KMT H2O JET
WATERJET INTENSIFIER

OPERATION AND MAINTENANCE MANUAL

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INTENSIFIER

72106161(R0)

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MANUAL 72106161(R0)

NOTICE

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72106161
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Electrical Schematic

SECTION 1
INTRODUCTION

1.1 Overview

The KMT H2O Jet combines all the unique capabilities and advantages of waterjet cutting with the reliability, ease of operation and service support that have made KMT Waterjet Systems a leader in waterjet technology.

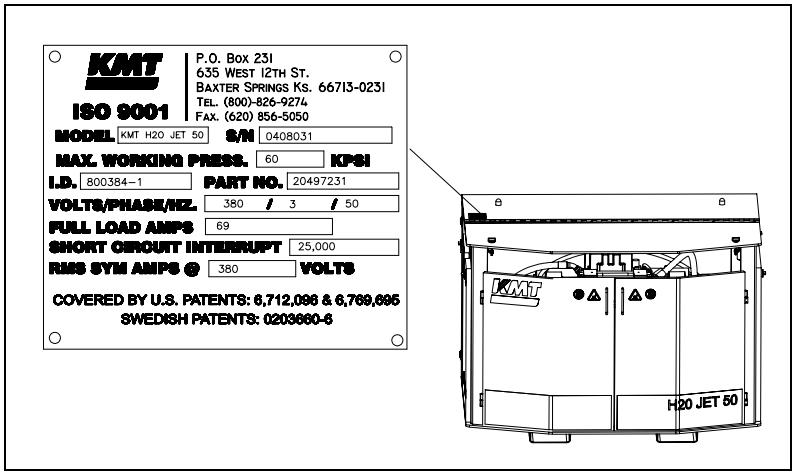
Table 1-1
KMT H2O Jet

Motor Horsepower Rating		Maximum Operating Pressure	Maximum Flow Rate (*at full pressure*)	Maximum Single Orifice Diameter (*at full pressure*)
HP	**Kw**			
50	37	60,000 psi (4,137 bar)	1.0 gpm (3.8 L/min)	0.014 inch (0..56 mm)

1.2 Product Nameplate

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

Figure 1-1: Nameplate



1.3 Operational Overview

The following provides a brief overview of the function and primary components associated with the individual systems. A detailed discussion of each system is provided in Sections 4 through 9. Equipment specifications are provided in Section 11, Specifications.

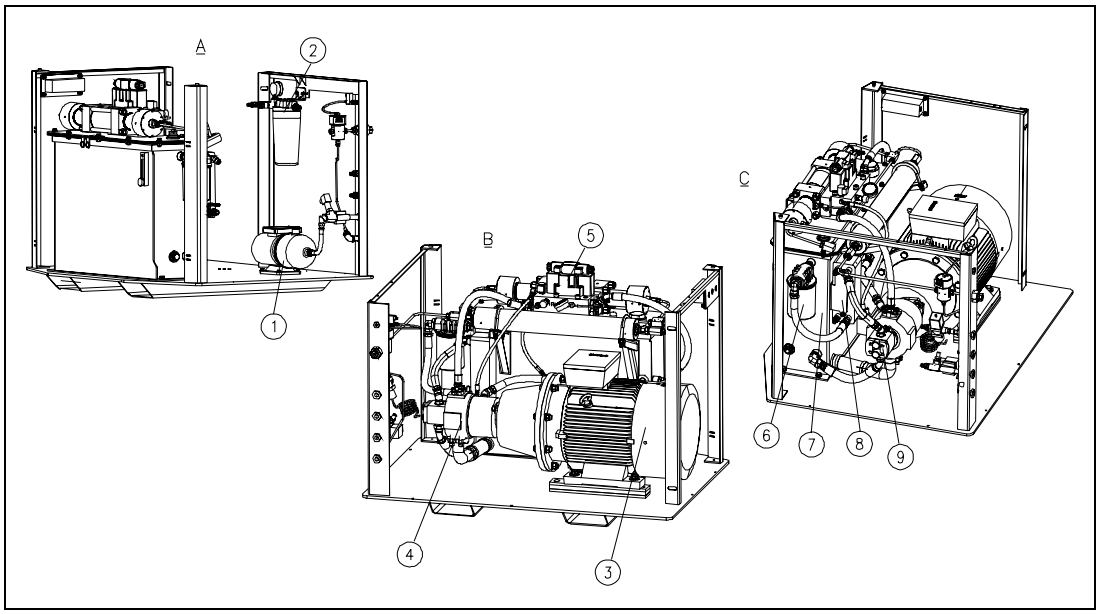
Low Pressure Water System

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

Recirculation System

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

Figure 1-1: System Components



A LP Water System

1 Booster Pump/Motor Assembly

2 LP Water Filter Assembly

B Hydraulic System

3 Electric Motor

4 Hydraulic Pump

5 Hydraulic Manifold

C Recirculation System

6 Oil Filter Assembly

7 Hydraulic Oil Reservoir

8 Heat Exchanger

9 Recirculation Pump

Hydraulic System

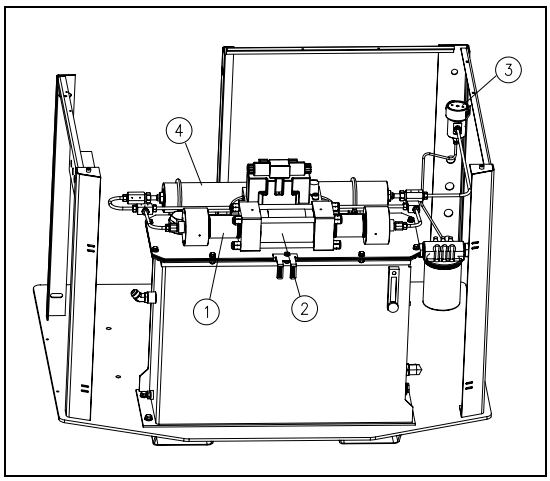
The hydraulic system supplies the intensifier with the hydraulic oil required to produce high pressure water. Major system components include the electric motor, hydraulic pump, and the 4-way directional control valve mounted on the hydraulic manifold.

High Pressure Water System

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

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

Figure 1-2: High Pressure System Components



1 High Pressure Cylinder
2 Hydraulic Cylinder
3 Safety Dump Valve
4 Attenuator

1.4 Safety

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

All personnel operating, servicing or working near the waterjet cutting equipment shall adhere to the following safety precautions, as well as the applicable plant safety precautions.

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

The operator shall practice and promote safety at all times to avoid potential injury and unnecessary downtime.

The operator shall ensure that the work area around the equipment is clean and free of debris and oil spills.

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

Safety glasses and ear protection shall be worn when operating or working near the equipment.

Lockout/Tagout Procedure

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

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

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

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

1. Shut down the machine and open the high pressure cutting water valve to bleed the water and hydraulic pressure from the system.

2. Disconnect, lockout and tag the main, customer supplied, power source.

3. Close, lockout and tag the manual shutoff valves for all service connections: cutting water in, cooling water in and out, and air.

Warning Labels

Warning labels are posted on the machine to indicate potential hazards. The operator and service personnel shall pay particular attention to these warning labels. Table 1-2 describes the necessary precautions and provides the part number required to order replacement labels.

Table 1-2
Warning Label Precautions

1	 P/N 05114962	The electrical enclosure and motor junction box can present an electrical shock hazard. Always disconnect and lockout the main power and the circuit breaker/disconnect on the electrical enclosure before performing any type of maintenance.

Table 1-2
Warning Label Precautions

2

P/N 05114970

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

3

P/N 05098017

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

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

4

P/N 20415794

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

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

WARNING

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

CAUTION

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

NOTE

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

Emergency Medical Treatment

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

Medical Alert

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

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

This person has been working with water jetting at pressures to 60,000 psi (414 MPa, 4137 bar, 4,218 Kg/cm^2) with a jet velocity of 3,000 fps (914 mps). Foreign material (sand) may have been injected with water. Unusual infections with microaerophilic organisms occurring at lower temperatures have been reported, such as gram negative pathogens as are found in sewage. Bacterial swabs and blood cultures may therefore be helpful. This injury must be treated as an acute surgical emergency and be evaluated by a qualified surgeon. Circulation may be compromised, therefore, DO NOT APPLY HEAT TO INJURED PART. For first aid: (1) Elevate injured part (2) Antibiotics (3) Keep injured person NPO.

1.5 Worldwide Product Support

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

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

Contact the KMT Waterjet Customer Service Department for additional information.

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1.6 Spare Parts

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

1.7 Equipment and Service Manual Questionnaire

We are interested in your impression of the KMT Waterjet System recently installed at your location. Your comments and recommendations will aid us in our continuing goal to improve our products, and make our technical information more useful to our customers.

At your convenience, please take a few minutes to complete the following questionnaire, and return it to the applicable Customer Service Department listed above.

Equipment and Service Manual Questionnaire

1. General Appearance

Was the unit received in good condition? ☐ Yes ☐ No

Comments: _____

_____

Is the unit a convenient size? ☐ Yes ☐ No

2. Controls

Are the controls user friendly? ☐ Yes ☐ No

Is the unit easy to operate? ☐ Yes ☐ No

Comments: _____

_____

3. Performance

Does the unit perform smoothly and meet your expectations? ☐ Yes ☐ No

Does the unit run quietly? ☐ Yes ☐ No

Comments: _____

_____

4. Did the installation and startup go smoothly? ☐ Yes ☐ No

Comments: _____

_____

5. What features do you consider the most significant?

Quiet operation ____

Appearance ____

Performance/Operation ____

Repair/Maintenance ____

Other _____

6. What areas could be improved?

Appearance ____

Performance ____

Serviceability ____

Other _____

7. Manual Organization

Does the Table of Contents help you find topics easily? ☐ Yes ☐ No

Comments: _____

Is the information well organized? ☐ Yes ☐ No

Comments: _____

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

Comments: _____

8. Graphics

Are the illustrations suitable for the material being presented? ☐ Yes ☐ No

Comments: _____

9. Text

Does the information adequately explain how to operate and service the equipment? ☐ Yes ☐ No

Comments: _____

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

Comments: _____

_____

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

Comments: _____

_____

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

Comments: _____

_____

Name _____ Title _____

Company _____ Date _____

Address _____

_____

_____

SECTION 2
INSTALLATION

2.1 Overview

Installation and commissioning requirements and procedures are detailed in this section. These procedures require a thorough understanding of the individual components and systems, safety issues, and the overall operation of the intensifier.

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

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

2.2 Installation Summary

The following summary lists the procedures required for the installation and commissioning of the intensifier system. Details and requirements for each item are discussed in this section.

Upon receipt, the machine must be uncrated and moved into position on a level surface.

Properly sized power drops with fused disconnects or circuit breakers, and properly sized starting components must be installed.

A pneumatic drop with a manual shutoff valve and regulator for the air connection must be installed.

Plumbing and manual shutoff valves for the inlet and outlet cooling water, and the inlet and outlet cutting water must be installed.

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

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

High pressure tubing runs from the intensifier to the cutting station must be installed with the appropriate mountings, support brackets and hardware.

Wiring must be installed and connected between the intensifier and the cutting station control system.

The machine must be commissioned and tested.

2.3 Site Requirements

The intensifier must be installed indoors where air borne dust and contaminants are minimal. The ambient temperature should be between 40 F (5 C) and 104 F (40 C), with a maximum relative humidity of 95 percent.

Refer to Table 2-1, Equipment Dimensions, to establish a suitable installation site. A minimum clearance of 36 inches (914 mm) should be provided on all sides of the machine to facilitate service.

Figure 2-1: Equipment Dimensions

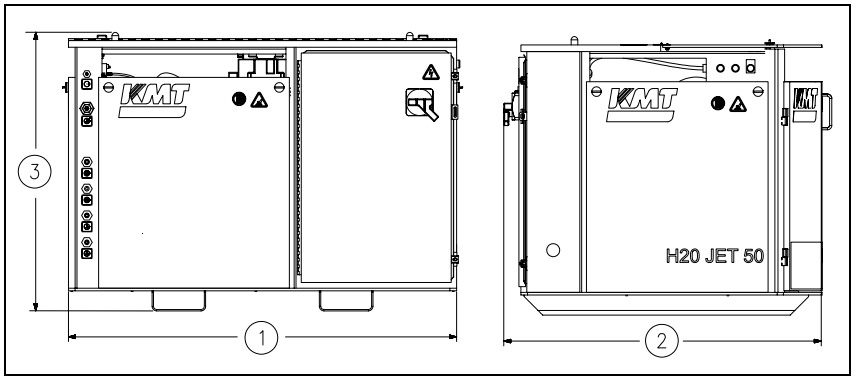


Table 2-1
Equipment Dimensions and Weight

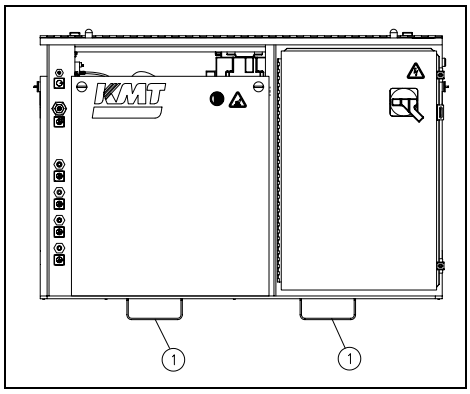
(1) Length	(2) Width	(3) Height	Weight
58.00” (1,473 mm)	47.44” (1,205 mm)	41.64” (1,058 mm)	2,260 lbs (1,025 kg)

Transporting

The weight of the machine is not evenly distributed from one end to the other. Note the warnings stamped on the crate. The center of gravity is clearly identified on the sides of the crate. The forklift should be positioned accordingly.

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

Figure 2-2: Fork Pockets



1 Fork Pockets

CAUTION

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

2.4 Power Requirements

Power supplied to the pump and wiring for remote control must comply with local, regional and national electrical codes. Service voltage and ampacity must meet the requirements detailed in Table 2-2. Voltage fluctuations in excess of +/- 10 percent of nominal voltage may damage the machine and void the warranty.

Table 2-2
Ampacity and Power Voltage Requirements

Power Voltage	Motor Horsepower	Full Load Amps	Recommended Circuit Breaker Amps
380/3/50	50	69	100

2.5 Service Connections

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

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

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

CAUTION

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

Figure 2-3: Service Connections

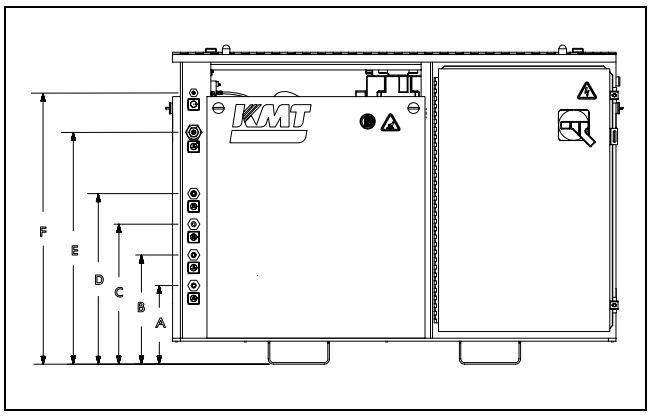


Table 2-3
Service Connections

		Connection	Height
A	Drain	1/2” BSPT	10.26” (260 mm)
B	Cutting Water In	1/2” BSPT	14.26” (362 mm)
C	Cooling Water Out	1/2” BSPT	18.26” (464 mm)
D	Cooling Water In	1/2” BSPT	22.26” (565 mm)
E	Cutting Water Out	9/16” HP	30.26” (768 mm)
F	Plant Air In	1/4” BSPT	35.39” (899 mm)

Cooling Water

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

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

If a facility-wide chilled water system is used for cooling, ensure there is a minimum of 60 psi (4.0 bar) pressure differential between the facility supply and discharge plumbing. Installation of an in-line pressure boosting pump may be necessary to provide adequate cooling flow. Dedicated chilled water systems should be sized according to pump horsepower as illustrated in Table 2-4, Chilled Water Systems.

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

Horsepower	BTU/HR
50	22,000

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

Cutting Water

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

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

The inlet cutting water must be maintained at a minimum pressure of 35 psi (2.5 bar) at all times. If the facility water pressure is below, or can fall below 35 psi (2.5 bar), a water pressure booster pump is required.

Drain

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

Plant Air

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

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

Table 2-5
ISO Air Quality Classifications

ISO Quality Class	Maximum Particle Size (microns)	Maximum Pressure Dew Point (water @ 100 psi)	Maximum Oil Content (Mg/m^3)
1	0.1	-94° F (-60° C)	0.01
2	1	-40° F (-40° C)	0.1

Table 2-5
ISO Air Quality Classifications

3	5	-4° F (-20° C)	1
4	15	+38° F (+3° C)	5
5	40	+45° F (+7° C)	25
6	--	+50° F (+10° C)	--

2.6 Flow Requirements

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

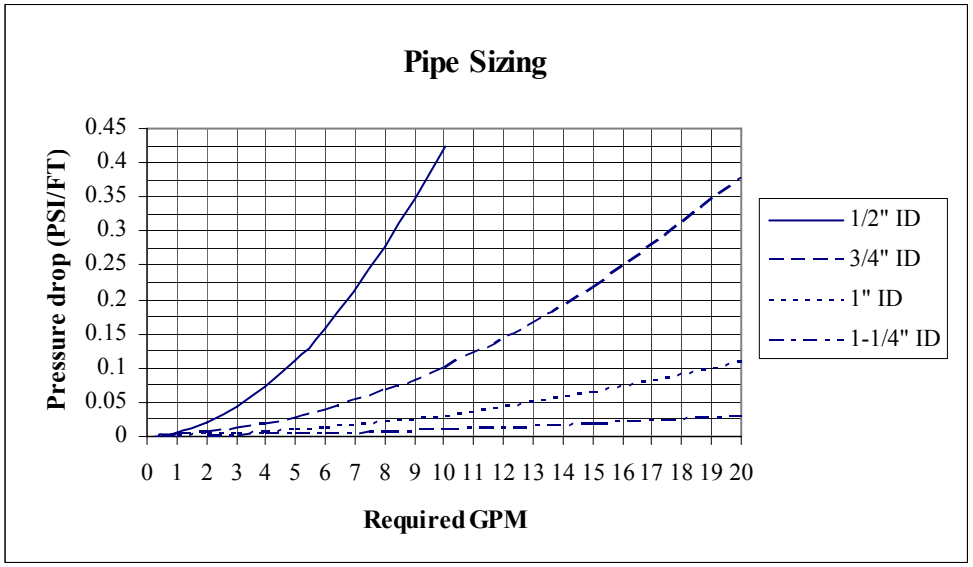
1. Enter the graph at the required GPM and note the pressure drop figures for the different pipe sizes.

