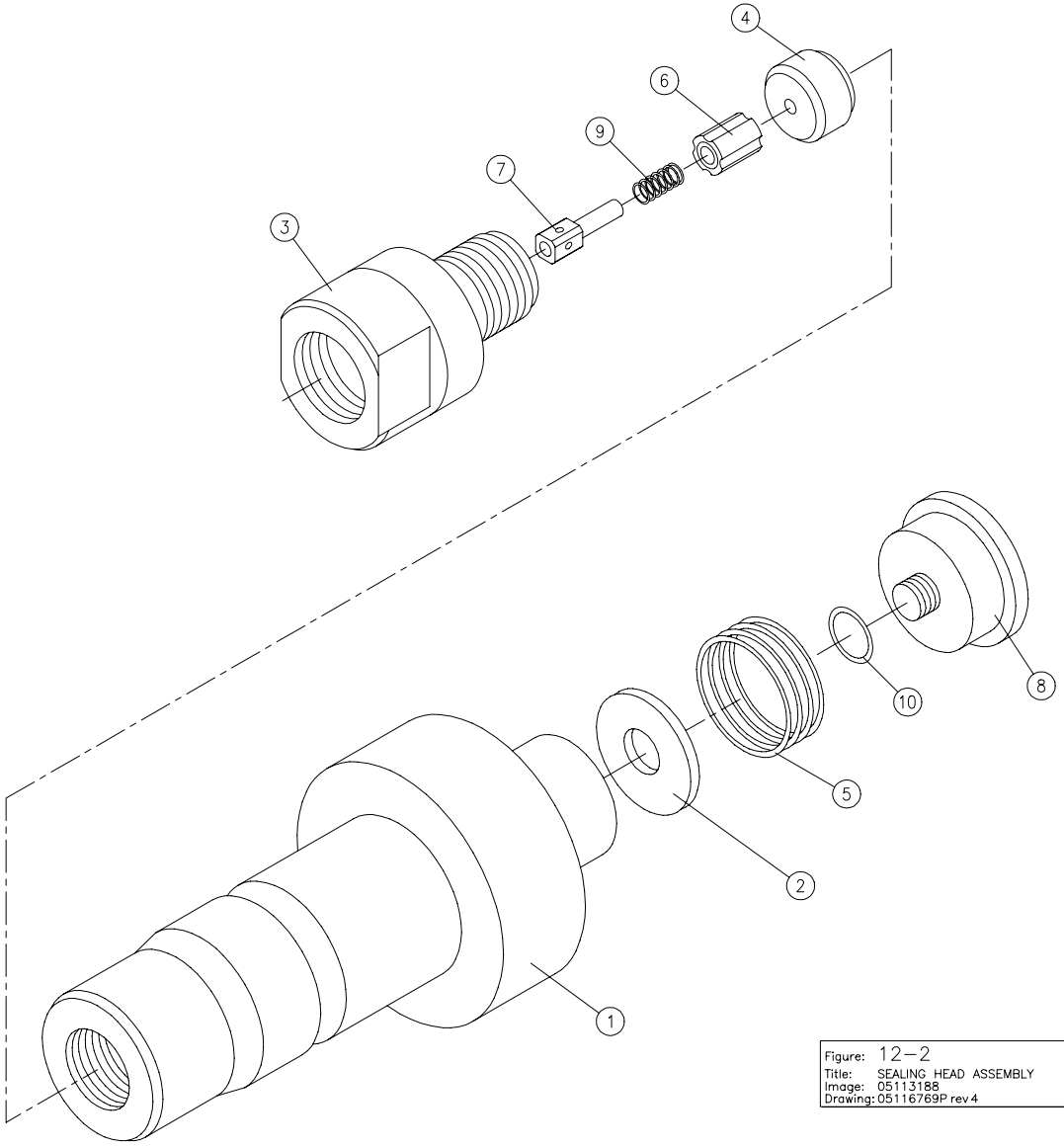


Figure: 12–2
Title: SEALING HEAD ASSEMBLY
Image: 05113188
Drawing: 05116769P rev 4

Figure 12-3. HYDRAULIC PISTON ASSEMBLY 05132253

ITEM No.	QTY	PART No.	DESCRIPTION
1	1	05132261	Body, Hyd Piston
2	12	05074380	Pin, Clevis
3	2	05049887	Screw, Set, Socket, with Through Hole
4	2	10148757	Valve, Check, Cartridge, with O-ring
5	--	49877509	Adhesive, Thread Locker
6	2	05088364	Ring, Snap, Flat Wire
7	2	05049994	Ring, Backup
8	2	05087713	O-ring
9	1	05117965	Seal Assembly, Hyd Piston
10	2	05117940	Bearing, Hyd Piston

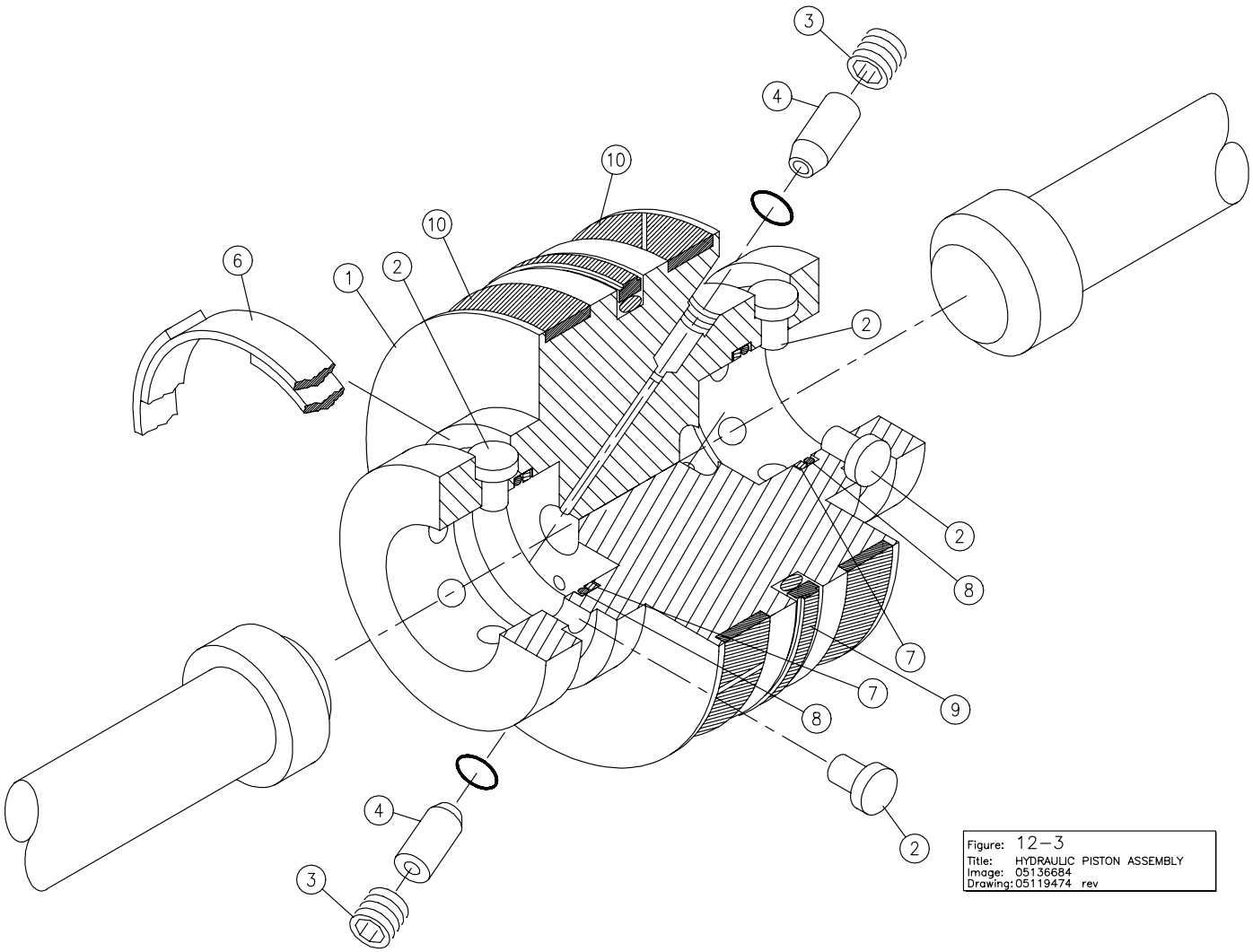


Figure: 12–3
Title: HYDRAULIC PISTON ASSEMBLY
Image: 05136684
Drawing: 05119474 rev

Figure 12-4. HYDRAULIC CARTRIDGE SEAL ASSEMBLY 05130091

ITEM No.	QTY	PART No.	DESCRIPTION
1	1	05130109	Body, Seal, Cartridge
2	2	05015060	Seal, U-Cup, with O-ring
3	1	10193522	O-ring
4	1	05050760	Ring, Backup
5	1	05129481	O-ring
6	1	05013024	O-ring
7	1	05129515	Back-up Ring
8	1	05027255	Seal, U-Cup
Ref 1	0	05009048	Tool, Seal Installation

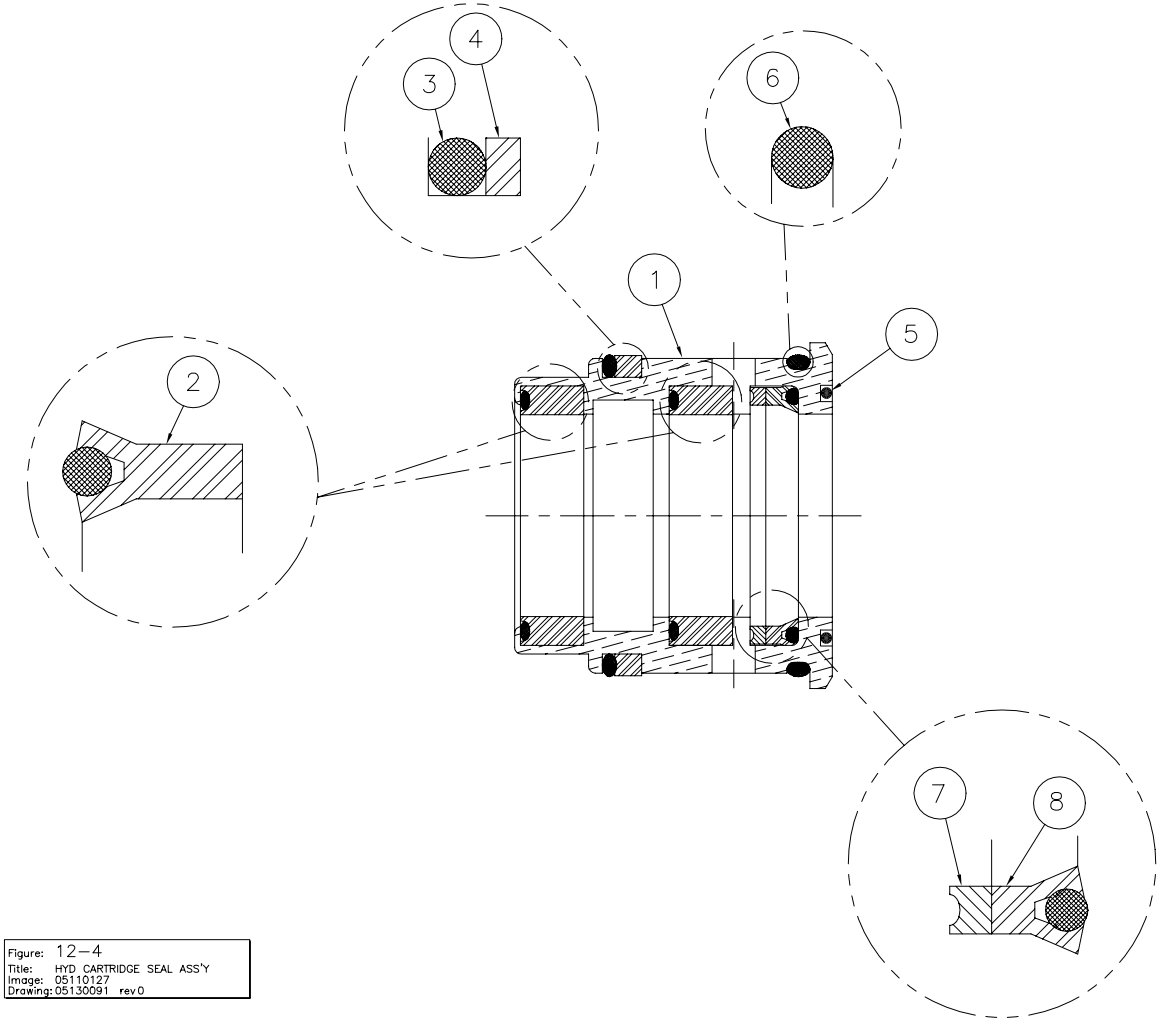
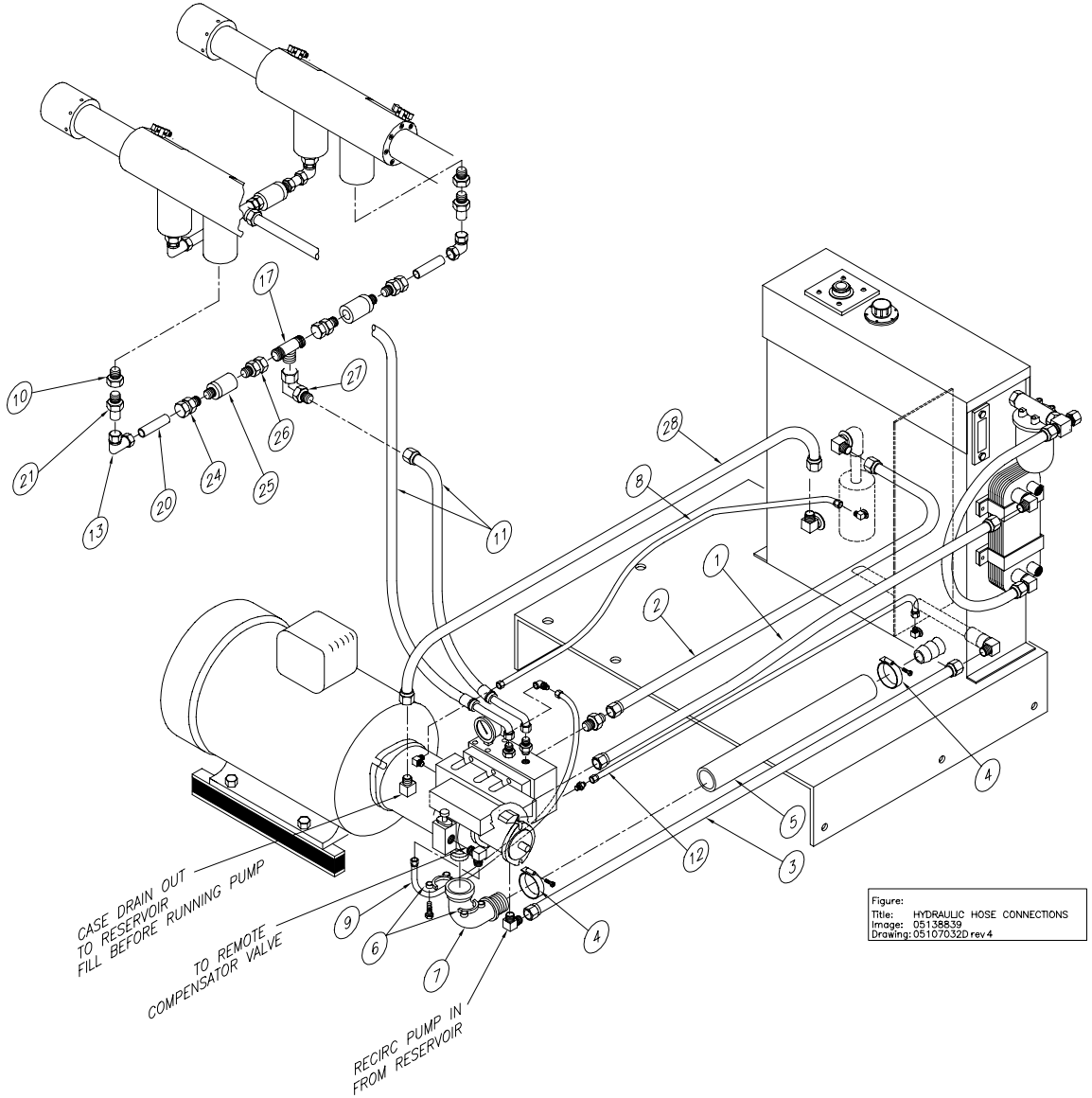


