KMT Waterjet Systems

STREAMLINE HIGH-PRESSURE WATERJET PUMP

OPERATION and SERVICE MANUAL

STREAMLINE SL-IV 30 *plus*

STREAMLINE SL-IV 30

400 V / 3 / 50 Hz

Manual No. 05146311 Rev. 3
Original: July 2003
CPN Nr.: 80800-GB-14

NOTICE

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TABLE OF CONTENTS

Section 1 INTRODUCTION

1 Introduction

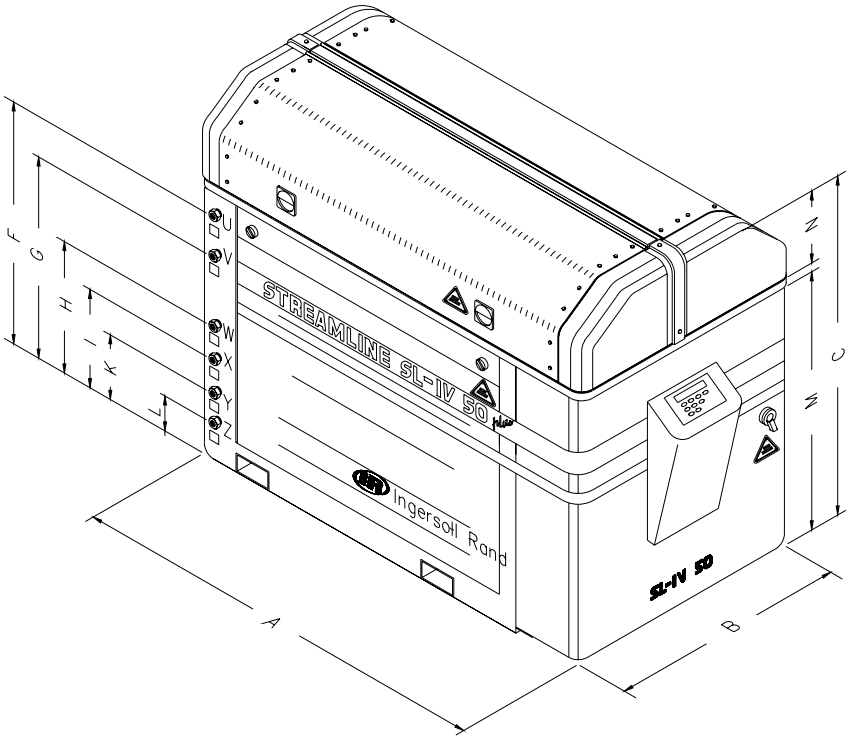
The Streamline™ IV / PLUS (SL-IV / PLUS) waterjet pump maintains the level of component reliability and the ease of installation and maintenance that has made KMT Waterjet Streamline waterjet pumps the standard of the industry for both water and Hydrobrasive™ applications.

The SL-IV / PLUS waterjet pump provides output water pressures up to 4,100 bar (60,000 psi) for ultrahigh-pressure waterjet cutting, hydrobrasive cutting, cleaning, surface preparation, etc.

This manual provides information for installation, operation, and maintenance of the SL-IV / PLUS waterjet pump.

1.1 Description

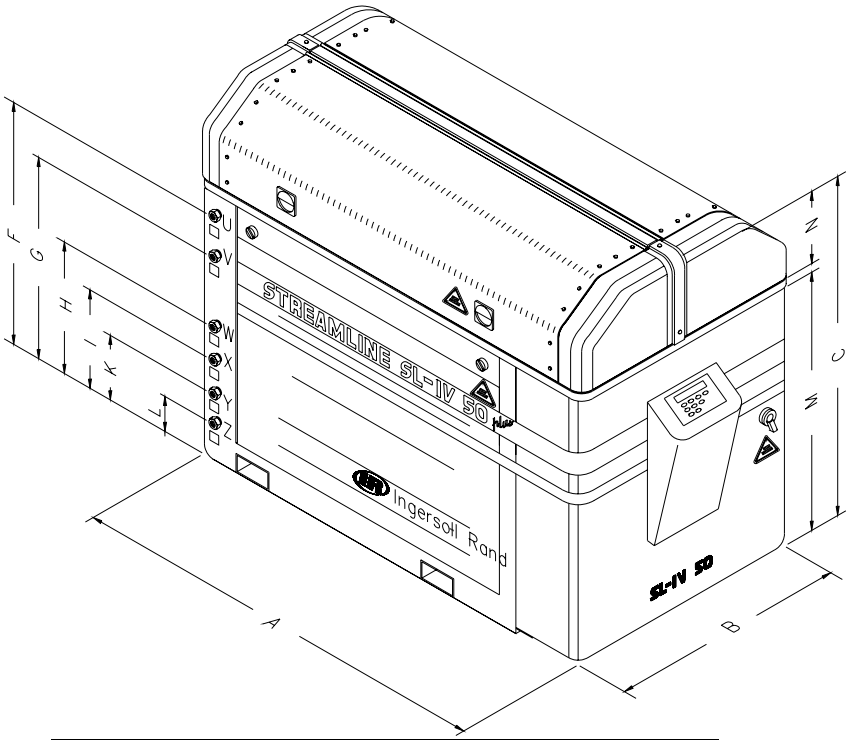
The SL-IV / PLUS waterjet pump is a self-contained functional unit. The major assemblies within the SL-IV / PLUS intensifier are single (or optional redundant) high-pressure intensification assemblies, single or dual high-pressure attenuator(s), a motor and hydraulic pump assembly, an oil cooling/filtration system, a low pressure water booster pump with low pressure water filtration, a fail-safe high-pressure venting valve, and an integrated NEMA 12 electrical control enclosure.



.jpg

Letter	Connection
U	Cutting Water OUT…9/16” HP
V	Plant Air……¼” NPT
W	Cooling Water IN……½” NPT
X	Cooling Water OUT…½” NPT
Y	Cutting Water IN……½” NPT
Z	Drain……½” NPT

NOTE
KMT Waterjet recommends approx. 950 mm / 36" minimum clearance around intensifier for maintenance.



Letter	Dimension	
	mm	Inch
A	1.721	67,75
B	914	36,00
C	1.453	57,19
F	914	36,00
G	812	32,00
H	419	16,50
I	343	13,50
K	267	10,50
L	191	7,50
M	1.092	43,00
N	330	13,00

The SL-IV / PLUS waterjet pump is enclosed in a frame 67.75" (1720 mm) long, 36.0" (910 mm) wide and 57.19" (1450 mm) tall. The high-pressure intensification assembly is mounted on a drip pan on the frame top at a convenient height for performing routine maintenance. All components requiring routine maintenance are easily accessible through self-levitating hinged transparent covers or removable protective panels covering the sides of the lower frame. The high-pressure intensification assembly can be easily and quickly removed from the intensifier base if deemed desirable or necessary for maintenance.

1.1.1 Features

- Variable displacement, pressure compensated axial piston hydraulic pump.
- Inlet water pressure booster pump and filtration system with 10-micron high capacity filter.
- High efficiency oil-to-water heat exchanger and cartridge oil filter in an oil circulation pump circuit separate from the main hydraulic pump circuit.
- Thermostatically controlled water-cooling system for optimum hydraulic oil temperature stability.
- Integrated electrical controls include a standard wye-delta motor starter to minimize motor inrush current at startup.
- High-pressure safety dump valve.
- Dual pressure compensators on the main hydraulic pump allow manual or program controlled selection of two different output pressures.
- Optional electronically controlled continuously variable hydraulic pressure control may be integrated into the host CNC unit for real-time pressure control.
- TUV approved high-pressure attenuator for smooth high-pressure water delivery.
- TUV approved pre-set hydraulic relief valve eliminates the need for rupture disc overpressure protection.
- Microprocessor control with diagnostic capability and multi-language touch screen operator interface.
- Cutting water solenoid-operated shutoff valve.
- Inlet water pressure and booster pressure switches insure that there is adequate supply water pressure to the SL-IV / PLUS high-pressure intensification assembly to prevent water starvation damage.
- Separate water and oil drip pans for cleanliness.
- Remote control electrical interface connector port.
- Remote diagnostic communication option.

1.2 Functional Description

The HP intensification assembly uses a hydraulically driven piston operating in electrically reversed reciprocating mode, coupled at both ends to high-pressure intensification cylinders. The HP intensification cylinders extrude high-pressure water alternately, while the HP attenuator minimizes fluctuations in the output water signal. The intensification ratio is 20:1 with maximum hydraulic pressure set at 3,100 psi.

1.2.1 Functional Features

- 4,150 bar (60,000 psi) operating pressure
- Electronic reversing

- 24vdc control logic
- Built-in high-pressure water leak detection diagnostics
- Standard dual pressure control facilitates hole piercing and kiss cut applications
- Exclusive long, slow plunger stroke
- Cartridge type hydraulic seals
- Low pressure water booster 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 GOLD- und SILVER-Service - Cost-Calculation Security

The economics of an investment in a waterjet cutting machine, is not only a top priority for start up companies. The purchase price of a machine was and always will continue to be an important consideration, the running costs however, have been rather difficult to estimate. The goal of our **Gold- & Silver-Service** is exactly the correction of this situation: The concept consists of a fixed per hour paid by the enduser of the KMT Waterjet high pressure and cutting equipment. The application type (pure water or abrasive) as well as the local installation-conditions at the customer site give us the cornerstones necessary for the construction of such a package. Within this offering, the customer has the option of deciding whether the maintenance and service activities are to be carried out by his own personnel (**Silver-Service**) or if KMT Waterjet Systems service technicians are to perform all of these actions (**Gold-Service**). Both packages include scheduled visits of KMT Waterjet Systems Technicians, as well as any possible additional training required by the responsible maintenance personnel. This is how KMT Waterjet Systems allows customers new to waterjet cutting to be fully prepared for all the possible technical questions down to the smallest detail. Questions get answered in direct dialog with our service technician, allowing for cost-conscious operation. For companies not interested in having to maintain their own equipment. The additional advantage of this lies in the fact that KMT Waterjet Systems is able to offer **Gold and Silver Service**, not only for new units, but also for pumps, already in the field.

1.3.2 Service Department

The KMT Waterjet Customer Service group provides parts and service support.

On-Site Service Support

- Equipment installation and start-up supervision.
- Equipment relocation supervision.
- Equipment performance assessment.
- Remedial maintenance supervision.
- Preventive maintenance supervision.
- Maintenance training.

Phone Service Support:

Service personnel available for technical phone assistance during and after work hours.

Scheduled Maintenance training
Periodic Periodic training sessions are conducted at KMT Waterjet designated training locations. Call the Waterjet Service Manager for schedule information.

1.3.3 Parts Support

KMT Waterjet maintains a comprehensive parts department staffed by trained, expert personnel. Same-day shipment is routine, and emergency shipment is available upon request.

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
Auf der Laukert 11
D–61231 Bad Nauheim
Germany

Phone: + 49–(0)6032–997–117
Fax: +49–(0)6032–997–270
E-Mail: order.service@kmt-waterjet.com

1.3.4 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

A new SL-IV / PLUS waterjet pump has been installed 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.

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

Comments:
_____
_

Is the unit a convenient size? ☐ Yes ☐ No

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

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

   Comments: _____

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

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

   Comments: _____

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

   Comments: _____

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

   Other_____
5. 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

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

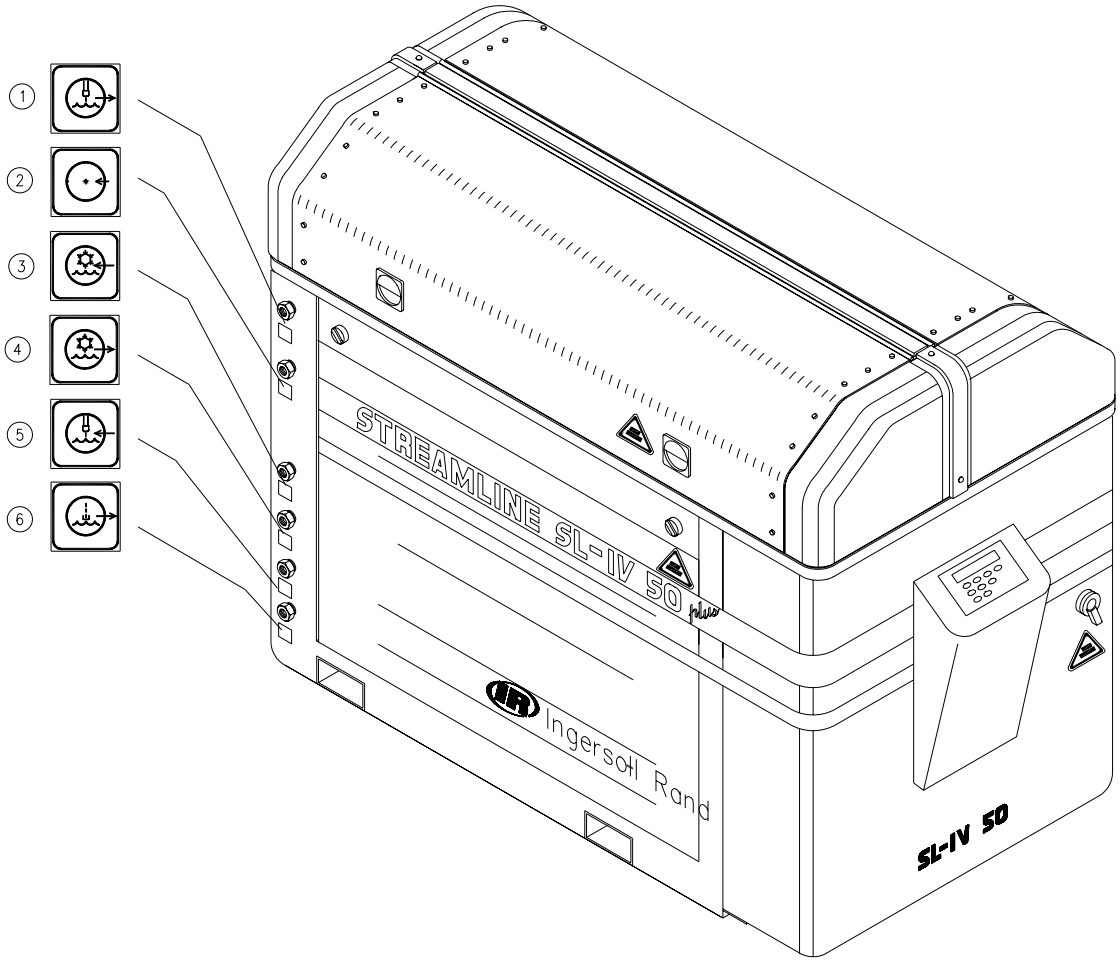
Safety procedures and safe practices must be followed during installation, operation, and maintenance of the waterjet pump. In this section we have provided label and sign descriptions used in this manual, as well as recommended safety procedures.

1.4.1 Labels and Abbreviations

The following describes hazard classifications of the waterjet pump.

⚠ CAUTION	Indicates the presence of a hazard that can cause personal injury, or property damage if the caution instruction is ignored.
⚠ WARNING	Indicates the presence of a hazard that 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



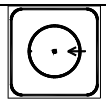
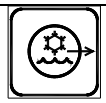
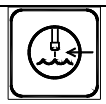
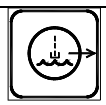
Item	Symbol	Connection
1		HP Water "OUT" ..... 9/16” HP
2		Plant Air "IN" ..... ¼” NPT
3		Cooling Water "IN" ..... ½” NPT
4		Cooling Water "OUT" ..... ½” NPT
5		Cutting Water "IN" ..... ½” NPT
6		Drain ..... ½” NPT

Figure 1-1 shows other safety labels or icons used on the SL-IV / PLUS waterjet pump. Pressure warning (Figure 1-1(a)) warns against the hazard of trapped HP water or hydraulic pressure after the pump has been shut off. All high-pressure can be safely bled off if the operator will leave the HP cutting water valve open for a few seconds after shutting off the pump.

Figure 1-1(b) warns of electrical shock hazard when in the vicinity of the electrical enclosure or motor junction box. Figure 1-1(c) warns of hot surfaces on the HP water and hydraulic components while the pump is in normal operation.

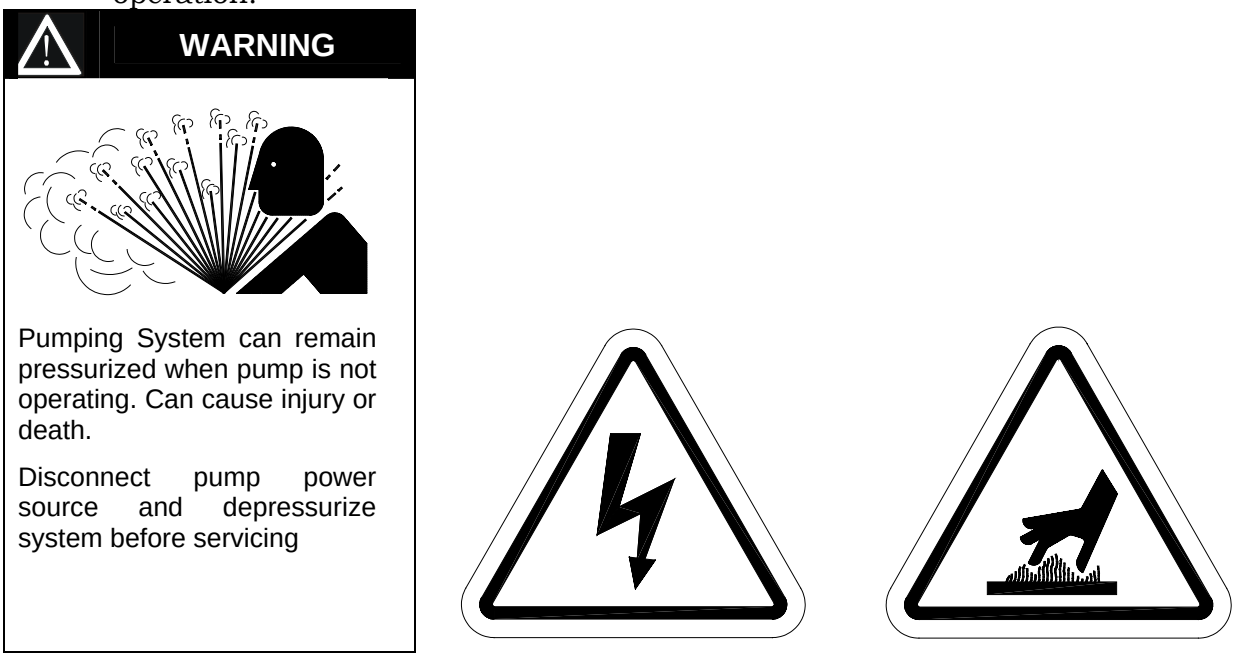


Figure 1-1. Other Safety Labels & Icons Used on the SL-IV Waterjet Pump
(a) Trapped HP Water or Hydraulic Oil (b) Electrical Shock Hazard (c) Hot Surface Warning

1.4.2 Safety Procedures

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

- The high-pressure water, 4,100 bar (60,000 psi) resident in a waterjet cutting system is an extremely high-energy medium. Persons working in the vicinity of high-pressure must exercise due respect for this pressure and always observe 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 and 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 one-at-a-time by pushing them in to insure that each button will shut the system down. Reset the pushbutton by pulling it out until it clicks. 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 49864887) 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 that all high-pressure has been bled off.

⚠ WARNING Never do any work on the unit without making sure the electrical panel disconnect is locked out with a padlock in the OFF position, and that the proper tagout procedure has been implemented.

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

⚠ WARNING Make sure the safety devices are operational. To panic stop the pump and bleed the high-pressure, an EMERGENCY STOP button must be pushed in while the system is active. The intensifier high-pressure dump valve will automatically open to bleed off the stored pressure.

⚠ WARNING Do not attempt to touch the waterjet stream, or contact the high-pressure water. The high-pressure water will penetrate all parts of human body without exception.

⚠ WARNING 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 large piping diameter also reduces dynamic pressure drop and pressure pulsation.

⚠ WARNING

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**.

⚠ WARNING

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.

⚠ WARNING

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). The whip will only flex in a single plane without being subjected to torsional stress. Torsional flexing will precipitate tubing failure. To prevent torsional stress, the use of high-pressure swivels is strongly recommended. To prolong swivel life the whip must pass through rigid support bearing blocks to prevent side-loading of the swivel spindle.

⚠ WARNING

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

⚠ WARNING

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

In order to aid treating a waterjet injury the below listed informations are to be forwarded to the doctor before starting any action.

Medical Alert

"This person has been working with water jetting at pressures to 55,000 psi (374MPa, 3740 bar, 3867 Kg/cm²) 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."

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Section 2 EQUIPMENT INSTALLATION

2 Installation

The installation, start-up, operation, and maintenance of the SL-IV / PLUS 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-IV / PLUS waterjet pump..

2.1.1 Buyer Obligations

Equipment installation requires cooperation between the user and KMT Waterjet. If on-site support is requested, the KMT 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 pump(s), 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 Service 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 Systems) for proper operation.
- 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 KMT Waterjet's standard acceptance document.

2.2 Installation Requirements (Utilities)

Environment: The SL-IV / PLUS waterjet pump must be installed indoors. Ambient conditions must not exceed maximum specifications.

Moving: The SL-IV / PLUS waterjet pump has provisions to be moved with a forklift. Check weight specifications.

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

⚠ WARNING 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:
Insure that the service voltage and ampacity are proper for this SL-IV / PLUS pump. Voltage fluctuations in excess of +/- ten percent of nominal voltage may damage the SL-IV / PLUS Pump and will void the warranty. Refer to Section 11, "**Specifications**".

Control Wiring:
Wiring for remote control of the pump must be in accordance with national and local electrical codes. The SL-IV / PLUS Waterjet Pump has a 24vdc electrical control system and has a connector port for remote operation wiring on the pump control enclosure.

2.2.2 Service Connections

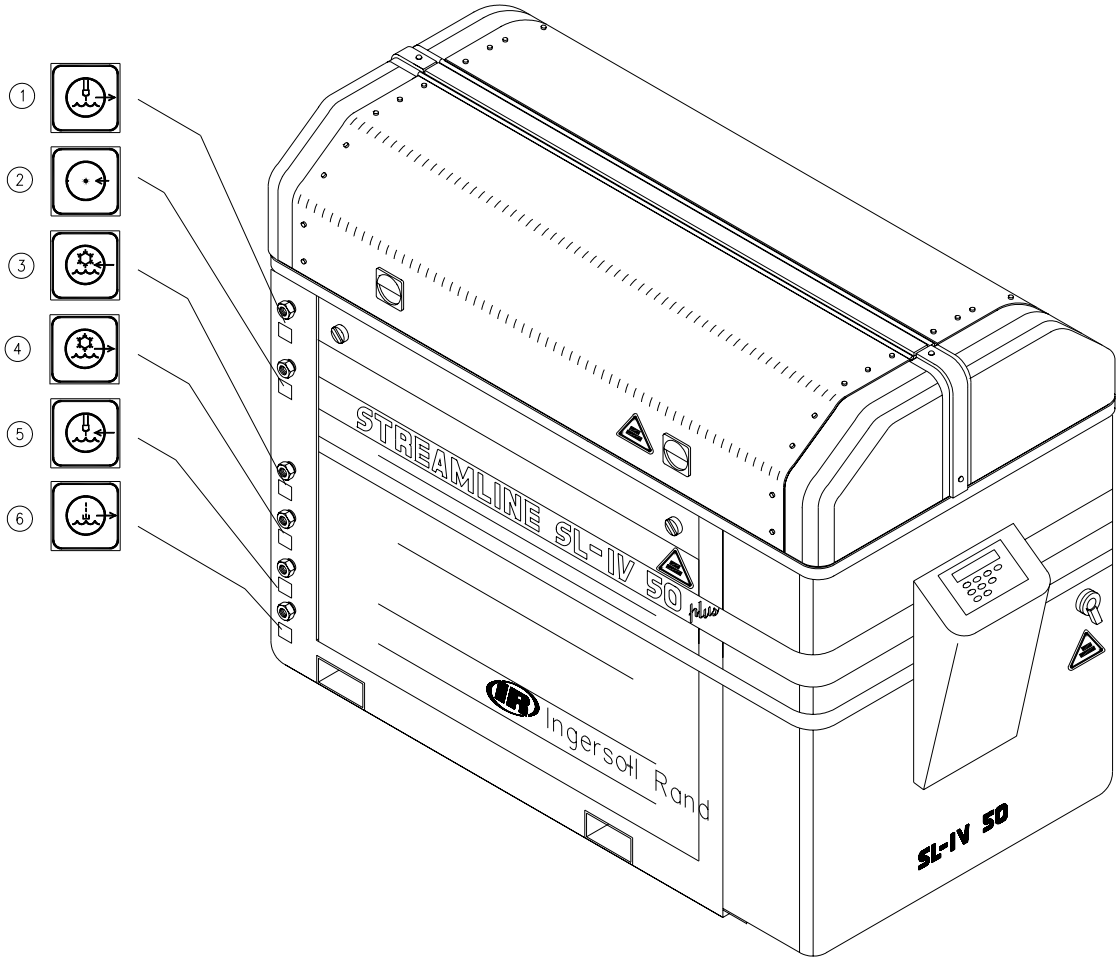
Cooling Water IN/OUT:
Supply plumbing must be properly sized to handle the necessary flow and pressure. Piping must meet national and local piping codes.
If municipal or well water is used for cooling, insure that the supply will flow a minimum of 3 gallons per minute at a minimum of 30 PSIG under maximum usage conditions.
If a facility-wide chilled water (active or evaporative tower) system is used for cooling, insure that there is a minimum of 30 PSIG pressure differential between the facility supply and the return (discharge) plumbing. Installation of an in-line pressure boosting pump may be necessary to provide adequate cooling flow.

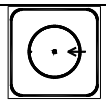
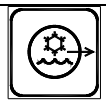
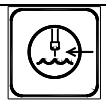
Cutting Water IN:
Supply piping must be properly sized to handle the necessary flow and pressure, and must be capable of providing a minimum of 30 psi at maximum flow demand to insure adequate supply to the intensifier. Piping must meet national and local piping codes.
Prior to operation, insure that the cutting water meets minimum standards listed in Section 11 "**Specifications**". Operation without proper water quality will shorten the life of certain intensifier parts and void their warranty.
Use only plastic or copper plumbing from the cutting water source to the SL-IV / PLUS pump cutting water supply filter.
Thoroughly purge the cutting water supply plumbing prior to connecting to the SL-IV / PLUS pump to avoid construction residue contaminating the pump.

HP Water OUT:
Properly rated, sized, and supported high pressure (HP) piping must be used to transport the high-pressure water from the SL-IV / PLUS pump to the point of use.
If new HP discharge piping is installed, all burrs that might come loose under high pressure must be carefully removed, and the tubing sections purged with compressed air prior to assembly. Further, it is strongly recommended that the HP piping be purged under high pressure operating conditions, using a large, cheap orifice. Contamination from the HP piping will be released when the tubing expands under pressure. If the HP piping is not purged, expect to have early HP valve and orifice failures.
All stainless steel parts should have High Purity Goop (P/N 49864887) applied to the threads and contact surfaces prior to assembly. Do NOT USE ANY OTHER ANTI-SEIZE COMPOUND. Failure to use High Purity Goop will result in galling of the parts, and will generally render them unusable. *Do not use High Purity Goop on ANYTHING but stainless steel*!

Drain:
Cutting water released in the activation of EMERGENCY STOP will be discharged from the intensifier drain port and must be piped to an appropriate location (i.e. sewer line). The volume of water released will be minimal, and will not require high-pressure plumbing. Piping must meet national and local piping codes.

Compressed Air:
The facility air connection to the SL-IV Pump should provide clean, dry air at 5,9 bar [85 PSIG]. Air usage is minimal and less than 1 SCFM.



Item	Symbol	Connection
1		HP Water "OUT" ..... 3/8" HP
2		Plant Air "IN" ..... ¼" NPT
3		Cooling Water "IN" ..... ½" NPT
4		Cooling Water "OUT" ..... ½" NPT
5		Cutting Water "IN" ..... ½" NPT
6		Drain ..... ½" NPT

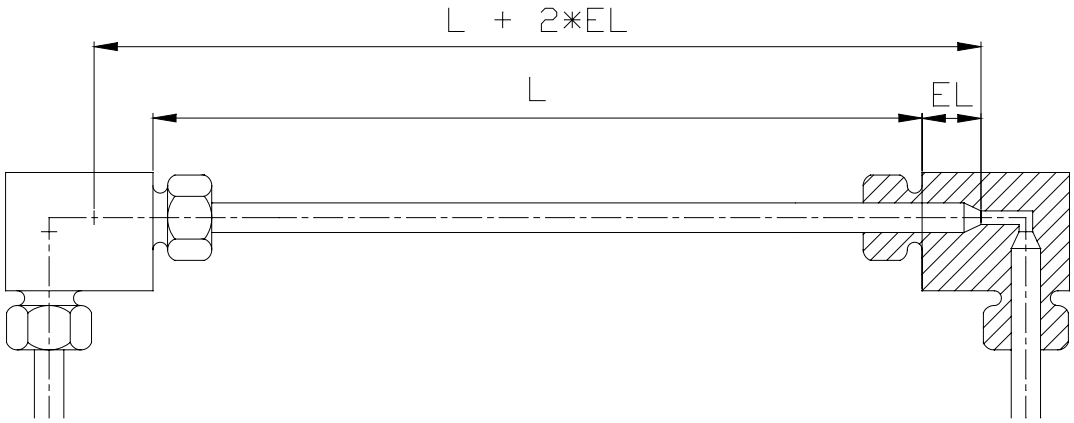
2.2.3 Tools and Equipment

2.2.3.1 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 result in component failure causing equipment damage, personal injury, or death.

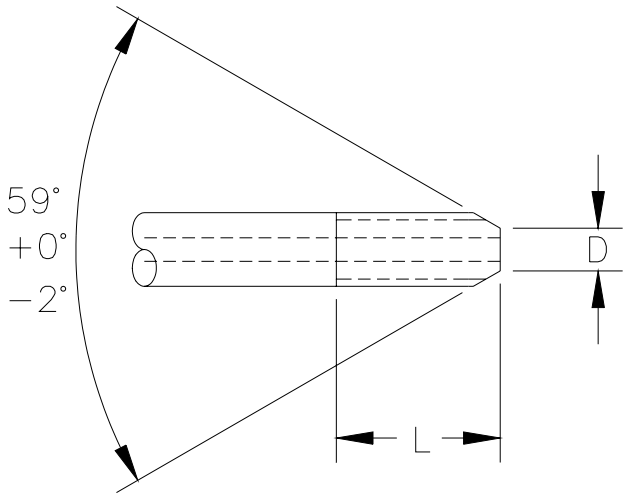


Tube Engagement Length

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.

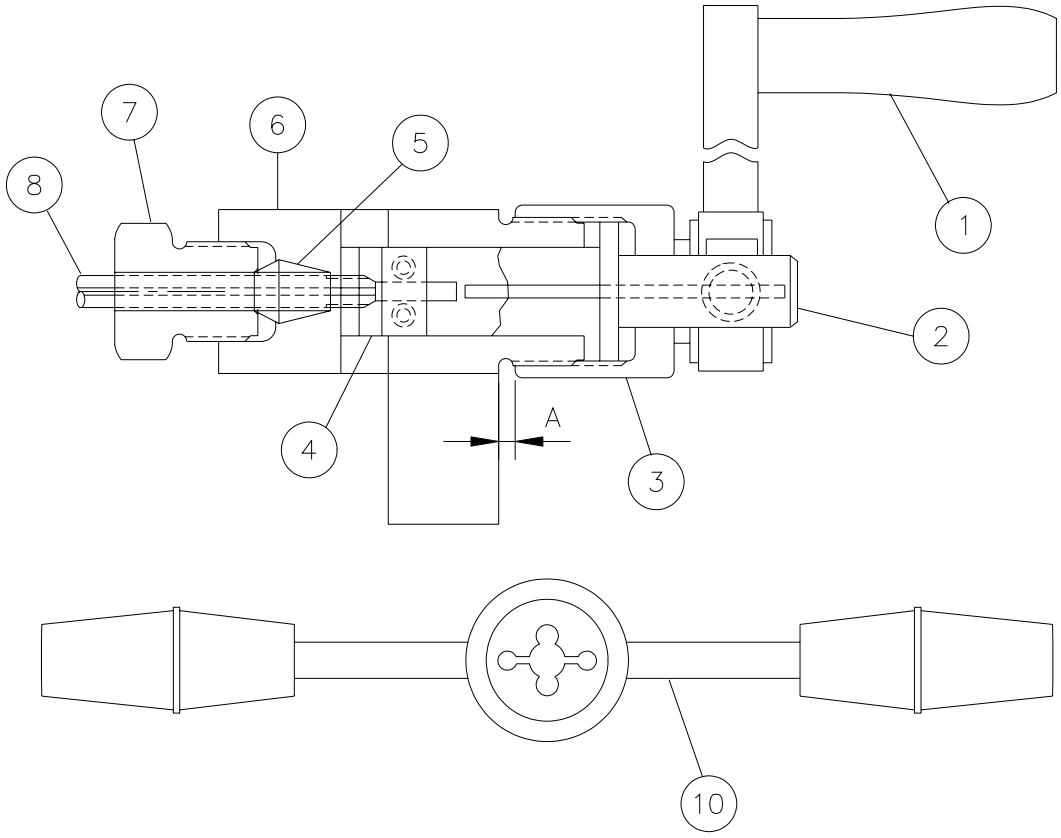


Cone and Thread Dimensions

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)

Cone and Threading Tool

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



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 (KMT Part)	10079556	10097418	10079663
Threading Tool (KMT Part)	10079697	10097434	10097442

Coning

- Place the appropriate size coning tool in a 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 firmly grip tubing.
- Turn feed nut (3) counterclockwise to back cutters away from tubing, and tighten gland nut (7) with wrench.
- Apply cutting oil through the opening in the coning tool. A medium weight cutting oil having high sulfur content is recommended. Use cutting oil freely throughout the cutting operation to prevent dulling the coning blade.
- 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 the end of the cone.
- Unscrew the 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) and then retighten the collet.

