

STREAMLINE HIGH PRESSURE WATERJET PUMP

OPERATION and SERVICE MANUAL

STREAMLINE SL-IV 50 plus
STREAMLINE SL-IV 50
400 V / 3 / 50 Hz

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Section 1 - Introduction

1 SL-IV Waterjet Pump General Information

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

The SL-IV Waterjet Pump uses low pressure water, which meets certain quality requirements, and increases the pressure up to 4,136 bar (60,000 psi) for ultra-high–pressure waterjet cutting, hydrobrasive cutting, cleaning, surface preparation, etc.

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

Basic configurations of SL-IV intensifier pumps discussed in this manual are listed in Table 1-1 below.

	TABLE 1-1. Model Data- SL-IV Waterjet Intensifier Pumps						
Motor Horsepower Rating		Intensifier		Plunger Quantity and Diameter (inches)		Frame Dim "L"	Redundant
Нр	Kw	Model	HP Water Max Oper Pressare	7/8 (0.875") [22 mm]	1-1/8 (1.125") [29 mm]	(inches)	Option Available?
30	22	SL-IV 30		2	-	67.75	Yes
50	37	SL-IV 50		2	-	67.75	Yes
60	45	SL-IV 60		2	-	77.75	Yes
75	56	SL-IV 75	4.100 bar	-	2	77.75	Yes
100	75	SL-IV 100D	60,000 psi	4	-	77.75	No
100	75	SL-IV 100S		-	2	77.75	Yes

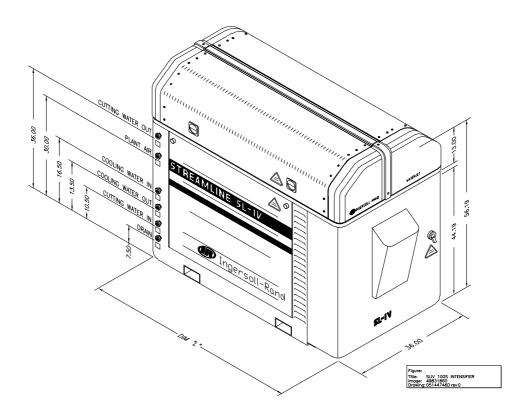
Physical Description

1.1

The waterjet pump is equipped with one or two hydraulically operated intensifiers, one or two liters of high pressure attenuator volume, a motor/hydraulic pump assembly, an electric starter panel, control sensors, solenoids and logic, control interface panel, a low pressure water booster pump, and a low pressure water filter.

The high pressure system is conveniently mounted on a drip pan. All service components are easily accessible from at least two sides simplifying maintenance. The entire high pressure system can be removed from the rest of the unit quickly for maintenance and serviceability.





1.1.1 Standard Equipment

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

- Variable displacement, pressure compensated hydraulic pump
- Water pressure booster and filtration system with 10-micron double-length filter
- High efficiency heat exchanger in independent recirculation pump circuit
- Stand-alone unit with built-in motor starter (wye delta or across the line)
- High pressure safety dump valve
- Dual pressure compensator
- 1 or 2 liters of high pressure attenuator volume
- Microprocessor control with diagnostic capability
- Water inlet shut-off valve
- Booster pump
- Integral water and oil drip pans
- Electrical remote control interface



1.2 Functional Description

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

HP water is produced by an intensifier consisting of two HP water cylinders mounted to a hydraulic cylinder. Ceramic plungers (2 per intensifier) attach to the hydraulic piston and extend into each HP cylinder. With two intensifiers mounted on one SL-IV frame, both may operate simultaneously (dual) or one may serve as stand-by for the other (redundant). Piston travel is sensed electronically by proximity switches which control hydraulic flow to/from the double-acting hydraulic piston/cylinder.

Refer to Table 1-2 for HP water performance limits for various power levels of SL-IV waterjet pumps.

	TABLE 1-2 HP WATER PERFORMANCE- SL-IV WATERJET INTENSIFIER PUMPS				
	3.792 bar ((55,000 psi)	4.137 bar	(60,000 psi)	
Horsepower	Orifice Size	Flow Rate	Orifice Size	Flow Data (gnm)	
	(inches)	(gpm)	(inches)	Flow Rate (gpm)	
30	0.011	0.60	0.010	0.52	
50	0.014	0.98	0.013	0.88	
60	0.015	1.12	0.014	1.02	
75	0.017	1.44	0.016	1.33	
100	0.020	2.00	0.019	1.88	

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

1.2.1 Functional Features

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

- 4,136 bar (60,000 psi) operating pressure
- Electronic reversing
- 24 vdc safety control
- Standard high pressure water leak detection
- Standard dual pressure control facilitates hole piercing and kiss cut applications
- Exclusive long slow stroke
- Cartridge type hydraulic seal
- Low pressure water booster pump and filtration
- Reduced cooling water requirements
- Choice of English, German, Spanish, Swedish and Italian readouts as standard
- Meets CE requirements



1.3 Worldwide Product Support

The KMT Waterjet Systems 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 Systems designated training locations. On-site training is also available.

1.3.1 Service Department

To contact the KMT Waterjet Systems Service Department:

USA: Service Manager Europe: Technical Manager

KMT KMT Waterjet Systems GmbH Waterjet Systems Wasserstrahl—Schneidetechnik

635 West 12th Street Auf der Laukert 11 Baxter Springs, KS 66713 D–61231 Bad Nauheim

USA Germany

1.3.2 Spare Parts

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

Contact the Service Department of KMT Waterjet Systems.

1.3.3 Questionnaire

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



EQUIPMENT AND SERVICE MANUAL QUESTIONNAIRE

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

	neral Appearance		
Wa	s unit received in good condition?	☐ Yes	□ No
Co	mments:		
Is t	he 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:		



Ma	nual Organization		
1.	Does the table of contents help you find topics easily? Comments:	□ Yes	□ No
2.	Is the information well organized? Comments:	□ Yes	□ No
3.	Is the page layout suitable for the material being presented? Comments:	□ Yes	□ No
Gr	aphics		
1.	How do you rate the quality and quantity of the photos/illustrations? Comments:	□ Yes	□ No
Tex	xt		
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:	_	
Nam	e: Title:		
Com	pany:		
Add	ress:		



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.

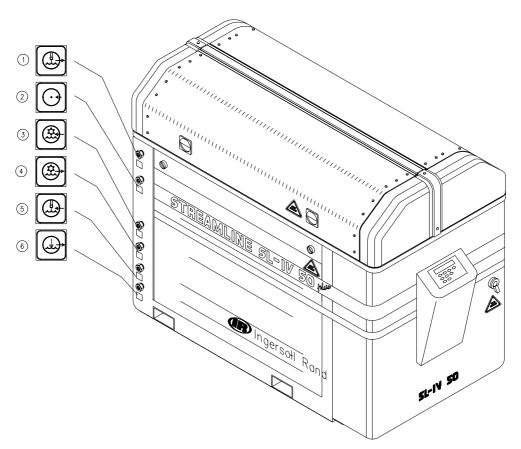
1.4.1 Labels and Abbreviations

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.
<u></u> MARNING	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.
<u>Á</u>	Hazardous voltage within can cause injury or death. Disconnect and lockout main power before opening cabinet.
I	Start/Control Power On
0	Stop
	Hot Surface inside. Do not touch.
	Do not operate with guard removed. Replace Guard before operating machine.



Rear of Waterjet Pump



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



1.4.2 Safety Procedures

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

- The high pressure water, 4,136 bar (60,000 psi) in waterjet cutting systems, should not be a cause for concern. Users must have due respect for these pressures and use proper SAFETY PROCEDURES and SAFE WORK HABITS.
- Everyone associated with the waterjet cutting system must realize that the force of the waterjet cutting stream can penetrate many dense or strong materials.
- Keep all untrained people away from the waterjet cutting area. Use barriers or partitions if needed.
- Safety glasses must be worn at all times in the waterjet cutting area.
- All EMERGENCY STOP buttons must be checked periodically. The normal operating position is pulled out.
- To check: turn on power and activate the EMERGENCY STOP buttons by pushing them in to see if the power goes off. Each device should be checked on a specified schedule. Each time the device is checked, it must function or be replaced before operating the system.
- Apply High Purity Goop (P/N 10084440) to all threaded high pressure connections. All tubing, fittings and bolted connections should be torqued to recommended values. Do NOT attempt to tighten or loosen a HP water fitting when the circuit is pressurized see High Pressure (HP) Piping Safety.
- All high pressure leaks must be repaired immediately.
- Inspect all equipment on a scheduled basis.
- Before performing any maintenance on the unit, MECHANICALLY LOCK THE MAIN CONTROL POWER OFF, and assure the high pressure has been bled off.
- Steam or fog inside the clear top cover indicates a high pressure leak. Turn off intensifier and bleed pressure before lifting the cover.
- Pressing the emergency stop button turns off the control power to the intensifier, stops the intensifier pump, and bleeds high pressure water through the dump valve. Depressurization of the high pressure system creates a loud hissing when the dump valve opens. The sound fades quickly as the pressure drops.





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



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



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



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



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



Do not operate the intensifier with any of the covers opened or removed.



1.4.3 High Pressure (HP) Piping Safety

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



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



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



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



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



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



1.4.4 Emergency Medical Treatment

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

(Front Side)

Medical Alert

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

injuries.

KMT

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

(Back Side)

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



Section 2 - Installation

2 Installation

The installation, start-up, operation, and maintenance of the SL-IV 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 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 Waterjet Systems 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) for proper operation.
- Set booster pump discharge pressure.
- Install and test high pressure plumbing.
- Follow the standard test procedure to insure satisfactory performance.
- Train maintenance personnel in the performance of maintenance and repair procedures.
- Sign off the installation and testing on KMT's standard acceptance document.

2.2 Installation Requirements (Utilities)

Environment:

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

Moving:

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



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



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

2.2.1 Equipment Location/Environment

Space Requirements:

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

Electrical Wiring:

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

Insure that the service voltage and ampacity are proper for this SL-IV pump. Voltage fluctuations in excess of +/- ten percent of nominal voltage may damage the SL-IV 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 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 <u>at maximum flow demand</u> 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 pump cutting water supply filter.

Thoroughly purge the cutting water supply plumbing prior to connecting to the SL-IV 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 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 10084440) applied to the threads and contact surfaces prior to assembly. <u>Do NOT USE ANY OTHER ANTI-SEIZE COMPOUND.</u> Failure to use High Purity Goop will result in galling of the parts, and will generally render them unusable. <u>Do not use High Purity Goop on ANYTHING but stainless steel!</u>

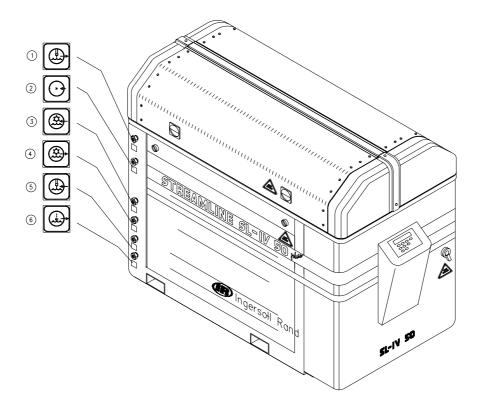
Drain:

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 85 PSIG. Air usage is minimal and less than 1 SCFM.



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



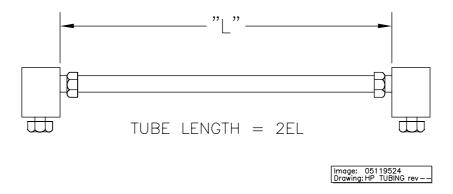
2.3 Tools and Equipment

HP Tube Coning and Threading Procedures

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



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.



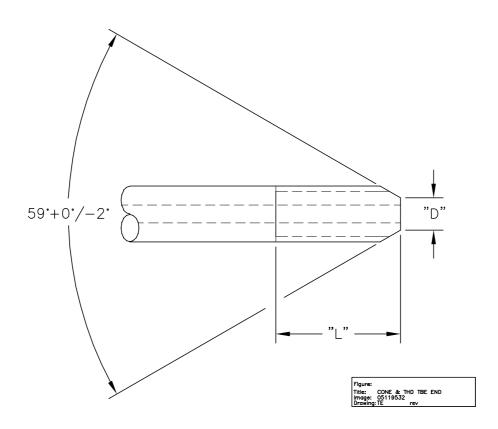
Tube Engagement Length

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



Cone and Thread Tube

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



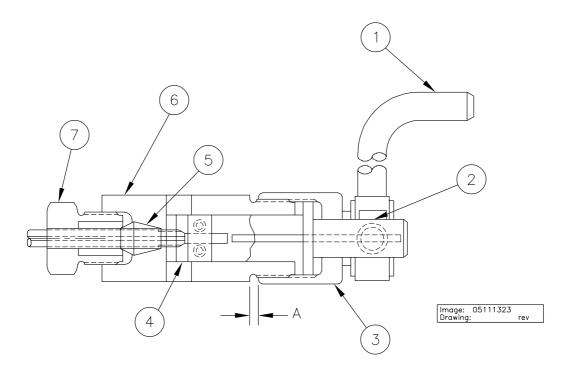
Cone and Thread Dimensions

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



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

Cone and Threading Tool



Item Description

1	Cutter Handle	4	Cutting Blades	6	Housing
2	Cutter Suppor	5	Collet	7	Gland Nut
3	Feed 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 (IR Part)	10079556	10097418	10079663
Threading Tool (IR 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 the feed nut (3) clockwise until cutting blades (4) contact end of tubing.
- Rotate the cutter handle (1) in a 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

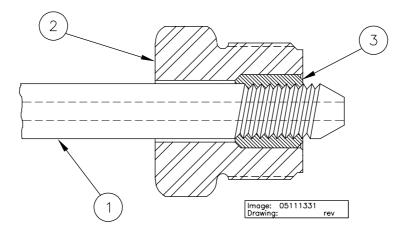
Place the appropriate sized threading tool on the coned end of the tubing, large end forward. Apply pressure to start the cutting action and rotate the die holder counterclockwise until the threads are cut per the cone and thread dimension table.



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.

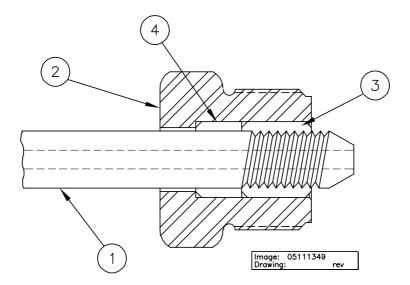


Do not depend on end connection to take the tubing load alone. Proper piping support and guide must be provided.



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

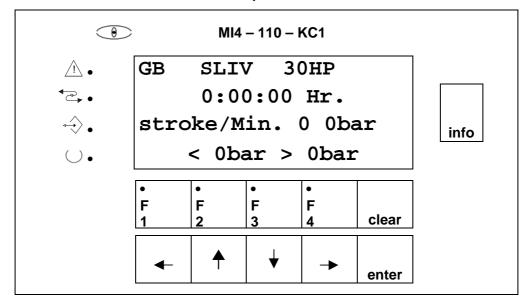
- 1. Slip the gland nut (2) and the anti-vibration collet (4) on the tubing (1). Thread the collar (3) on the tube until one to two threads are exposed between the collar and the tube cone.
- 2. Lubricate the male threads of the gland nut with High Purity Goop. Insert the tubing assembly into the fitting, 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.



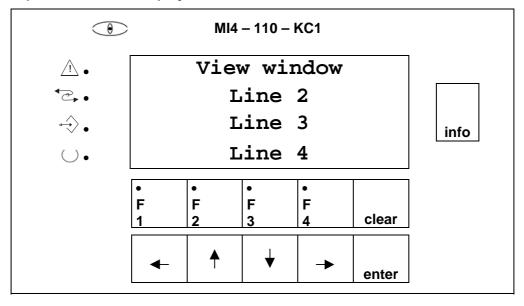


Section 3 - Operation

Text Operator Panel



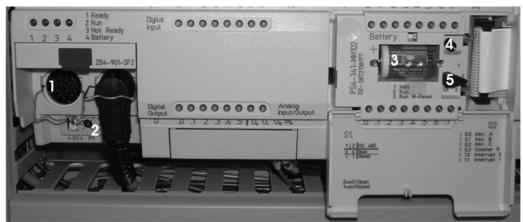
3 Explanation of the display



The four digit display window is located in the center of the operating panel. It displays actual information and values are entered into it.



3.1 The most important elements of the PLC (Programmable Logic Controller)



Item Description

1	PRG socket	4	Reset switch
2	P1 and P2 potentiometer	5	S2 switch
3	Battery		

3.2 Using the arrow keys

You can use the arrow keys to control the views and the lines.

Changing to a different line

You can use the vertical \uparrow and \checkmark arrow keys to scroll up and down the entries in order to access the next line entries or the previous ones.

Changing to a different view

The display has over 20 different views that can be accessed by pressing the horizontal arrow keys \leftarrow or \rightarrow .

Switching over to the system display (View 1)

Press the "Clear" key to return to the system display (View 1).

3.3 Info, clear and enter keys

Info key:

In View 1, pressing the info key calls up the KMT Waterjet Systems contact information such as address, telephone number, fax, Web site address as well as PLC and M14 versions. In View 4, pressing the info key switches the view over to the information display for the memory card.

Clear key:

Go to View 1 (systems display)

Reset alarm

Cancel entry

Open water supply shutoff valve



Enter key:

Function 1: Activates enter function Function 2: Confirms pre-selected entries

3.4 Function keys F1 to F4

F1 key:

ON/OFF pump operation LED ON = Pump in operation LED OFF = Pump off

F2 key:

ON/OFF Pump recirculation

LED ON = Pump recirculation ON

LED OFF = Pump recirculation OFF

Recirculation turns off automatically after 10 minutes.

The "clear" and "enter" keys and the arrow keys are locked during recirculation.

F3 key:

Low pressure – high pressure LED ON = high pressure LED OFF = low pressure

F4 key:

Function 1: Start Password entry

Function 2: Stroke control mode: By pressing this key in View 8, you can integrate the pump into a pump group or remove it from the pump group (optional).

3.5 Symbols and LED's

Symbol	Name	Color	Status	Function
\wedge	Alarm	red	Off	Alarm not active
/!\			On	Alarm active
			Blinking	Alarm (confirmation required)
←	com	green	On	No communication error
	Com		Blinking	Communication error
	_	green	_	Programmable with Macro Editor
, ,	run	Green	Off	Hardware error
			On	o.k.
	-	red	Off	Hardware o.k.
0			On	Hardware error
			Blinking	Performance low
		Green	Off	No key pressed
			On	Key pressed

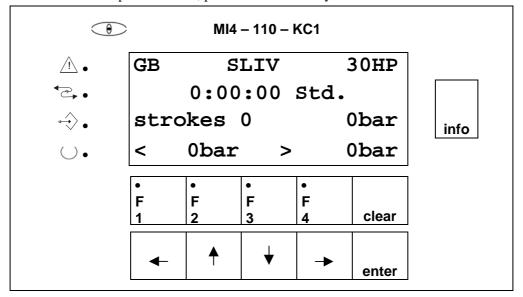


3.6 System display (View 1)

This view displays the pump version (e.g. 50 HP plus), the operating hours, strokes per minute and the pressure as nominal, min. and max. in bar or psi. The pressure can only be displayed if a pressure recorder has been installed (optional).

3.6.1 Setting the pressure display to bar or psi

To switch between pressure units, press the \checkmark arrow key.



NoteTo switch to a different line, press the ← or → arrow keys.



3.7 Display of operating hours for topwork 1 and 2 (View 2)

This view displays and resets the operating hours of topwork 1 and 2.

In order to be able to perform the steps in this chapter, the pump may not be in operation.

Note

Redundant only with SL-IV pump equipment!

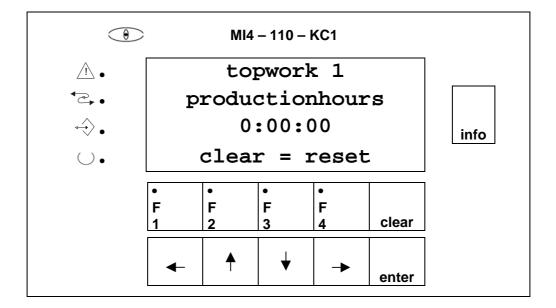
Later installation of a second (redundant) topwork requires initialization of the programmable logic controller (PLC).

This process only has to be performed once if:

- the second attenuator is installed later on or
- the PLC memory card is changed.

3.7.1 Switching to active topwork 1 or 2

To switch to active topwork 1 or 2, press the ↑ arrow key.





3.8 Resetting the operating hours

Select the desired topwork and press the "Clear" key for five seconds until the topwork's operating hours have been reset to 0:00:00. Releasing the "clear" key automatically returns you to to View 1 (systems display).

Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys. To switch to the systems display (View 1), press the clear key.

3.9 Initializing the second attenuator

To initialize the second attenuator, perform the following steps:

- Close the manual valves on the first attenuator and open the hand valves on the second attenuator.
- Turn on the pump by pressing F1 and wait until the diodes of the proximity switch sensor on the topwork have blinked twice.
- Press F1 again to turn the pump off. Now, you can use the arrow keys to select the desired topwork.

Note

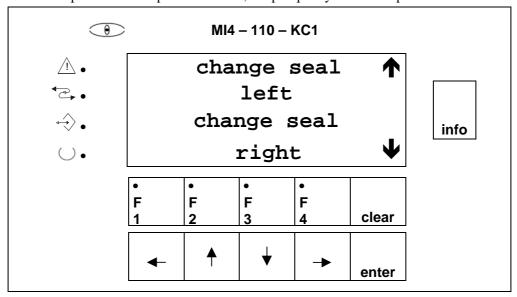
The second topwork is still operational even if the second memory card has not been initialized and the switch from topwork 1 to topwork 2 has not been not made. The operating hours and the number of strokes are then assigned to topwork 1.



3.10 Stop positioning for changing the seal (View 3)

This view enables you to position the hydraulic piston of topwork 1 or 2, depending on the preselection (see View 2), in its right or left stop position in order to make it easier to change seals.

In order to perform the steps in this menu, the pump may not be in operation.



In order to position the topwork's piston in a stop position, press the \uparrow arrow key (for the left stop position) or the \checkmark arrow key (for the right stop position)

The pump is turned on and the dump valve is opened.

If the hydraulic piston has reached its stop position, the diode of the right or left proximity switch sensor lights up and the pump turns on by itself.

Note

To switch to a different line, press the ← or → arrow keys.

To switch to the systems display (View 1), press the clear key.



3.11 Counter for operation and malfunctions (View 4)

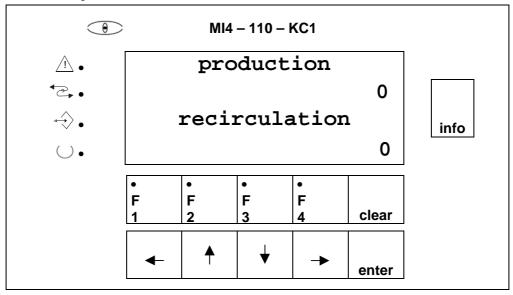
View 4 displays the individual operating conditions. The integrated memory chip can archive up to approx. 4.3 billion data records and documents how often operating conditions and fault messages occur. In addition, the display shows the overall number of operating hours of topwork 1 or 2. Entries in the view change automatically every five seconds and within these intervals display all current operating conditions in sequence.

3.11.1 Frequency of "Pump operation ON"

The number under "production" indicates how often the pump was turned on.

3.11.2 Frequency of "Pump recirculation ON"

The number under "recirculation" indicates how often the pump was turned on to cool the hydraulic oil in recirc operation.



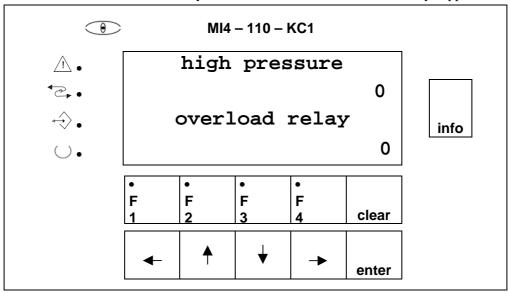


3.12 Frequency of "High pressure operation ON"

The number next to "high pressure" indicates how often the pump was switched to high pressure.

3.13 Frequency of "Overload relay activated"

The number under "Overload relay" indicates how often the overload relay tripped out.

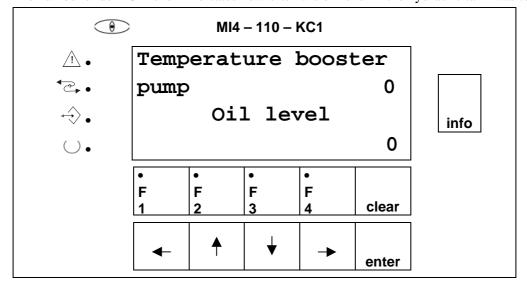


3.14 Frequency of "Inlet temperature too high"

The number next to "Temperature booster pump" indicates how often the temperature detector on the booster pump tripped out.

3.15 Frequency of "Oil level too low"

The number under "Oil level" indicates how often the oil level in the hydraulic tank was too low.



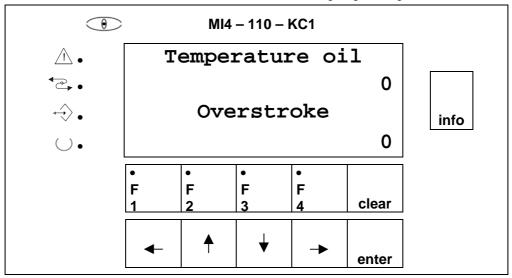


3.16 Frequency of "Oil temperature too high"

The number under "temperature oil" indicates how often the maximum permissible oil temperature was exceeded.

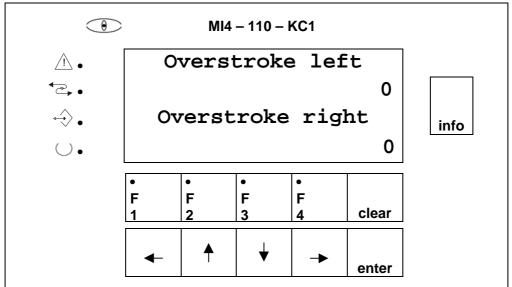
3.17 Frequency of "Overstroke active"

The number under "Overstroke" indicates how often the pump was operated in overstroke.



3.18 Frequency of "Left/right overstroke active"

The number under "overstroke left" indicates how often the topwork was operated from right to left in overstroke. The number under "overstroke Right" indicates how often the topwork was operated in the opposite direction in overstroke.



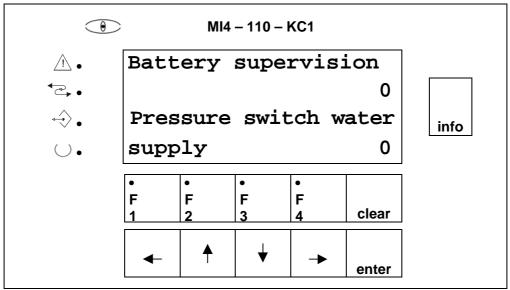


3.19 Frequency of "Battery supervision signal active"

This number indicates how often battery supervision responded or how often the S2 switch on the PLC was set to position 3.

3.20 Frequency of "insufficient water supply pressure prior to LP pressure increase"

This number indicates how often the water supply pressure of 30 psi = 2.068 bar was not maintained.

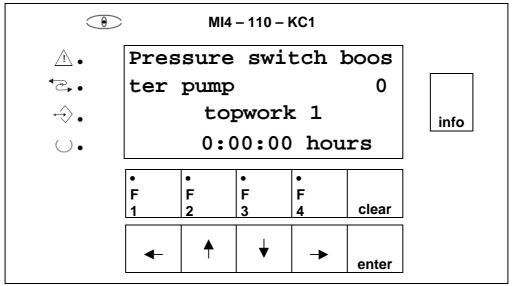


3.21 Frequency of "insufficient water supply pressure after LP pressure increase"

The number next to "booster pump pressure switch" indicates how often the water supply pressure was not maintained at 60 psi = 4.136 bar after the booster pump.

3.22 Display of operating hours for "topwork 1"

The number under "topwork 1" indicates the overall number of hours topwork 1 has been in operation.