Figure: 12–4
Title: HYD CARTRIDGE SEAL ASS'Y
Image: 05110127
Drawing: 05130091 rev 0

Figure 12-5. HYDRAULIC HOSE CONNECTIONS 05107032

ITEM No.	QTY	PART No.	DESCRIPTION
1	2	05106950	Hose Assembly
2	1	05106968	Hose Assembly
3	1	05106976	Hose Assembly
4	2	10194207	Hose Clamp
5	8.5	10079754	Radiator Hose
6	1	49872245	Split Flange
7	1	05106984	Split Flange Elbow
8	1	05112750	Hose Assembly
9	1	05051214	Hose Assembly
10	4	05073176	O-ring Adapter
11	2	05106992	Hose Assembly
12	1	05071121	Hose Assembly
13	4	05107008	90 Degree Elbow, .75
17	2	05057666	Union Tee
20	18.25	05107016	Tube, .75 x .083 Wall
21	4	05107024	Adapter, .75 Tube Stub x .75
24	4	05100433	Adapter-tbe/O-ring, 1-12
25	4	05112222	Throttle Check Valve
26	4	05070743	Adapter, JIC/O-ring, 12-12
27	2	05112792	90 Degree Elbow, .75
28	1	05061163	Hose Assembly


17
10
27
21
26
24
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11
28
8
1
2
4
5
12
3
CASE DRAIN OUT
TO RESERVOIR
FILL BEFORE RUNNING PUMP
TO REMOTE
COMPENSATOR VALVE
9
6
7
4
RECIRC PUMP IN
FROM RESERVOIR
Figure:
Title: HYDRAULIC HOSE CONNECTIONS
Image: 05138839
Drawing: 05107032D rev 4

Figure 12-6 HIGH PRESSURE PIPING 05113659

ITEM No.	QTY	PART No.	DESCRIPTION
1	2	05070628	Tube, HP, Bent, 3/8
2	2	05070644	Tube, Hp, Bent, 3/8
3	2	10078590	Tee, HP, 3/8, 60,000 psi,
4	3	10079457	Adapter, HP, 9/6 x 3/8,
5	1	05106778	Tube, HP, Bent, 3/8
6	4	10078129	Gland, HP, 3/8, 60,000 psi,
7	5	10078715	Collar, HP, 3/8, 60,000 psi,
8	2	05119169	Intensifier Topworks Assembly
9	2	05040696	Attenuator, HP, .96 liter
10	1	05111539	Tube, HP, 3/8, 60,000 psi, Sst
11	3	10078525	Elbow, 90-deg, HP, 60,000 psi,
12	20”	05086905	Conduit, Extra Flexible, 5/8-ID
13	8	95413696	Washer, Lock, ½-in.
14	6	05131347	Hose Ferrule, .56
15	8	95383790	Socket Head Screw, ½-13
16	33”	05144837	Spacer
17	12	10083897	Hose Ferrule, .25
18	1	10078772	Plug, .56
19	158”	10186153	Conduit, Extra Flexible, 3/8-ID
20	4	05090717	Nut, Retaining, Accumulator
21	5	10079465	Tee, HP, 9/16, 60,000 psi, SST
22	2	05112057	Tube, HP, 9/16, 60,000 psi,
23	1	05106794	Tube, HP, 9/16, 60,000 psi,
24	1	10094704	Tube, HP, 3/8, 60,000 psi, Sst
25	1	10184760	Pneumatic Valve
27	1	10079580	Adapter, HP, 9/16 x
28	1	10078913	Gland, HP, Anti-Vib, 3/8,
29	1	10069326	Tube, HP, 9/16, 60,000 psi,
30	1	10077030	Elbow, 90-deg, ¼ x 1/8 NPT
31	1	05112552	Tube, HP, ¼, 60,000 psi, SST
32	1	05105473	Tube, HP, 9/16, 60,000 psi
33	1	05109939	Tube, HP, 9/16, 60,000 psi
34	1	10079705	Coupling, Bulkhead, HP, 9/16,

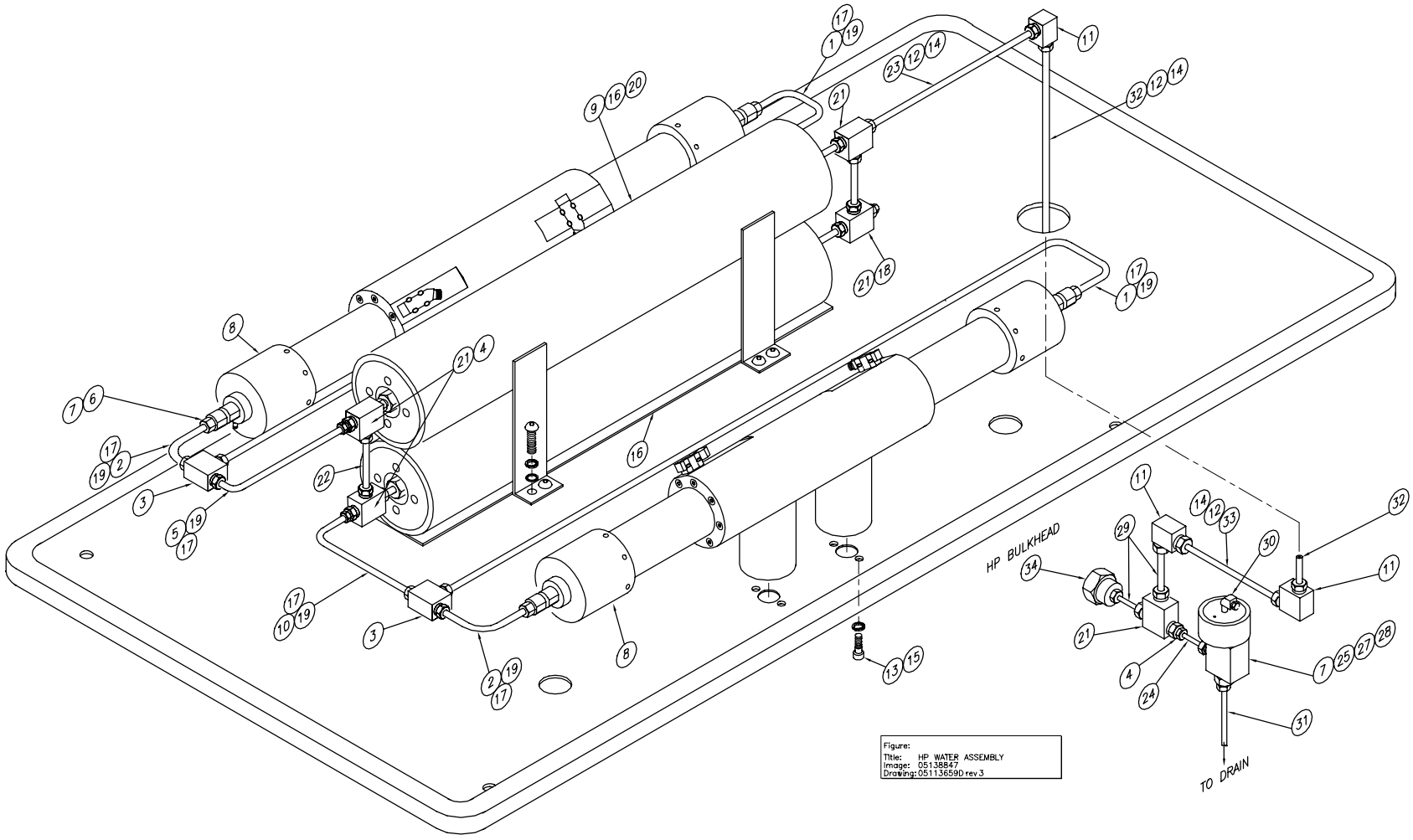

HP BULKHEAD
TO DRAIN
Figure:
Title: HP WATER ASSEMBLY
Image: 05138847
Drawing: 05113659D rev 3

Figure 12-7 HYDRAULIC MANIFOLD ASSEMBLY 05103171

ITEM No.	QTY.	PART No.	DESCRIPTION
1	1	05103197	Block, Manifold, Hydraulic
2	1	10187417	O-ring, -128
3	4	05071055	Plug, -12 SAE O-ring, Hex Socket, Steel
4	1	05103189	Valve, Check, Hyd, Cartridge
5	1	10187060	Valve, Relief, Hyd, 25 – 800 psi Range, Adjustable
6	1	10187052	Valve, Relief, Hyd, 100 – 3,000 psi Range, Knob-Adjustable
7	1	05071717	Valve, Relief, Hyd, 234 bar (3,400 psi), Non-adjustable, TUV
8	2	05055017	Plug, -2 SAE O-ring, Hex Socket, Steel
9	1	05045497	Gage, Pressure, Hyd, O – 5,000 psig, -4 SAE O-ring, Bottom-Mount
10	1	10185585	Valve, Solenoid, Hyd, 24 – VDC, Normally – Closed, 2-Way/2-Position
11	2	05064407	Adapter, Straight, -16 JIC x -12 O-ring
12	1	10144749	Adapter, 45 Degree, -4 JIC x -4 O-ring
13	1	49876089	Adapter, Straight, -4 JIC x -4 O-ring
14	1	10142644	Adapter, 90 Degree, -4 JIC x -4 O-ring
15	1	49889769	O-ring Plug, .25
Ref	--	10189595	Kit, O-ring, 4-way Valve (6 each O-ring)