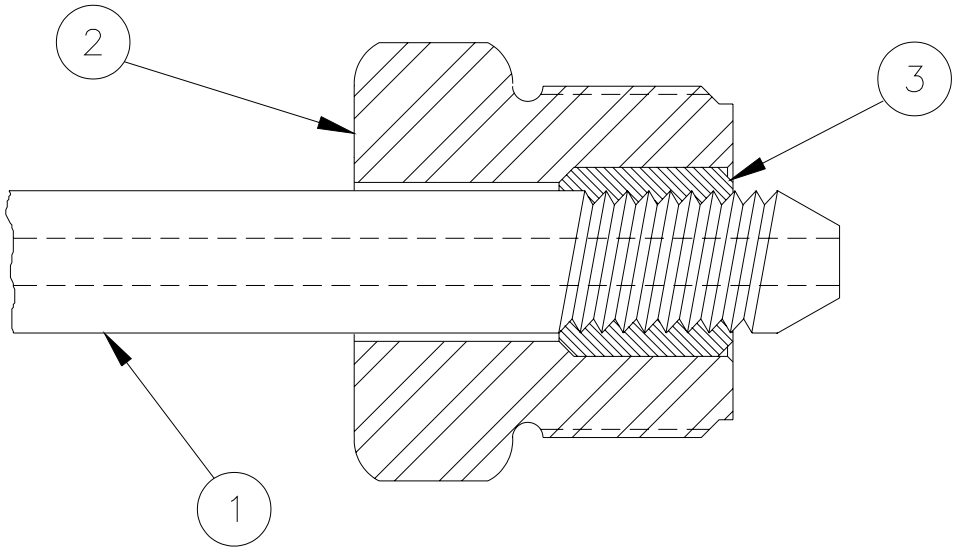
Threading

Place the appropriate sized threading tool on the coned end of the tubing, large end forward. Apply pressure to start the cutting action and rotate the die holder counterclockwise until the threads are cut per the 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 the gland nut (2) on the tubing (1) as shown and lubricate the threads with a light coat of High Purity Goop. Thread the collar (3) on the tubing until one to two threads are exposed between the collar (3) and the tube cone.
2. Lubricate the male threads of the gland nut with High Purity Goop. Insert the tubing assembly into the fitting, engage the gland nut and tighten finger-tight.
3. Tighten the gland nut to the specified torque given in the torque table.



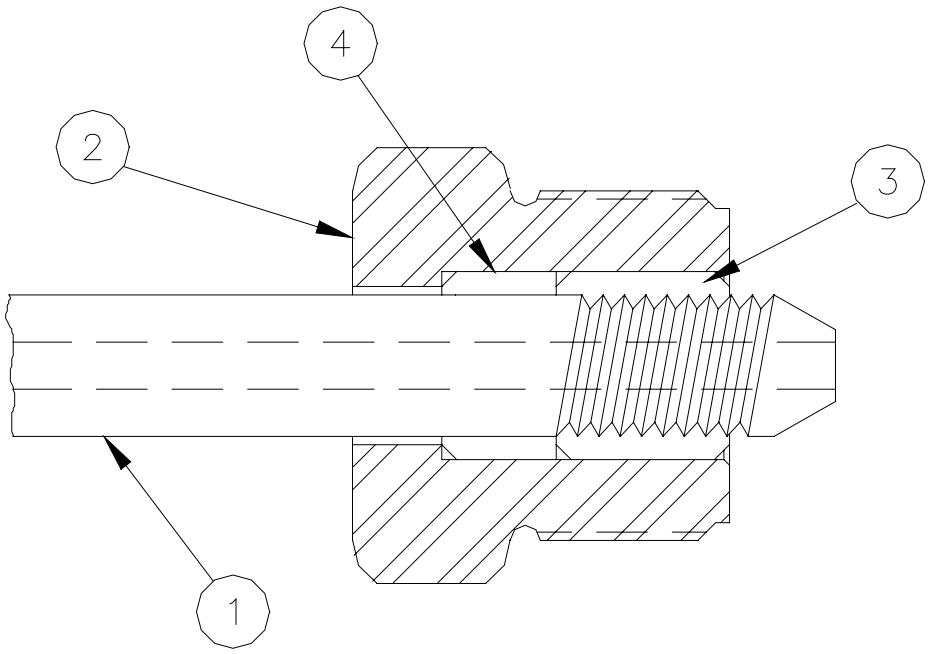
HP Tube End Connection - Antivibration

The following type of connection must be used when tubing will be 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 the tubing load alone. Proper piping support and guide must be provided.

⚠ WARNING Do not subject the tubing to torsional (rotational) stress. To do so will cause premature failure.

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



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Section 3 OPERATION

3 OPERATION

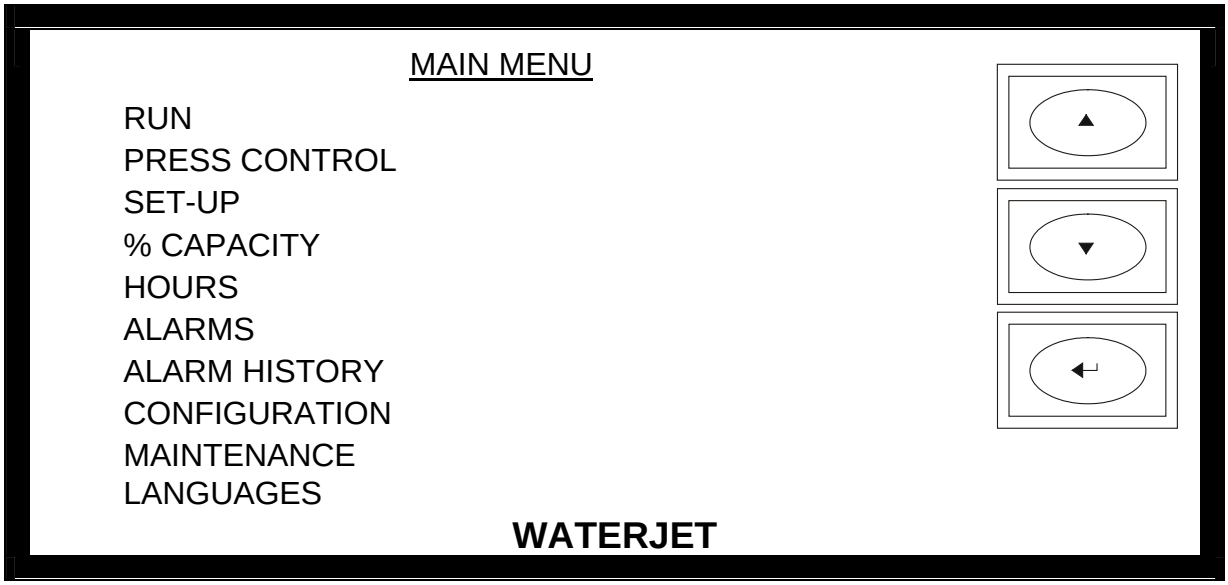
This section is devoted to an explanation of the SL-IV / PLUS control logic and operators interaction with it. The SL-IV / PLUS now has new, comprehensive fault detection and troubleshooting logic in the control, and allows operator control of the sensitivity of the overstroke detection in order to optimize the logic for specific operating conditions. The operator functions and warnings programmed in the control of this intensifier offers an unprecedented and comprehensive view of the operating parameters, impending faults, shutdown faults, and suggested remedies. The operator's interface is now through a touch sensitive control display on the control console where several menu screens can be selected for various purposes. The screens and their use are explained in this section. The pages following will explain the functions available in the control, how to select them and use them to your advantage. The SL-IV / PLUS Waterjet Pump is composed of the following systems:

Following is an explanation of the functions of the new control logic, including the revised start-up sequence.

- The intensifier is now equipped with a booster pump output pressure switch. Seven seconds after the intensifier is started, the switch is monitored. If the switch opens, a warning is issued (message and flashing red light). If the condition persists for 30 consecutive seconds, the intensifier is shut down.
- The intensifier is now equipped with an inlet cutting water pressure switch. If the switch is not closed, the intensifier will not start and a warning is issued (message and red flashing light). After the intensifier is started, if the switch opens, the same warning is issued. If the condition persists for 20 consecutive seconds, the intensifier is shut down.
- The intensifier is now equipped with separate total hour and maintenance hour meters for topworks (T/W) one and (T/W) two. The operator can reset both maintenance meters. Both total meters can be set to any value via a password protected configuration screen. Without access to this screen, the hour meters will not be reset or changed.
- The intensifier is now equipped with a maintenance function to allow the user to set the plunger in either the left or right position for ease of maintenance.
- Overstroke (no longer called Leak) shutdown level is adjustable between 30% and 120% of full capacity. The overstroke warning level is automatically set 10% below the shutdown level set by the operator. Overstroke warnings, pending shutdowns and shutdowns are issued in three types, left, right and T/W. A T/W warning or shutdown indicates that the topworks is shifting too fast in both directions and would point more towards a problem with the orifice or plumbing rather than check valves or seals. If a left or right shutdown occurs, the display tells the operator which parts are suspect. Sometimes, especially if the intensifier is running near full capacity to begin with, a T/W shutdown can be displayed when it is actually caused by a left or right fault. This can be diagnosed further by turning the operating pressure down and watching the Alarms screen, which displays all alarm occurrences.

- Real-time running capacity and stroke rate are shown on the display.
- A resettable stroke counter for both T/W one and T/W two are provided on the display.
- The part numbers for both the plc and display logic along with revision number running on the machine are shown on the Maintenance Screen.
- The plc now monitors the motor overload relay and displays a message when the overloads trip. The overloads will now be set on automatic reset rather than manual so the enclosure does not have to be opened to reset them.
- The display will give a message (motor feedback failure) if the motor output goes high and the motor does not start or if the motor is running and the motor output is not high.
- The start-up sequence will now be different depending on the circumstances.
    1. **Standard machine, start-up after machine has been E-stopped**: Safety dump valve will be open. It will close 3 seconds after the T/W begins stroking. The pump will be held in low pressure for 20 seconds after motor is started after which pressure will go to high if high is selected, otherwise will stay in low.
       The purpose for this is to allow entrapped air to be bled from any HP cylinder that has been maintained to avoid hot air burning the plunger seals.
    2. **Standard machine, start up after normal stop**: Safety dump valve will be closed, pump will be held in low pressure for 20 seconds after motor is started, after which the pressure will go to high if high is selected, otherwise will stay in low. The purpose for this is to allow entrapped air to be bled from any HP cylinder that has been maintained to avoid hot air burning the plunger seals.
    3. **Machine equipped with hp transducer, start up after E-stop**: same as (1) above.
    4. **Machine equipped with hp transducer, start up after normal stop**: If pressure is allowed to bleed through orifice to below 1000 psi, dump valve will open and start up will be like (1) above, if pressure is not allowed to bleed, start up will be as (2) above.
- The display screen will always default to the Run screen after being on any other screen more than 5 minutes.
- If the intensifier is equipped with a hp transducer, the displayed pressure can be shown in PSI or Bar. Recalibration of the transducer is automatic and does not require operator input.
- If the intensifier is equipped with a hp transducer, another level of overstroke protection is obtained by shutting down at the warning level if the pressure is less than 3000 psi.
- The display saves the last 100 shutdown messages, which can be viewed with times, dates and message contents.

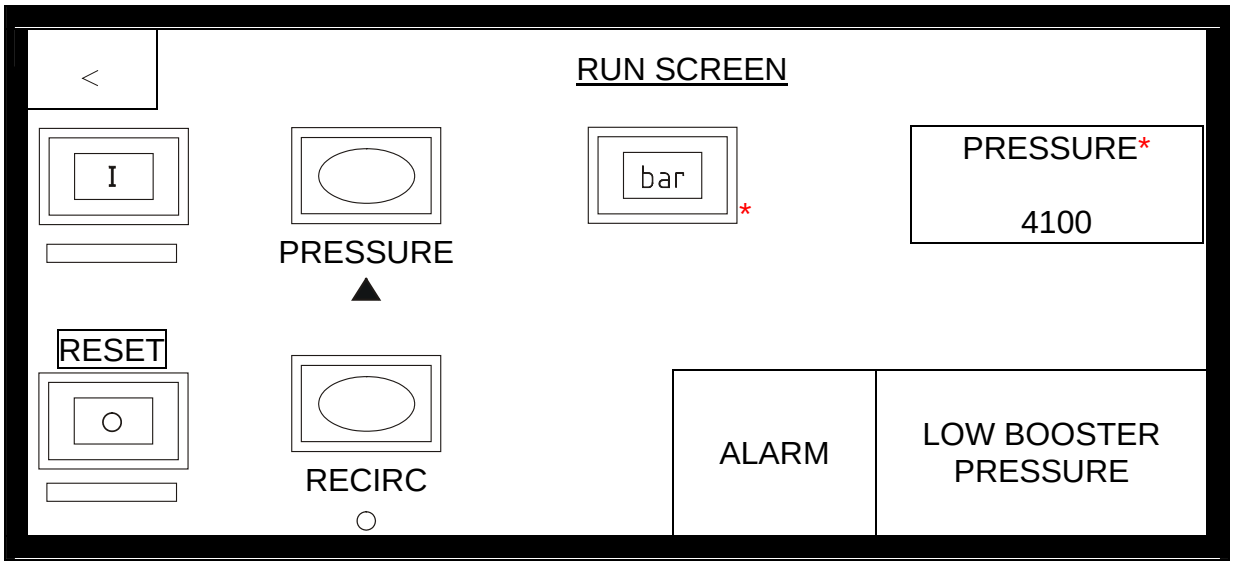
MAIN MENUE



MAIN MENU	Scroll up and down to page through the various screens and press ENTER to select desired screen.
RUN SCREEN	(2) Start, Stop, Recirc, High/Low pressure, alarm indication. Select PSI/BAR.
PRESSURE CONTROL	(2) Increment or decrement pressure setting – used only on machines equipped with analog pressure control.
SET-UP	(2) Displays PLC and Display logic part and revision number, water reset function, and idle shutdown function. With analog control installed, screen includes Transducer and Proportional Select buttons.
PERCENT CAPACITY	Set capacity, stroke count, select T/W 1 or 2.
HOUR METERS	Display total operating hours for TW 1 and 2, resettable maintenance hours.
ALARMS	Displays current alarms.
ALARM HISTORY	Displays time and date of alarms and keeps history of 100 past alarms.
CONFIGURATION	Secure screen used by manufacturer only.
MAINTENANCE	Jog left, Jog right, start recirc, stop.
LANGUAGE	Select Language.

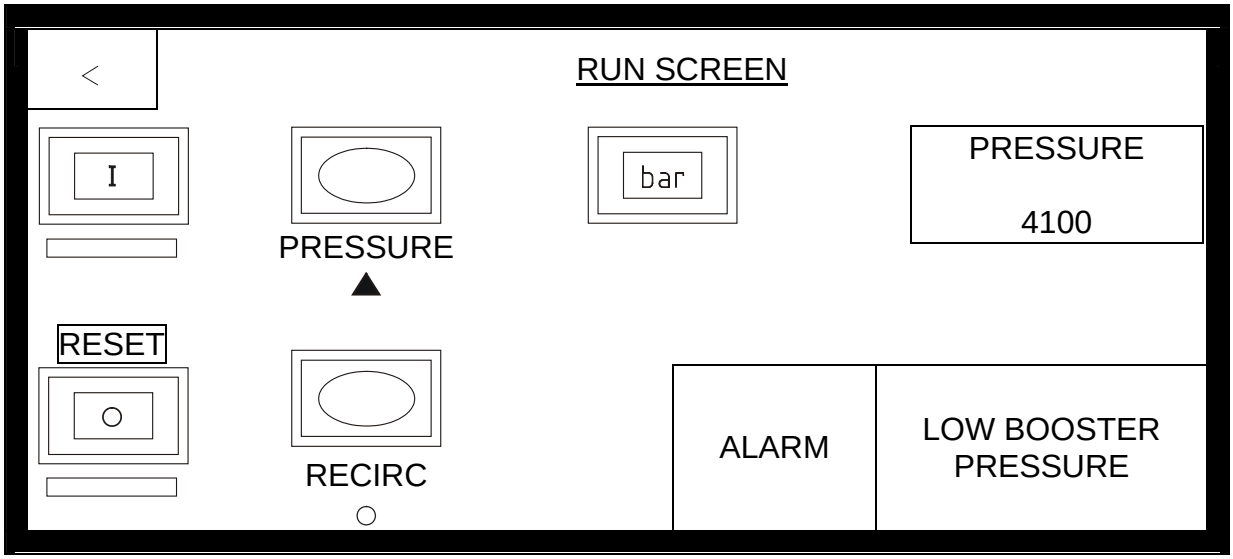
RUN SCREEN

THIS IS THE ONLY SCREEN WITH A MACHINE START FUNCTION



*In case no analog (pressure transducer or proportional valve) is installed on the machine, the display will not indicate any datas related to the operating pressure or pressure unit.

Ref.	Symbol	Description
START "I"	I	On all screens this indicates **start** or **on**
STOP "O"	O	On all screens this indicates **stop** or **off**
Pressure	Pressure #####	Indicates machine output pressure, either in Bar or PSI
BAR/PSI	bar	The BAR/PSI button toggles the display for Bar or PSI
Return	<	Returns to **Main Menu**
ALARM	ALARM	In alarm state, the **last** alarm sensed by machine will be displayed. Multiple alarms can be displayed on the alarm screen.
Start Bar	I	Will flash when the machine can be started
Stop Bar	O	Will flash when the machine is running. The machine can be stopped with this button



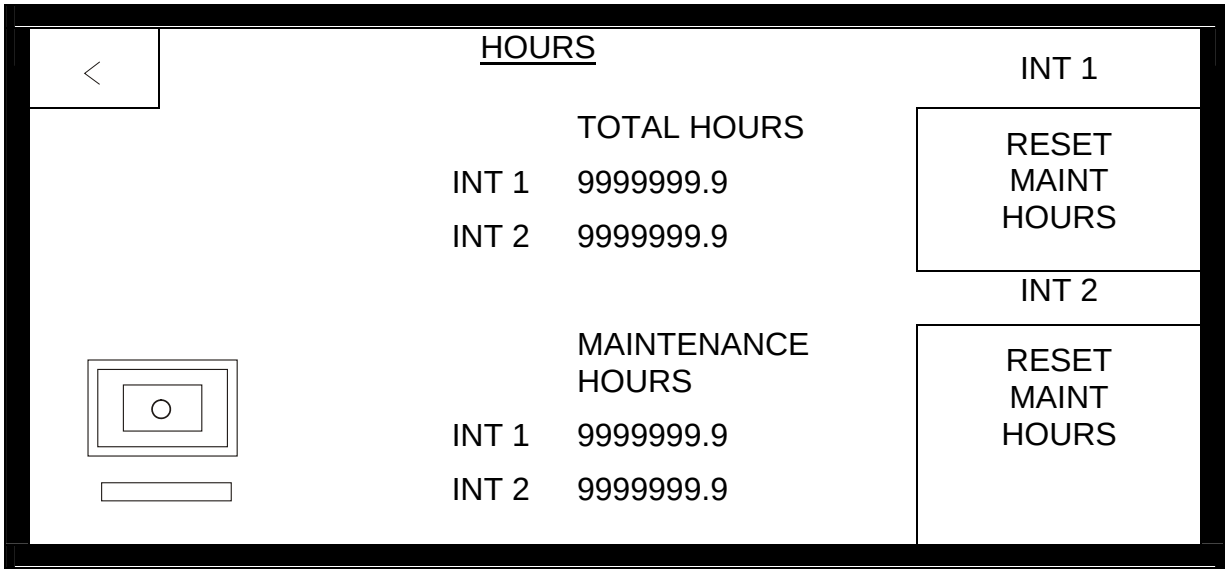
Ref.	Symbol	Description
Recirc	RECIRC O	Select this to toggle the recirculation mode on or off. The recirc mode runs the machine without generating high pressure, and is used to circulate the hydraulic oil through the heat exchanger to cool the oil following a high temperature shutdown. (I) indicates recirc on (O) Indicates recirc is off Stop Recirc with STOP button
High-Low Pressure Switch	PRESSURE ▲	Select high or low water pressure. (Machine always starts in low pressure.) Arrow indicates selected pressure following machine startup delay expiration
RESET	RESET	Indicates inlet water function must be reset. Reset by pressing STOP button

Run Screen ALARMS

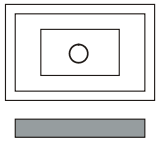
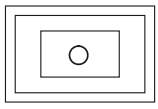
1. High Oil temperature – Indicates high hydraulic oil temperature.
2. High Pressure Warning – Indicates that output pressure is above 64000 PSI or 4413 BAR.
3. Booster Temperature High – Indicates booster pump water temperature is high and machine shutdown is pending.
4. Low Booster Pressure – Indicates that booster pump output pressure is inadequate for proper machine operation and shutdown is pending.
5. Low Inlet Water Pressure – indicates that cutting supply water pressure is inadequate to permit proper machine operation and shutdown is pending.
6. Bleed High Pressure Lines – Indicates that the intensifier is shut down and that high pressure is present in the discharge plumbing of the intensifier that should be bled off to avoid the possibility of injury.

7. Left/Right/TW Overstroke Warning and Shutdown Pending – Indicates an abnormal high stroke rate caused by an external or internal leak. If the condition persists, the machine will be shut down with an Overstroke Shutdown alarm.

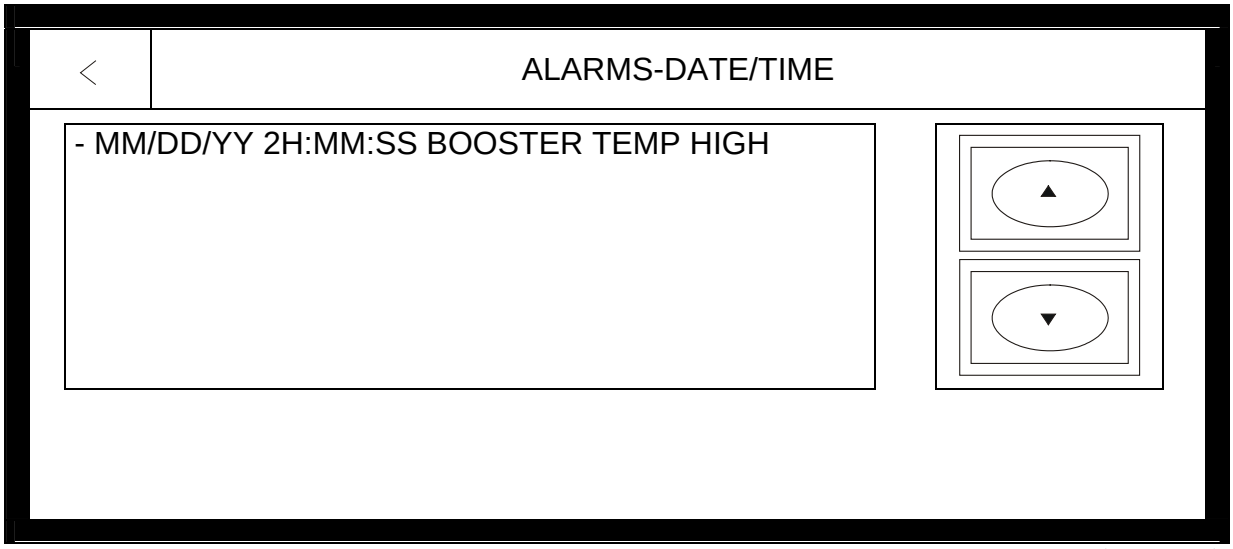
HOURS



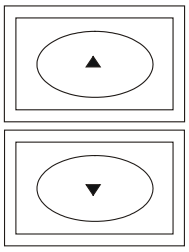
Machine <u>can</u> be <u>Stopped</u> from this screen.

Ref.	Symbol	Description
HOURS	TOTAL HOURS	This screen displays total machine hours*...
	MAINTENANCE HOURS	... and resettable maintenance hours to 9,999,999 for intensifiers 1 and 2
		Flashing bar indicates that the machine is on
TOTAL HOURS		... cannot be reset
MAINTENANCE HOURS		... on intensifiers 1 and 2 can be reset by pressing the RESET MAINT HOURS display button
Return	<	Returns to **Main Menu**

ALARM HISTORY SCREEN

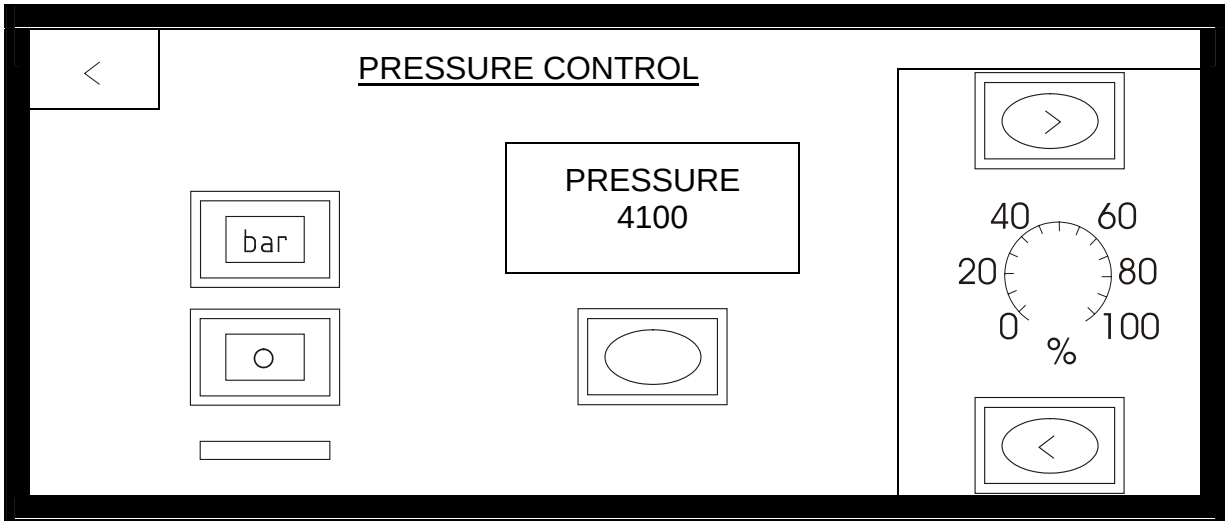


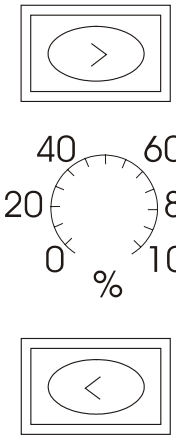
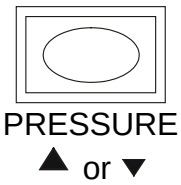
(EXAMPLE)

Ref.	Symbol	Description
		The alarm list stores the last 100 triggered alarms indicating date, time and type of alarm
		Scroll up and down to see alarm history
Return	<	Returns to **Main Menu**

The Alarm History Screen **does not have** an intensifier **STOP** function.

PRESSURE CONTROL SCREEN

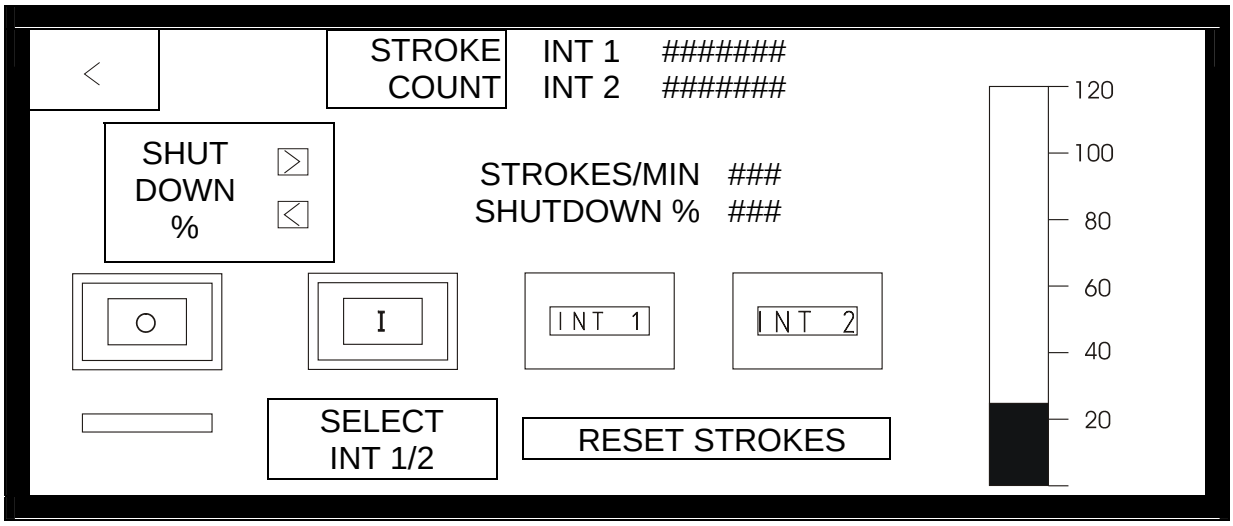


Ref.	Symbol	Description
SET PRESSURE		Set pressure to desired setting from 0 to 100 % in 1 % increments. RIGHT arrow to increase pressure, LEFT arrow to decrease pressure
HIGH/LOW PRESSURE		**HIGH/LOW** pressure switch and **UP/DOWN** arrow indicating high or low pressure also on this screen. The same function is on the **RUN** screen
Machine PRESSURE	PRESSURE 4100	… is also indicated on this screen in either PSI or BAR. Can be changed on PSI/BAR SELECT button. Same function is on the RUN screen. This function is only found on machines with a transducer installed
Return	<	Returns to **Main Menu**

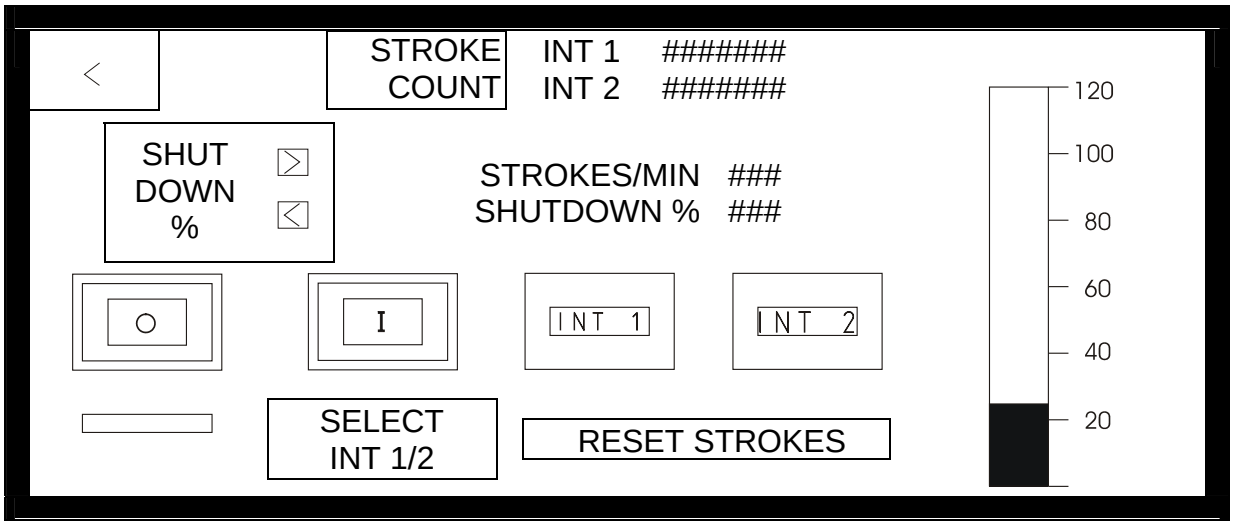
PRESSURE CONTROL SCREENS will not appear if analog module (pressure transducer and/or proportional valve) is not installed on the machine. If pressure control on main menu is selected and a proportional valve is not installed, a screen will appear indicating "**THIS UNIT IS NOT EQUIPPED WITH PROPORTIONAL CONTROL**".

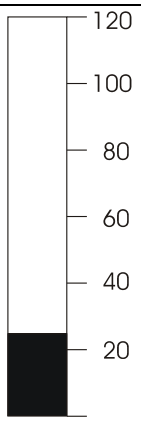
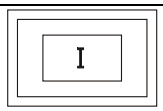
The **PRESSURE CONTROL SCREEN** that is required can be selected on the SET-UP SCREEN for the appropriate pressure control. Used if a proportional valve, a pressure transducer, or both are used on machine. These are the **TRANSDUCER SELECT** and **PROPORTIONAL SELECT** buttons on the **SET-UP SCREEN**.