3.23 Number of strokes for "topwork 1"

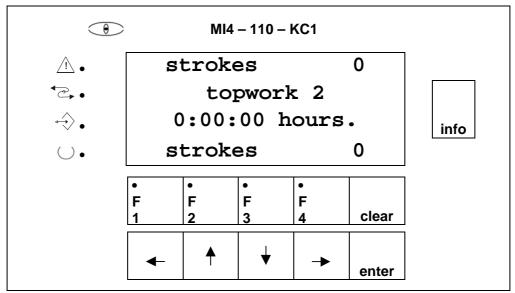
The number next to "strokes" indicates how often topwork 1 was operated from one side to the other side.

3.24 Display of operating hours for "topwor 2"

This number indicates the overall operating hours of topwork 2.

3.25 Number of strokes for "topwor 2"

The number next to "strokes" indicates how often topwork 2 was operated from one side to the other side.



Note
To switch to a different line, press the

← or → arrow keys.



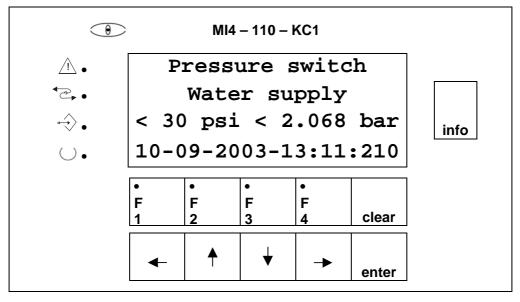
3.26 Reading out information from the memory card

In addition to the operating hours, the memory card documents the fault messages. This makes it easier for the service personnel to localize possible sources of errors.

In order to get to the information page, press the "Info" key in View 4.

Pressing the → arrow key will cause the most recent message that was written on the memory card to appear.

The text in the top three lines describes the current operating conditions. The bottom line displays the date and time.



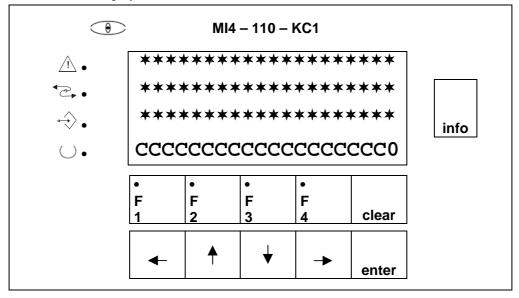


3.27 Displaying previous messages

In order to be able to read out previous messages from the memory card, press the \uparrow arrow key.

Should no further messages be available on the memory card, the \star symbol will be displayed in the top three lines.

"CCC" will be displayed in the bottom line.





3.28 Displaying messages on the PC via "MS HyperTerminal"

In order to be able to transfer messages to the PC, you need the ZB4-303-KB1 connection cable which is connected between the PRG socket on the PLC and the COM socket on the PC. (Number 1, below fig.)

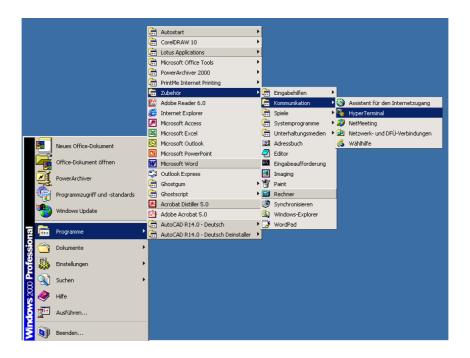


All entries must be adopted exactly as explained in the following section in order to ensure that the messages are transmitted without any problems. Only the Com interface and the folder directory in the "Record file" dialog field can be freely selected.

3.28.1 Opening the HyperTerminal

The HyperTerminal is a standard program under MS Windows. Open the "HyperTerminal" application under MS Windows 2000 Professional as follows:

Start/Programs/Accessories/Communication/HyperTerminal.





3.28.2 Assigning connection names

Under "Description of the connection," assign a connection name.

Example:

PS4-341-MM1.

Press "OK" to confirm the name.



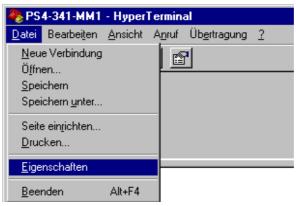
Close the following window "Connect with" by clicking on "Cancel."





3.28.3 Defining connection features

Select File/Properties.



3.28.4 Selecting interface

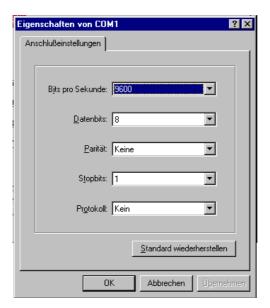
Under the "Connect with" tab, enter COM1, for example, in the field "Connect via" and click on "Configure."





3.28.5 Defining interface properties

Under the "Connection settings" tab, adopt the settings as displayed below and press "OK."



Select the "Settings" tab, accept the default settings as displayed below and click on the "terminal configuration" button





Adopt the entries as displayed below and press "OK" to confirm.



Click on the "ASCII configuration" button, adopt the entries as displayed below and press "OK" to confirm.





Confirm the settings by pressing "OK."

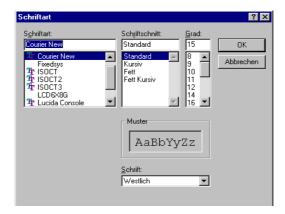


3.28.6 Selecting the font

In the "HyperTerminal" window, select the "View/font" menu option.



Adopt the entries as displayed in the below figure and press "OK" to confirm.



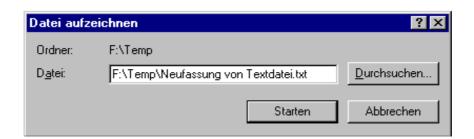


3.28.7 Selecting the folder for result file

In the "HyperTerminal" window, select the "Transfer/Save text..." menu option.



In the "Save file" window, enter in the "Folder" field the disk drive and the folder in which the .txt format result file should be saved. Confirm the entry by pressing "OK."





3.28.8 Transferring message texts from the memory card to the PC (Computer)

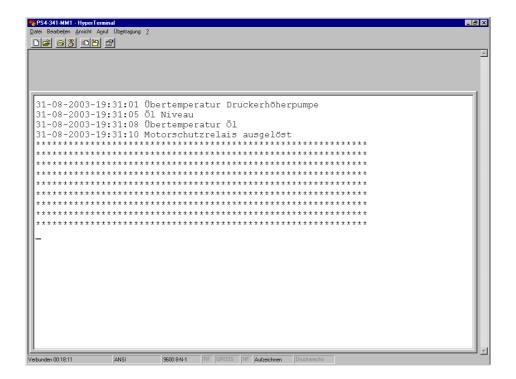
Press the \leftarrow arrow key for at least five seconds in order to start the data transfer. During data transfer, the message texts from the memory card are transferred to the Möller display.

Note

The transfer of all data from the memory card to the PC takes approx. 35 minutes.

Once the transfer process is completed, the message text most recently copied from the memory card is displayed on the Moeller display.

If there are no further message texts on the memory card, the star symbols (*) are transferred.



Note

To cancel the data transfer, press the ← key and the "Info" key for at least five seconds.



3.28.9 Exiting the HyperTerminal

To exit the "HyperTerminal" window, select the "Exit" from the menu.



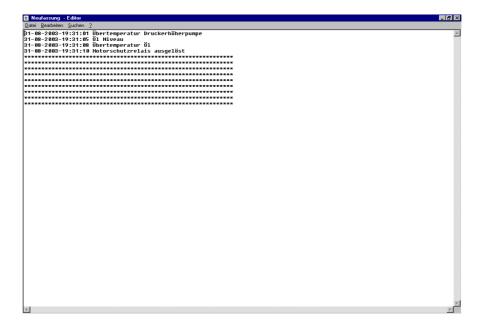
Confirm the subsequent dialog field by pressing "Yes" in order to cancel the connection.





3.28.10 Opening the result file containing the message texts

In order to view the history of the message texts, open the result file created in the .txt format. You will find the result file in the folder that you created under above point 0.





3.29 Print setting with (optional) proportion valve (View 5)

This view enables you to set the maximum and minimum pressure (rest pressure). Pressure can be defined in either bar or psi. The maximum adjustable pressure appears in line 5 of the view which becomes visible by pressing the \checkmark arrow key.

Note

If, in the lines for "max. bar" and "max psi" or "min. bar" and "min psi," values for both pressure units are simultaneously entered, <u>all</u> values are automatically reset to "0" because the controller is then not able to recognize which entries should be valid.

If the maximum value for "bar" or "psi" listed in line 5 is either exceeded or not reached when entering the max. or min. pressure, the following key values are automatically entered:

- For the max. "bar," the value is taken from line 5 and for the "min.," the value "800" (bar) is used.
- For the max. "psi," the value is taken from line 5 and for the "min.," the value "12000" (psi) is used.

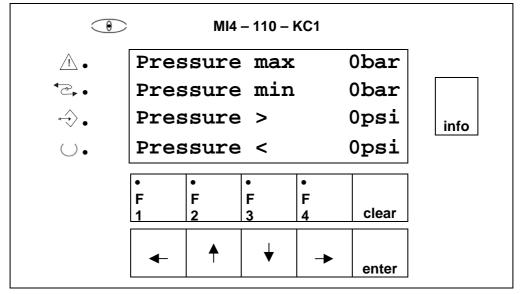
Should the topwork be equipped with a pressure recorder (optional), the recorder provides the current actual value of the impending high pressure within a closed loop control system. The selected maximum pressure is then readjusted with an accuracy of approx. ± 10 bar in which case the resting pressure displayed in line 5 is not exceeded.

By pressing the \uparrow or \checkmark arrow keys, the separate lines can be selected.

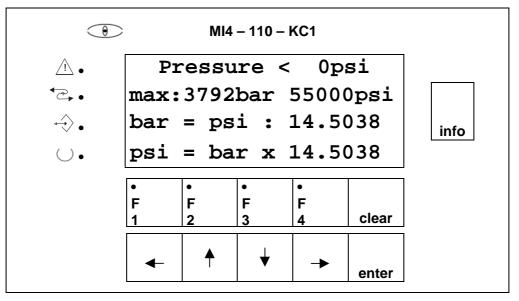
Before entering data, type in your password.

Note

Should no proportional valve be installed in the pump, 0 must be entered in lines 1 to 4. Otherwise, the low pressure-high pressure switch will no longer function.







3.29.1 Entering your password

- 1. Press the "F4" button.
 PASSWORD: _ appears on the display.
- Press the ← arrow key 4 times.
 PASSWORD:■■■0 appears on the display.
- 3. Press the "Enter" key.

Note

If it takes longer than five minutes after entering your password to press the keys, the password is deactivated.

3.29.2 Pressure settings

Press the "Enter" key.
max. ■■■0bar appears on the display.

Note

By pressing the \uparrow or \checkmark arrow keys, the separate lines can be selected.

- 2. Press the "Enter" key once to confirm the selected line.
- 3. To enter the first digit, press the \uparrow or \checkmark arrow keys down until the desired value appears.
- 4. To preselect the decade, press the ← arrow key. To select the desired number, press the ↑ or ↓ arrow keys until the desired value appears.
- 5. Proceed with setting the rest of the digits according to point 4.
- 6. Press the "Enter" key once in order to confirm the data entered.

Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys.

To switch to the systems display (View 1), press the clear key.



3.30 Pressure calibration, with pressure recorder and proportional valve option (View 6)

Note

During the calibration process, only one single cutting head, equipped with the maximum permissible orifice size, should be used.

This view enables you to calibrate the operating pressure using a pressure recorder (optional) and a proportional valve (optional). The advantage in this is that the max. resting pressure adjusted in View 5 is roughly achieved also with an open cutting valve during the cutting procedure. The pump is independently directed upwards during the calibration process in 100bar steps (beginning with 300 bar). In doing so, the pressure recorder signal delivers the actual value within the closed loop control system. If the setpoint and actual values deviate from one another for one 1 second less than +- 30 bar, the PLC writes the actual voltage of the proportional valve into a new table that later provides the setpoint voltages to the proportional valve during actual pump operation.

Before entering data, type in your password.

The display reproduces the following values:

Pressure calibration:

0 = Pressure calibration "OFF"

1 = Pressure calibration "ON"

In the "Pressure calibration ON" mode, the number 1 appears for approx. two seconds in the display.

Step:

Number of calibration steps from 3 to x. With a 3792 bar = 55.000 psi Pump x = 38With a 4137 bar = 60.000 psi Pump x = 41

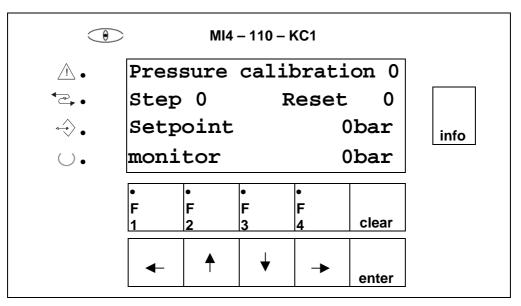
Resets

0 = Pressure calibration is not set to PLC key values 1 = Pressure calibration is reset to PLC key values

In the "Reset" mode, the number 1 appears for approx. two seconds in the display.

Setpoint: The preselected pressure is displayed monitor: The nominal actual pressure is displayed





3.30.1 Turning on the pump

Press the "F1" key in order to turn on the pump.

Wait until the pump has been flushed of air and a pressure of min. 30 bar or 440 psi appears in the display.

Note

The pump may not be switched to stroke control mode (Optional, see View 8)

3.30.2 Activating pressure calibration

Before entering data, type in your password.

- Press the "Enter" key.
 Pressure calibration appears on the display.
- 2. By pressing the \uparrow or \lor arrow keys, the separate lines can be selected.
- 3. In the pressure calibration line press the "Enter" key once to confirm the selected line.
- 4. Press the \uparrow or \checkmark arrow key **once** so that a 1 appears in the field.
- 5. Press the "Enter" key to confirm.

Note

After approx. 2 seconds, the number in the pressure calibration field changes from "1" back to "0."

Note

Should the actual pressure in the display be less than 30 bar or less than 440 psi, then pressure calibration is cancelled.

After pressure calibration finished, a "0" once again appears next to the display step.



3.30.3 Resetting pressure calibration

Before entering data, type in your password.

- Press the "Enter" key.
 Reset appears in the display.
- 2. By pressing the \uparrow or \checkmark arrow keys, the separate lines can be selected.
- 3. In the pressure calibration line press the "Enter" key once to confirm the selected line.
- 4. Press the \uparrow or \checkmark arrow key **once** so that a 1 appears in the field.
- 5. Press the "Enter" key to confirm.

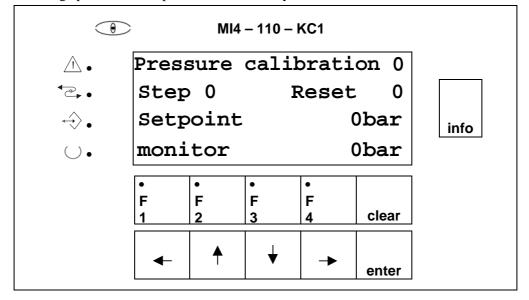
Note

After approx. 2 seconds, the number in the reset field changes from "1" back to "0."



3.30.4 Adjusting the pressure display in bar or psi

To change pressure units, press the Ψ arrow key.



Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys. To switch to the systems display (View 1), press the clear key.



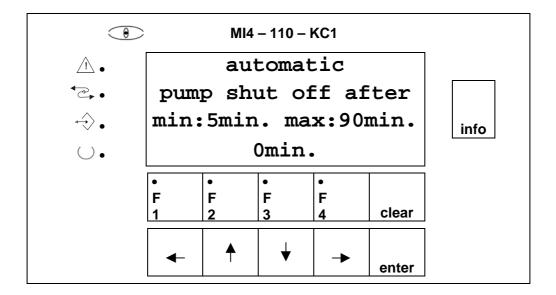
3.31 Setting the time period for automatic pump shut-off

This view enables you to set the time period for automatic pump shut-off.

If the pump is turned on and, over a set period of time, does not pump high pressure water, the pump automatically shuts off.

Note

If a time period of > 0 min. and < 5 min. is entered, a minimum value of 30 min. is specified. **Entering a time period of "0 min." is the same as deactivating this function.**



Before entering data, type in your password.

- Press the "Enter" key.
 ■0min. appears in the display.
- 2. Press the "Enter" key once to confirm the selected line.
- 3. To enter the first digit, press the \uparrow or \checkmark arrow keys down until the desired value appears.
- 4. To preselect the decade, press the ← arrow key. Press the ↑ or ▶ arrow keys to enter the first digit as long as the desired value appears.
- 5. Press the "Enter" key once to confirm the data entered.

Note

To switch to a different line, press the ← or → arrow keys.

To switch to the systems display (View 1), press the clear key.



3.32 Stroke control, Option with server and proportional valve (View 8)

This view enables you to connect the pump to other STREAMLINE LV-IV pumps of the same configuration in order to form a pump group network. This is done using the optional proportional valve. The central server is responsible for the overall monitoring of the network formed this way. Connecting the high pressure pumps to one another contributes to additionally reducing pressure fluctuations in the high pressure system. Moreover, all pumps are equally used to capacity. Unutilized capacities of the individual pumps are made available to the entire system, thus optimizing the workload of the complete system.

The server can normally manage up to 8 pumps.

If requested, the number of pumps can be increased up to 30.

By pressing the "F4" key, a pump can be integrated into the pump group or removed from the pump group and operated as an autonomous unit.

If the LED in the "F4" key lights up, this means that the pump within the pump group (say, in stroke control mode) is working and receives its settings via the server.

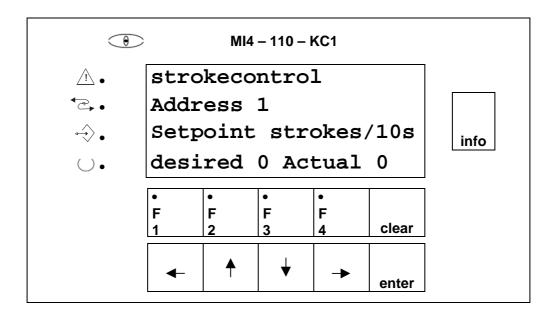
The following information appears in the display:

- 1. The first line shows whether the pump is participating in pump group's stroke control mode.
- 2. The second line indicates the individual address of the pump in the group, shown directly adjacent is whether the pump in the group is registered in the server file as a master pump or a slave pump.
- 3. Next to the word "setpoint," the fourth line lists the setpoint strokes (every 10 seconds) for the slave pump. This setpoint value is calculated based on the overall available output of the pump group. Displayed directly adjacent is the actual number of pump strokes (every 10 seconds).

Note

If the pump in question is a master pump, the "setpoint" entry is omitted.





Explanation of master, slave, ON and OFF using one example:

Eight pumps are networked in one plant, however, only the pumps with addresses 1, 4 and 8 are switched to stroke control mode and are meant to form one pump group.

The pumps are arranged in a certain hierarchy due to their address name, which includes consecutive numbering at the end. The server respectively identifies the pump with the smallest number at the end of the address name as the master pump.

The pump with pump address 1 is thereby automatically the master pump, the pumps with pump addresses 4 and 8 are therefore automatically defined as slave pumps.

This means that master pump 1 routes to the server the set setpoint value for the pressure and the setpoint strokes (strokes every 10 seconds). Depending on the pump types networked, the server calculates for each individual pump the number of strokes to be set in order for all pumps to achieve an equal workload percentage. Each individual slave pump obtains from the server its individual setpoint values for the pressure and number of strokes to be set.

The slave pumps then regulate their integrated proportional valve according to the designated setpoint values.

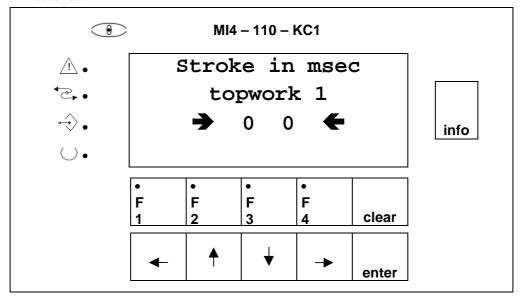
Now, if the slave pump with pump address 4 is switched out of stroke control mode, the pump with pump address 1 remains the master pump and the pump with pump address 8 remains the slave pump.

However, if the master pump with pump address 1 is switched out of stroke control mode, the pump with pump address 4 automatically becomes the master pump and the pump with pump address 8 remains the slave pump.



3.33 Display for "right strokes/left strokes in milliseconds" (View 9)

This view indicates the times that topwork 1's hydraulic piston requires in order to go from the left to the right stop position or from the right to the left stop position. The times are displayed in milliseconds.



Note

The display of stroke times (right, left) for topwork 2 is located in View 13.

Note

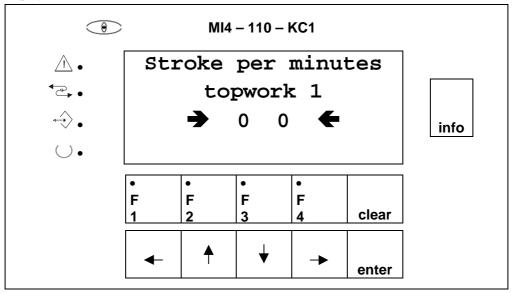
To switch to a different line, press the \leftarrow or \rightarrow arrow keys.

To switch to the systems display (View 1), press the clear key:



3.34 Number of "Right strokes/ left strokes per minute" (View 10)

This view shows the number of strokes performed by topwork 1 which the hydraulic piston would theoretically cover per minute based on the stroke times recorded in View 9. As part of this view, the values of the strokes from left to right and those from right to left are each shown separately on the display.



Note

The display of stroke times (right, left) for topwork 2 is located in View 14.

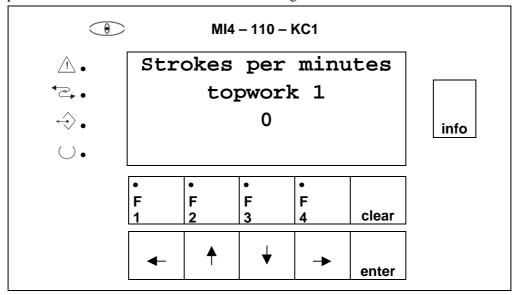
Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys. To switch to the systems display (View 1), press the clear key:



3.34.1 Number of "Overall strokes per minute" (View 11)

This view indicates the number of strokes from topwork 1 that the hydraulic piston actually performs per minute based on the number of direction changes.



Note

The display of overall strokes per minute (right, left) for topwork 2 is located in View 15.

Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys.

To switch to the systems display (View 1), press the clear key:



3.35 Capacity in percent (View 12)

This view displays the percentage capacity of topwork 1 in % and l/min. or % and gal.(US)/min. and it also enables you to adjust these settings.

The display shows the following information:

- 1. The third line displays the current capacity in % and l/min. or % and gal.(US)/min. The display is updated in 60 second intervals.
- 2. The upper capacity limit is defined in the fourth line.

Assessing the capacity:

If, for example, an upper limit of 80% is defined, an alarm is generally issued if capacity falls 5 percent points below this value (=75%).

If the upper limit of 80% is achieved or exceeded, the pump turns off as soon as it has reached or exceeded this upper limit 10 times during current operation.

Note

The upper limit can be set between 10% and 120%. If a value of <10% is entered, a default value of 120% is assigned.

Example:

SLIV 30HP = 100% = 54 strokes/min. = 1111 ms pro stroke = 3.7093 l/min. = 0.98 gal.(US)/min.

Shut-off due to overstroke set to 80%:

80% = 43.2 strokes/min. = 1389 ms per stroke = 2.9674 l/min.

= 0.7863 gal.(US)/min.

Alarm:

75% = 40.5 strokes/min. = 1302 ms per stroke = 2.78154 l/min.

= 0.7320 gal. (US)/min.

Shut-off due to overstroke:

If the time per stroke is lesser than (or equal to) 1389ms or 80%, the pump is shut off as soon as this time has been achieved or gone below for the tenth time after turning on the pump. When turning on the pump again, the internal counter automatically resets the value to zero.

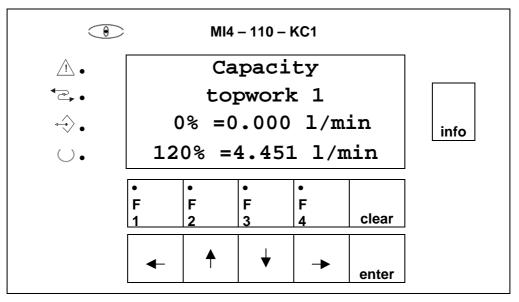
Note

The display for the percentage capacity of topwork 2 is located in View 16.

Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys.





3.35.1 Setting the capacity in percent for topwork 1

Before entering data, type in your password.

- Press the "Enter" key.
 ■■0% appears on the display.
- 2. Press the "Enter" key once to confirm the selected line.
- 3. To enter the first digit, press the \uparrow or \checkmark arrow keys down until the desired value appears.
- 4. To preselect the tenth digit, press the ← arrow key. To select the desired number, press the ↑ or ↓ arrow keys down until the desired value appears.
- 5. Proceed with setting the rest of the digits according to point 4.
- 6. Press the "Enter" key to confirm the data entered.

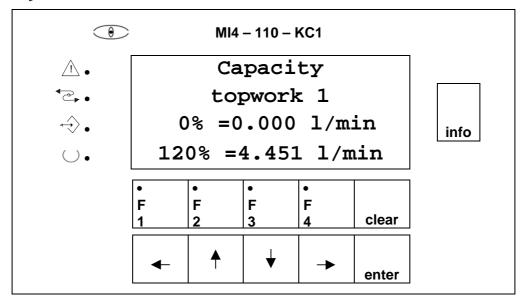
Note

To set the percentage capacity for topwork 2, switch over to View 16 and proceed as described under point 12.1.



3.35.2 Setting the volume display in I/min or gal/min

To switch the display from $1/\min$ to gal/\min or gal/\min to $1/\min$, press the Ψ arrow key.



Note

To set the volume display for topwork 2, switch over to View 16 and proceed as described under point 12.2.

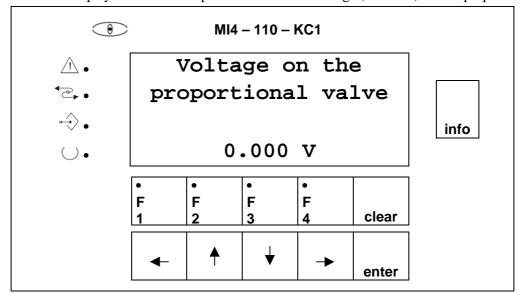
Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys. To switch to the systems display (View 1), press the clear key:



3.36 Display of the voltage on the proportional valve, optional (View 17)

This view displays the current setpoint of the control voltage (0 - 10 V) for the proportional valve.



Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys. To switch to the systems display (View 1), press the clear key:



3.36.1 Parametering for options (View 18)

In this view, the following parameterizations can be displayed and adjusted:

- the maximum pressure that can be measured by the pressure recorder (end pressure value)
- the solution for setpoint and actual values
- the setpoint value
- the source of the actual value (pump or stroke control)
- automatic shut-off of the master pump.

By pressing the \uparrow or \checkmark arrow keys, the separate lines can be selected.

Before entering data, type in your password.

Note

For remote setpoint and actual values (10bit), the high pressure pump's PLC has to be calibrated via the P1 and P2 potentiometers.

P1 = External setpoint value 0-x Volt

P2 = Actual value 0-10Volt or 2-10Volt

3.36.2 Setting the parameter value for the "end pressure value" (maximum pressure for the pressure recorder)

The "end pressure value" view window enables you to set the maximum pressure that can be measured by the pressure recorder:

4-20mA = 0-xxxxxbar or 0-xxxxxxpsi

or

x-10V

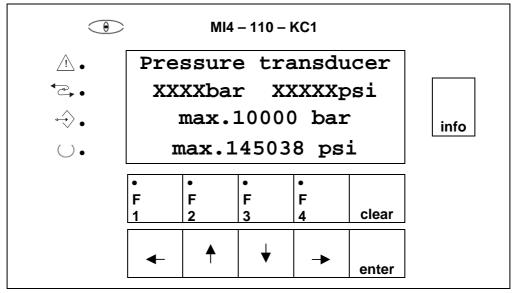
Example:

For bar = 5000 or for psi = 70000



Before entering data, type in your password.