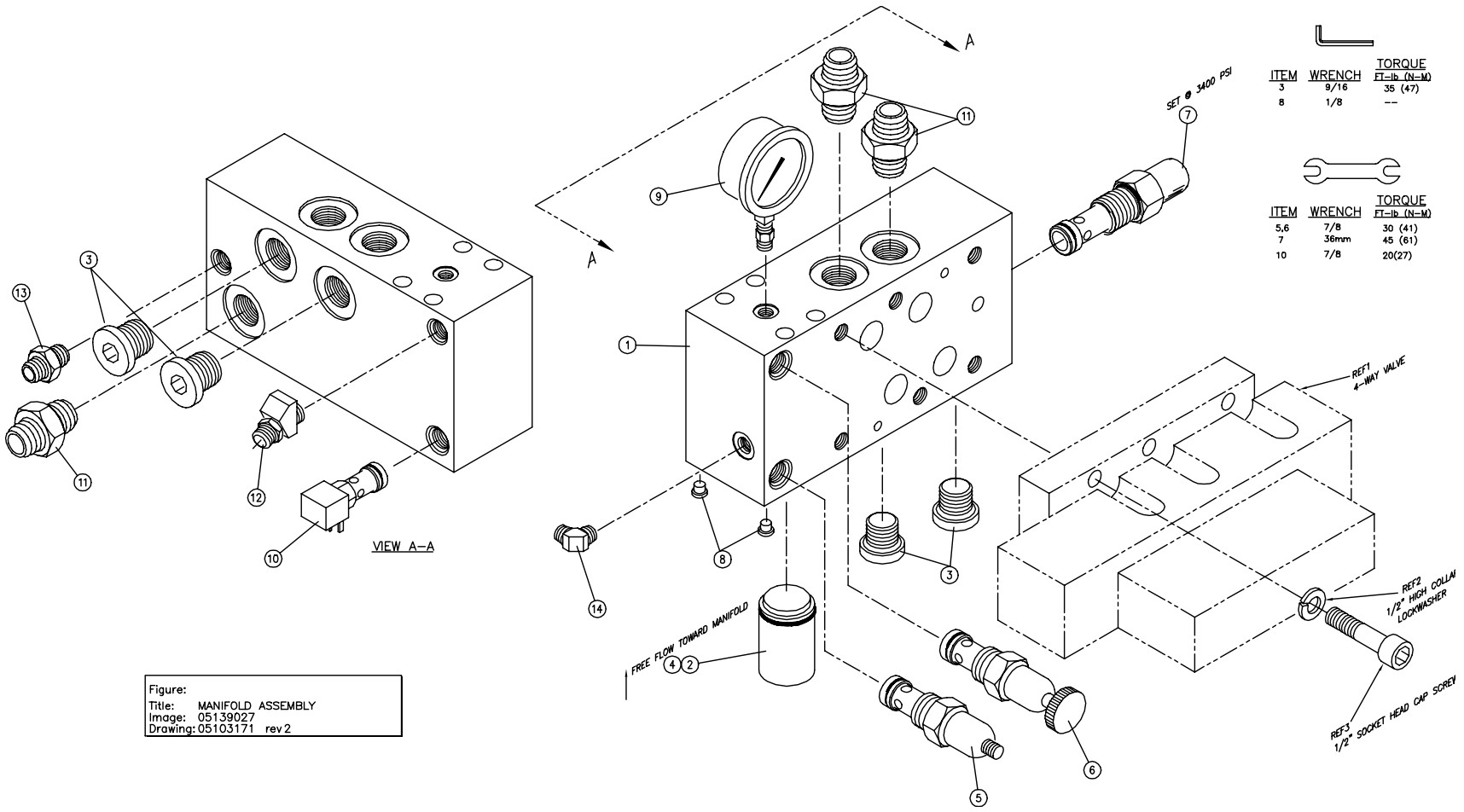


Figure:
Title: MANIFOLD ASSEMBLY
Image: 05139027
Drawing: 05103171 rev 2

Figure 12-8 BULKHEAD PIPING ASSEMBLY 05105499

ITEM No.	QTY	PART No.	DESCRIPTION
1	2	49887011	Elbow, 90-deg, 1/2
2	1	10091866	Modulating, Valve
3	1	05060207	Nipple, SST, 1/2 NPT
4	4	05111398	Quick Disconnect Coupling
5	1	05024815	Solenoid Valve
6	4	49886922	Bulkhead Adapter, -8 x –24
7	--	10127348	Tube, Flexible, Nylon, ½-OD
8	1	49888035	Solenoid Valve
9	4	10070092	Jam Nut, 1-14
10	1	10127306	Male Run Tee, ½-NPT
11	2	05111364	Union Tee, 1/2 NPT
12	1	05135678	Low Pressure Filter Assy
13	1	49834328	Adapter, .25 x .50
14	3	10173805	Hose Barb, .50, Swivel,
15	2	10079713	Barb, .50 Hose x ½-NPT,
16	1	10077055	Adapter, Bulkhead, Brass
17	4	05111380	Quick Disconnect Body, 1/4
18	1	49895303	Adapter, Str ½-NPT x –8
19	16	10069714	Washer, Flat, 3/8
20	4	05111406	Adapter, Str, ¼-NPT x –8
21	1	95157418	Adapter, Str, ½-NPT x –8
22	1	49834302	Adapter, Tube/Pipe, .50
23	1	10078335	Nipple, Reducer, ¼ x 1/8
24	2	95680922	O-Ring
25	13	10189025	Quick Disconnect Nipple
26	16	95416319	Screw, Hex Head, 3/8-16
27	16	95750394	Washer, Lock, 3/8
29	1	10078095	Coupling, (size)
30	36”	10079903	Tube, Polyethylene, ¼-OD
31	1	49834310	Adapter-Tube/Pipe, .50
32	4	05113964	Grommet
33	1	10084523	Pipe Nipple, .50 x 4.00

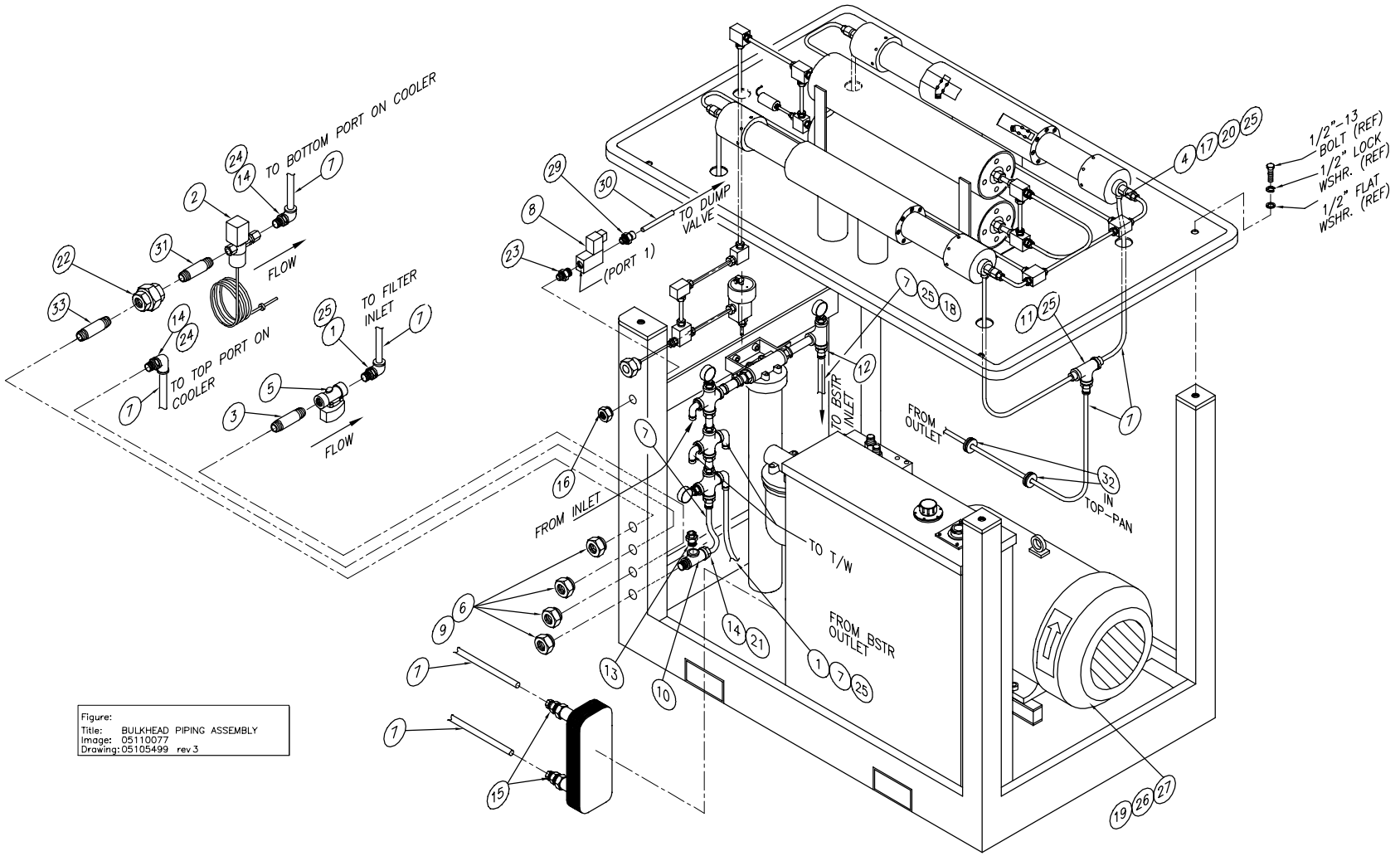


Figure:
Title: BULKHEAD PIPING ASSEMBLY
Image: 05110077
Drawing: 05105499 rev 3

Figure 12-9 LOW PRESSURE WATER FILTER ASSEMBLY 05135678

ITEM No.	QTY.	PART No.	DESCRIPTION
1	1	05044052	Gage, Pressure, O–200 psig, ¼ NPT, Stainless, Bottom-Mount
2	1	10100428	Adapter, Bushing, ½ x ¼ NPT, Stainless
3	1	05070982	Valve, Relief, 50 – 150 psi, ½ NPT
4	2	05074067	Nipple, ½ NPT x 3-in., Stainless
5	2	10078111	Adapter, Bushing, ¾ x ½ - NPT, Stainless
6	1	05135611	Low Pressure Manifold
7	1	05135629	Low Pressure Manifold
8	4	05135660	Elbow, JIC/O-ring, 90 Degree, -8 x 2
9	1	05165645	Adapter-Pipe/Hose Barb, -8NPT x –8 Hose
10	1	05038690	Body, Filter, Water, ¾ - NPT
11	1	05135652	Check Valve
12	1	10192425	Barb Insert
13	2	05105440	Gage, 0 – 100 psig, Dual Scale, ¼ - NPT, 2.5-in. Diameter
14	2	10106722	Element, Filter, LP Water, Polypropylene, 10 Micron
15	4	10189025	Adapter-Hose/JIC, .50 x .50
16	2	10114023	U-Bolt, ¼ - 20, Stainless
17	1	10113983	Tee, ½ - NPT, Stainless
18	2	05135637	Plug, .25 NPT
19	4	95416335	Nut, Hex, ¼ - 20
20	4	95838314	Washer, Lock, .25
21	4	95391322	Washer, Flat, .25

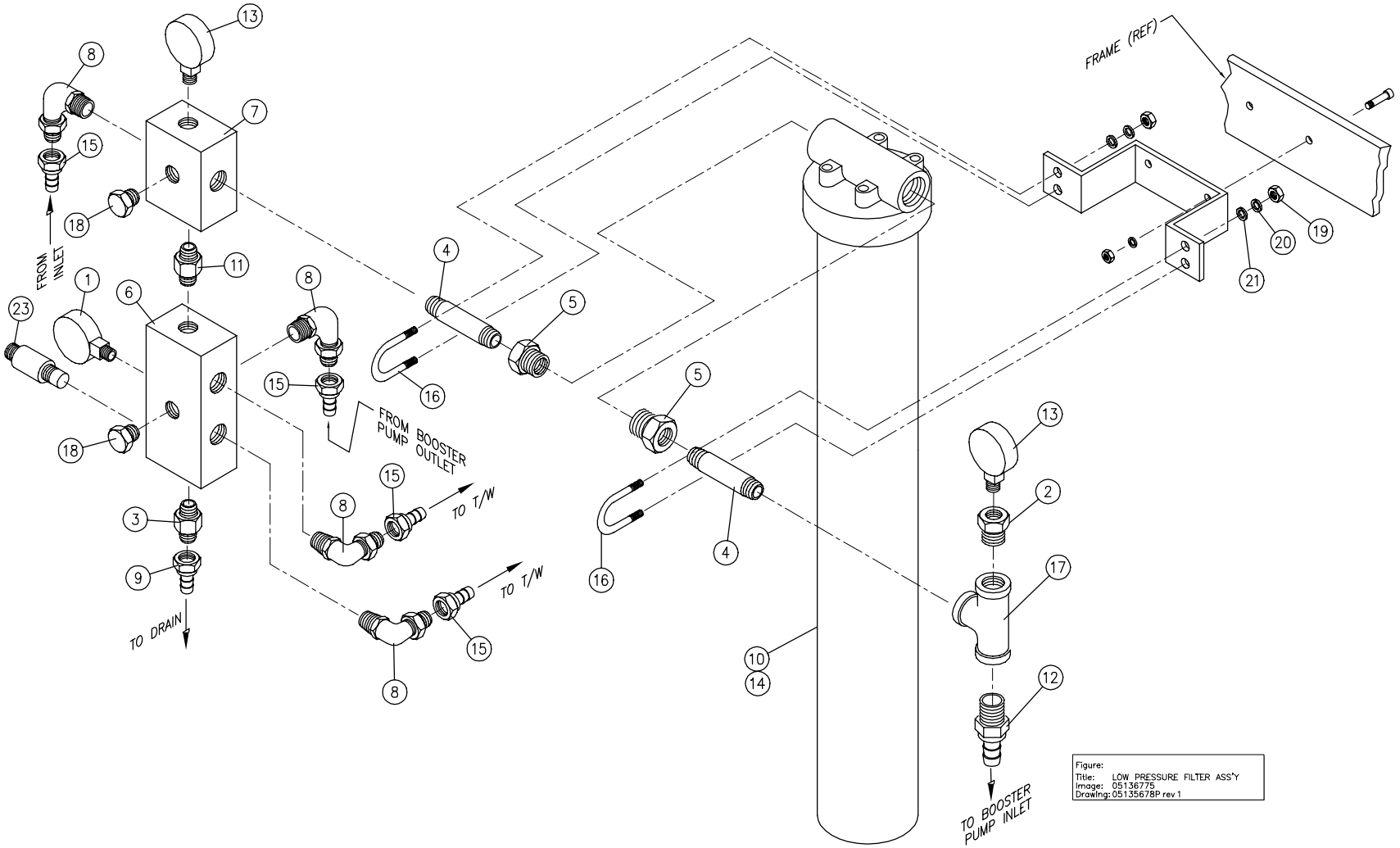

FRAME (REF)
FROM INLET
FROM PUMP BOOSTER OUTLET
TO T/W
TO T/W
TO DRAIN
TO BOOSTER PUMP INLET
Figure:
Title: LOW PRESSURE FILTER ASS'Y
Image: 05136775
Drawing: 05135678P rev 1