2. Multiply the pressure drop (PSI/FT) by the length in feet of each pipe size used from the water source to the intensifier. Add the values together for a total pressure drop value.

3. Add 30 to the total pressure drop to determine the minimum flowing, source water pressure required to provide adequate supply to the intensifier.

Cutting water and cooling water capacity should be calculated separately. Note that the cutting water requirements represent instantaneous, not average, demand.

Figure 2-4: Pressure Drop Values



2.7 High Pressure Piping

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

WARNING

High pressure tubing and fittings must be rated for 60,000 psi (4,136 bar). Failure to use properly rated components may result in component failure causing equipment damage, personal injury or death.

High pressure tubing lengths must be coned and threaded prior to installation. KMT Waterjet provides both hand and power tools for coning and threading high pressure tubing. Tool descriptions and part numbers are provided in Table 2-6.

Table 2-6
Coning and Threading Tools

	Part Number	
	Hand Tools	**Power Tools**
1/4” Coning Tool	05108832	05109897
3/8” Coning Tool	05108857	05109889
9/16” Coning Tool	05108840	05109871
1/4” Threading Tool	05108865	05122742
3/8” Threading Tool	05108873	05120258
9/16” Threading Tool	05108881	05122759
1/4” Tube Vise	05108782	
3/8” Tube Vise	05108790	
9/16” Tube Vise	05108774	

Measurements and Dimensions

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

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

Figure 2-5: Tube Length

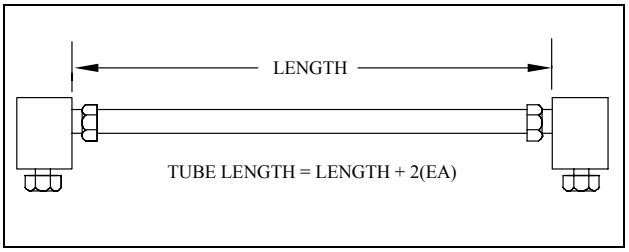


Table 2-7
Engagement Allowance (EA)

1/4” Tubing	0.49” (12.4 mm)
3/8” Tubing	0.68” (17.3 mm)
9/16” Tubing	0.86” (21.8 mm)

Figure 2-6: Cone and Thread Dimensions

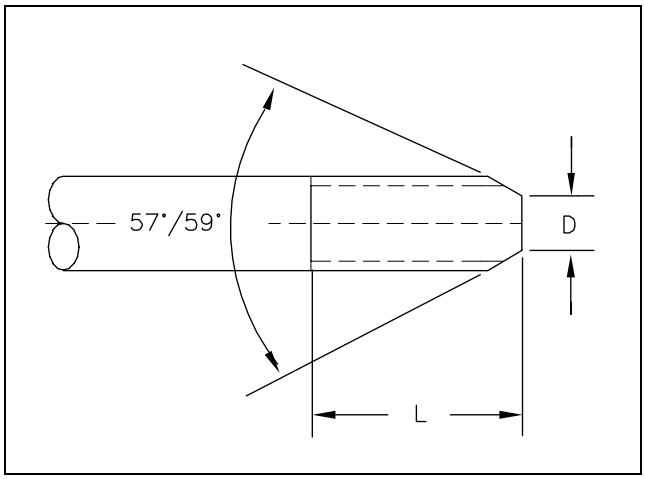
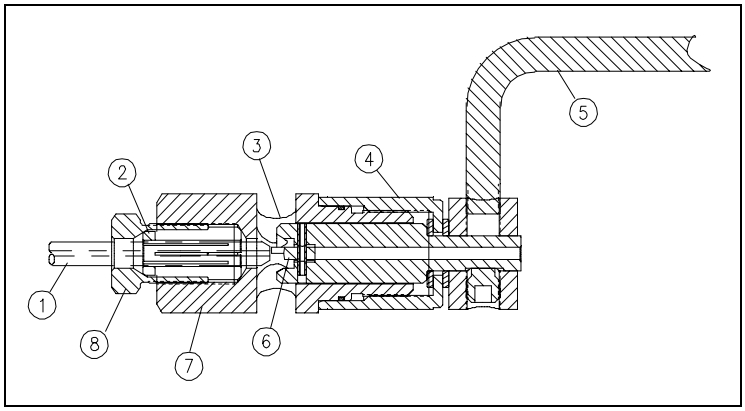


Table 2-8
Cone and Thread Dimensions

Tube OD	Tube ID	D (Maximum)	L (Maximum)	Thread UNF-LH
1/4” (6.35 mm)	0.083” (2.11 mm)	0.125” (3.2 mm)	0.562” (14.3 mm)	1/4” - 28
3/8” (9.52 mm)	0.125” (3.18 mm	0.219” (5.6 mm)	0.750” (19.1 mm)	3/8” - 24
9/16” (14.29 mm)	0.188” (4.78 mm)	0.281” (7.1 mm)	0.938” (23.8 mm)	9/16” - 18

Hand Coning

Figure 2-7: Hand Coning Tool



1	Tubing	5	Handle
2	Collet	6	Blade
3	Access Window	7	Body
4	Feed Nut	8	Gland Nut

1. Place the body of the coning tool in a vise allowing adequate clearance for the rotation of the cutter handle. Position the tool so the cutter handle is elevated slightly so the lubricant will flow to the cutting blades.

2. Turn the feed nut counter-clockwise to retract the cutting blades past the access window.

3. Loosen the gland nut and insert the tubing through the collet. The end of the tubing should just make contact with the cutting blades. Loosely tighten the gland nut to slightly grip the tubing.

4. Turn the feed nut counter-clockwise 1/4 turn to retract the cutting blades away from the tubing, and tighten the gland nut with a wrench.

5. Apply a liberal amount of cutting oil to the exposed end of the tubing, the cutting blades and through the lubrication channel at the cutter handle.

   Apply cutting oil frequently and liberally throughout the cutting operation. A medium weight cutting oil with high sulfur content is recommended.

6. Turn the feed nut clockwise until the cutting blades contact the end of the tubing.

7. In a smooth, continuous motion, turn the cutter handle in a clockwise direction. Simultaneously turn the feed nut in a clockwise direction to establish a constant feed. Do not remove too much material at once; the cutting blades should make light, uninterrupted cuts.

NOTE

Before interrupting the cut, back the cutter blades away from the tubing. Use compressed air or a small brush to remove the accumulation of chips from the blades and the tubing throughout the coning operation.

8. Continue the operation until the feed nut bottoms on the housing. Turn the cutter handle several more rotations to face-off the end of the cone.

9. Retract the cutter blades, loosen the gland nut and remove the tubing. Inspect the cone for surface finish and completeness.

NOTE

Clean the machining chips from the blade and from the collet before coning the next tube.

Power Coning

1. Secure the tubing in a tube vise. No more than the recommended length of tubing should extend beyond the face of the vice. See Table 2-9, Recommended Extension Length.

2. Mount the coning tool in a 3/8-inch or 1/2-inch, variable speed power drill. Apply cutting oil to the end of the tube and slide the coning tool on the tubing.

3. Apply steady pressure against the end of the tubing while the cone is being cut.

   Apply cutting oil frequently and liberally throughout the cutting operation. A medium weight cutting oil with high sulfur content is recommended.

4. The tool will stop cutting when the tube angle and facing is complete.

NOTE

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

Table 2-9
Recommended Extension Length

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

Hand Threading

1. Secure the coned tubing in a tube vise. No more than the recommended length of tubing should extend beyond the face of the vice. See Table 2-9, Recommended Extension Length.

2. Apply cutting oil to the end of the tube and slide the threading tool on the tubing.

3. Grip the handles of the tool firmly, apply steady pressure and turn the tool counter-clockwise. Approximately every half turn, reverse direction to break off and remove the chips.

   Apply cutting oil frequently and liberally throughout the cutting operation. A medium weight cutting oil with high sulfur content is recommended.

4. Continue threading until the proper thread length is reached, see Table 2-8, Column L. Remove the tool from the end of the tubing.

NOTE

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

Power Threading

1. Secure the coned tubing in a tube vise. No more than the recommended length of tubing should extend beyond the face of the vice. See Table 2-9, Recommended Extension Length.

2. Mount the threading tool in a 3/8-inch or 1/2-inch, variable speed power drill. Apply cutting oil to the end of the tube and slide the threading tool on the tubing.

3. Make sure the drill is set to turn counter-clockwise. Apply steady pressure against the end of the tubing while the threads are being cut.

   Apply cutting oil frequently and liberally throughout the cutting operation. A medium weight cutting oil with high sulfur content is recommended.

4. Continue threading until the proper thread length is reached, see Table 2-8, Column L. Reverse the direction of the drill and remove the threading tool.

NOTE

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

2.8 High Pressure Connections

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

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

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

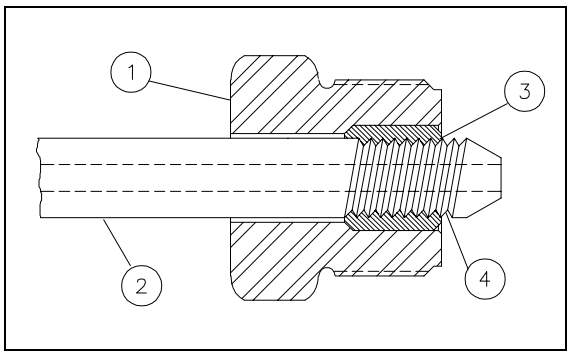
CAUTION

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

Standard Connections

Standard connections are used for general applications where internal pressure is the only load on the tubing.

Figure 2-8: Standard High Pressure Connections



1 Gland Nut
2 Tubing
3 Collar
4 Exposed Threads

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

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

WARNING

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

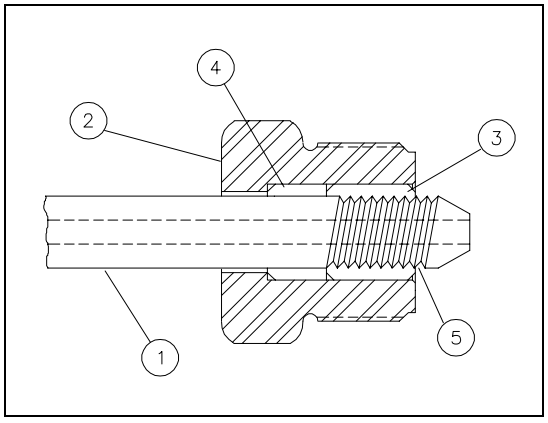
Table 2-10
Torque Specifications
High Pressure Connections

1/4" Tubing	25 ft-lb (34 Nm)
3/8" Tubing	50 ft-lb (68 Nm)
9/16" Tubing	110 ft-lb (149 Nm)

Anti-Vibration Connections

The bending stresses resulting from excessive vibration or shock on the threaded area of the tubing can cause premature failure at the back of the thread. When tubing will be subjected to vibration, rotation and movement, anti-vibration connections must be used. The anti-vibration collet gland transfers the stress to the unthreaded section of the tubing, and the gripping action of the collet strengthens the entire assembly.

Figure 2-9: Anti-Vibration Connections



1 Tubing
2 Gland Nut
3 Collar
4 Collet
5 Exposed Threads

1. Deburr the tubing ID and thoroughly clean the tubing threads.
2. Slip the gland nut and the collet onto the tubing.

3. Apply Pure Goop to the threads on the tubing. Screw the collar onto the threaded end of the tubing leaving 1-1/2 to 2-1/2 threads exposed on the tubing between the collar and the coned tubing.

4. Apply Pure Goop to the male threads on the gland nut and insert the tubing into the connection. Engage the gland nut and tighten finger tight.

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

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

2.9 Commissioning

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

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

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

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

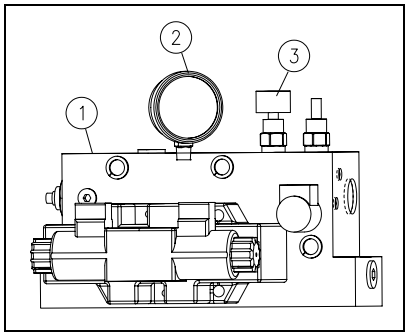
3. Open the shutoff valves on the service connections and check for leaks.

4. Check the connection between the customer supplied, main power disconnect and the machine. Verify the proper voltage supply.

5. Turn the control power on and use the customer supplied control to select low pressure operation.

6. To avoid a sudden increase in pressure, it is necessary to adjust the high pressure setting. The high pressure adjustment is made at the high pressure control valve on the hydraulic manifold. Refer to Section 7, Hydraulic System, for additional information.

   Loosen the locking nut on the high pressure control valve by turning counter-clockwise. Turn the high pressure control valve counter-clockwise, decreasing the pressure to the lowest setting.



1 Hydraulic Manifold
2 Hydraulic Pressure Gauge
3 High Pressure Control Valve

7. Check the motor rotation. The correct direction of rotation is marked with an arrow on the electric motor.

CAUTION

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

Start the motor and observe the pressure gauge on the hydraulic manifold. If the motor rotation is correct, pressure will begin to build in just a few seconds. If the rotation is not correct, the gauge will not move.

If the motor shaft is rotating in the wrong direction turn the control power off. The electrical power phase must be reversed to any two motor leads. The leads must be reversed at the electric motor, or at the main power disconnect.

8. Remove the cutting orifice and open the nozzle valve.

9. Start the motor and run the machine at a low pressure for approximately five minutes with the orifice removed to purge the system.

10. Check for any leaks in the plumbing, or around the high pressure cylinders. If leaks are detected, stop the machine and correct any problems.

11. Check the safety circuits by pushing the EMERGENCY STOP button in and verifying that the power goes off and high pressure water is drained from the system. If applicable, check all remote start and emergency stop functions.

12. Install a large, inexpensive orifice and start the machine.

13. Use the customer supplied control to select high pressure operation and increase the high pressure setting in gradual increments, checking for leaks at each interval. Continue increasing the pressure until the operating pressure is reached.

    The high pressure setting is increased by turning the high pressure control valve on the hydraulic manifold clockwise.

NOTE

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

2.10 Decommissioning

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

SECTION 3
MAINTENANCE

3.1 Overview

The KMT H2O Jet has been designed to fail safely. Systems fail gradually; seals and connections can begin to leak slowly or suddenly through specially designed weep holes. Water or oil dripping from a weep hole indicates internal seals or valves are beginning to fail, a warning that maintenance will be required.

3.2 Maintenance

The waterjet system has been designed for ease of maintenance and long, reliable operation. In order to keep the equipment in optimum operating condition, routine and preventive maintenance is essential. Detailed maintenance procedures for specific systems are provided in subsequent sections of this manual.

Daily Inspection

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

Prior to startup, inspect the area around the machine, the high pressure piping and connections for indications of leaks.

Make sure there is no maintenance work in process.

Check the hydraulic oil level.

As the machine is started and water pressure increases, listen for unusual sounds.

Check for water or oil leakage.

Check the condition of the hydraulic oil filter

Periodic Maintenance

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

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

Maintain a clean, dust and dirt free work area for maintenance.

Use only clean, dry air and clean, filtered solvent when flushing parts.

Use lint free cloths for cleaning.

Use extreme care when aligning close tolerance parts for assembly. Do not force the parts together. If parts bind during assembly, they must be disassembled and re-aligned.

Use only original KMT Waterjet replacement parts for consistent performance and reliability; and to protect equipment warranty.

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

High Pressure System Maintenance

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

High pressure fittings, valves and tubing must be rated for 60,000 psi (4,137 bar). Failure to use properly rated components may result in component failure, equipment damage and personal injury.

Do not over-torque fittings to stop leakage.

Ensure all components are clean, free of burrs, metal particles, dirt and dust prior to assembly.

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

1. Operate the intensifier for a short period with the nozzle valve open and the orifice removed.

2. Turn the intensifier off and install an orifice.

3. Turn the machine on and increase the operating pressure in gradual increments. Check all high pressure connections for leaks.

Many components are lubricated prior to assembly. Table 3-1 lists the recommended lubricants and their applications. Substitutions are not recommended.

Table 3-1
Lubrication Specifications

Description	Application	Part Number
Blue Goop, 2 ounce	Stainless steel threads	20460486
FML-2 Grease, 14-1/2 ounce	O-rings, backup rings, bearing rings, seal components	10087385
JL-M Grease, 16 ounce	Non-stainless steel threads	49832199

3.3 Maintenance Precautions

Make sure all safety devices are operational. Each device should be checked on a specified schedule. If the device does not function, it must be replaced before operating the machine.

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

Never service or maintain the equipment while it is operating.

All high pressure leaks must be repaired immediately. Turn the control power off and bleed off the high pressure water from the intensifier **before** performing maintenance.

Never service or maintain any high pressure component, or loosen any high pressure fitting when it is pressurized. Turn the control power off and bleed off the high pressure water from the intensifier before servicing.

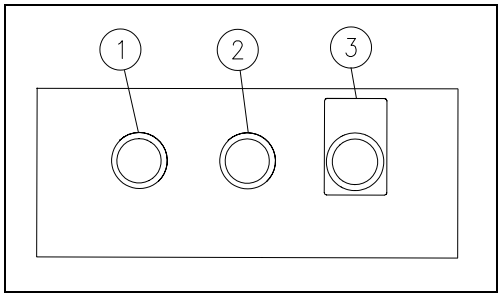
If leakage occurs at a sealing surface, high pressure water is released through weep holes. If a pressurized fitting is loosened, a jet of high pressure water will exit the nearest weep hole with **possible hazardous results**.

SECTION 4
OPERATION

4.1 Overview

The operator interface on the KMT H2O Jet is through the control panel or an optional, remote control panel. Figure 4-1 identifies the control panel components and functions.

Figure 4-1: Control Panel



1 Start Pump
2 Stop Pump
3 Emergency Stop

EMERGENCY STOP button turns the control power off. The electric motor, hydraulic pump and intensifier stop, the dump valve opens and high pressure is bled from the system. Pull the EMERGENCY STOP button out to reset.

START button starts the pump and generates high pressure. This green button is illuminated during normal operation.

STOP button turns the electric motor and hydraulic pump off. Control power remains on. This red button flashes during abnormal operation and remains on if the pump stops due to an abnormal condition.

4.2 Startup and Stop Sequence

The following procedure is used to start and stop the pump under normal operating conditions.

1. Pull the EMERGENCY STOP button out.

2. Press the START button. The green button will illuminate, the motor will start and after a brief delay, the hydraulic pump will start.

3. To stop the pump, press the STOP button. The green light will go off, the pump will stop, and the red light will illuminate.

Startup Following High Pressure Maintenance

The following startup procedure should be used following maintenance on any high pressure components.

1. Disconnect the electrical power cable from the solenoid valve on the dump valve.

2. Press the START button.

   The intensifier will cycle and discharge water through the dump valve, purging the air from the high pressure cylinders and filling them with water.