1. Press the ↑ arrow key down until the "end pressure value" is displayed.



2. Press the "Enter" key.
Pressure ■■■□0bar appears on the display.

Note

By pressing the ← or → arrow keys, the separate fields "bar" or "psi" can be selected.

- 3. Press the "Enter" key once to confirm the selected field.
- 4. To enter the first digit, press the \uparrow or \checkmark arrow keys down until the desired value appears.
- 5. To preselect the tenth digit, press the ← arrow key. To select the desired number, press the ↑ or ↓ arrow keys down until the desired value appears.
- 6. Proceed with setting the rest of the digits according to point 5.
- 7. Press the "Enter" key once to confirm the data entered.

Note

If you enter a number for both "bar" and "psi," both values are reset to "0" because the control system cannot recognize which value is meant to be valid.



3.37 Setting parameter value for "Remote resolution"

The "Remote resolution" view window enables you to set the resolution (10 or 12 bit) for remote setpoint and actual values.

Example:

Setpoint = 0-xV = 10bit, actual value = 0-10V or 2-10V = 10bit.

or

Setpoint and actual value = 4-20mA = 12bit.

Ot

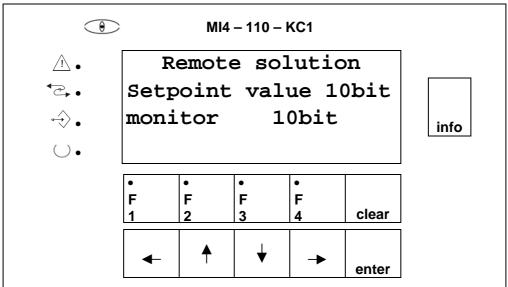
Setpoint = 0-xV = 10bit, actual value = 4-20mA = 12bit.

or

Setpoint = 4-20mA = 12bit, actual value = 0-xV = 10bit.

Before entering data, type in your password.

1. Press the \uparrow or \checkmark arrow key down until the "Remote resolution" is displayed.



- 2. Press the "Enter" key.
 - ■■bit appears on the display.

Note

By pressing the ♠ or ▶ arrow keys, the separate fields "setpoint" or "actual" can be selected.

- 3. Press the "Enter" key once to confirm the selected field.
- 4. To enter the first digit, press the \uparrow or \checkmark arrow keys down until the desired value appears.
- 5. To preselect the tenth digit, press the ← arrow key. To select the desired number, press the ↑ or ↓ arrow keys down until the desired value appears.
- 6. Proceed with setting the rest of the digits according to point 5.
- 7. Press the "Enter" key once to confirm the data entered.

Note

If 11 bit is entered for the setpoint or actual, a default value of 10 bit is assigned.



3.37.1 Setting the parameter value for the pressure setpoint value

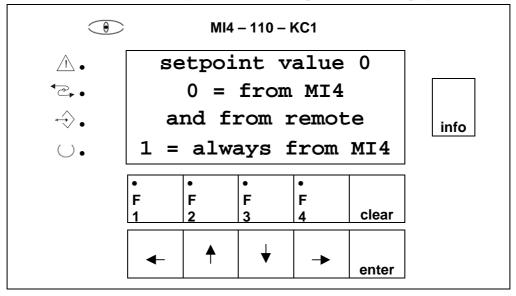
The "Setpoint value" view window enables you to set the signal source for the pressure setpoint value.

Example:

- 0 = for the pressure setpoint value for internal operation using the display and for remote operation using a control console.
- 1 = for pressure setpoint value always using the display.

Enter your password before adjusting the setting.

1. Press the \uparrow or \checkmark arrow key down until the "Setpoint value" is displayed.



- Press the "Enter" key.
 Setpoint value ■appears on the display.
- 3. Press the "Enter" key once to confirm the selected line.
- 4. To enter the first digit, press the \uparrow or \checkmark arrow keys down until the desired value appears.
- 5. Press the "Enter" key once to confirm the data entered.



3.38 Setting the parameter value for the pressure actual value

The "setpoint monitor" view window enables you to set the signal source for the pressure actual value.

Example:

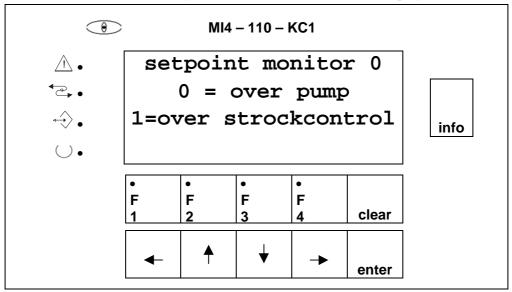
- 0 = internal connection in the pump control cabinet
- 1 = external connection via the stroke control server

Note

If a "1" is defined as the pressure actual value, then the end pressure value must also be set.

Before entering data, type in your password.

1. Press the \uparrow or \checkmark arrow key down until the "Actual value" is displayed.



- Press the "Enter" key.
 Actual value ■appears on the display.
- 3. Press the "Enter" key once to confirm the selected line.
- 4. To enter the first digit, press the \uparrow or \checkmark arrow keys down until the desired value appears.
- 5. Press the "Enter" key once to confirm the data entered.



3.38.1 Setting the parameter value for automatic shut-off of the master pump

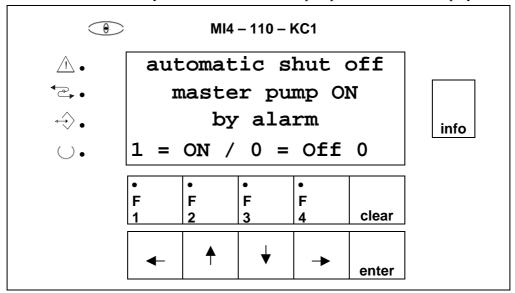
The "Automatic master pump ON shut-off in case of alarm" view window enables to you to define whether a master pump that is in stroke control mode automatically shuts itself off from the group if a malfunction occurs. The next subsequent slave pump would then be automatically elevated to the status of master pump.

Example:

- 0 = The master pump does not automatically shut itself off from the group if a malfunction occurs.
- 1 = The master pump automatically shuts itself off from the group if a malfunction occurs.

Before entering data, type in your password.

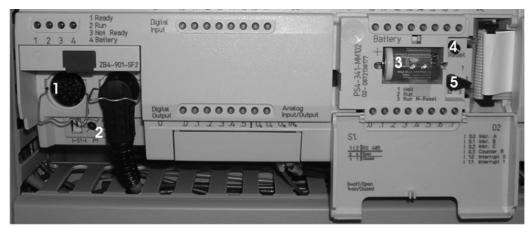
1. Press the **♥** arrow key until "Automatic master pump ON shut-off" is displayed.



- 2. Press the "Enter" key. $1 = ON / 0 = OFF \blacksquare$ appears on the display.
- 3. Press the "Enter" key once to confirm the selected line.
- 4. To enter the first digit, press the \uparrow or \checkmark arrow keys down until the desired value appears.
- 5. Press the "Enter" key once to confirm the data entered.



3.38.2 Calibrating the "Remote 0-xV setpoint" via P1 on the PLC in the high pressure pump control cabinet



- 1. Turn the pump off, the control voltage has to stay switched on.
- 2. From your system control (= remote setpoint), enter the maximum voltage that matches the maximum pressure.
- 3. Turn the P1 potentiometer (item 2, above fig.) carefully to the left stop.
- 4. Turn the P1 potentiometer (item 2, above fig.) carefully to the right stop.
- 5. Turn the P1 potentiometer (item 2, above fig.) carefully to the center position.

3.38.3 Calibrating the "Remote 0-10V actual value" via P2 on the PLC

- 1. Turn the pump off, the control voltage has to stay turned on.
- 2. For 0-10V, turn the P2 potentiometer carefully to the left stop.

3.38.4 Calibrating the "Remote 2-10V actual value" via P2 on the PLC

- 1. Turn the pump off, the control voltage has to stay turned on.
- 2. For 2-10V, turn the P2 potentiometer carefully to the right stop.

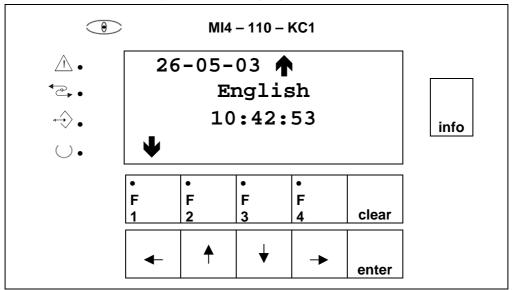
Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys. To switch to the systems display (View 1), press the clear key:



3.39 Setting language, date and time (View 19)

This view window enables you to set the language, date and time.



3.39.1 Setting the language

Before entering data, type in your password.

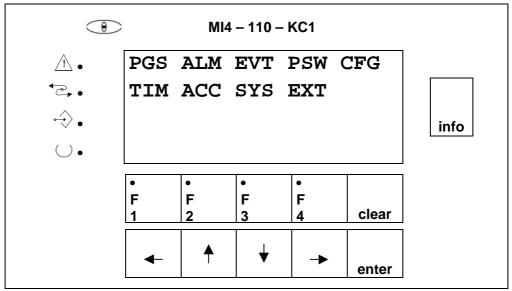
Press the \uparrow or \checkmark arrow keys to set the language.



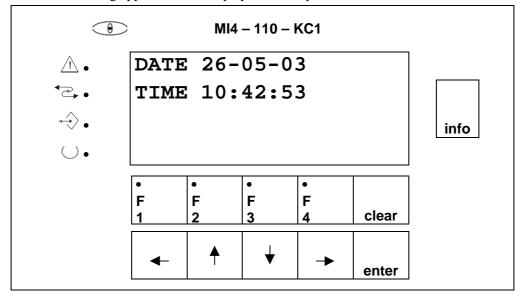
3.39.2 Entering date and time

Before entering data, type in your password.

1. Press and hold down the "Enter" key again until you are able to see the below illustrated entry in the display.



- 2. Press the arrow key twice until you get to "TIM."
- 3. Press the "Enter" key.
 The following appears on the display, for example:





Note

If the date 0-01-95 appears in the display, wait approx. 1.5 minutes until the display has automatically switched to a different date.

If "97" appears after the automatic switch, you first have to change the year:

- 3.1 Press the "Enter" key twice.
- 3.2 Press the ↑ key until the desired year appears.

 Make sure that the year that appears does not jump back. (Jumps back every 20 seconds)
- 3.3 Press the "Clear" key once to confirm the data entered.
- 3.4 Repeat steps 4, 5 and 6.
- 4. To enter the day (26), press the \uparrow or \checkmark arrow keys.
- 5. Press the "Enter" key once to confirm the data entered.
- 6. To enter the month (05), press the \uparrow or \checkmark arrow keys.
- 7. Press the "Enter" key once to confirm the data entered.
- 8. To enter the year (03), press the \uparrow or \checkmark arrow keys.
- 9. Press the "Enter" key once to confirm the data entered.
- 10. To enter the hour (10), press the \uparrow or \checkmark arrow keys.
- 11. Press the "Enter" key once to confirm the data entered.
- 12. To enter the minute (42), press the \uparrow or \checkmark arrow keys.
- 13. Press the "clear" key once to confirm all of the data entered.

Note

The seconds may not be changed because otherwise synchronization between the display and the PLC does not take place.

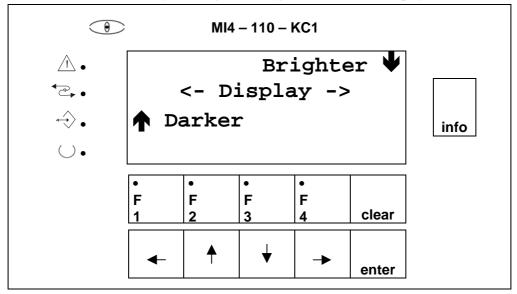
Note

To switch to a different line, press the \leftarrow or \rightarrow arrow keys. To switch to the systems display (View 1), press the clear key:



3.40 Brightness setting in the text display (View 20)

This view window enables you to adjust the brightness of the text display.



Press the \uparrow or \checkmark arrow keys to adjust the brightness.

Note

To change to a different line, press the \leftarrow or \rightarrow arrow keys.

To switch to the systems display (View 1), press the clear key.

3.41 Fault report

In case of fault reports please follow the instruction on the screen. For technical help the customer service is available to customers.

Europa: Head of Engineering KMT Waterjet Systems GmbH

Auf der Laukert 11 D-61231 Bad Nauheim

Tel.: +49-6032-997-117 Fax: +49-6032-997-270

E-Mail: order.service@kmt-waterjet.com



Section 4 - Maintenance

4 Maintenance

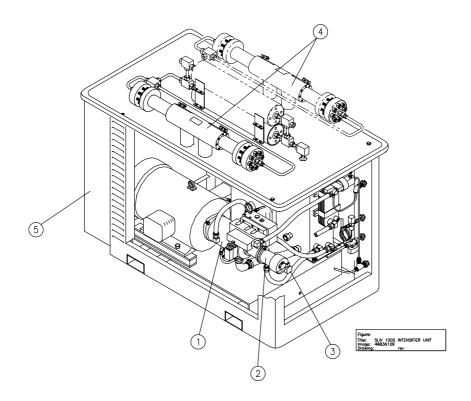
This section provides an overview of "Scheduled Maintenance" and "Preventive Maintenance". In addition, maintenance of the five systems is necessary and is described in their respective sections. Refer to the following sections for detailed information on the operator console and systems maintenance:

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

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

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





Item Description

1	Hydraulic Pump	3	Booster Pump	6	Control Panel
2	Recirculation Pump	4	Intensifier Assembly		



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
	Oil Level	Hydraulic Oil Tank		X					R
Fluid Level &	Oil Sample	Hydraulic System				F			
Leak Checks	Hydraulic Cartridge Seals	Hydraulic Cylinder	X	X					
Leak Cheeks	Plunger Seals	HP Cylinder	X	X					
	Sealing Head	HP Cylinder	X	X					
Pressure &	Water Supply Pressure	Low Pressure Filter Assembly	X	X					
Flow Checks	Intensifier Discharge Pressure	HP Piping	X						
	Hydraulic Pump Pressure	Hydraulic Pump		X					
	Plunger Seal	HP Cylinder	X	X					
Temperature	HP Check Valve	Port Sealing Head	X	X					
Checks	Cooling Water Inlet/Outlet	Oil/Water Heat Exchanger	X			F			
Lubrication &	Motor Bearings Lube	Hydraulic Power Unit	X					R	
Filter Checks	Hydraulic Filter	Hydraulic Oil Tank	X	X				R	
Vibrations-	Electric Motor					F			L
Rotating Equip.	Hydraulic Pump					F			
Splined Shaft Service	Motor/Pump Connection	Motor-Female Spline Piston Pump-Male Spline							L
	Hydraulic Pump					F			
System	HP Tubing, Valves, & Fittings					F			
Cleaning &	Hydraulic Manifolds	Hydraulic Intensifier				F			
Inspections	Control Panel	Electrical Enclosure				F			
	Gage Calibration	Hydraulic Pump & HP Piping				F			
Control Lights			X						

Key:

F: Information

X: To be observed

R: To be replaced

L: To be lubricated

¹Yearly or 4,000 hours, whichever comes first.

²See Section 9.3.3 concerning spline lubrication recommendations.



4.2 General Maintenance

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



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

Maintenance Guidelines

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

Work Area

- Maintain a clean work area for repair and maintenance of the waterjet pump.
- Use a clean work bench in a dust and dirt free work area.
- Use lint-free material for wipe cloths.
- When blowing off parts with compressed air, use only clean, dry air. When flushing parts with a solvent, use only clean, filtered fluid.
- Always use original 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.
- Lock out all electrical power.
- Close all incoming supply valves and open all drain valves.
- Close the nozzle valves and manifold valves. When the power is shut off, the safety dump valve will open and bleed off high pressure water stored in the discharge piping.
- Provide suitable receptacles, pans, trays, etc. to catch and retain fluids to avoid a hazardous work area.
- DOUBLE CHECK to insure that all pressure is relieved from the system before proceeding.



Binding and Interference

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

NOTE

It should never be necessary to force an assembly together.

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

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

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

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

To contact the KMT Waterjet Spare Parts Department:

USA: Parts Department **Europe:** Spare Parts Manager

KMT Water Systems KMT Waterjet Systems GmbH 635 West 12th Street Wasserstrahl-Schneidetechnik

Baxter Springs, KS 66713 USA Auf der Laukert 11

Phone: (620)856-2151 D-61231 Bad Nauheim Germany Fax: (620)856-5050 Phone: +49-6032-997-115 Fax: +49-6032-997-271

E-Mail: order.spares@kmt-waterjet.com



4.3 Service Log Data

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

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

Note

SLIV 100D intensifiers with flanged ends do not have item (6) sealing head HP seal.

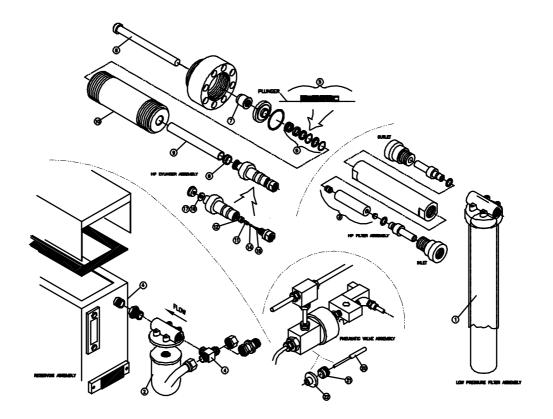


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SL-IV	SL-IV SERVICE LOG – PARTS REFERENCE LIST								
Ref. No.	Part No. (CCN)	PART DESCRIPTION							
1	10106722	Filter Element, Low Pressure Water, 2 each x 10 microns							
2	05104187	Filter Element, Hydraulic Oil							
3		Filter Element, High Pressure Water, ¹ / ₄ HP, 3/8 HP, or 9/16 HP							
4	05071063	Hydraulic Oil Change							
5	49834294	Seal, HP Plunger, U-cup							
6	05144597	Ring Spacer							
7	05009030	Seal, Hydraulic, Plunger Cartridge							
8	05144506	Plunger, Ceramic							
9	05144555	Liner, HP Cylinder							
10	05059712	Cylinder, HP							
12	05116579	Seat, HP Check Valve (Wear out first side, then reverse and use opposite side)							
13	05116579	Seat, HP Check Valve (Wear out second side, then replace)							
14	05147863	Spring, HP Check Valve							
15	05119839	Pin							
16	05119680	Poppet, LP Water Inlet Check Valve (Wear out first side, then reverse to use opposite side)							
17	05119680	Poppet, LP Water Inlet Check Valve (Wear out second side, then replace poppet)							
20	BV901184	Stem, HP Dump Valve							
21	10178978	Seal Assy, HP Dump Valve							
22	10178697	Seat, Replaceable, HP Dump Valve							







Section 5 - Troubleshooting

5 Troubleshooting

SL-IV Pump Will Not Start

Condition & Possible Causes	Corrective Action
E-STOP Button Depressed	Pull out E-STOP button. Push CONTROL POWER ON button – white light on CONTROL POWER ON button should illuminate.
Power Disconnected	Check that main power is present. Check that main power disconnect is ON.
Control Power Interrupted	Check power supply circuit protection (tripped breaker). Check power supply (24vdc) input and output.
Protection Activated	Check LOW OIL LEVEL, HIGH OIL TEMPERATURE, LEAK CONDITION, or HIGH TEMPERATURE BOOSTER PUMP (bold letters indicate display messages)
Motor Overload Relay Tripped	Find reason for overload. Reset overload relay.
Inlet Water Valve Turned Off	Reset water valve by pressing F6
Console Display and Lig	hts Fail to Illuminate
E-STOP Button Depressed	Pull out E-STOP button. Push CONTROL POWER ON button - white light on CONTROL POWER ON button should illuminate.
Main Power Disconnected	Check main power.
Door Unlatched (locked out)	Check that the door disconnect switch is properly engaged.
Control Power Not Available	Check power supply circuit protection (tripped breaker). Check power supply (24vdc) input and output.
Pump Quit Running	
Unsafe Operation Detected	Check fault indication on operator's console and correct: LOW OIL LEVEL, HIGH OIL TEMPERATURE, LEAK CONDITION, or HIGH TEMPERATURE BOOSTER PUMP.
Electrical Power Interruption	Check power supply circuit protection (tripped breaker). Check power supply (24vdc) input and output. Check that main power is available.
Motor Overload Relay Tripped	Find reason for overload. Reset overload relay.
No Control Power (24vd	c)
Circuit Breaker Tripped	Check input circuit breaker of power supply. Check output circuit breaker (24vdc) of power supply.
Power Supply Fault	Check power supply input and output voltages.



Red Flashing Light, Message On Operator's Console

Condition and Possible Causes	Corrective Action
LEAK	Check for HP piping leaks Check for HP seal leak Check for HP check valve leaks Check for HP valve leaks Check for sufficient water supply Check for dump valve closure or seal leakage. Check orifices condition, and proper diameters.
OIL TEMP	Verify hydraulic oil tank temperature is above 62 ^o C (144 ^o F). Check cooling water flow to heat exchanger. Adjust water modulating valve.
OIL LEVEL	Check hydraulic oil level on the reservoir sight glass. Check for and correct hydraulic oil leak, add oil to tank.
BOOSTER PUMP	Check booster pump temperature if above 53°C (128°F). Check cutting flow to/from booster pump. Check water bypass orifice. Excessive time in deadheaded condition.
HP Water Signal Abnorr	nal Fluctuation
Orifice Large/ Worn/ Damaged	Check that orifices do not exceed capacity of pump. Check that orifices are in good working order. Verify that stone is not missing.
Check Piping Leaks	Check system components for leaks including dump valve condition.
Check Valve Leakage	Inspect pump discharge HP check valves. Inspect pump inlet low pressure (LP) check valves.
Check Seal Leakage	Inspect plunger, sealing head seals.
Hydraulic Control Malfunction	Check hydraulic valves operation. Verify proper shifting of 4-way reversing valve. Verify proper proximity switch operation.
Hot Surfaces On HP Cyl	inder Components
HP Discharge Check Leaking	Inspect check valve seat, poppet, spring, and guide condition.
LP Inlet Check Valve Leaking	Inspect check valve poppet, spring, seat, and sealing head.
Sealing Head or Plunger	Check plunger and sealing head seal leak and repair. Inspect seal head body for crack in the bottom of the inlet water groove.
Damaged HP Cylinder	Check cylinder inside diameter for damage. Polish if required.



Oil or Water Leaks from HP Cylinder Weep Holes

Condition and Possible Causes	Corrective Action
Oil Leak HP Intensifier	Check hydraulic cylinder O-ring leakage. Check proximity switch area for oil leakage. Remove, inspect, replace or clean hydraulic seal (cartridge).
Water Leak at HP Plunger Seal	Replace seal assembly. Check plunger and follower if leak exceeds about 1 drop in 10 strokes. Check for scratches, circumferential or longitudinal grooves, or material build up on inside diameter of HP cylinder. Polish i.d. of cylinder if required. Plunger should be returned to KMT if polishing is needed.
Water Leak at Sealing Head Seal	Check seal assembly. Check for scratches on inside diameter of HP cylinder. Polish if required. Check for scratches in area of sealing head seal. Polish if required.
Hot Hydraulic Oil	
Restricted or No Cooling Flow	Check cooling water flow to and from heat exchanger. Check setting of water modulating valve. Check water pressure differential across heat exchanger, 2.75 bar (40 psi) minimum required for flow through the exchanger. Check operation of water modulating valve.
Water Modulating Valve Set High	Check and adjust setting of cooling water valve. - Compressing spring slows water flow and increases temp, decompressing spring increases water flow and lowers oil temp.
Heat Exchanger Clogged	Flush heat exchanger, improve quality of cooling water.
Low Cutting Water Pres	sure
Low Hydraulic Pressure Setting	If in LO, turn pressure switch to HI. Check hydraulic pump pressure setting.
Restricted or No Cutting Water Supply	Check cutting water supply flow and pressure
Water Filter Clogged	Check pressure differential at filter gages, and replace elements if exceeds 1 bar (15 psi) while the pump is operating.
Air Trapped	Bleed air from cutting water plumbing.



HP Check Valves Leak

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

Disconnect the proximity switch cables of the opposite (normal) HP cylinders.

With the cutting nozzle valve open, start pump at low pressure; the pistons will move and stop at the opposite (normal) HP cylinders. Stop pump, assure all pressure is bled, block system by closing cutting valves.

Start pump, switch hydraulic pump to HI pressure.

Assure there are no external water leaks.

Reconnect the proximity switch cables. The pistons will reverse:

- If the plunger moves (the problem side proximity switch light will turn ON), it means inlet check valve problem.
- If the plunger does not move, it means a HP discharge check valve problem.

Normal Temperature, but Check Valve Problem

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

Check inlet HP check valve

- 1. Follow the procedure outlined in "HP Check Valves Leak".
- 2. A bad inlet check valve will be indicated by a piston moving after the proximity switch cables are reconnected.

Check discharge HP check valve after completing inlet check.

- 1. Re-install all HP plumbing and proximity switch cables
- 2. Start pump, switch to HI, and then close nozzle valve.
- 3. Stop pump and watch high pressure gage.
- 4. If the pressure drops, one of the four discharge check valves is leaking.
- 5. Determine which valve is leaking by inspection. Look for erosion or uneven wear on the poppet or seat.



Section 6 - Low pressure water supply

6 Low Pressure Water System

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 "Reciculation 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 40 psig and 70^o 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), T and Q series).
- Low water pressure at the intensifier inlet (switch (16), T and Q series).
- High temperature at the booster pump outlet (switch (2).
- If the motor does not run for 3 minutes, the solenoid valve (11) will shut off. To re-open the valve, press key "clear".



Note

Pressure gages for T series KMT pumps are installed in a frame leg for easy access. Pressure gages provide a qualitative measure of LP water system performance, while pressure switches on the T&Q series pumps 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 bar (30 psi) max 7 bar (73 psi), (T and Q series).
 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), (T and Q series).
- Water at booster pump outlet maintained at less than 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

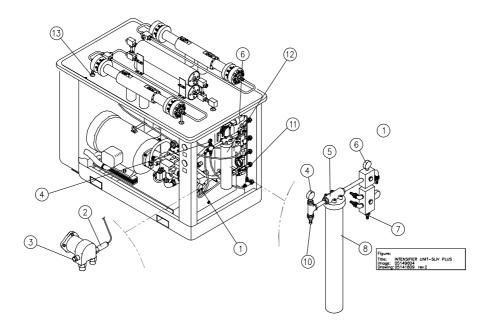
The cutting water enters the pump through port "B". When the CONTROL POWER-- ON button on the operator control panel is activated, solenoid valve (11) opens allowing water to flow through filter assembly (5), then to the inlet of the booster pump (1). The booster pump increases cutting water supply pressure 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 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.

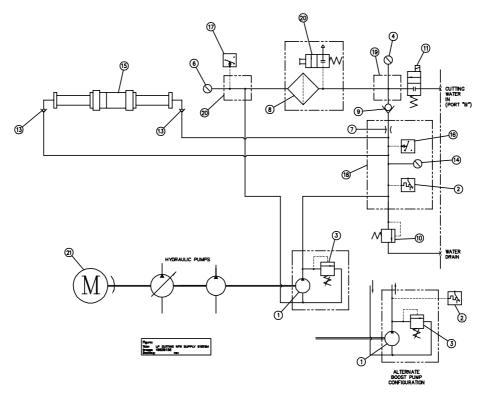
The LP water filter (5) is located ahead of the booster pump to protect the pump as well as the intensifier and other HP components. The filter gages (4 and 6) indicate the condition of the filter. A difference of 1 bar (15 psi) indicates a dirty filter element that should be replaced.