Figure 12-10 HYDRAULIC POWER PACKAGE, 100 HP SL-IV 200-208v/3/50-60 05145321

ITEM No.	QTY	PART No.	PART DESCRIPTION
1	1	05145305	Motor/Pump Assembly-200-208/3/50-60
2	1	05103411	Water Pump Adapter
3	1	95572897	Hex Head Screw, 1/4-20 x 5/8
4	1	95838314	Lock Washer, .25
5	1	05093638	Vane Water Pump
6	1	05069885	Temperature Switch Adapter
7	1	05103429	Spline Shaft
8	1	49868813	Temperature Sensor
9	2	95055026	Socket Head Screw, 1/2-13 x 1-3/4
10	1	05112107	Directional Control Valve
11	1	10074938	O-ring, 5/8 x 3/4 x 1/16
12	1	05103395	Shaft Coupling
13	1	95688750	Lock Washer, .50
14	2	95750394	Lock Washer, .38
15	1	05041033	Socket Head Screw, 3/8-16 x 1-1/4
16	1	10091510	Arrow Decal

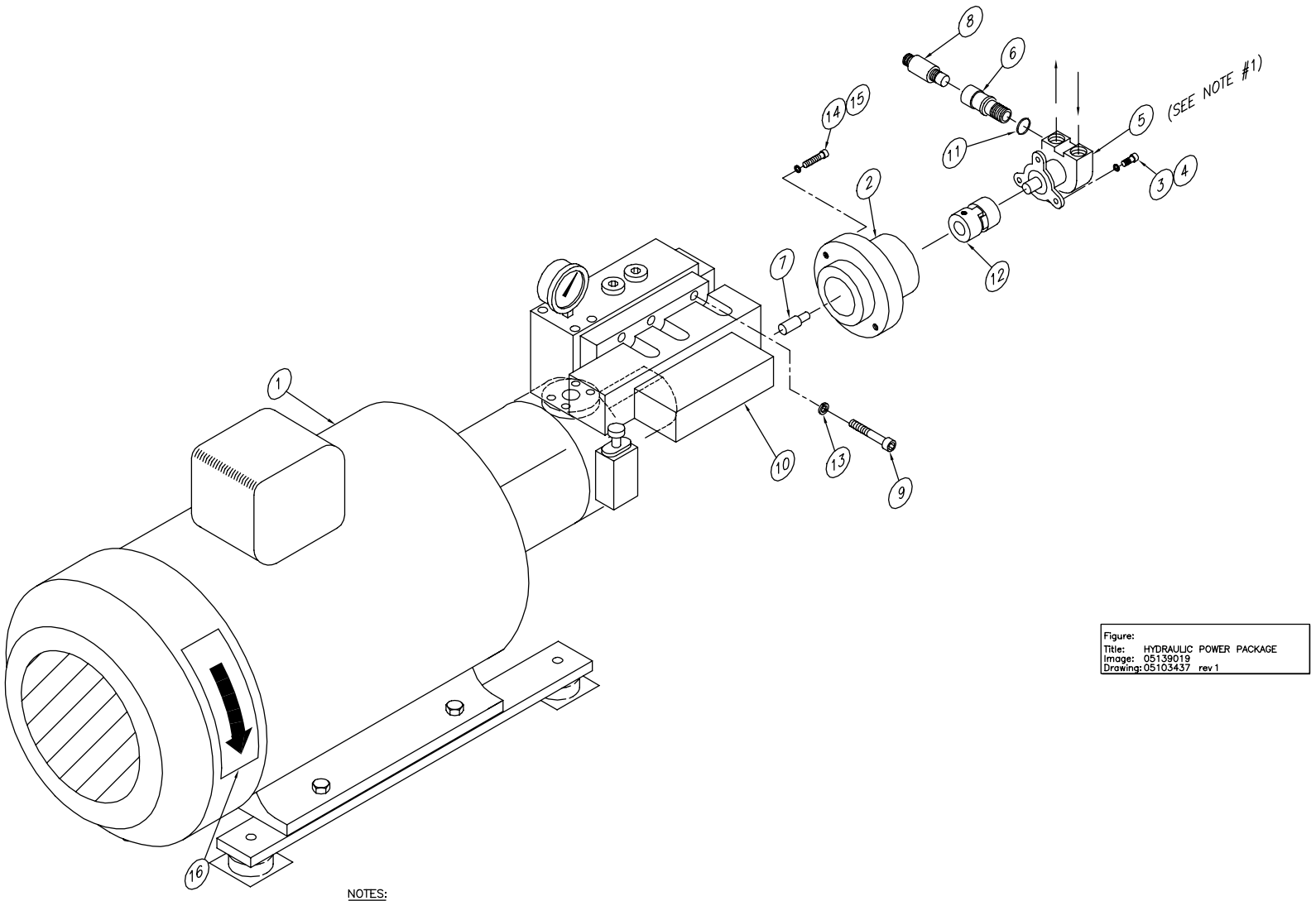
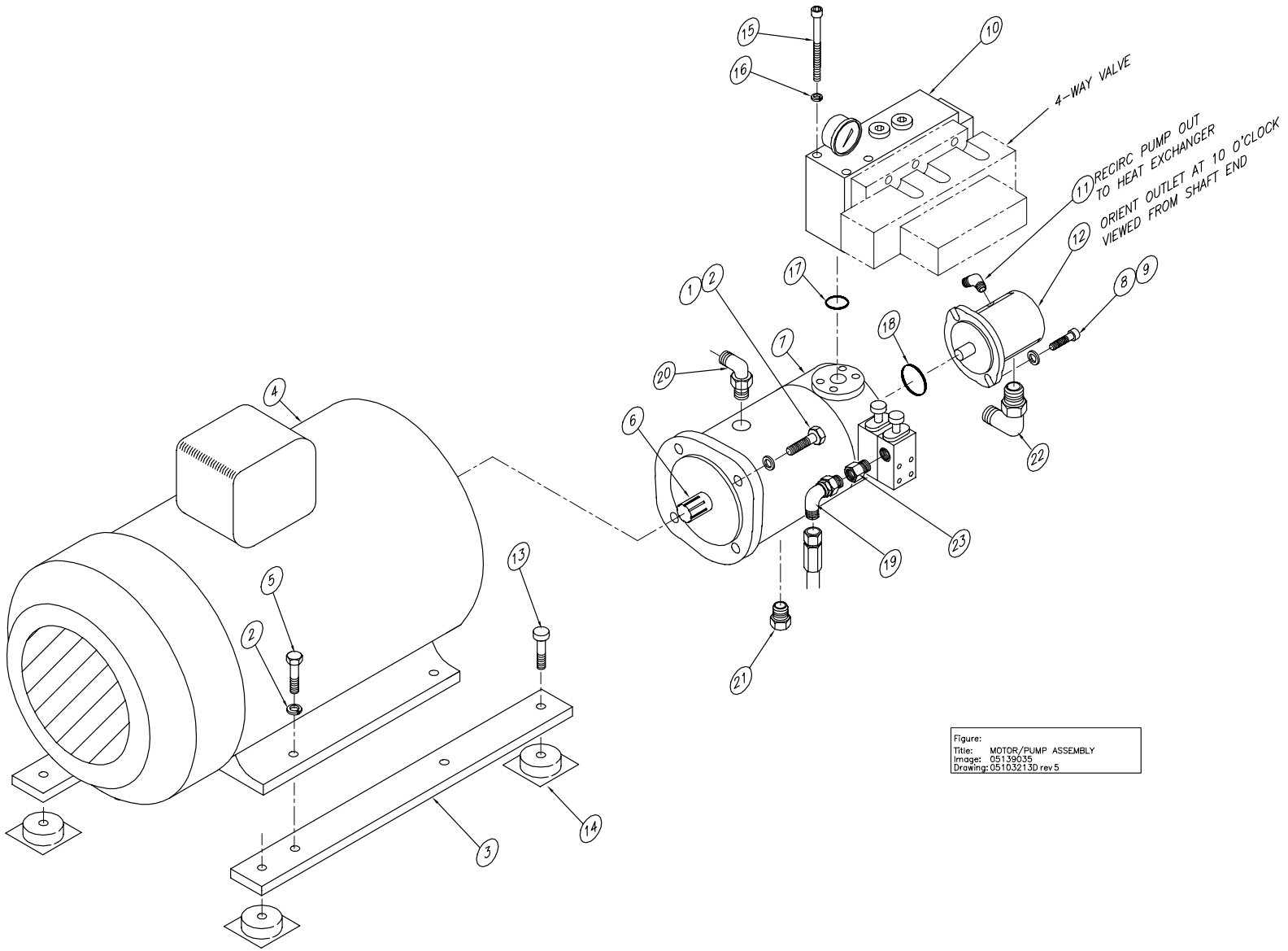


Figure:
Title: HYDRAULIC POWER PACKAGE
Image: 05139019
Drawing: 05103437 rev 1

Figure 12-11 MOTOR / PUMP ASSY SL-IV 100 hp, 200-208v 05145305

ITEM No	QTY	PART NO.	DESCRIPTION
1	4	95296281	Capscrew, Hex Head, ¾-10
2	8	95688735	Washer, Lock, ¾
3	2	05103205	Mount, Motor
4	1	05145248	Electric Motor, 200-208/3/50-60
5	4	10066256	Capscrew, Hex Head, ¾-10
6	.1	10184802	Grease, Anti-Seize, Optimol
7	1	05103239	Pump, Hyd, Variable-Displacement, Axial-Piston
8	2	10192961	Capscrew, Soc Hd, M12x1.75
9	2	10069763	Washer, Flat, ½
10	1	05103171	Manifold Assembly
11	1	10151470	Adapter, 90-deg, -12 JIC x –16 SAE O-ring
12	1	05091301	Pump, Gear, Hyd
13	4	95013785	Capscrew, Soc Head, 5/8-11
14	4	05103254	Vibration Isolator Pad
15	4	05103247	Capscrew, Soc Head, ½-13
16	4	95688750	Washer, Lock, High Collar, ½
17	1	49882087	O-ring, -225
18	1	05112727	O-ring, 102mm x 2mm
19	1	05085758	Adapter-JIC/O-ring, 90 degree, 4-6
20	1	10091163	Adapter, 90-deg, 12-12 JIC/O-ring
21	1	10118057	Plug-O-ring Boss
22	1	10099760	Elbow-Tube/O-ring, 20
23	1	05139639	Adapter, M14 x 4,M/F SAE O-ring


15
16
10
4-WAY VALVE
11 RECIRC PUMP OUT TO HEAT EXCHANGER
12 ORIENT OUTLET AT 10 O'CLOCK VIEWED FROM SHAFT END
17
1
2
8
9
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7
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4
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22
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13
19
23
21
3
14
Figure:
Title: MOTOR/PUMP ASSEMBLY
Image: 05139035
Drawing: 05103213D rev 5

Figure 12-12 RESERVOIR ASSEMBLY 05104153

ITEM No.	QTY	PART No.	DESCRIPTION
1	1	05104161	Weldment, Reservoir
2	1	05104179	Gasket, Cover, Reservoir
3	1	05050026	Switch, Temperature / Level, Hyd, Cartridge- Type, 149 deg F
4	1	05092739	Breather, Air
5	1	10168862	Gage, Dual Scale, Level/Temperature, Oil
6	1	05103809	Housing, Filter, Hyd Oil, w/Gage
7	1	05104187	Element, Filter, Hyd Oil, Spin-on
8	1	05049655	Adapter, 90-Deg, 1" NPTx–12 JIC,
9	1	05069976	Cap, ¾ NPT Hex, Steel
10	1	05071063	Tee, Male Branch, O-ring/JIC,-12,
11	1	05049713	Hose Assy, Hyd
12	1	05145941	Heat Exchanger
13	1	05060777	Adapter-JIC, 45 Degrees, M/F 12-12
14	1	95830766	Lock Washer, .31
15	1	10091858	Bulb Well, .75
16	2	95829248	Hex Head Screw, 5/16-18 x 1.00
17	1	05104195	Bushing-Straight Thread, 1.0 SAE M x .75 SAE F O-Ring Boss
18	1	05104203	Elbow-90 Deg, 1.25 Male NPT x 1.25 Male JIC
19	1	05079967	Gasket, Sensor, Hyd Oil, 0.06"
20	1	10170645	Adapter, Pipe/O-ring, Straight, 12-16
21	1	05079371	Adapter, Straight Swivel, -12 JIC x -12 BSPP
22	1	05006291	Diffuser, Return Line, Hyd Oil
23	2	10099901	Elbow, 90-Deg, 1/4 NPT x –4 JIC,
24	1	10080901	Valve, Shutoff, Manual, 1/2 NPT,
25	2	10091163	Adapter-JIC, 90 Degrees, 12-12
26	1	95033619	Plug, .50
27	2	05145966	Heat Exchanger Bracket