CAUTION

Failure to purge the air from the high pressure system following maintenance will damage the high pressure seals.

3. Connect the electrical power cable to the solenoid valve on the dump valve.

4. Check for any leaks in the plumbing, or around the high pressure cylinders.

Emergency Stop

When the EMERGENCY STOP button is pressed, all electrical power is immediately terminated. The dump valve opens and high pressure is relieved in the system. The emergency stop function can be wired to a remote control panel.

4.3 Fault Conditions

Automatic shutdown will occur as a result of the faults listed in Table 4-1. The red, STOP button will blink and the number of blinks will indicate the type of fault.

Table 4-1
Fault Conditions

Number of Blinks	Indication	Comments
1	Left Overstroke A left overstroke condition has occurred	Abnormally high stroke rate caused by an external or internal leak. Shutdown will occur if condition persists.
2	Right Overstroke A right overstroke condition has occurred	Abnormally high stroke rate caused by an external or internal leak. Shutdown will occur if condition persists.
3	Topworks Overstroke An intensifier overstroke condition has occurred.	Abnormally high stroke rate in both directions caused by an external or internal leak. Shutdown will occur if condition persists.
4	Motor Overload Fault	The motor overload relay is monitored and displayed when the overloads trip. Overloads are set on automatic reset.

Table 4-1
Fault Conditions

Number of Blinks	Indication	Comments
5	High Oil Temperature High hydraulic oil temperature, in excess of 144 F (62 C)	The red light will illuminate and shutdown will occur. When the temperature returns to normal, the red light will go off.
6	Low Oil Level Oil level is below 21 gallons (79 liters)	The red light will illuminate and shutdown will occur. When the fault has been corrected, the red light will go off.

SECTION 5
LOW PRESSURE WATER SYSTEM

5.1 Overview

The low pressure water system, cutting water supply circuit, supplies the intensifier with the required cutting water flow and pressure.

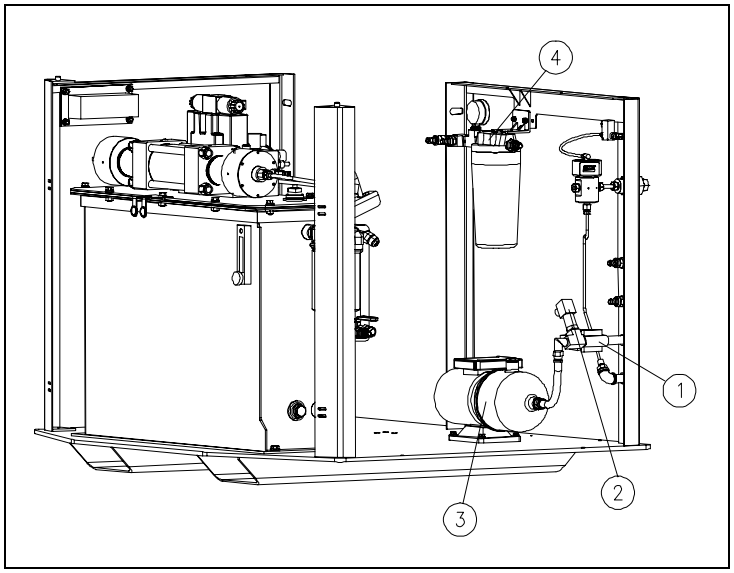
5.2 Cutting Water Supply Quality

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

5.3 Operation

Cutting water is introduced through the 1/2-inch BSPT connection on the bulkhead of the machine and passes through the normally closed, inlet water solenoid valve. When the control power is turned on, the solenoid valve opens and allows water to flow through the valve. The inlet water is monitored by a 30 psi pressure switch. If the pressure drops below 30 psi (2 bar) the switch activates an automatic shutdown.

Figure 5-1: Low Pressure Water System



1 Inlet Water Solenoid Valve
2 30 psi Pressure Switch
3 Booster Pump/Motor Assembly
4 LP Water Filter Assembly

Cutting water is then routed to booster pump. The booster pump increases the pressure to the relief valve setting to ensure proper supply to the intensifier assembly.

Pressurized water passes through the filter assembly where debris is removed to prevent contaminates from damaging the check valves and seals in the intensifier. The filter assembly consists of a filter head, housing and a filter element. A bleed valve on the top of filter head is used to release pressure or air inside the housing.

From the filter assembly, cutting water is routed to the inlet check valves in the sealing heads on each end of the intensifier.

5.4 Service and Maintenance Procedures

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

NOTE

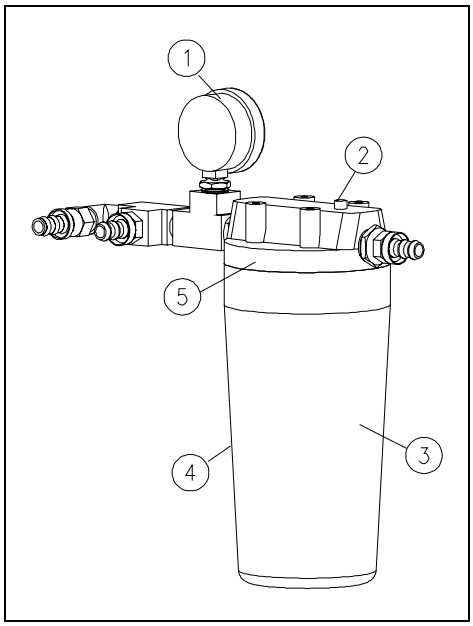
Refer to Section 12, Parts List for a complete listing of replacement parts and part numbers.

Filter Assembly Maintenance

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

The following procedure is used to replace the filter element and clean the strainer.

Figure 5-3: Filter Element



1 Pressure Gauge
2 Bleed Valve
3 Filter Element
4 Filter Element
5 Filter Housing

1. Turn the cutting water supply off.
2. Press the red bleed valve on the filter head to release any pressure trapped inside the housing.
3. Use a filter wrench to unscrew the housing and remove the old element.
4. Install the new element. Apply FML-2 grease to the o-ring in the filter housing and use the filter wrench to replace the housing.
5. Turn the cutting water supply on.
6. Press the red bleed valve to remove any air inside the filter housing.
7. Start the machine and verify satisfactory pressure readings.

SECTION 6
RECIRCULATION SYSTEM

6.1 Overview

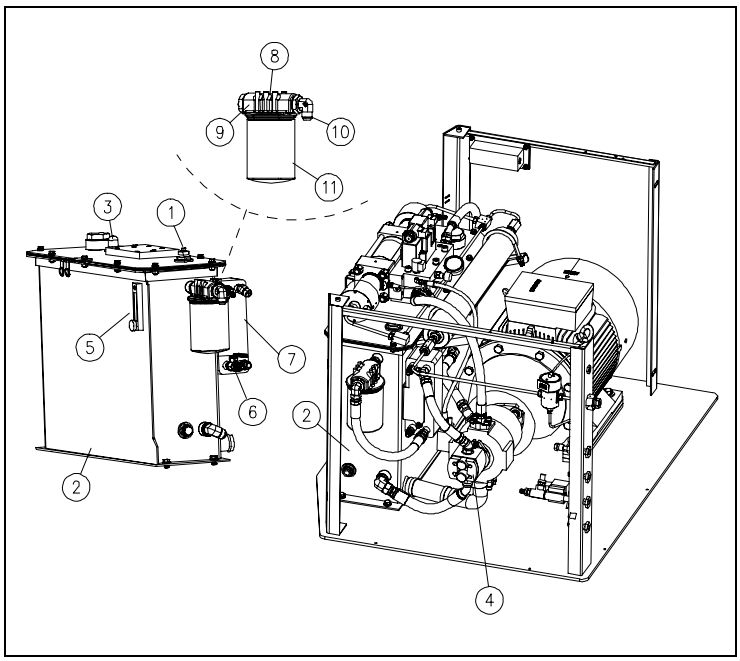
The oil recirculation circuit is a cooling and filtration system that provides properly conditioned oil to the main hydraulic system. Hydraulic oil is maintained at the proper operating temperature and condition by continuous recirculation.

System components include the recirculation pump, oil-to-water heat exchanger, oil filter assembly and the hydraulic oil reservoir.

6.2 Operation

Cooling water is introduced through the 1/2-inch BSPT connection on the bulkhead and routed to the ball valve mounted on the heat exchanger. The ball valve is used to manually regulate the cooling flow to the heat exchanger. Oil temperature can be visually monitored from a dual scale level/temperature sight gauge on the side of the hydraulic oil reservoir.

Figure 6-1: Recirculation System Components



1 Temperature/Low Level Switch
2 Hydraulic Oil Reservoir
3 Air Breather
4 Recirculation Pump
5 Level/Temperature Sight Gauge
6 Manual Ball Valve
7 Heat Exchanger
8 Pressure Gauge
9 Filter Head
10 Oil Fill Port
11 Filter Element

The recirculation pump pulls oil from the reservoir and sends it to the heat exchanger where heat buildup is controlled in the hydraulic oil.

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

The hydraulic oil filter assembly consists of the filter head with a bypass relief valve and pressure gauge, a filter element and the oil fill port. The filter element should be changed when the gauge reads 30 psi (2.1 bar) at normal operating temperature.

If the element is not replaced, and fills with debris, the bypass relief in the filter head will open to prevent over pressurization. The relief valve opens at 50 psi (3.4 bar). When the valve opens, the oil bypasses the filter and unfiltered oil is allowed to return to the reservoir.

The temperature/low level switch monitors the oil temperature and level in the reservoir.

NOTE

To conserve water usage it is recommended that the cooling water be shut off at the end of the day. A sensor bulb from the modulating valve is submerged in the reservoir. Even when the control power is off, the valve will remain open, allowing water to flow until the oil is cooled.

6.3 Service and Maintenance Procedures

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

NOTE

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

Hydraulic Oil Maintenance

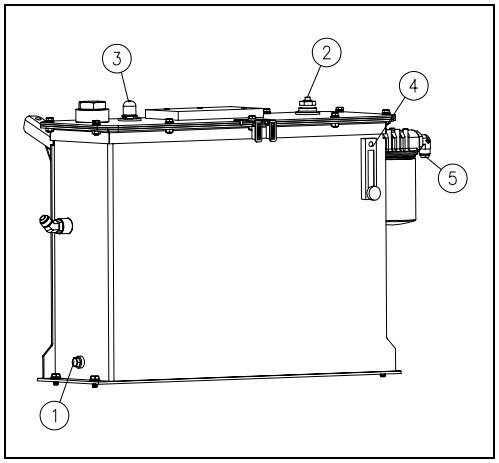
The hydraulic oil should be replaced after 3,000 hours or one year of service, whichever comes first. The oil should be replaced sooner if a fluid sample indicates contamination that cannot be rectified by filtering.

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

CAUTION

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

Figure 6-2: Hydraulic Oil Reservoir



1 Drain
2 Temperature/Low Level Switch
3 Breather
4 Level/Temperature Sight Gauge
5 Oil Fill Port

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

WARNING

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

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

2. Drain the oil reservoir by connecting the inlet hose from an oil transfer pump to the drain on the reservoir.

3. Pump the used oil out to a container and remove the inlet hose from the drain.

NOTE

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

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

CAUTION

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

5. Check the oil sight gauge on the reservoir to ensure proper fill level.

6. Remove the hose from the case drain on the hydraulic pump to make sure the pump case fills with oil. With the hose removed, head pressure from the reservoir will force oil into the pump case.

CAUTION

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

7. Disconnect the discharge hose from the fill port.

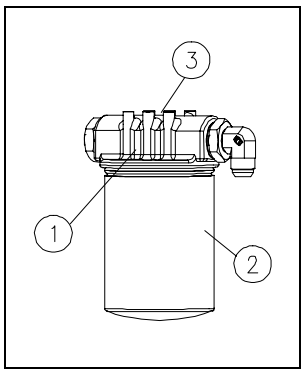
8. Check the sight gauge again and follow the same procedure to add additional oil if necessary.

Oil Filter Maintenance

If the filter element is not properly serviced and is allowed to fill with debris, the oil will be forced through the relief valve, bypassing the filter. The bypass relief valve opens at 50 psi (3.4 bar).

The filter element must be replaced when the pressure gauge reading is 30 psi (2.1 bar) or greater during normal operating conditions. Normal operating conditions indicate the machine is running and the oil temperature has reached 115 F (46 C).

Figure 6-3: Oil Filter Assembly



1 Filter Head
2 Filter Element
3 Pressure Gauge

1. Use a filter wrench to unscrew the filter element from the filter head. Ensure the old gasket is removed with the filter.

2. Lubricate the gasket on the new element with fresh oil.

3. Use the filter wrench to screw the new element onto the filter head and hand-tighten. Do not over tighten.

4. Start the machine and check for leaks.

Section deleted – Water Modulating Valve

SECTION 7
HYDRAULIC SYSTEM

7.1 Overview

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

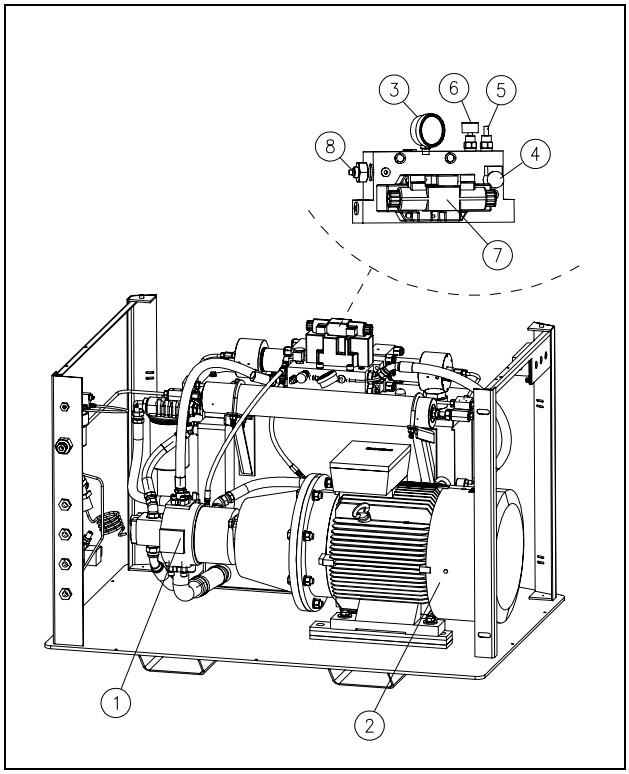
System components include the electric motor, hydraulic pump, and the hydraulic manifold. The manifold houses the 4-way directional control valve and the system relief valve. The relief valve monitors hydraulic oil pressure and provides system protection by limiting excess pressure.

7.2 Operation

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

Hydraulic fluid from the reservoir is drawn into the inlet, low pressure side of the hydraulic pump. Oil delivered to the pump should be maintained at 110-115 F (43-46 C). Hydraulic fluid then enters the bottom of the manifold through an internal anti-rotation check valve. After a shutdown, the anti-rotation check valve prevents the pump from running backwards.

Figure 7-1: Hydraulic System Components



1 Hydraulic Pump
2 Electric Motor
3 Pressure Gauge
4 High/Low Solenoid Valve
5 Low Pressure Control
6 High Pressure Control
7 Directional Control Valve
8 System Relief Valve

The main system relief valve provides system protection by monitoring the oil pressure entering the manifold. If the hydraulic pressure exceeds 3,400 psi (234 bar), the valve opens to limit the pressure. The valve is factory calibrated and is not serviceable. A drain line from the valve prevents oil from collecting behind the relief valve to ensure a constant pressure under all operating conditions.

The hydraulic system operates at high or low pressure settings up to the maximum flow capacity of the hydraulic pump. The high and low limit compensators mounted on the pump regulate the flow of hydraulic fluid to maintain constant operating pressures. Operating pressures are set and adjusted at the high and low pressure control valves on the manifold.

CAUTION

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

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

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

The directional valve consists of a spool with internal passages that direct hydraulic flow to one end of the hydraulic cylinder while returning fluid to the reservoir through the opposite end. Spool position is solenoid operated. The solenoids are alternately energized in response to the position of the hydraulic piston as the proximity switch detects the end of the stroke.

7.3 Service and Maintenance Procedures

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

The operating pressure setting must be checked daily, and the electric motor must be inspected at regular intervals.

NOTE

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

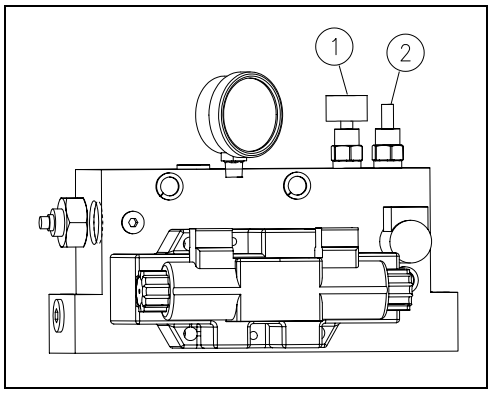
Hydraulic Operating Pressure

Hydraulic operating pressure settings should be checked daily and adjusted as necessary. High and low operating pressure is adjusted at the high and low pressure control valves per the specifications in Table 7-1.

Table 7-1
Hydraulic Operating Pressure Limits

	Adjustment		Pressure Limits	
	Increase	**Decrease**	**Minimum**	**Maximum**
High Pressure	Clockwise	Counter-clockwise	290 psi (20 bar)	3,000 psi (207 bar)
Low Pressure	Clockwise	Counter-clockwise	290 psi (20 bar)	800 psi (55 bar)

Figure 7-2: High/Low Pressure Controls



1 High Pressure Control 2 Low Pressure Control

1. Check the operating pressure to determine if adjustment is necessary.
2. If high pressure adjustment is required, loosen the locking thumbscrew on the high pressure control valve by turning counter-clockwise.
3. Turn the knob on the control valve clockwise to increase operating pressure. Turn the knob counter-clockwise to decrease pressure.
4. Tighten the locking nut and verify the high pressure setting.
5. If low pressure adjustment is required, loosen the locking nut on the low pressure control valve by turning counter-clockwise.
6. Turn the hex clockwise to increase operating pressure. Turn the hex counter-clockwise to decrease pressure.
7. Tighten the locking nut and verify the low pressure setting.

Motor/Hydraulic Pump Maintenance

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

NOTE

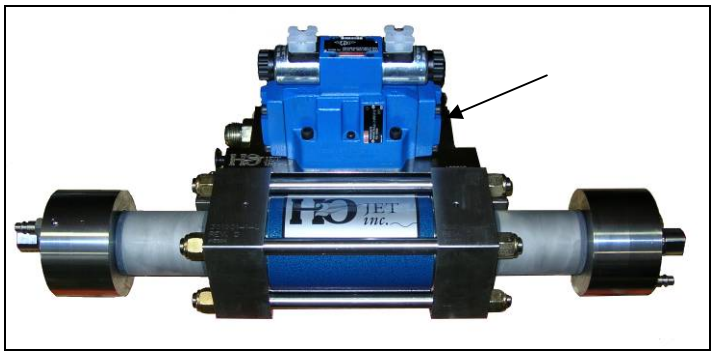
Motor bearings are sealed for life and require no periodic maintenance.