Item Description Fig. 6.1

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





LP Cutting Water Supply Circuit, Fig. 6.2



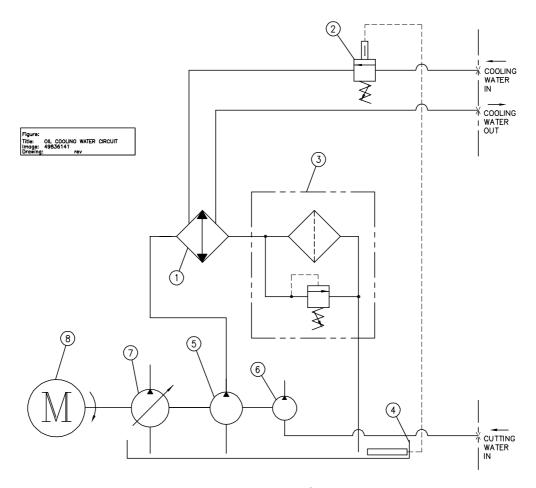


Figure 6.3 LP Water Cooling Circuit

- Water/Oil Heat Exchanger 1
- 2 Water Modulating Valve
- 3 Hydraulic Filter
- 4
- Hydraulic Reservoir Recirculating Hydraulic Pump 5
- 6 Water Booster Pump
- Main Hydraulic Pump 7
- 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) for Q and later T series KMT pumps, but is located on the booster pump for earlier series pumps (see Detail A, Figure 6.2)
- 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 ignors 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 and exposed adjustment screw, while on others the adjustment screw is accessed by removing an acorn nut.



Control	Pressure A	djustment	Pressure Settings Bar (psi)					
	Increase	Decrease	Maximum	Minimum				
Booster Relief Valve (3)	Clockwise	Counter- clockwise	8.3 (120)	8.0 (115)				
LP Manif. Relief Valve (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 3 minutes. To reset the water supply valve, press key "clear". 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 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

ElementHeadHousing

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

- Turn off cutting water supply
- Press bleed valve to relieve trapped pressure
- Unscrew housing from head. Remove element.
- Install new elements in housing. Screw housing into head.
- Open cutting water supply.
- Press bleed valve to remove trapped air.
- 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

Turn on cutting water supply

- Start waterjet pump and observe booster discharge pressure
- Stop waterjet pump and press E-Stop button.
- Remove acorn nut from the side of the booster pump and turn screw clockwise to increase pressure or counter-clockwise to decrease pressure.
- Replace acorn nut, restart waterjet pump and observe booster discharge pressure.

• Repeat steps 4 and 5 if necessary.



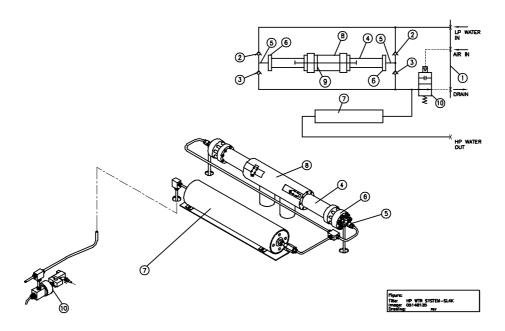
Section 7 - High pressure water

7 High Pressure 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

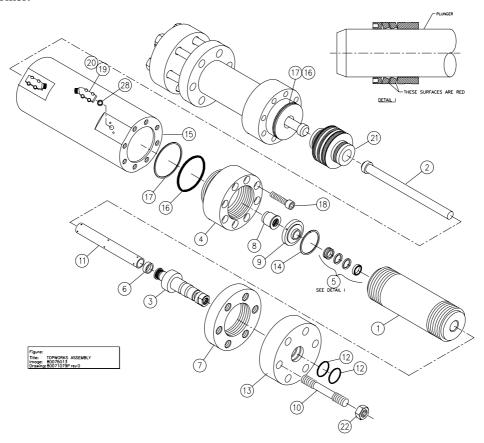
- 1 Bulkhead Fittings
- 2 Inlet Check Valve
- 3 Discharge Check Valve
- 4 HP Cylinder
- 5 Sealing Head

- 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



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".
- 3. Note that the sealing head can be removed with the discharge HP check valve attached.
- 4. 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.
- 5. 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:

- 6. Slide inlet water collar over sealing head until it rests against the head nut. Connect LP inlet water quick disconnect to collar.
- 7. 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.



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.

8. 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 / Reassembly

NOTE

KMT Waterjet 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 Figure 7.2 for suggested special tools to support the HP cylinder jug for this procedure.

HP Cylinder Jug Removal

Prior to removing electrical power from the 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 the 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 pump, shut off LP water supply, observe LOCK-OUT/ TAG-OUT
safety rules.



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.
- 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.





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 the 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 Waterjet 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

 Prior to removing electrical power from the 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 the 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 pump, shut off LP water supply, observe LOCK-OUT/ TAG-OUT safety rules.



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. Apply molygrease to stud threads (Table 7-2 item 3). 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.



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 the 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 the 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 refer to Table 7-2 item 1 prior to installing seal parts on plunger. Install new HP plunger seal assembly onto plunger, refer to Figure, Detail I, (paragraph 7.2) 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.

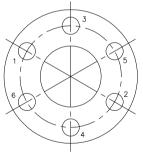
NOTE:

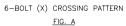
Bronze packing follower intended to fit tightly on plunger. If follower is too tight to slip onto plunger, try heating follower in hot water. Then attempt to slip follower over plunger.

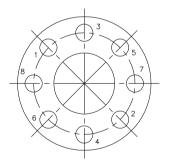
- 8. Slip plastic cylinder liner tube over plunger.
- 9. Install HP cylinder jug to hydraulic cylinder head per paragraph 7.2.2.



TABLE 7.1 FLANGE NUT TORQUE SPECIFICATIONS						
Plunger Diameter	7/8" Diameter l	Plunger (SL-IV)	1-1/8" Diameter Pl	unger (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.		
1 st Stage	Hand Tight	Hand Tight	Hand Tight	Hand Tight		
2 nd Stage	135	100	135	100		
3 rd Stage	200	150	200	150		
4 th 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"		







8-BOLT (X) CROSSING PATTERN FIG. B

Ta	Table 7-2. Lube Specs KMT Intensifier Pumps						
Item No.	KMT P/N	Description	Applications				
1	10087385	FML Grease, White	Lube Parts, HP Cylinder				
2	10084440	High Purity Goop- SS Thds	SS Threads				
3	49832199	Moly Disulfide Grease	Non-SS Thds				



	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. 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.

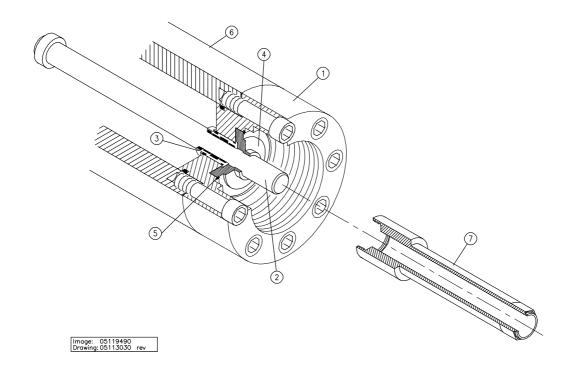
 Tighten 12M socket head cap screws (8 per cylinder head) in a crossing pattern to 190-210 N-m (140- 155 ft-lbs).



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.

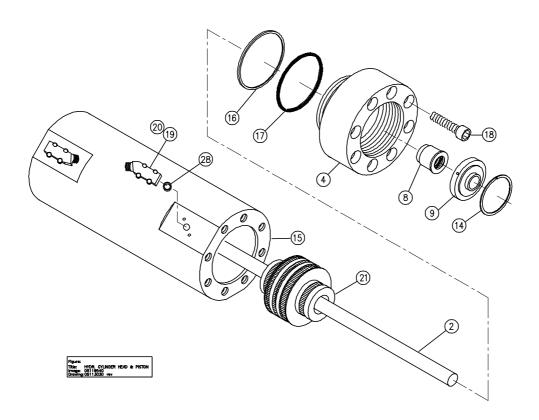




Item Description

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





Item Description

2	Plunger	9	Bushing Retainer Flange	18	Cap Screw
4	Cylinder Head	15	Hydraulic Cylinder	19	Proximity Switch
8	Hyd Cartridge, Plunger	16	O-ring	20	Cap Screw
	Seal Assy	17	Backup Ring	21	Hyd Piston Assy
				28	Spacer



7.3 Intensifier Subassemblies Inspection and Repair

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

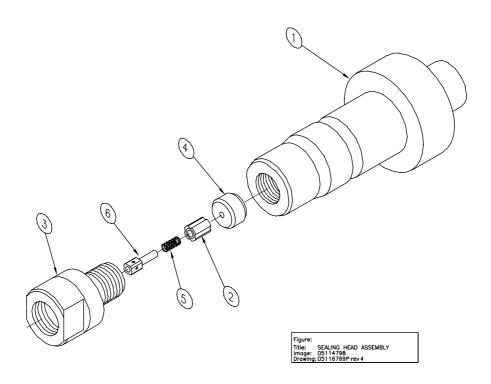
- Discharge HP Check Valve, Section 7.3.1
- Inlet Check Valve, Section 7.3.2
- Sealing Head, Section 7.3.3
- HP Cylinder, Section 7.3.4
- Plunger, Section 7.3.5
- Hydraulic Seal Cartridge, Section 7.3.6
- Hydraulic Piston, Section 7.3.7
- Hydraulic Cylinder, Section 7.3.8

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 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	4	Poppet Seat
2	Poppet	5	Spring
3	Gland Nut	6	Guide Pin



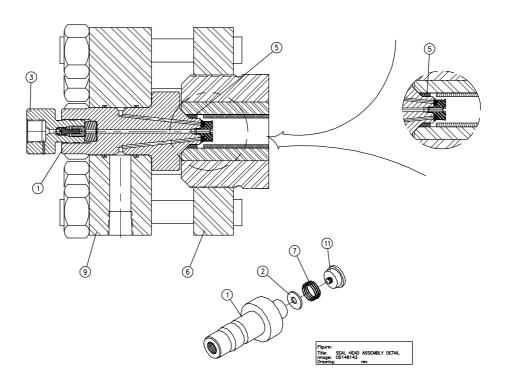
- 1. Inspect the poppet, spring, and guide for wear. Replace the spring and guide if worn.
- 2. Apply a thin film of High Purity Goop to the sealing face of the gland nut. Install the guide, spring, and poppet into the gland nut.
- 3. Apply High Purity Goop to the gland nut threads. Install the gland 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 one of the parts has slipped out of place, and they must be removed, inspected and reassembled.
- 4. Using a crowfoot/torque wrench combination, torque the gland nut to 176 Nm (130 ft-lbs.).
- 5. Reconnect high pressure and low pressure piping, 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. Assemble poppet (2) and spring (7) on poppet retainer (11). Apply small amount of Locktite 222 thread locker to thread of poppet retainer, taking care not to get Locktite on poppet or other inlet check valve sealing surfaces.
- 5. Tighten poppet retainer (11) using 1/2-in. flat blade screwdriver taking care not to twist off poppet retainer. If torque wrench tools are available, tighten to 25-30 in-lbs.
- 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	5	Seal Head Spacer
2	Poppet	6	Flange Ring
3	Gland Nut	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
- 1. Polish the cone ring 45 degree surface to achieve a smooth finish. Grooves or machine tool marks should be barely 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.

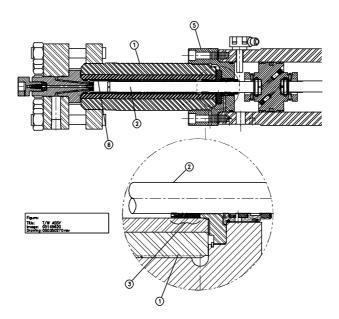


7.3.4 HP Cylinder

- 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 HP seal.
- 2. Remove the bore liner. Use a plastic-faced hammer and the seal removal tool to drive out the plunger HP seal and follower. Be careful not to scratch the bore of the cylinder or damage the cylinder threads.
- 3. Clean sealing areas of HP cylinder inside diameter and inspect cylinder for rings, scratches, pits, residue build-up and other potential leak paths. Seal material or residue can build up forming a ring, and running a fingernail across it, will cause it to appear as a surface flaw. It is usually necessary to clean the area before performing an inspection.
- 4. Use 600 grit wet/dry sandpaper to polish HP cylinder inside diameter where the seal will locate. Polish only in a circumferential motion. Do not polish or drag the sandpaper along the length of the cylinder. Hold the sandpaper on the end of your finger, and move in a cylindrical wiping motion in the bore of the HP cylinder. Wipe residue from cylinder inside diameter and re-inspect for surface defects.

NOTE

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



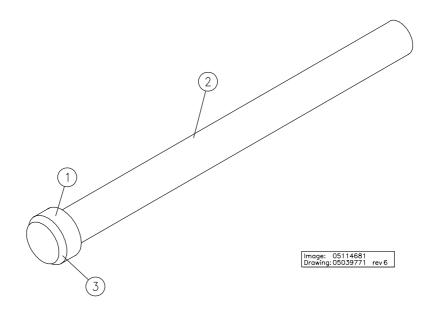
Item Description

1	Cylinder Body	5	Cylinder Head
2	Plunger	6	Liner
3	Plunger Seal Follower		



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 offers a plunger reconditioning service.



Item Description

1	Plunger Button	2	Plunger	3	Button Chamfer
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7.3.6 Hydraulic Piston

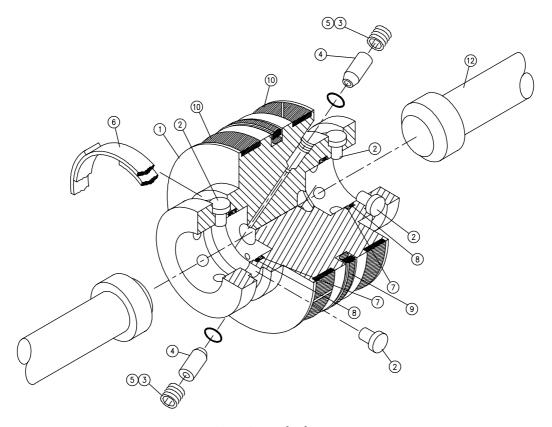
The hydraulic piston contains a seal assembly, bearing rings, pins and flat spring bands, and check valves. Bearing rings (10) provide wear contact between piston and cylinder ID. Plungers (12) are held in place by 6 each pins (2) per plunger. Pins (2) are maintained in place by flat steel band (6). 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

Remove bearing rings (10) and worn seal ring assembly (9).
 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. 2With 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. 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.

- 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).
 - 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.

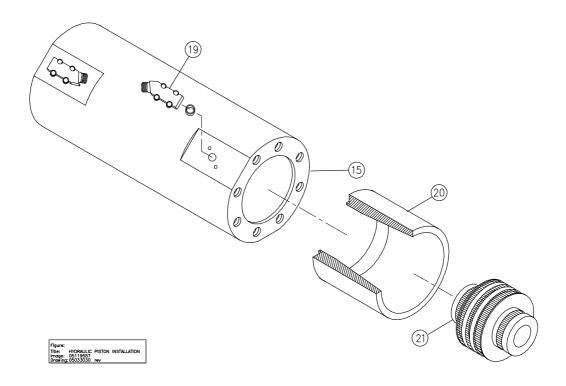
Install Hydraulic Piston Assy into Hydraulic Cylinder

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.





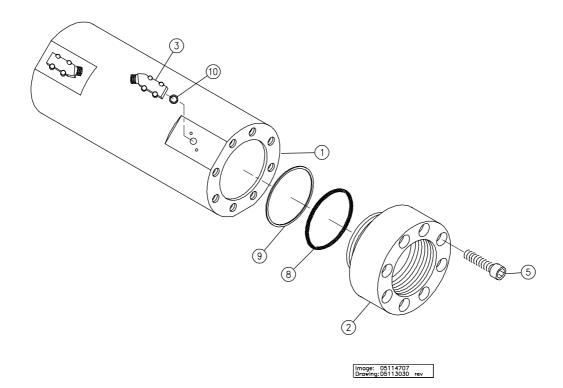
Item Description

15.	Hydraulic Cylinder	20.	Seal Ring Compression Tool (P460)
19.	Proximity Switch	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	8	Back-up ring
2	Cylinder Head	9	O-ring
3	Proximity Switch	10	Spacer
5	Cap Screw		



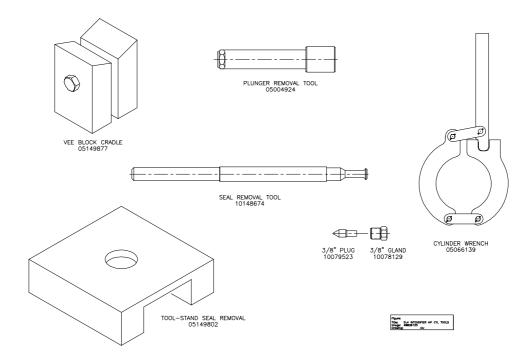
7.4 HP Dump Valve

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

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

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

8.1 Electrical Overview

There is only one 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.



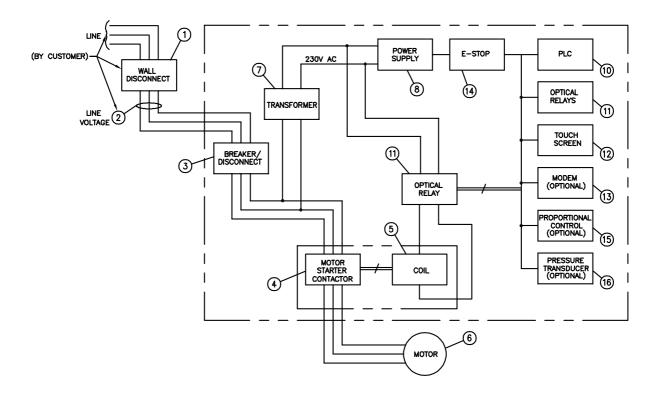


Figure 8-1 ELECTRICAL CONTROL POWER

Item Description

1	Wall Disconnect-Main Power	9	Master Control Relay
2	3-Phase Line (Service Drop) Power	10	Programmable Logic Controller
3	Enclosure Door Disconnect/Circuit	11	Optical Relays
	Breaker		
4	Motor Starter Contactor(s)	12	Touch Screen Interface Panel
5	Contractor Coil(s) (230V)	13	Modem (Optional)
6	Electric Motor	14	Emergency Stop Button
7	Transformer (230V AC Out)	15	Proportional Control (Optional)
8	Power Supply (24V DC Out)	16	Pressure Transducer (Optional)



8.1.1 Motor Starter Circuit

All horsepower levels of KMT SL-IV Waterjet Pumps are available with built-in starter/control panels . Two starter circuits are typically used:

- Wye-Delta for reduced voltage starting: Required in Europe and standard on the SL-IV for motors of 75 hp or greater. Three each 3-phase contactors are used to accomplish Wye-Delta starting.
- Across- the- Line, or Full- Voltage starting: Commonly used in North America, only a single 3phase contactor is required. Low initial hardware costs. Utility costs due to high current draw on start-up.

Electrical power from the utility grid enters the SL-IV Intensifier Pump at the combination circuit breaker/ disconnect (3). Note that whenever the door to the electrical enclosure is opened, all electrical power is automatically disconnected from the intensifier pump. Be aware that 3-phase, medium voltage power is still present at the input side of the main circuit breaker/ door disconnect. To make the SL-IV Intensifier Pump electrically safe, one should switch the wall disconnect (1) OFF and observe LOCK-OUT/ TAG-OUT safety practices. Note that the wall disconnect (1) should have circuit breakers or fuses, but that this over current protection may be oversized for the current draw of the particular SL-IV Intensifier Pump. The primary over-current protection for the SL-IV Intensifier Pump is the main breaker/ door disconnect (3) built into the electrical enclosure. On the output side of the main breaker/ door disconnect (3) main power leads connect to the motor starter contactor(s) (4), then to the electric motor (6). Secondary power leads connect to two phases of the main breaker/ door disconnect output side to supply the control 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.
- 9-post 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 avoid 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
- Topworks Overstroke Shutdown

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



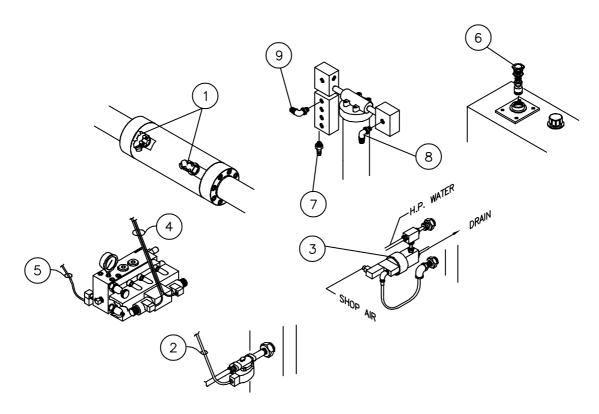


Table 8-2. SENSORS/SOLENOIDS – SLIV

Item Description

No.	FUNCTION	COMPONENT DESCRIPTION	LOCATION
1	Intensifier shift	Proximity switches	Hydraulic cylinder,
	sensors		intensifier assy
2	Cutting water supply	Solenoid shutoff valve, water	Bulkhead plumbing assembly
3	HP water dump valve	HP shutoff valve, pneumatically- operated, solenoid valve (pneu)	HP discharge piping, betw. HP atten. and bulkhead piping.
4	Intensifier Shift, A/B Port Shifting	Solenoid- operated, directional control valve (DCV), hydraulic pilot- operated spool	Hydr manifold assy, motor/ pump group
5	HI/LO Pressure Select	Solenoid shutoff valve, hydr cartridge style	Hydr manifold assy, motor/ pump group
6	Low oil level/ temperature	Combination level/ temp switch, immersed in hyd fluid	Hydraulic reservoir
7	High Booster Pump Temp	Temperature sensor	LP water filter assy, manifold block
8	Low cutting water supply pressure	Pressure switch, 30 psig	LP water filter assy, manifold block
9	Low booster pump pressure	Pressure switch, 60 psig	LP water filter assy, manifold block



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.

8.1.3 CONTROL POWER CIRCUITS (see Figure 8-1)

A control power transformer (7) provides all control power to the SL-IV Intensifier Pump. A pair of leads from the main breaker/ door disconnect (3) are routed to the transformer (7) input side.

Wiring from the control power transformer (7) output (secondary windings) is directed to two places: 1) motor contactor(s) (5) and 2) 24 volt-DC power supply (8). To minimize the load requirement on the 24 volt-DC power supply, motor contactor coil(s) (5) use 230 volt-AC coil(s), while the relay logic (9) controlling the motor contactor(s) (4) is powered by 24 volts-DC.

The 24 volt DC power supply (8) receives 230 volts-AC input power and regulates it to 24 volts DC, 5 amps maximum output power. 24 volt-DC power from the power supply (8) first passes through a circuit breaker and the EMERGENCY STOP (E-Stop) (14) logic, then to the PLC (10), the text operator panel (12), the optical relays (11), and to other control functions.

8.1.4 (OPTIONAL) PROPORTIONAL PRESSURE CONTROL

Proportional pressure control (optional) allows the operator to change cutting water pressure using the display panel. An electronically- controlled hydraulic cartridge relief valve mounted on the hydraulic manifold accomplishes this proportional control. The proportional relief valve receives its commands from a section of the PLC.

8.1.5 (OPTIONAL) MODEM

Modem option available for remote maintenance, trouble-shooting and software updating.



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: - Intensifier Assembly (1)

- Piston (2)

- Proximity Switch (3)

- Hydraulic Cylinder (4)

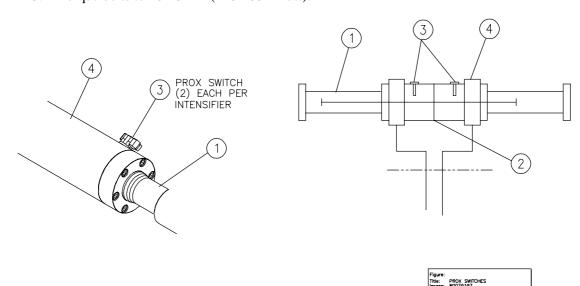
Recommended - Allen (hex) Wrench, M5 **Tools:** - Torque Wrench

- 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.).



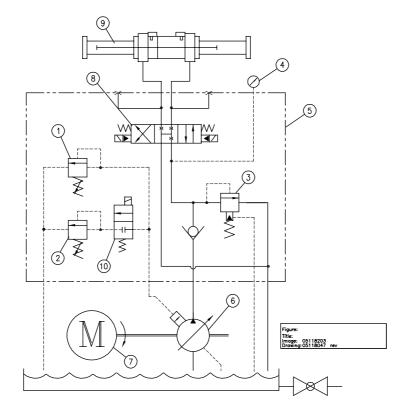


Section 9 - Hydraulic System

9 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.



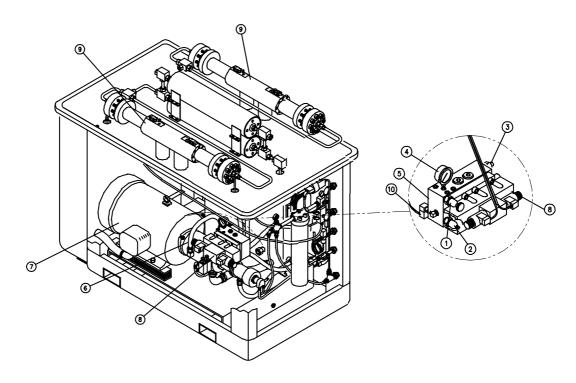


9.1.1 Components

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).

		Pressure Adjustment		Hyd. Pressure Bar (psi)		
Control	Valve	Increase	Decrease	Maximum	Minimum	
High Pressure	1	Clockwise	Counterclockwise	207 (3,000)	1.7 (25)	
Low Pressure	2	Clockwise	Counterclockwise	103 (1,500)	1.7 (25)	
Main Relief	3	Fixed	Fixed	234 (3,400)	(Not applicable)	

NOTE

Do not adjust the HI pressure control to pressures greater than 207 bar (3,000 psi). Doing so will cause the main relief to open limiting hydraulic pressure to 234 bar (3,400 psi). Also due to excessive opening of the main relief valve will result in significant wasted heating of the hydraulic oil, and the decrease of water flow performance.



9.3 Motor/Hydraulic Service Maintenance

The hydraulic oil filter should be checked daily and replaced if the pressure gage reads over 40 psi. The hydraulic oil should be replaced every 2000 hours or yearly, whichever occurs first. For hydraulic oil and filter maintenance, see Section 10, **Recirculation System**.

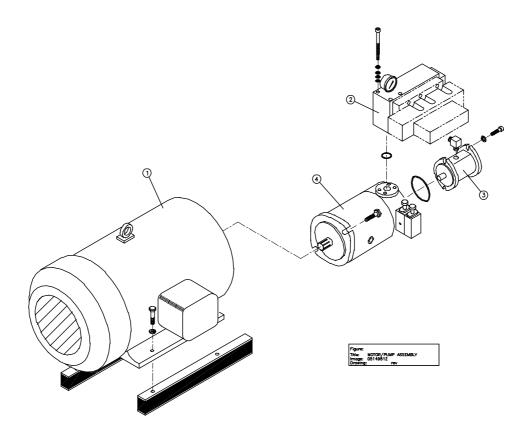
The hydraulic system components that require periodic maintenance are the motor and the manifold. The motor needs to be serviced every 5000 hours of use. The operating pressure settings of the manifold needs to be checked daily and adjusted if necessary.

Recommended Tools: - Manual Grease Gun

- Open End Wrench 14mm (9/16")

- Rags

Parts: - Bearing Grease, SRI #2 or equivalent



Item Description

1	Motor	2	Manifold
3	Recirculation Pump	4	Hydraulic Pump



9.3.1 Motor Service

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

9.3.2 Manifold Service

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

9.3.3 Motor/ Pump Coupling – Spline Lubrication

(Recommended Annual Service Procedure)

Special Tools and Supplies:

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

Shaft Seal Part No's Hydraulic Pumps				
Model/ hp (kw)	Piston Pump Displacement (cc's/rev)	Shaft Seal – KMT Part No.		
SL-IV/ 30 (22) & S30-OEM	45	05096011		
SL-IV / 50 (37)	71	05088083		
SL-IV / 100 (75)	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 IR Waterjet pump frame (SL-IV/30/50/100hp). Remove 4 ea ½-in. nuts from studs holding electrical panel to end of frame. Move electrical panel 4-8 inches away from frame. Disconnecting of motor lead wires should not be necessary to perform this procedure. Note that wire ties holding the electrical control harness to the top pan should be removed to allow the electrical control panel.