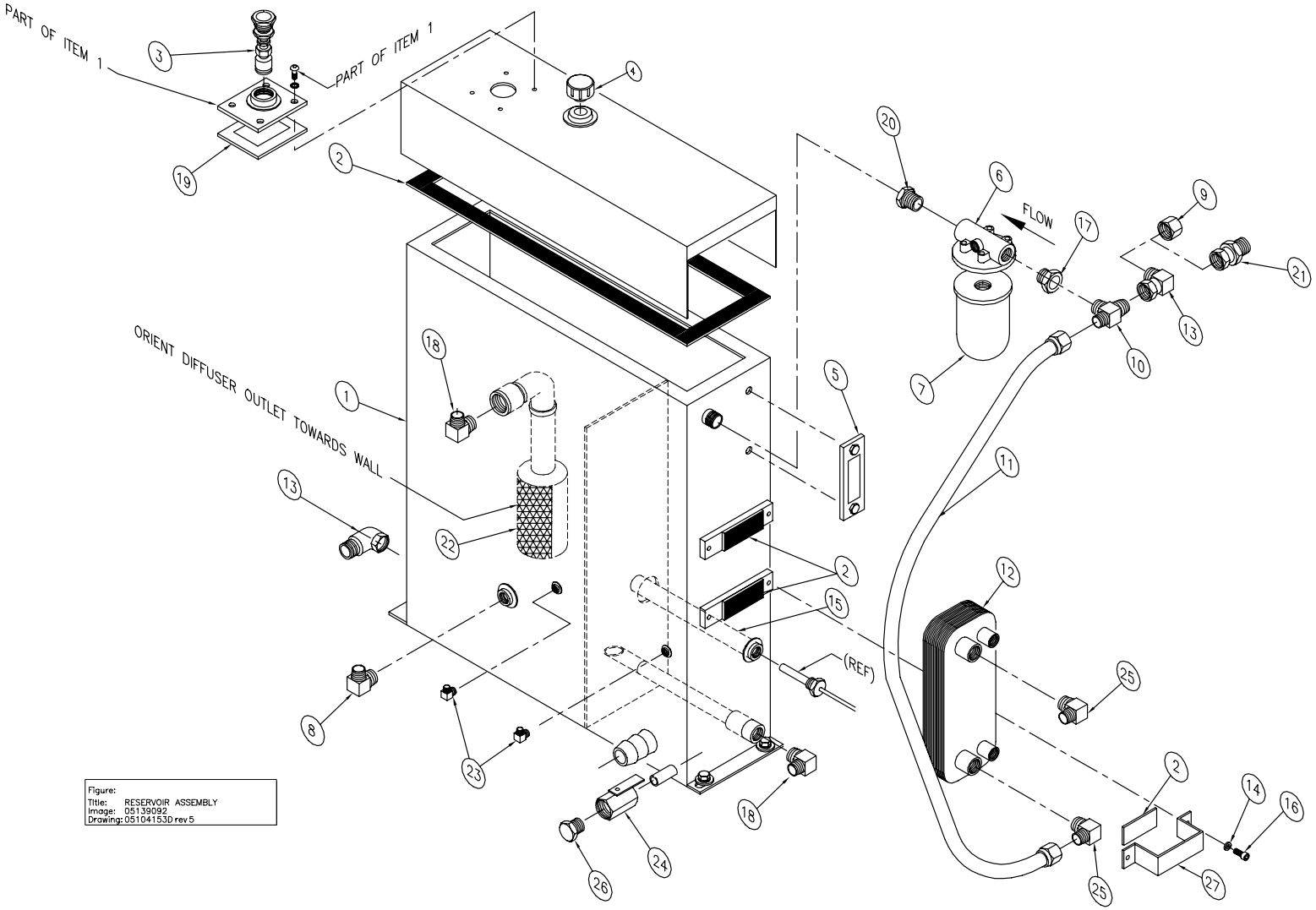

PART OF ITEM 1
PART OF ITEM 1
ORIENT DIFFUSER OUTLET TOWARDS WALL
FLOW
(REF)
Figure:
Title: RESERVOIR ASSEMBLY
Image: 05139092
Drawing: 05104153D rev 5

Figure 12- 13 TOP COVER ASSEMBLY, 05106026

ITEM No.	QTY.	PART No.	DESCRIPTION
1	24	05091970	Screw, Machine, Flat Head, #10 – 32 x .75-in., Stainless Steel, Phillips Head
2	1	05106034	Support, Cover, SL-IV, Weldment
3	1	05106042	Hinge, Cover
4	2	05106059	Cover, Top
5	48	05092002	Screw, Flange Head, 3/8 – 16 x 1.25
6	28	95484382	Nut, Hex, 3/8 – 16
7	24	05041439	Nut, Machine, Hex, #10 – 24, Nylon Locking
9	20	05091988	Nut, Flanged, 3/8 – 16
10	1	05106067	Gasket, Cover
12	28	95670972	Washer, Lock, 3/8 – ID, Black Oxide
14	24	95367207	Washer, Flat, #10
15	8	10069714	Washer, Flat, 3/8

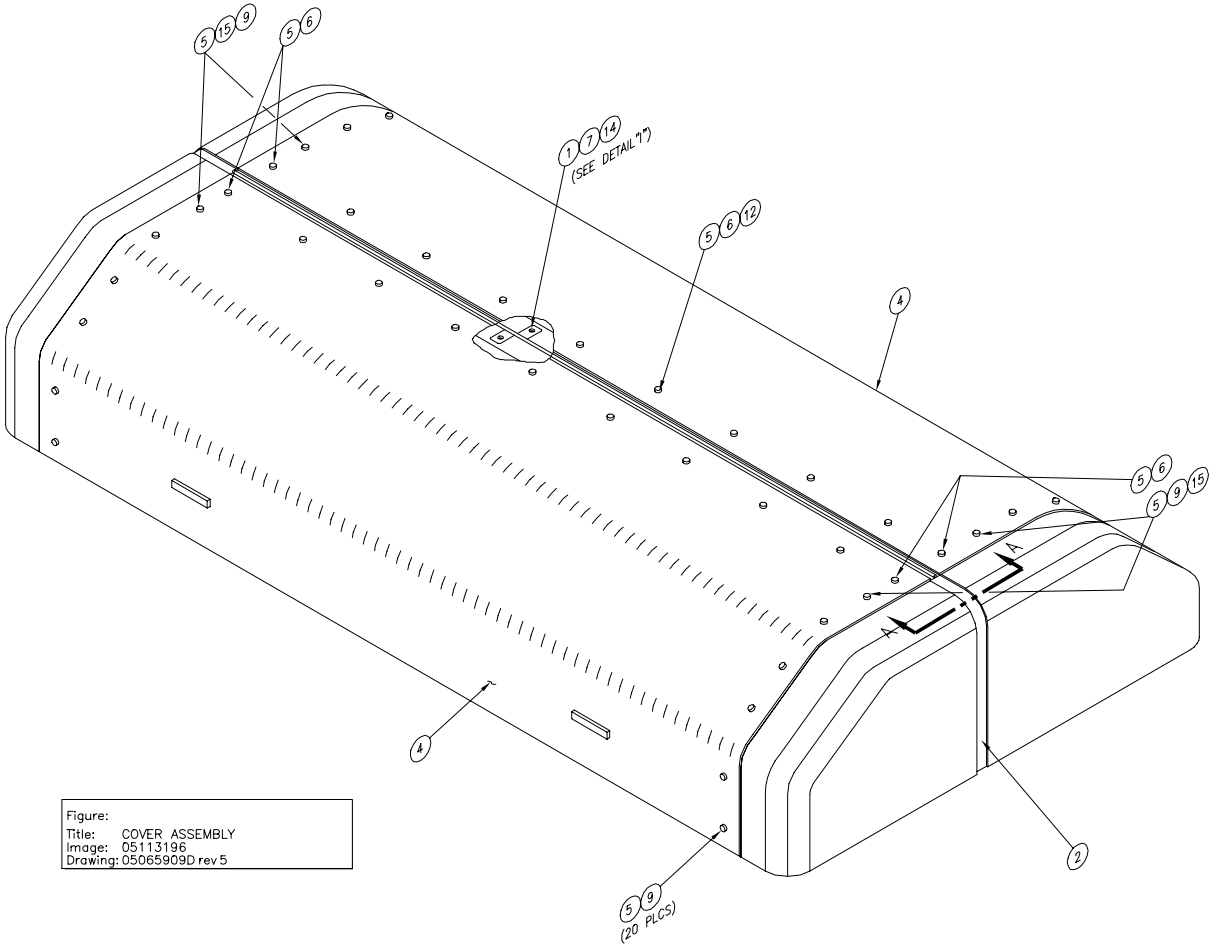
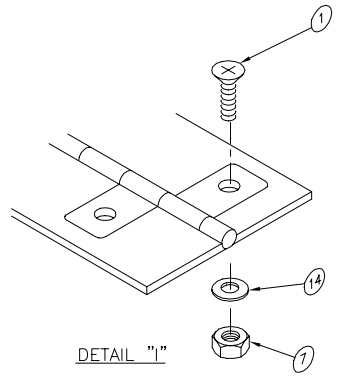


Figure:
Title: COVER ASSEMBLY
Image: 05113196
Drawing: 05065909D rev 5



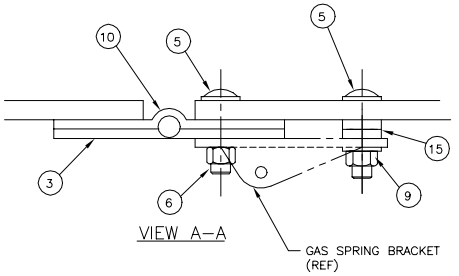
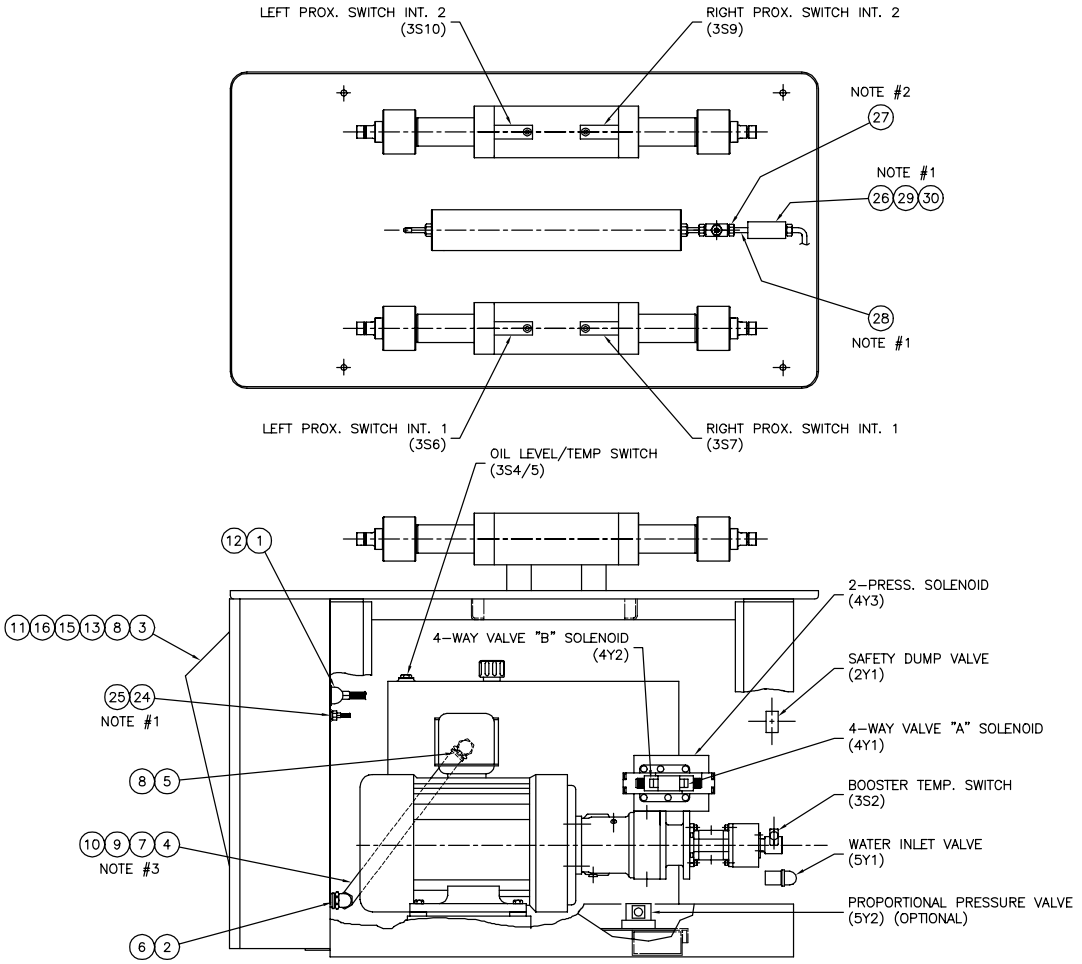


Figure 12-14 SL-4/100 hp, ELECTRICAL ASSEMBLY 200-208v/3/50-60-05145826

ITEM No.	QTY	PART No.	DESCRIPTION
1	1	05107040	Sensor Harness
2	1	10098804	Flexible Conduit Conn, 90 deg
3	4	10069763	Washer, .50
4	42”	05039938	Flexible Conduit, 1.50
5	1	10114932	Flexible Conduit Conn, 45 deg
6	1	05147251	Conduit Bushing, 1.50
7	6	80073109	Split Bolt Connector
8	4	95423695	Hex Nut, 1/2-13
9	1008”	10121648	Wire, #3, Black
10	168”	05139498	Wire, #3, Green
11	4	95738514	Hex Head Screw, 1/2-13 x 1.00
12	5	10125912	Cable Tie
13	4	95716890	Lock Washer, .50
15	2	05073127	Washer, 1.44
16	1	05145818	Control Panel Configuration, 200-208/3/50-60