The hydraulic pump is mounted to the electric motor by means of a keyed shaft, close coupling. If the pump and motor are separated, the shaft and coupling must be lubricated with anti-seize grease prior to re-assembly.

Shift Valve and Manifold Service

As oil flows in and out of the hydraulic cylinder it flows through the shift valve. The valve spool opens and closes passageways to direct pressurized oil into one end of the cylinder, and bleeds the oil from the opposite end, causing the cylinder to stroke. The spool movement is controlled hydraulically by a pilot valve mounted directly on the shift valve. The shift valve and manifold require no routine maintenance.

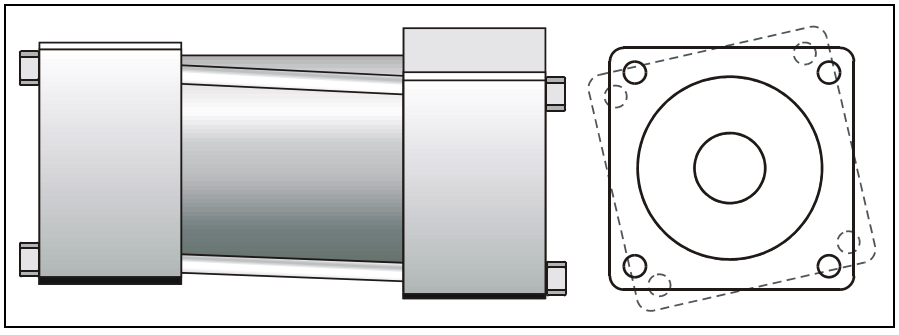
Figure 7-3: Shift Valve



Problems associated with a faulty shift valve are usually limited to an uneven, slow, or non-cycling intensifier. Uneven stroking can also be caused by check valve problems.

A cracked manifold or leaking o-rings are usually the result of misaligned end bells, i.e., one end bell is rotated in relation to the other.

Figure 7-4: End Bell Misalignment



Whenever the tie rods are removed, the intensifier assembly fixture must be used to ensure that the end bells are aligned during the assembly process.

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

WARNING

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

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

2. Remove the cap screws securing the end covers on the shift valve and remove the covers.

3. Using your fingers, check the shift valve spool for freedom of movement. The spool must move with light pressure through the full stroke. If the spool is jammed, the valve must be replaced.

4. Remove the spool and check that all grooves in the spool are clean and all polished surfaces are undamaged. Check the inside of the shift valve body for any damage or foreign material. If everything is satisfactory, insert the spool into the shift valve.

5. If the shift valve and manifold are satisfactory, replace the end cap.

Shift Valve Replacement

WARNING

The shift valve is a specially modified unit designed for use in this application. Using a substitute shift valve may create a potential safety hazard, lower performance of the pump and will void the warranty.

1. If the shift valve or port o-rings must be replaced, remove the shift cable and pilot valve and set them aside. See the Solenoid and Pilot Valve Service for the correct procedure.

2. Loosen the fasteners in one-eighth turn increments until all torque has been removed. Remove the shift valve and discard it if faulty.

3. Check the manifold and o-rings. If they are not in need of service, proceed to Step 18. If the manifold or o-rings need service continue with Step 4.

4. Disconnect the oil supply and return lines from the manifold; cap the lines with the plugs supplied with the pump.

5. Disconnect the water supply lines at the quick-disconnects.

6. Remove the pressure relief valve and set aside. Use a spanner wrench (20460162) to make removal easier.

7. Disconnect the small diameter, hydraulic high pressure line connected to the manifold. Move the high pressure lines out of the way.

8. Loosen the screws mounting the manifold to the intensifier in one-eighth turn increments.

9. Remove the screws mounting the manifold to the frame and remove the manifold.

10. If the manifold is cracked, check that the end bells are in alignment with each other using a steel straight edge. If any misalignment is noted, mount the intensifier on the intensifier assembly fixture and loosen the tie rod nuts. Torque the four cap screws mounting the end bells to the assembly fixture to 35 ft-lbs (48 Nm), then back off one-eighth to one-quarter turn until more than finger tight. The bolts must hold the end bells tight against the fixture to prevent any misalignment but not interfere with the tightening of the tie rod nuts.

11. Using a figure-eight pattern, torque all tie rod nuts to 40 ft-lbs (54 Nm)], then 60 ft-lbs (81 Nm)], then 80 ft-lbs (108 Nm)], then 100 ft-lbs (135 Nm), then 120 ft-lbs (163 Nm). Remove the intensifier from the intensifier assembly fixture and place it back in the pump.

12. Clean and inspect all parts to be reused.

13. Lubricate the new o-rings with Parker Super O-Lube and place in the port cavity's end bell. If any oil is lost in the process, refill with fresh oil.

14. Align the manifold ports with the intensifier ports and thread in the fasteners.

15. Torque all cap screws to 25 ft-lbs (34 Nm) in one-eighth to one-quarter turn increments using a figure-eight pattern.

16. Install the cap screws mounting the manifold to the pump frame and torque to 110 ft-lbs (149 Nm).

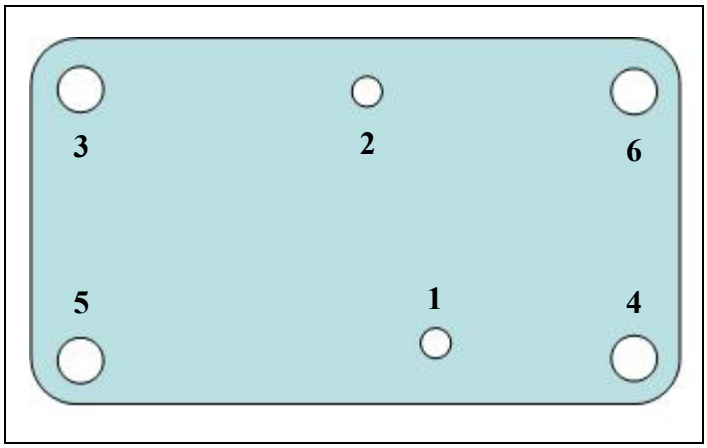
17. Connect the oil supply and return lines to the manifold.

18. Lubricate the o-rings with Parker Super O Lube and place the o-rings in the port grooves of the shift valve to be installed.

19. Place the shift valve onto the manifold and install the fasteners. Torque the fasteners in one-eighth turn increments in a two-step process.

    Torque screws 1 and 2 to 11.5 ft-lbs (15.5 Nm). Torque the outer screws (3-6) incrementally to 55 ft-lbs (75Nm) in a crisscross pattern. Verify screws 1 and 2 are at 11.5 ft-lbs (15.5 Nm).

Figure 7-5: Torque Sequence



CAUTION

Failure to correctly follow torque sequence when installing the shift valve may sufficiently warp the body, preventing spool movement. Such damage is usually not reversible.

20. Using your fingers, make sure the spool moves freely.

21. Lubricate the end cover o-rings with Parker Super O-Lube and mount the end cover to the shift valve housing. Torque the cap screws to 10 ft-lbs (14Nm).

22. Install the pilot valve and the solenoid cables.

23. Attach the water supply lines at the quick-disconnect fittings. Attach the high pressure tubing at both ends, and then torque the gland nuts.

24. Check the intensifier for incomplete work, tools, parts and rags. Start the pump and operate at idle oil pressure.

25. Slowly increase the pressure to the rated output while checking for leaks.

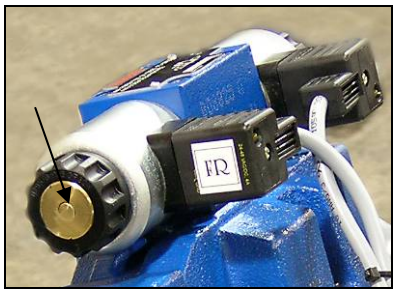
26. Stop the pump and inspect for any leakage and correct as required.

Solenoid and Pilot Valve Service

The pilot valve spool and solenoid plunger can be checked for freedom of movement without disassembling the pilot valve.

1. With the machine turned off, depress the small center ring on the end of the solenoid with a small wooden dowel. It will initially depress about .25” (6 mm) and then the movement of the valve spool can be felt. If movement is not felt, repeat this process on the other side. The spool itself will only move .13” (3 mm). If no movement is felt the entire assembly will probably require replacement.

Figure 7-6: Solenoid



2. While the intensifier is off, apply 24 volts across the front and rear contacts (not the side one) on the solenoid connection to check for solenoid movement.

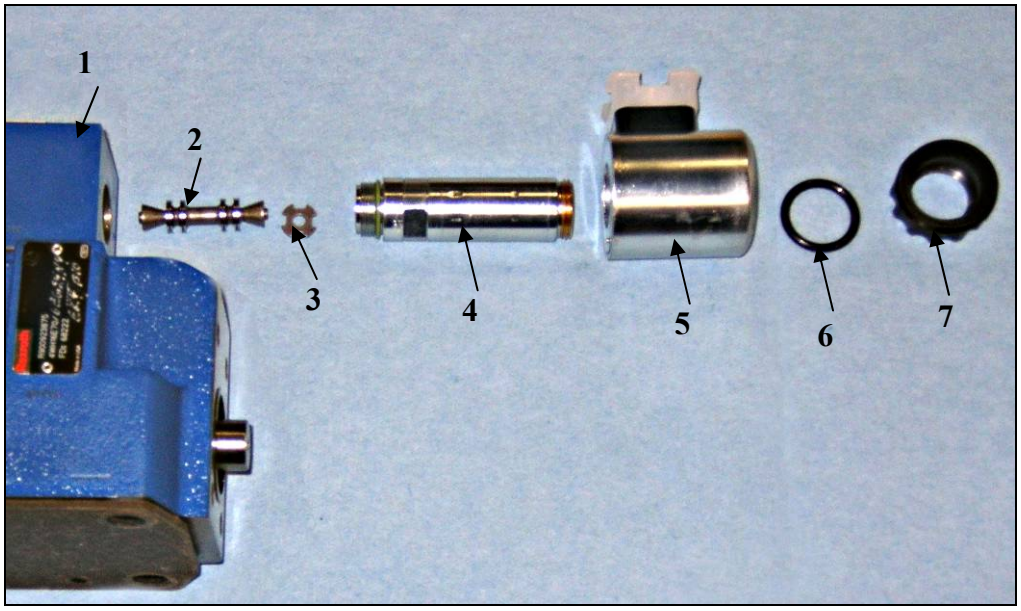
3. The black plastic nut on each solenoid can be unscrewed and the electro-magnet portion of the solenoid removed.

4. Inside there is a silver shaft that houses the solenoid plunger and a spring to absorb shock from the movement of the pilot valve spool. This shaft has a set of notches on it to receive a wrench for removal.

5. When the assemblies are removed from each side the pilot valve spool can be manually pushed from side to side to check the movement.

6. The pilot valve spool should then be removed at this point to check for burrs and other signs of wear and leakage. If there is any wear or leakage across the valve, the entire assembly must be replaced.

Figure 7-7: Pilot Valve



1 Pilot Valve
2 Pilot Valve Spool
3 Spool Stop
4 Solenoid Plunger Housing
5 Solenoid Electro Magnet
6 O-Ring
7 Plastic Nut

Pilot Valve Assembly Replacement

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

WARNING

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

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

2. Unplug the connections at the solenoid where the shift lights are located.
3. Remove the screws on top of the pilot valve assembly.
4. Make sure there is a slight film of oil on the o-rings and face of the new pilot.
5. Clean any debris that may be on the joining surface on the top of the shift valve and check for scratches or other marks.
6. Mount the new pilot valve assembly in place so the wire connections on the solenoids face the back of the cabinet.
7. The screws only have to be hand tight at about 15 ft- lbs (20 Nm).
8. Reconnect the cables to the solenoids. Notice they are labeled for front left (FL), front right (FR) and so on.

SECTION 8
ELECTRICAL SYSTEM

8.1 Overview

Major components of the electrical system for the KMT H2O Jet include the electric motors and the wiring harness that connects the sensors and solenoid valves to the customer supplied controller.

The 12-lead electric motor can be wired for either wye-delta or across-the-line starting. The motor includes a 9-post terminal block for the junction of motor and starter wire leads.

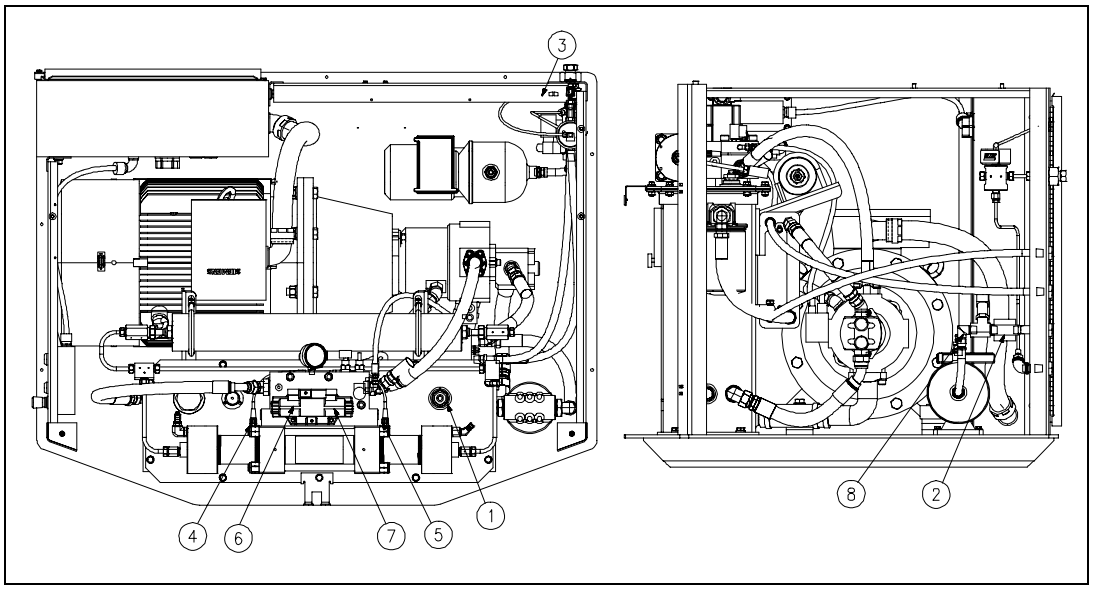
8.2 Sensors and Solenoids

Sensors monitor operating conditions and electronically operated solenoids provide basic intensifier shift control. The cables connected to these sensors and solenoids are bundled into a wiring harness. Table 8-1 lists the recommended shutdown settings.

Table 8-1
Recommended Shutdown Settings

Label	Sensor	Shutdown Setting
1	Low hydraulic oil level	21 gal (79 L)
1	High hydraulic oil temperature	144 F (62 C)

Figure 8-1: Sensors and Solenoids



1 Oil Level/Temperature Switch (1)
2 Inlet Water Solenoid (6)
3 Safety Dump Valve (7)
4 Left Proximity Switch (2)
5 Right Proximity Switch (3)
6 4-Way Valve 'A' Solenoid (4)
7 4-Way Valve 'B' Solenoid (5)
8 Inlet Water Pressure Switch

Table 7-2
Sensors and Solenoids

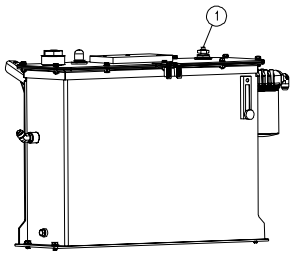
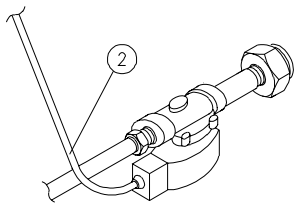
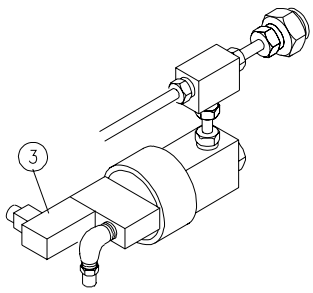
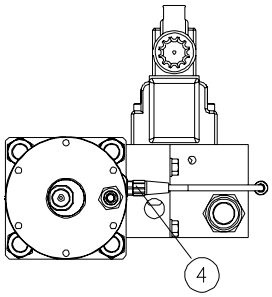
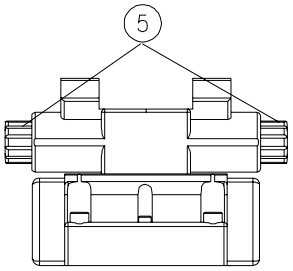
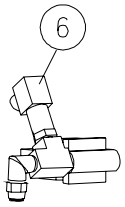
Component		Function
Hydraulic Reservoir		
	1	The temperature/low level switch monitors the oil temperature and level in the reservoir. Although the float switch and the temperature switch are combined in a single unit, the two switches function independently.
Inlet Water Solenoid Valve		
	2	The normally closed, inlet water solenoid valve is located at the service bulkhead. When the control power is turned on, the valve opens and allows low pressure cutting water to enter.
Safety Dump Valve		
	3	When control power is removed, the safety dump valve releases the stored pressure in the intensifier and high pressure delivery lines. The high pressure dump valve assembly includes a normally open high pressure water valve and a solenoid operated air valve. The normally open pneumatic dump valve is held closed by air pressure. When the air supply is interrupted, the valve opens and allows water to flow through the valve. Pressure is released in the intensifier and the high pressure water stream exits through the drain.

Table 7-2
Sensors and Solenoids

Component		Function
Hydraulic Cylinder		
	4	As pressurized hydraulic oil is sent to one side of the hydraulic cylinder, it pushes against the piston, moving it in one direction until it activates the proximity switch at the end of the stroke. The hydraulic flow is then sent to the opposite side of the cylinder, and the piston reverses direction until it activates the proximity switch at the opposite end of the stroke. The proximity switches are activated when the piston makes contact with the shift pin and the movement is transferred to the magnet in the actuator assembly. When the switch is activated, it sends a signal to the controller to change the flow of the directional control valve and reverse direction.
Hydraulic Manifold		
	5	The 4-way directional control valve shifts the hydraulics back and forth to the intensifier. A shift valve directs pressurized oil to one end of the hydraulic cylinder and returns fluid to the reservoir from the opposite end, causing the intensifier to stroke. The movement is controlled hydraulically by a pilot valve that is electronically operated by two solenoids.
Inlet Water		
	6	The 30 psi pressure switch monitors the inlet cutting water. If the pressure drops below 30 psi (2 bar) the switch activates an automatic shutdown circuit, protecting the booster pump from damage due to insufficient water supply pressure.