- 6. Wipe residue from motor internal spline and from male pump splines. Avoid damage to shaft seal on hydraulic pump.
- 7. Inspect splines for unusual wear. Consult with KMT 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. 1Move 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

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

10.1 Components

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

- Recirculation pump (gear-type)—which receives oil from the oil tank
- **Heat exchanger** cooling water is controlled by the water modulating valve
- Oil filter assembly includes a gage 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.

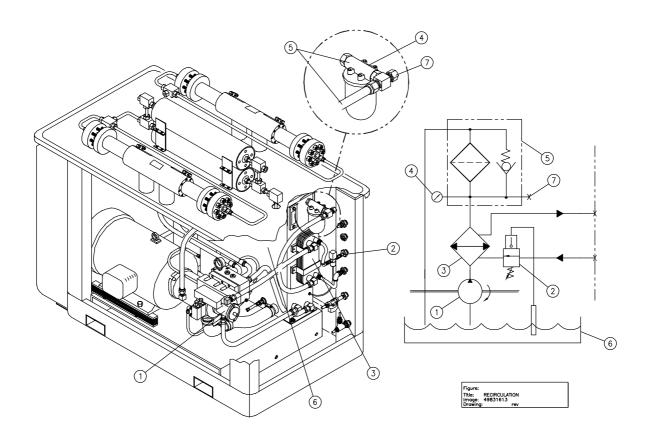
10.2 Operation

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.

Condition of the hydraulic filter is determined by analyzing gage pressure. It should be read when both the water jet pump is running and the oil temperature is approximately 115°F. 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.

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Item Description

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

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 a relief valve located on filter head (5).



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

10.4 Maintenance Overview

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

In order to get the best value from the hydraulic system (including the recirculation system) one should change the filter element when it indicates that it is time. The hydraulic oil should be changed at intervals recommended in the scheduled maintenance table, section 4.1 or whenever a fluid sample indicates that it is contaminated and beyond being fixed by simply operating the filter.

Parts: Hydraulic Oil:

General service, use Mobil #DTE Heavy Medium, No. 021029 (I-R part 05022702)

Food service, use Conoco AA-20

(I-R part 49835762)

Oil with additives such as zinc diophosphate for antiwear are not recommended because of reaction with water.

Tools: Open End Wrench, 1-1/4"

Rags

Container to collect oil

Oil transfer pump with 3/4" hoses. Inlet hose with ½" male pipe connector, and pump

discharge hose with 3/4" female JIC connector.

Oil Filter

Replace filter element when the pressure reading is 1.4 bar (20psi) above normal when at operating temperature. Maximum normal pressure is 1.7 bar (25psi).

Components: - Oil Filter Head (1)

- Element (2)

- Pressure Gage (3)

Parts: - Element

Tools: - Filter Wrench

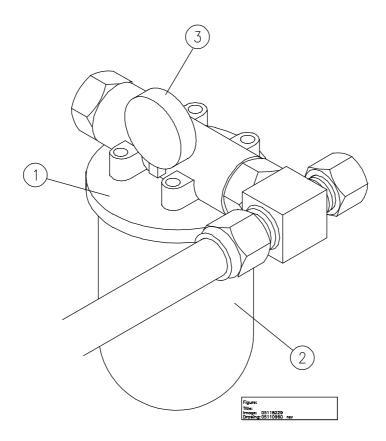
- Rags

- 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 Tank

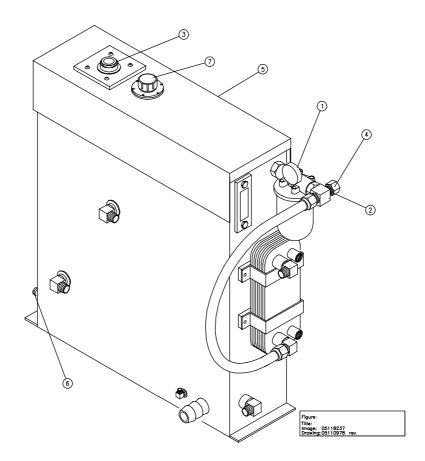
The oil tank is equipped with the following:

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

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



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



Item Description

1	Filter Assembly	2	Oil Fill Port	3	Temperature Sensor
4	Oil Fill Port Cap	5	Oil Tank Cover	6	Shut-Off Valve
7	Breather				



Replace Hydraulic Oil

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

NOTE

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

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



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

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



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 KMT Waterjet SLIV Waterjet Pump. Included are the specifications for the equipment, torque, cutting water, cooling water, and the maximum quantity of orifices that can be supported. 30hp and 50hp power units are listed.

11.1 Equipment Specifications

SL-IV Waterjet Pump Size		22 (30)	37 (50)	kW (hp)
Installation location		Indoors	Indoors	
-Air borne dust/contaminants		Minimal	Minimal	
Ambient temperature				
-Minimum storage		2(36)	2(36)	°C(°F)
-Minimum operating		5(40)	5(40)	°C(°F)
-Maximum operating		40(104)	40(104)	°C(°F) (see note [1])
Maximum Relative Humidity				(see note [2])
-At Maximum Operating Temp.		95%	95%	
Electrical				(see note [3])
-Motor type		TEFC	TEFC	(see note [4])
Voltage / Service Amps	200/3/50	92	150	Volts/Phase/Hertz/Amps
	208/3/60	88	144	_
	240/3/60	80	130	
	400/3/50	46	75	
	415/3/50	44	72	
	480/3/60	40	65	
	575/3/60	32	52	
Sound Level		72.5	72.5	dB(A) (see note [5])

(Note: Specifications listed below apply equally to 30 hp and 50 hp models)

-Voltage 24 volts, DC -Power Supply 10 amps, DC -Safety shutdown switch settings	Controls							
	-Voltage	24	volts, DC					
-Safety shutdown switch settings	-Power Supply	10	amps, DC					
Butery shadown switch settings	-Safety shutdown switch settings							
High oil temperature 62 (144) °C (°F)	High oil temperature	62 (144)	°C (°F)					
Low inlet water pressure 2 (30) bar (psi)	Low inlet water pressure	2 (30)	bar (psi)					
Low oil level 80 (21) 1 (gal).	Low oil level	80 (21)	l (gal).					
Booster pump overheat 53 (128) °C (°F) (see note [5])	Booster pump overheat	53 (128)	°C (°F) (see note [5])					
Low booster pressure 4 (60) bar (psi)	Low booster pressure	4 (60)	bar (psi)					
Hydraulic System	Hydraulic System							
-Oil tank capacity 106 (28) 1 (gal)	-Oil tank capacity	106 (28)	1 (gal)					
-Recommended oil type	-Recommended oil type							
Regular applications Mobil, DTE Heavy Medium, # 021029 (KMT # 05022702)	Regular applications	· ·	•					
Food applications Conoco AA-20 (KMT # 49835762)	Food applications	Conoco AA-2	0 (KMT # 49835762)					
-Hydraulic oil operation	-Hydraulic oil operation	_						
Minimum temperature $15(60)$ $15(60)$ °C(°F)	Minimum temperature	15(60) 15(60)	°C(°F)					
Maximum temperature $65(150)$ $65(150)$ $^{\circ}$ C($^{\circ}$ F)	Maximum temperature	65(150) 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)	37 (50)	kW (hp)					
Optimum temperature	46(115)	46(115)	°C(°F)					
Hot oil shutdown	62(144)	62(144)	°C(°F)					
Fluid Filtration Rating	Beta 10	>/= 100	Note [6]					
Fluid Cleanliness Level	17/	14	Note [7]					
-Hydraulic Pump Type	Pist	on						
Displacement		V	ariable					
Pressure		Con	npensated					
Flow rate	65(1		l/min(gpm)					
-Hydraulic Hi-Lo Settings (factory)	`		C1					
Lo pressure	34 (5	500)	bar (psi)					
Hi pressure	206 (3		bar (psi)					
-Hydraulic oil cooling		,	1					
Total heat rejection	3.7 (5.0)	7.4 (10)	kW (hp)					
Cooling fluid requirements at inlet fluid			. 1					
temperature	18 (65)	°C (°F)					
Maximum cooling flow	1	7.57(2.0)	l/min (gpm)					
Maximum inlet pressure	6.9(1	•	bar (psi)					
Pressure drop	2 (3		bar (psi)					
Cutting Water "IN"	_ (,	Jul (491)					
-Minimum inlet pressure	2.4 (35)	bar (psi)					
-Maximum inlet pressure Important:								
inlet pressure must be constant	5 (7	['] 3)	bar (psi)					
-Maximum outlet pressure	8.3(1	20)	bar (psi)					
-Maximum inlet temperature	29(8	•	°C (°F)					
-Optimum inlet temperature	18(6	•	°C (°F)					
-Factory Booster Pump Settings	10((] 	C(1)					
Inlet Pressure	4 (5	[8] [bar (psi)					
Outlet Pressure Set at	8.3(1	,	bar (psi) (see Note [8])					
Cutting Water Out	0.5(1	120)	oai (psi) (see 110te [0])					
Cutting Water Out	2.4 (0.63)	3.8 (1.0)	1/min(gpm) @ 55,000					
-Maximum flow rate	2.4 (0.03)	3.4(0.9)	1/min(gpm) @ 55,000 1/min(gpm) @ 60,000					
	' '							
(Note: Specifications listed below apply equally	· .	-						
-Minimum outlet pressure	345 (5	,000)	bar (psi)					
-Maximum cont. outlet pressure								
(Q-series)	3,800 (5		bar (psi)					
(T-series)	4,100 (50,000	bar (psi)					
Compressed Air			2					
-Flow rate maximum	0.028		m ³ /min(cfm)					
-Inlet pressure range	75-85	(5-6)	bar (psi)					
Service Connections								
-Cutting water in	1/2"]							
-Cutting water out	9/1		60,000 psi HP fitting					
-Cooling water in	1/2"]							
-Cooling water out	1/2"]							
-Plant air in	1/4"]							
-Cutting water drain	1/2"]							
-Oil tank drain valve	1/2"]							
-Oil tank fill port	3/4" ma	ıle 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 \sim < 1,300 particles per ml > 25 microns // 14 \sim < 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



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
Flange Stud Nuts	271 (200)	(1-7/16) socket*
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

^{*}See Section 7 for complete tightening procedure.

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 10084440) 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
Magnesium as Mg (mg/l)	0.5	0.1	0.1
Manganese as Mn (mg/l)	0.1	0.1	0.1
Nitrate (mg/l)	25	25	10
Oxygen (mg/l)	2	1	0.1
pH Value	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
Silica (mg/l)	15	10	1
Sodium (mg/l)	50	10	1
Sulfate (mg/l)	25	25	1
Total Dissolved Solids (mg/l)	200	100	5*
Total Hardness as CaCO3 (mg/l)	25	15	1
Turbidity (NTU)	5	5	1

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

11.4 Cooling Water Specifications

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

Closed recirculation:

Corrosion

Fouling

Once through:

Corrosion

Fouling

Scale

Microbiological

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



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

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

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

11.5 Orifice Support Capacity

The SL-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	Pressure	Flow	Qty of Orifice by size [1]													
power kW(hp)	Bar (Psi)	lpm (gpm)	14	13	11	10	9	7	5							
22 (30)	3,800 (55,000)	2.4 (0.63)	-	-	1	-	-	2	4							
22 (30)	4,100 (60,000)	2.2 (0.58)	-	-	-	1	-	2	4							
37 (50)	3,800 (55,000)	3.8 (1.0)	1	-	-	2	-	4	7							
37 (50)	4,100 (60,000)	3.4 (0.9)	-	1	1	1	2	3	6							

Note [1]: Orifice sizes: See below

Nom. Orif Size	5	7	9	10	11	13	14
in.	.005	.007	.009	.010	.011	.013	.014
mm	.12	.17	.22	.25	.28	.33	.35



Section 12 - Parts List

12 Spare Parts Catalogue

STREAMLINE SL-IV 30 High Pressure Waterjet Pump

To contact the KMT Waterjet Spare Parts Department:

USA Europe

Parts DepartmentSpare Parts ManagerKMT WaterjetKMT Waterjet Systems

Fluid Products Wasserstrahl-Schneidetechnik GmbH

635 West 12th Street / POB 231 Auf der Laukert 11

Baxter Springs, KS 66713-0231 D-61231 Bad Nauheim

USA Germany

Phone: (620) 856–2151 Phone: +49-6032–997–115 Fax: (620) 856–5050 Fax: +49-6032–997–271

E-mail: Wj.service@kmtwaterjet.com E-mail: order.spares@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:

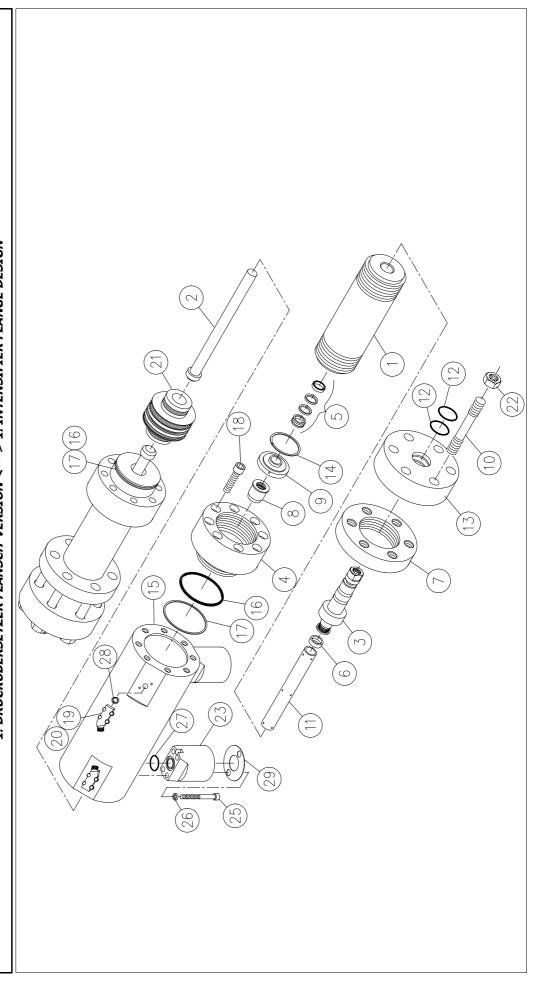
Table 12-1 Part Description Abbreviations and Nominal Size Guide

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





STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5144217 1. DRUCKÜBERSETZER FLANSCH-VERSION <> 1. INTENSIFIER FLANGE DESIGN	Description	BODY, HD-CYLINDER, SLIV FD	PLUNGER, 7/8", CERAMIC	SEAL HEAD, ASSY, PORT, SLIV FD	HEAD, HD-ZYL, SLIV FD	SEAL ASSY-HP FD, .875	SPCR-SEAL HD, SL4K	FLANGE RING SL-IV	SEAL ASSY, HYDRAULIC "CARTRIDGE" NEW	FLANGE, SEAL HYDRAULIC, "CARTRIDGE"	STUD, 7/8-9 x 6.00	LINER-HP CYL, 1.12X8.63, ERTALYTE	O-RING, RING, LP WATER INLET, SLIII/IV	FLANGE, END, SL-IV	RING, FLANGE, HYD. SEAL, "CARTRIDGE"	CYLINDER, HYDRAULIC, SLIV	O-RING, 3-3/4"x4"x1/8"	RING, BACK-UP, 3-3/4"x42	SCREW, CAP, M14 x 60	SWITCH, PROXIMITY, 20-250 VAC/VAC	SCREW SOCKET HEAD, M6-1x30 MM	PISTON ASSY HYDRAULIK, SL-IV+	NUT, HEAVY HEX, 7/8"- 9 SLI/SLII	STEM, MOUNTING TOPWORKS, SLIV	SCREW, SOCKET HEAD, M10-1.5 x 85 mm	WASHER, LOCK, M10	O-RING, 1"x1-1/4"x1/8"	SPACER, PROXIMITY SWITCH (AB), SLIV
	Bezeichnung	KÖRPER HD-ZYLINDER SLIV FD	KOLBENSTANGE 7/8" KERAMIK	DICHTKOPF KOMPLETT AUSGANG SLIV FD	KOPF HD-ZYL SLIV FD	DICHTSATZ HYPERLIFE SLIV FD	DISTANZRING, DICHTKOPF SLIV FD	FLANSCHRING SL-IV	DICHTUNG HYDRAULIK "CARTRIDGE" NEU	FLANSCH DICHTUNG HYDRAULIK "CARTRIDGE"	STEHBOLZEN 7/8-9 x 6.00	BÜCHSE HD-ZYL, 1.12X8.63, ERTALYTE	O-RING ND-WASSER ANSCHLUSSRING SLIII/IV	FLANSCH STIRN SL-IV	RING FLANSCH HYD. DICHTUNG "CARTRIDGE"	ZYLINDER HYDRAULIK SLIV	O-RING 3-3/4"x4"x1/8"	STÜTZRING 3-3/4"x4"	SCHRAUBE M14 x 60	SCHALTER NÄHERUNG 20-250 VAC/VAC	SCHRAUBE INNENSECHSKANT M6-1x30 MM	KOLBEN HYDRAULIK KOMPLETT, SL-IV+	MUTTER-SECHSKANT ZUGANKER SLI/SLII	ZYLINDER HALTERUNG DRUCKÜBERSETZER SLIV	SCHRAUBE INNENSECHSKANT M10-1.5 x 85 mm	FEDERRING M10	O-RING 1"x1-1/4"x1/8"	ABSTANDHALTER NÄHRUNGSSCHALTER (AB) SLIV
	Qty.	2	7	2	2	2	2	7	2	7	12	7	4	7	7	⊣	2	2	16	2	4	\vdash	12	2	8	8	2	7
	CPN	05144647	05119151	05144688	05147913	05149703	05144696	05144225	05130091	05007786	05144753	05144712	10074904	05144209	05034798	05034764	10075000	05034855	05141106	05127584	10183572	05132253	10069904	05049812	05079652	05061486	10074409	05144183
	Pos.	01	02	03	04	05	90	20	80	60	10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28



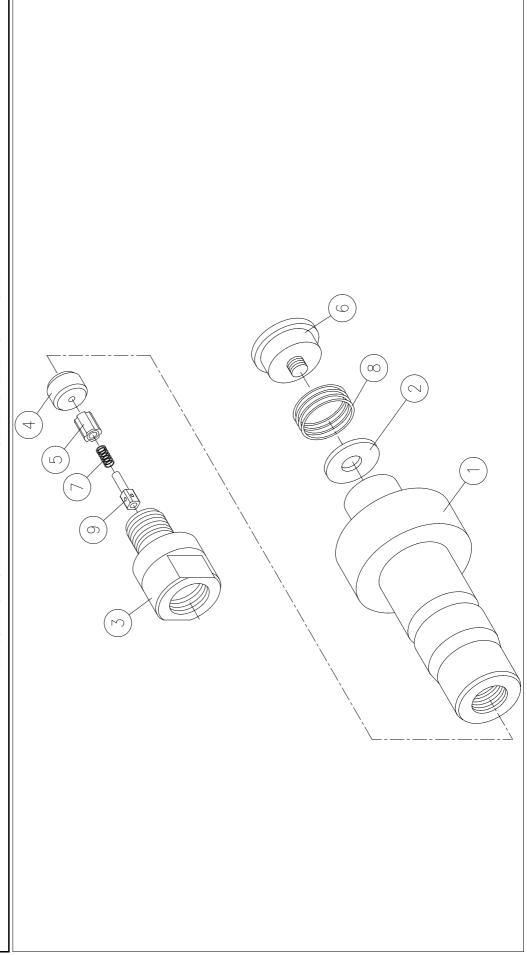
1. DRUCKÜBERSETZER FLANSCH-VERSION <---> 1. INTENSIFIER FLANGE DESIGN STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5144217

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



A. HOCHDRUCKWASSERSYSTEM / A. HIGH PRESSURE WATER SYSTEM

2. DICHTKOPF SITZVENTIL <---> 2. SEALING HEAD POPPET SEAT ZEICHNUNG VON / DRAWING OF CPN 5144688





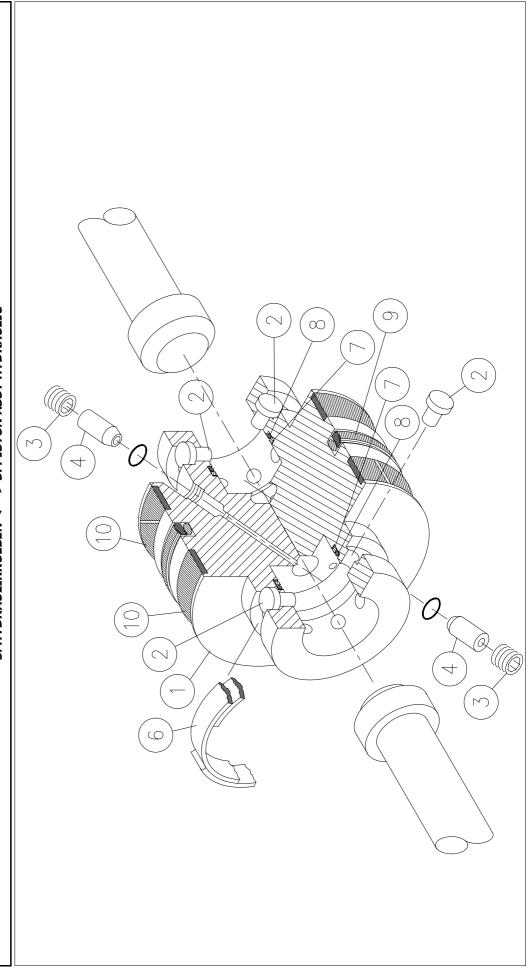
2. DICHTKOPF SITZVENTIL <--> 2. SEALING HEAD POPPET SEAT STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5144688

Pos.	CPN	Qty.	Bezeichnung	Description
0.1	05144357	1	KÖRPER DICHTKOPF AUSGANG SLIV	BODY, SEAL HEAD, PORT, SLIV
03	05144662	Н	SCHEIBE DICHTUNG ND-WASSEREIN SLIV FD	VALVE, POPPET, LP WATER INLET SLIV FD
03	05116777	П	MUTTER DICHTKOPF SITZVENTIL SL-IV	NUT, GLAND, SEAL HEAD, POPPET SL-IV
04	05112768	П	SITZ DICHTKOPF 17MM SL-IV 100HP	SEAT, SEAL HEAD, 17MM, SL-IV 100HP
05	05116561	П	SITZ DICHTKOPF SITZVENTIL SL-IV	SEAT, SEAL HEAD, POPPET SL-IV
90	05144670	Н	HALTERUNG FEDER WASSEREING. SLIV FD	RETAINER, POPPET, LP-WATER SLIV FD
20	05147863	Н	FEDER RÜCKSCHLAGVENTIL SLIV FD	SPRING, CHECK VALVE, SLIV FD
80	49884562	П	FEDER ND-WASSEREINGANG SLIII/IV	SPRING, LP-WATER INLET, SLIII/IV
60	05116751	↔	HALTERUNG SITZVENTIL SL-IV	RETAINER. POPPET VALVE. SL-IV



A. HOCHDRUCKWASSERSYSTEM / A. HIGH PRESSURE WATER SYSTEM

3. HYDRAULIKKOLBEN <---> 3. PISTON ASSY HYDRAULIC ZEICHNUNG VON / DRAWING OF CPN 5132253





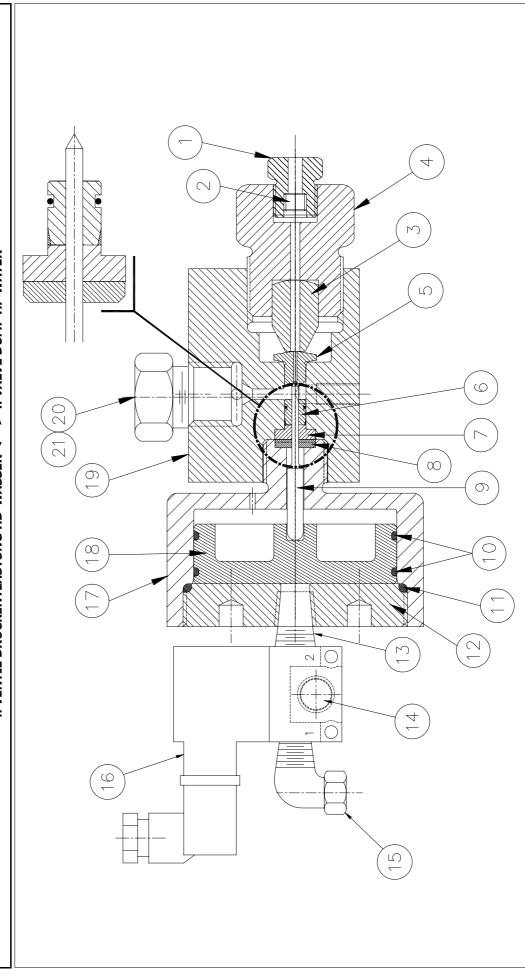
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5132253 3. HYDRAULIKKOLBEN <---> 3. PISTON ASSY HYDRAULIC

Pos.	CPN	Qty.	Bezeichnung	Description
0.1	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
90	05088364	2	RING STAHLBAND HALTERING PINS	RING SNAP, FLAT STEEL BAND, RETAINER PINS
20	05049994	2	STÜTZRING O-RING HYD. KOLBEN SLIV	RING, BACK-UP, O-RING, HYD. PISTON SLIV
80	05087713	7	O-RING 1-1/4"x1-1/2"x1/8"	O-RING, 1-1/4"x1-1/2"x1/8"
60	05117965	1	DICHTSATZ HYDRAULIKKOLBEN SL-IV NEU	SEAL ASSY, HYDRAULIC PISTON, SL-IV
10	05117940	7	GLEITRING HYDRAULIKKOLBEN SL-IV NEU	RING, GLIDE, HYDRAULIC PISTON, SL-IV





ZEICHNUNG VON / DRAWING OF CPN 5069703 4. VENTIL DRUCKENTLASTUNG HD-WASSER <---> 4. VALVE DUMP HP WATER





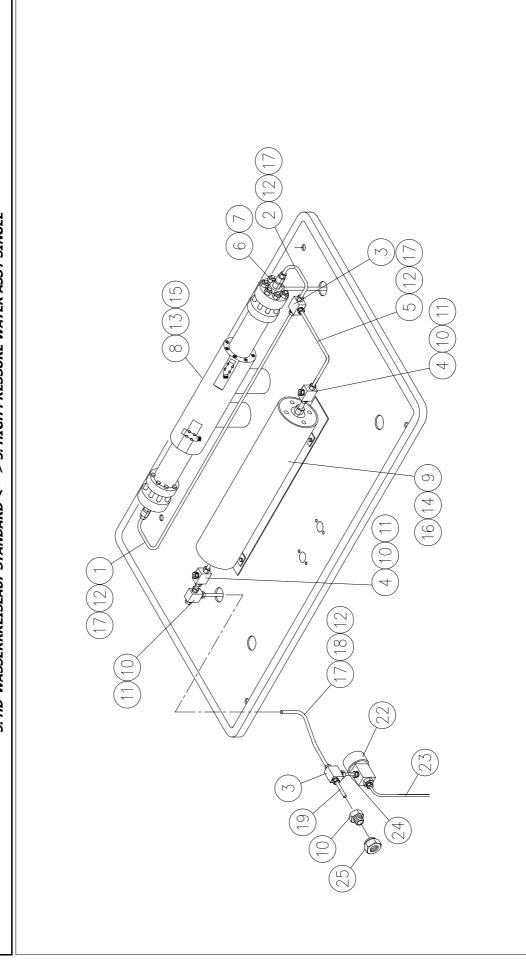
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5060703