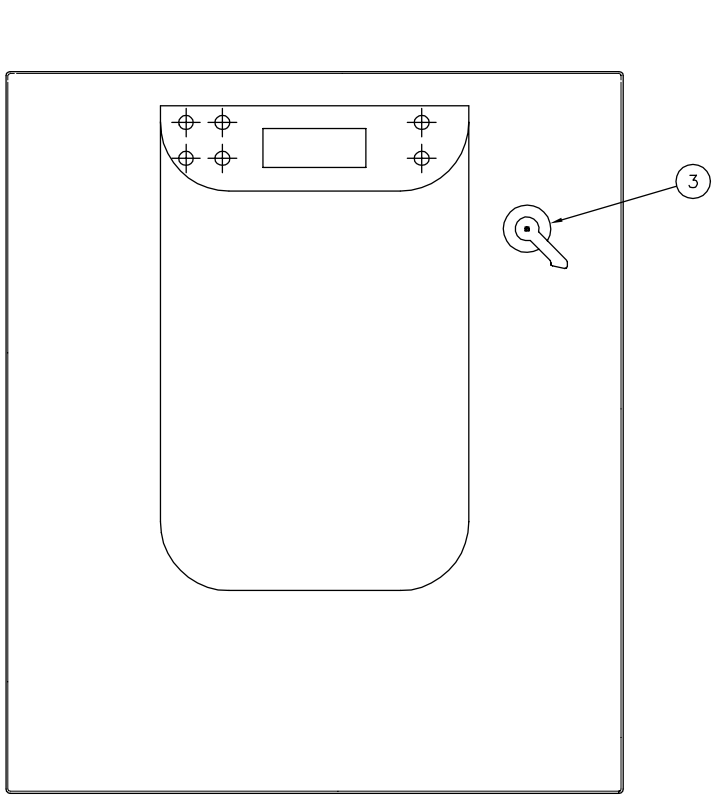
NOTES:

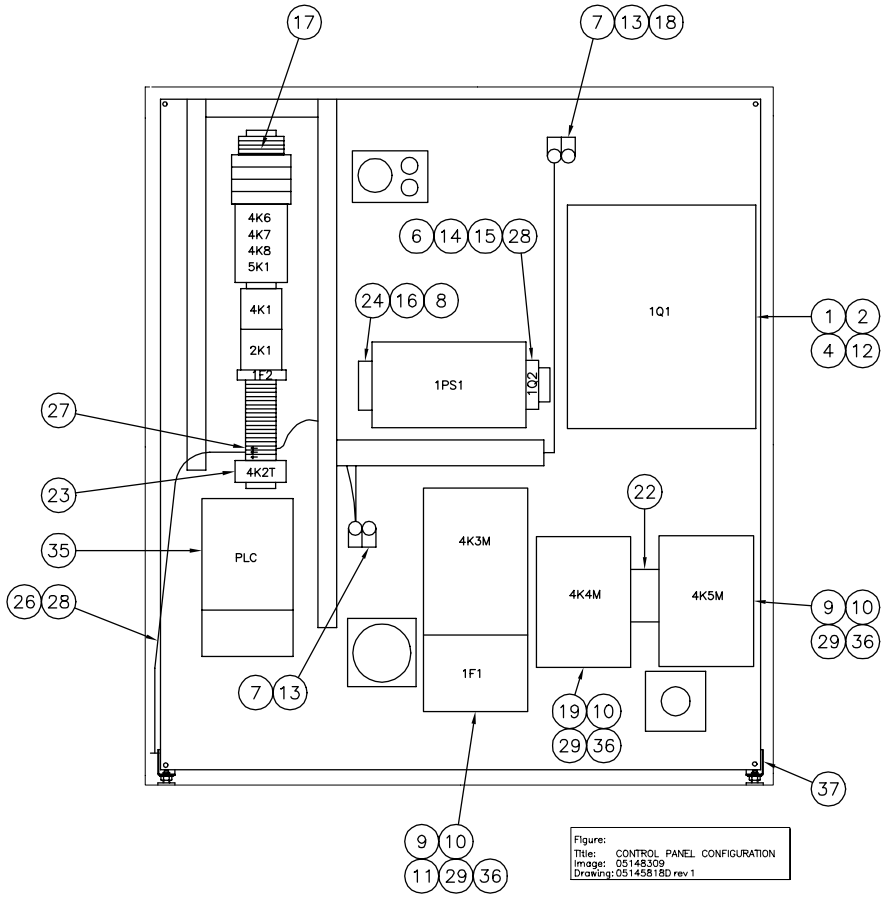
1. ITEM #24, #25 AND #27 THRU #31 ARE USED FOR OPTIONAL PRESSURE TRANSDUCER.
2. REPLACE EXISTING PLUG WITH ITEM #27.
3. USE TWO PARALLEL WIRES (ITEM #9 AND #10) FOR EACH MOTOR CONNECTION.

Figure:
Title: ELECTRICAL ASSEMBLY
Image: 05148291
Drawing: 05145826D rev 2

Figure 12-15 CONTROL PANEL CONFIGURATION, 200-208/3/50-60-05145818

ITEM No.	QTY	PART No	DESCRIPTION
1	1	05145453	Circuit Breaker, 400A
2	4	05031620	Skt Hd Screw, #10-32 x 1 3/4
3	1	05145487	Door Interlock Handle
4	2	05145461	Terminal Lug
5	288”	10121648	#3 Wire, Black
6	1	05115183	Power Supply, 24 VDC
7	2	49873110	Round Hd Screw, 1/4-20 x 3/4
8	4	10073492	Pan Head Screw, #8-32 x 1/2
9	2	05145511	Non-reversing Contactor
10	12	10157667	Pan Head Screw, #10-32 x 3/4
11	1	05145529	Relay Overload
12	4	05145479	Terminal Lug
13	2	05095609	Ground Lug
14	192”	05019898	#14 Wire, Black
15	1	05116744	Circuit Breaker
16	12”	10103034	Din Rail
17	1	05105929	Control Sub-assembly
18	48”	05106398	#3 Wire, Green/Yellow
19	1	05145537	Non-reversing Contactor
20	40	05107248	Crimp Ferrule
21	1	05145552	Contactor Jumper
22	1	05127527	Contactor Interlock
23	1	05091699	Timing Relay
24	2	05032362	End Anchor
25	48	05019617	Crimp Connector
26	1	10094712	Terminal Ring
27	1	05115704	Terminal Block
28	72”	10170157	#10 Wire, Green/Yellow
29	6	05145560	Terminal Cover
30	8	10185395	Crimp Connector
35	1	10194066	Slot Filler
36	6	05145503	Terminal Kit
37	2	05145701	Support Panel

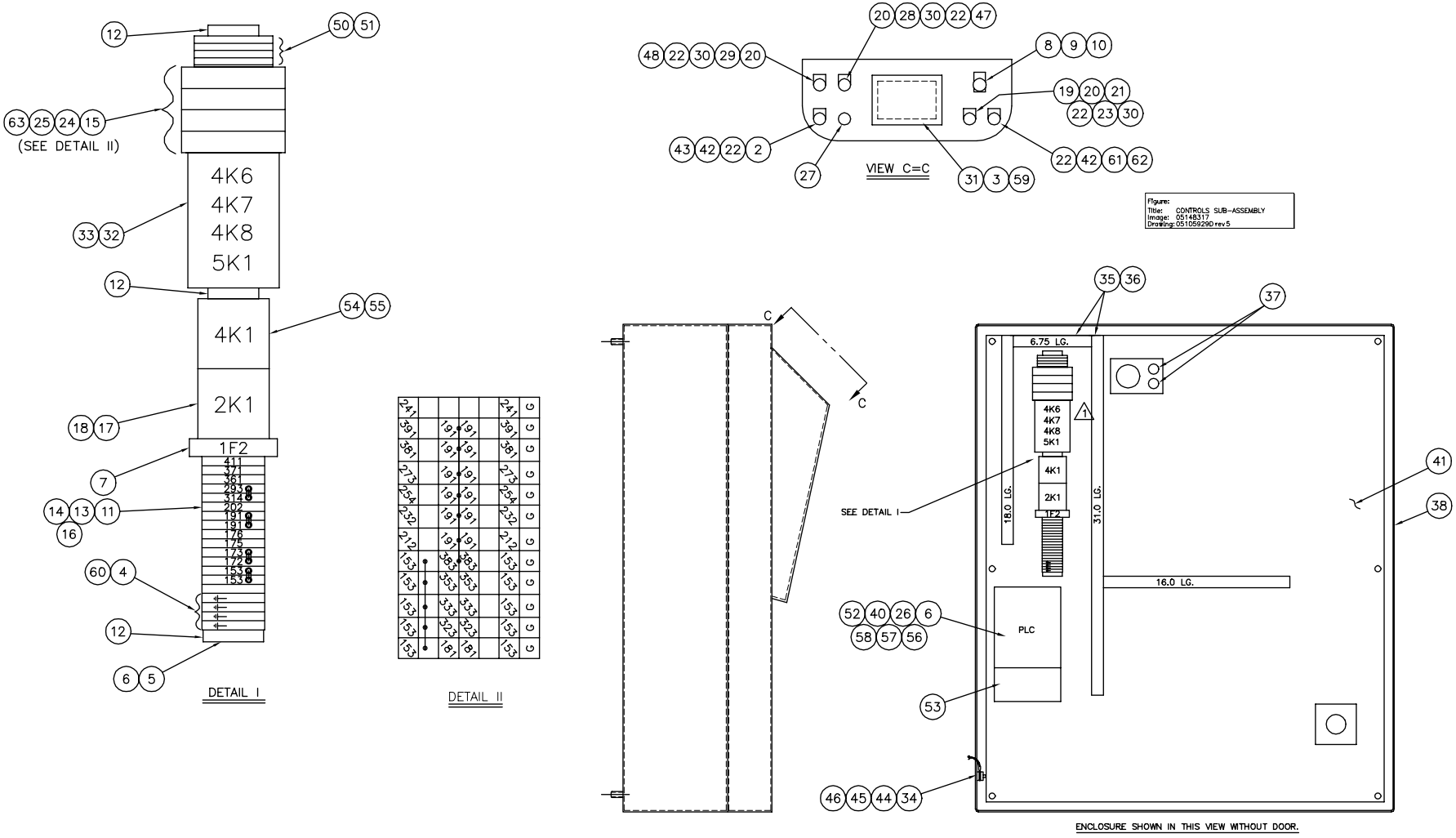




ENCLOSURE SHOWN IN THIS VIEW WITHOUT DOOR.

Figure 12-16. CONTROLS SUB-ASSEMBLY, 05105929

ITEM No.	QTY	PART No	DESCRIPTION
1	1584'	10176410	#16 Wire, Blue
2	1	05049416	Seletor Switch
3	168"	10170165	#16 Wire, Green/Yellow
4	4	05032420	Terminal Block
5	20"	10103134	Din Rail
6	12	10073492	Pan Head Screw, #8-32 x 1/2
7	1	05105994	Circuit Breaker
8	1	05049499	Push/pull Switch
9	1	05049481	Contact Block
10	1	05049473	Legend Plate
11	15	05032438	Terminal Block
12	3	05032362	End Anchor
13	1	05032370	End Barrier
14	.8	05032388	Terminal Block Jumper
15	.48	05112818	Terminal Block Marker
16	.3	05032412	Terminal Block Marker
17	1	10186104	Tube Base Relay
18	1	10196012	Relay Base
19	1	05049465	Pushbutton Switch
20	3	05049457	Lamp Socket Block
21	1	05049440	Contact Block
22	5	05049432	Legend Plate Holder
23	1	05049424	Legend Plate
24	12	05113634	Terminal Block
25	1.5	05112826	Terminal Block Jumper
26	1	05107131	PLC Processor
27	1	05050208	Plug
28	1	05049358	Pilot Light, Green
29	1	05049341	Pilot Light, Red
30	3	05050216	Light Bulb
31	1	05107107	Operator Interface
32	1	10156859	I/O Rack
33	4	10146363	Single Point Module
34	2	10157659	Star Lock Washer, .25
35	1	05021944	Wiring Duct
36	26	10170132	Rivet
37	2	49874191	Seal
38	1	05050372	Electrical Enclosure
39	180	10185395	Crimp Connector
40	1	05107149	PLC Output Module
41	1	05077227	Sub-plate
42	2	05049374	Contact Block
43	1	05049366	Legend Plate
44	10"	10170157	#10 Wire, Green/Yellow
45	2	10094712	Ring Terminal
46	4	95416335	Hex Nut, 1/4-20
47	1	05081831	Legend Plate
48	1	05081849	Legend Plate
49	12"	10102242	Spiral Wrap
50	4	05096052	Terminal Block
51	1	05096060	End Barrier
52	1	05107123	PLC Chassis
53	1	05107115	Power Supply
54	1	10098226	Tube Base Relay
55	1	10098242	Screw Terminal Tube Base
56	1	10194041	Single Point Module
57	1	05118492	Battery
58	1	10135184	EEPROM Memory Module
59	1	10181915	Fork Terminal
60	1	05115134	End Barrier
61	1	05115126	Selector Switch
62	1	05114889	Legend Plate
63	1	05117601	End Barrier