PERCENT CAPACITY SCREEN

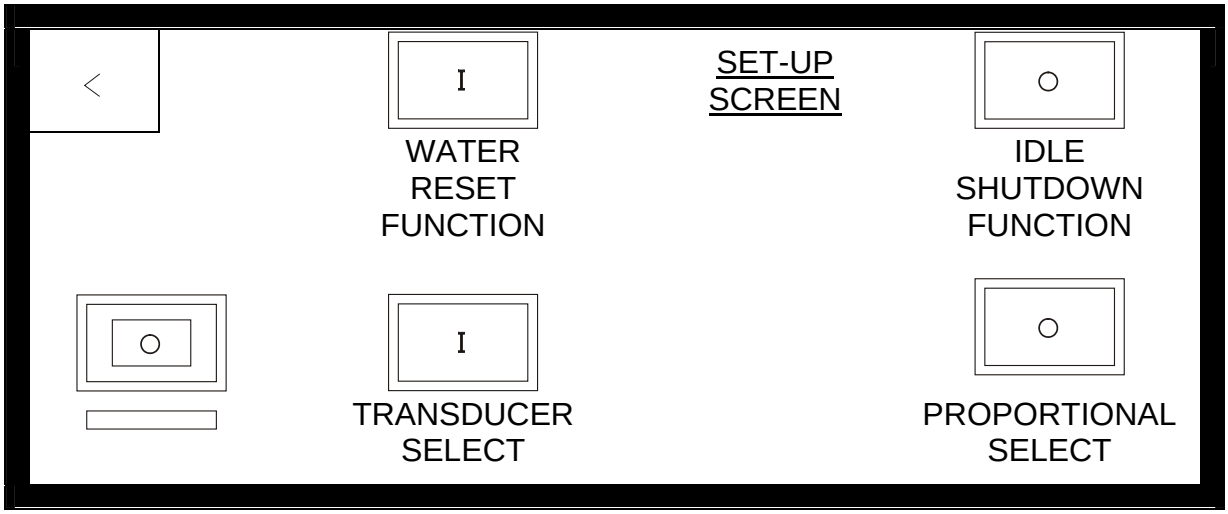


Ref.	Symbol	Description
RESET STROKES	INT 1	Press to reset intensifier one (1) stroke count
	INT 2	Press to reset intensifier two (2) stroke count
SHUTDOWN	SHUT DOW N %	Press UP and DOWN arrows to increment or decrement OVERSTROKE SETPOINT or OVERSTROKE SHUTDOWN. Because overstroke protection is related to stroke speed under actual pressure setting, this allows you to control sensitivity of the overstroke protection software for your particular operating pressure
STROKES/MIN	STROKES/MIN	... is actual stroke rate



Ref.	Symbol	Description
ACTUAL LOAD		The bar graph illustrates percent of capacity that the machine is presently running
SHUTDOWN %	SHUTDOWN %	... Set by using up/down keys. Set at 10% above running capacity to shutdown at operating conditions. Warning will be activated if less than 10 % below operating conditions
SELECT INTENSIFIER	 SELECT INT 1/2	SET INTENSIFIER 1/2 button to “2” on dual intensifier units, and to “1” on single intensifier units.
Return	<	Returns to **Main Menu**

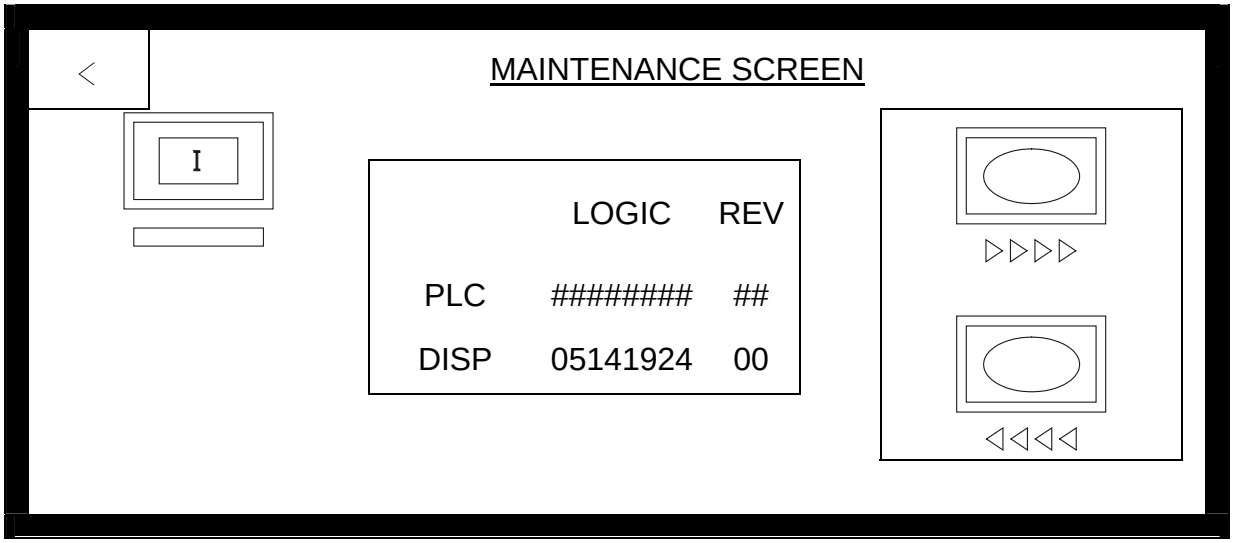
SET-UP SCREEN

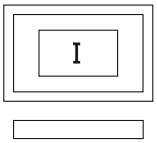
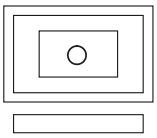
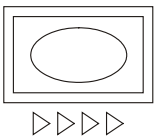
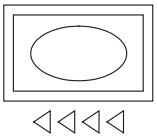


There are two **SET-UP SCREENS** – If analog pressure control is not installed on the machine, a screen will appear that does not include the **TRANSDUCER** and **PROPORTIONAL SELECT** buttons. These buttons are used only if a pressure transducer and/or a proportional valve are installed on the machine

Ref.	Symbol	Description
WATER RESET	WATER RESET FUNCTION	Press on (I) to shut water off five (5) minutes after machine shuts down. Selecting this function will insure that the inlet cutting water is shut off following a shutdown fault. This can prevent water from leaking past a damaged water seal following an overstroke shutdown caused by a seal failure.
IDLE SHUTDOWN	IDLE SHUTDOWN FUNCTION	Press on (I) to stop machine after 30 minutes of inactivity (machine not stroking). This feature saves energy by automatically shutting down the intensifier if it is not being used
PROPORTIONAL SELECT	PROPORTIONAL SELECT	… select if proportional valve is installed
TRANSDUCER SELECT	TRANSDUCER SELECT	… select if pressure transducer is installed
INDICATING PUMP CONDITION		Flashing bar indicates machine is on
STOP BUTTON		

MAINTENANCE SCREEN

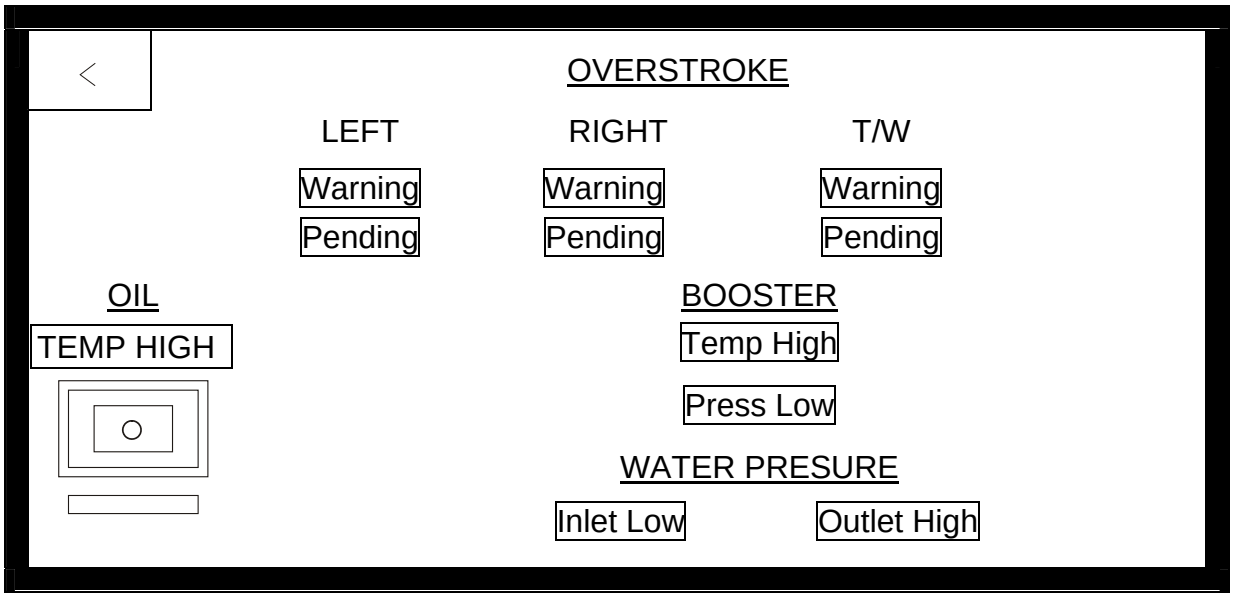


Recirculation		Start button will start unit in RECIRC mode and will open dump valve.
Stop		STOP button will stop unit.
Jog right		Jog right will extend piston to the right giving full exposure to the right plunger once the unit is disassembled.
Jog left		Jog left will extend piston to the left giving full exposure to the left plunger once the unit is disassembled.

CAUTION Unit must be completely assembled to use Jog functions.

ALARM SCREEN

In **ALARM** condition, message/alarm will flash. Message will not be visible if alarm condition does not exist.



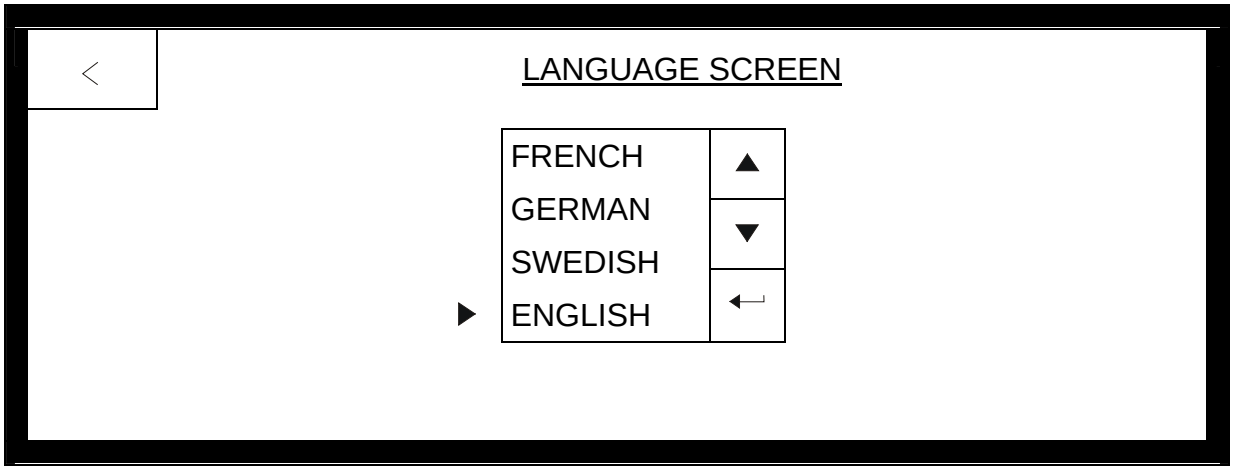
Ref.	Symbol	Description
OIL Temperature	OIL TEMP HIGH	Indicates high oil temperature. High oil temperature will shut the machine off 60 seconds after detection of this alarm condition
OIL Level		Low oil level will immediately shut the machine off. This alarm will appear on the **ALARM BANNER**
BOOSTER PRESSURE LOW	BOOSTER PRESS LOW	Alarm indicates low booster pump output pressure. Low booster pressure will shut down the machine 40 seconds after alarm condition is detected
Booster Teperature	Temp High	Alarm indicates high booster pump temperature. The machine will shut down 30 seconds after this alarm condition is detected
Booster Inlet Pressure	Inlet Low	**INLET LOW** alarm indicates low booster outlet water pressure. The machine will be shut off if the condition persists for 30 seconds
HP Outlet Pressure	Outlet High	**OUTLET HIGH** alarm indicates excessively high discharge water pressure. This alarm is available only if a pressure transducer is installed on the machine
Overstroke	OVERSTROKE	Alarms indicate overstroke conditions. First a WARNING, then a PENDING SHUTDOWN alarm will occur. If condition persists the machine will SHUTDOWN due to overstroke. This shutdown condition is indicated on the **ALARM BANNER**

NO PRESSURE CONTROL

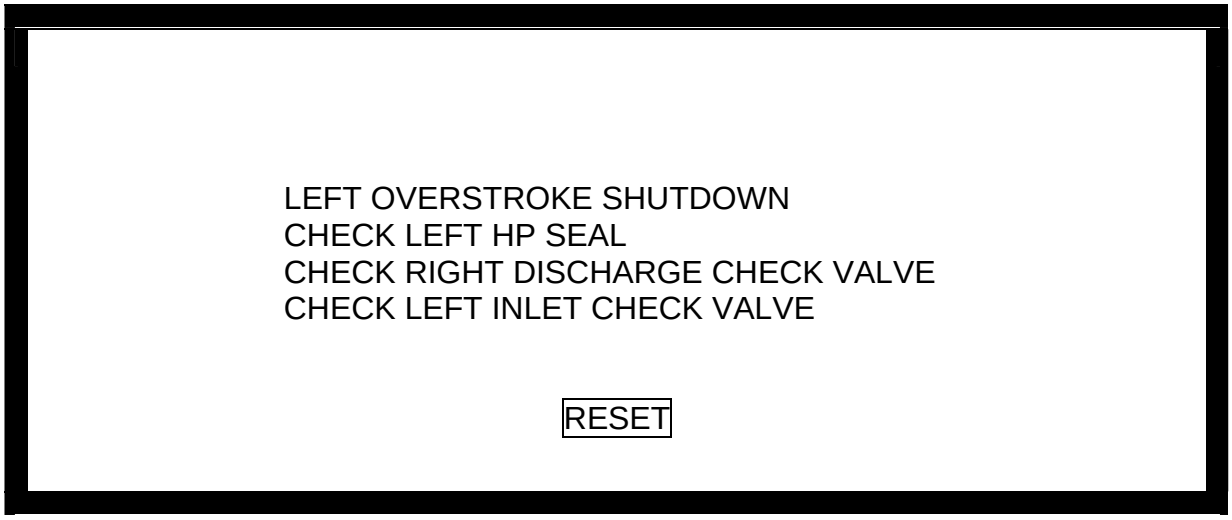
This screen will appear if the pressure control on main menu is selected and machine does not have PROPORTIONAL control.

The machine cannot be stopped from this screen.

LANGUAGE



Scroll up and down for desired language and press ENTER ↵ to select FRENCH, GERMAN, ITALIAN, SWEDISH, or ENGLISH.



⚠ CAUTION To reset the alarm does not mean that the alarm condition has been cleared.
Recommended action must happen!

- When a shut-down condition occurs, an ALARM BANNER will appear hiding the current screen. The ALARM BANNER will display the type of shutdown and remedy to clear the alarm.
- Pressing the reset button will clear the ALARM BANNER but does not clear the alarm. The banner will continue to appear until the alarm condition is cleared.
- Shutdowns will appear on ALARM HISTORY SCREEN.
- The ALARM BANNER shutdowns are:

Banner Message	Required Action
Motor Overload	check incoming voltage, check overload relay setting
Motor Feedback Failure	Check motor starter relay
Oil Level Low	Check the oil level gauge on the reservoir, check for leaks
Oil Temp High	Check cooling water flow with a flow meter
Low Booster Pressure	Check the booster pressure adjustment and check booster condition
Low Inlet Water Pressure	Check water supply pressure at maximum flow rate
Long Idle Time Shutdown	May be selected for energy saving
Overstroke Shutdown	Check plumbing for leaks, check HP orifice, check for leaking HP check valves

Banner Message	Required Action
Booster Temp High	Check incoming water temperature, check for long idle time
Left Overstroke Shutdown	Check left high-pressure seal, check right discharge check valve and check left inlet check valve
Right Overstroke Shutdown	Check right high-pressure seal, check left discharge check valve and check right inlet check valve
T/W Overstroke Shutdown	Check plumbing for leaks, check for long idle time

Section 4 MAINTENANCE

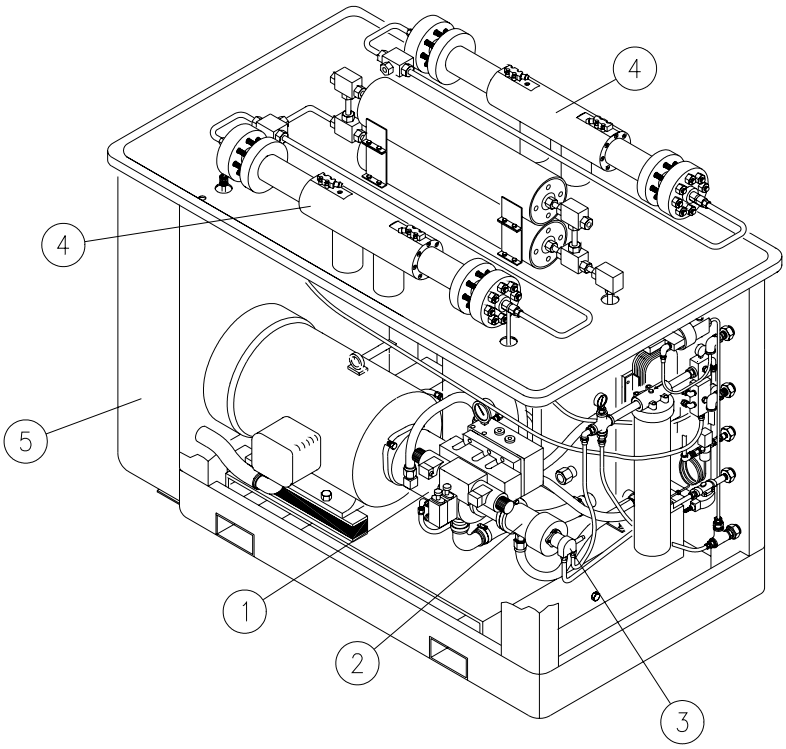
4 Maintenance

This section provides an overview of scheduled and preventive maintenance. In addition, maintenance of the five systems shown below is described in the 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** System – including electric motor, pump and hydraulic valve manifold block. The pump is a variable displacement, axial piston, pressure compensated type.
- **Oil Recirculation System** – including a fixed displacement gear –gear pump, oil to water heat exchanger, hydraulic cartridge type oil filter, and related hydraulic hoses and fittings. The gear pump mounts to the back of the ·main hydraulic pump. This system is separate from the main hydraulic circuit and cleans and cools the hydraulic fluid whenever the main pump is running..
- **Booster Pump System** – includes a stainless steel positive displacement vane pump with pressure adjustment and high temperature switch, low pressure water filter, bypass relief valve, and associated water tubing and fittings. The booster pump is mounted to the back of the oil recirculation gear pump.
- **Intensifier System** – includes one or two high-pressure (HP) attenuators, one or two hydraulic intensifier assemblies , a HP dump valve and associated HP piping and fittings.



Item Description

(1) Hydraulic Pump	(2) Recirculation Pump	(3) Booster 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]	Other
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						
Tempera-ture 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[2]	
	Hydraulic Filter	Hydraulic Oil Tank	X	X				R		
Vibrations-Rotating Equip.	Electric Motor					F				
	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 Manifold	Hydraulic Intensifier				F				
	Control Panel	Electrical Enclosure				F				
	Gage Calibration	Hydraulic Pump & HP Piping				F				
Control Lights			X							
Hydraulic Piston	Seal & Wear Rings	Intensifier Hydraulic Cylinder								R[3]

Key:

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

[1] Yearly or 4,000 hours, whichever comes first.
[2] Manufacturer recommends motor bearings to be lubed at 12,000-hour intervals.
[3] Recommended Overhaul Interval: 10,000 hours.

4.2 General Maintenance

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

⚠ CAUTION 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.
- Keep a repair log of all maintenance performed.

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 KMT Waterjet 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.
- Perform all lockout and tagout procedures prior to working on the intensifier.
- 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 (KMT Part 49864887), 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 Systems.
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
Auf der Laukert 11
D–61231 Bad Nauheim
Germany

Phone: + 49–(0)6032–997–115
Fax: +49–(0)6032–997–270
E-Mail: order.spares@kmt-waterjet.com

Section 5 TROUBLESHOOTING

5 TROUBLESHOOTING

5.1 TROUBLESHOOTING - Electrical

Condition & Possible Causes	*Corrective Action*
SL-IV Pump Will Not Start	
E-STOP Button Depressed	Pull out E-STOP button. Check all remote E-STOP pushbuttons. 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.
Motor Overload Relay Tripped	Find reason for overload. Reset overload relay.
Protection Fault Activated	Check LOW OIL LEVEL, HIGH OIL TEMPERATURE, OVERSTROKE CONDITION, or HIGH TEMPERATURE BOOSTER PUMP (bold letters indicate display messages)
Inlet Water Valve Turned Off	Reset water valve by pressing RESET on Run menu.
Console Display and Lights Fail to Illuminate	
E-STOP Button Depressed	Pull out E-STOP button. Check all remote E-STOP pushbuttons. 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, OVERSTROKE 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.
No Control Power (24vdc)	
E-stop Button Depressed	Pull out E-stop button. Check all remote E-stop pushbuttons
Control Power On Button	Check for voltage through switch when button is pushed.
MCR Relay Not Energized	Check to see if coil is pulling in on the master control relay (MCR)
MCR Contact Set Failure	Check to see if contact sets on MCR are changing state when MCR is energized.
Flashing Light, Message On Operator's Console	
Condition and Possible Causes	*Corrective Action*
Overstroke	Check for HP piping leaks. Check for HP seal leak.Check air pressure. Check booster pump pressure. 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 orifice condition, and proper diameter.
OIL TEMP	Verify hydraulic oil tank temperature is above 620C (1440F). Check output pressure of oil recirculation pump. 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. If reservoir is full, check oil level switch.
Booster Pump Hot	Check if booster pump temperature is above 530C (1280F).Check cutting water flow to/from booster pump.Check water bypass orifice. Check excessive time in deadheaded condition. Check booster pump temperature switch.

5.2 TROUBLESHOOTING – HP WATER

HP Water Signal Abnormal Fluctuation

Orifice Large/ Worn/ Damaged	Check that orifices in use do not exceed capacity of pump. Check that orifices are in good working order. rify that a jewel is not missing from the orifice mount.
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 and sealing head seals.
Hydraulic Control Malfunction	Check hydraulic valve operation. Verify proper shifting of 4-way directional control valve. Verify proper proximity switch operation.
Check Cutting Water Supply	Pressure of cutting water supply to intensifier should be at least 2 bar (30 psi).

Hot Surfaces On HP Cylinder Components

HP Discharge Check Leaking	Inspect check valve seat, poppet, spring, and spring guide condition and sealing head.
LP Inlet Check Valve Leaking	Inspect check valve poppet, spring, o-ring, poppet retaining screw, and sealing head.
Sealing Head or Plunger	Check plunger and sealing head for erosion scratches or mechanical damage and replace if necessary.
Damaged HP Cylinder	Check cylinder bore 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 and back-up ring for leakage. Check proximity switch and spacer O-ring area for oil leakage. Replace hydraulic seal (cartridge) and clean holes in hydraulic seal retaining flange.

Oil or Water Leaks from HP Cylinder Weep Holes		
	Water Leak at HP Plunger Seal	Replace seal assembly if leak exceeds one drop in 10 strokes. Check plunger surface and cylinder bore for build-up of seal material and polish off with 600 emery cloth, polishing the cylinder circumferential and plunger any direction Check Plunger surface and cylinder bore for scratches circumferential and longitudinal, if any are found, contact KMT for possible rework and polishing. Check plunger for dull finish, contact KMT for polishing.
	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.
HP Check Valve Leak		
		If there are no visible HP water leaks, but there are higher temperatures on HP cylinder or sealing head, this indicates a HP or LP check valve leak. Use corrective action listed in section "PROCEDURE – HP WATER CHECK VALVE TROUBLE SHOOTING" for both discharge and inlet checks:
Normal Temperature, but Check Valve Problem		
	Low Hydraulic Pressure Setting	Follow the instructions for HP check valve leak described in section "PROCEDURE – HP WATER CHECK VALVE TROUBLE SHOOTING"
HP Cutting Water Too Low		
	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. Check HP line filter for collapsed element.
	Air Trapped	Bleed air from cutting water plumbing.

5.3 TROUBLESHOOTING – LP WATER

Low Booster Pump Pressure	
Booster pump pressure below 5 bar (70 psi)	If at anytime the pump is running and the booster pump pressure falls below 5 bar (70 psi), adjust the relief valve clockwise to increase the pressure above 5 bar (70 psi). If the booster pump pressure cannot be adjusted above 5 bar (70 psi), replace the booster pump.
Booster pump pressure above 8,5 bar (125 psi)	If at anytime the pump is running and the booster pump pressure is above 8,5 bar (125 psi), the relief valve is opening up and sending water to the drain.
Hot Hydraulic Oil	
Restricted or No Cooling Flow	Check cooling water flow to and from heat exchanger. The water pressure differential across the heat exchanger, 2.75 bar (40 psi) minimum required for flow through the exchanger. Check operation and setting of water modulating valve.
Water Modulating Valve Setting	Check and adjust setting of water modulating valve. Compressing spring (clockwise) slows water flow and increases temp; reducing spring tension (counterclockwise) increases water flow and lowers oil temp.
Heat Exchanger Clogged	Flush heat exchanger, improve flow of cooling water or replace heat exchanger.
Recirculation Pump Hydraulic Pressure below 1,5 bar (20psi)	Replace hydraulic oil filter.If filter is new, replace recirculation pump.
Hydraulic Pressure but no High Pressure Water Pressure	
Proximity switch failure	Verify left hand and right hand LED lights on DC alternately illuminate ON/OFF. If so, both proximity switches are properly functioning. If both the green and red LED lights are on at the same time on one proximity switch, replace the proximity switch. Flag the proximity switches one at a time, checking to see if it is sending a signal to the PLC.
Hydraulic Pressure but no High Pressure Water Pressure	
I/O relay failure	Check if PLC output is shifting the I/O output relays and allowing power to go to the coils on the directional valve.
Directional valve coil failure	Check coils on the directional valve with a volt meter to verify good or bad

Hydraulic Pressure but no High Pressure Water Pressure	
PLC failure	If there are inputs from the proximity switches but no outputs, contact KMT service for a logic review and verification of PLC failure.

5.4 SPECIAL PROCEDURE—HP WATER CHECK VALVE TROUBLESHOOTING

5.4.1 HP Check Valve Troubleshooting

A leaking HP check valve is suspected if either HP cylinder or sealing head is unusually hot. Compare temperatures of opposing sealing heads or HP cylinders to decide location of hot spot. Note any heat in LP water ring or hose fitting attached to LP water ring.

5.4.2 OUTLET HP Check Valve – Troubleshooting

NOTE
An alternative approach is to switch the HI/LO hydraulic pressure control switch to LO pressure, which should slow the stroke rate enough to hear a difference in plunger motion between HP cylinders. Study the LED's on the HP cylinders to decide in which direction the hydraulic piston is moving rapidly, then decide which pair of INLET and OUTLET check valves are suspect.

1. Start KMT pump. Set HP water to above 45,000 psi.
2. Close HP water nozzle valve (deadhead KMT pump)
3. Note pressure indication on HP water pressure gage.
4. Turn KMT pump OFF, allowing HP water to remain trapped in HP piping and HP attenuator.
5. Wait approximately 60 seconds to see if HP water pressure "bleeds" down
6. If gage pressure "bleeds" downward, then one of the HP OUTLET check valves is the likely leak path.

NOTE
If the HP water nozzle valve is leaking, or if HP leaks exist elsewhere in the HP water manifold, then the above test is less valid.

If the "bleed-down" test shows a leaking OUTLET HP water check valve, and if one HP cylinder or sealing head is noticeably warmer than the other, then the OUTLET check valve in that hot sealing head is probably leaking. If this OUTLET HP check valve is not the problem, then continue to troubleshoot the INLET cutting water check valves.

Note that cutting water entering the sealing head through the LP water ring is normally cool. Any heat in the LP water near a sealing head is an indication of HP water escaping from the HP cylinder back through the INLET cutting water check valve.

5.4.3 INLET Cutting Water Check Valve – Troubleshooting

NOTE
An alternative approach is to switch the HI/LO hydraulic pressure control switch to LO pressure, which should slow the stroke rate enough to hear a difference in plunger motion between HP cylinders. Study the LED's on the HP cylinders to decide in which direction the hydraulic piston is moving rapidly, then decide which pair of INLET and OUTLET check valves are suspect.

1. With KMT intensifer pump turned OFF, close a HP hand valve located in the HP piping manifold between the KMT pump and the cutting station.
2. Open this HP hand valve approximately one turn.
3. Start KMT intensifier pump, switch or adjust pressure to high pressure (greater than 45,000 psi), then open HP nozzle valve.
4. Without closing the HP hand valve, slowly turn hand valve handle in the CLOSE direction, until a difference in stroke rate, i.e., a short stroke in one direction, alternating with a long stroke in the opposite direction is noticeable.

NOTE
Do not close the HP hand valve, but rather leave it at the metered position giving the SHORT / LONG / SHORT / LONG stroking sequence.

5. Observe LED lights on the hydraulic directional control valve (located above the main hydraulic pump). Identify whether the left hand (LH) or right hand (RH) LED light corresponds with the short stroke established in Step 4 above.
6. If, e.g., the LH LED indicates short stroking in that direction, then either the leak is in the RH INLET cutting water check valve or the LH OUTLET HP water check valve.
7. Conversely, if the RH LED indicates short stroking in the Right Hand HP cylinder, either the LH INLET cutting water check valve or the RH OUTLET HP water check valve is at fault.
8. Combining the results of the dead head/ bleed down test described in paragraph 5.5.2 above with the short stroke test described in steps 4 and 5 above, determine which HP cylinder (LH or RH) HP OUTLET check valve is at fault.

NOTE
The bolted flange / metal-to-metal seal arrangement of the SL-IV / SL-IV sealing head make the INLET check valves much more difficult to access for maintenance than the HP OUTLET check valves. Therefore one should generally rule out problems with the OUTLET HP check valves prior to disassembling the INLET check valves.

Section 6 LOW PRESSURE WATER SYSTEM

6 LOW PRESSURE WATER SYSTEM - Features

The SL-IV 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 two (2) HP cylinders.
- 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. Refer to Figure 6.1 for a schematic diagram of the oil cooling water circuit.

See "**Recirculation System**" Section 10.2 for details on adjustment of water modulating valve (2).

The maximum flow rate of the cooling water is specified in Section 11 "**Specifications**" under "Hydraulic Oil Cooling." A minimum inlet pressure of 2.8 bar (40 psig) and 21 deg C (70^0 Fahrenheit) maximum inlet temperature is required to maintain oil temperature under extreme operating conditions.

6.2 Cutting Water Supply

Refer to Figure 6.2 for a schematic diagram of the LP cutting The cutting water supply circuit. Refer to the Parts Lists (Section 12) for detailed component information on the LP cutting water circuit. The LP water supply includes the following:

- Low pressure water filter
- Inlet water shutoff valve (solenoid operated)
- Booster pump driven by main motor

Several pressure gages and switches, and a temperature switch.

Most components in the LP cutting water supply circuit are stainless steel or neoprene or other plastic. A stainless steel inlet solenoid shutoff valve (11) is available on request. Pressure and temperature switches are connected to a PLC located in the electrical enclosure. The PLC which monitors out-of-tolerance conditions, including the following:

- Low water pressure at the booster pump inlet [switch (17)].
- Low water pressure at the intensifier inlet [switch (16)].
- High temperature at the booster pump outlet [switch (2)].
- If the motor does not run for 2 minutes, the solenoid valve (11) will shut off. To re-open the valve, select RUN SCREEN.

Note that pressure gages are installed in a frame leg for easy access. Pressure gages provide a qualitative measure of LP water system performance, while pressure switches provide automatic shutdown protection against out of tolerance conditions.

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)
- Booster pump inlet pressure: min 2,5 bar / 35 psi, max. 5 bar / 73 psi. Important: inlet pressure must be constant.
- Booster pump discharge pressure gage reading 8.0-8.3 bar (115-120 psi)
- Intensifier LP cutting water supply pressure greater than 4 bar (60 psi).
- Water at booster pump outlet maintained at less than 53,3 °C / 128 deg-F.

NOTE
While the intensifier assembly reverses direction, the booster 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 booster pump performance.

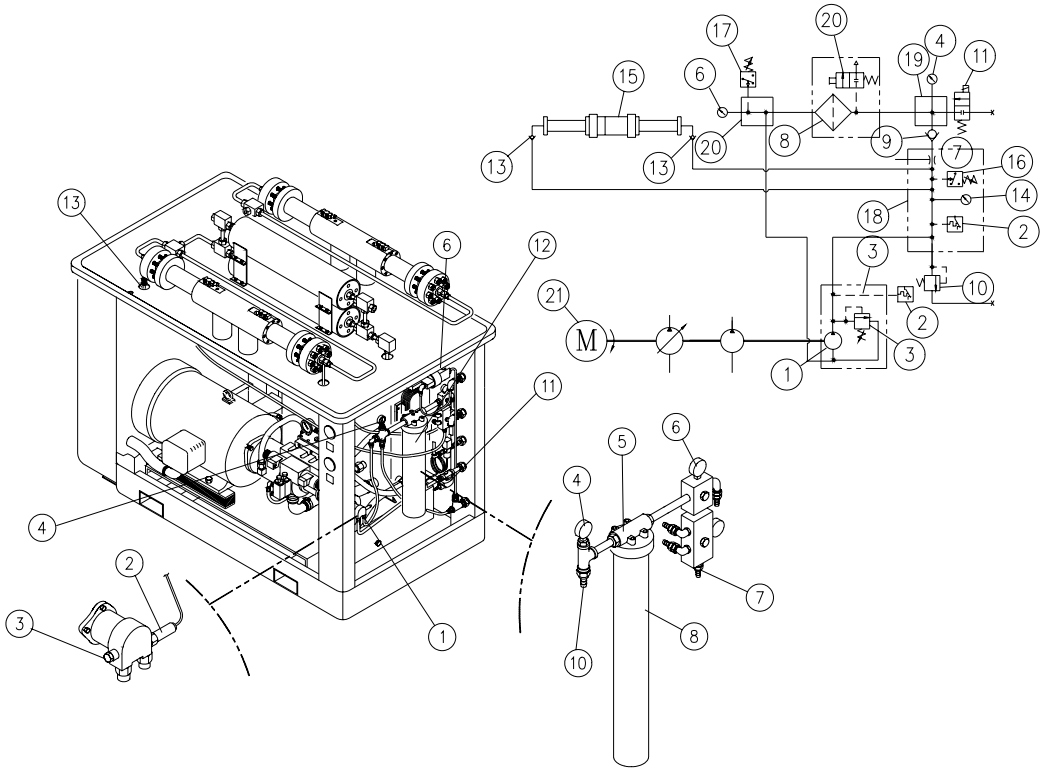
6.2.2 Operation

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 through filter assembly (5), then to the inlet of the booster pump (1). The booster pump increases cutting water supply pressure to 8 bar (120 psi) to assure proper supply to both intensifier inlet check valves (13). Pressurized water from the booster pump is supplied to manifold (18). From this manifold, cutting water is routed to the inlet check valves (13) of the intensifier. Note that if

NOTE a redundant intensifier is installed, the inlet cutting water must be manually disconnected from the inactive intensifier, then connected to the inlet check valves of the inactive intensifier.

NOTE
The booster 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 LP water filter (5) is located ahead of the booster pump to protect the pump as well as the intensifier and other HP components. 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.