AL FOR CPN SUBSTUS -> 4. VALVE DUMP HP WATER	Description	NUT, GLAND, HP, 1/4"	COLLAR, HP, 1/4"	CONE, 9/16", SAFETY HEAD	ADAPTER, 9/16"x1/4"	SEAT, REPLACEABLE, PNEUMATIC VALVE	SEAL ASSY, PNEUMATIC VALVE, ø 0.25"	RING, BACK-UP, PNEUMATIC VALVE ø 0.25"	RING, BACK-UP, ACTUATOR, PNEU. VALVE	STEM, PNEUMATIC VALVE, 3/8"	O-RING, 2-1/4"x2-3/8"x1/16" VITON	O-RING, 2-7/16"x2-5/8"x3/32" VITON	COVER, TOP, PNEUMATIC VALVE, N/O	ADAPTER, MALE, 1/8"x1/8", BRASS	SILENCER, SOLENOID VALVE, 5.4-8.5 W	COUPLING, 90°, MALE, 0.25"x0.13"	VALVE, SOLENOID, 2/3-WAY, 24VDC, 5.4 W	CYLINDER, PNEUMATIC VALVE, N/O	PISTON, PNEUMATIC VALVE, N/O	BODY, PNEUMATIC VALVE, ø 0.25"	COLLET, GLAND, ANTIVIBRATION, 3/8"	COLLAR, HP, 3/8"
STUCKLISTE FUR / BILL OF MATERIAL FOR CPN 5069703 4. VENTIL DRUCKENTLASTUNG HD WASSER <> 4. VALVE DUMP HP WATER	Bezeichnung	MUTTER ÜBERWURF HOCHDRUCK 1/4"	ROHRMUTTER 1/4" HOCHDRUCK	DRUCKSTÜCK KONUSTEIL 9/16"	ADAPTER 9/16"x1/4"	NADELSITZ AUSTAUSCHBAR PNEUM. VENTIL	DICHTSATZ PNEUMATIKVENTIL ø 0.25"	STÜTZRING PNEUMATIKVENTIL ø 0.25"	STÜTZRING ZYLINDER PNEUMATIKVENTIL	NADEL PNEUMATIKVENTIL 3/8"	O-RING 2-1/4"x2-3/8"x1/16" VITON	O-RING 2-7/16"x2-5/8"x3/32" VITON	DECKEL PNEUMATIKVENTIL N/O (OBEN)	VERSCHRAUBUNG 1/8"x1/8" MESSING	SCHALLDÄMPFER MAGNETVENTIL 5.4-8.5 W	KUPPLUNG 90° MÄNNLICH 0.25"x0.13"	MAGNETVENTIL 2/3-WEGE 24VDC 5.4 W	ZYLINDER PNEUMATIKVENTIL N/O	KOLBEN PNEUMATIKVENTIL N/O	KÖRPER PNEUMATIKVENTIL ø 0.25"	MUTTER STABILISIERUNG SPANNZANGE 3/8"	ROHRMUTTER 3/8" HOCHDRUCK
	Qty.	1	П	П	П	1	Н	П	П	1	2	1	1	1	1	1	П	П	П	1	1	1
	CPN	10078459	10078426	10079291	49864309	10178697	10178978	10188233	10187250	49865843	10074565	10074714	49894173	05450176	49890825	10077030	49888035	49894199	49894181	10189181	49864564	49864622
	Pos.	0.1	02	03	04	05	90	20	80	60	10	11	12	13	14	15	16	17	18	19	20	21



A. HOCHDRUCKWASSERSYSTEM / A. HIGH PRESSURE WATER SYSTEM

5. HD-WASSERKREISLAUF STANDARD <---> 5. HIGH PRESSURE WATER ASSY SINGLE ZEICHNUNG VON / DRAWING OF CPN 5144738

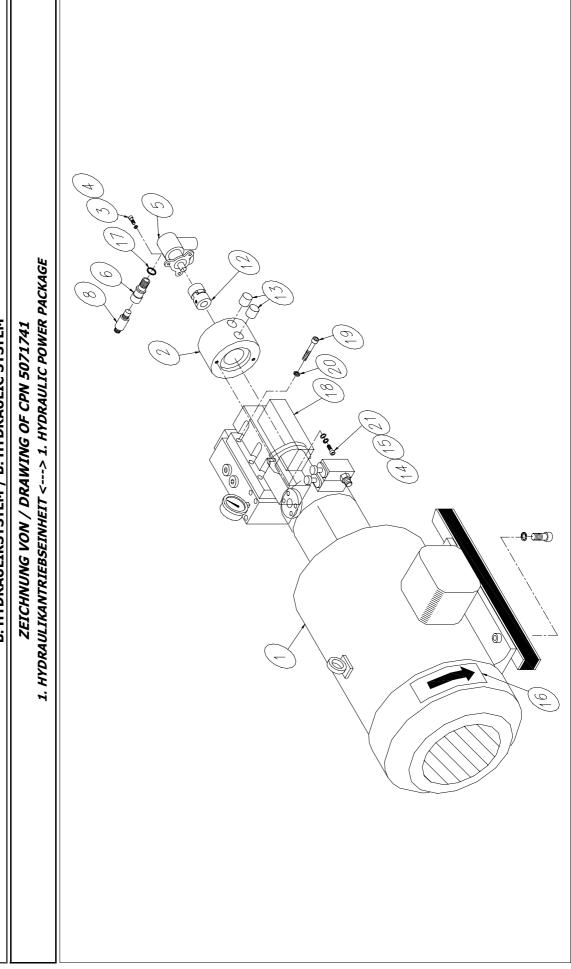




AL FOR CPN 5144738 H PRESSURE WATER ASSY SINGLE	Description	TUBE HP 3/8"BENT SLIV FD TOPW.	TUBE HP 3/8" BENT SLIV FD	COUPLINH, HP, TEE, 3/8"	PLUG, 9/16", HP-TUBE	TUBE HP 3/8" BENT 4150	NUT, GLAND, HP, 3/8"	COLLAR, HP, 3/8"	TOPWORKS, INTENSIFIER, SL-IVPLUS	ACCUMULATOR, TUV, 1 LITER, SLIV	COUPLING HP TEE $9/16 \times 3/8$ "	FERRULE, 1/4"	WASHER, LOCK, 1/2"x0.125"	SPACER, ACCUMULATOR	SCREW, SOCKET HEAD, 1/2"x1"	NUT, HOUSING, ACCUMULATOR, SLIV	CONDUIT, PROTECTION, HP TUBE 1/4"&3/8"	TUBE HP 3/8" BENT SLIV FD	HP-NIPPLE TUBE, 3/8" L=4"	COUPLING, HP, 90°, 3/8"	VALVE ASSY, DUMP, PNEUMATIC, SLIV	HP-NIPPLE TUBE, 1/4"x25.5"	HP-NIPPLE TUBE 3/8" L=3"	TUBE HP 3/8" BENT SLIV FD	COUPLING, BULKHEAD, 9/16"
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5144738 5. HD-WASSERKREISLAUF STANDARD <> 5. HIGH PRESSURE WATER ASSY SINGLE	Bezeichnung	HD-ROHR 3/8"GEBOGEN SLIV FD TOPW.	HD-ROHR 3/8" GEBOGEN SLIV FD P.2	KUPPLUNG HOCHDRUCK T-STÜCK 3/8"	STOPFEN 9/16" HD-ROHR	HD-ROHR 3/8" GEBOGEN 4150	MUTTER ÜBERWURF HD 3/8"	ROHRMUTTER 3/8" HD	DRUCKÜBERSETZER KOMPLETT SL-IVPLUS	DRUCKSPEICHER TÜV 1 LITER SLIV	KUPPLUNG HD T-STÜCK $9/16 \times 3/8$ "	ENDRING, ROHRSCHUTZ, 1/4"	FEDERRING 1/2"x0.125"	ABSTANDSHALTER, DRUCKSPEICHER	SCHRAUBE INNENSECHSKANT 1/2"x1"	MUTTER GEHÄUSE DRUCKSPEICHER SLIV	SCHLAUCH SCHUTZ HD-ROHR 1/4"&3/8"	HD-ROHR 3/8" GEBOGEN SLIV FD P.18	HD-NIPPELROHR 3/8" L=101,6MM	KUPPLUNG HD 90° 3/8"	ENTLASTUNGSVENTIL PNEUMATISCH SLIV	HD-NIPPELROHR 1/4"x25.5"	HD-NIPPELROHR 3/8" L=76mm	HD-ROHR 3/8" GEBOGEN SLIV FD P.25	VERSCHRAUBUNG SCHOTT 9/16"
	Qty.	1	П	7	2	1	2	7	П	П	2	∞	4	4	4	7	3,8	1	П	П	П	1	7	1	1
	CPN	05148861	05148853	10078590	49864663	05148846	10078129	10078715	05144217	05040696	49830599	10083897	95413696	05144837	95383790	05090717	10186153	05148820	10105443	10078780	05069703	05080528	10094704	49830581	10090280
	Pos.	01	02	03	04	05	90	07	80	60	11	12	13	14	15	16	17	18	19	20	22	23	24	25	56



B. HYDRAULIKSYSTEM / B. HYDRAULIC SYSTEM





STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5071741

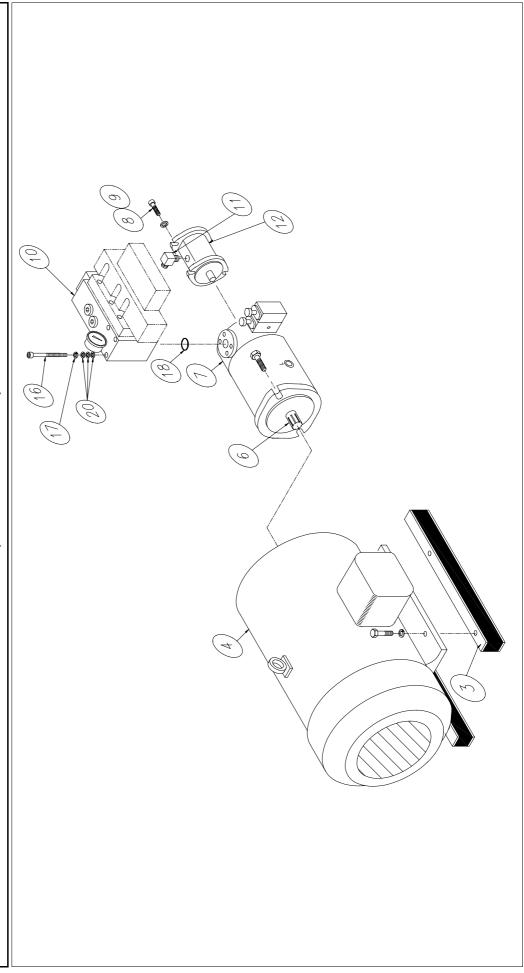
			STUCKLISTE FUR / BILL OF MATERIAL FOR CFN 5071741 1. HYDRAULIKANTRIEBSEINHEIT <> 1. HYDRAULIC POWER PACKAGE	L FOR CFN 5071741 DRAULIC POWER PACKAGE
Pos.	CPN	Qty.	Bezeichnung	Description
01	05071758	1	BAUGRUPPE MOTOR/PUMPE SLIV-50HP	MOTOR/PUMP ASSY, SLIV-50HP
02	05049168	П	ADAPTER BOOSTERPUMPE SLIV	ADAPTER, BOOSTER PUMP, SLIV
03	95572897	က	SCHRAUBE SECHSKANT 1/4"x5/8"	SCREW, HEX HEAD, 1/4"x5/8"
04	95838314	က	SCHEIBE 1/4"x0.063"	WASHER, LOCK, 1/4"x0.063"
05	49887094	П	PUMPE DRUCKERHÖHUNG V2A SLIV-PLUS	PUMP, BOOSTER, WATER, SS, SLIV-PLUS
12	10092302	П	KUPPLUNG DRUCKERHÖHERPUMPE SLIII/IV	COUPLING, SHAFT, BOOSTER PUMP, SLIII/IV
13	10116952	7	STOPFEN, ADAPTER BOOSTER SLIV	PLUG, ADAPTER BOOSTER, SLIV
14	95750394	7	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	П	AUFKLEBER PFEIL DREHRICHTUNG	DECAL, ARROW, DIRECTION ROTATION
18	05092523	П	VENTIL UMSTEUERUNG 24VDC SLIV 30/50HP	VALVE, CONTROL, 24VDC SLIV 30/50HP
19	95055026	9	SCHRAUBE I-SECHSKANT 1/2"x1-3/4"	SCREW, SOCKET HEAD, 1/2"x1-3/4"
20	95688750	9	SCHEIBE 1/2"x0.172"	WASHER, LOCK, 1/4"x0.172"
21	10069714	7	SCHEIBE 3/8"x0.078	WASHER, FLAT, 3/8"x0.078"



B. HYDRAULIKSYSTEM / B. HYDRAULIC SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5071758

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





STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5071758

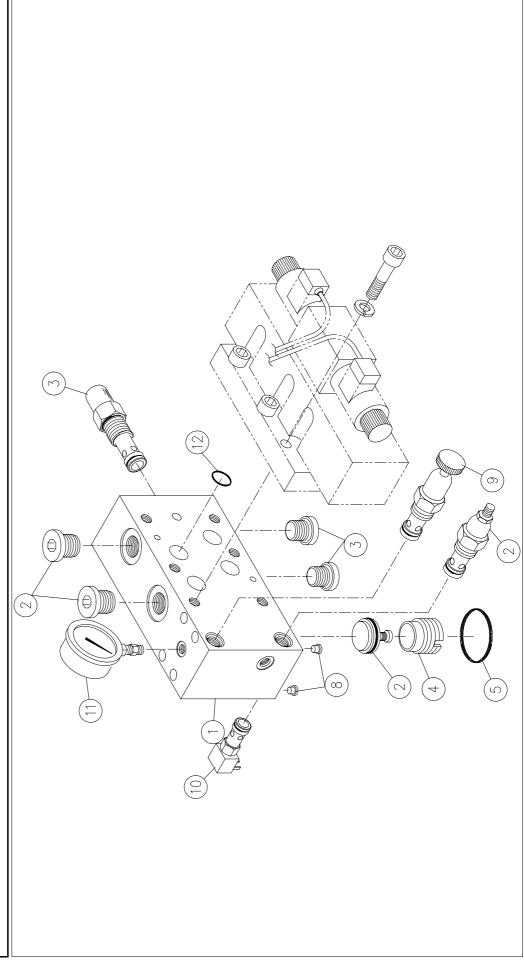
			2. BAUGRUPPE MOTOR/PUMPE <> 2. MOTOR/PUMP ASSEMBLY	OR/PUMP ASSEMBLY
Pos.	CPN	Qty.	Bezeichnung	Description
03	05101613	2	VIBRATIONSDÄMPFER MOTOR SLIV 50HP	ISOLATOR, VIBRATION, MOTOR SLIV 50HP
04	05045513	П	MOTORHAUPTANSLIV50HP37kW)U N G Ü L T I G	MOTOR, ELECTRICAL, SLIV50HP(37kW) 05105234
90	05047519	1	PASSFEDER SLIV 50HP MOTOR/HYD. PUMPE	KEY, SLIV 50HP, MOTOR/HYD. PUMP
20	05045505	П	PUMPE HYDRAULIK VERSTELLBAR SLIV 50HP	PUMP, HYDRAULIC, VARIABLE, SLIV 50HP
80	05037593	7	SCHRAUBE INNENSECHSKANT M10x25mm	SCREW, SOCKET HEAD, M10x25mm
60	10069714	П	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





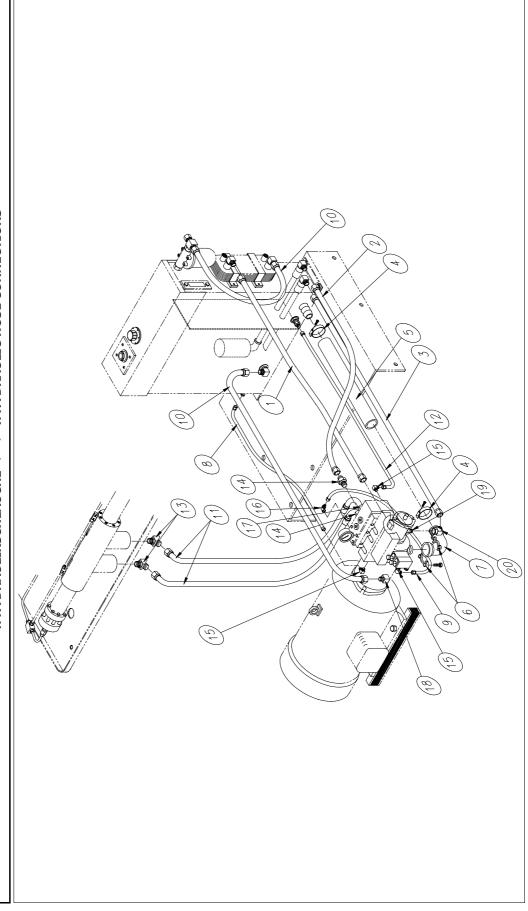
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5071766 3. HYDRAULIKBLOCK <--> 3. MANIFOLD ASSY HYDRAULIC

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	П	VENTIL ÜBERSTRÖMUNG 3200 PSI (220 BAR)	VALVE, RELIEF, 3200 PSI (220 BAR)
94	05055017	7	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
90	05045497	П	MANOMETER HYDRAULIKDRUCK SLIV	GAUGE, PRESSURE, HYDRAULIC SLIV
20	10187052	П	VENTIL ÜBERSTRÖMUNG 1/4" 100-3000 PSI	VALVE, RELIEF, 1/4" 100-3000 PSI
80	10187060	1	VENTIL ÜBERSTRÖMUNG 1/4" 25-800 PSI	VALVE, RELIEF, 1/4" 25-800 PSI
60	10074953	П	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	П	SATZ O-RINGE 4-WEGE UMSTEUERVENTIL	KIT, O-RING, 4-WAY VALVE



B. HYDRAULIKSYSTEM / B. HYDRAULIC SYSTEM

4. HYDRAULIKSCHLÄUCHE <---> 4. HYDRAULIC HOSE CONNECTIONS ZEICHNUNG VON / DRAWING OF CPN 5052519





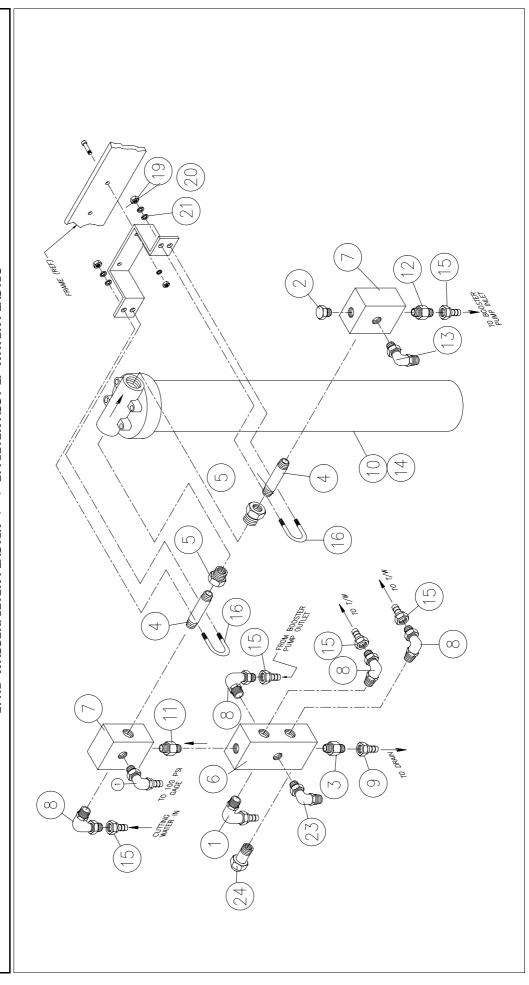
			STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5052519 4. HYDRAULIKSCHLÄUCHE <> 4. HYDRAULIC HOSE CONNECTIONS	L FOR CPN 5052519 LIC HOSE CONNECTIONS
Pos.	CPN	Qty.	Bezeichnung	Description
01	05060744	1	SCHLAUCH ND-HYDRAULIK 3/4" L=445 mm	HOSE ASSY, LP HYDRAULIC, 3/4" L=445 mm
02	05049705	\vdash	SCHLAUCH ND-HYDRAULIK 3/4" L=559 mm	HOSE ASSY, LP HYDRAULIC, 3/4" L=559 mm
03	05049739	⊣	SCHLAUCH ND-HYDRAULIK 3/4" L=356 mm	HOSE ASSY, LP HYDRAULIC, 3/4" L=356 mm
94	10083517	7	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
90	05048780	\vdash	FLANSCH 2-TEILIG 2"	FLANGE, SPLIT-KIT, 2"
07	05048806	⊣	KUPPLUNG FLANSCH 2-TEILIG/SCHLAUCH 2"	COUPLING, SPLIT FLANGE/HOSE, 2"
80	05051214	⊣	SCHLAUCH MD-HYDRAULIK 1/4" L=1524 mm	HOSE ASSY, MP HYDRAULIC, 1/4" L=1524 mm
60	05060751	⊣	SCHLAUCH MD-HYDRAULIK 1/4" L=813 mm	HOSE ASSY, MP HYDRAULIC, 1/4" L=813 mm
10	05049713	⊣	SCHLAUCH ND-HYDRAULIK 3/4" WEIBLICH	HOSE ASSY, LP HYDRAULIC, 3/4" FEMALE
11	05071105	7	SCHLAUCH HD-HYDRAULIK 3/4" L=1016 mm	HOSE ASSY, HP HYDRAULIC, 3/4" L=1016 mm
12	05071121	\vdash	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	\vdash	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	⊣	ADAPTER 45° O-RING/JIC 1/4"x1/4"	ADAPTER, 45°, O-RING/JIC, 1/4"x1/4"
17	05071113	⊣	ADAPTER O-RING/JIC 3/4"	ADAPTER, O-RING/JIC 3/4"
18	05050331	⊣	KUPPLUNG 90° JIC/O-RING 12-10	COUPLING, 90°, JIC/O-RING, 12-10
19	10142594	⊣	ADAPTER GERADE JIC/O-RING 12-16	ADAPTER, STRAIGHT, JIC/O-RING, 12-16
20	05060777	Н	ADAPTER 45° JIC M/W 12-12	ADAPTER, 45°, JIC, M/F 12-12



STREAMLINE SL-IV 50HP - STD/PLUS C. NIEDERDRUCKWASSERSYSTEM / C. LOW PRESSURE WATER SYSTEM

ERSATZTEILLISTE / SPARE PARTS LISTS

ZEICHNUNG VON / DRAWING OF CPN 5140009 1. ND-WASSERFILTER PLASTIK <---> 1. FILTER ASSY LP WATER PLASTIC





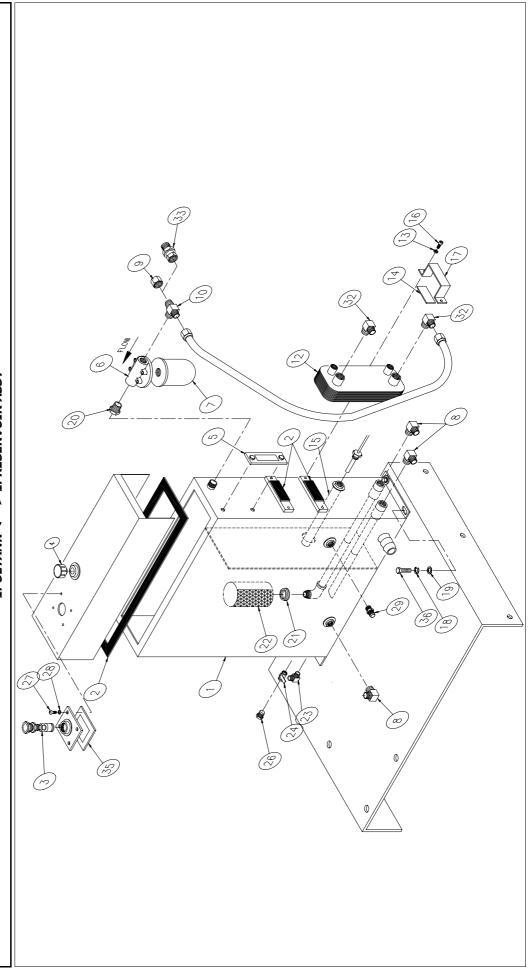
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5140009

ASSY LP WATER PLASTIC	Description	ADAPTER 90° -4 NPT X -4 HOSE	PLUG, O-RING, 1/2"	VALVE, RELIEF, 1/2" 50 - 150 PSI	NIPPLE, PIPE, $1/2$ "x3"	ADAPTER, PIPE, M/F 3/4"x1/2"	MANIFOLD, LP-INLET, SLIV	MANIFOLD, LP-GAUGE, SLIV	ELBOW, LP-WATER, FROM BOOSTER OUTLET	ADAPTER, -8 NPT X -8 HOSE	BODY, LP WATER FILTER, SLIV	VALVE, CHECK, LP-WATER, SLIV	ADAPTER, PIPE/HOSE, $1/2$ " x $1/2$ "	PRESSURE SWITCH; 30PSI	FILTER ELEMENT, WATER, 10 MICRON ABS.	ADAPTER, HOSE/JIC, 1/2"x1/2"	U-BOLT, $\hat{Y}1/2$ " - $1/4$ "x1"x1-3/4"	NUT, HEX, 1/4"-20	WASHER, LOCK, 1/4"x0.063"	WASHER, FLAT, 1/4"x0.063"	PRESSURE SWITCH; 60 PS I
1. ND-WASSERFILTER PLASTIK <> 1. FILTER ASSY LP WATER PLASTIC	Bezeichnung	ADAPTER 90° -4 NPT X -4 SCHLAUCH	STOPFEN O-RING 1/2"	VENTIL ÜBERSTRÖMUNG $1/2$ " 50 - 150 PSI	NIPPELROHR WASSER 1/2"x3"	ADAPTER ROHR M/W 3/4"x1/2"	ANSCHLUSSBLOCK, ND-EINLASS, SLIV	ANSCHLUSSBLOCK, ND-MANOMETER SLIV	WINKEL, ND-WINKEL, VON BOOSTER AUSLASS	ADAPTER -8 NPT X -8 SCHLAUCH	KÖRPER ND-WASSERFILTER SLIV	RÜCKSCHLAGVENTIL, ND-WASSER, SLIV	ADAPTER SCHLAUCHANSCHLUSS M/M1,2" x 1,2	DRUCKSCHALTER; 30PSI	FILTER-ELEMENT WASSER 10 MICRON ABS.	ADAPTER SCHLAUCH/JIC 1/2"x1/2"	BÜGELSCHRAUBE Ý1/2" - 1/4"x1"x1-3/4"	MUTTER SECHSKANT 1/4"-20	SCHEIBE 1/4"x0.063"	SCHEIBE 1/4"x0.063"	DRUCKSCHALTER; 60 PS I
	Qty.	2	П	П	7	7	П	7	4	П	П	П	П	П	7	П	7	4	4	4	П
	CPN	49830714	05129689	05070982	05074067	10078111	05135611	05142070	05135660	49830730	05038690	05135652	10100485	05140751	10106722	10189025	10114023	95416335	95838314	95391322	05142062
	Pos.	0.1	02	03	04	05	90	20	80	60	10	11	12	13	14	15	16	19	20	21	23