12
50 51
63 25 24 15
(SEE DETAIL II)
4K6
4K7
4K8
5K1
33 32
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54 55
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60 4
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DETAIL I
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20 28 30 22 47
48 22 30 29 20
8 9 10
19 20 21
22 23 30
43 42 22 2
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VIEW C=C
22 42 61 62
31 3 59
Figure:
Title: CONTROLS SUB-ASSEMBLY
Image: 05148317
Drawing: 05105929D rev.5
C
C
35 36
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6.75 LG.
4K6
4K7
4K8
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2K1
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SEE DETAIL I
18.0 LG.
31.0 LG.
16.0 LG.
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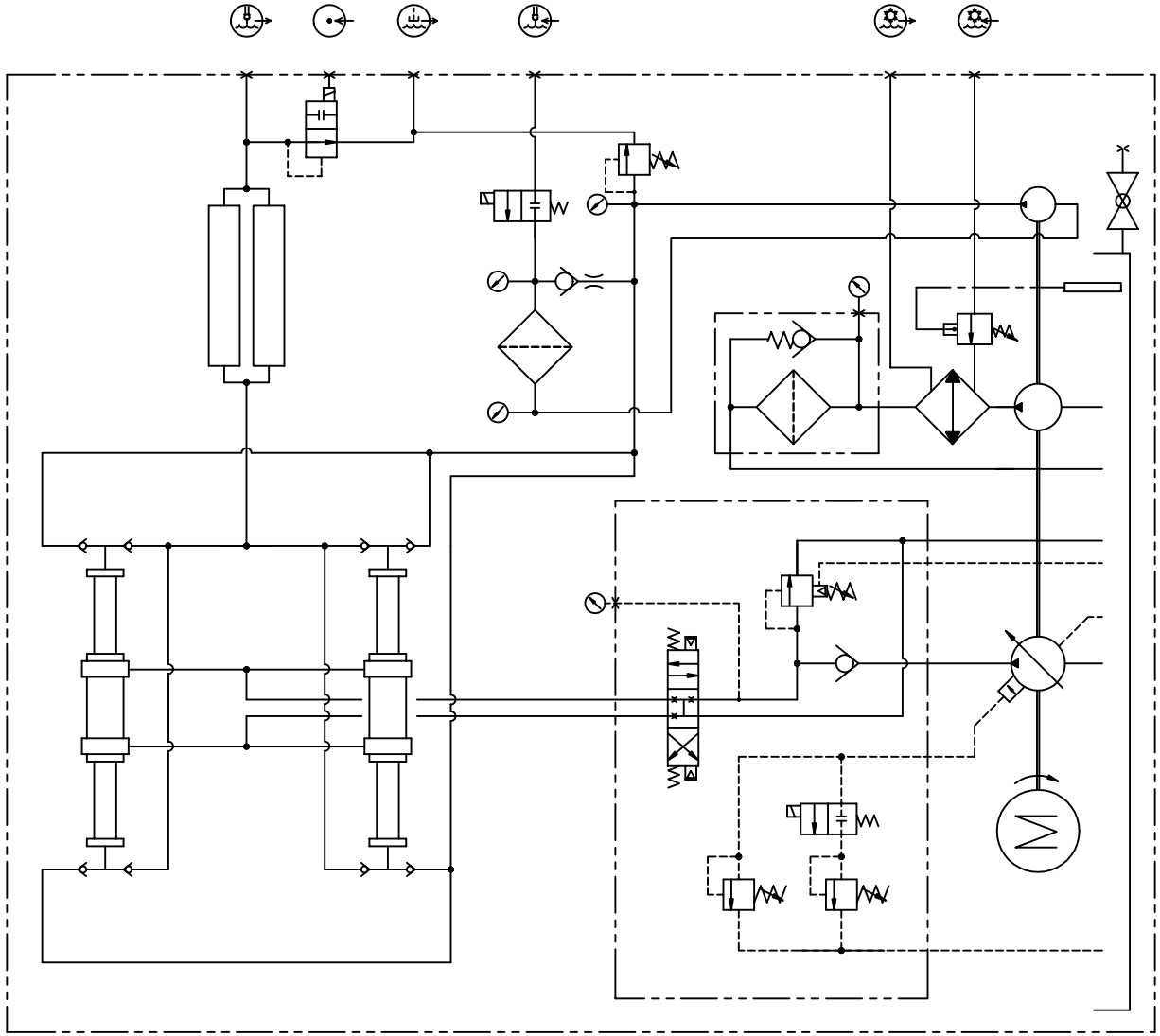
ENCLOSURE SHOWN IN THIS VIEW WITHOUT DOOR.

Date: 4/24/2003 Time : 12:49:39 PM



DWG NO	SHT	REV
05107172D	1	

REVISIONS

NO	DESCRIPTION	DATE	APPROVED

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GEOMETRIC SYMBOLS

STRAIGHTNESS	
CIRCULARITY (ROUNDNESS)	○
CYLINDRICITY	⌭
FLATNESS	⏥
ANGULARITY	∠
PERPENDICULARITY	⊥
PARALLELISM	∥
CONCENTRICITY	◎
TRUE POSITION	⌖
CIRCULAR RUNOUT	↗
TOTAL RUNOUT	⌰

UNLESS OTHERWISE NOTED, BREAK SHARP EDGES & CORNERS .015 R ✓ SURFACE FINISH ALL OVER

STANDARD TOLERANCES

X.X	= ±.063
X.XX	= ±.015
X.XXX	= ±.005
ANGLE	= ±0°30'

DESIGN	.XX	DATE 5/15
DRAWN		
APPROVED		
ENG. APPVL.	.XX	5/15
RELEASED BY		

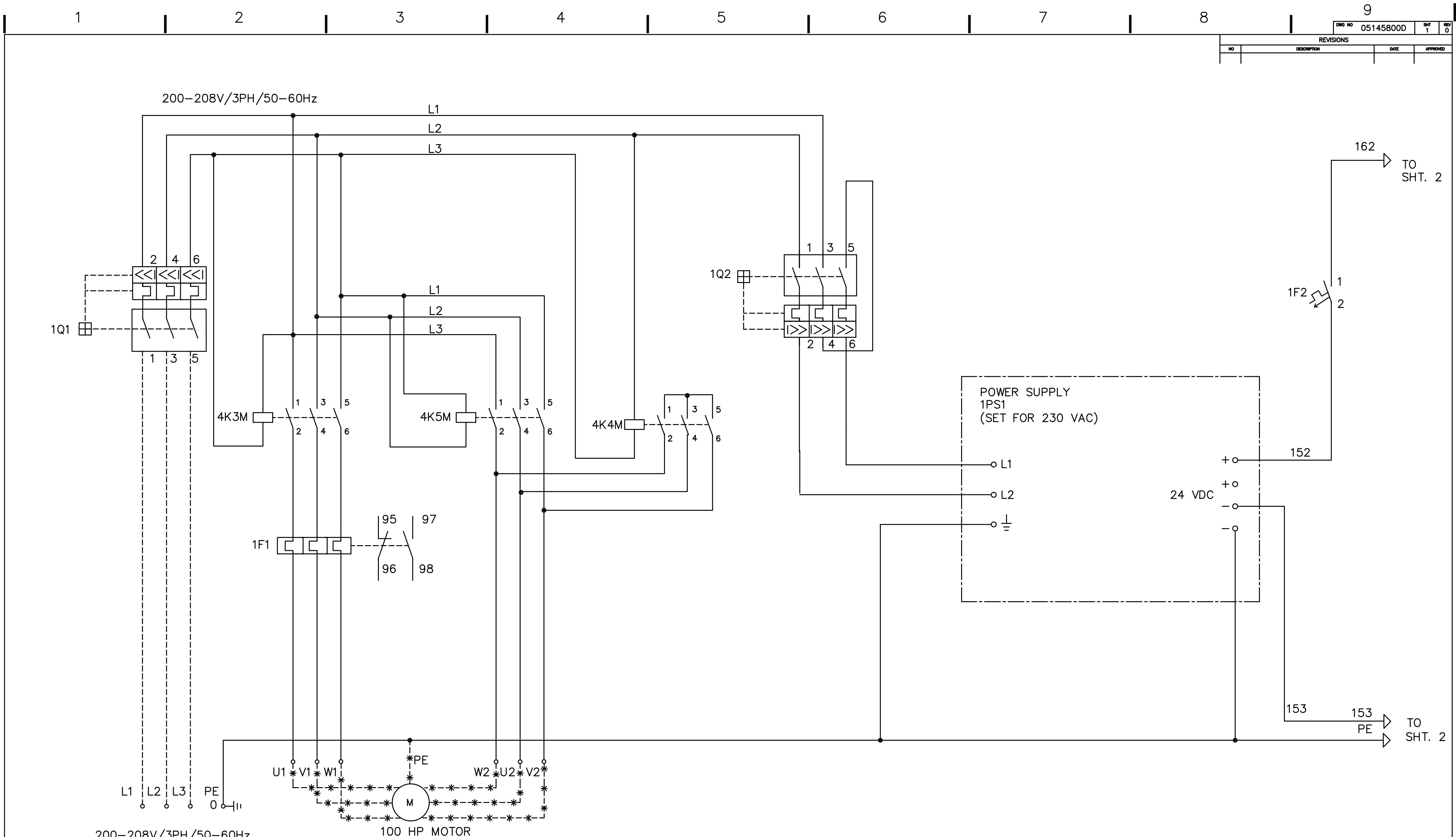
INGERSOLL-RAND
WATERJET SYSTEMS

SYSTEM SCHEMATIC
SLIV 100HP

MATL.	DWG. NO.	REV.
-	05107172D	
NEXT ASSY.	-	SCALE -	SHEET 1 OF 1

NEXT ASSEMBLY

Title: J:\cad\Release\0510\05107172.DWG



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REF. 05115712

GEOMETRIC SYMBOLS

- STRAIGHTNESS
- CIRCULARITY (ROUNDNESS)
- CYLINDRICITY
- FLATNESS
- ANGULARITY
- PERPENDICULARITY
- PARALLELISM
- CONCENTRICITY
- TRUE POSITION
- CIRCULAR RUNOUT
- TOTAL RUNOUT

UNLESS OTHERWISE NOTED BREAK SHARP EDGES & CORNERS .015 & √ SURFACE FINISH ALL OVER

STANDARD TOLERANCES

X.X = ±.063
X.XX = ±.015
X.XXX = ±.005
ANGLE = ±0°30'

DRAWN J.Miller	DATE 06/27/01
CHECKED	
APPROVED	
ENG. APPVL. GPN	06/27/01
RELEASED BY	

INGERSOLL-RAND®
WATERJET SYSTEMS

ELECTRICAL SCHEMATIC SLIV–100HP, 200 VAC

MATL. | DWG. NO. 05145800D | REV. 0
HEAT TREAT: | SCALE: | SHEET 1 OF 5

NEXT ASSEMBLY

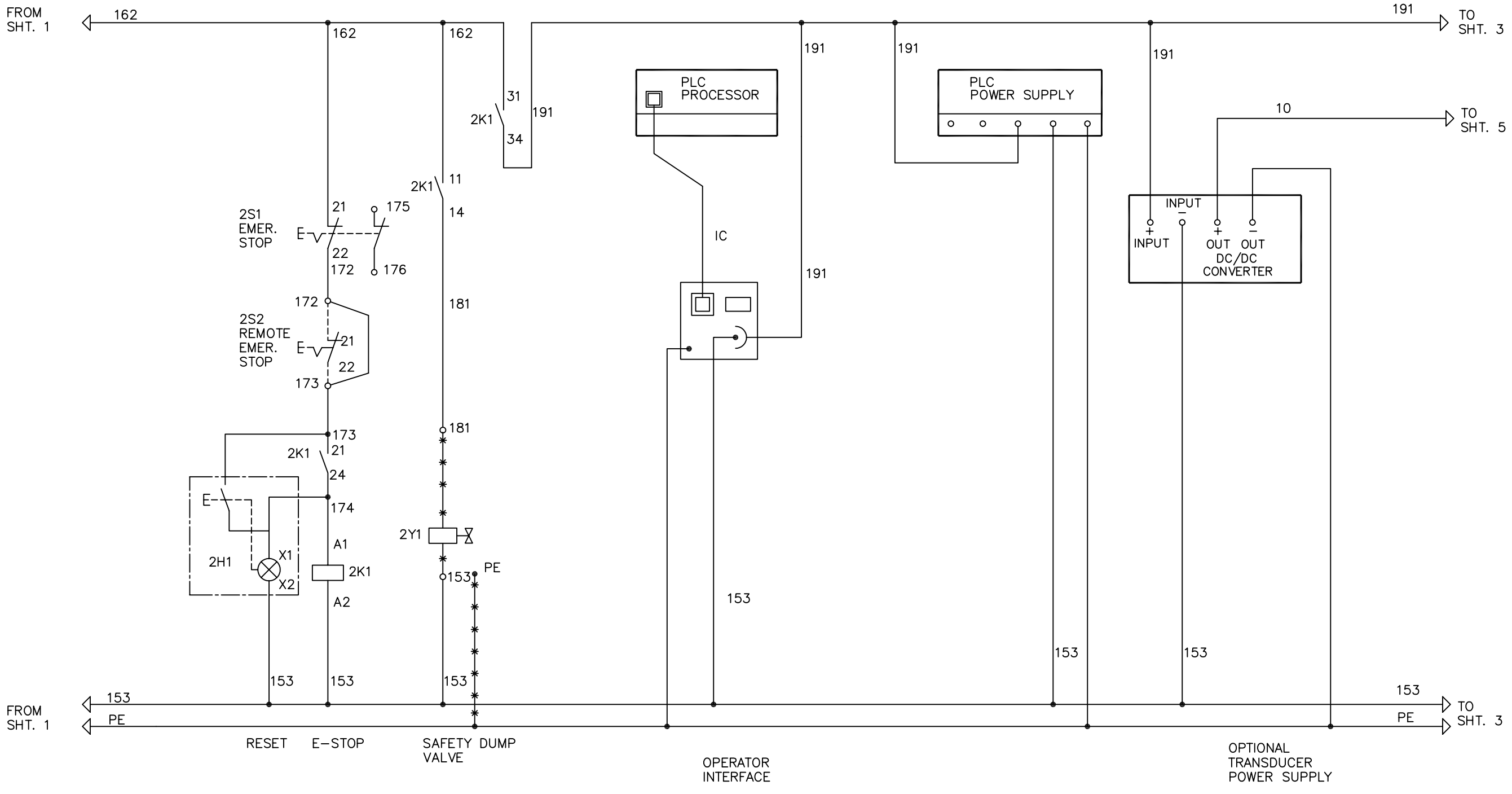
REVISIONS: NO | DESCRIPTION | DATE | APPROVED

DWG NO 05145800D | SHT 1 | REV 0

DWG NO 05145800D | SHT 2 | REV 0

REVISIONS

NO	DESCRIPTION	DATE	APPROVED



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NEXT ASSEMBLY

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REF. 05115712D

GEOMETRIC SYMBOLS

—	STRAIGHTNESS
○	CIRCULARITY (ROUNDNESS)
⌭	CYLINDRICITY
▱	FLATNESS
∠	ANGULARITY
⊥	PERPENDICULARITY
//	PARALLELISM
◎	CONCENTRICITY
⌖	TRUE POSITION
↗	CIRCULAR RUNOUT
⌰	TOTAL RUNOUT