Item Description

1	Booster Pump
2	Temperature Sensor
3	Pressure Control Valve
4	Pressure Gage
5	Filter Head
6	Pressure Gage
7	Orifice
8	Filter Element
9	Check Valve
10	Relief Valve
11	Inlet Solenoid Valve
12	Filter Housing
13	Intens. Inlet check Valve (2 ea)
14	Pressure Gage
15	Intensifier
16	Pressure Switch (60 psi)
17	Pressure Switch (30 psi)
18	Manifold, LP Water
19	Relief Valve
20	Air Bleed Valve
21	Electric Motor

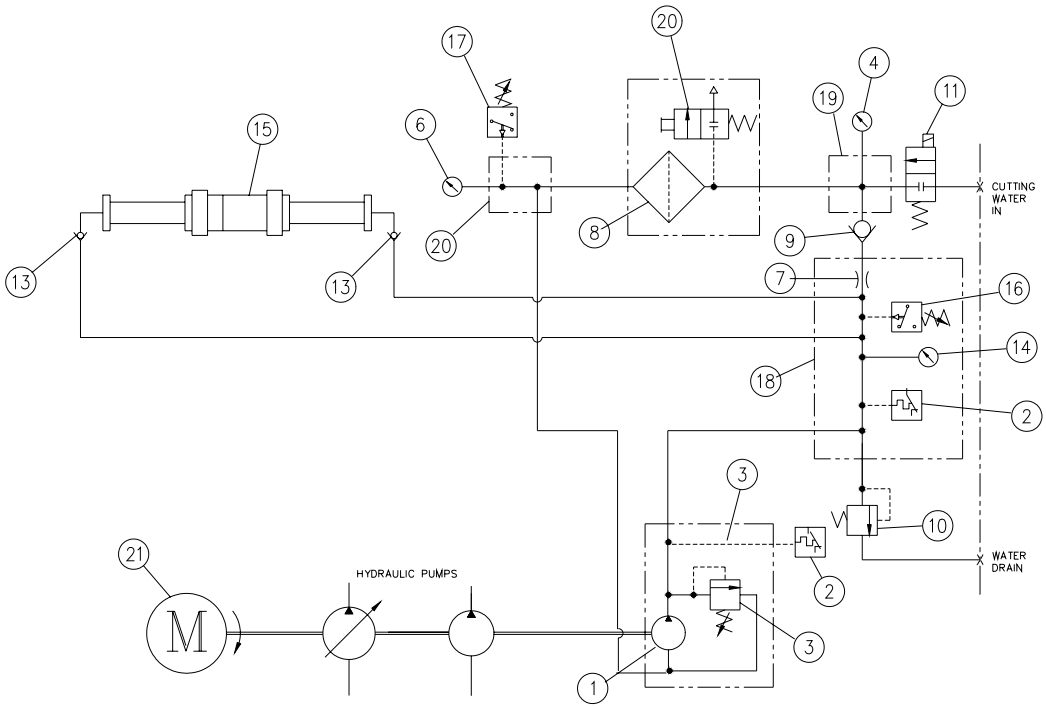


Figure 6.2 LP Cutting Water Supply Circuit

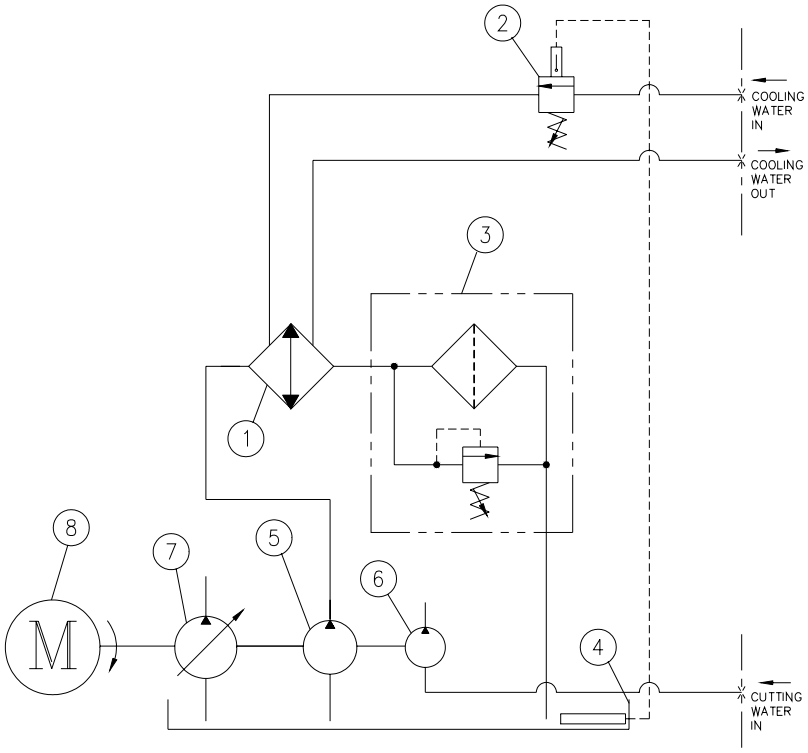


Figure 6.3 LP Water Cooling Circuit

Item Description

1	Water/Oil Heat Exchanger	5	Recirculating Hydraulic Pump
2	Water Modulating Valve	6	Water Booster Pump
3	Hydraulic Filter	7	Main Hydraulic Pump
4	Hydraulic Reservoir	8	Electric Motor

6.2.3 Booster Pump

The LP cutting water circuit (refer to Figure 6.2) incorporates several features relating to the booster pump:

a. Booster pump overpressure protection—relief valve (3) is built into the booster pump body and is intended to prevent excessive pump outlet pressure. This relief valve typically operates when the intensifier is dead-headed.

b. If either check valve (13) leaks, the circuit and booster pump could be subjected to HP water from the intensifier. Inline relief valve (10)—provides circuit and booster pump protection in the event of a leaking check valve (13) at the intensifier.

c. High cutting water supply pressure could result if circulation were blocked as with dead headed HP water flow. Orifice (7) and check valve (9) allow a minimal amount of LP water to circulate through the filter back to the pump inlet, thereby reducing the likelihood of overheating the cutting water.

d. If temperature of cutting water at the booster pump outlet is too high, then temperature switch (2) activates an automatic shutdown circuit in the PLC that stops the main electric motor (pumps stop rotating). Note that temperature switch (2) is located on manifold (18)

e. If water pressure to the booster pump inlet is too low, then the pump might be starved, resulting in pump damage. Pressure switch (17) activates an automatic shutdown circuit in the PLC when pressure drops below the switch setting. Logic in the PLC ignores momentary low pressure signals that might result in erroneous shutdown commands. Typical conditions likely to cause low booster pump inlet pressure are clogged LP filter or problems with the customer-supplied cutting water pressure.

6.2.4 Low Pressure System Protection

The booster pump pressure relief valve (3) is adjusted by turning with a flat blade screwdriver. Turn clockwise to increase pressure or counterclockwise to decrease pressure. Some booster pumps have an exposed adjustment screw, while on others the adjustment screw is accessed by removing screw is accessed by removing an acorn nut.
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 booster pump (1), which turns the pump off. To reduce booster pump overheating while deadheaded, water is recirculated through orifice (7) and backflow check valve (8) to the booster pump inlet.

Control	#	Pressure Adjustment		**Pressure Settings bar (psi)**	
		Increase	**Decrease**	**Maximum**	**Minimum**
Booster Pressure	3	Clockwise	Counter-clockwise	8.3 (120)	8.0 (115)
Booster Relief	10	Fixed	Fixed	9.0 (130)	8.6 (125)

The cutting water supply circuit is automatically shut off after the motor has been off for 2 minutes. To reset the water supply valve, select RUN SCREEN.

Automatic shutoff of the cutting water supply prevents unnecessary water spillage in the event of an external leak that triggers an automatic shutdown on an unattended KMT pump.

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 on the water filter and/or adjust the booster pump. The guidelines for servicing these parts are described below.

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 Booster Pump

If booster pressure, as read on the booster pump discharge pressure gage (14) is less than 8.0-8.3 bar (115-120 psi), the booster pump needs to be adjusted.

Components:	(1) Booster pump (3) Pressure control knob
Recommended Tools:	Flat screwdriver (To turn pressure control knob) Container (To capture some water spill) Rags
Parts:	None required

Booster Pump Adjustment Procedure

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

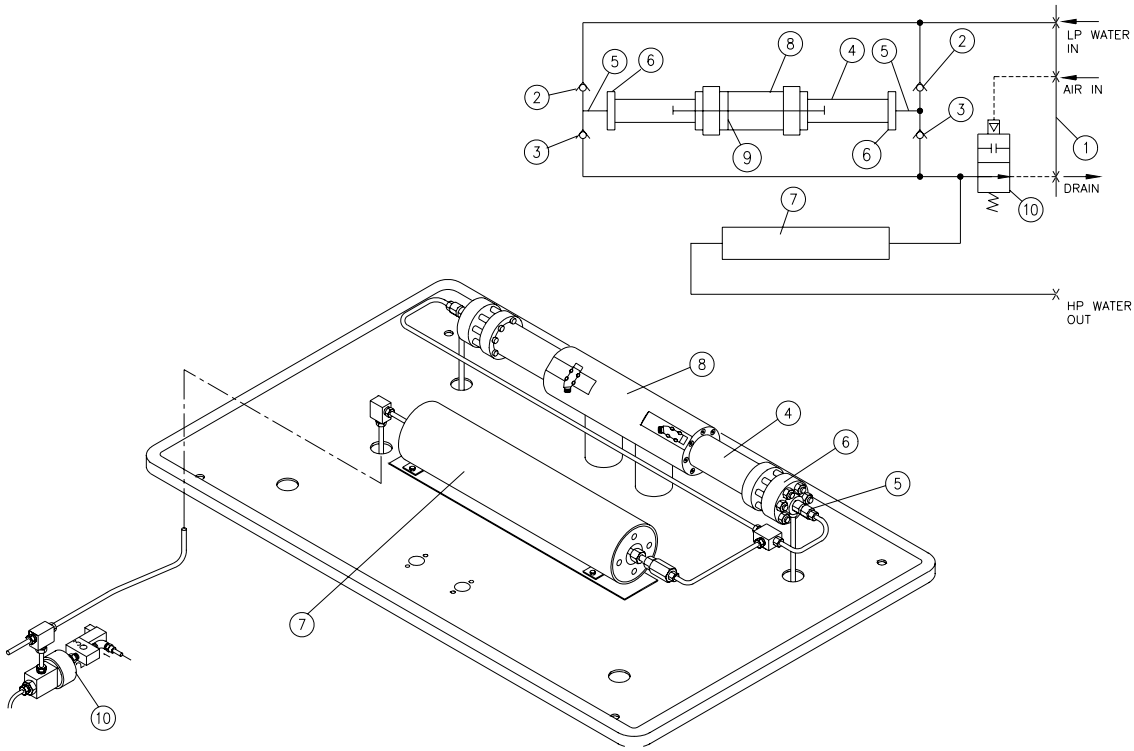
Section 7 HIGH PRESSURE WATER

7 High-Pressure (HP) Water

The high pressure (HP) water system takes the relatively low pressure water inlet to up to maximum pressure in excess of 3,400 bar (50,000 psi) supplying orifice diameters appropriate to the waterjet pump's operating power (See Specifications, Section 11).

7.1 Components

The HP water components include the hydraulic intensifier, HP attenuator(s), HP dump valve, HP pressure indicator (optional), and HP piping. Maintenance on the intensifier is discussed in detail in this section. In addition to HP components and assemblies, the hydraulic cylinder features of the intensifier are discussed in this section.

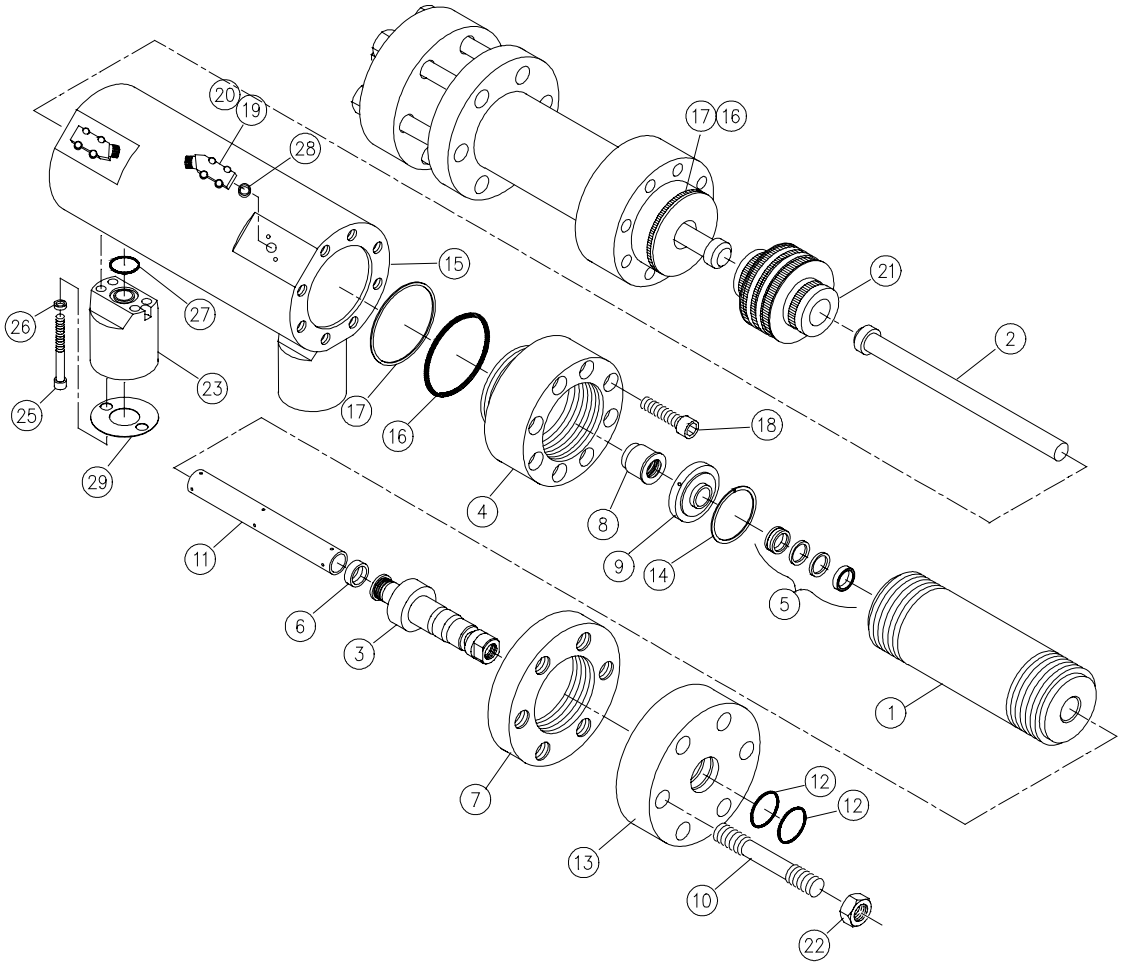


Item	Description	
(1) Bulkhead Fittings	(2) Inlet Check Valve	(3) Discharge Check Valve
(4) HP Cylinder	(5) Sealing Head	(6) Sealing Head Nut
(7) HP Attenuator	(8) Hydraulic Cylinder	(9) Hydraulic Piston
(10) HP Dump Valve		

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 components and subassemblies is also provided. The HP attenuator is discussed but no disassembly procedures are

included. Note that HP attenuators are not considered to be serviceable by the customer.



Item Description

(1) HP Cylinder	(2) Plunger	(3) Sealing Head
(4) Hydraulic Cylinder Head	(5) HP Seal	(6) Ring
(7) Ring Flange	(8) Hydr Seal Cartridge	(9) Retaining Flange
(10) Stud Bolt	(11) Cylinder Liner	(12) O-ring
(13) End Flange	(14) Retainer Ring	(15) Hydraulic Cylinder
(16) Back-up Ring	(17) O-ring	(18) Cap Screw
(19) Proximity Switch	(20) Cap Screw	(21) Piston Assembly
(22) Hex Nut		

Standard HP gland nut hex sizes for HP piping is as follows:

- 3/8" HP fittings: 13/16" (open end) wrench.
- 9/16" HP fittings: 30mm (1-3/13") wrench.
- Tie bolts nuts: 1-7/16" socket (7/8" and 1-1/8" plunger models)

7.2.1 HP & LP Water Piping

Disconnect from/Reconnect to Waterjet Pump

⚠ WARNING Before performing maintenance on the waterjet pump observe electrical LOCK OUT/TAG OUT procedures.

1. Loosen and remove HP Piping attached to the discharge HP check valve. Move tubing to clear work area.
2. For servicing the discharge HP check valve on the intensifier assembly, refer to section 7.3.1."Discharge HP Check Valve". Note that the sealing head can be removed with the discharge HP check valve attached.
3. Disconnect LP water at end flange. Note that to service the sealing head, including the inlet HP check valve, the tie bolts must be loosened allowing removal of the end flange.
4. With the HP piping and the LP cutting water plumbing disconnected, the following operations can be performed:
   - HP cylinder can be removed from hydraulic cylinder head
   - HP plunger seal can be serviced
   - After the pump has been reassembled, then the HP water piping and LP water disconnect 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 to the intensifier. Check HP fittings for proper collar position (1 to 1-1/2 threads exposed) and for adequate thread lubricant (High Purity Goop). Turn on cutting water supply and check for low-pressure leaks.

⚠ CAUTION Check that all proximity switches are properly installed and secured prior to starting the motor. Failure to tighten proximity switch hold down screws (2 each per proximity switch) will result in hydraulic oil spraying in general directions.

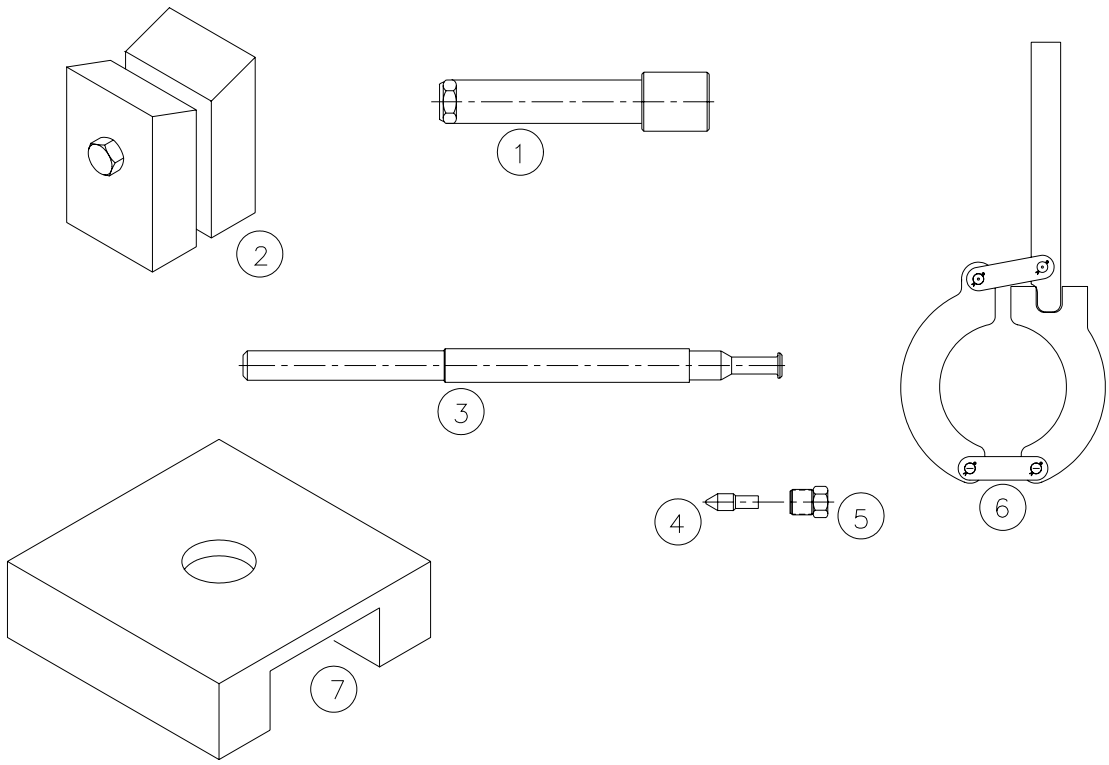
7. Start the waterjet pump. Operate at low pressure (without a cutting orifice) to flush the HP passages, then operate at high pressure with orifice installed to check for leaks.

7.2.2 HP Cylinder "Jug" (HP Cyl., Sealing Head, Flanges, & Studs)— Disassembly / Re-assembly

NOTE

KMT recommends removing the HP cylinder/ sealing head/ flanges AS AN ASSEMBLY for servicing the plunger HP seals, plunger, hydraulic seals, etc. KMT DOES NOT recommend loosening stud nuts except to service the sealing head inlet HP check valve, cone seat, etc. Refer to Table 7.1 for recommended disassembly / re-assembly practices.

Due to the weight (approx. 70 lbs) of the HP cylinder jug, adequate support should be provided to prevent damage to the plunger or seals during disassembly/ re-assembly. See below listed overview for suggested special tools to support the HP cylinder jug for this procedure.



Item Description

(1) Vee Block Cradle	05149877	(2) Plunger Removal Tool	05004924
(3) Seal Removal Tool	10148674	(4) 3/8" Plug	10079523
(5) 3/8" Gland	10078129	(6) Cylinder Wrench	05066139
(7) Tool-Stand Seal Removal	05149802		

HP Cylinder Jug Removal

1. Prior to removing electrical power from the KMT pump, extend plunger on end to be serviced. Remove connector from proximity switch on end of hydraulic cylinder closest to HP cylinder jug to be removed. Start KMT pump in LOW pressure mode, allow approximately 20 seconds for appropriate startup and cycling of intensifier to extend and stop toward the disconnected proximity switch. Shut off KMT pump, shut off LP water supply, observe LOCK-OUT/ TAG-OUT safety rules.

⚠ CAUTION Before performing maintenance on the waterjet pump observe electrical LOCK OUT/TAG OUT procedures.

2. Disconnect HP and LP piping / hoses per paragraph 7.2.1 above.
3. With support cradle tool located under HP cylinder jug, unthread and remove jug from plunger and hydraulic cylinder head.

NOTE
several methods for rotating the HP cylinder jug are available. The cylinder wrench is available, or the jug can be rotated by hand with the help of the studs and stud nuts. A slight lift force applied to the HP gland nut of the outlet HP check valve can help ease the effort of rotating the HP cylinder jug.

HP Cylinder Jug Re-Installation

1. Verify that HP cylinder threads are adequately lubed with High Purity Goop and that the threads have been sanded/ dressed if galling was encountered during HP cylinder jug removal.
2. Verify that the HP plunger seals, packing follower, and plastic cylinder liner tube are correctly installed. Align HP cylinder jug with plunger using cradle tool to support weight and provide approximate alignment. Carefully push/ lift jug into place until threads are ready to engage.
3. While lifting upward on the outlet HP check valve gland nut, push upward on a stud nut, rotating the jug CW, while pushing inboard and upward until thread engagement is accomplished. Continue to thread HP cylinder into hydraulic cylinder head until hand tight.
4. Re-connect HP and LP piping / hoses per paragraph 7.2.1 above.

⚠ CAUTION Check that all proximity switches are properly installed and secured prior to starting the motor. Failure to tighten proximity switch hold down screws (2 each per proximity switch) will result in hydraulic oil spraying in general directions.

5. Restart KMT pump, first operating in LOW pressure mode to flush out air in HP components and also to check for obvious leaks. Switch to HIGH pressure after 5-10 minutes of LOW pressure operation, watching for obvious leaks. Be ready to shut off the pump if leaks appear. Remedy leaks then repeat start procedure, moving from LOW pressure to HIGH pressure soon after intensifier starts pumping water (no further need to flush air from lines).

7.2.3 Stud Nuts and End Flange, Sealing Head—Disassembly / Re-assembly

NOTE
KMT recommends removing the HP cylinder/ sealing head/ flanges AS AN ASSEMBLY for servicing the plunger HP seals, plunger, hydraulic seals, etc. KMT DOES NOT recommend loosening stud nuts except to service the sealing head inlet HP check valve, cone seat, etc. Refer to Table 7.1 for recommended disassembly / re-assembly practices.

End Flange and Sealing Head Removal

1. Prior to removing electrical power from the KMT pump, extend plunger at intensifier end to be serviced. Remove connector from proximity switch on end of hydraulic cylinder closest to HP cylinder jug to be removed. Start KMT pump in LOW pressure mode, allow approximately 20 seconds for appropriate startup and cycling of intensifier to extend and stop toward the disconnected proximity switch. Shut off KMT pump, shut off LP water supply, observe LOCK-OUT/ TAG-OUT safety rules.

⚠ CAUTION Before performing maintenance on the waterjet pump observe electrical LOCK OUT/TAG OUT procedures.

2. Disconnect HP and LP piping / hoses per paragraph 7.2.1 above.
3. Loosen stud nuts, then remove nuts.
4. Remove end flange. Note that sealing head may be removed with end flange.
5. Remove sealing head. Note that a white plastic ring used to position the sealing head relative to the HP cylinder bore may not have been removed with the sealing head. This ring should be removed prior to re-installing a sealing head to avoid pushing the ring further into the HP cylinder bore. Note that a fully- assembled spare sealing head greatly reduces pump downtime.

Re-Assemble Sealing Head and End Flange to HP Cylinder

1. Verify that sealing head cone surface is smooth. Perform any necessary maintenance on inlet check valve. (Refer to paragraph 7.3.2) Verify that a white plastic alignment ring is installed on the 'nose' of the sealing head. Verify O-rings (2 ea) properly installed in ID grooves of end flange. Check HP cylinder bore to verify presence of plastic tubular cylinder liner and to verify that no white plastic alignment ring remains in end of HP cylinder bore. Feel sealing edge of HP cylinder bore to verify that no unusual blemishes are present that might hinder proper cone ring seal.
2. Install sealing head into end flange. Install sealing head and end flange over stud bolts and into cylinder bore. Note that end flange should be oriented with the LP water fitting oriented near the 9 o'clock or 3 o'clock positions for ease of making the LP water connection.
3. Thread nuts onto studs to hand-tightness. Verify end flange and ring flange are parallel to within 0.070-inch.
4. Tighten stud nuts (using a torque wrench) in a crossing pattern in several stages to reach maximum torque. See Table 7.1 for suggested nut tightening sequence. Verify flange parallelism at completion of tightening sequence.
5. Re-connect HP and LP piping / hoses per paragraph 7.2.1 above.

⚠ CAUTION Verify that proximity switches (2 ea) are properly installed Failure to tighten proximity switch hold down screws will result in hydraulic oil spraying in general directions.

6. Restart KMT pump, first operating in LOW pressure mode to flush out air in HP components and also to check for obvious leaks. Switch to HIGH pressure after 5-10 minutes of LOW pressure operation, watching for

obvious leaks. Be ready to shut off the pump if leaks appear. Remedy leaks then repeat start procedure, moving from LOW pressure to HIGH pressure soon after intensifier starts pumping water (no further need to flush air from lines).

7.2.4 HP Plunger Seal Service-- Disassembly / Re-assembly

1. Remove HP and LP piping/ hose, then remove HP cylinder jug following procedure 7.2.2, above.
2. Thread HP plug and gland fitting (items C1 & C2, Special Tools, Table 7.3) into HP check valve gland nut. Hand tight is sufficient.
3. Stand HP cylinder jug upright with stud nuts resting on platform of wood blocks or stand tool item (B), Table 7.3.

⚠ DANGER HP cylinder jug is heavy and if it is stood on top pan of KMT pump, will present a falling object hazard. Take care to properly support jug so that it will not fall.

4. Fill HP cylinder bore with water, then fit a used plunger or seal removal tool (item (E), Table 7.3) into bronze packing follower. Note that wrapping a shop rag around the plunger at the packing follower avoids splash-back. Use a dead blow hammer to strike the button end of the plunger as though attempting to drive the plunger into the HP cylinder. This technique should 'hydraulic' the HP seal components upward onto the plunger/ tool shaft and out of the HP cylinder.

5. Slip plastic liner tube from bore of HP cylinder, inspect for possible heat or wear damage or for possible debris. Feel ID of HP cylinder for approximately 1-inch into bore. Sand any obvious ridges or grooves with 600-grit wet/dry sandpaper. Note that grooves or ridges are typically caused by seal debris buildup rather than by marks in ID wall of HP cylinder.

6. Inspect plunger surface for flaws. Rotate plunger 360- degrees by hand while viewing light reflection on plunger surface to note any dullness, streaks, pits or other defects. Run fingernail perpendicular to direction of suspected surface flaws to gage severity of defects. Depending on seal life achieved with removed HP plunger seal, make judgment regarding whether to replace plunger. Refer to Paragraph 7.2.6 for procedure regarding plunger removal/ installation.

7. Lightly coat seal components with FML grease prior to installing seal parts on plunger. Install new HP plunger seal assembly onto plunger, referring to appropriate diagram in Figure 7.___ for proper seal component orientation. Note that steel spring inside U-cup (if so equipped) can be easily distorted. Verify that U-cup spring, lips and cavity appear uniform prior to installation.

NOTE
Bronze packing follower intended to fit tightly on plunger. If follower is too tight to slip onto plunger, try heating follower in hot water. Then attempt to slip follower over plunger.

8. Slip plastic cylinder liner tube over plunger.

9. Install HP cylinder jug to hydraulic cylinder head per paragraph 7.2.2.

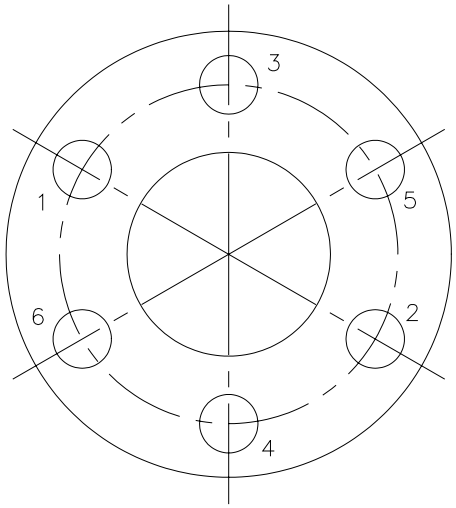
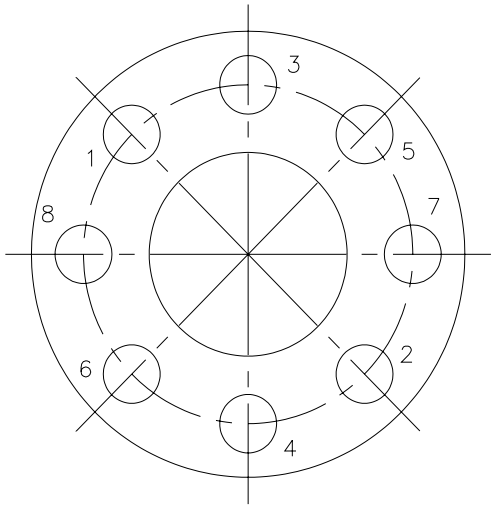
TABLE 7.1 FLANGE NUT TORQUE SPECIFICATIONS				
Plunger Diameter	**7/8" Diameter Plunger (SL-IV Plus)**		**1-1/8" Diameter Plunger (SL-IV 100S)**	
No. of Studs, Tightening Sequence	6 each (Fig A)		8 each (Fig B)	
Units	N-m	Ft-Lb.	N-m	Ft-Lb.
1st Stage	Hand Tight	Hand Tight	Hand Tight	Hand Tight
2nd Stage	135	100	135	100
3rd Stage	200	150	200	150
4th Stage	257-285	190-210	257-285	190-210
Max Out-of Parallel	1.8mm	0.070"	1.8mm	0.070"
Socket Wrench Size	1-7/16"		1-7/16"	
	6 BOLT CROSSING PATTERN: 		8 BOLT CROSSING PATTERN 	

Table 7.2 HP INTENSIFIER SERVICE TEARDOWN SEQUENCE								
			Disassemble/Re-assemble					
	Intensifier Component Maintenance	**Related Component Assembly**	**HP Piping**	**LP Water Plumbing**	**HP Cylinder Sealing Head, Flanges & Studs [1]**	**Stud Nuts & End Flange**	**Retainer Flanges & Hydraulic Cartridge**	**Hydraulic Cylinder Head**
	Ref Part No.→	--	7.2.1	7.2.1	7.2.2	7.2.3	7.2.5	7.2.6
1	**Outlet HP Check Valve**	Sealing Head	Yes	No	No	No	No	No
2	**Inlet HP Check Valve**	Sealing Head	Yes	Yes	No	Yes	No	No
3	**HP Plunger Seal**	HP Cylinder	Yes	Yes	Yes	No	No	No
4	**Hydraulic Seal Cartridge-Plunger**	Hydraulic Cylinder Head	Yes	Yes	Yes	No	Yes	No
5	**Sealing Head Cone Seal**	Sealing Head	Yes	Yes	No	Yes	No	No
6	**HP Cylinder**	--	Yes	Yes	No	Yes	No	No
7	**Plunger**	--	Yes	Yes	Yes	No	Yes	No
8	**Hydraulic Piston**	--	Yes	Yes	Yes	No	No	Yes

Note [1]: Remove/installed as a unit (HP Cylinder "Jug")

7.2.5 Plunger and Hydraulic Cartridge Removal and Installation

1. Remove HP and LP piping/ hose, then remove HP cylinder jug following procedure 7.2.2 above.

2. Remove the proximity switch on the intensifier side nearest HP cylinder to be serviced. This procedure will allow hydraulic oil to drain to tank and will minimize oil spillage. Draining takes about 5 minutes. 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.

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), 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. Note that hydraulic cartridge O-rings may take up clearance. To install retaining ring, first tap lightly on retainer flange using plunger removal tool. This will compress cartridge O-rings enough to get retaining ring started in groove. Push on outer edge of retainer flange with a flat bladed screwdriver while working one end of retaining ring into groove. Retainer flange should tilt or tip enough to allow retaining ring to move into its groove. Continue working ring into groove while tilting flange until retaining ring is fully installed.

8. Install HP cylinder jug to hydraulic cylinder head per paragraph 7.2.2.

7.2.6 Hydraulic Cylinder Head and Piston—Removal / Re-Installation

1. Remove HP and LP piping/ hose, then remove HP cylinder jug following procedure 7.2.2 above.

2. Remove proximity switch (19) at cylinder end to be serviced. Loosen the remaining proximity switch to drain hydraulic oil in tank.

3. Remove hydraulic seal cartridge (8). Seal cartridge (8) removal is recommended to avoid sliding cylinder head (4) over plunger (2). The plunger need not be removed at this stage.

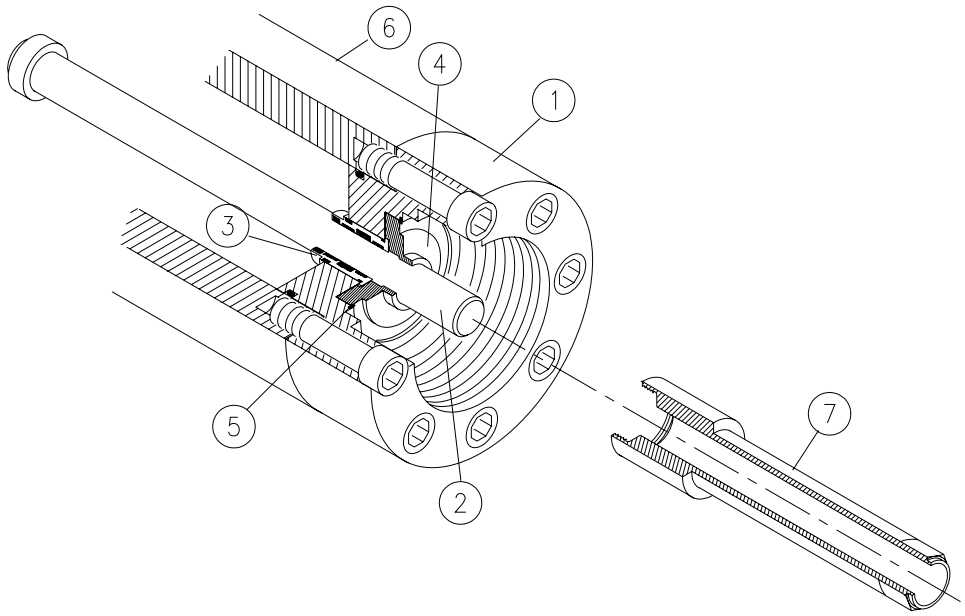
4. Loosen and remove 8 each socket head cap screws (18) retaining cylinder head (4) to hydraulic cylinder (15). The cylinder head and its O-ring (16) can be removed. The proximity switch mounting flats provide a small lip for loosening the cylinder head.

5. 5. To remove the hydraulic piston (21) from the hydraulic cylinder (15), remove one cylinder head, remove the proximity switch toward that end. On the opposite end remove the HP cylinder and end cap, then remove the retainer flange and hydraulic cartridge. 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. Tighten 12M socket head capscrews (8 per cylinder head) in a crossing pattern to 190-210 N-m (140- 155 ft-lbs).