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

JIR ASSY	Description	RESERVOIR, SLIV, WELDMENT	GASKET, OIL RESERVOIR, SLIV	SWITCH, TEMPERATURE/LEVEL, 1" SLIV	CAP, FILLER, OIL RESERVOIR, SLIV	GAUGE, TEMP./OIL LEVEL, DUAL SCALE	FILTER, HEAD, OIL, WITH GAUGE, SLIV	FILTER ELEMENT, OIL, 6 MICRON, ABS. SLIV	COUPLING, 90°, PIPE/JIC, 16x12	PLUG, HEX, OIL FILL PORT, SLIV	TEE, MALE, O-RING/JIC, 3/4"	HOSE ASSY, LP HYDRAULIC, 3/4" FEMALE	HEAT EXCHANGER SL-IV-PLUS	WASHER, LOCK, 0.31"x0.078"	PLATE, NEOPREN, 0,13 \times 1	BULB, 3/4"	SCREW, HEX, 5/16"-18 x 1/2	BRACKET, HEAT EXCHANGER	WASHER, LOCK, 1/2"x0.031"	WASHER, FLAT, 1/2"x0.109"	ADAPTER, STRAIGHT, O-RING/JIC, 3/4"	ADAPTER, REDUCING, 1-1/4" x 1" (M-F)	DIFFUSOR, RETURN LINE, 1-1/4"	COUPLING, 90°, PIPE/JIC, 4-4	VALVE, BALL, 1/2"	PLUG, SQUARE HEAD, 1/2"	SCREW, BUTTON HEAD, 10-24x1/2"	WASHER, LOCK, 10x0.047"
1. OLTANK <> 1. RESERVOIR ASSY	Bezeichnung	ÖLTANK SLIV GESCHWEISST	DICHTUNG ÖLTANK SLIV	SCHALTER TEMPERATUR/ÖLNIVEAU 1" SLIV	VERSCHLUSSKAPPE ÖLTANK SLIV	MANOMETER TEMPERATUR/ÖLNIVEAU 2x SKALA	FILTERKOPF ÖL MIT MANOMETER SLIV	FILTERELEMENT ÖL 6 MIKRON ABSOL. SLIV	KUPPLUNG 90° ROHR/JIC 16x12	STOPFEN VERSCHLUSS ÖLBEFÜLLUNG SLIV	T-STÜCK MÄNNLICH O-RING/JIC 3/4"	SCHLAUCH ND-HYDRAULIK 3/4" WEIBLICH	WÄRMETAUSCHER SL-IV-PLUS	FEDERRING 0.31"x0.078"	PLATTE, NEOPREN, 0,13 x 1	GLÜHBIRNE 3/4"	SCHRAUBE, INNENSECHSKANT, $5/16$ "- $18 \times 1/2$	HALTERUNG, WÄREMTAUSCHER	FEDERRING 1/2"x0.031"	SCHEIBE 1/2"x0.109"	ADAPTER GERADE O-RING/JIC 3/4"	REDUZIERUNG 1-1/4" x 1" (A-I)	DIFFUSOR RÜCKLEITUNG 1-1/4"	KUPPLUNG 90° ROHR/JIC 4-4	VENTIL KUGELHAHN 1/2"	STOPFEN VIERKANT 1/2"	SCHRAUBE RUNDKOPF 10-24x1/2"	FEDERRING 10x0.047"
	Qty.	П	1	1	1	1	1	1	က	1	1	1	1	1	1	1	4	1	4	4	1	1	1	1	1	1	4	4
	CPN	05041686	05049861	05050026	05092739	10168862	05049697	05049689	05049655	05069976	05071063	05049713	05145958	95830766	10103232	10091858	95119897	05145974	95716890	10069763	05057559	49868524	05006291	10099901	10080901	95033619	95897948	95367728
	Pos.	01	02	03	04	05	90	20	80	60	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	26	27	28



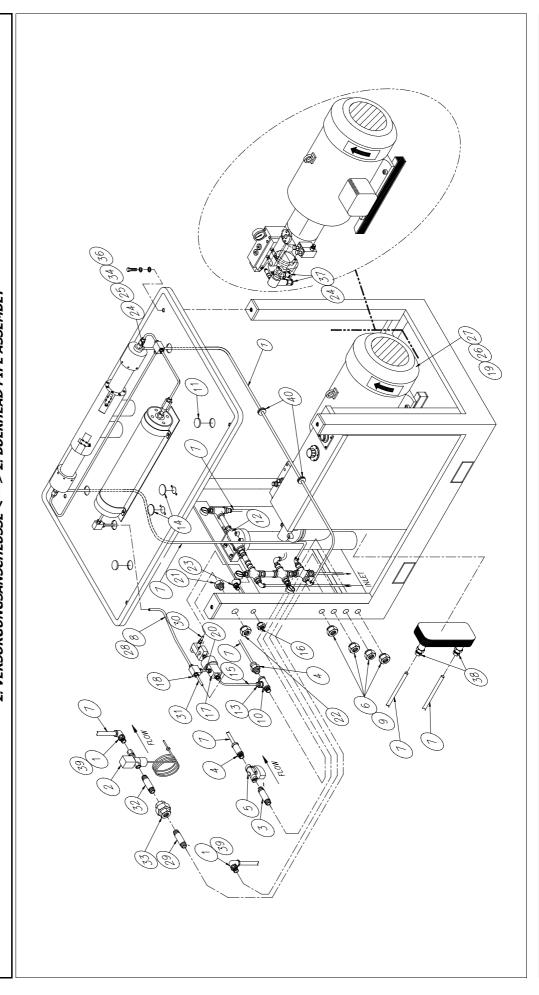
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5041660 1. ÖLTANK <---> 1. RESERVOIR ASSY

Pos.	CPN	Qty.	Qty. Bezeichnung	Description
29	10099877	1	ADAPTER GERADE ROHR/JIC 1/4"	ADAPTER, STRAIGHT, PIPE/JIC, 1/4"
32	05050331	7	KUPPLUNG 90° JIC/O-RING 12-10	COUPLING, 90°, JIC/O-RING, 12-10
33	05079371	⊣	ADAPTER GERADE JIC/BSPP 12-12	ADAPTER, STRAIGHT, JIC/BSPP 12-12
35	05079967	\vdash	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

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





STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5100318

HEAD PIPE ASSEMBLY	Description	COUPLING, 90°, PIPE/JIC, 8-8 BRASS	VALVE, WATER, TEMPERATURE, SLIII	PIPE, STAINLESS STEEL, $1/2$ " x 5"	ADAPTER, 1/2" NPT X 1/2" HOSE	VALVE, SOLENOID, 24VDC-1/2", LP-WATER	ADAPTER, BULKHEAD, 8-24	HOSE, WATER INLET, SLII	HP-NIPPLE TUBE, 3/8" BENT	NUT, JAM, BULKHEAD CONNECTOR, LP-WATER	TEE, MALE, 1/2", STAINLESS STEEL	PLUG, 1-1/2"	FILTER ASSY, LP WATER, SL-IV SS	ADAPTER, TUBE/PIPE, 1/4"x1/2" MALE	CAP, SEAL HOLE, 2-1/2", SLIV	HP-NIPPLE TUBE, 1/4"x25.5", BENT	ADAPTER, BULKHEAD, 4-15, BRASS	VALVE ASSY, DUMP, PNEUMATIC, SLIV	COUPLING, HP, TEE, 3/8"	WASHER, FLAT, 1/2"x0.109"	HP-NIPPLE TUBE 3/8" L=3"	ADAPTER, MALE/FEMALE, 9/16"x3/8"	COUPLING, BULKHEAD, 9/16"	COUPLING, 90°, POLY, 1/4"x1/4"	ADAPTER, HOSE/JIC, $1/2$ "x $1/2$ "	QUICK DISCONNECT, LP WATER, SL-IV 100HP	SCREW, HEX HEAD, 1/2"x1" SLIII	WASHER, LOCK, 1/2"x0.125"
2. VERSORGUNGSANSCHLÜSSE <> 2. BULKHEAD PIPE ASSEMBLY	Bezeichnung	KUPPLUNG 90° ROHR/JIC 8-8 MESSING	VENTIL WASSERTEMPERATUR SLIII	ROHR EDELSTAHL 1/2" x 5"	ADAPTER 1/2" NPT X 1/2" SCHLAUCH	MAGNETVENTIL 24VDC-1/2" ND-WASSER SLII	SCHOTTVERSCHRAUBUNG 8-24	SCHLAUCH WASSERZUFUHR SLII	HD-NIPPELROHR 3/8" GEBOGEN	MUTTER SCHOTTVERSCHRAUBUNG ND-WASSER	T-STÜCK MÄNNLICH 1/2" EDELSTAHL	STOPFEN 1-1/2"	BAUGRUPPE ND-WASSERFILTER SL-IV V2A	ADAPTER ROHR/SCHLAUCH 1/4"x1/2" MÄNNLICH	DECKEL VERSCHLUSS 2-1/2" SLIV	HD-NIPPELROHR 1/4"x25.5" GEBOGEN	SCHOTTVERSCHRAUBUNG 4-15 MESSING	ENTLASTUNGSVENTIL PNEUMATISCH SLIV	KUPPLUNG HOCHDRUCK T-STÜCK 3/8"	SCHEIBE 1/2"x0.109"	HD-NIPPELROHR 3/8" L=76mm	ADAPTER MÄNNLICH/WEIBLICH 9/16"x3/8"	VERSCHRAUBUNG SCHOTT 9/16"	KUPPLUNG 90° KUNSTSTOFF 1/4"x1/4"	ADAPTER SCHLAUCH/JIC 1/2"x1/2"	SCHNELLKUPPLUNG ND-WASSER 1/4" SL-IV 100	SCHRAUBE SECHSKANT 1/2"x1" SLIII	FEDERRING 1/2"x0.125"
	Qty.	2	1	1	7	1	4	7,1	1	4	1	7	1	1	7	1	1	1	1	4	1	1	1	1	4	7	4	4
	CPN	10147460	10091866	05060207	10192425	49890239	49886922	10127348	05071022	10070092	49896749	05061643	05105432	05087143	05061312	05080528	10077055	05069703	49864507	10069763	10094704	10079457	49864341	10176766	10189025	05111398	95738514	10170686
	Pos.	0.1	02	03	94	05	90	20	80	60	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27



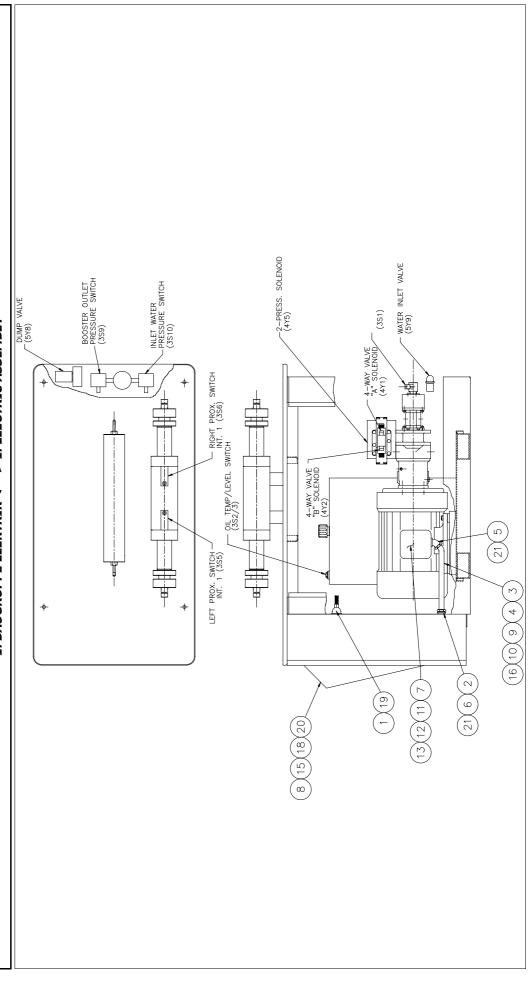
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5100318	2. VERSORGUNGSANSCHLÜSSE <> 2. BULKHEAD PIPE ASSEMBLY

			2. VENSONGOINGRAINSCILLOSSE <> 2. DOLINIEAD III E ASSEMBLI	MEAD III E ASSEMBLI
Pos.	CPN	Qty.	Bezeichnung	Description
28	10186153	9,0	SCHLAUCH SCHUTZ HD-ROHR 1/4"&3/8"	CONDUIT, PROTECTION, HP TUBE 1/4"&3/8"
30	10078293	9,0	SCHLAUCH KUNSTSTOFF 1/4" TRANSP.	HOSE, POLY, 1/4", TRANSPARENT
31	10105443	П	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	П	ADAPTER VENTIL/KÜHLER 1/2"(MS)	ADAPTER, VALVE/HEAT EXCHANGER, 1/2"
34	05111380	7	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	7	SCHLAUCHTÜLLE 1/2"x8JIC MESSING	COUPLING, HOSE, 1/2"x8JIC BRASS
40	05113964	4	SCHLAUCHSCHUTZ GUMMI	GROMMET, RUBBER



E. ELEKTRISCHES SYSTEM / E. ELECTRICAL SYSTEM

ZEICHNUNG VON / DRAWING OF CPN 5148556 1. BAUGRUPPE ELEKTRIK <---> 1. ELECTRIC ASSEMBLY





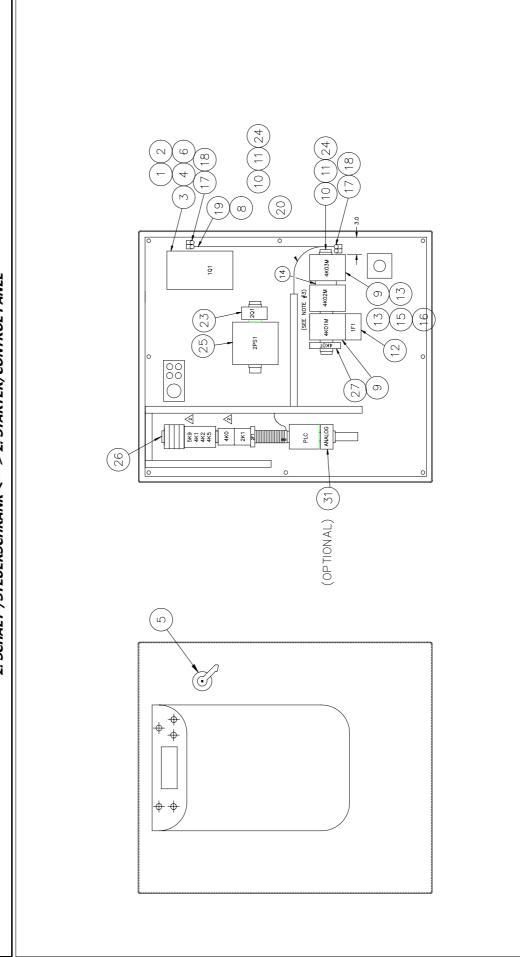
STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5148556

ECTRIC ASSEMBLY	Description	HARNESS-WIRE CONTROL-PANEL SLIV+	CONNECTOR, STRAIGHT, FLEXIBLE, 1-1/2"	RING, TERMINAL	CONDUIT, FLEXIBLE, 1-1/2" GRAY	COUPLING, 45°, FLEXIBLE CONDUIT, 1-1/2"	BUSHING, CONDUIT, 1-1/2"	RING, TERMINAL BLOCK, MOTOR #8-1/4"	WASHER, FLAT, 1/2"x0.109"	WIRE, #6, BLACK	WIRE, #6/10MM2, GREEN/YELLOW	ADAPTER, FIBERGLASS, MOTOR JUNCTION BOX	SCREW, HEX HEAD, 5/16"x1-3/4"	TERMINAL BLOCK, MOTOR, 9-POST, M6	SCREW, SOCKET HEAD, 1/4-20x1-3/4	NUT, HEX, 1/2-13	RING, TERMINAL BLOCK, MOTOR #6-1/4"	NUT, LOCK, 1/4-20	WASHER, LOCK, 1/2"x0.031"	CABLE TIE	CONTROL-PANEL SLIV+COMPLETE	GASKET ASSY, FLEX CONDUIT, 1.5"	WASHER, FLAT, 0.31"x0.078"
1. BAUGRUPPE ELEKTRIK <> 1. ELECTRIC ASSEMBLY	Bezeichnung	KABELBAUM STEUERSCHRANK SLIV+	STECKER GERADE FLEXIBLE 1-1/2"	RING, MOTORKLEMMBRETT	KABELFÜHRUNG 1-1/2" GRAU	KUPPLUNG 45° KABELFÜHRUNG 1-1/2"	HÜLSE KABELFÜHRUNG 1-1/2"	RING MOTORKLEMMBRETT #8-1/4"	SCHEIBE 1/2"x0.109"	KABEL #6 SCHWARZ	KABEL #6/10MM2, GRÜN/GELB	ADAPTER FIBERGLASS KLEMMBRETT/MOTOR	SCHRAUBE SECHSKANT 5/16"x1-3/4"	KLEMMBRETT MOTOR 9-POLIG M6	SCHRAUBE, INNENSECHSKANT, 1/4-20x1-3/4	MUTTER, SECHSKANT, 1/2-13	RING MOTORKLEMMBRETT #6-1/4"	MUTTER, VERSCHLUSS, 1/4-20	FEDERRING 1/2"x0.031"	KABELBINDER	STEUERSCHRANK SLIV+KOMPLETT	DICHTUNG KABELKANAL 1.5"	SCHEIBE FLACH 0.31"x0.078"
	Qty.	1	П	П	0,46	П	П	12	4	6,25	1,05	П	2	П	7	4	П	2	4	ß	П	2	7
	CPN	05148531	10080661	05138219	10086700	10115830	05081377	10159143	10069763	49878754	10170140	05044029	95077012	05043161	95686721	95423695	10174357	05062344	95716890	10125912	05148564	10085405	10069755
	Pos.	0.1	02	03	94	05	90	20	80	60	10	11	12	13	14	15	16	17	18	19	20	21	22



E. ELEKTRISCHES SYSTEM / E. ELECTRICAL SYSTEM

2. SCHALT-/STEUERSCHRANK <---> 2. STARTER/CONTROL PANEL ZEICHNUNG VON / DRAWING OF CPN 5148564





STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5148564

ARTER/CONTROL PANEL	Description	CIRCUIT BREAKER, 100A	SCREW, SOCKET HEAD, 8-32x2	DRIVE, ROTARY MECHANISM, SL-IV-PLUS	EXTENSION, ROTARY HANDLE, SLIV 50-PLUS	ROTARY HANDLE, CIRC. BREAKER SLIV 50PLUS	COVER, TERMINAL	WIRE, #6, BLACK	CRIMP, CONNECTOR, #6/10 MM2	CONTACTOR, NONREVERSING, 81A	SCREW, #10-32 x 3/4	RAIL, DIN-STEEL	RELAY, OVERLOAD	AUXILIARY CONTACTOR	INTERLOCK, MECHANICAL	CONTACTOR, NONREVERSING, 81 A	KIT, WIRING Y/D	CABLE, GROUND LUG-COPPER, #6-#350	SCREW, HEX, 5/16-18 x 3/4	WIRE, #6/10MM2, GREEN/YELLOW	WIRE, #10/4MM2, GREEN/YELLOW	WIRE, #14, BLACK	CRIMP, CONNECTOR, #14/2.5 MM2	CIRCUIT BREAKER	END ANCHOR, TERMINAL BLOCK	POWER SUPPLY, 220/380/415 VAC - 24 VDC	SUBASSEMBLY CONTROLS SLIV 50-PLUS	RELAY, TIMING
2. SCHALT-/STEUERSCHRANK <> 2. STARTER/CONTROL PANEL	Bezeichnung	SCHALTER SICHERUNG 100A	SCHRAUBE, INNENSECHSKANT, 8-32x2	DREHANTRIEB HAUPTSCHALTER SLIV-PLUS	VERLÄNGERUNG DREHANTRIEB SLIV 50-PLUS	DREHANTRIEB HAUPTSCHALTER SLIV 50-PLUS	ABDECKUNG SCHUTZ	KABEL #6 SCHWARZ	ADERENDHÜLSE #6/10 MM2	SCHÜTZ MOTORANLAUF 81 A	SCHRAUBE, #10-32 x 3/4	ANSCHLUSSKLEMMLEISTE	ÜBERLASTRELAIS	HILFSSSCHÜTZ	VERRIEGELUNG MECHANISCH	SCHÜTZ MOTORANLAUF 81 A	SATZ, KABEL Y/D	KABEL ERDUNG #6-#350	SCHRAUBE, SECHSKANT, $5/16-18 \times 3/4$	KABEL #6/10MM2, GRÜN/GELB	KABEL #10/4MM2, GRÜN/GELB	KABEL #14 SCHWARZ	ADERENDHÜLSE #14/2.5 MM2	SCHALTER SICHERUNG	HALTERUNG KLEMMLEISTE	TRANSFORMATOR 220/380/415 VAC - 24 VDC	UNTERBAUGRUPPE STEUERUNG SLIV 50-PLUS	RELAIS ZEITVERZÖGERUNG
	Qty.	1	1	1	1	1	1	3,66	20	1	8	0,61	1	1	1	П	1	7	7	0,61	1,07	2,29	12	1	7	1	1	П
	CPN	05138086	05081955	05137963	05137989	05137997	05137948	49878754	10170355	49833437	10157667	10103034	05117643	49833452	49833460	49833445	49833478	02092609	95423620	10170140	10170157	05019898	05019617	05140686	05032362	05140223	05148515	49833429
	Pos.	01	02	03	04	05	90	20	80	60	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27



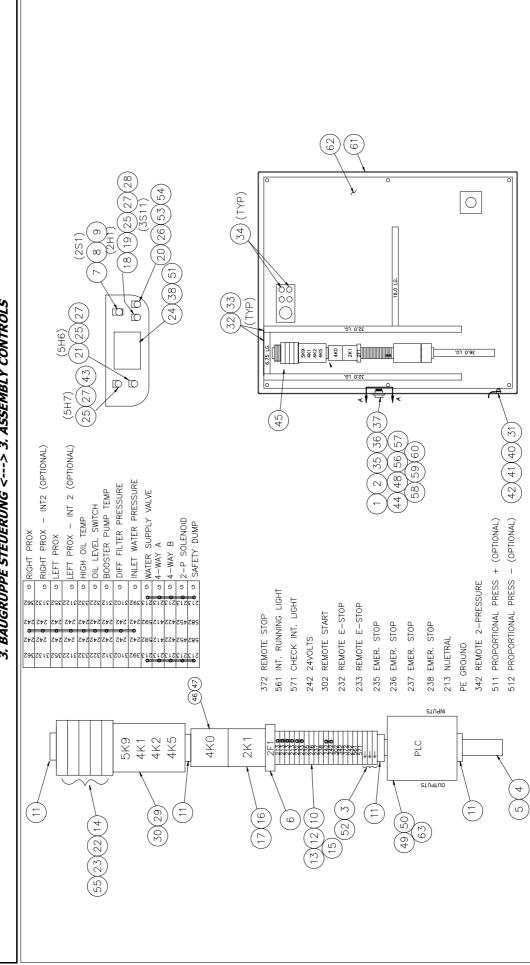
2. SCHALT-/STEUERSCHRANK <--> 2. STARTER/CONTROL PANEL STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5148564

Pos.	CPN	Qty.	Qty. Bezeichnung	Description
28	10185395	8	ADERENDHÜLSE #16	CRIMP, CONNECTOR, #16
29	10176410	1,22	LEITUNG VERDRAHTUNG BLAU	WIRE #16 BLUE
30	10170165	1,22	LEITUNG VERDRAHTUNG GRÜN/GELB	WIRE #16 GREEN/YELLOW





3. BAUGRUPPE STEUERUNG <---> 3. ASSEMBLY CONTROLS ZEICHNUNG VON / DRAWING OF CPN 5148515





STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5148515 3. BAUGRUPPE STEUERUNG <--> 3. ASSEMBLY CONTROLS

SCHALTER SICHERUNG 10A/480V 1-POLIG
SCHALTER NOTAUS, SLIV-PLUS
E 5 MM
SCHILDER KLEMMLEISTE, SLIV-50-PLUS
GRUNDPLATTE RELAIS, 11 PINS
SCHALTER, DRUCKKNOPF, WEISS
DRUCKKNOPF GRÜN, SL-IV-PLUS
18-12 GRAU 3x ERDE
HALTER SCHILDER SCHWARZ
GRUNDPLATTE, SL-IV 50-PLUS
PLATINE OPTO-KOPPLER 4 SLOT SLIII
MODUL SIGNAL DRUCK/TEMPERATUR SLIII
KABELKANAL 1"x2"x6FEET PVC



STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5148515

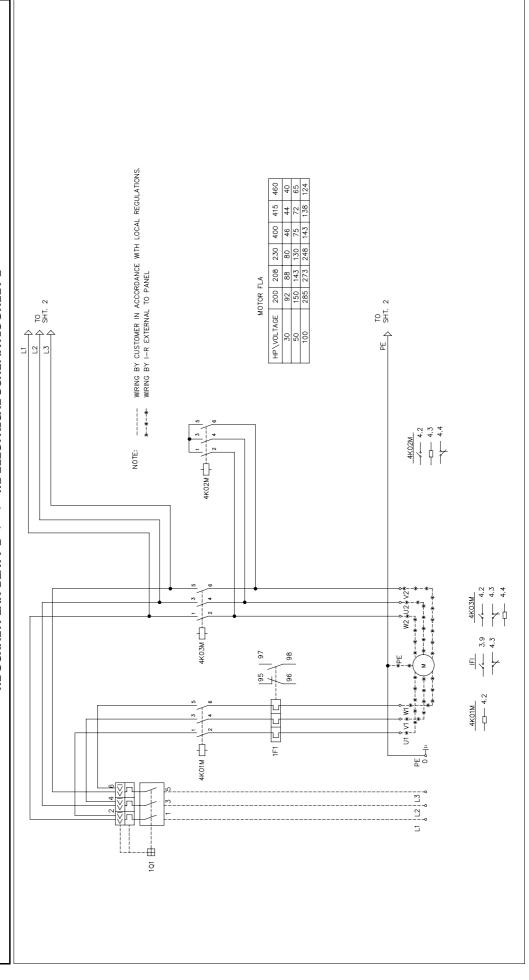
3. BAUGRUPPE STEUERUNG <--> 3. ASSEMBLY CONTROLS

CPN 49874191 10069888 05140082	Qty. 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Bezeichnung VERSCHLUSSKAPPE RUND KABELKANAL 1/2" FEDERRING #6 GEHAEUSE STEUERSCHRANK SL-IV 50PLUS DICHTUNG STECKER	Description SEAL, HOLE, CONDUIT, 1/2" WASHER, LOCK, #6 ENCLOSURE, ELECTRICAL SL-IV 50-PLUS GASKET, CONNECTOR
	0,91 3	KABEL #10/4MM2, GRÜN/GELB RING MOTORKLEMMBRETT 14-10 1/4" MITTER SECHSKANT 1/4"-20	WIRE, #10/4MM2, GREEN/YELLOW RING, TERMINAL BLOCK, 14-10 1/4"
		LEUCHTE ROT 24 VDC KAPPE, STECKER	LIGHT, PILOT, RED 24 VDC CAP, CONNECTOR
	0,31	SPIRALSCHLAUCH 3/8" POLY RELAIS RÖHRENBASIS 24VDC	SPIRAL WRAP, 3/8", POLY RELAY, TUBE BASE, 24VDC
	н н	HALTERUNG RELAIS RÖHRENBASIS SCHEIBE, FLACH, #6	SOCKET BASE, TUBE RELAIS WASHER, FLAT, #6
		SPS-STEUERUNG BASISEINHEIT SLIV SCHRAUBE, SCHLITZKOPF, 6-32x3/4	CTRL-BASE, 1500, 24V SCREW, PAN HEAD, 6-32x3/4
		ANZEIGE PANELVIEW 550 TOUCHSCREEN ANSCHLUSSKAPPE WIDERSTAND	DISPLAY PANELVIEW 550 TOUCHSCREEN END BARRIER
	. ,	WAHLSCHALTER	SWITCH, SELECTOR
		SCHILD -FERNSTEUERUNG- ANSCHLUSSKAPPE	PLATE -REMOTE CONTROL- END BARRIER
		STECKER WEIBLICH	CONNECTOR, RECEPTACLE
		MUTTER, SECHSKANT, #6	NUT, HEX, #6
	1	KLEMMLEISTE	TERMINAL BLOCK
	П	SPS-STEUERUNG SLIV 50 FD AB	CONTROLLER PROGRAMM SLIV FD AB
	П	VERSCHLUSSKAPPE	SEAL, HOLE