8.3 Service and Maintenance Procedures

Electrical components require minimal service. The proximity switches on the hydraulic cylinder may require replacement.

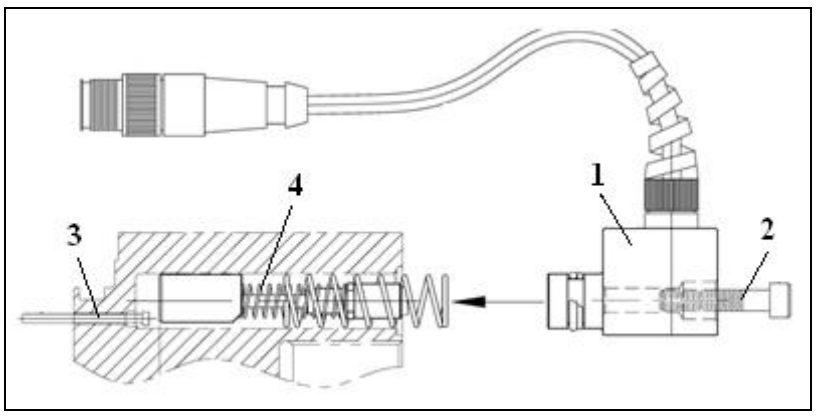
NOTE

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

Proximity Switch Maintenance

A proximity switch has failed and needs to be replaced if the LEDs do not change state, indicating they are not sensing the piston, or if an LED flashes continuously.

Figure 8-2: Proximity Switch



1 Proximity Switch
2 Proximity Switch Screw
3 Firing Pin
4 Actuator Assembly

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

WARNING

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

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

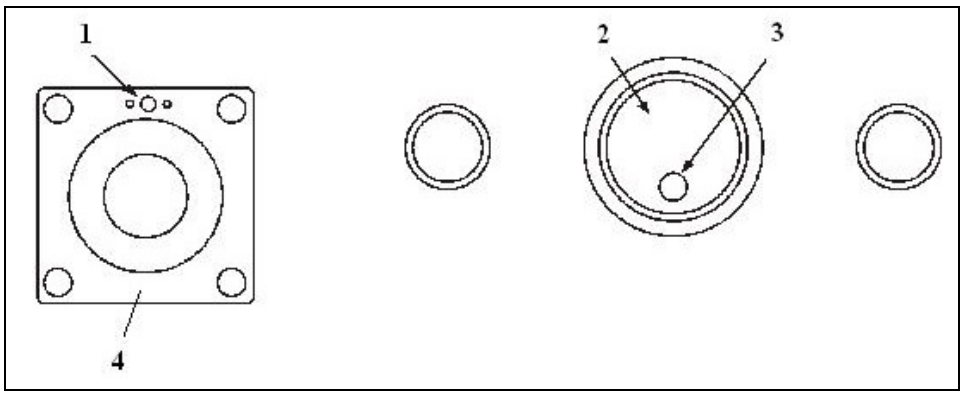
2. Disconnect the proximity switch cable.

3. Remove the proximity switch screws and carefully remove the proximity switch. Some force may be required due to the resistance created by the o-rings.

4. Remove the actuator assembly and inspect for ease of movement and to ensure the springs and magnet are intact.

5. To remove the firing pin, lubricate the o-ring in the firing pin tool and insert the tool into the actuator assembly bore in the end bell, o-ring end first. This creates a suction that extracts the pin.

Figure 8-3: Firing Pin Removal



1 Actuator Assembly Bore
2 Actuator Assembly Bore
3 Firing Pin Bore
4 End Bell

6. Inspect the firing pin. It should be approximately 1.150" (29.20 mm) long, with a shaft OD of approximately 0.082" (2.08 mm) and have no measurable bend.

7. Inspect the firing pin bore in the end bell. It must be polished and have no gouges, burrs or other surface disruptions. It must not be elongated or egg shaped.

8. Use the firing pin tool and a small Allen wrench to replace the firing pin. Position the firing pin in the groove of the tool with the head toward the o-ring. Insert the tool into the actuator assembly bore using the Allen wrench to apply pressure against the firing pin. Rotate the tool until the pin lines up with the firing pin bore. The pressure applied will force the firing pin into the bore. Visually inspect the pin to ensure it is correctly installed.

9. Install the actuator assembly, large end first, so the magnet faces the proximity switch.

10. Install the new proximity switch. Apply JL-M grease to the threads on the screws and tighten to 140-160 in-lbs (16-18 Nm).

CAUTION

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

11. Reconnect the proximity switch cable.

SECTION 9
HIGH PRESSURE WATER SYSTEM

9.1 Overview

The high pressure water system is supported by both the cutting water supply circuit and the hydraulic circuit. Cutting water of sufficient flow and pressure is routed from the cutting water supply circuit to the intensifier where it is pressurized up to 60,000 psi (4,137 bar) and delivered to the cutting head.

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

System components include a double-ended hydraulic cylinder; reciprocating piston assembly; high pressure cylinders attached to each end of the hydraulic cylinder; two plungers, sealing heads and end caps; and a .41 liter capacity attenuator. Sophisticated check valves and seal assemblies ensure hydraulic oil, and the low pressure and high pressure water travel in the appropriate direction.

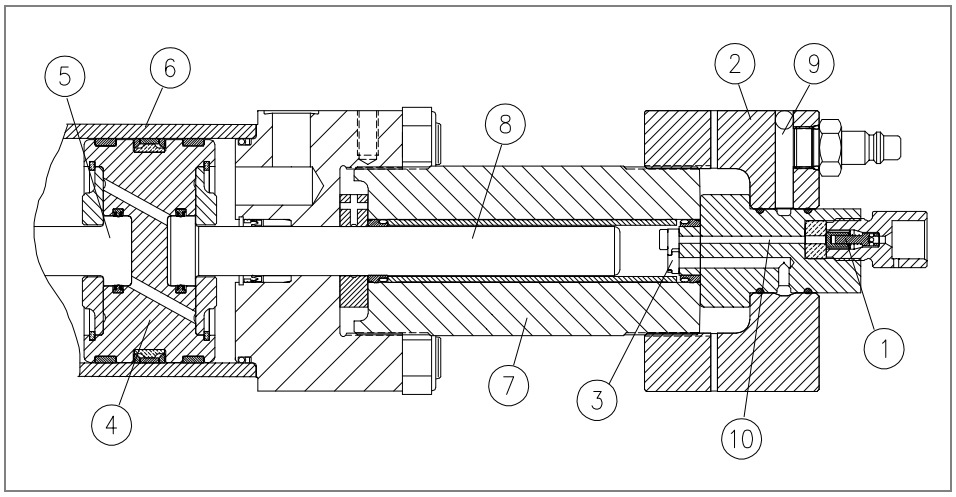
9.2 Operation

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

The green light on the proximity switch indicates there is power to the switch. The red light illuminates when the switch is activated. The proximity switches are magnetically activated by the presence of the magnet in the actuator assembly. When the switch is activated, the flow of the directional control valve is changed and the direction is reversed.

As the pressurized oil pushes the piston in one direction, the plunger on that end extends and pushes against the water in the high pressure cylinder, increasing the pressure up to 60,000 psi (4,137 bar). When the piston reverses direction, the plunger retracts and the plunger in the opposite cylinder extends to deliver the high pressure water.

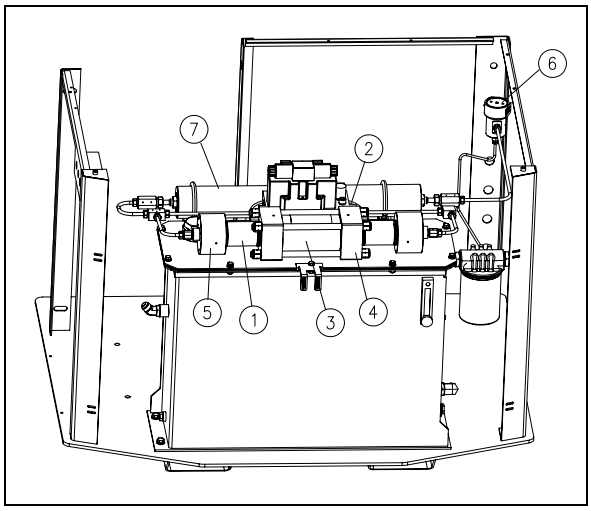
Figure 9-1: High Pressure Cylinder



1 Discharge Check Valve
2 Sealing Head
3 Inlet Check Valve
4 Hydraulic Piston
5 Retracted Plunger
6 Hydraulic Cylinder
7 High Pressure Cylinder
8 Extended Plunger
9 Inlet Water Passage
10 Outlet Water Passage

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

Figure 9-2: High Pressure Water System



1 High Pressure Cylinder
2 Proximity Switch
3 Hydraulic Cylinder
4 End Bell
5 High Pressure End Cap
6 Safety Dump Valve
7 Attenuator

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

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

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

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

9.3 Service and Maintenance Overview

Never perform any type of maintenance on the high pressure water system while it is pressurized. Always turn the main control power off and bleed the high pressure water before servicing.

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

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

NOTE

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

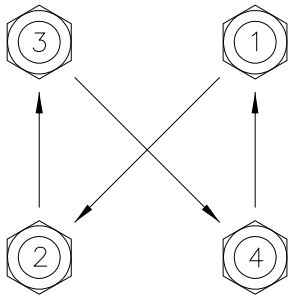
Torque Specifications

Table 9-1, Torque Specifications, details the torque specifications and tightening sequences for the high pressure components and connections.

Table 9-1
Torque Specifications
High Pressure Water System

End Bell Lock Nuts	
1st Stage	Finger-tight
2nd Stage	40 ft-lbs (27 Nm) Crossing Pattern
3rd Stage	60 ft-lbs (43-47 Nm) Crossing Pattern
4th Stage	80 ft-lbs (43-47 Nm) Crossing Pattern
5th Stage	100 ft-lbs Crossing Pattern
6th Stage	120 ft-lbs Crossing Pattern

Crossing Pattern



Proximity Switch	
Torque	140-160 in-lbs (16-18 Nm)
Sealing Head	
Discharge Gland Nut	30-50 ft-lbs (41-67 Nm)
Pneumatic Control Valve	
3/8-inch HP Gland	50 ft-lbs (68 Nm)
1/4-inch HP Gland	25 ft-lbs (34 Nm)
Pneumatic Actuator	5 ft-lbs (7 Nm)
HP Adapter	25 ft-lbs (34 Nm)

Table 9-1
Torque Specifications
High Pressure Water System

High Pressure Fittings	
1/4” HP Gland Nut	25 ft-lbs (34 Nm)
3/8” HP Gland Nut	50 ft-lbs (68 Nm)
9/16” HP Gland Nut	110 ft-lbs (149 Nm)

9.4 High and Low Pressure Water Piping

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

WARNING

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

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

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

9.5 High Pressure End Caps

High Pressure End Cap Removal

Prior to removing electrical power or any high or low pressure piping, start the machine and retract the plunger on the opposite end to be serviced to allow full exposure when the unit is disassembled.

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

WARNING

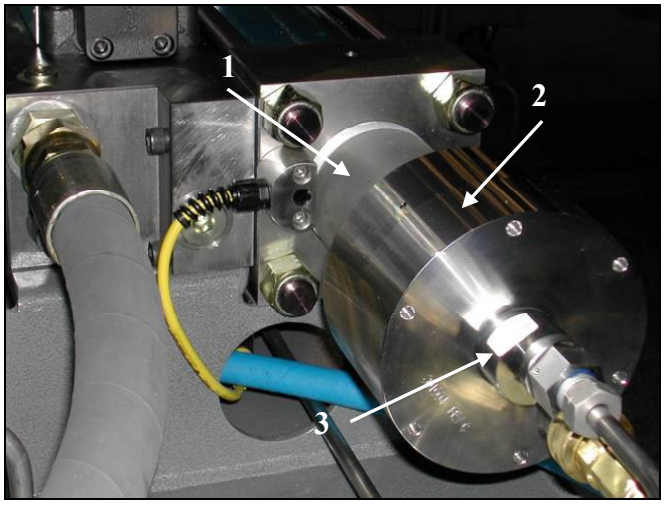
Severe injury can result if the machine is not properly locked out. Observe electrical Lockout/Tagout procedures before proceeding.

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

2. Disconnect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.

3. Use a pin spanner wrench (P/N 20460162) to turn the end cap counter-clockwise to break the end cap loose. It may be necessary to tap the spanner wrench with a plastic mallet. Continue to unscrew the end cap until it is removed. Removing the sealing head assembly at the same time is recommended.

Figure 9-3: High Pressure End Cap



1 High Pressure Cylinder
2 High Pressure End Cap
3 Sealing Head Assembly

High Pressure End Cap Installation

1. Apply Blue Goop to the flat end of the high pressure cylinder and the shoulders on the sealing head. Apply FML-2 grease to the o-rings on the sealing head.

2. Install the sealing head in the high pressure cylinder and thread the end cap onto the cylinder. Turn the end cap clockwise until it bottoms out and then tighten with a spanner wrench using only your hands. Any additional torque could cause problems the next time the end bell is removed.

3. Connect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.

9.6 High Pressure Cylinder Assembly

The high pressure cylinder can be removed from the end bell with the end cap and sealing head assembly installed. However, due to the combined weight of these components, removing the end cap and sealing head first is recommended.

High Pressure Cylinder Removal

Prior to removing electrical power or any high or low pressure piping, start the machine and extend the plunger on the end to be serviced to allow full exposure when the unit is disassembled.

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

WARNING

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

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

2. Disconnect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.

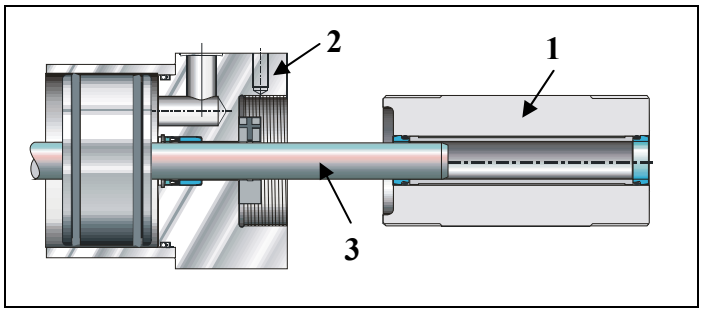
3. Remove the end cap and sealing head assembly, following the procedure, End Cap Removal.

4. Use a girth grip wrench to unthread the high pressure cylinder from the end bell. Support the weight of the cylinder until it completely clears the plunger.

CAUTION

The high pressure cylinder is heavy and can damage the plunger or cause injury if it not supported correctly.

Figure 9-4: High Pressure Cylinder Assembly Removal



1 High Pressure Cylinder
2 End Bell
3 Plunger

NOTE

If thread or metal surface galling is detected during removal, galled surfaces and threads must be filed, sanded and lubricated prior to reassembly. See the procedure, High Pressure Cylinder Maintenance.

High Pressure Cylinder Installation

1. Inspect and clean the high pressure cylinder threads and alignment surfaces.

2. Apply Pure Goop the high pressure cylinder threads and shoulder guides. Thread the cylinder into the end bell. Supporting the weight of the cylinder, use caution to not slam the cylinder against the end bell, damaging the threads.

NOTE

The shoulder guides are close fitting, smooth diameters located at either end of the cylinder threads. As the plunger goes into the cylinder, the cylinder will become difficult to rotate. If necessary, use the cylinder wrench to assist.

3. Use the cylinder wrench (P/N 20459001) to tighten the high pressure cylinder hand-tight. Then tap the wrench with the palm of your hand to tighten.

4. Install the end cap and sealing head assembly, following the procedure, End Cap Installation.

5. Connect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.

6. Start the machine at low pressure to flush air from the high pressure components and to check for obvious leaks. After 5-10 strokes, switch to high pressure operation and check for leaks.

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

High Pressure Cylinder Maintenance

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

1. Clean the sealing area on the inside diameter of the high pressure cylinder and inspect the bore for rings, scratches, pits, residue or other potential leak paths.

   Seal material or residue can build up, forming a ring. Running a fingernail across the buildup will cause it to appear as a surface flaw. Grooves or ridges are typically seal debris buildup rather than marks on the inside diameter wall of the cylinder.

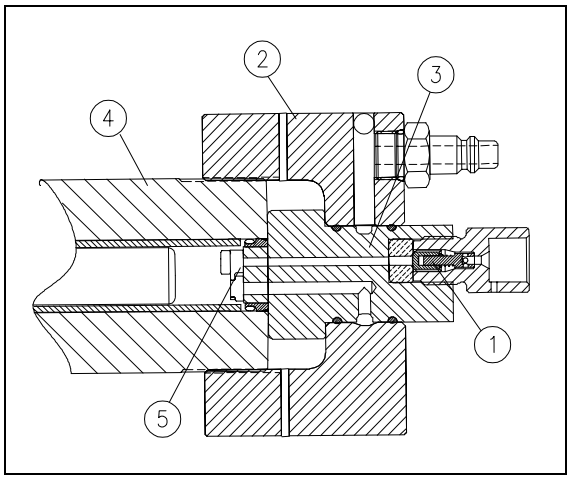
2. Polish the inside diameter of the cylinder where the seal will locate with 600-grit wet/dry sandpaper. Hold the sandpaper on the end of your finger and move in a cylindrical wiping motion. Polish in a circumferential motion only. Do not polish or drag the sandpaper along the length of the cylinder.

3. Clean the residue from the inside diameter of the cylinder and re-inspect for surface defects.

9.7 Sealing Head Assembly

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

Figure 9-5: Sealing Head



1 Discharge Check Valve
2 End Cap
3 Sealing Head
4 High Pressure Cylinder
5 Inlet Check Valve

High Pressure Discharge Check Valve

The discharge check valve can only be serviced with the end cap removed from the high pressure cylinder.

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

WARNING

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

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

2. Disconnect the high pressure water piping, following the procedure, High and Low Pressure Water Piping.

3. Remove the end cap and sealing head assembly, following the procedure, End Cap Removal.

4. Remove the gland nut. The poppet pin, spring and discharge poppet will normally remain in the gland nut when it is removed. Remove the components from the gland nut.