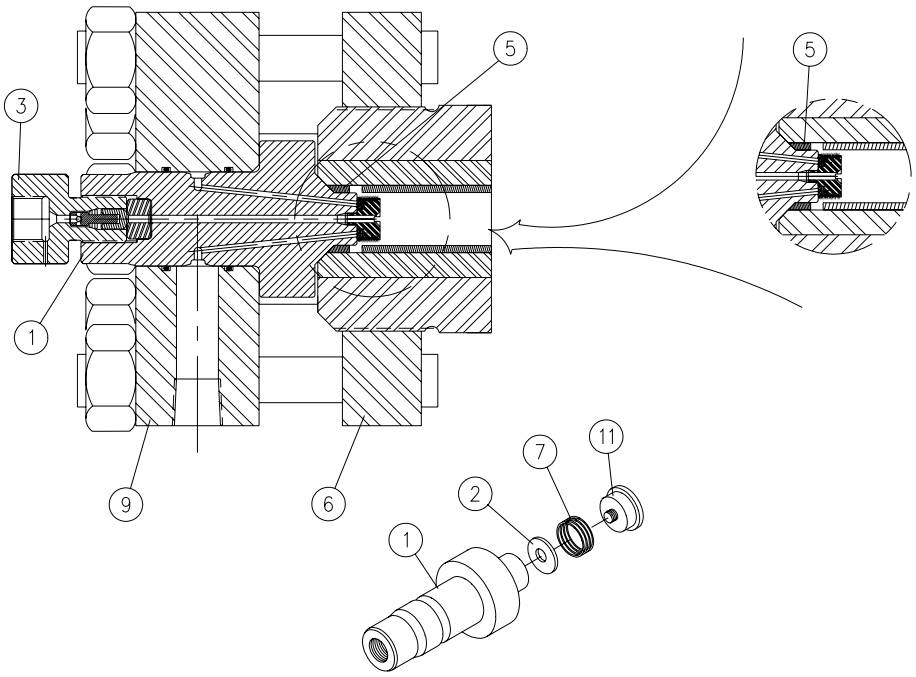
⚠ CAUTION Remember to install and tighten proximity switches. Failure to do so will result in considerable spraying of hydraulic oil.

7. Install HP cylinder jug to hydraulic cylinder head per paragraph 7.2.2.



Item Description

(1) Cylinder Head
(2) Plunger
(3) Hydraulic Cartridge, Plunger Seal
(4) Bushing Retainer Flange
(5) Retaining Ring
(6) Hydraulic Cylinder
(7) Plunger Removal Tool



Item Description

(1) Sealing Head
(2) Inlet Poppet
(3) Gland Nut
(5) Seal Head Spacer
(6) Flange Ring
(7) Suction Spring
(9) End Flange
(11) Retainer

7.3 Intensifier Subassemblies Inspection and Repair

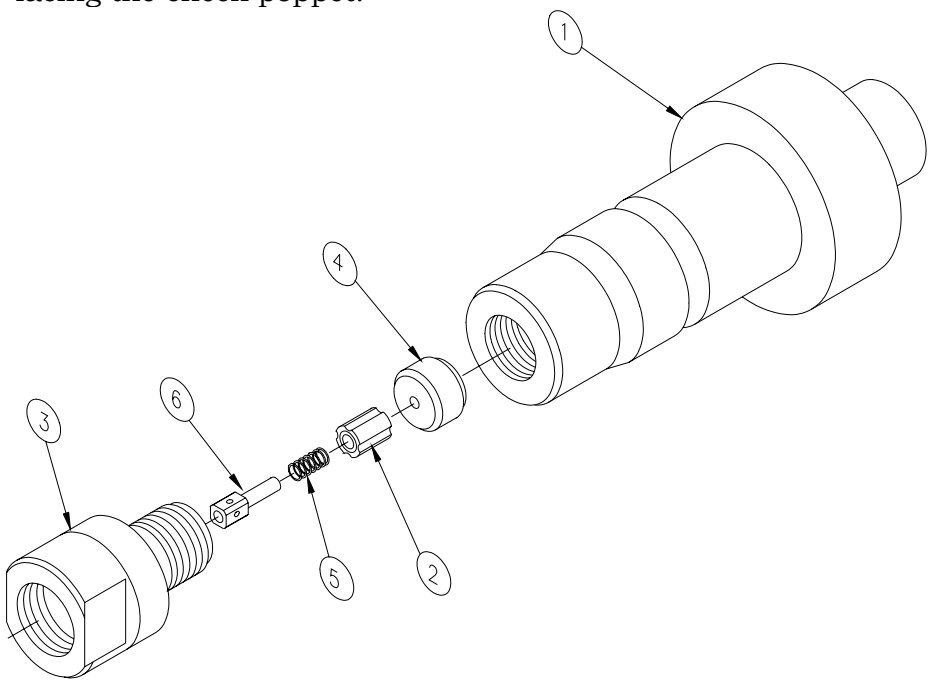
The inspection and repair of the following subassemblies will be discussed:

- 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 a pair of wrenches.
2. When the gland nut is removed, the spring guide and spring will normally stay in the gland nut. The poppet is removed by carefully dislodging it with a screwdriver. The 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. Note that a slight burr at the hole edge identifies the used side of the poppet seat. 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 check poppet.

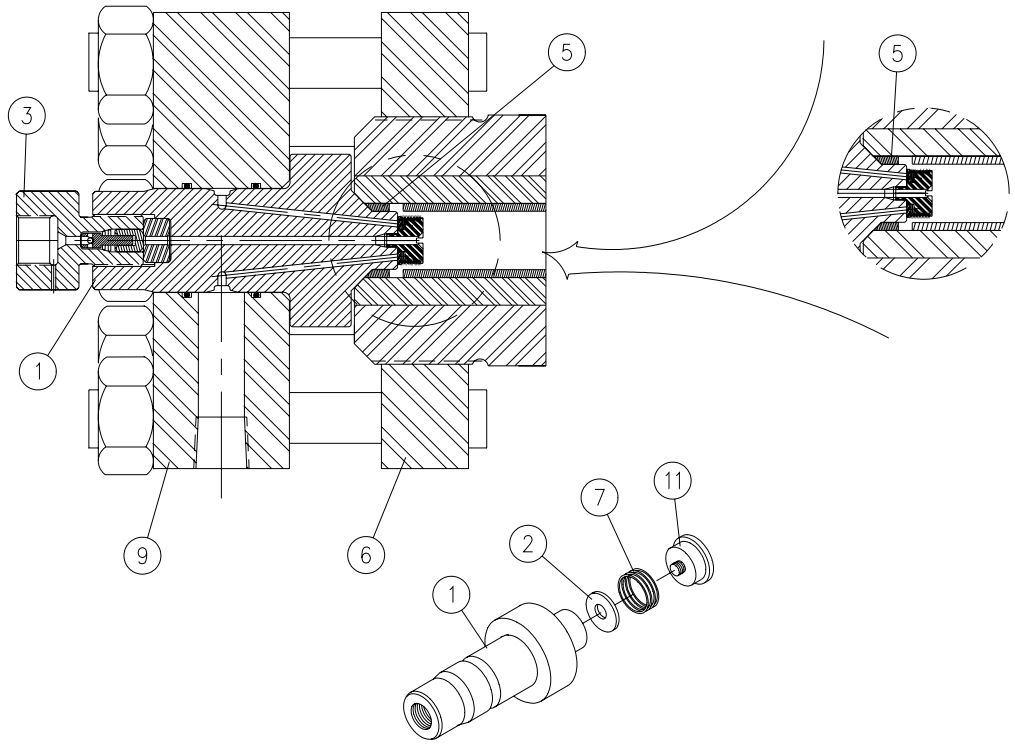


Item	Description	
(1) Sealing Head	(2)Poppet	(3) Gland Nut
(4) Poppet Seat	(5) Spring	(6) Guide Pin

3. Inspect the poppet, spring, and guide for wear. Replace the spring and guide if worn.
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. Apply a coating of food grade grease to the check poppet to hold it in place when installing gland nut in sealing head.
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 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.



Item Description

(1) Sealing Head	(2) Inlet Poppet
(3) Gland Nut	(5) Seal Head Spacer
(6) Flange Ring	(7) Suction Spring
(9) End Flange	(11) Retainer

7.3.3 Sealing Head

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

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

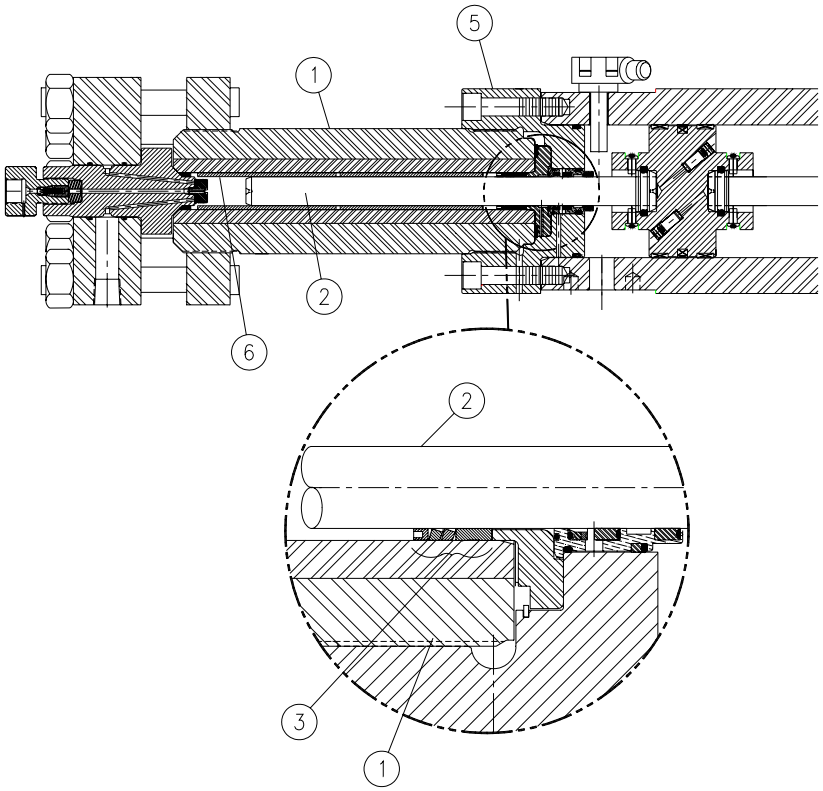
In addition, the sealing head inlet water groove should be examined for cracking.

1. Polish the cone ring 45 degree surface to achieve a smooth finish. Grooves or machine tool marks should be bearly discernable by fingernail test.
2. Inspect the inlet poppet sealing surface of the sealing head for pits, scratches, or jetting erosion. Refinishing the seal head inlet poppet face is mandatory when rebuilding the sealing head. 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.
3. When the sealing head is flat and smooth, perform a final polish with 600 grit wet/dry sandpaper. A mirror finish is required. KMT Waterjet 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 guiding ring.
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.

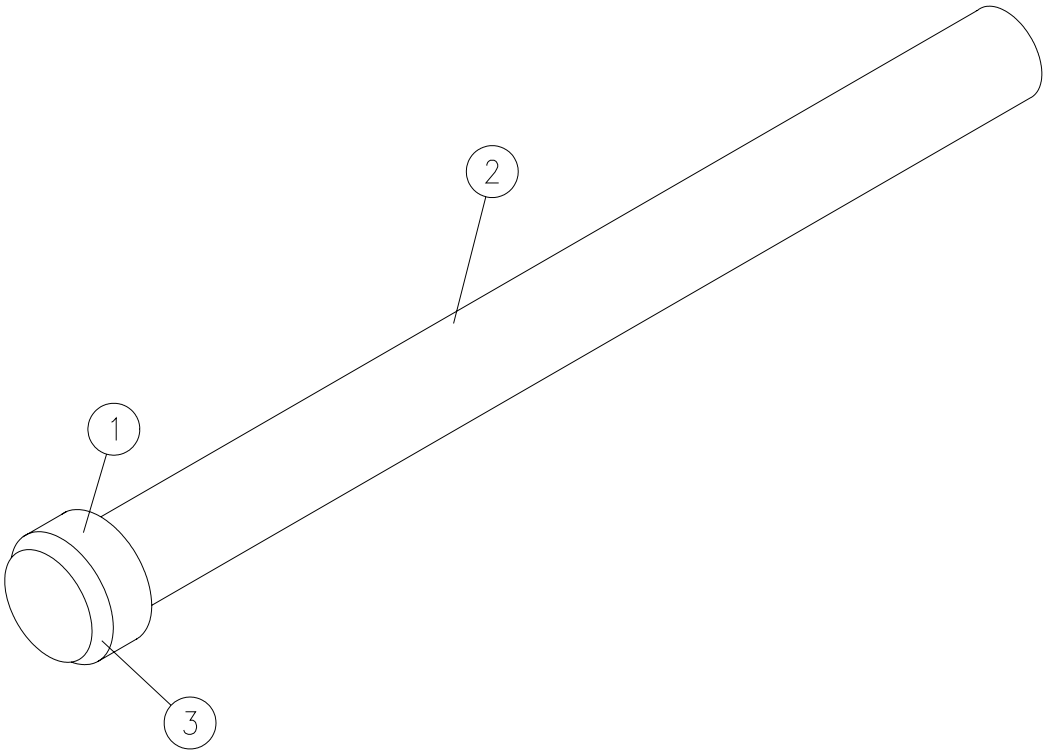


Item Description

(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. Repair of plunger surface flaws usually cannot be accomplished on site. KMT Waterjet Systems offers a plunger reconditioning service.



Item Description

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

7.3.6 Hydraulic Piston

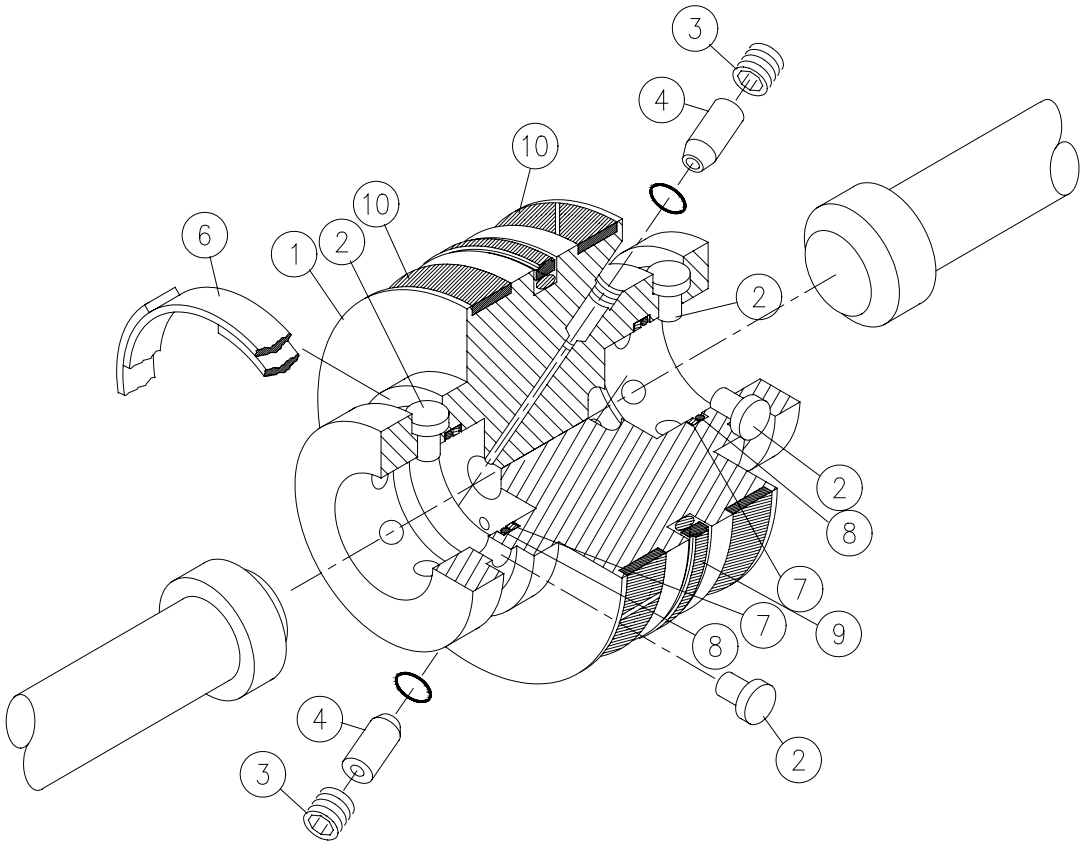
The hydraulic piston contains a seal assembly, bearing rings, pins and flat spring bands, and check valves. Bearing rings (10) provide wear contact between piston and cylinder ID. Plungers (12) are held in place by 6 each pins (2) per plunger. Pins (2) are maintained in place by flat steel band (6). Check valves (4) are mounted internal to the piston to vent unwanted hydraulic pressure to the piston opposite side. These check valves prevent hydraulic pressure from building behind the plunger button

Replace Piston Seal

1. Remove bearing rings (10) and worn seal ring assembly (9).

⚠ CAUTION Do not scratch bottom surface of piston seal groove. Scratches to the seal groove sides and/or bottom can result in a hydraulic leak.

NOTE:
Use a smooth, dull-edged blade made from brass or similar soft (relative to steel) material to remove and install seal assemblies.



Item Description

(1) Piston	(2) Pin (12 ea)	(3) Set Screw (2 ea.)
(4) Check Valve (2 ea.)	(5) Adhesive	(6) Snap Ring (2 ea.)
(7) Backup Ring (2 ea.)	(8) O-ring	(9) Seal Assembly
(10) Bearing Ring (2 ea)	(11) Set Screw (4 ea.)	(12) Plunger (2 ea.)
(13) O-ring (2 ea.)		

2. With seal and bearings removed, inspect seal groove bottom for marks or scratches and residue buildup. Clean and /or repair groove surfaces as required.
3. Install replacement bearing rings (10).
4. Install replacement piston seal assembly (9). First install inner ring, taking care that this ring is not twisted after installation. Slide outer seal ring over metal edges, easing seal into place over inner ring.

NOTE:
Heating the piston seal ring in hot water (150 degree F for 3-5 minutes) increases seal flexibility.

Service Piston Plunger Sockets (2 each)

1. Remove flat spring bands (6) and remove plunger retainer pins (2). Inspect pins and spring band for deformation or unusual wear. Clean and inspect pin holes in piston for unusual wear or hole deformation/ enlargement.
2. Remove plunger button O-ring (8) and backup ring (7) (2 places), taking care not to scratch or otherwise damage seal groove surfaces. Clean and inspect seal grooves for residue buildup or surface marks that might cause seal leaks.
3. Inspect plunger button sockets for unusual wear.

NOTE:
Plungers may make an indentation in the bottom of the plunger socket. The bottom of this socket may show the impression of the plunger on it due to the high contact forces between piston and plunger. This compression mark is normal.

Service Piston Internal Check Valves

NOTE:
Check valve (4) servicing is not necessary unless there is suspicion of a problem. If the check valves (2 each) or piston internal passages must be serviced, seal and pin servicing is also recommended.

1. Check valves (items (4), 2 each) or cross-drill plug (11) removal may be necessary. Re-install using thread locking compound applied sparingly on the plug threads.

⚠ CAUTION Excess compound may clog a check valve or block a drilled passageway.

NOTE:
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.

2. 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 (3) with thread locking compound. Then thread retainer

(3) over check valve cartridge (4). Allow 24 hours for thread locking compound to set.

3. Install plugs (11) 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.

Install Plunger Button Seals and Retainer Pins in Hydraulic Piston

1. Install new backup ring (7) and O-ring (8) in each internal groove in each plunger pocket (2 places).

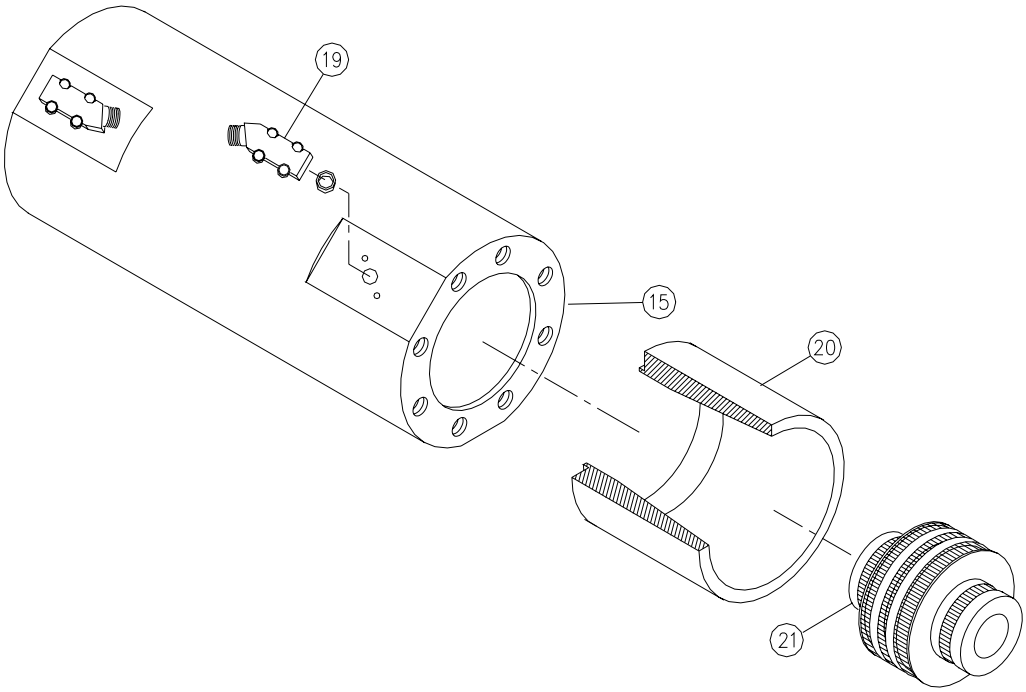
⚠ CAUTION Failure to install backup ring can result in plunger being forced out of plunger pocket.

2. Reinstall pins in piston, verifying that each pin moves freely without excess side play in its cavity.
3. Reinstall band (6) over pins. Repeat this process for the opposite piston side. With piston on bench, install plunger in each end of piston, checking snap-in feature of plunger attachment. Use plunger removal tool to verify that pins retract (release plunger) and close (retain plunger) in a uniform manner.

Install Hydraulic Piston Assy into Hydraulic Cylinder

NOTE:
Piston seal assembly must be compressed before the piston assembly will slide into the hydraulic cylinder. A ring compression tool such as shown in the figure below is recommended.

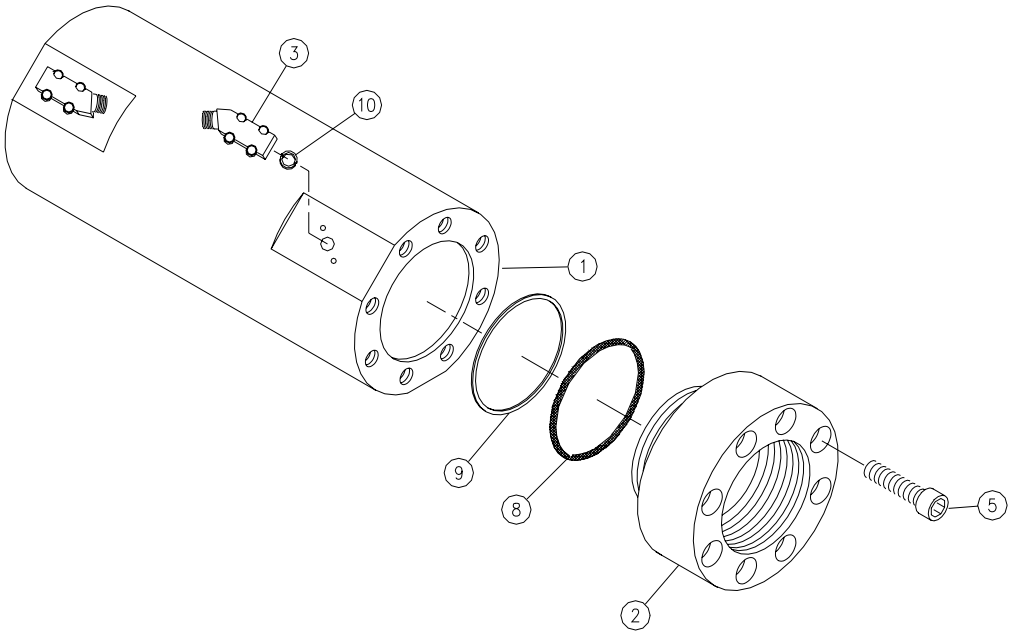
1. Check that hydraulic cylinder bore is free grit, or contamination, and that the proximity switches are removed to prevent interference. Lubricate piston bearing and seal surfaces with FML-2 grease. Lightly lubricate 2-3 inches of cylinder (15) bore with same grease.
2. Fit or drive piston assembly into ring compression tool (20). Position compression tool with piston assembly over end of hydraulic cylinder. Using a plastic- faced hammer so as not to damage piston surfaces, gently drive the piston assembly into the hydraulic cylinder.
3. Remove seal compression tool, continue driving piston assembly into hydraulic cylinder until it is between the proximity switch holes. Continue intensifier re- assembly by installing cylinder heads, plungers, hydraulic seal cartridges, and HP components.



(15) Hydraulic Cylinder
(19) Proximity Switch
(20) Seal Ring Compression Tool (P460)
(21)Hydraulic Piston Assy

7.3.7 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.



Item Description

(1) Hydraulic Cylinder
(2) Cylinder Head
(3) Proximity Switch
(5) Cap Screw
(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. Replacement parts for the HP valve are provided in the **Parts Lists** (Section 12, see Figure 12-7, "Bulkhead Piping Assy").

7.5 HP Attenuator

There is no servicing of the HP attenuator at the customer level. The seals in the HP attenuator 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 for replacement or servicing.

Section 8 ELECTRICAL SYSTEM

8 ELECTRICAL SYSTEM - Features

The electrical system contains all functions necessary for turnkey operation. This includes the control and starter panel, intensifier reversal circuit.
The electrical enclosure, 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 electric motor on the SL-IV 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

Two motor starter circuits are offered as built- in assemblies for the SL-IV 30hp and 50 hp Waterjet Pumps:

- Wye- delta starter, commonly used in Europe to reduce current surges during motor startup, and
- Across- the- line starter, commonly used in North America, which is a simpler circuit.

Other features included in the motor starter circuits include:

- Manual disconnect with door handle interlock
- Overcurrent protection
- Hydraulic unloading during startup, allowing the motor to reach full speed
- Motor terminal block for European models

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. The inputs that trigger automatic shutdown are:

- Motor Overload
- Motor Feedback Failure
- Oil Level Low
- Oil Temp High
- Low Booster Pressure
- Low Inlet Water Pressure
- Long Idle Time Shutdown
- Booster Temp High
- Left Overstroke Shutdown
- Right Overstroke Shutdown
- T/W Overstroke Shutdown

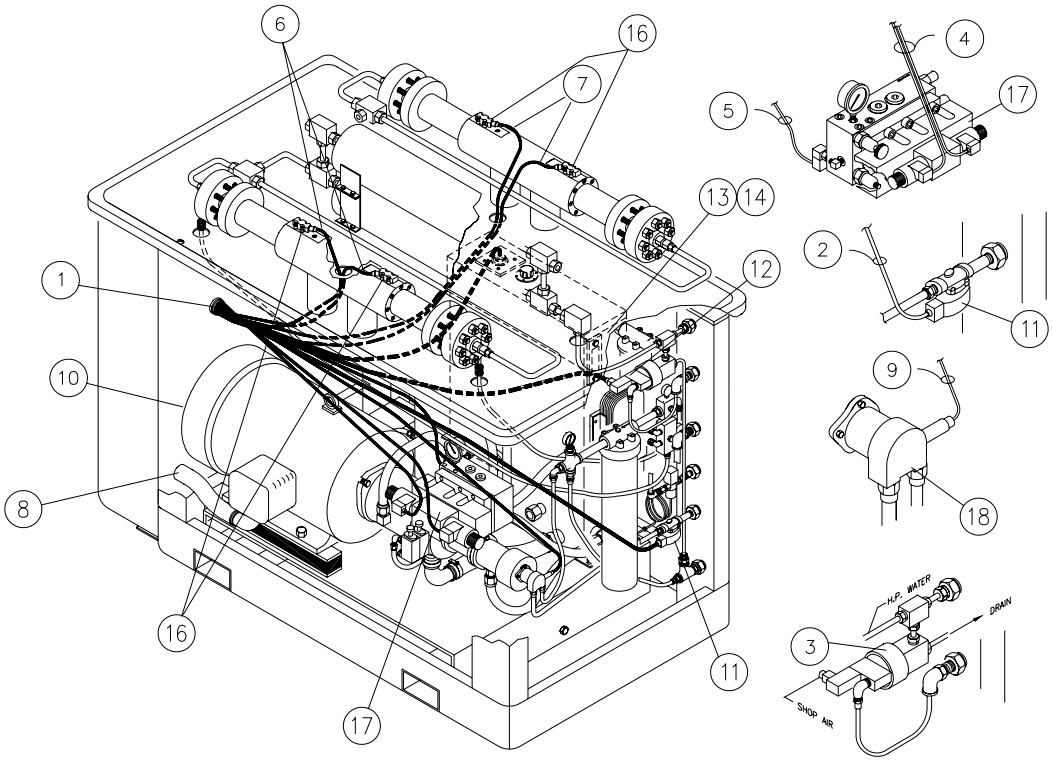
For more information on these conditions and recovery procedures, refer to Section 3, **Operation**, of this manual.

A circular connector in the side of the enclosure is provided in order to interface with the remote operator's station

- Start
- Stop
- Emergency Stop (E-Stop)
- Pump RUN indicator light
- Pump malfunction light
- Remote 2-pressure
- Proportional Pressure (optional)

8.1.3 Operation

To energize the Control Panel, pull the **EMERGENCY STOP** button, then press the **RESET** button. The Control Panel will display the **RUN** screen. After a five second delay, if all run conditions are met (no alarm conditions, and inlet water pressure above 30 psi) the **RUN BAR** will flash, indicating machine is ready to start.



Item	Description
1	Electrical Harness, Sensor/ Control
2	Cable, Cutting Water Supply Solenoid
3	HP Shutoff (Dump) Valve
4	Cable (2 ea), Directional Control Valve
5	Cable, HI/LO Pressure Solenoid
6	Cable, Proximity Switch Sensor- Single Intensifier
7	Cable, Proximity Switch Sensor- Redundant Intensifier
8	Motor Electrical Hookup
9	Cable, Hot Booster Pump Temperature Sensor
10	Electric Motor
11	Cutting Water Inlet Shutoff Valve
12	HP Dump Valve (Air Solenoid)
13	Low Oil Level Sensor (Reservoir- Mounted)
14	High Oil Temperature Sensor (Reservoir- Mounted)
16	Proximity Limit Switch
17	Directional Control Valve
18	Booster Pump

Before starting intensifier insure all parameters are set to users specifications.

On **RUN** screen press **PRESSURE** button to set final pressure. The arrow below the **PRESSURE** switch indicates final pressure. The pump will be held in low

pressure for 20 seconds after motor is started, after which pressure will go to high if high is selected, otherwise the pump will stay in low pressure. The final pressure may also be set on the **PRESSURE CONTROL** screen if analog control is present.

On **MAIN MENU** scroll to **% CAPACITY** screen and insure the correct intensifier is set – either intensifier one or two, by pressing the **SELECT INT 1 / 2** button.

On the **% CAPACITY** screen set the **SHUTDOWN %.** Press UP and DOWN arrows to increment or decrement OVERSTROKE SETPOINT or OVERSTROKE SHUTDOWN. Because overstroke protection is related to stroke speed under actual pressure setting, this allows you to control sensitivity of the overstroke protection software for your particular operating pressure.

Return to the **MAIN MENU**. Scroll to **SET-UP** screen. There are two **SET-UP SCREENS** – If analog pressure control is not installed on the machine, a screen will appear that does not include the **TRANSDUCER** and **PROPORTIONAL SELECT** buttons. These buttons are used only if a pressure transducer and/or a proportional valve are installed on the machine. Set water reset function and idle shutdown function on or off.

WATER RESET FUNCTION Press on (**I**) to shut water off five (5) minutes after machine shuts down. Selecting this function will insure that the inlet cutting water is shut off following a shutdown fault. This can prevent water from leaking past a damaged water seal following an overstroke shutdown caused by a seal failure.

IDLE SHUTDOWN FUNCTION Press on (**I**) to stop machine after 30 minutes of inactivity (machine not stroking). This feature saves energy by automatically shutting down the intensifier if it is not being used.

For more information, refer to Section 3, **Operation**, of this manual.

(1) Standard machine, start-up after machine has been E-stopped: Safety dump valve will be open. It will close 3 seconds after the T/W begins stroking. The pump will be held in low pressure for 20 seconds after motor is started after which pressure will go to high if high is selected, otherwise will stay in low.
The purpose for this is to allow entrapped air to be bled from any HP cylinder that has been maintained to avoid hot air burning the plunger seals.

(2) Standard machine, start up after normal stop: Safety dump valve will be closed, pump will be held in low pressure for 20 seconds after motor is started, after which the pressure will go to high if high is selected, otherwise will stay in low.

(3) Machine equipped with hp transducer, start up after E-stop: same as (1) above.

(4) Machine equipped with hp transducer, start up after normal stop: If pressure is allowed to bleed through orifice to below 1000 psi, dump valve

will open and start up will be like (1) above, if pressure is not allowed to bleed, start up will be as (2) above.

The display screen will always default to the **Run** screen after being on any other screen more than 5 minutes.

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

After pressing the Start button:

The motor starter in the control panel is activated and the motor starts.

The intensifier assembly starts operating. Reversal position is sensed by proximity switches, which send signals to the PLC inside the control panel. The PLC activates the opposite solenoid on the pump reversing valve.