E. ELEKTRISCHES SYSTEM / E. ELECTRICAL SYSTEM

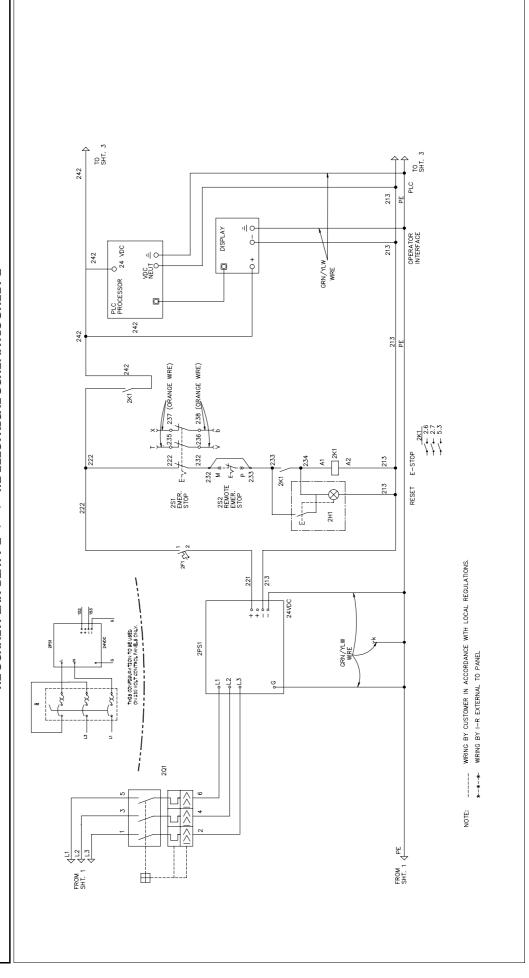
4.1 SCHALTPLAN BLATT 1 <---> 4.1 ELECTRICAL SCHEMATIC SHEET 1 ZEICHNUNG VON / DRAWING OF CPN 51485491





E. ELEKTRISCHES SYSTEM / E. ELECTRICAL SYSTEM

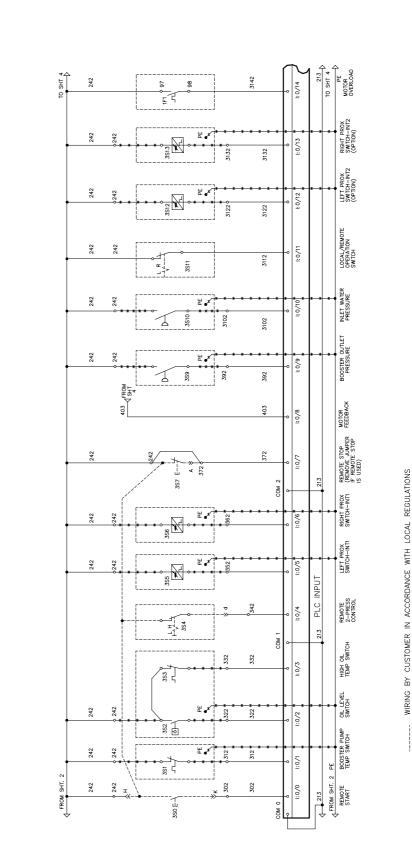
4.2 SCHALTPLAN BLATT 2 <---> 4.2 ELECTRICAL SCHEMATIC SHEET 2 ZEICHNUNG VON / DRAWING OF CPN 51485492





E. ELEKTRISCHES SYSTEM / E. ELECTRICAL SYSTEM

4.3 SCHALTPLAN BLATT 3 <---> 4.3 ELECTRICAL SCHEMATIC SHEET 3 ZEICHNUNG VON / DRAWING OF CPN 51485493

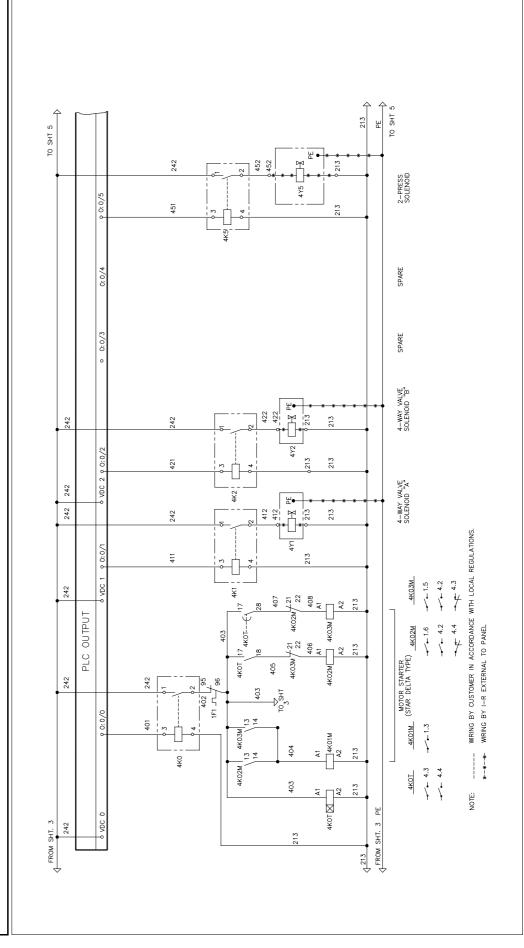


WIRING BY I-R EXTERNAL TO PANEL



E. ELEKTRISCHES SYSTEM / E. ELECTRICAL SYSTEM

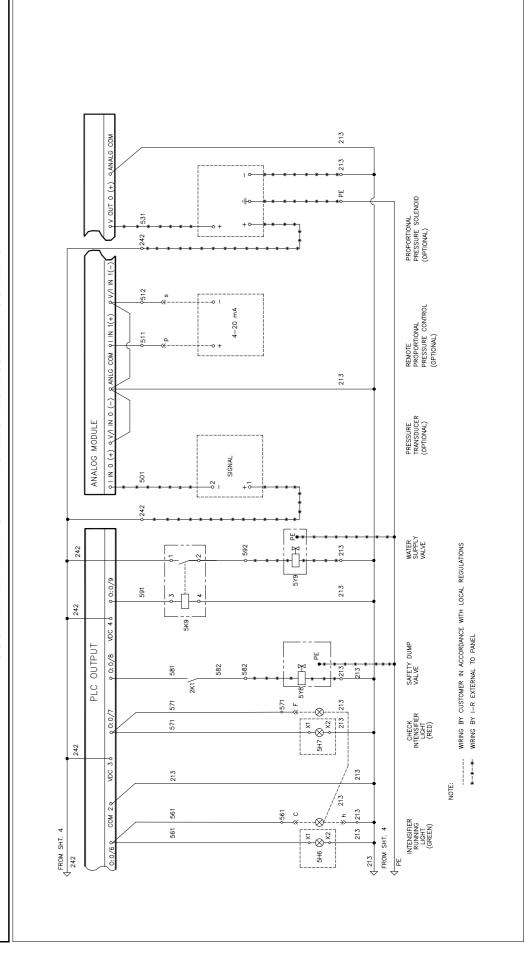
4.4 SCHALTPLAN BLATT 4 <---> 4.4 ELECTRICAL SCHEMATIC SHEET 4 ZEICHNUNG VON / DRAWING OF CPN 51485494





E. ELEKTRISCHES SYSTEM / E. ELECTRICAL SYSTEM

4.5 SCHALTPLAN BLATT 5 <---> 4.5 ELECTRICAL SCHEMATIC SHEET 5 ZEICHNUNG VON / DRAWING OF CPN 51485495

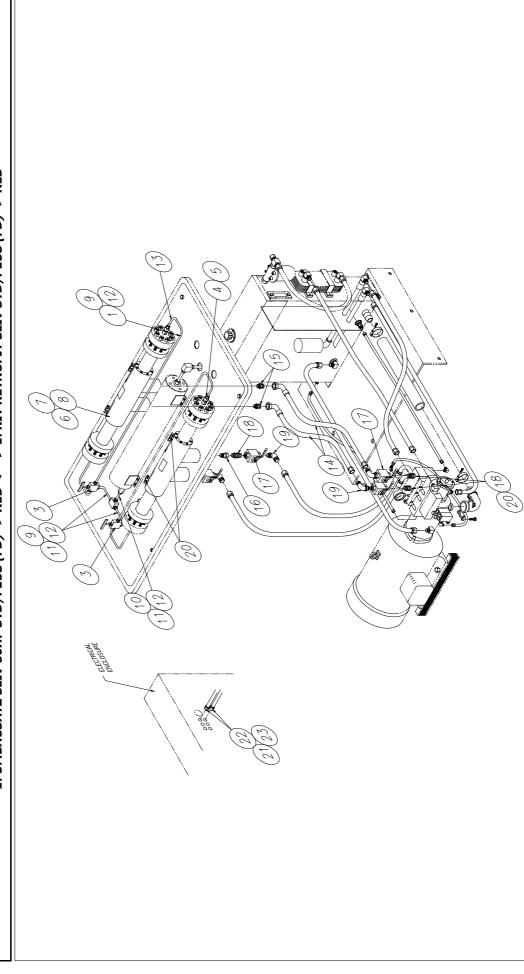




F. OPTIONEN / E. OPTIONS

ZEICHNUNG VON / DRAWING OF CPN 5148762

1. UMBAUSATZ SLIV 50HP STD/PLUS (FD) -> RED <---> 1. KIT RETROFIT SLIV STD/PLUS (FD) -> RED





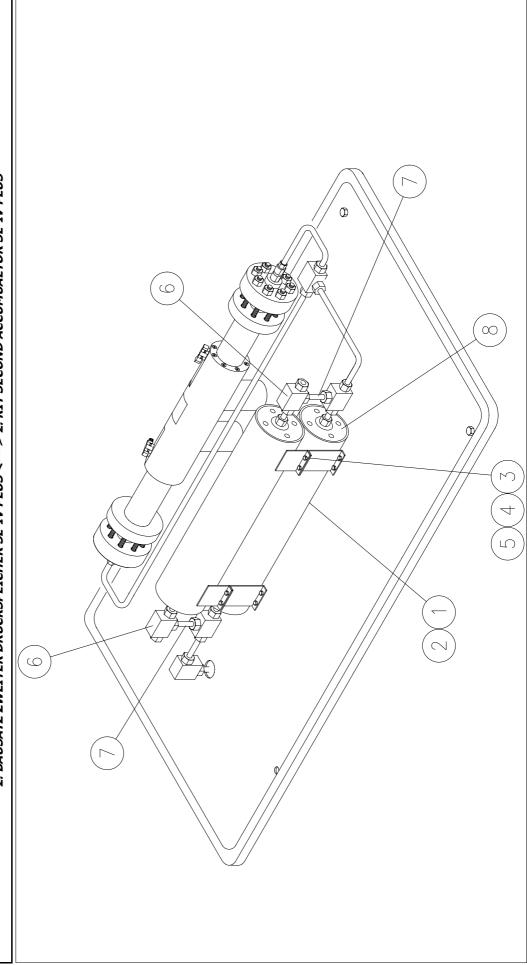
1. UMBAUSATZ SLIV 50HP STD/PLUS (FD) -> RED <--> 1. KIT RETROFIT SLIV STD/PLUS (FD) -> RED STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 5148762

Pos.	CPN	Qty.	Bezeichnung	Description
	05148861	П	HD-ROHR 3/8" GEBOGEN	TUBE 3/8" BENT
02	05148853	П	HD-ROHR 3/8" GEBOGEN	TUBE 3/8" BENT
	10097533	П	VENTIL, 3-WEGE	VALVE, 3-WAY
	10078129	7	HD-MUTTER, ÜBERWURF, 3/8"	NUT, GLAND, HP, 3/8"
05	10078715	7	HD-ROHRMUTTER, 3/8"	COLLAR, HP, 3/8"
90	05144217	\vdash	DRUCKÜBERSETZER KOMPLETT SLIV-PLUS	TOPWORKS, INTENSIFIER, SLIV-PLUS
20	95413696	4	FEDERRING 1/2"x0.125"	WASHER, LOCK, 1/2"x0.125"
80	95383790	4	SCHRAUBE INNENSECHSKANT 1/2"x1"	SCREW, SOCKET HEAD, 1/2"x1"
60	10186153	2,16	SCHLAUCH SCHUTZ HD-ROHR 1/4"&3/8"	CONDUIT, PROTECTION, HP TUBE 1/4"&3/8"
	10105443	\vdash	HD-NIPPELROHR 3/8" L=101,6MM	HP-NIPPLE TUBE, 3/8" L=4"
	05148655	2	HD-ROHR 3/8" GEBOGEN, 3/8" x 4	TUBE 3/8" BENT, 3/8" x 4
	10083897	10	ENDRING, ROHRSCHUTZ	FERRULE, 1/4"
	49895303	7	ADAPTER GERADE 1/2" NPT X -8 JIC V2A	ADAPTER, STRAIGHT, 1/2" NPT X -8 JIC SS
	05071105	7	SCHLAUCH HD-HYDRAULIK 3/4" L=1016 mm	HOSE ASSY, HP HYDRAULIC, 3/4" L=1016 mm
	05073150	7	ADAPTER JIC/O-RING GERADE 10-12	ADAPTER, JIC/O-RING, STRAIGHT 10-12
	05073176	7	ADAPTER O-RING MOD 05073143	ADAPTER, O-RING, MOD 05073143
	05070750	4	VENTIL KUGEL 2-WEGE 3/4"	VALVE, BALL, 2-WAY, 3/4"
	05057542	4	ADAPTER O-RING/O-RING GERADE 12	ADAPTER, O-RING/O-RING, STRAIGHT 12
	05073168	4	KUPPLUNG 45° JIC/O-RING 3/4"x3/4"	COUPLING, 45° JIC/O-RING, 3/4"x3/4"
	10084184	7	STECKER WEIBLICH 3-2M	CONNECTOR, PLUG, FEMALE, 3-2M
	10067205	7	KABEL STECKER 1/2"	CABLE, CONNECTOR, 1/2"
	10083012	7	MUTTER SICHERUNG 1/2"	NUT, LOCK, 1/2"
	10082857	7	DICHTUNG FLEXIBLE 1/2"	GASKET ASSY, FLEXIBLE, 1/2"



F. OPTIONEN / E. OPTIONS

2. BAUSATZ ZWEITER DRUCKSPEICHER SL-IV PLUS <---> 2. KIT SECOND ACCUMUALTOR SL-IV PLUS ZEICHNUNG VON / DRAWING OF CPN 5144803





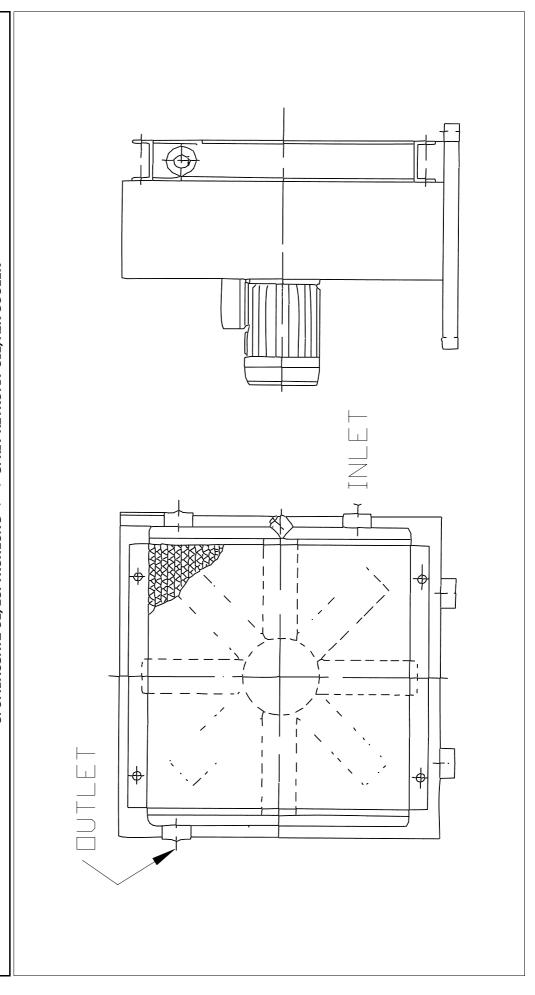
Pos.	CPN	Qty.	Qty. Bezeichnung	Description
01	05148804	1	HALTERUNG, DRUCKSPEICHER, SL-IVPLUS	SUPPORT, ACCUMULATOR, SL-IVPLUS
02	05040696	П	DRUCKSPEICHER TÜV 1 LITER SLIV	ACCUMULATOR, TUV, 1 LITER, SLIV
03	05091954	∞	SCHRAUBE RUNDKOPF 3/8"x1"	SCREW, BUTTON HEAD, 3/8"x1"
90	95670972	∞	FEDERRING 0.36"x0.094"	WASHER, RING, 0.36"x0.094"
05	95660957	∞	SCHEIBE FLACH 3/8"x0.078"	WASHER, FLAT, 3/8"x0.078"
90	10079465	7	KUPPLUNG HOCHDRUCK T-STÜCK 9/16"	COUPLING, HP, TEE, 9/16"
20	05112057	2	HD-NIPPELROHR $9/16$ " L = 126 MM	HP-NIPPLE $9/16$ " L = 4.97 "
80	05090717	2	MUTTER GEHÄUSE DRUCKSPEICHER SLIV	NUT, HOUSING, ACCUMULATOR, SLIV



F. OPTIONEN / E. OPTIONS

ZEICHNUNG VON / DRAWING OF CPN 80195

3. UMBAUSATZ ÖL/LUFTKÜHLUNG <---> 3. KIT RETROFIT OIL/AIR COOLER



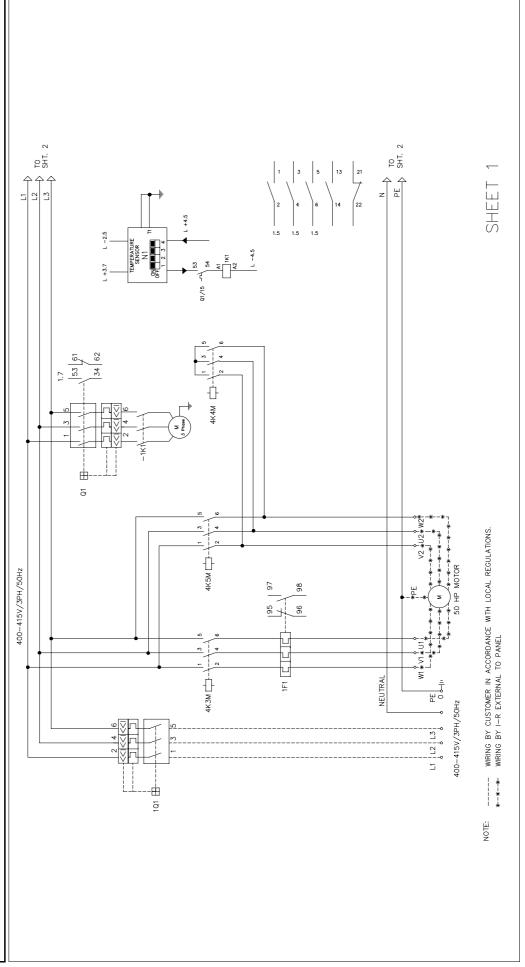


STÜCKLISTE FÜR / BILL OF MATERIAL FOR CPN 80195 3. UMBAUSATZ ÖL/LUFTKÜHLUNG <> 3. KIT RETROFIT OIL/AIR COOLER	CPN Qty. Bezeichnung Description	00080197 1 ÖL/LUFTKÜHLER SL-IV 30/50HP OIL/AIR COOLER, SL-IV 30/50HP	00080198 1 FÜHLER TEMPERATUR ÖL/LUFTKÜHLER SENSOR, TEMPERATURE, OIL/AIR COOLER	05049713 1 SCHLAUCH ND-HYDRAULIK 3/4" WEIBLICH HOSE ASSY, LP HYDRAULIC, 3/4" FEMALE	05085741 2 VERSCHRAUBUNG SCHOTT 1/2" NPT COUPLING, BULKHEAD, 1/2" NPT	05071105 1 SCHLAUCH HD-HYDRAULIK 3/4" L=1016 mm HOSE ASSY, HP HYDRAULIC, 3/4" L=1016 mm	05069976 2 STOPFEN VERSCHLUSS ÖLBEFÜLLUNG SLIV PLUG, HEX, OIL FILL PORT, SLIV	10067205 3 KABEL STECKER 1/2" CABLE, CONNECTOR, 1/2"	10083012 3 MUTTER SICHERUNG 1/2" NUT, LOCK, 1/2"	05049655 1 KUPPLUNG 90° ROHR/JIC 16x12 COUPLING, 90°, PIPE/JIC, 16x12	10087823 1 KUPPLUNG 45° ROHR/JIC 12x12 COUPLING, 45°, PIPE/JIC, 12x12	10087989 1 KUPPLUNG GERADE ROHR/JIC 12x12 COUPLING, STRAIGHT, PIPE/JIC, 12x12	10100188 1 KUPPLUNG GERADE ROHR/JIC 16x12 COUPLING, STRAIGHT, PIPE/JIC, 16x12	00080203 2 SCHRAUBE SECHSKANT M4X25 MM SCREW, HEX HEAD, M4X25 MM	00080204 3,3 STEUERLEITUNG ÖZ-J 3X0.75 qmm CABLE, CONTROL, ÖZ-J 3X0.75 qmm	00080205 5 STEUERLEITUNG ÖZ-J 4X0.75 qmm CABLE, CONTROL, ÖZ-J 4X0.75 qmm	00080206 1 KLEMME ERDUNG CLAMP GROUND	00080207 1 KABEL GELB/GRÜN 1.5 qmm CABLE YELLOW/GREEN 1.5 qmm	00080208 1 KABEL BLAU 0.75 qmm CABLE BLUE 0.75 qmm	00080209 1 KABEL SCHWARZ 2.5 qmm CABLE BLACK 2.5 qmm	00080210 1 SCHALTER MOTORSCHUTZ 24VDC-1.6 A CIRCUIT BREAKER, MOTOR, 24VDC-1.6 A	00080211 1 SCHALTER ZUSATZ MOTORSCHUTZ CIRCUIT BREAKER, AUXILIARY, MOTOR
	CPN	00080197	00080198	05049713	05085741	05071105	05069976	10067205	10083012	05049655	10087823	10087989	10100188	00080203	00080204	00080205	00080206	00080207	00080208	00080209	00080210	00080211
	Pos.	0.1	02	03	94	05	90	20	80	60	10	11	12	13	14	15	16	17	18	19	20	21

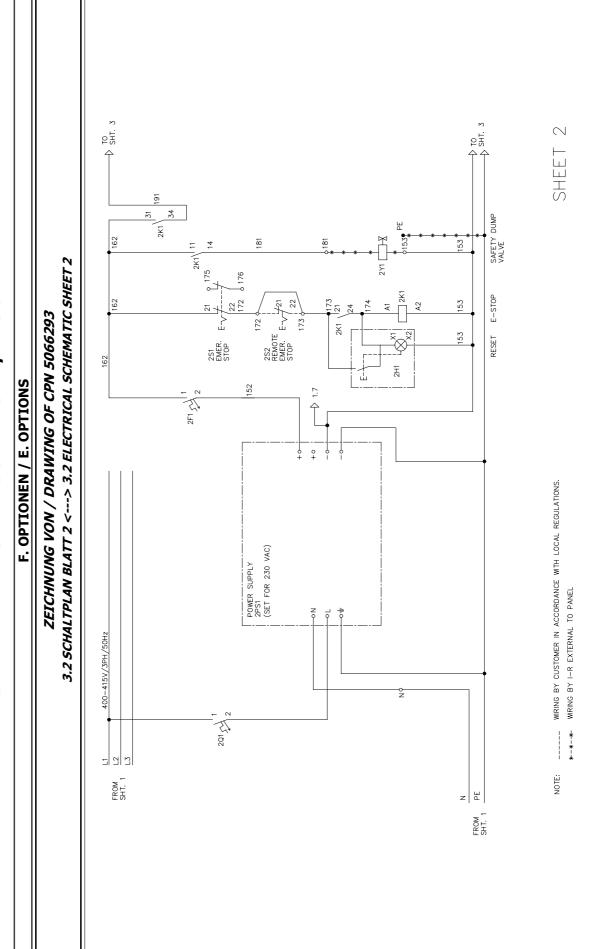




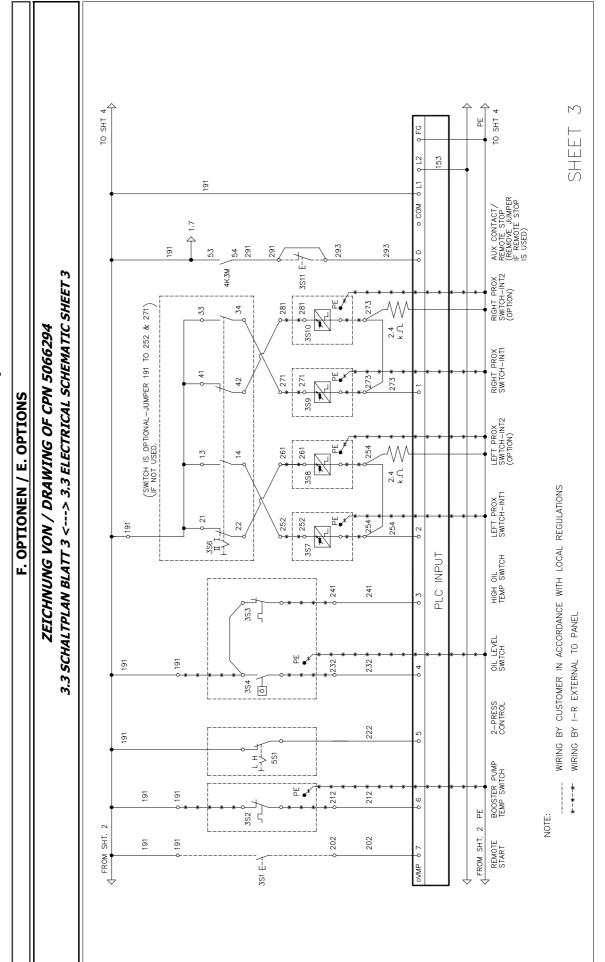
3.1 SCHALTPLAN BLATT 1 <---> 3.1 ELECTRICAL SCHEMATIC SHEET 1 ZEICHNUNG VON / DRAWING OF CPN 5066292



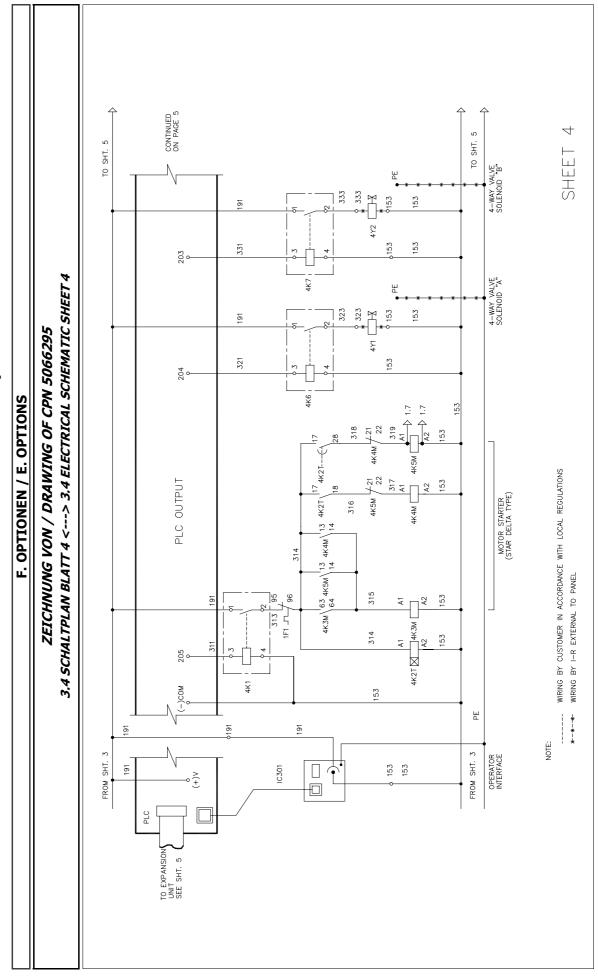
















3.5 SCHALTPLAN BLATT 5 <---> 3.5 ELECTRICAL SCHEMATIC SHEET 5 ZEICHNUNG VON / DRAWING OF CPN 5066296