UNLESS OTHERWISE NOTED BREAK SHARP EDGES & CORNERS .015 & √ SURFACE FINISH ALL OVER

STANDARD TOLERANCES

X.X = ±.063
X.XX = ±.015
X.XXX = ±.005
ANGLE = ±0°30'

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ENG. APPVL. QPN		96/27/0
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INGERSOLL-RAND
WATERJET SYSTEMS

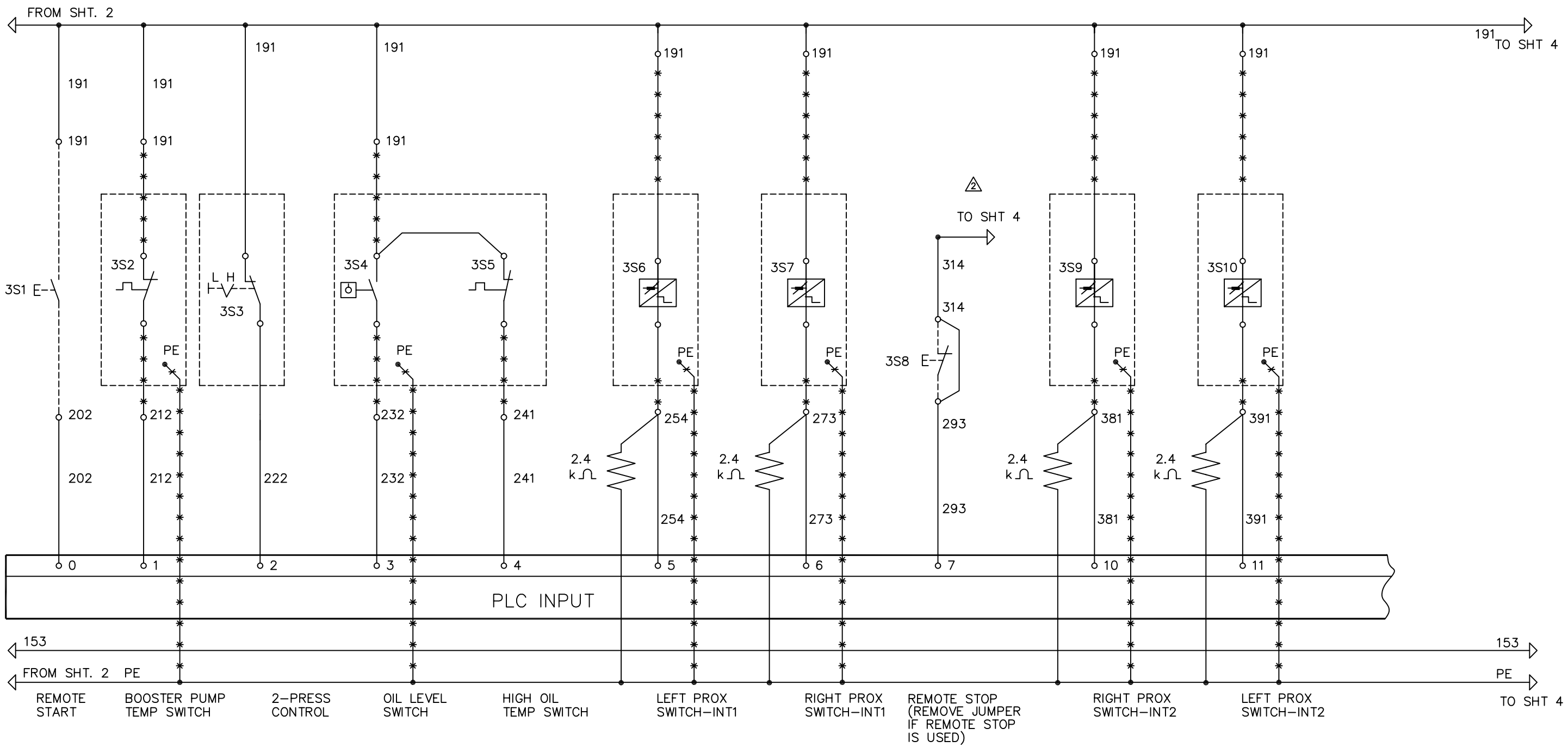
ELECTRICAL SCHEMATIC SLIV-100HP, 200 VAC

MATL. | DWG. NO. 05145800D | REV. 0
HEAT TREAT: | SCALE: | SHEET 2 OF 5

DWG NO	SHT	REV
05145800D	3	0

REVISIONS

NO	DESCRIPTION	DATE	APPROVED



NOTE:

_____ WIRING BY CUSTOMER IN ACCORDANCE WITH LOCAL REGULATIONS

--* WIRING BY I-R EXTERNAL TO PANEL

DIMENSIONS IN [ ] ARE MILLIMETRES

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REF. 05117512D

GEOMETRIC SYMBOLS

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WATERJET SYSTEMS

ELECTRICAL SCHEMATIC
SLIV-100HP, 200 VAC

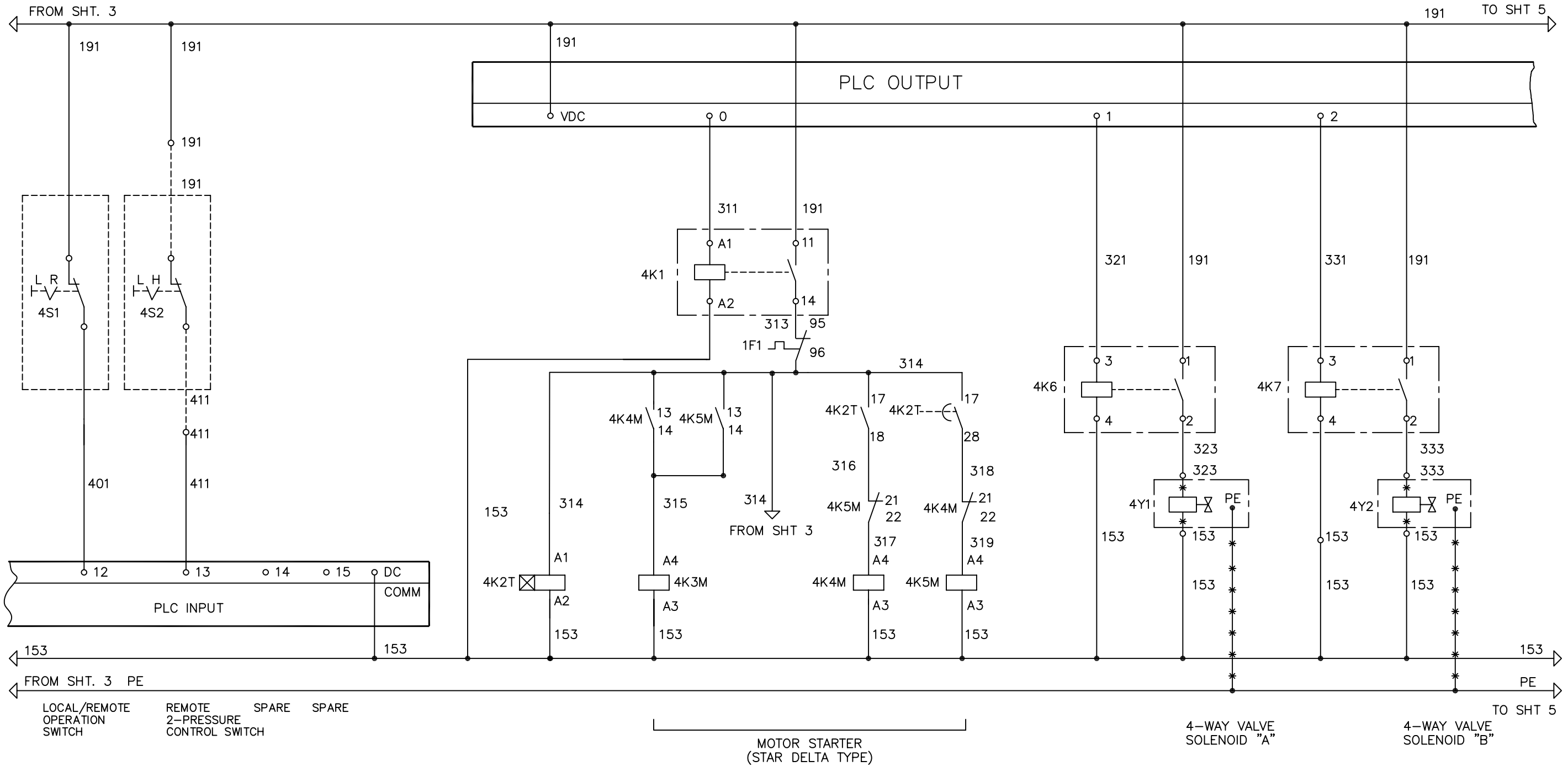
MATL.	DWG. NO.	REV.
	05145800D	0
HEAT TREAT:	SCALE:	SHEET 3 OF 5

NEXT ASSEMBLY

DWG NO 05145800D | SHT 4 | REV 0

REVISIONS

NO	DESCRIPTION	DATE	APPROVED



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WATERJET SYSTEMS

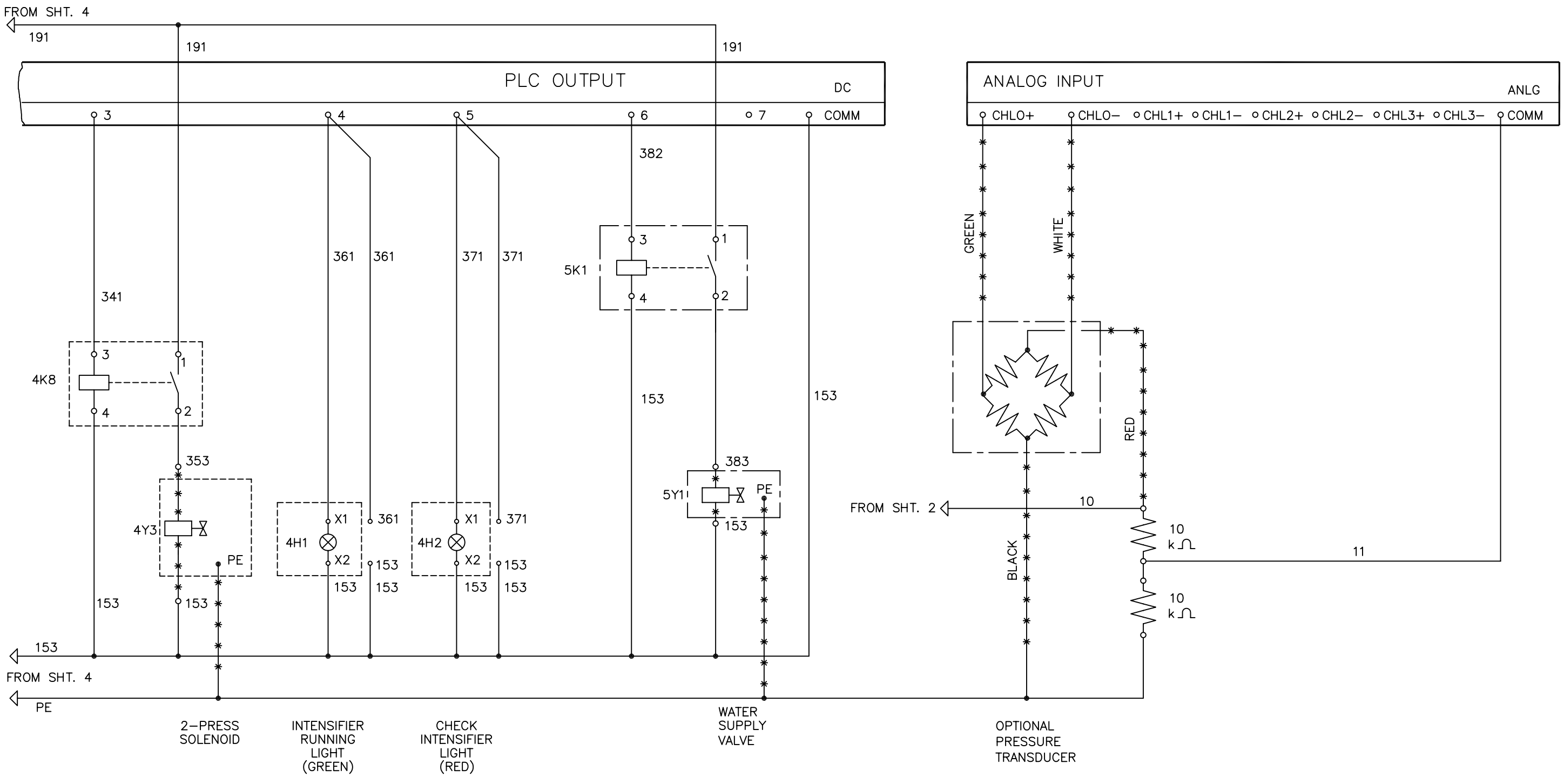
ELECTRICAL SCHEMATIC SLIV–100HP, 200 VAC

MATL. | DWG. NO. 05145800D | REV. 0
HEAT TREAT: | SCALE: | SHEET 4 OF 5

DWG NO	SHT	REV
05145800D	5	0

REVISIONS

NO	DESCRIPTION	DATE	APPROVED



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NEXT ASSEMBLY

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		DATE
DRAWN	J.Miller	96/27/0
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ENG. APPRL. GPN		96/27/0
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WATERJET SYSTEMS

ELECTRICAL SCHEMATIC SLIV–100HP, 200 VAC

MATL.	DWG. NO.	REV.
	051458002D	0
HEAT TREAT:	SCALE:	SHEET 5 OF 5