5. Use a magnet to remove the poppet seat from the sealing head.

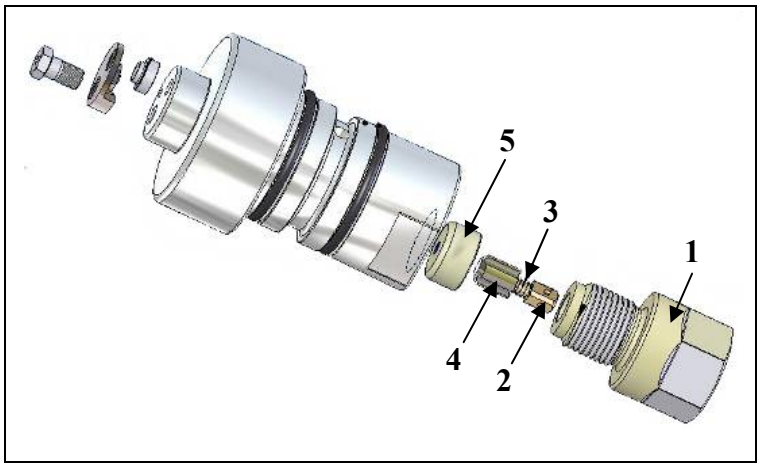
6. Inspect the poppet pin, spring and discharge poppet for wear. If any component is worn, replace all components.

NOTE

The spring and discharge poppet should be replaced as a set. If one component requires replacement, replace all components.

7. Inspect both faces of the seat for damage or cracking. A cracked or damaged seat must be replaced. The seat is not symmetrical; the rounded side must face the sealing head body.

Figure 9-6: High Pressure Discharge Check Valve



1 Gland Nut
2 Poppet Pin
3 Compression Spring
4 Discharge Poppet
5 Seat

8. Apply a thin film of Blue Goop to the rounded face of the seat and insert the seat into the sealing head body. **Do not** apply Goop to the flat face.

9. Install the poppet pin, spring and discharge poppet in the gland nut.

10. Apply Blue Goop to the threads on the gland nut and thread the gland nut into the sealing head. **Do not** apply Goop to the sealing face of the gland.

11. Use a torque wrench to tighten the gland nut to the torque specifications in Table 8-1.

12. Install the end cap and sealing head assembly, following the procedure, End Cap Removal.

13. Connect the high pressure water piping, following the procedure, High and Low Pressure Water Piping.

14. Start the pump and operate at low pressure, without a cutting orifice, to flush the high pressure passages, and then operate the pump at high pressure with orifice installed to check for leaks. Verify that the high pressure fittings do not leak, and that the high pressure water signal is normal, indicative of the normal check valve operation.

Low Pressure Inlet Check Valve

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

WARNING

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

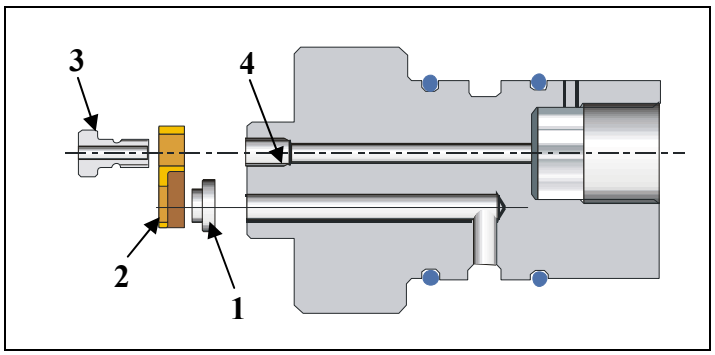
Ensure all pressure is relieved or blocked from the hydraulic and high pressure circuits before proceeding.

2. Disconnect the high pressure water piping, following the procedure, High and Low Pressure Water Piping.

3. Remove the end cap and sealing head assembly, following the procedure, End Cap Removal.

4. Remove the poppet retainer screw and then remove the poppet retainer and inlet poppet.

Figure 9-7: Low Pressure Inlet Check Valve



1 Inlet Poppet
2 Poppet Retainer
3 Poppet Retainer Screw
4 Inlet Water Passage

5. Inspect the sealing head for pits, scratches jetting erosion on the sealing surface. If defects are detected, the surface must be refinished. See the procedure, Sealing Head Maintenance.

6. Inspect the inlet water port in the sealing head of cracking.

7. Inspect the sealing surface of the inlet poppet. If the surface is marred it can be re-lapped. If the poppet will not be within the required limits after re-lapping it must be replaced. See the procedure, Sealing Head Maintenance.

8. Install the inlet poppet assembly

9. Inspect the assembled unit to ensure the poppet moves freely and the poppet retainer screw is seated.

Sealing Head Maintenance

The sealing head should be inspected for scratches, excessive sealing damage or erosion marking on the contact surface, and on the inlet poppet valve contact surface. If defects are detected, the surfaces must be refinished. The sealing head can be returned to KMT Waterjet for refinishing.

Place a piece of 600-grit wet/dry abrasive strip on the granite lapping block. Make sure there are no air bubbles between the abrasive sheet and the lapping block.

1. Lap the discharge poppet and gland nut as necessary. A minimum allowable thickness of 0.350" (8.890 mm) must be maintained on the insert. The minimum allowable length of the discharge poppet is 0.607" (15.418 mm).

NOTE

The discharge poppet requires only the use of a 600 grit wet/dry abrasive strip. Use of above 600 grit and lapping to a mirror-like surface may cause check valve sticking problems.

2. Use a figure eight pattern when lapping the inlet poppet and sealing head body. Finish with one straight pass, then rotate 90-degrees and do one more pass. This will give a crosshatch appearance.

   A minimum height of 0.365" (9.271 mm) must be retained on the shoulder of the inlet poppet face. A radius of 0.035" (0.889 mm) and a minimum thickness of 0.120: (3.048 mm) must also be maintained.

9.8 High Pressure Seal Assembly

The following procedure should be used to replace the high pressure seal assembly. The high pressure seal tool kit (P/N 20458926) will be required for this procedure.

Prior to removing electrical power or any high or low pressure piping, start the machine and extend the plunger on the end to be serviced to allow full exposure when the unit is disassembled.

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

WARNING

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

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

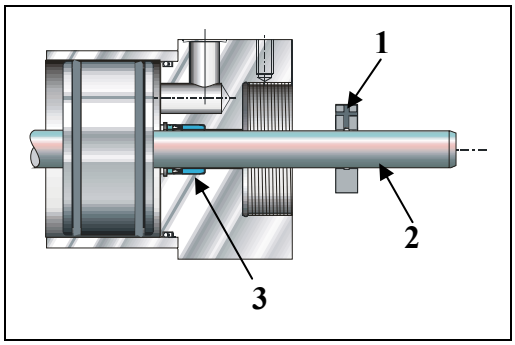
2. Disconnect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.

3. Remove the end cap and sealing head assembly, following the procedure, End Cap Removal.

4. Remove the high pressure cylinder, following the procedure, High Pressure Cylinder Removal.

5. Remove the seal buttress from the end bell. Wipe and clean surfaces, weep holes and grooves and check for cracks.

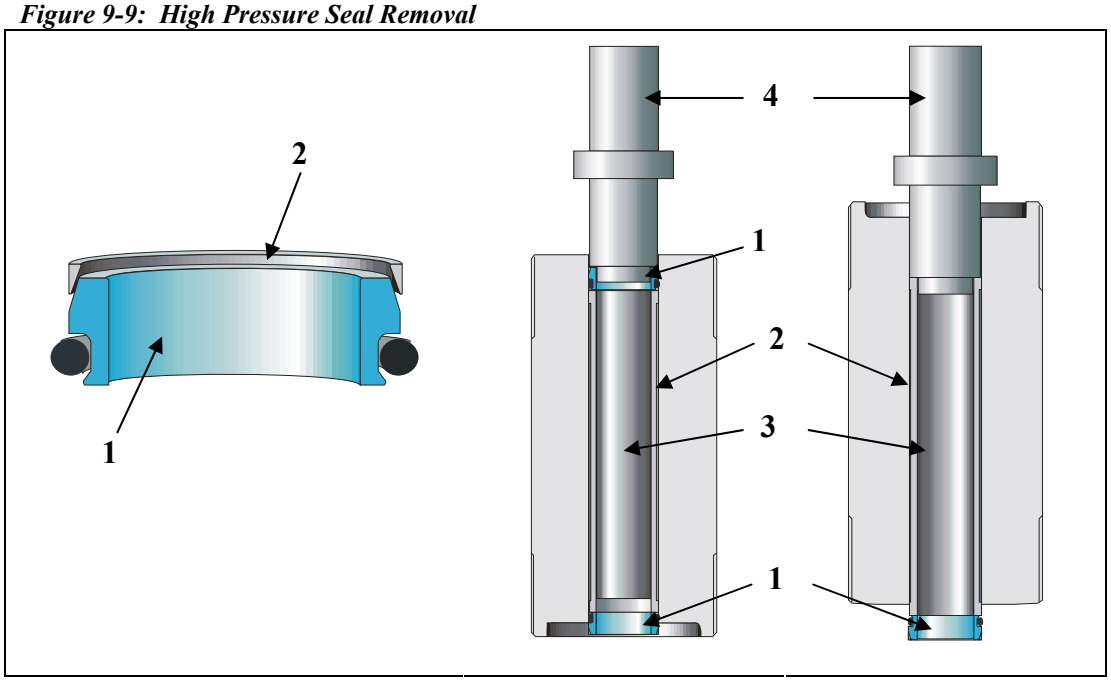
Figure 9-8: Seal Buttress Removal



1 Seal Buttress
2 Plunger
3 High Pressure Seal Assembly

6. Use the seal removal tool and a plastic faced mallet to remove the high pressure seal assembly and backup sleeve from both ends of the high pressure cylinder. Be careful not to scratch the cylinder bore.

Figure 9-9: High Pressure Seal Removal



1 High Pressure Seal Assembly
2 Backup Sleeve
3 High Pressure Cylinder
4 Seal Removal Tool

7. Inspect the backup sleeve for wear. Polish is necessary.

8. Clean and inspect the cylinder bore for obvious ridges or grooves. If seal debris is present, follow the procedure, High Pressure Cylinder Maintenance.

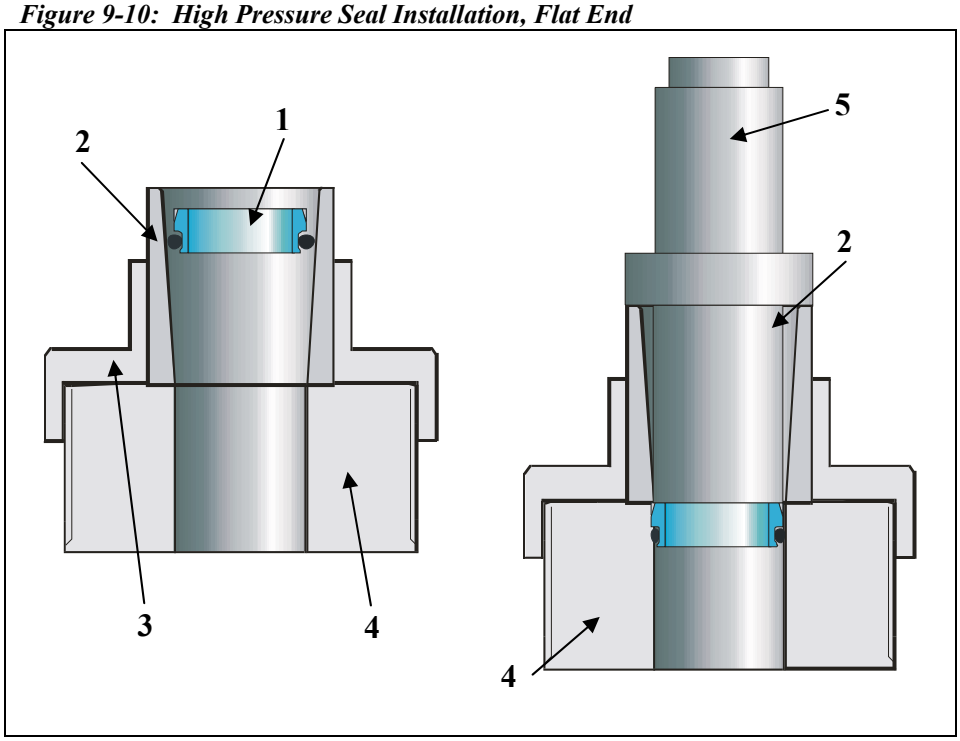
NOTE

The ends of the high pressure cylinder often show a 'step' between the backup sleeve and the high pressure seal where the two overlap by a small amount. This is normal and does not indicate a flaw in the cylinder.

9. Inspect the exposed surface of the plunger for scratches, surface discoloration or unusual contact markings. Replace the plunger if necessary.

10. Screw the adapter flange onto the flat end of the high pressure cylinder and place the tapered sleeve compressor into the flange with the largest ID facing out.

Figure 9-10: High Pressure Seal Installation, Flat End



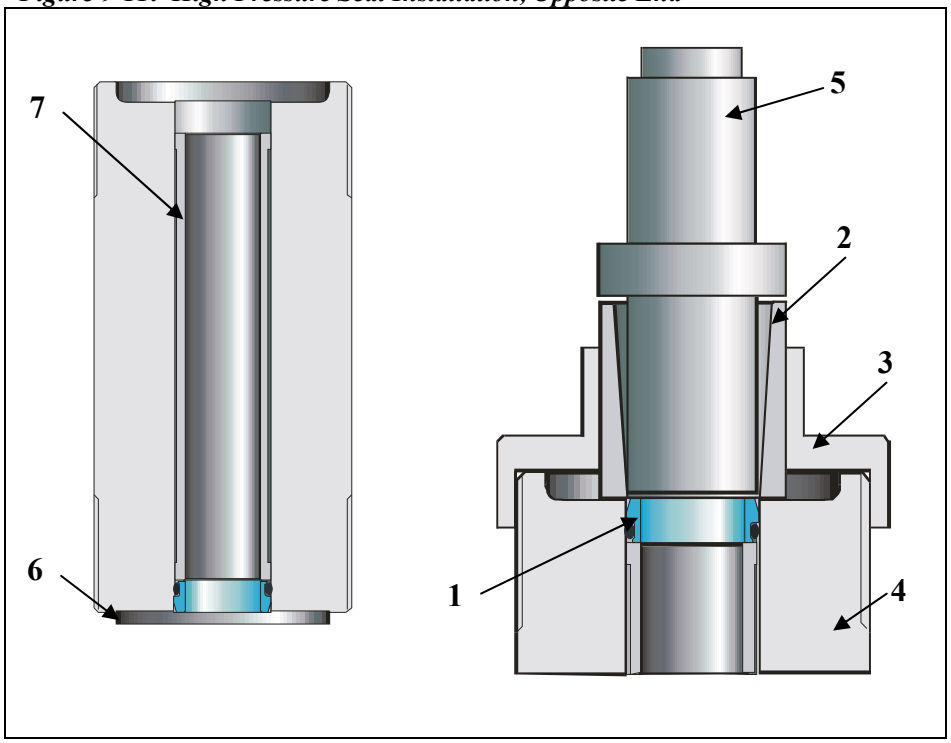
1 High Pressure Seal Assembly
2 Tapered Sleeve Compressor
3 Adapter Flange
4 High Pressure Cylinder
5 Seal Removal Tool

11. Apply food grade grease to the high pressure seal assembly and insert the assembly into the tapered sleeve with the o-ring facing in.

12. Use the seal plunger tool to push the seal assembly into the high pressure cylinder until it is flush with the end of the cylinder. A rubber mallet may be required to position the seal assembly correctly.

13. Unscrew the adapter flange from the high pressure cylinder, turn the cylinder over and place the flat end on the large aluminum spacer.

Figure 9-11: High Pressure Seal Installation, Opposite End



1 High Pressure Seal Assembly
2 Tapered Sleeve Compressor
3 Adapter Flange
4 High Pressure Cylinder
5 Seal Removal Tool
6 Spacer
7 Backup Sleeve

14. Apply food grade grease to the backup sleeve and slide the sleeve into the high pressure cylinder.

15. Screw the adapter flange onto the end of the high pressure cylinder and place the tapered sleeve compressor into the flange with the largest ID facing out.

16. Apply food grade grease to the high pressure seal assembly and to the inside of the sleeve and insert the assembly into the tapered sleeve with the o-ring facing in.

17. Use the seal plunger tool to push the seal assembly into the high pressure cylinder until it is flush with the end of the cylinder.

18. Install the seal buttress.

19. Install the high pressure cylinder, following the procedure, High Pressure Cylinder Assembly Installation.

20. Install the end cap and sealing head assembly, following the procedure, End Cap Installation.

21. Reconnect the high and low pressure water piping and turn the low pressure water supply on.

9.9 Hydraulic Seals

The intensifier assembly fixture is required for this procedure. The fixture is used during the reassembly process to square the end bells with each other and to minimize the possibility of o-ring damage as the cylinder is being drawn onto the end bells. When the end bells are assembled out of alignment, oil manifold leakage and breakage may occur.

Prior to removing electrical power or any high or low pressure piping, start the machine and extend the plunger on the end to be serviced to allow full exposure when the unit is disassembled.

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

WARNING

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

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

2. Disconnect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.

3. Remove the end cap and sealing head assembly, following the procedure, End Cap Removal.

4. Remove the high pressure cylinder, following the procedure, High Pressure Cylinder Removal.

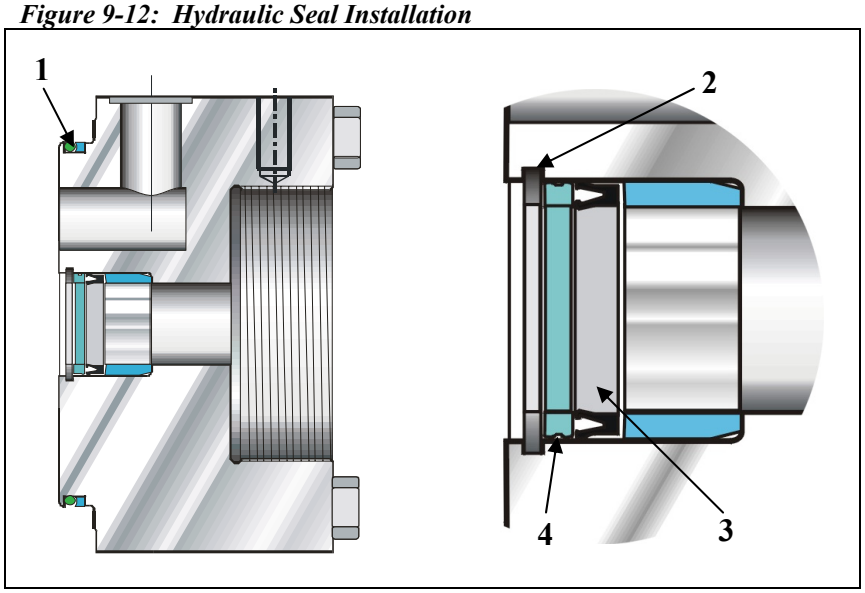
5. Remove the proximity switch on the end of the hydraulic cylinder to be serviced. Remove the opposite proximity switch to drain hydraulic oil into the reservoir if both ends of the hydraulic cylinder are to be serviced.

6. Remove the lock nuts and then remove the tie rods retaining the end bells to the hydraulic cylinder. Remove the end bell.