After pressing the START Pushbutton:

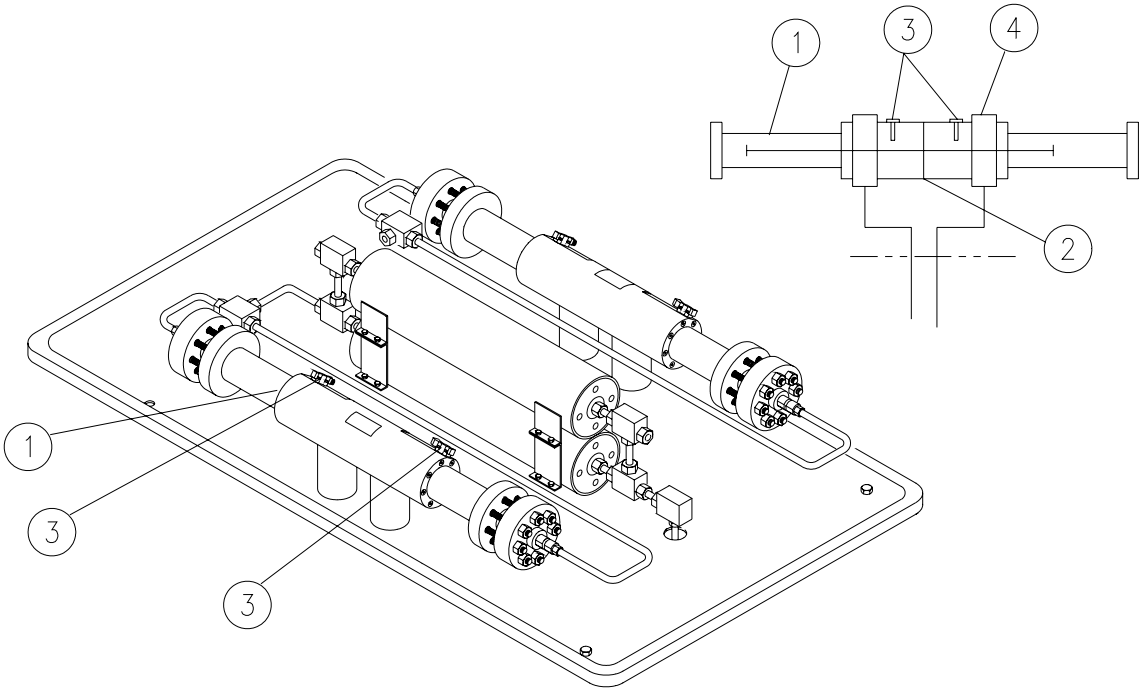
- The unloading valve delays hydraulic pressure build-up while the motor starter circuit accelerates the motor to normal rotating speed.
- The intensifier assembly starts operating. Reversal position is sensed by proximity switches, which send signals to the relay logic inside the control panel. The relay logic activates the opposite solenoid on the directional control valve.

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

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

Components:	Optical Relay Switch
Recommended Tools:	Flat screwdriver, 3mm (1/8 inch)
Parts:	Optical Relay

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.

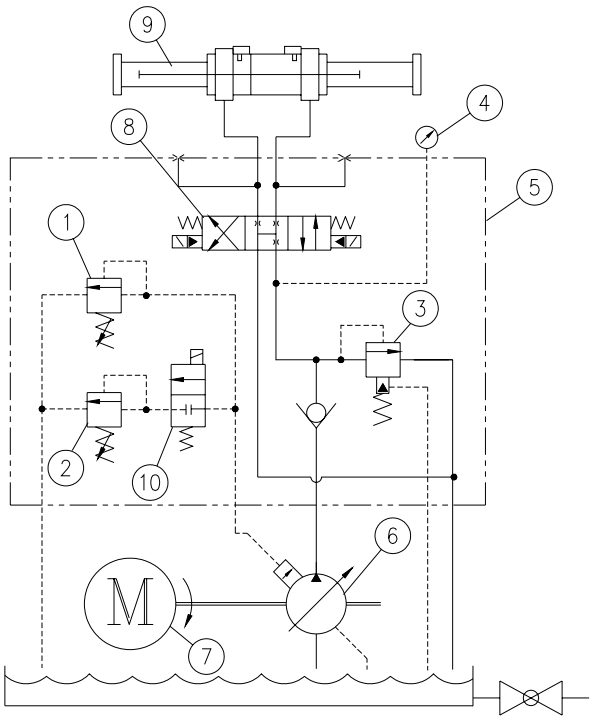
If the motor will not start and a “motor feedback” fault message appears, the optical relay which controls the motor starter may need replaced.

Section 9 HYDRAULIC SYSTEM

9 HYDRAULIC SYSTEM - Features

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

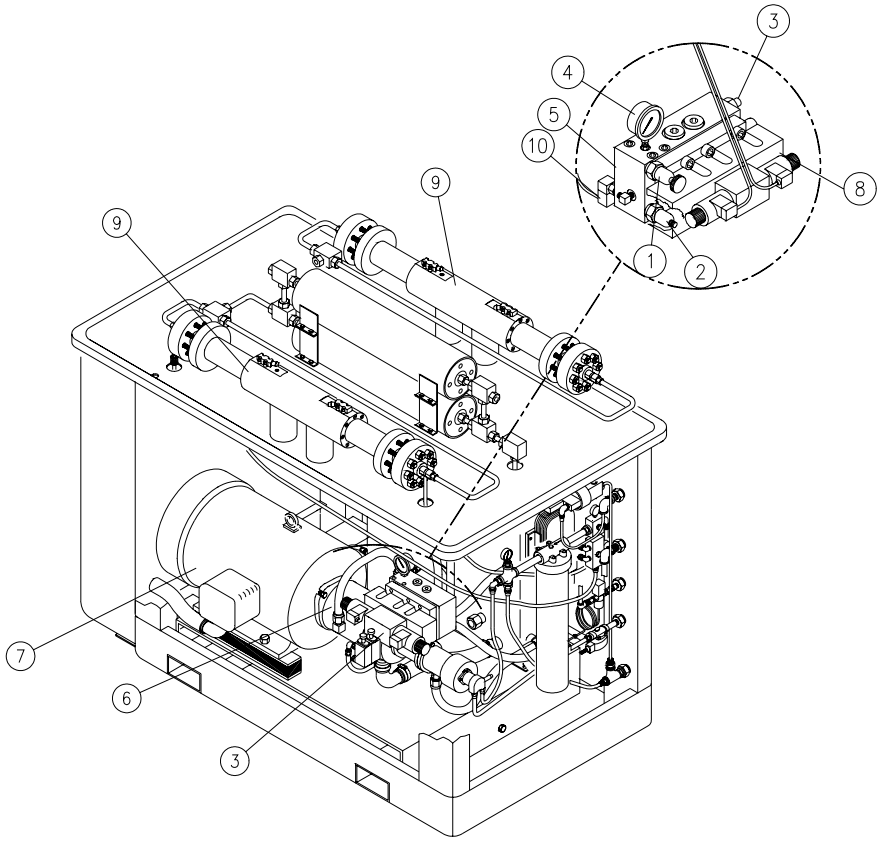
- **Hydraulic 4-way valve –** directional control valve (DCV)–solenoid–operated. Used for HP cylinder shifting.
- **Close - coupled motor/hydraulic pump –** pump mounts directly to the motor, saving approximately 8-10 inches of length on the overall pump/motor assembly, reducing footprint of the waterjet 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.



9.1.1 Components

Following are the hydraulic system components:

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.



Item	Description
(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

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 (HI)	1	Clockwise	Counterclockwise	207 (3,000)	1.7 (25)
Low Pressure (LO)	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 excessive opening of the main relief valve will result in significant wasted heating of the hydraulic oil, and a decrease of HP water flow performance.

9.3 Motor / Hydraulic Service Maintenance

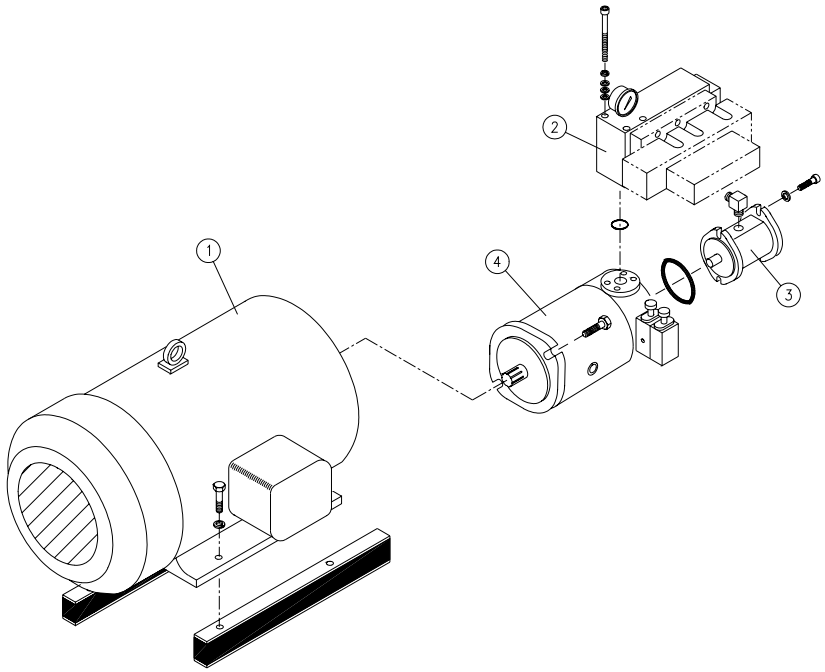
The hydraulic oil filter should be checked daily and replaced when the visual indicator is in the red zone. The hydraulic oil should be replaced every 3000 hours or yearly, whichever occurs first. For hydraulic oil and filter maintenance, see **Section 10, Recirculation System**.

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 need 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- (KMT 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	**Piston Pump Displacement (cc's/rev)**	**SHAFT SEAL – KMT PARTNO.**
SL IV 30 / PLUS	45	05096011
SL IV 50 / PLUS	71	05088083
SL IV 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 KMT Waterjet pump frame (SL-IV30/PLUS, SL-IV50/PLUS SL-IV100). 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 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 capscrews (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)

Section 10 RECIRCULATION SYSTEM

10 RECIRCULATION SYSTEM - Features

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 hydraulic reservoir
- **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 be allowed to become entirely clogged with dirt/contaminants.

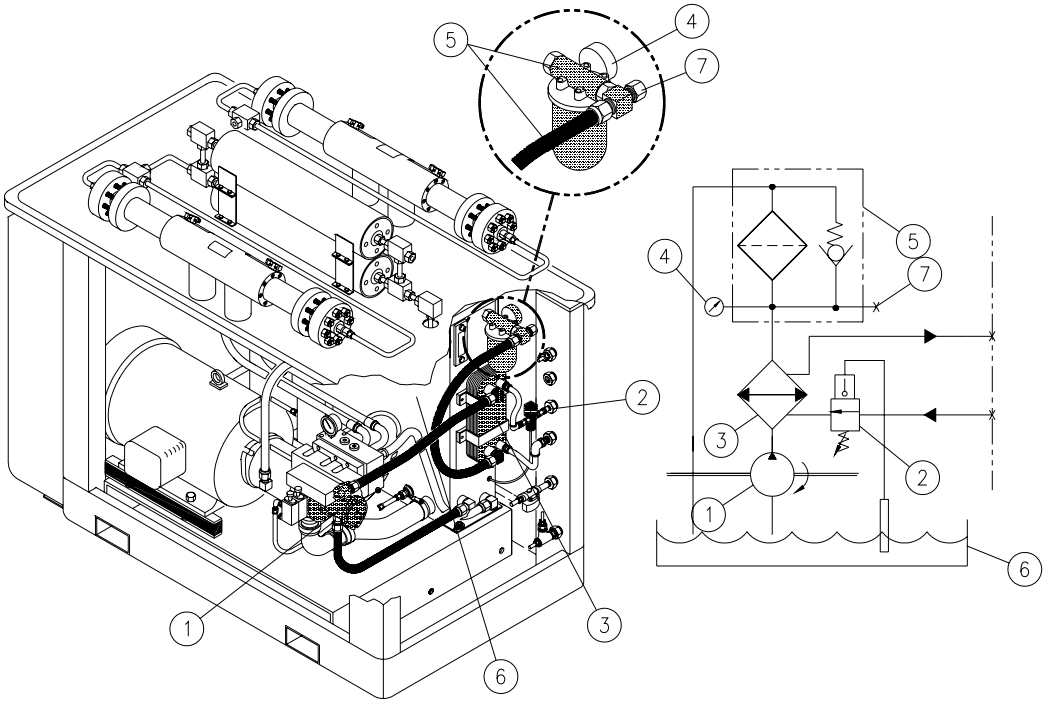
10.2 Operation

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 46°C/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 good filter.

Operating Temperature Adjustment

The operating temperature is adjusted by turning the water modulating valve (19) adjusting knob with a flat blade screwdriver. Clockwise increases the oil temperature.
The water modulating valve regulates the cooling flow that enters the heat exchanger (6) and then discharges 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.



Item Description

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

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 and the visual indicator will read in the green zone. 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 3,000 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. 60016-3
(KMT part 05022702)
Food service, use Conoco AA-20
(KMT 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 filter/ 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.

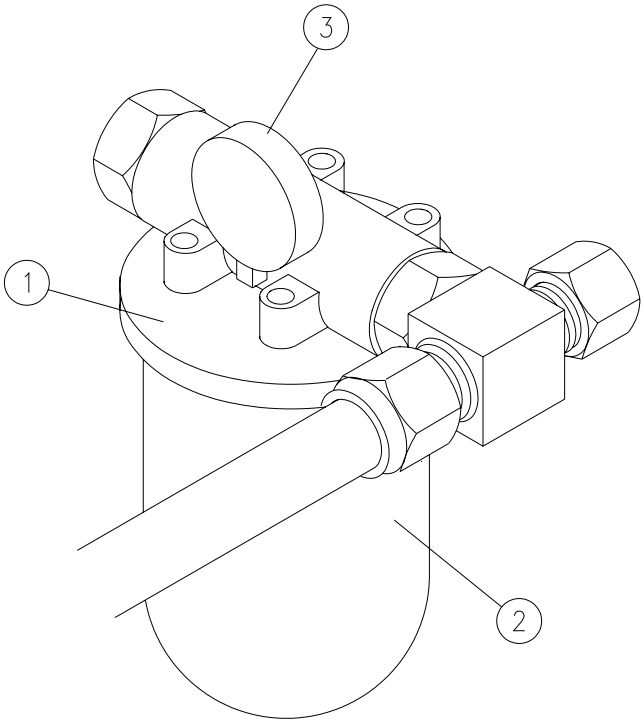
Components: (1) Oil Filter Head
(2) Element
(3) Pressure Gage

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.



Oil Reservoir

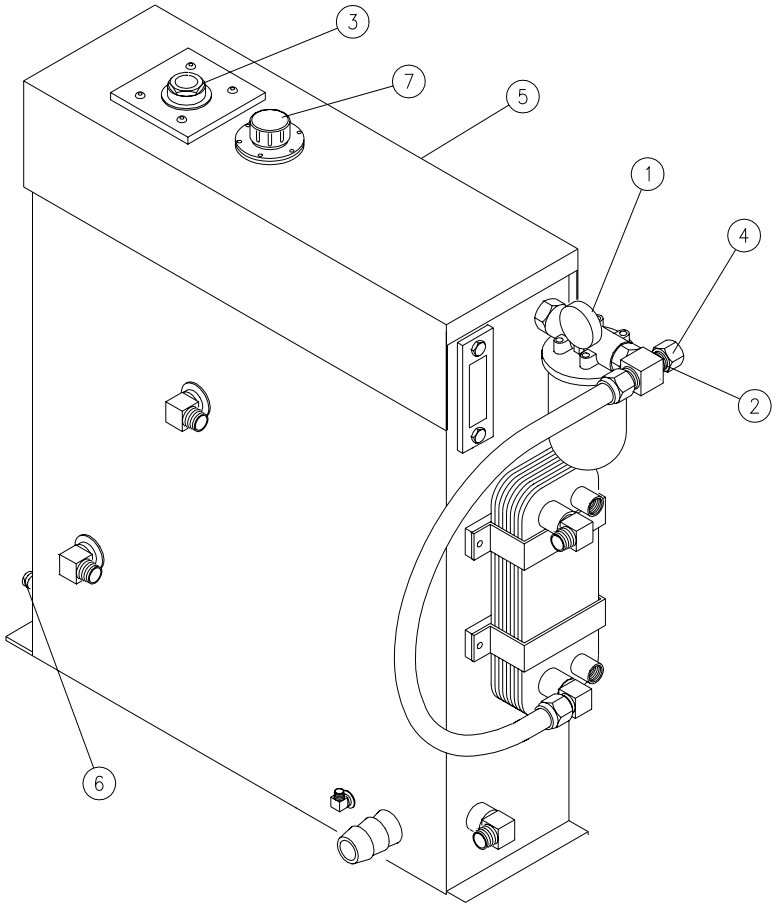
The oil reservoir is equipped with the following:

- Visual temperature and level indicator
- Air breather and filter that prevents dirt from being sucked into the reservoir 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.

After 3,000 hours of operation, or yearly (whichever happens first), analyze the hydraulic oil and replace if necessary.



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 reservoir, by connecting the inlet hose of the oil filter/ transfer pump to the drain valve. Open valve and pump oil to container.
2. Close hand valve, remove oil filter/ 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 filter/ transfer pump, which forces oil through the return filter into the reservoir.

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

⚠ 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 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 filter/ 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.

Section 11 SPECIFICATIONS

11 Specifications

Following are the specifications for the 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

SL-IV Waterjet Pump Size		**22 (30)**	**kW (hp)**
Installation location		Indoors	
-Air borne dust/contaminants		Minimal	
Ambient temperature			
-Minimum storage		2(36)	°C(°F)
-Minimum operating		5(40)	°C(°F)
-Maximum operating		40(104)	°C(°F) (see note [1])
Maximum Relative Humidity			(see note [2])
-At Maximum Operating Temp.		95%	
Electrical			(see note [3])
-Motor type		TEFC	(see note [4])
Voltage / Service Amps	200/3/50	92	Volts/Phase/Hertz/Amps
	208/3/60	88	
	240/3/60	80	
	400/3/50	46	
	415/3/50	44	
	480/3/60	40	
	575/3/60	32	
Sound Level		72.5	dB(A)
Controls			
-Voltage		24	volts, DC
-Power Supply		10	amps, DC
-Safety shutdown switch settings			
High oil temperature		62 (144)	°C (°F)
Low oil level		80 (21)	liters (gal).
Booster Pump Overheat		53 (128)	°C (°F) (see note [5])
Hydraulic System			
-Oil tank capacity		106(28)	liters (gal)
-Recommended oil type			
Regular applications		Mobil, DTE Heavy Medium, # 60016-3 (KMT # 05022702)	
Food applications		AMOCO #FG68EL (KMT # 49835762)	
-Hydraulic oil operation			
Minimum temperature		15(60)	°C(°F)
Maximum temperature		65(150)	°C(°F)

Note [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.
[3]: Not all motor voltages are readily available, check with factory for availability.
[4]: Totally enclosed fan cooled.
(5): Sound level per TUV report DE1-I-9047401

SL-IV Waterjet Pump Size	22(30)	kW (hp)
Optimum temperature	46(115)	°C(°F)
Hot oil shutdown	62(144)	°C(°F)
Fluid Filtration Rating	Beta 10 >/= 100	Note [6]
Fluid Cleanliness Level	17/14	Note [7]
-Hydraulic Pump Type	Piston	
Displacement	Variable	
Pressure	Compensated	
Flow rate	65(17)	l/min(gpm)
-Hydraulic Settings (factory)		
Main Relief Valve	206 (3000)	bar (psi) Note [8]
-Hydraulic oil cooling		
Total heat rejection	3.7 (5.0)	kW (hp)
Cooling fluid requirements at inlet fluid temperature	18 (65)	°C (°F)
Maximum cooling flow	3.8 (1.0)	l/min (gpm)
Maximum inlet pressure	6.9(100)	bar (psi)
Pressure drop	2 (30)	bar (psi)
Cutting Water "IN"		
-Minimum inlet pressure	2.4(35)	bar (psi)
-Maximum inlet pressure Important: must be a constant inlet pressure	5 (73)	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 Booster Pump Settings		
Inlet Pressure	4 (58)	bar (psi)
Outlet Pressure Set at	8.3(120)	bar (psi) (see Note [8])
Cutting Water Out		
-Maximum flow rate	2,3 (0.65)	l/min(gpm)
(Note: Specifications listed below apply equally to 30 hp and 50 hp models)		
-Maximum allowable pressure	4,100 (60,000)	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	½" NPT	
-Cutting water out	9/16"	60,000 psi HP fitting
-Cooling water in	½" 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	¾" male JIC	

Note [6]: Beta filtration rating—There are 100 particles per ml larger than 10 microns upstream of the filter for each particle (per ml) greater than 10 microns downstream of the filter.

Note [7]: ISO-4406 fluid cleanliness ratings—17 ~ < 1,300 particles per ml > 25 microns // 14 ~ < 160 particles per ml > 15 microns.

Note [8]: Booster pump discharge pressure is dependent on inlet pressure.

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
- Cylinder Flange Nut	275 (200)	1-7/16 hex
Seal Head		
- Gland Nut	176(130)	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 (KMT P/N 49864887) is highly recommended for tightening of stainless steel HP water fittings.

A torque wrench kit is available from KMT Waterjet. (KMT 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)	15	1	0,1
Free Chlorine (mg/l)	0,05	0,05	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	25*
Electrical Conductivity [µS/cm]	290	145	45*
Total Hardness as CaCO3 (mg/l)	25	15	1
Turbidity (NTU)	5	5	1

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

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.

Orifice Support Capacity

The SL-IV 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)
22 (30)	4.136(60.000)	2,1 (0,54)	1	0.25 (0.010)
			2	0.17 (0.007)
			4	0.12 (0.005)

Section 12 PARTS LIST

12 Spare Parts Catalogue

STREAMLINE SL-IV 30 (PLUS)
High Pressure Waterjet Pump

To contact the KMT Waterjet Systems 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
E-mail: Wj.parts@kmtwaterjet.com

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Spare Parts Manager
KMT Waterjet Systems
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D–61231 Bad Nauheim
Germany
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Fax: +49–(0)6032–997–271
E-mail: info@kmt-waterjet.com

12.1 General

This section contains parts lists for service procedures and part identification, along with electrical and plumbing schematics of the SL-IV 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:

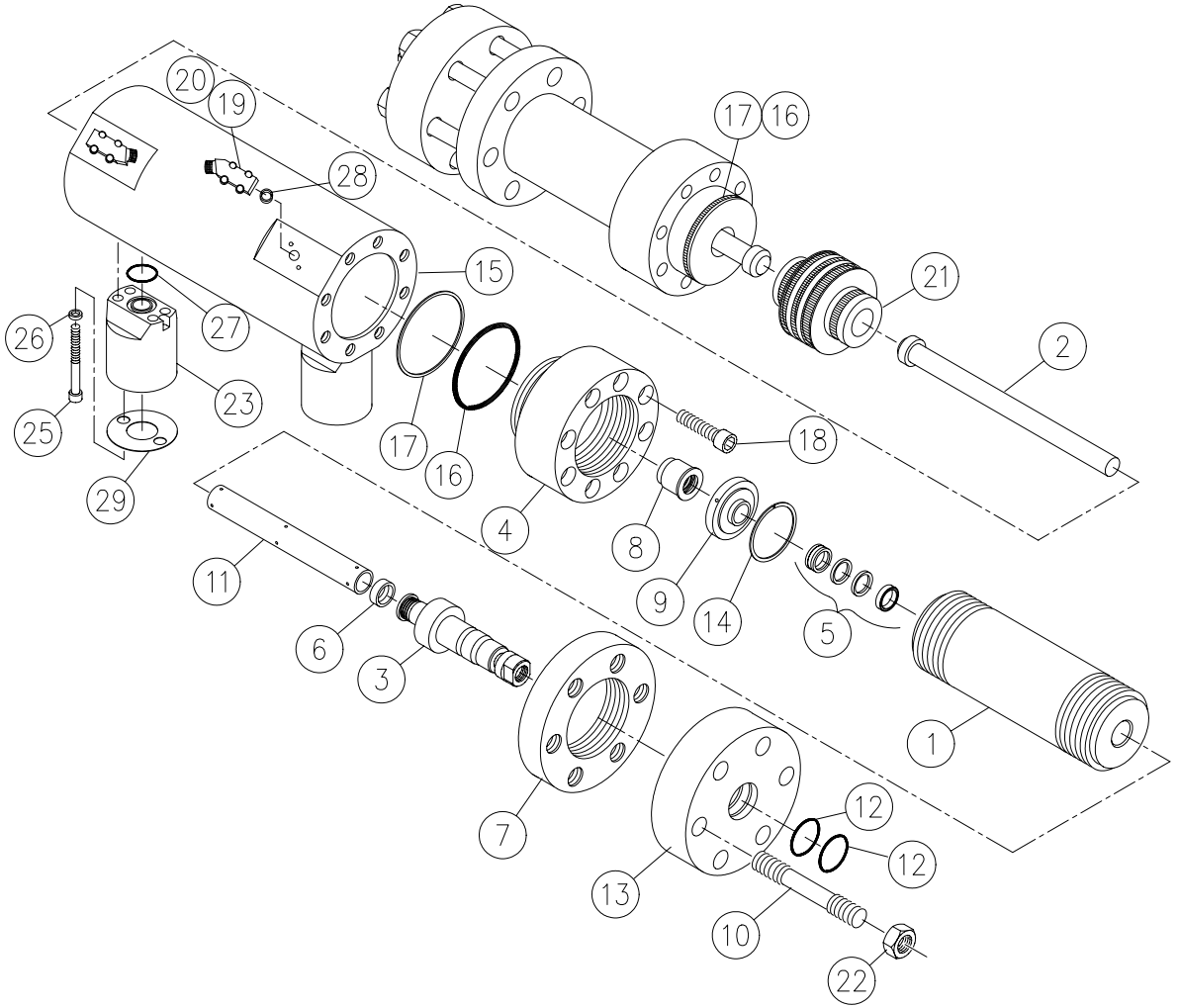
Table 12-1 Part Description Abbreviations and Nominal Size Guide

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

A. HOCHDRUCKWASSERSYSTEM / A. HIGH PRESSURE WATER SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5144217

1. DRUCKÜBERSETZER FLANSCH-VERSION <---> 1. INTENSIFIER FLANGE DESIGN



ERSATZTEILLISTE / SPARE PARTS LISTS
STREAMLINE SL-IV 30HP - STD/PLUS

KMT Waterjet Systems

STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5144217

1. DRUCKÜBERSETZER FLANSCH-VERSION <---> 1. INTENSIFIER FLANGE DESIGN

Pos.	CPN	Qty.	Bezeichnung	Description
01	05144647	2	KÖRPER HD-ZYLINDER SLIV FD	BODY, HD-CYLINDER, SLIV FD
02	05119151	2	KOLBENSTANGE 7/8" KERAMIK	PLUNGER, 7/8", CERAMIC
03	05144688	2	DICHTKOPF KOMPLETT AUSGANG SLIV FD	SEAL HEAD, ASSY, PORT, SLIV FD
04	05147913	2	KOPF HD-ZYL SLIV FD	HEAD,HD-ZYL,SLIV FD
05	05149703	2	DICHTSATZ HYPERLIFE SLIV FD	SEAL ASSY-HP FD, .875
06	05144696	2	DISTANZRING, DICHTKOPF SLIV FD	SPCR-SEAL HD, SL4K
07	05144225	2	FLANSCHRING SL-IV	FLANGE RING SL-IV
08	05130091	2	DICHTUNG HYDRAULIK "CARTRIDGE" NEU	SEAL ASSY, HYDRAULIC "CARTRIDGE" NEW
09	05007786	2	FLANSCH DICHTUNG HYDRAULIK "CARTRIDGE"	FLANGE, SEAL HYDRAULIC, "CARTRIDGE"
10	05144753	12	STEHBOLZEN 7/8-9 x 6.00	STUD, 7/8-9 x 6.00
11	05144712	2	BÜCHSE HD-ZYL, 1.12X8.63, ERTALYTE	LINER-HP CYL, 1.12X8.63, ERTALYTE
12	10074904	4	O-RING ND-WASSER ANSCHLUSSRING SLIII/IV	O-RING, RING, LP WATER INLET, SLIII/IV
13	05144209	2	FLANSCH STIRN SL-IV	FLANGE, END, SL-IV
14	05034798	2	RING FLANSCH HYD. DICHTUNG "CARTRIDGE"	RING, FLANGE, HYD. SEAL, "CARTRIDGE"
15	05034764	1	ZYLINDER HYDRAULIK SLIV	CYLINDER, HYDRAULIC, SLIV
16	10075000	2	O-RING 3-3/4"x4"x1/8"	O-RING, 3-3/4"x4"x1/8"
17	05034855	2	STÜTZRING 3-3/4"x4"	RING, BACK-UP, 3-3/4"x42
18	05141106	16	SCHRAUBE M14 x 60	SCREW, CAP, M14 x 60
19	05127584	2	SCHALTER NÄHERUNG 20-250 VAC/VAC	SWITCH, PROXIMITY, 20-250 VAC/VAC
20	10183572	4	SCHRAUBE INNENSECHSKANT M6-1x30 MM	SCREW SOCKET HEAD, M6-1x30 MM
21	05132253	1	KOLBEN HYDRAULIK KOMPLETT, SL-IV+	PISTON ASSY HYDRAULIK, SL-IV+
22	10069904	12	MUTTER-SECHSKANT ZUGANKER SLI/SLII	NUT, HEAVY HEX, 7/8"- 9 SLI/SLII
23	05049812	2	ZYLINDER HALTERUNG DRUCKÜBERSETZER SLIV	STEM, MOUNTING TOPWORKS, SLIV
25	05079652	8	SCHRAUBE INNENSECHSKANT M10-1.5 x 85 mm	SCREW, SOCKET HEAD, M10-1.5 x 85 mm
26	05061486	8	FEDERRING M10	WASHER, LOCK, M10
27	10074409	2	O-RING 1"x1-1/4"x1/8"	O-RING, 1"x1-1/4"x1/8"
28	05144183	2	ABSTANDHALTER NÄHRUNGSSCHALTER (AB) SLIV	SPACER, PROXIMITY SWITCH (AB), SLIV

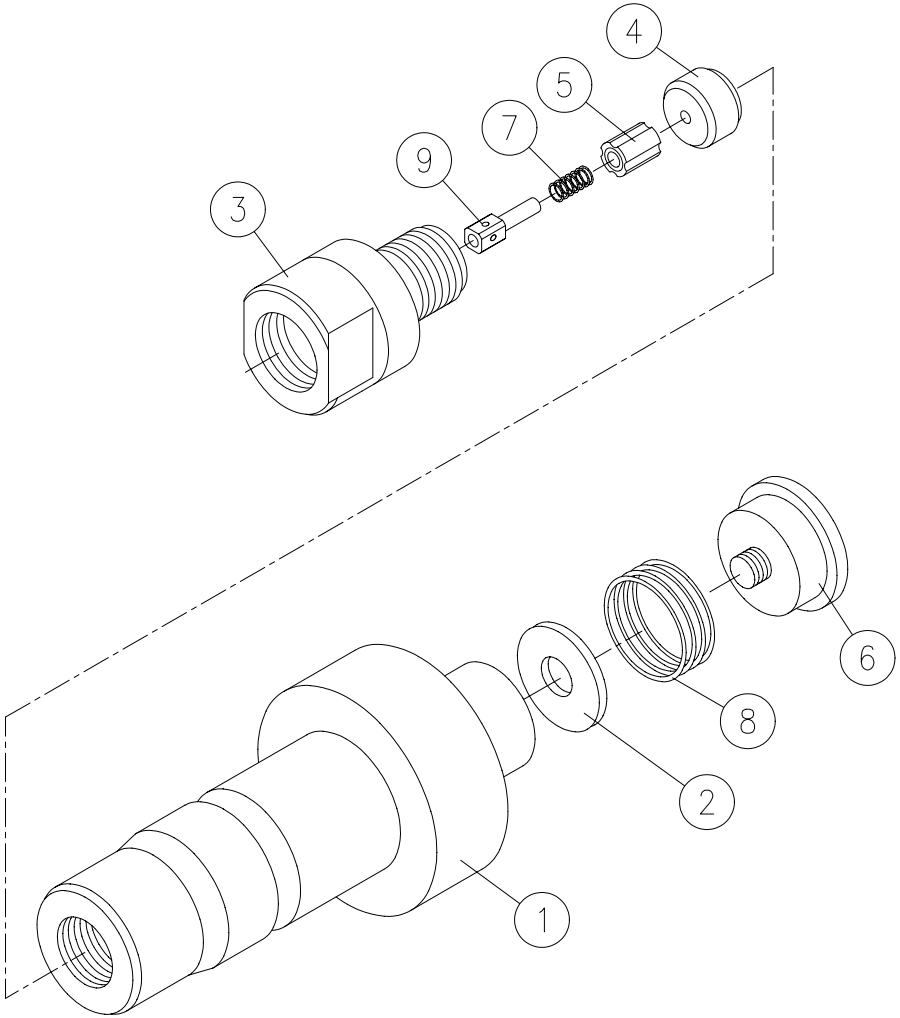
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5144217

1. DRUCKÜBERSETZER FLANSCH-VERSION <---> 1. INTENSIFIER FLANGE DESIGN

Pos.	CPN	Qty.	Bezeichnung	Description
29	05081872	2	DICHTUNG HALTERUNG HYD. ZYLINDER SL-IV	GASKET, STEM, HYD. CYLINDER, SL-IV