NOTE

The bore of the hydraulic cylinder should be inspected for wear grooves and surface finished whenever the end bells are removed. Excessive grooving on the bore is indicative of piston seal wear.

Figure 9-12: Hydraulic Seal Installation



1 Low Pressure Seal Assembly
2 Snap Ring
3 Hydraulic Seal Assembly
4 Hydraulic Seal Spacer

7. Remove the snap ring and the hydraulic seal spacer from the end bell.

8. Remove the hydraulic seal assembly from the inside of the end bell and remove the low pressure seal assembly from the outside.

9. Apply FML-2 food grade grease to the new hydraulic and low pressure seal assemblies and install.

10. Position the end bell, apply JL-M grease to the threads on the tie rods and install the tie rods and lock nuts. Torque the nuts to the specifications in Table 8-1.

11. Apply JL-M grease to the screw threads and install the proximity switch(s). Torque the screws to the specifications in Table 8-1.

CAUTION

It is recommended that the proximity switch be reinstalled as soon as practical. Removal of the switch presents the potential of an oil spray hazard.

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

9.10 Hydraulic Piston and Plunger Service

The following procedures are used to remove, repair and install the hydraulic piston and plunger.

Hydraulic Piston and Plunger Removal

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

WARNING

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

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

2. Disconnect the high and low pressure water piping, following the procedure, High and Low Pressure Water Piping.

3. Remove the end cap and sealing head assembly, following the procedure, End Cap Removal.

4. Remove the high pressure cylinder, following the procedure, High Pressure Cylinder Removal.

5. Remove the proximity switches on the each end of the hydraulic cylinder to drain the hydraulic oil into the reservoir.

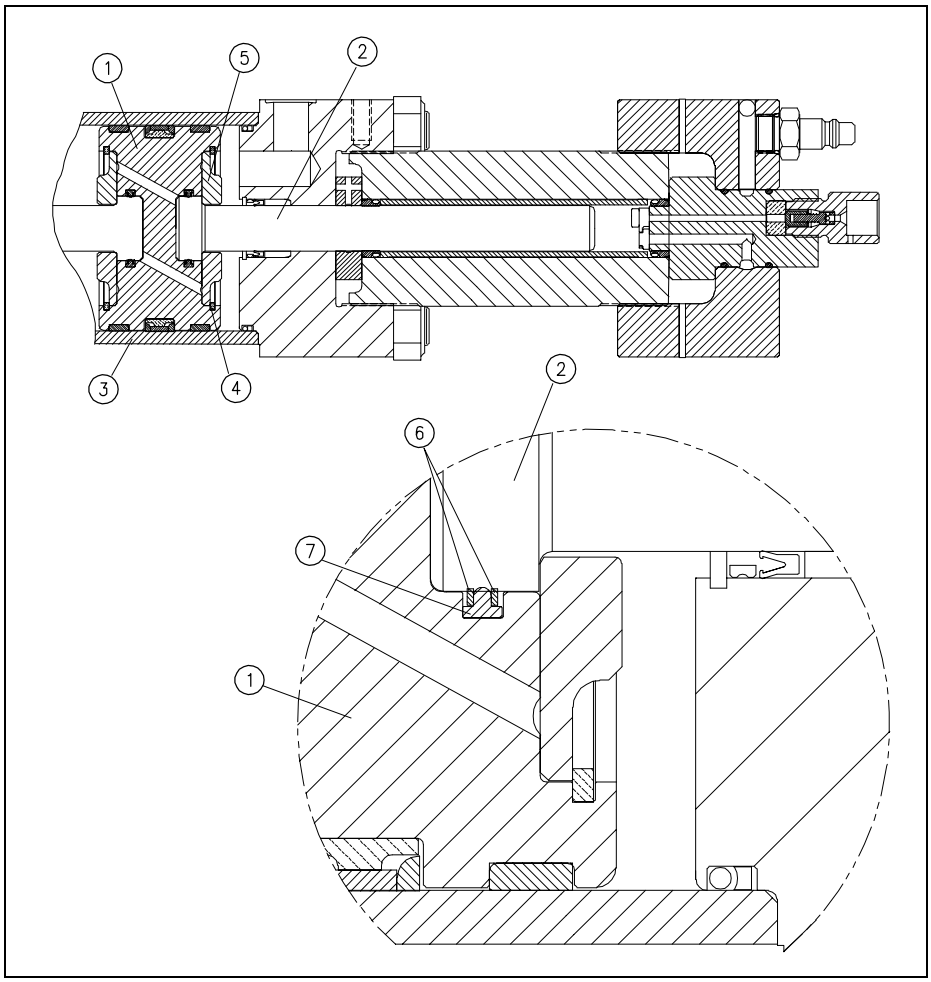
6. Remove the lock nuts and then remove the tie rods retaining the end bells to the hydraulic cylinder. Remove both end bells.

NOTE

The bore of the hydraulic cylinder should be inspected for wear grooves and surface finished whenever the end bells are removed. Excessive grooving on the bore is indicative of piston seal wear.

7. Remove the hydraulic piston and plungers from the hydraulic cylinder. If the piston must be driven out of the cylinder due to seal squeeze and friction, us a plastic headed hammer to avoid striking the assembly with a metal object.

Figure 9-13: Plunger Removal



1 Hydraulic Piston
2 Plunger
3 Hydraulic Cylinder
4 Snap Ring
5 Plunger Retainer
6 Backup Ring
7 Plunger Seal

8. Remove the snap ring and the plunger retainer. The retainer can be loosened by blowing air into one of the four openings in the retainer. Remove the plunger by hand.

9. Repeat Step 8 to remove the other plunger.

10. Remove the backup rings from each side of the piston using a non-metallic tool to prevent scratching or scoring the piston.

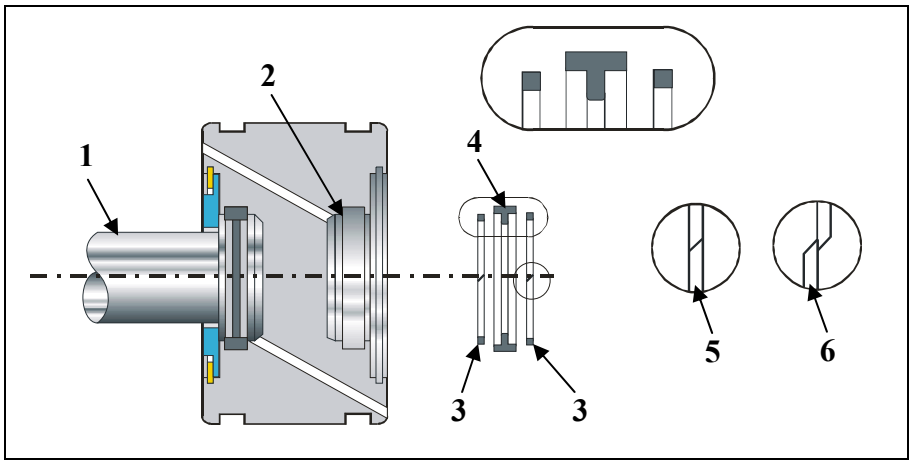
11. Remove the plunger seals from each side of the piston.

12. Clean off parts of the piston assembly. Ensure all oil, dirt and burrs are removed from all surfaces.

Plunger Installation

1. Apply Parker O-Lube to the backup rings and plunger seals. Install two backup rings and one plunger seal in each piston groove. The plunger seal must be positioned between the backup rings.

Figure 9-14: Plunger Seal Installation



1 Plunger	4 Plunger Seal
2 Grooves	5 Correct
3 Backup Ring	6 Incorrect

2. Install the plungers in the counter-bores in the piston with a turning motion. Ensure the plunger seal and backup rings do not get nicked or rolled.

3. Slide the plunger retainers over the plungers with the large end facing the piston. Install the snap rings to secure the plungers.

Hydraulic Piston Installation

The center band on the piston consists of four parts. There are two nylon backup rings, an inner energized ring and an outer Teflon cap ring. Two bearing rings are installed in the outer band on the piston.

1. Remove the old piston seals.

CAUTION

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

2. Inspect the seal groove bottom for marks or scratches and residue buildup. Clean and/or repair the groove surfaces as required.

3. Carefully slide inner energized ring over the piston until it rest in the center slot. Use a mandrel and finger sleeve to stretch the Teflon cap ring over the piston. The Teflon cap ring must be centered on top of the energized ring.

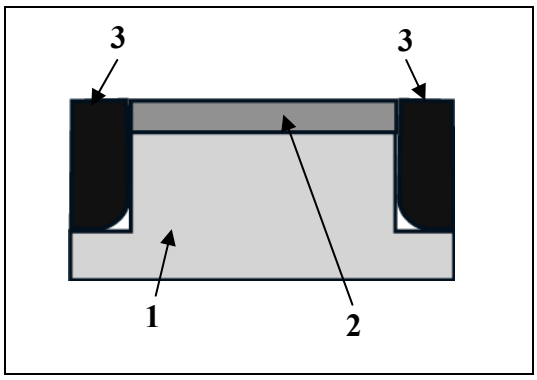
NOTE

Heating the Teflon cap ring in 150-200° F (65-90° C) water for 2-3 minutes will soften the ring enough to facilitate installation.

The Teflon cap ring must be resized using a ring compressor for at least three minutes so it will fit in the hydraulic cylinder.

4. Install the nylon backup rings on each side of the Teflon cap ring with the curved inside edge facing the cap.

Figure 9-15: Center Band Component Installation



1 Energized Ring
2 Teflon Cap Ring
3 Nylon Backup Ring

5. Install the bearing rings in the outside slots in the piston. Rotate the bearing rings so the end joints do not line up.

6. Inspect the hydraulic cylinder for scratches, burrs or gouges to ensure it is suitable for use.

7. Lubricate the cylinder bore and the piston assembly with hydraulic oil.

8. Use a ring compressor to contain the bearing rings and plunger seal assemblies.

9. Push the piston assembly into the hydraulic cylinder bore.

10. Remove the ring compressor and continue to drive the piston assembly into the cylinder until it is approximately centered in the cylinder.

11. Install the plungers, following the procedure, Plunger Installation.

12. Position the end bells, apply JL-M grease to the threads on the tie rods and install the tie rods and lock nuts. Torque the nuts to the specifications in Table 8-1.

CAUTION

The intensifier assembly fixture must be used to ensure the end bells are aligned during the assembly process.

13. Apply JL-M grease to the screw threads and install the proximity switches. Torque the screws to the specifications in Table 8-1.

CAUTION

It is recommended that the proximity switch be reinstalled as soon as practical. Removal of the switch presents the potential of an oil spray hazard.

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

14. Install the high pressure cylinder, following the procedure, High Pressure Cylinder Assembly Installation.

15. Install the end cap and sealing head assembly, following the procedure, End Cap Installation.

16. Reconnect the high and low pressure water piping and turn the low pressure water supply on.

9.11 Hydraulic Cylinder Maintenance

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

9.12 Plunger Maintenance

Plunger surfaces can become streaked with longitudinal scratches or flaws, and discolored or dull in appearance; or the outboard end can become smeared with stainless steel due to contact with the backup sleeve. If any of these conditions become severe, the high pressure seal assembly and possibly the hydraulic seals will leak.

Plunger surface flaws usually cannot be repaired on site. The plunger can be returned to KMT Waterjet for reconditioning.

9.13 High Pressure Attenuator

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

9.14 High Pressure Dump Valve

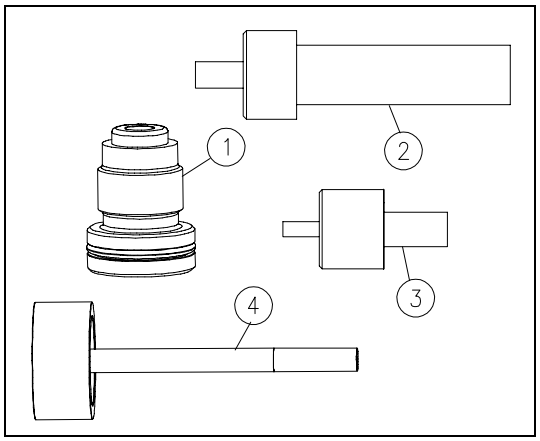
The high pressure dump valve assembly includes a normally open high pressure water valve and a solenoid operated air valve. The following procedures are recommended for servicing the high pressure dump valve. Failure to follow these procedures will cause damage to the stem, valve seat, or both.

WARNING

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

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

Figure 9-16: Pneumatic Valve Seal Tools



1 Seal Installation Tool (20470417)

2 Seal Positioning Tool (05067350)
2-Port Dump Valve

3 Seal Positioning Tool (49833114)
3-Port Dump Valve

3 Seal Push Tool (20470413)
Seal Tool Kit (20470475)

Pneumatic Control Dump Valve

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

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

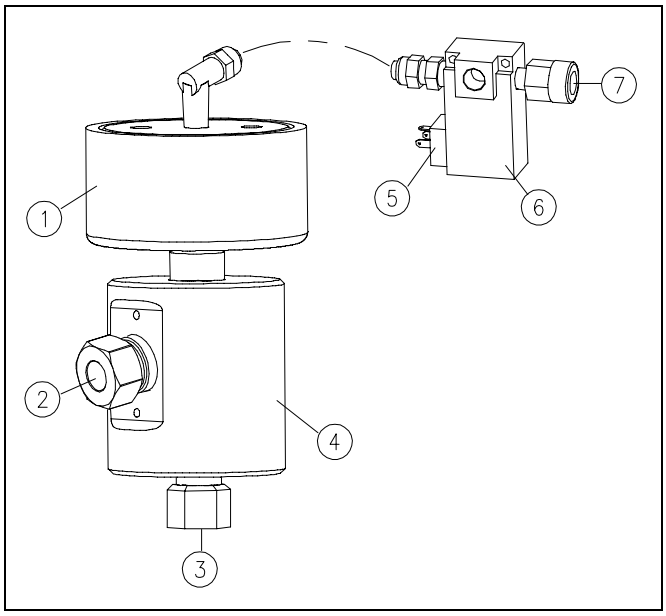
WARNING

Severe injury can result if the machine is not properly locked out. Observe electrical Lock Out/Tag Out procedures before proceeding.

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

1. Turn the air supply off.
2. Remove the air supply hose, and the electrical connection to the solenoid valve.

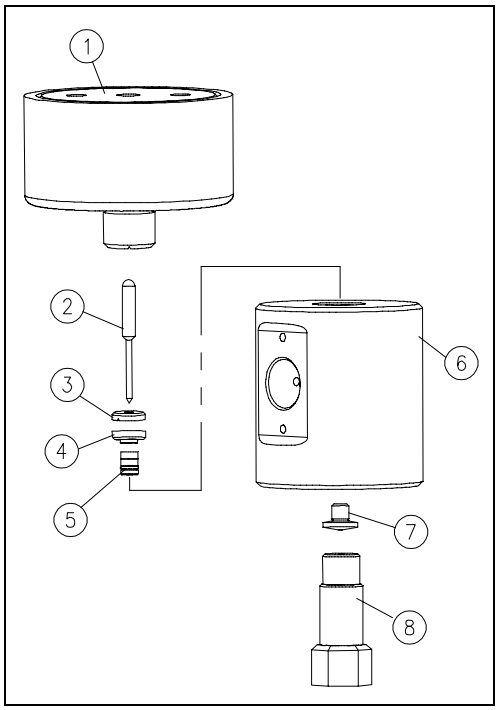
Figure 9-17: High Pressure Dump Valve



1 Pneumatic Actuator
2 HP Water Out to Cutting Head
3 Out to Drain
4 Valve Assembly
5 Signal
6 Solenoid Valve
7 Control Air In

3. Loosen and remove the high pressure gland connections and the drain connection.
4. Remove the valve and actuator assembly from the machine.

Figure 9-18: Dump Valve Components



1	Pneumatic Actuator	5	Seal Assembly
2	Stem	6	Valve Body
3	SST Backup Ring	7	Valve Seat
4	Brass Backup Ring	8	High Pressure Adapter

5. Loosen the cylinder head on the actuator. Unscrew and remove the actuator from the valve body.

6. Unscrew the high pressure adapter and remove the adapter and valve seat.

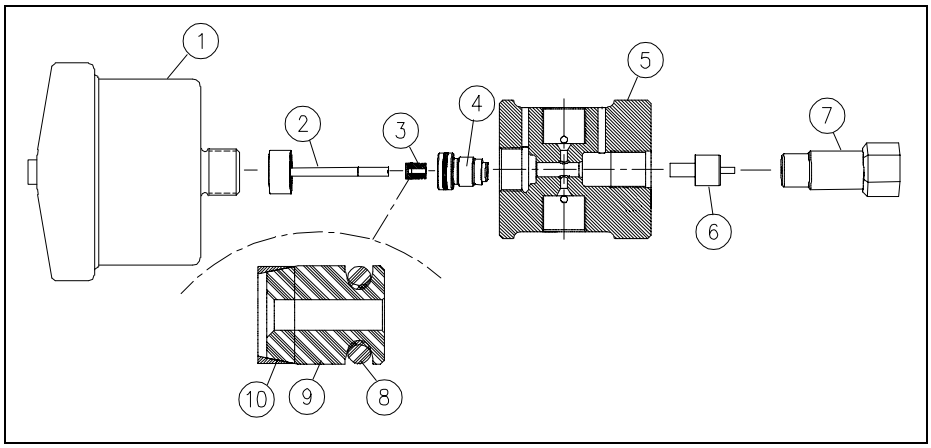
7. Remove the stem, SST backup ring and brass backup ring from the valve body.

8. Remove the seal assembly by pushing it with the seal push tool (P/N 20470413). **The assembly must be pushed out through the actuator port in the top of the valve body.**

9. **Discard** the stem, brass backup ring, seal assembly and valve seat.

10. Clean and inspect the valve body, being careful not to damage or scratch the bore.

Figure 9-19: Valve Seal Installation



1	Pneumatic Actuator	6	Seal Positioning Tool
2	Seal Push Tool	7	High Pressure Adapter
3	Seal Assembly	8	O-Ring
4	Seal Installation Tool	9	Seal
5	Valve Body	10	Bronze Wedge Ring

11. Place the seal positioning tool into the opposite end of the valve body as shown in Figure 9-19, Valve Seal Installation. Thread the high pressure adapter into the valve body until light contact is made with the positioning tool. **Tighten finger-tight only.**

12. Apply Pure Goop anti-seize compound to the threads on the seal installation tool. Screw the seal installation tool into the threads of the valve body. **Tighten finger-tight only.** See Figure 9-19, Valve Seal Installation.

13. Lubricate the new seal and o-ring with FML-2 food grade grease. Insert the seal, o-ring and bronze wedge ring into the seal installation tool, inserting the o-ring end of the seal first so the tapered end of the seal (wedge ring end) faces the actuator. The tapered end of the seal must face the actuator. See Figure 9-19, Valve Seal Installation.