ZEICHNUNG VON / DRAWING OF CPN 5144688

2. DICHTKOPF SITZVENTIL <---> 2. SEALING HEAD POPPET SEAT



STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5144688

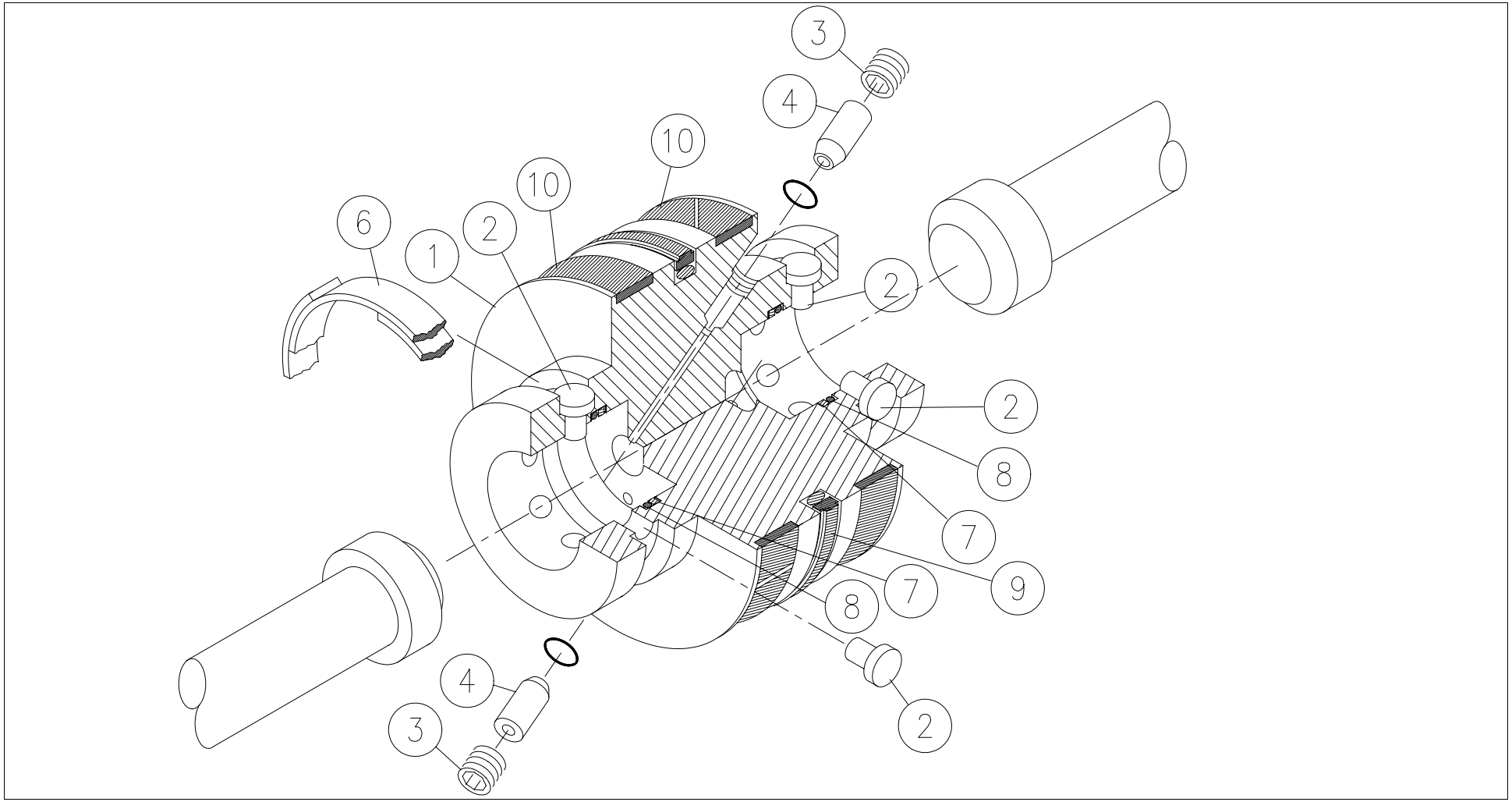
2. DICHTKOPF SITZVENTIL <---> 2. SEALING HEAD POPPET SEAT

Pos.	CPN	Qty.	Bezeichnung	Description
01	05144357	1	KÖRPER DICHTKOPF AUSGANG SLIV	BODY, SEAL HEAD, PORT, SLIV
02	05144662	1	SCHEIBE DICHTUNG ND-WASSEREIN SLIV FD	VALVE, POPPET, LP WATER INLET SLIV FD
03	05116777	1	MUTTER DICHTKOPF SITZVENTIL SL-IV	NUT, GLAND, SEAL HEAD, POPPET SL-IV
04	05112768	1	SITZ DICHTKOPF 17MM SL-IV 100HP	SEAT, SEAL HEAD, 17MM, SL-IV 100HP
05	05116561	1	SITZ DICHTKOPF SITZVENTIL SL-IV	SEAT, SEAL HEAD, POPPET SL-IV
06	05144670	1	HALTERUNG FEDER WASSEREING. SLIV FD	RETAINER, POPPET, LP-WATER SLIV FD
07	05147863	1	FEDER RÜCKSCHLAGVENTIL SLIV FD	SPRING, CHECK VALVE, SLIV FD
08	49884562	1	FEDER ND-WASSEREINGANG SLIII/IV	SPRING, LP-WATER INLET, SLIII/IV
09	05116751	1	HALTERUNG SITZVENTIL SL-IV	RETAINER, POPPET VALVE, SL-IV

A. HOCHDRUCKWASSERSYSTEM / A. HIGH PRESSURE WATER SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5132253

3. HYDRAULIKKOLBEN <---> 3. PISTON ASSY HYDRAULIC



ERSATZTEILLISTE / SPARE PARTS LISTS
STREAMLINE SL-IV 30HP - STD/PLUS

KMT Waterjet Systems

STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5132253

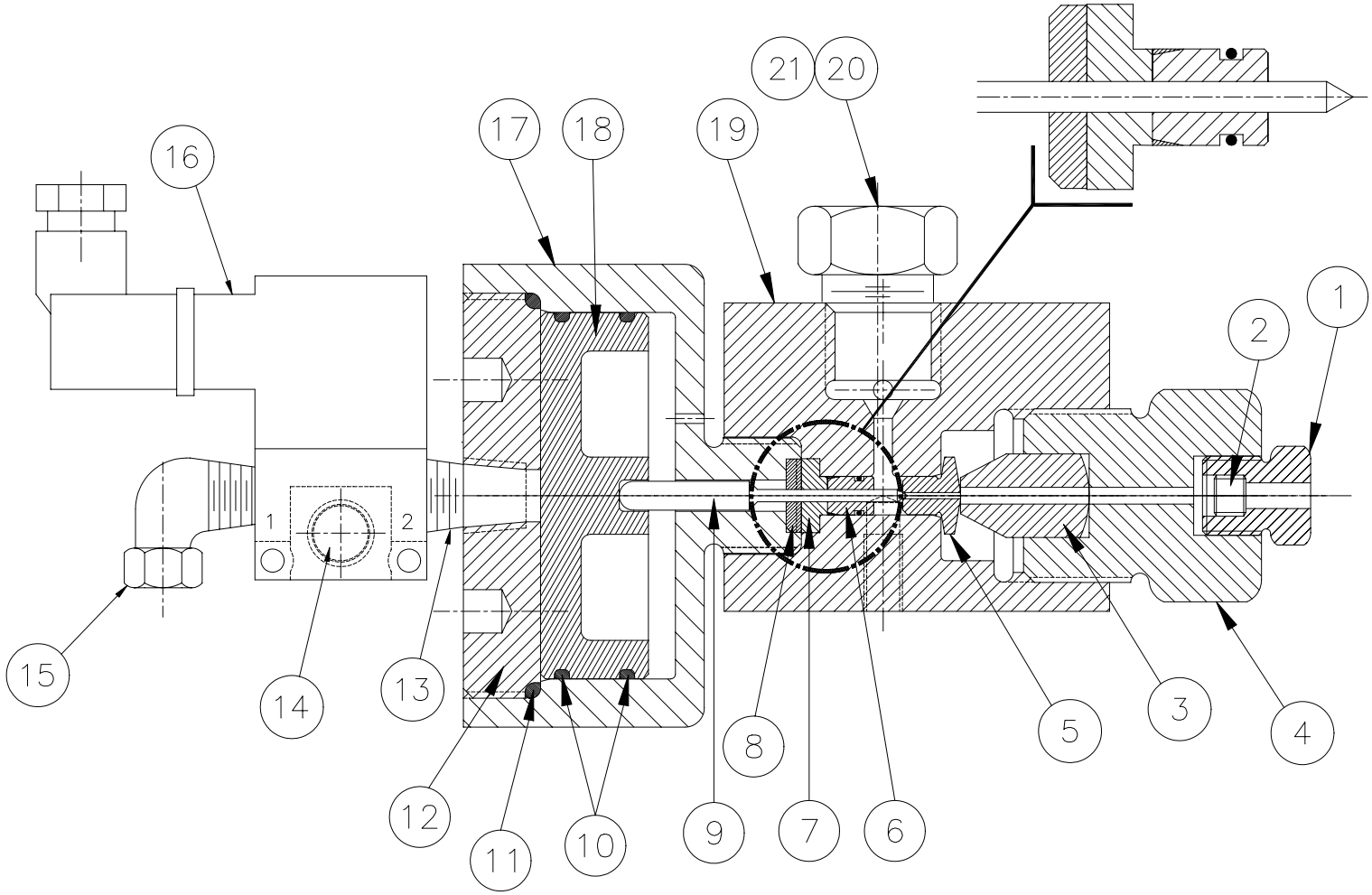
3. HYDRAULIKKOLBEN <---> 3. PISTON ASSY HYDRAULIC

Pos.	CPN	Qty.	Bezeichnung	Description
01	05132261	1	KOLBEN HYDRAULIK SL-IV 08/01	PISTON, RAM, HYDRAULIC, SL-IV 08/01
02	05074380	12	RÜCKHALTESTIFT KOLBENSTANGE SLIV	PIN, RETAINING, PLUNGER SLIV
03	05049887	2	STOPFEN VERSCHLUSS HYDRAULIKKOLBEN SLIV	PLUG, HEX, HYDRAULIC PISTON SLIV
04	10148757	2	VENTIL RÜCKSCHLAG HYD. KOLBEN SLIV	VALVE, CHECK, HYD. PISTON SLIV
06	05088364	2	RING STAHLBAND HALTERING PINS	RING SNAP, FLAT STEEL BAND,RETAINER PINS
07	05049994	2	STÜTZRING O-RING HYD. KOLBEN SLIV	RING, BACK-UP, O-RING, HYD. PISTON SLIV
08	05087713	2	O-RING 1-1/4"x1-1/2"x1/8"	O-RING, 1-1/4"x1-1/2"x1/8"
09	05117965	1	DICHTSATZ HYDRAULIKKOLBEN SL-IV NEU	SEAL ASSY, HYDRAULIC PISTON, SL-IV
10	05117940	2	GLEITRING HYDRAULIKKOLBEN SL-IV NEU	RING, GLIDE, HYDRAULIC PISTON, SL-IV

A. HOCHDRUCKWASSERSYSTEM / A. HIGH PRESSURE WATER SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5069703

4. VENTIL DRUCKENTLASTUNG <---> 4. VALVE DUMP HP WATER



ERSATZTEILLISTE / SPARE PARTS LISTS
STREAMLINE SL-IV 30HP - STD/PLUS

KMT Waterjet Systems

STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5069703

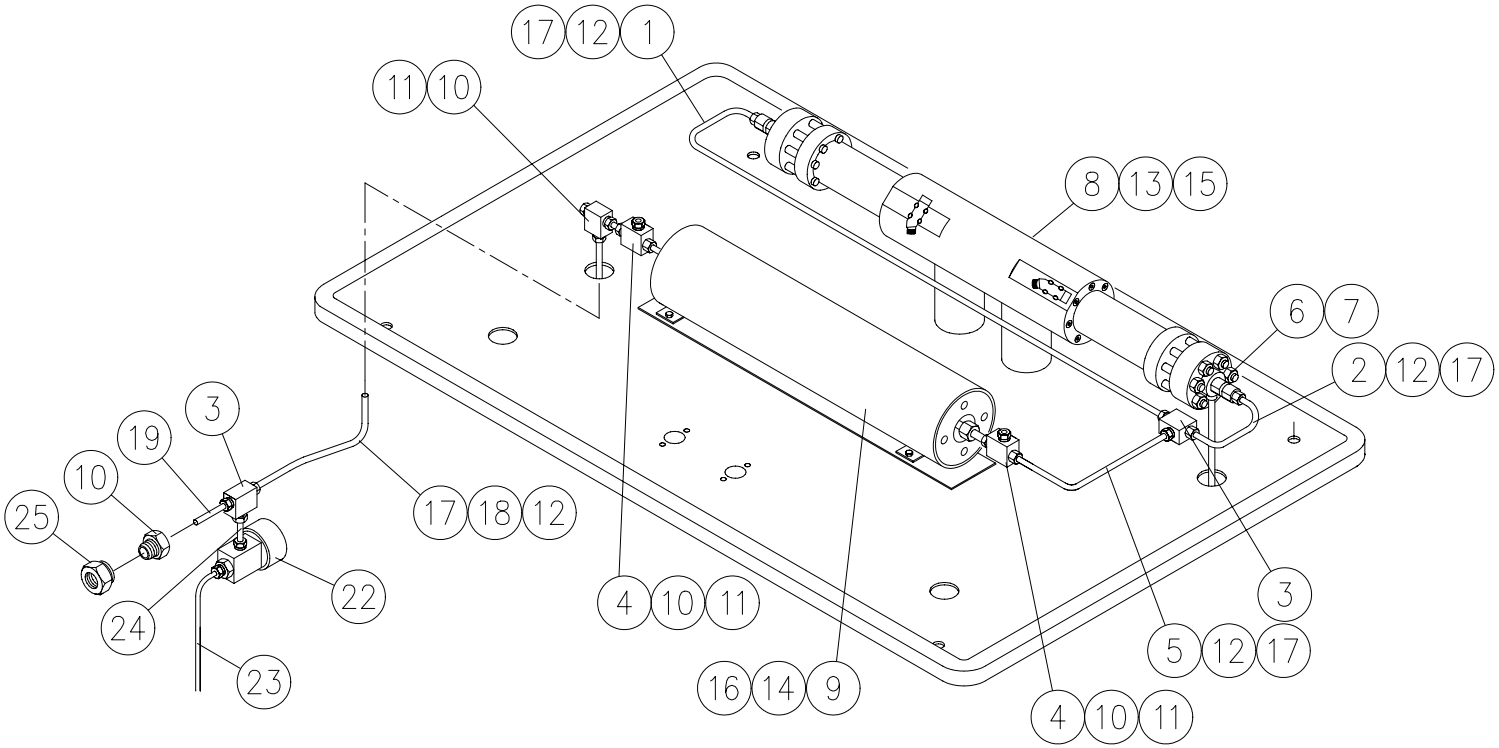
4. VENTIL DRUCKENTLASTUNG <---> 4. VALVE DUMP HP WATER

Pos.	CPN	Qty.	Bezeichnung	Description
01	10078459	1	MUTTER ÜBERWURF HOCHDRUCK 1/4"	NUT, GLAND, HP, 1/4"
02	10078426	1	ROHRMUTTER 1/4" HOCHDRUCK	COLLAR, HP, 1/4"
03	10079291	1	DRUCKSTÜCK KONUSTEIL 9/16"	CONE, 9/16", SAFETY HEAD
04	49864309	1	ADAPTER 9/16"x1/4"	ADAPTER, 9/16"x1/4"
05	10178697	1	NADELSITZ AUSTAUSCHBAR PNEUM. VENTIL	SEAT, REPLACEABLE, PNEUMATIC VALVE
06	10178978	1	DICHTSATZ PNEUMATIKVENTIL ø 0.25"	SEAL ASSY, PNEUMATIC VALVE, ø 0.25"
07	10188233	1	STÜTZRING PNEUMATIKVENTIL ø 0.25"	RING, BACK-UP, PNEUMATIC VALVE ø 0.25"
08	10187250	1	STÜTZRING ZYLINDER PNEUMATIKVENTIL	RING, BACK-UP, ACTUATOR, PNEU. VALVE
09	49865843	1	NADEL PNEUMATIKVENTIL 3/8"	STEM, PNEUMATIC VALVE, 3/8"
10	10074565	2	O-RING 2-1/4"x2-3/8"x1/16" VITON	O-RING, 2-1/4"x2-3/8"x1/16" VITON
11	10074714	1	O-RING 2-7/16"x2-5/8"x3/32" VITON	O-RING, 2-7/16"x2-5/8"x3/32" VITON
12	49894173	1	DECKEL PNEUMATIKVENTIL N/O (OBEN)	COVER, TOP, PNEUMATIC VALVE, N/O
13	05450176	1	VERSCHRAUBUNG 1/8"x1/8" MESSING	ADAPTER, MALE, 1/8"x1/8", BRASS
14	49890825	1	SCHALLDÄMPFER MAGNETVENTIL 5.4-8.5 W	SILENCER, SOLENOID VALVE, 5.4-8.5 W
15	10077030	1	KUPPLUNG 90° MÄNNLICH 0.25"x0.13"	COUPLING, 90°, MALE, 0.25"x0.13"
16	49888035	1	MAGNETVENTIL 2/3-WEGE 24VDC 5.4 W	VALVE, SOLENOID, 2/3-WAY, 24VDC, 5.4 W
17	49894199	1	ZYLINDER PNEUMATIKVENTIL N/O	CYLINDER, PNEUMATIC VALVE, N/O
18	49894181	1	KOLBEN PNEUMATIKVENTIL N/O	PISTON, PNEUMATIC VALVE, N/O
19	10189181	1	KÖRPER PNEUMATIKVENTIL ø 0.25"	BODY, PNEUMATIC VALVE, ø 0.25"
20	49864564	1	MUTTER STABILISIERUNG SPANNZANGE 3/8"	COLLET, GLAND, ANTIVIBRATION, 3/8"
21	49864622	1	ROHRMUTTER 3/8" HOCHDRUCK	COLLAR, HP, 3/8"

A. HOCHDRUCKWASSERSYSTEM / A. HIGH PRESSURE WATER SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5144738

5. HD-WASSERKREISLAUF STANDARD <---> 5. HIGH PRESSURE WATER ASSY SINGLE



ERSATZTEILLISTE / SPARE PARTS LISTS
STREAMLINE SL-IV 30HP - STD/PLUS

KMT Waterjet Systems

STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5144738

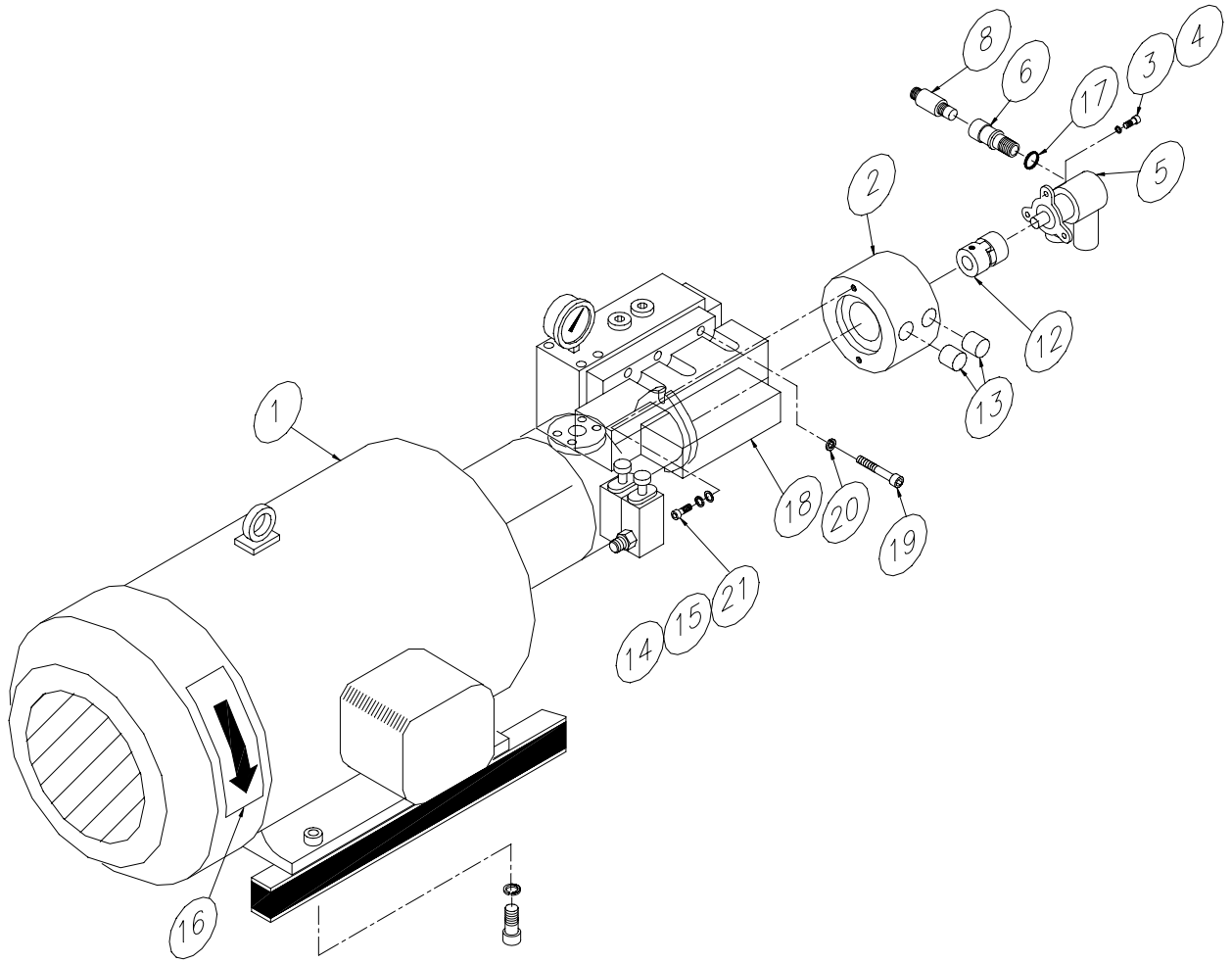
5. HD-WASSERKREISLAUF STANDARD <---> 5. HIGH PRESSURE WATER ASSY SINGLE

Pos.	CPN	Qty.	Bezeichnung	Description
01	05148861	1	HD-ROHR 3/8"GEBOGEN SLIV FD TOPW.	TUBE HP 3/8"BENT SLIV FD TOPW.
02	05148853	1	HD-ROHR 3/8" GEBOGEN SLIV FD P.2	TUBE HP 3/8" BENT SLIV FD
03	10078590	2	KUPPLUNG HOCHDRUCK T-STÜCK 3/8"	COUPLINH, HP, TEE, 3/8"
04	49864663	2	STOPFEN 9/16" HD-ROHR	PLUG, 9/16", HP-TUBE
05	05148846	1	HD-ROHR 3/8" GEBOGEN 4150	TUBE HP 3/8" BENT 4150
06	10078129	2	MUTTER ÜBERWURF HD 3/8"	NUT, GLAND, HP, 3/8"
07	10078715	2	ROHRMUTTER 3/8" HD	COLLAR, HP, 3/8"
08	05144217	1	DRUCKÜBERSETZER KOMPLETT SL-IVPLUS	TOPWORKS, INTENSIFIER, SL-IVPLUS
09	05040696	1	DRUCKSPEICHER TÜV 1 LITER SLIV	ACCUMULATOR, TUV, 1 LITER, SLIV
11	49830599	2	KUPPLUNG HD T-STÜCK 9/16 x 3/8"	COUPLING HP TEE 9/16 x 3/8"
12	10083897	8	ENDRING, ROHRSCHUTZ, 1/4"	FERRULE, 1/4"
13	95413696	4	FEDERRING 1/2"x0.125"	WASHER, LOCK, 1/2"x0.125"
14	05144837	4	ABSTANDSHALTER, DRUCKSPEICHER	SPACER, ACCUMULATOR
15	95383790	4	SCHRAUBE INNENSECHSKANT 1/2"x1"	SCREW, SOCKET HEAD, 1/2"x1"
16	05090717	2	MUTTER GEHÄUSE DRUCKSPEICHER SLIV	NUT, HOUSING, ACCUMULATOR, SLIV
17	10186153	3,8	SCHLAUCH SCHUTZ HD-ROHR 1/4"&3/8"	CONDUIT, PROTECTION, HP TUBE 1/4"&3/8"
18	05148820	1	HD-ROHR 3/8" GEBOGEN SLIV FD P.18	TUBE HP 3/8" BENT SLIV FD
19	10105443	1	HD-NIPPELROHR 3/8" L=101,6MM	HP-NIPPLE TUBE, 3/8" L=4"
20	10078780	1	KUPPLUNG HD 90° 3/8"	COUPLING, HP, 90°, 3/8"
22	05069703	1	ENTLASTUNGSVENTIL PNEUMATISCH SLIV	VALVE ASSY, DUMP, PNEUMATIC, SLIV
23	05080528	1	HD-NIPPELROHR 1/4"x25.5"	HP-NIPPLE TUBE, 1/4"x25.5"
24	10094704	2	HD-NIPPELROHR 3/8" L=76mm	HP-NIPPLE TUBE 3/8" L=3"
25	49830581	1	HD-ROHR 3/8" GEBOGEN SLIV FD P.25	TUBE HP 3/8" BENT SLIV FD
26	10090280	1	VERSCHRAUBUNG SCHOTT 9/16"	COUPLING, BULKHEAD, 9/16"

B. HYDRAULIKSYSTEM / B. HYDRAULIC SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5071741

1. HYDRAULIKANTRIEBSEINHEIT <---> 1. HYDRAULIC POWER PACKAGE



ERSATZTEILLISTE / SPARE PARTS LISTS
STREAMLINE SL-IV 30HP - STD/PLUS

KMT Waterjet Systems

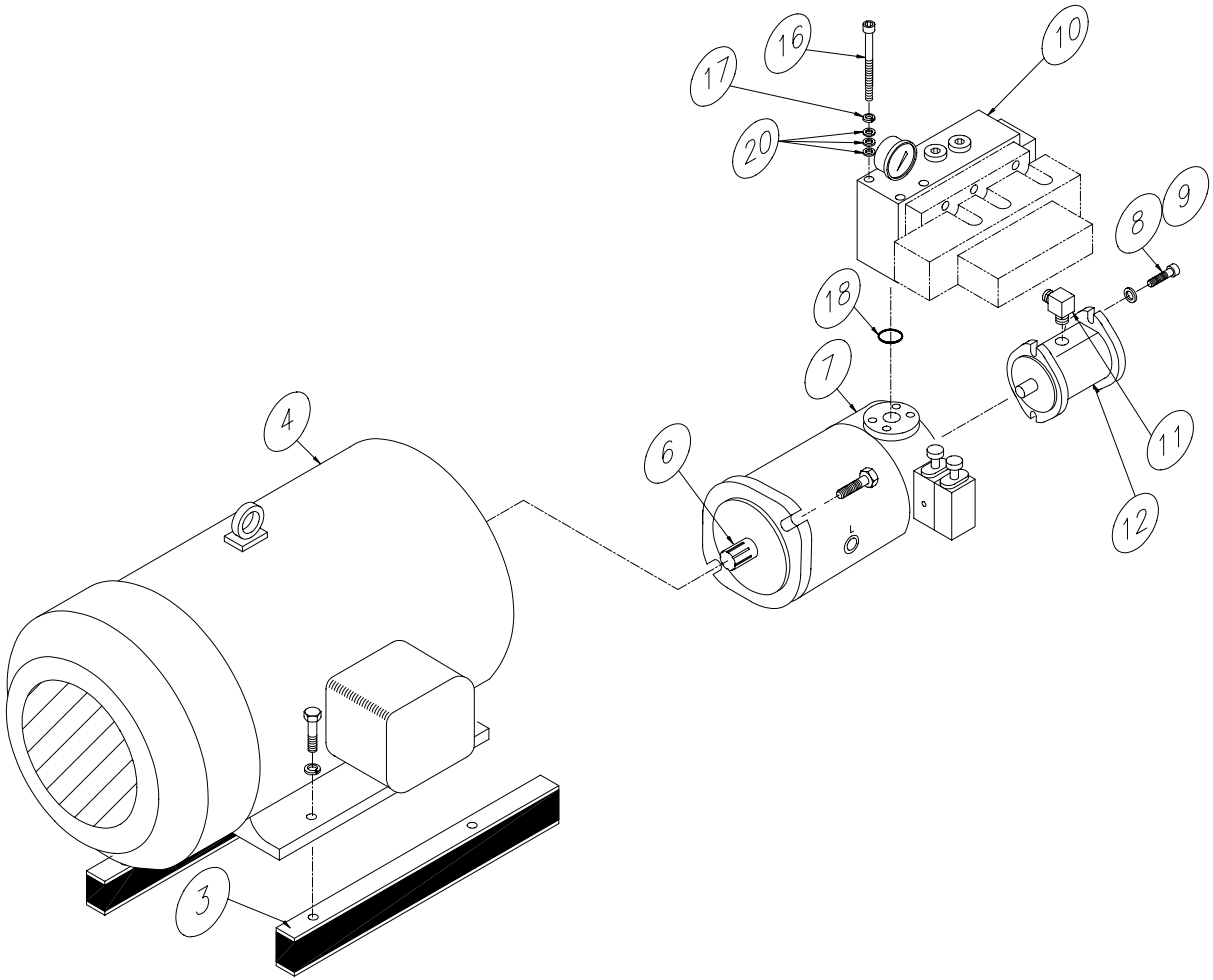
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5071741

1. HYDRAULIKANTRIEBSEINHEIT <---> 1. HYDRAULIC POWER PACKAGE

Pos.	CPN	Qty.	Bezeichnung	Description
01	05071758	1	BAUGRUPPE MOTOR/PUMPE SLIV-50HP	MOTOR/PUMP ASSY, SLIV-50HP
02	05049168	1	ADAPTER BOOSTERPUMPE SLIV	ADAPTER, BOOSTER PUMP, SLIV
03	95572897	3	SCHRAUBE SECHSKANT 1/4"x5/8"	SCREW, HEX HEAD, 1/4"x5/8"
04	95838314	3	SCHEIBE 1/4"x0.063"	WASHER, LOCK, 1/4"x0.063"
05	05071659	1	PUMPE DRUCKERHÖHUNG V2A SLIV	PUMP, BOOSTER, WATER, SS, SLIV
06	05069885	1	ADAPTER TEMPERATURSCHALTER BOOSTER SLIV	ADAPTER, TEMP. SWITCH, BOOSTER SLIV
08	49868813	1	FÜHLER TEMPERATUR SLIII/IV 1/4" NC	SENSOR, TEMPERATURE, 1/4" NC, SLIII/IV
12	10092302	1	KUPPLUNG DRUCKERHÖHERPUMPE SLIII/IV	COUPLING, SHAFT, BOOSTER PUMP, SLIII/IV
13	10116952	2	STOPFEN, ADAPTER BOOSTER SLIV	PLUG, ADAPTER BOOSTER, SLIV
14	95750394	2	SCHEIBE 3/8"x0.094"	WASHER, LOCK, 3/8"x0.094"
15	95416319	2	SCHRAUBE SECHSKANT 3/8"x1"	SCREW, HEX HEAD, 3/8"x1"
16	10091510	1	AUFKLEBER PFEIL DREHRICHTUNG	DECAL, ARROW, DIRECTION ROTATION
17	10074938	1	O-RING 5/8"x3/4"x1/16"	O-RING 5/8"x3/4"x1/16"
18	05092523	1	VENTIL UMSTEUERUNG 24VDC SLIV 30/50HP	VALVE, CONTROL, 24VDC SLIV 30/50HP
19	95055026	6	SCHRAUBE I-SECHSKANT 1/2"x1-3/4"	SCREW, SOCKET HEAD, 1/2"x1-3/4"
20	95688750	6	SCHEIBE 1/2"x0.172"	WASHER, LOCK, 1/4"x0.172"
21	10069714	2	SCHEIBE 3/8"x0.078	WASHER, FLAT, 3/8"x0.078"

ZEICHNUNG VON / DRAWING OF CPN 5071758

2. BAUGRUPPE MOTOR/PUMPE <---> 2. MOTOR/PUMP ASSY



ERSATZTEILLISTE / SPARE PARTS LISTS
STREAMLINE SL-IV 30HP - STD/PLUS

STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5071758

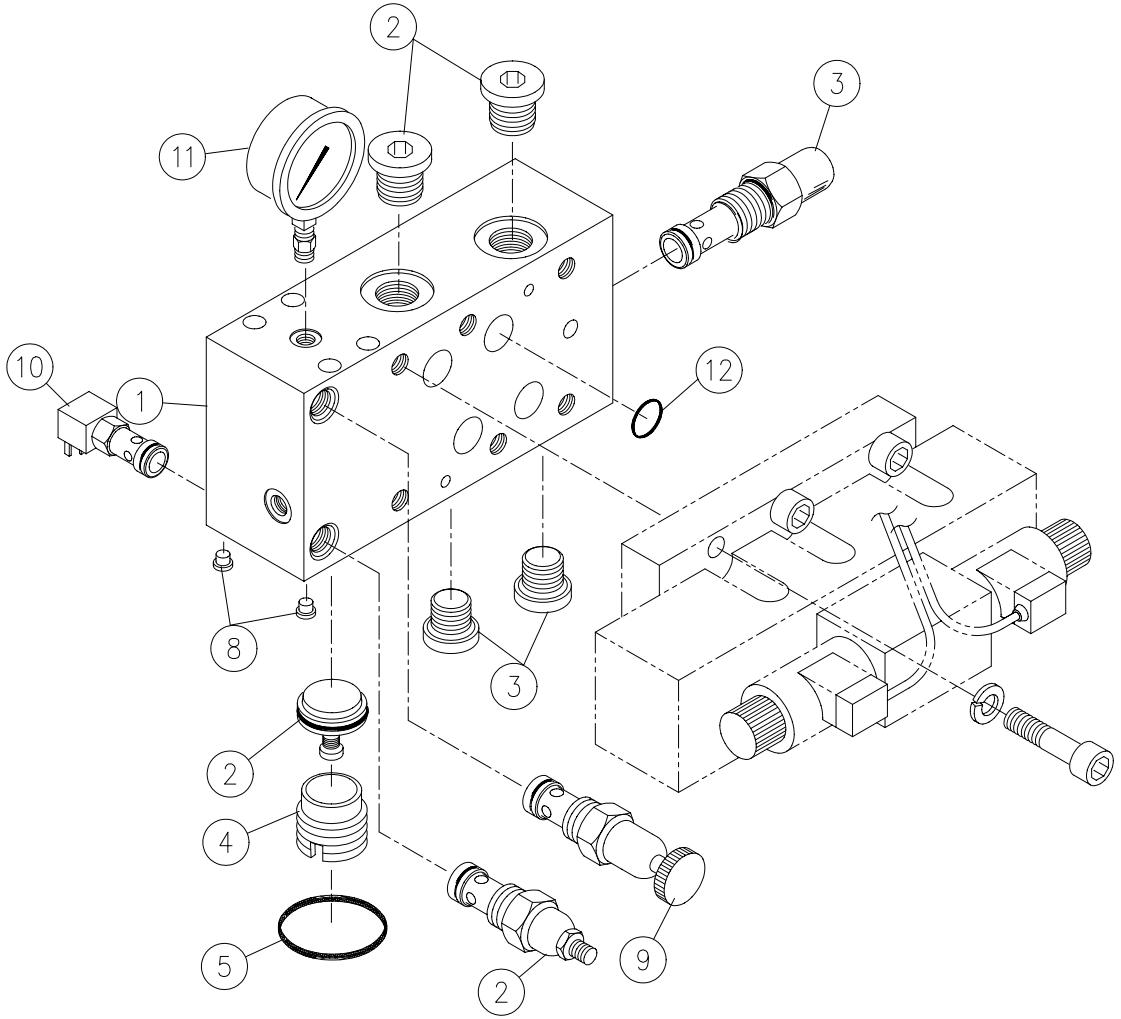
2. BAUGRUPPE MOTOR/PUMPE <---> 2. MOTOR/PUMP ASSY

Pos.	CPN	Qty.	Bezeichnung	Description
03	05101613	2	VIBRATIONSDÄMPFER MOTOR SLIV 50HP	ISOLATOR, VIBRATION, MOTOR SLIV 50HP
04	05045513	1	MOTORHAUPTANSLIV50HP37kW)U N G Ü L T I G	MOTOR,ELECTRICAL,SLIV50HP(37kW) 05105234
06	05047519	1	PASSFEDER SLIV 50HP MOTOR/HYD. PUMPE	KEY, SLIV 50HP, MOTOR/HYD. PUMP
07	05045505	1	PUMPE HYDRAULIK VERSTELLBAR SLIV 50HP	PUMP, HYDRAULIC, VARIABLE, SLIV 50HP
08	05037593	2	SCHRAUBE INNENSECHSKANT M10x25mm	SCREW, SOCKET HEAD, M10x25mm
09	10069714	1	SCHEIBE 3/8"x0.078	WASHER, FLAT, 3/8"x0.078"
10	05071766	1	BLOCK HYDRAULIK KOMPLETT SLIV	MANIFOLD ASSY, HYDRAULIC, SLIV
11	05047451	1	ADAPTER 90° JIC/O-RING 3/4"	ADAPTER, 90°, O-RING/JIC, 3/4"
12	05045364	1	PUMPE HYDRAULIK ZAHNRAD SLIV	PUMP, HYDRAULIC, GEAR, SLIV
16	05091756	4	SCHRAUBE INNENSECHSKANT 7/16"x6"	SCREW, SOCKET HEAD, 7/16"x6"

B. HYDRAULIKSYSTEM / B. HYDRAULIC SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5071766

3. HYDRAULIKBLOCK <---> 3. MANIFOLD ASSY HYDRAULIC



STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5071766

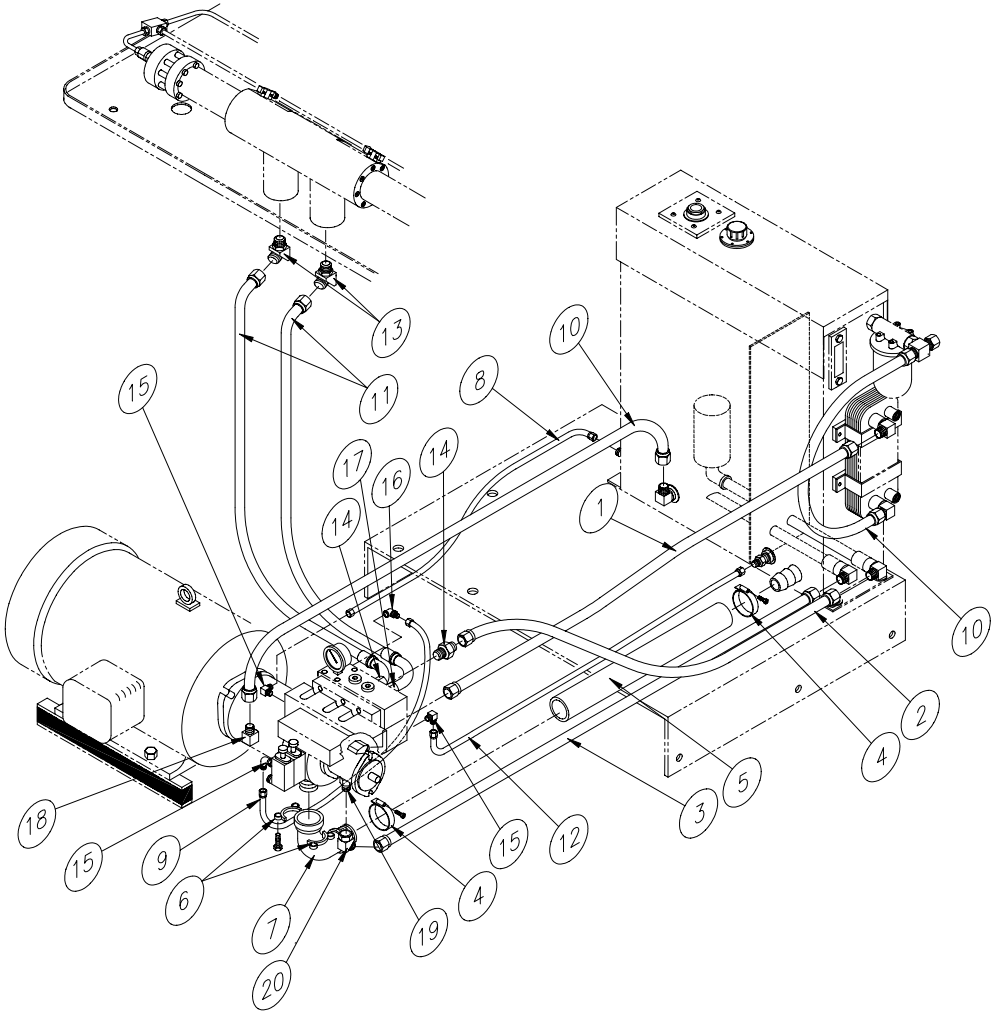
3. HYDRAULIKBLOCK <---> 3. MANIFOLD ASSY HYDRAULIC

Pos.	CPN	Qty.	Bezeichnung	Description
01	05044144	1	KÖRPER HYDRAULIKBLOCK SLIV	BODY, HYDRAULIC MANIFOLD, SLIV
02	05071055	4	STOPFEN INNENSECHSKANT O-RING 3/4"	PLUG, SOCKET HEAD, O-RING 3/4"
03	05071717	1	VENTIL ÜBERSTRÖMUNG 3200 PSI (220 BAR)	VALVE, RELIEF, 3200 PSI (220 BAR)
04	05055017	2	STOPFEN INNENSECHSKANT O-RING 1/4"	PLUG, SOCKET HEAD, O-RING 1/4"
05	10185585	1	MAGNETVENTIL 2/2-WEGE 24VDC N/O	VALVE, SOLENOID, 2/2 WAY, 24VDC N/O
06	05045497	1	MANOMETER HYDRAULIKDRUCK SLIV	GAUGE, PRESSURE, HYDRAULIC SLIV
07	10187052	1	VENTIL ÜBERSTRÖMUNG 1/4" 100-3000 PSI	VALVE, RELIEF, 1/4" 100-3000 PSI
08	10187060	1	VENTIL ÜBERSTRÖMUNG 1/4" 25-800 PSI	VALVE, RELIEF, 1/4" 25-800 PSI
09	10074953	1	O-RING 1-1/2"x1-3/4"x1/8"	O-RING, 1-1/2"x1-3/4"x1/8"
10	49889744	1	HALTERUNG RÜCKSCHLAGVENTIL SLIII/IV	RETAINER, HYD. CHECK VALVE, SLIII/IV
11	49889736	1	VENTIL RÜCKSCHLAG CARTRIDGE SLIII/IV	VALVE, CHECK, CARTRIDGE, SLIII/IV
12	10189595	1	SATZ O-RINGE 4-WEGE UMSTEUERVENTIL	KIT, O-RING, 4-WAY VALVE

B. HYDRAULIKSYSTEM / B. HYDRAULIC SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5052519

4. HYDRAULIKSCHLÄUCHE <---> 4. HYDRAULIC HOSE CONNECTIONS



STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5052519

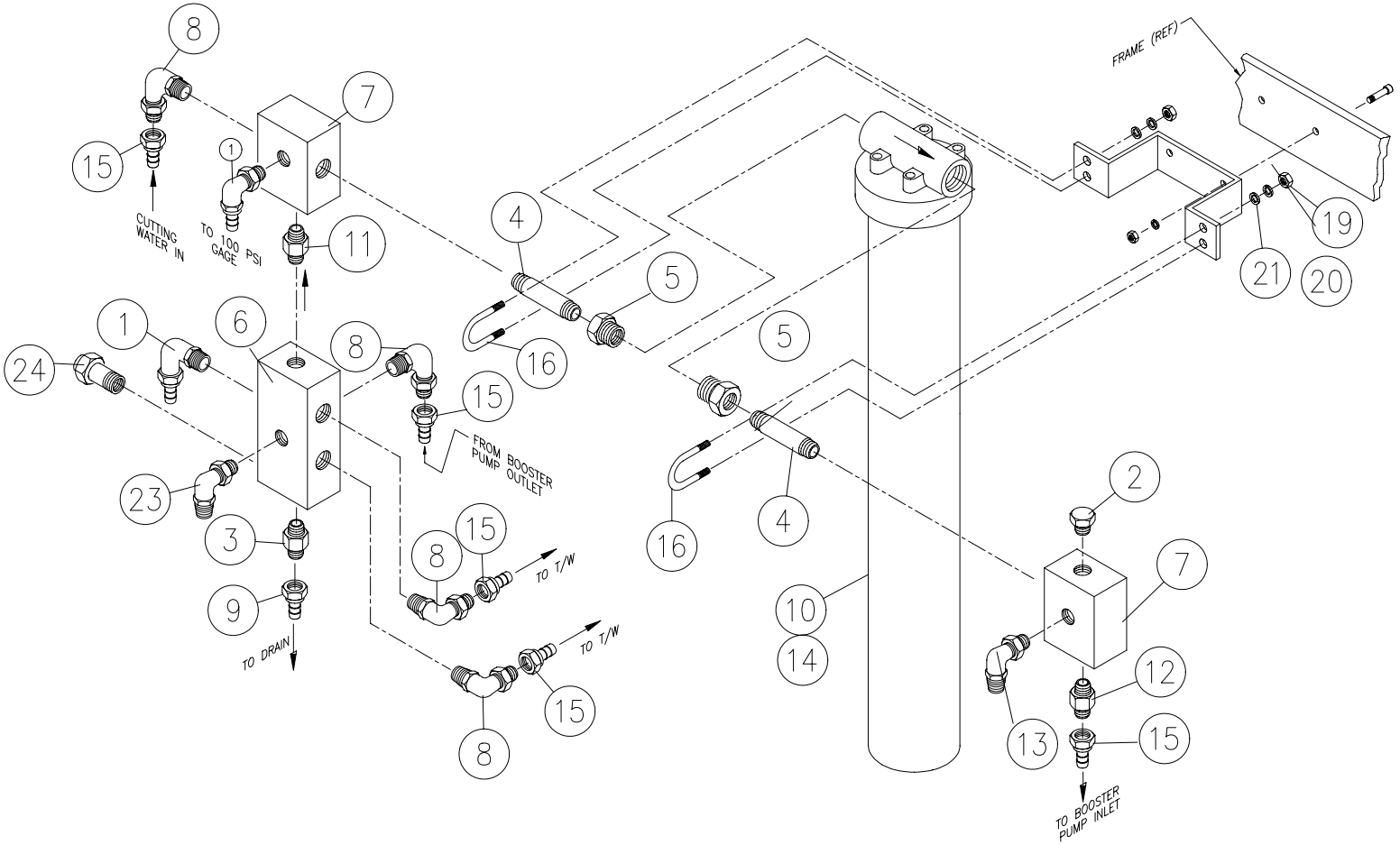
4. HYDRAULIKSCHLÄUCHE <---> 4. HYDRAULIC HOSE CONNECTIONS

Pos.	CPN	Qty.	Bezeichnung	Description
01	05060744	1	SCHLAUCH ND-HYDRAULIK 3/4" L=445 mm	HOSE ASSY, LP HYDRAULIC, 3/4" L=445 mm
02	05049705	1	SCHLAUCH ND-HYDRAULIK 3/4" L=559 mm	HOSE ASSY, LP HYDRAULIC, 3/4" L=559 mm
03	05049739	1	SCHLAUCH ND-HYDRAULIK 3/4" L=356 mm	HOSE ASSY, LP HYDRAULIC, 3/4" L=356 mm
04	10083517	2	SCHLAUCHSCHELLE 1.81 - 2.75"	CLAMP, HOSE, WORM GEAR, 1.81 - 2.75"
05	10179018	0,16	SCHLAUCH HYDRAULIKPUMPE SLII/IV	HOSE ASSY, HYDRAULIC PUMP, SLII/IV
06	05048780	1	FLANSCH 2-TEILIG 2"	FLANGE, SPLIT-KIT, 2"
07	05048806	1	KUPPLUNG FLANSCH 2-TEILIG/SCHLAUCH 2"	COUPLING, SPLIT FLANGE/HOSE, 2"
08	05051214	1	SCHLAUCH MD-HYDRAULIK 1/4" L=1524 mm	HOSE ASSY, MP HYDRAULIC, 1/4" L=1524 mm
09	05060751	1	SCHLAUCH MD-HYDRAULIK 1/4" L=813 mm	HOSE ASSY, MP HYDRAULIC, 1/4" L=813 mm
10	05049713	1	SCHLAUCH ND-HYDRAULIK 3/4" WEIBLICH	HOSE ASSY, LP HYDRAULIC, 3/4" FEMALE
11	05071105	2	SCHLAUCH HD-HYDRAULIK 3/4" L=1016 mm	HOSE ASSY, HP HYDRAULIC, 3/4" L=1016 mm
12	05071121	1	SCHLAUCH MD-HYDRAULIK 1/4" L= mm	HOSE ASSY, MP HYDRAULIC, 1/4" L= mm
13	05052493	2	KUPPLUNG 45° O-RING/JIC 12-10	COUPLING, 45°, O-RING/JIC, 12-10
14	95702619	1	ADAPTER GERADE O-RING/JIC 3/4"	ADAPTER, STRAIGHT, O-RING/JIC, 3/4"
15	10142644	2	ADAPTER 90° HYDRAULIKBLOCK SLIII/IV	ADAPTER, 90°, HYD. MANIFOLD, SLIII/IV
16	10144749	1	ADAPTER 45° O-RING/JIC 1/4"x1/4"	ADAPTER, 45°, O-RING/JIC, 1/4"x1/4"
17	05071113	1	ADAPTER O-RING/JIC 3/4"	ADAPTER, O-RING/JIC 3/4"
18	05050331	1	KUPPLUNG 90° JIC/O-RING 12-10	COUPLING, 90°, JIC/O-RING, 12-10
19	10142594	1	ADAPTER GERADE JIC/O-RING 12-16	ADAPTER, STRAIGHT, JIC/O-RING, 12-16
20	05060777	1	ADAPTER 45° JIC M/W 12-12	ADAPTER, 45°, JIC, M/F 12-12

C. NIEDERDRUCKWASSERSYSTEM / C. LOW PRESSURE WATER SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5140009

1. ND-WASSERFILTER PLASTIK <---> 1. FILTER ASSY LP WATER PLASTIC



ERSATZTEILLISTE / SPARE PARTS LISTS
STREAMLINE SL-IV 30HP - STD/PLUS

KMT Waterjet Systems

STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5140009

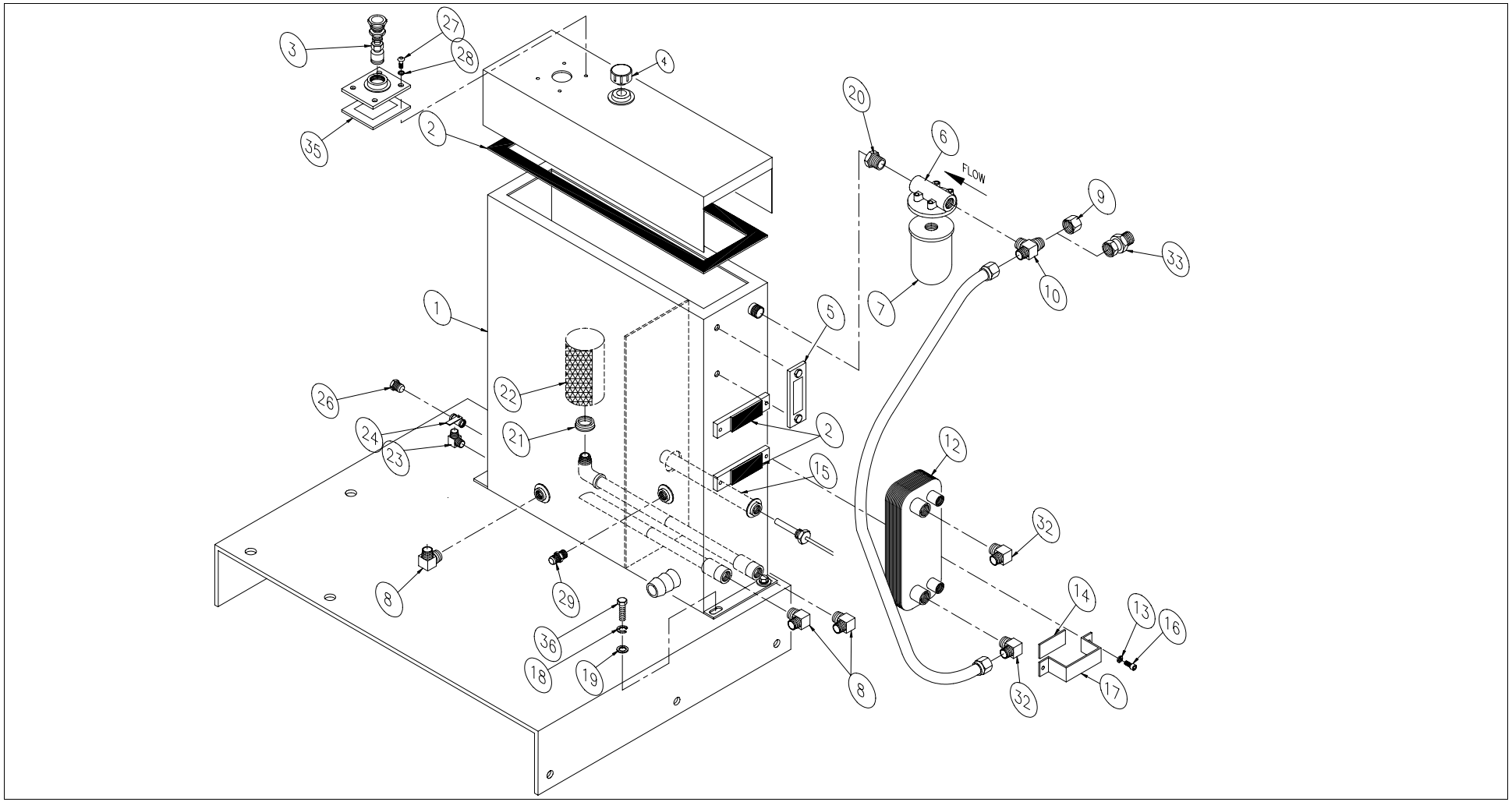
1. ND-WASSERFILTER PLASTIK <---> 1. FILTER ASSY LP WATER PLASTIC

Pos.	CPN	Qty.	Bezeichnung	Description
01	49830714	2	ADAPTER 90° -4 NPT X -4 SCHLAUCH	ADAPTER 90° -4 NPT X -4 HOSE
02	05129689	1	STOPFEN O-RING 1/2"	PLUG, O-RING, 1/2"
03	05070982	1	VENTIL ÜBERSTRÖMUNG 1/2" 50 - 150 PSI	VALVE, RELIEF, 1/2" 50 - 150 PSI
04	05074067	2	NIPPELROHR WASSER 1/2"x3"	NIPPLE, PIPE, 1/2"x3"
05	10078111	2	ADAPTER ROHR M/W 3/4"x1/2"	ADAPTER, PIPE, M/F 3/4"x1/2"
06	05135611	1	ANSCHLUSSBLOCK, ND-EINLASS, SLIV	MANIFOLD, LP-INLET, SLIV
07	05142070	2	ANSCHLUSSBLOCK, ND-MANOMETER SLIV	MANIFOLD, LP-GAUGE, SLIV
08	05135660	4	WINKEL, ND-WINKEL, VON BOOSTER AUSLASS	ELBOW, LP-WATER, FROM BOOSTER OUTLET
09	49830730	1	ADAPTER -8 NPT X -8 SCHLAUCH	ADAPTER, -8 NPT X -8 HOSE
10	05038690	1	KÖRPER ND-WASSERFILTER SLIV	BODY, LP WATER FILTER, SLIV
11	05135652	1	RÜCKSCHLAGVENTIL, ND-WASSER, SLIV	VALVE, CHECK, LP-WATER, SLIV
12	10100485	1	ADAPTER SCHLAUCHANSCHLUSS M/M1,2" x 1,2	ADAPTER, PIPE/HOSE, 1/2" x 1/2"
13	05140751	1	DRUCKSCHALTER; 30PSI	PRESSURE SWITCH; 30PSI
14	10106722	2	FILTER-ELEMENT WASSER 10 MICRON ABS.	FILTER ELEMENT, WATER, 10 MICRON ABS.
15	10189025	1	ADAPTER SCHLAUCH/JIC 1/2"x1/2"	ADAPTER, HOSE/JIC, 1/2"x1/2"
16	10114023	2	BÜGELSCHRAUBE Ý1/2" - 1/4"x1"x1-3/4"	U-BOLT, Ý1/2" - 1/4"x1"x1-3/4"
19	95416335	4	MUTTER SECHSKANT 1/4"-20	NUT, HEX, 1/4"-20
20	95838314	4	SCHEIBE 1/4"x0.063"	WASHER, LOCK, 1/4"x0.063"
21	95391322	4	SCHEIBE 1/4"x0.063"	WASHER, FLAT, 1/4"x0.063"
23	05142062	1	DRUCKSCHALTER; 60 PS I	PRESSURE SWITCH; 60 PS I

D. KÜHLWASSERSYSTEM / D. COOLING WATER SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5041660

1. ÖLTANK <---> 1. RESERVOIR ASSY



STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5041660

1. ÖLTANK <---> 1. RESERVOIR ASSY

Pos.	CPN	Qty.	Bezeichnung	Description
01	05041686	1	ÖLTANK SLIV GESCHWEISST	RESERVOIR, SLIV, WELDMENT
02	05049861	1	DICHTUNG ÖLTANK SLIV	GASKET, OIL RESERVOIR, SLIV
03	05050026	1	SCHALTER TEMPERATUR/ÖLNIVEAU 1" SLIV	SWITCH, TEMPERATURE/LEVEL, 1" SLIV
04	05092739	1	VERSCHLUSSKAPPE ÖLTANK SLIV	CAP, FILLER, OIL RESERVOIR, SLIV
05	10168862	1	MANOMETER TEMPERATUR/ÖLNIVEAU 2x SKALA	GAUGE, TEMP./OIL LEVEL, DUAL SCALE
06	05049697	1	FILTERKOPF ÖL MIT MANOMETER SLIV	FILTER, HEAD, OIL, WITH GAUGE, SLIV
07	05049689	1	FILTERELEMENT ÖL 6 MIKRON ABSOL. SLIV	FILTER ELEMENT, OIL, 6 MICRON,ABS.SLIV
08	05049655	3	KUPPLUNG 90° ROHR/JIC 16x12	COUPLING, 90°, PIPE/JIC, 16x12
09	05069976	1	STOPFEN VERSCHLUSS ÖLBEFÜLLUNG SLIV	PLUG, HEX, OIL FILL PORT, SLIV
10	05071063	1	T-STÜCK MÄNNLICH O-RING/JIC 3/4"	TEE, MALE, O-RING/JIC, 3/4"
11	05049713	1	SCHLAUCH ND-HYDRAULIK 3/4" WEIBLICH	HOSE ASSY, LP HYDRAULIC, 3/4" FEMALE
12	05145958	1	WÄRMETAUSCHER SL-IV-PLUS	HEAT EXCHANGER SL-IV-PLUS
13	95830766	1	FEDERRING 0.31"x0.078"	WASHER, LOCK, 0.31"x0.078"
14	10103232	1	PLATTE, NEOPREN, 0,13 x 1	PLATE, NEOPREN, 0,13 x 1
15	10091858	1	GLÜHBIRNE 3/4"	BULB, 3/4"
16	95119897	4	SCHRAUBE, INNENSECHSKANT, 5/16"-18 x 1/2	SCREW, HEX, 5/16"-18 x 1/2
17	05145974	1	HALTERUNG, WÄREMTAUSCHER	BRACKET, HEAT EXCHANGER
18	95716890	4	FEDERRING 1/2"x0.031"	WASHER, LOCK, 1/2"x0.031"
19	10069763	4	SCHEIBE 1/2"x0.109"	WASHER, FLAT, 1/2"x0.109"
20	05057559	1	ADAPTER GERADE O-RING/JIC 3/4"	ADAPTER, STRAIGHT, O-RING/JIC, 3/4"
21	49868524	1	REDUZIERUNG 1-1/4" x 1" (A-I)	ADAPTER, REDUCING, 1-1/4" x 1" (M-F)
22	05006291	1	DIFFUSOR RÜCKLEITUNG 1-1/4"	DIFFUSOR, RETURN LINE, 1-1/4"
23	10099901	1	KUPPLUNG 90° ROHR/JIC 4-4	COUPLING, 90°, PIPE/JIC, 4-4
24	10080901	1	VENTIL KUGELHAHN 1/2"	VALVE, BALL, 1/2"
26	95033619	1	STOPFEN VIERKANT 1/2"	PLUG, SQUARE HEAD, 1/2"
27	95897948	4	SCHRAUBE RUNDKOPF 10-24x1/2"	SCREW, BUTTON HEAD, 10-24x1/2"
28	95367728	4	FEDERRING 10x0.047"	WASHER, LOCK, 10x0.047"

STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5041660

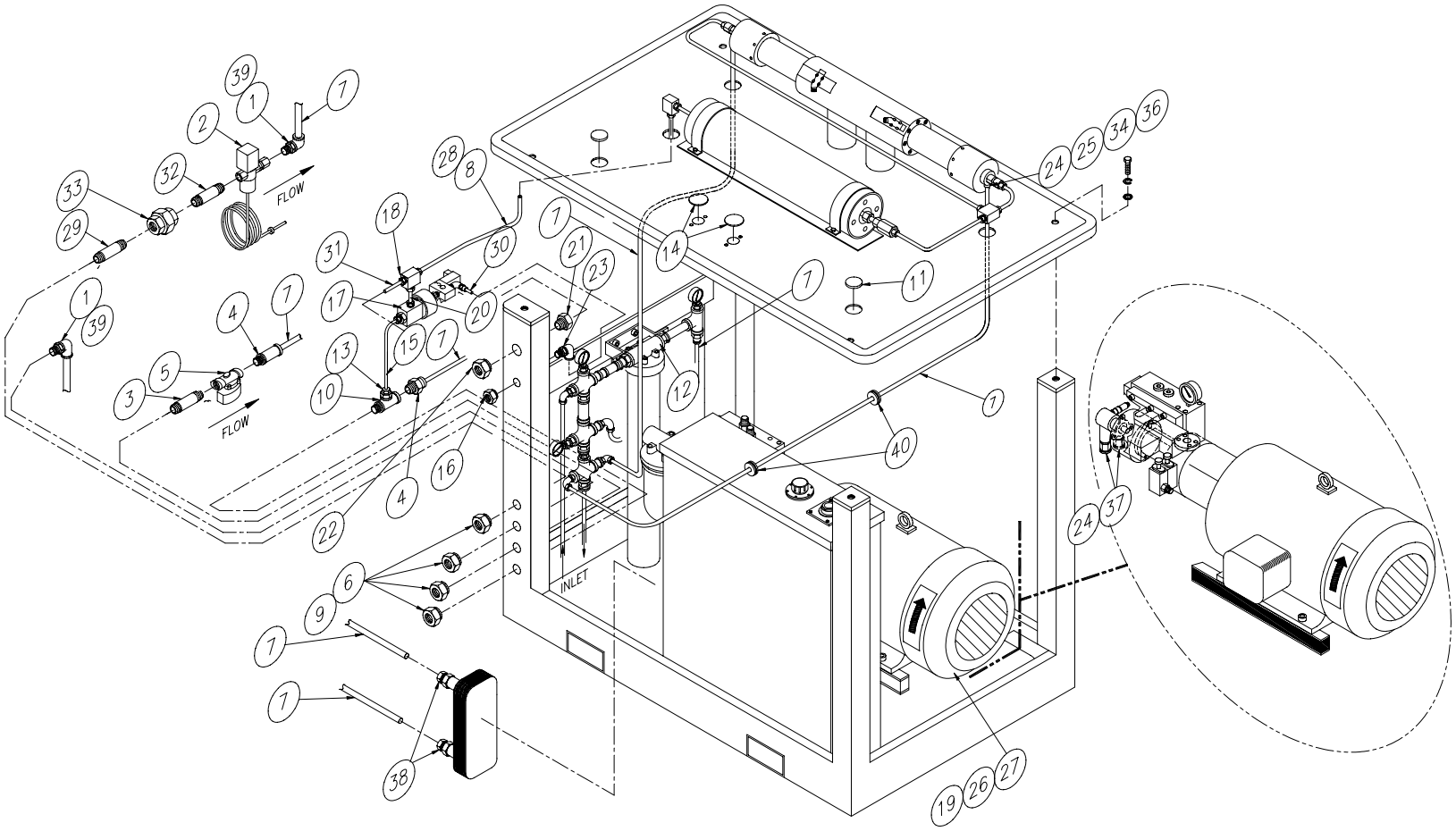
1. ÖLTANK <---> 1. RESERVOIR ASSY

Pos.	CPN	Qty.	Bezeichnung	Description
29	10099877	1	ADAPTER GERADE ROHR/JIC 1/4"	ADAPTER, STRAIGHT, PIPE/JIC, 1/4"
32	05050331	2	KUPPLUNG 90° JIC/O-RING 12-10	COUPLING, 90°, JIC/O-RING, 12-10
33	05079371	1	ADAPTER GERADE JIC/BSPP 12-12	ADAPTER, STRAIGHT, JIC/BSPP 12-12
35	05079967	1	DICHTUNG SCHALTER ÖLTEMP./NIVEAU SLIV	GASKET, SWITCH OIL TEMP./LEVEL, SLIV
36	95738514	4	SCHRAUBE SECHSKANT 1/2"x1" SLIII	SCREW, HEX HEAD, 1/2"x1" SLIII

D. KÜHLWASSERSYSTEM / D. COOLING WATER SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5100318

2. VERSORGUNGSANSCHLÜSSE <---> 2. BULKHEAD PIPE ASSEMBLY



STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5100318

2. VERSORGUNGSANSCHLÜSSE <---> 2. BULKHEAD PIPE ASSEMBLY

Pos.	CPN	Qty.	Bezeichnung	Description
01	10147460	2	KUPPLUNG 90° ROHR/JIC 8-8 MESSING	COUPLING, 90°, PIPE/JIC, 8-8 BRASS
02	10091866	1	VENTIL WASSERTEMPERATUR SLIII	VALVE, WATER, TEMPERATURE, SLIII
03	05060207	1	ROHR EDELSTAHL 1/2" x 5"	PIPE, STAINLESS STEEL, 1/2" x 5"
04	10192425	2	ADAPTER 1/2" NPT X 1/2" SCHLAUCH	ADAPTER, 1/2" NPT X 1/2" HOSE
05	49890239	1	MAGNETVENTIL 24VDC-1/2" ND-WASSER SLII	VALVE, SOLENOID, 24VDC-1/2", LP-WATER
06	49886922	4	SCHOTTVERSCHRAUBUNG 8-24	ADAPTER, BULKHEAD, 8-24
07	10127348	7,1	SCHLAUCH WASSERZUFUHR SLII	HOSE, WATER INLET, SLII
08	05071022	1	HD-NIPPELROHR 3/8" GEBOGEN	HP-NIPPLE TUBE, 3/8" BENT
09	10070092	4	MUTTER SCHOTTVERSCHRAUBUNG ND-WASSER	NUT, JAM, BULKHEAD CONNECTOR, LP-WATER
10	49896749	1	T-STÜCK MÄNNLICH 1/2" EDELSTAHL	TEE, MALE, 1/2", STAINLESS STEEL
11	05061643	2	STOPFEN 1-1/2"	PLUG, 1-1/2"
12	05105432	1	BAUGRUPPE ND-WASSERFILTER SL-IV V2A	FILTER ASSY, LP WATER, SL-IV SS
13	05087143	1	ADAPTER ROHR/SCHLAUCH 1/4"x1/2" MÄNNLICH	ADAPTER, TUBE/PIPE, 1/4"x1/2" MALE
14	05061312	2	DECKEL VERSCHLUSS 2-1/2" SLIV	CAP, SEAL HOLE, 2-1/2", SLIV
15	05080528	1	HD-NIPPELROHR 1/4"x25.5" GEBOGEN	HP-NIPPLE TUBE, 1/4"x25.5", BENT
16	10077055	1	SCHOTTVERSCHRAUBUNG 4-15 MESSING	ADAPTER, BULKHEAD, 4-15, BRASS
17	05069703	1	ENTLASTUNGSVENTIL PNEUMATISCH SLIV	VALVE ASSY, DUMP, PNEUMATIC, SLIV
18	49864507	1	KUPPLUNG HOCHDRUCK T-STÜCK 3/8"	COUPLING, HP, TEE, 3/8"
19	10069763	4	SCHEIBE 1/2"x0.109"	WASHER, FLAT, 1/2"x0.109"
20	10094704	1	HD-NIPPELROHR 3/8" L=76mm	HP-NIPPLE TUBE 3/8" L=3"
21	10079457	1	ADAPTER MÄNNLICH/WEIBLICH 9/16"x3/8"	ADAPTER, MALE/FEMALE, 9/16"x3/8"
22	49864341	1	VERSCHRAUBUNG SCHOTT 9/16"	COUPLING, BULKHEAD, 9/16"
23	10176766	1	KUPPLUNG 90° KUNSTSTOFF 1/4"x1/4"	COUPLING, 90°, POLY, 1/4"x1/4"
24	10189025	4	ADAPTER SCHLAUCH/JIC 1/2"x1/2"	ADAPTER, HOSE/JIC, 1/2"x1/2"
25	05111398	2	SCHNELLKUPPLUNG ND-WASSER 1/4" SL-IV 100	QUICK DISCONNECT, LP WATER, SL-IV 100HP
26	95738514	4	SCHRAUBE SECHSKANT 1/2"x1" SLIII	SCREW, HEX HEAD, 1/2"x1" SLIII
27	10170686	4	FEDERRING 1/2"x0.125"	WASHER, LOCK, 1/2"x0.125"

STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5100318

2. VERSORGUNGSANSCHLÜSSE <---> 2. BULKHEAD PIPE ASSEMBLY

Pos.	CPN	Qty.	Bezeichnung	Description
28	10186153	0,6	SCHLAUCH SCHUTZ HD-ROHR 1/4"&3/8"	CONDUIT, PROTECTION, HP TUBE 1/4"&3/8"
30	10078293	0,6	SCHLAUCH KUNSTSTOFF 1/4" TRANSP.	HOSE, POLY, 1/4", TRANSPARENT
31	10105443	1	HD-NIPPELROHR 3/8" L=101,6MM	HP-NIPPLE TUBE, 3/8" L=4"
32	10145829	2	DOPPELNIPPEL TEMP. SENSOR 1/2"	NIPPLE, DOUBLE, TEMP. SENSOR, 1/2"
33	10082550	1	ADAPTER VENTIL/KÜHLER 1/2"(MS)	ADAPTER, VALVE/HEAT EXCHANGER, 1/2"
34	05111380	2	SCHNELLKUPPLUNG ND-WASSER 1/4" SL-IV 100	QUICK DISCONNECT, LP WATER, SL-IV 100HP
36	05111406	2	ADAPTER SCHNELLKUPPLUNG SL-IV 100	ADAPTER, QUICK DISCONNECT, SL-IV 100HP
37	49886989	2	ADAPTER ROHR/JIC GERADE 6-8 EDELSTAHL	ADAPTER, PIPE/JIC, STRAIGHT 6-8, SS
38	49891468	2	SCHLAUCHANSCHLUSS KOMPLETT SLII	FITTING, HOSE, PUSH-LOK, MALE
39	10173805	2	SCHLAUCHTÜLLE 1/2"x8JIC MESSING	COUPLING, HOSE, 1/2"x8JIC BRASS
40	05113964	4	SCHLAUCHSCHUTZ GUMMI	GROMMET, RUBBER