14. Use the seal push tool to push the seal assembly into the bore of the valve body until the seal makes light contact with the seal positioning tool.

15. Remove the push tool and the installation tool from the valve body.

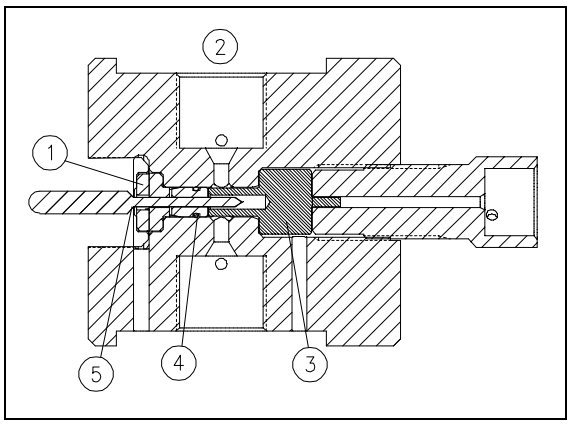
16. Install the existing SST backup ring and a new brass backup ring on a new stem. The vee groove on the SST backup ring must face toward the brass backup ring. The small OD of the brass backup ring must face toward the seal assembly. See Figure 9-18, Dump Valve Components.

17. Apply FML-2 grease to the tip of the stem and insert the stem with the backup rings into the top of the valve body so the stem enters the ID of the seal assembly. **Insert the stem until the chamfer on the stem is seated against the SST backup ring.** See Figure 9-20, Valve Stem Placement.

CAUTION

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

Figure 9-20: Valve Stem Placement



1 SST Backup Ring
2 Inlet Port
3 Seal Positioning Tool
4 Seal O-Ring
5 Stem Chamfer

18. Remove the high pressure adapter and the seal positioning tool.

19. Apply Pure Goop anti-seize compound to the threads of the actuator and carefully thread it into the valve body, guiding the stem head into the hole in the actuator. Turn the actuator clockwise until resistance is felt. Reverse the actuator 1/4-turn, and give it a quick spin clockwise to seat it. **Hand-tighten only, 5 ft-lbs (7 Nm)**.

20. Apply Pure Goop anti-seize compound to all surfaces, except the ID, of a new valve seat. Install the seat into the valve body, inserting the small OD first.

21. Apply anti-seize compound to the threads on the high pressure adapter. Install the adapter and torque to 25 ft-lbs (34 Nm).

22. Replace the 1/4-inch drain gland nut and collar and torque to 25 ft-lbs (34 Nm).

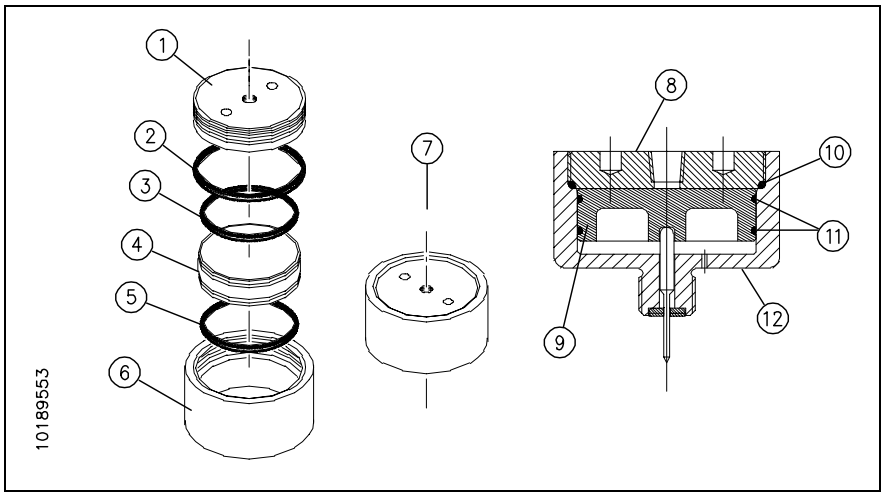
23. Apply anti-seize compound to the threads on the 3/8-inch high pressure gland fittings. Install the collar and the gland fittings and torque to 50 ft-lbs (68 Nm).

24. Install the air supply hose and the electrical connection to the solenoid valve. Turn the air pressure to the actuator on and test the valve for leaks and proper operation.

Pneumatic Actuator

The following procedure is used to service the pneumatic actuator.

Figure 9-21: Pneumatic Actuator



Normally Open Actuator - Air Pressure to Close

1	Cylinder Head	7	Control Air 1/8 Female NPT
2	O-Ring	8	Cylinder Head
3	O-Ring	9	Piston
4	Piston	10	O-Ring
5	O-Ring	11	O-Ring
6	Pneumatic Cylinder	12	Pneumatic Cylinder

1. Unscrew and remove the cylinder head. Remove the piston from the cylinder.

2. Remove the o-ring on the cylinder head. Apply FML-2 grease to a new o-ring and install.

3. Remove the two o-rings on the piston. Apply FML-2 grease to two new o-rings and install.

4. Install the piston in the pneumatic cylinder. Apply anti-seize compound to the threads on the cylinder head and screw it into the pneumatic cylinder.

SECTION 10
TROUBLESHOOTING

10.1 Overview

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

1. High oil temperature
2. Low oil level
3. Restricted or no cooling flow
4. Hydraulic pressure but no high pressure water pressure
5. No hydraulic oil pressure
6. Pump shaft will not turn
7. Pump will not start
8. Pump quits running
9. Abnormal fluctuations in high pressure water signal
10. Hot surfaces on the high pressure cylinder components
11. Low cutting water supply pressure
12. Oil pressure is satisfactory, but cutting water flow or pressure is low
13. Hydraulic oil leaking from the weep hole at the intensifier
14. Water leaking from the weep hole at the high pressure plunger seal
15. Water leaking from the weep hole at the high pressure sealing head seal

10.2 Troubleshooting Guide

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

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

KMT H2O Jet Troubleshooting Guide

	Malfunction	Indication	Comments
1.	High oil temperature	Cooling water flow is restricted	Check cooling water source for proper temperature and flow rate.
		Water modulating valve is stuck open or closed	Replace the valve.
		Scale build up in the heat exchanger has restricted the flow	The heat exchanger will need to be flushed or replaced.
2.	Low oil level		Check the level gauge.
			Check for hydraulic leaks.
			Check the level switch.
3.	Restricted or no cooling flow	Check cooling water flow to and from the heat exchanger	The water pressure differential across the heat exchanger requires a minimum of 35 psi (2.4 bar) for flow through the exchanger.
		Water modulating valve is stuck or out of adjustment	Replace the valve.
			Adjust the valve.
4.	Hydraulic pressure but no high pressure water pressure	Proximity switch failure	Jog the intensifier left and right and verify that the red light comes on at both proximity switches.
		Coil failure on the directional control valve	Check the coils on the directional valve with a volt meter to verify if they are good or bad.
5.	No hydraulic oil pressure	The high and low limit compensators on the hydraulic pump are blocked with debris	Disassemble the compensators, clean and inspect the components.
		Incorrect motor rotation	Check the motor rotation.
6.	Pump shaft will not turn	Hydraulic pump has seized	Replace the hydraulic pump.

KMT H2O Jet Troubleshooting Guide

	Malfunction	Indication	Comments
7.	Pump will not start	Emergency stop button is depressed	Check all remote E-STOP buttons.
		Main power is disconnected	Check the main power and verify that the main power disconnect is on.
8.	Pump quits running	Electrical power has been interrupted	Check the power supply circuit for a tripped breaker.
			Verify that power is available at the main power source.
9.	Abnormal fluctuations in high pressure water signal	Large, worn or damaged orifice	Make sure the orifice does not exceed the capacity of the pump.
			Make sure the orifice is in good working condition. Verify that the jewel is installed in the orifice mount.
		Piping leaks	Check system components for leaks, including the dump valve connection.
		Check valve leakage	Inspect the discharge check valves in the sealing heads.
			Inspect the inlet check valves in the sealing heads.
		Seal leakage	Inspect the high pressure seal at the plunger.
			Inspect the high pressure seal at the sealing head.
		Hydraulic control malfunction	Check the operation of the hydraulic relief valve.
			Verify that the directional control valve is shifting properly.
			Check the operation of the proximity switches.

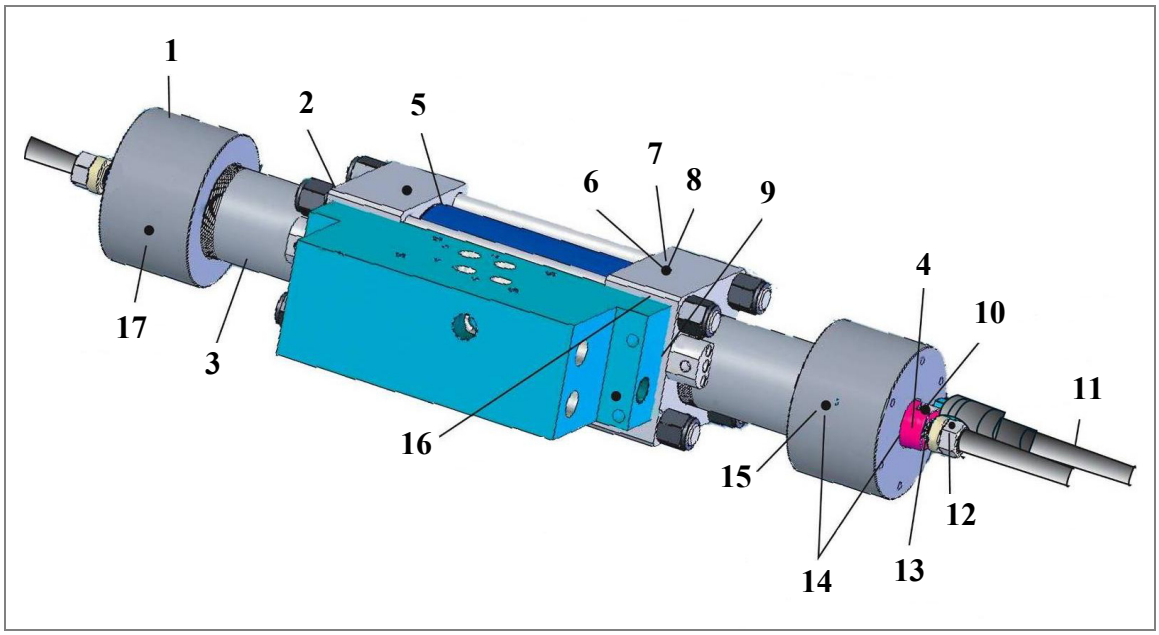
KMT H2O Jet Troubleshooting Guide

	Malfunction	Indication	Comments
10.	Hot surfaces on the high pressure cylinder components	Leaking discharge check valve	Inspect the condition of the seat, poppet valve, spring, and guide.
		Leaking inlet check valve	Inspect the condition of the poppet valve and poppet retainer.
		Worn plunger	Check the high pressure seal at the plunger and check the plunger for wear. Replace if necessary.
		Damaged high pressure cylinder	Check the high pressure cylinder for cracks or damage.
11.	Low cutting water supply pressure	Restricted water supply	Check cutting water supply flow and pressure.
		Clogged strainer	Check the strainer and clean if necessary.
12.	Oil pressure is satisfactory, but cutting water flow or pressure is low	Low hydraulic pressure setting	If operating in low pressure, switch to high pressure operation and check the hydraulic pressure setting.
		Restricted or no cutting water supply	Check the cutting water supply flow and pressure.
		Leak in high pressure water lines	Inspect fittings for leakage and torque to the specified values.
		Worn hydraulic piston seals	Replace the piston seals. Replacing all hydraulic oil seals at the same time is recommended.
		Excessive demand for high pressure water	Reduce demand to rated output.
		Worn check valves	Repair the check valves.
		Leaking high pressure seals	Replace the seals.

KMT H2O Jet Troubleshooting Guide

	Malfunction	Indication	Comments
13.	Hydraulic oil leaking from the weep hole at the intensifier		Check the hydraulic cylinder o-ring for leakage.
			Check the proximity switch area for oil leakage.
			Check the hydraulic oil seal and clean or replace as necessary.
14.	Water leaking from the weep hole at the high pressure plunger seal	Worn high pressure plunger seal	Replace the high pressure seal assembly.
		Damaged plunger	If the leak is greater than 1 drop in 10 strokes, check the plunger.
		Damaged high pressure cylinder	Check for the scratches, grooves or material buildup on the inside diameter of the high pressure cylinder. Replace if damage is detected.
15.	Water leaking from the weep hole at the high pressure sealing head seal	Worn high pressure sealing head seal	Check the seal assembly
		Damaged high pressure cylinder	Check for the scratches, grooves or material buildup on the inside diameter of the high pressure cylinder. Replace if damage is detected.

Figure 10-1: Troubleshooting Guide



1.	End Cap	
2.	End Bell	
3.	High Pressure Cylinder	
4.	Discharge Check Valve	
5.	Hydraulic oil	Pinched or failed o-ring or incorrectly torque tie rod
6.	Hydraulic oil	Failed oil seal
7.	Cold water	Failed o-ring on high pressure plunger seal
8.	Hot water	Failed high pressure plunger seal or high pressure cylinder
9.	Hydraulic oil	Improperly torque, pinched or failed o-ring
10.	Hot water	Loose discharge gland
11.	Pulsing warm water	Leaking inlet check valve
12.	Hot water	Leaking discharge check valve
13.	Hot water	Loose gland nut or failed cone or seat
14.	Cold water	Failed inlet water o-ring
15.	Cold water	Failed o-ring on high pressure sealing head seal
16.	Hydraulic oil	Incorrect torque or end bell alignment, possible failed o-ring
17.	Hot water	Failed high pressure sealing head seal or high pressure cylinder

SECTION 11
SPECIFICATIONS

11.1 Overview

Comprehensive listings of specifications for the KMT H2O Jet are provided in this section.

Table 11-1
KMT H2O Jet

Model	Motor Horsepower Rating	
	HP	Kw
KMT H2O Jet	50	37

11.2 Installation Specifications

Environment

Installation location	Indoors
Air borne dust/contaminants	Minimal
Ambient temperature	
Minimum storage	36 F (2 C)
Minimum operating	40 F (5 C)
Maximum operating	104 F (40 C)
Maximum relative humidity* *(at maximum operating temperature)*	95%

***Note:** When the relative humidity is above 50%, the oil in the reservoir should be checked frequently for water content.

Sound Level

Sound level with optional side panels	75.0 [dB(A)]

Equipment Dimensions and Weights

Length	Width	Height	Weight
58.00” (1,473 mm)	47.44” (205 mm)	41.64” (1,058 mm)	2,260 lbs (1,025 kg)

Service Connections

		Connection	Height
A	Drain	1/2” BSPT	10.26” (260 mm)
B	Cutting Water In	1/2” BSPT	14.26” (362 mm)
C	Cooling Water Out	1/2” BSPT	18.26” (464 mm)
D	Cooling Water In	1/2” BSPT	22.26” (565 mm)
E	Cutting Water Out	9/16” HP	30.26” (768 mm)
F	Plant Air In	1/4” BSPT	35.39” (899 mm)

Plant Air

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

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

Table 11-2
ISO Air Quality Classifications

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

11.3 Water Specifications

Cutting Water Supply (Low Pressure Water System)

Maximum consumption	4.0 gpm (15.1 L/min)
Minimum inlet water pressure	35 psi (2.4 bar) flowing
Maximum inlet water pressure	100 psi (6.9 bar)
Optimum inlet water temperature	65 F (18 C)
Maximum inlet water temperature	85 F (29 C)
Low inlet water pressure	30 psi (2 bar)

Cooling Water Supply (Recirculation System)

Maximum consumption at 75 F (24 C)	3.0 gpm (11.4 L/min)
Total heat rejection	8.6 HP (6.4 kW)
Reservoir capacity	30 gal (114 L)
Low oil level shutdown	21 gal (79 L)
Minimum operating oil temperature	60 F (15 C)
Optimum operating oil temperature	115 F (46 C)
Hot oil shutdown (maximum operating oil temperature)	144 F (62 C)
Minimum inlet cooling water pressure	35 psi (2.4 bar)
Maximum inlet cooling water pressure	100 psi (6.9 bar)
Oil filtration rating (Beta filtration rating)	$B_7 \geq 1000$*
Fluid cleanliness rating (ISO fluid cleanliness rating))	17/14**
Nominal recirculation pressure	30 psi (2 bar)
Recommended oil type	
General service	Mobil DTE 26, Grade 68
	Conoco Hydroclear ™ multi-purpose R&O
Food service	Fuchs/Geralyn AW68 Food Grade Oil

***Note:** For each particle per milliliter downstream of the filter greater than 7 microns, there are 1000 particles per milliliter larger than 7 microns upstream of the filter.

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

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

14 <160 particles per milliliter, >15 microns

Water Quality Standards

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

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

Table 11-3
Water Quality Standards

Constituent (mg/l)	Minimum Requirement	Better	Best
Alkalinity	50	25	10
Calcium	25	5	0.5
Chloride	100	15	1
Free Chlorine	1	1	0.05
Iron	0.2	0.1	0.01
Magnesium as Mg	0.5	0.1	0.1
Manganese as Mn	0.1	0.1	0.1
Nitrate	25	25	10
Silica	15	10	1
Sodium	50	10	1
Sulfate	25	25	1
TDS*	200	100	35**
Total Hardness	25	10	1
pH	6.5-8.5	6.5-8.5	6.5-8.5
Turbidity (NTU)	5	5	1

Note: Total dissolved solids

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

Table 11-4
Water Impurities

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

11.4 Electrical Specifications

Electrical System

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

Ampacity and Power Voltage Requirements

Power Voltage	Motor Horsepower	Full Load Amps	Circuit Breaker Amps
380/3/50	50	69	100

11.5 Hydraulic and High Pressure System Specifications

Hydraulic System

Maximum operating pressure	2,750 psi (190 bar)
Main system relief valve	3,408 psi (235 bar)

High Pressure Water System

Maximum flow rate	
60,000 psi (4,137 bar)	1.0 gpm (3.8 L/min)
Plunger diameter	0.875” (22 mm)
Piston diameter	4.00” (101.64 mm)
Intensification ratio	19.9:1
Minimum outlet pressure	10,000 psi (689 bar)
Maximum outlet pressure	60,000 psi (4,137 bar)
Pneumatic Control Valve	
Maximum water pressure	60,000 psi (4,137 bar)
Regulated air pressure	85 psi (5.9 bar)
Maximum flow rate	1.0 cfm (0.028) m^3/min

Orifice Capacity

The following tables provide horsepower requirements for some of the more popular orifices.

Table 11-5
Single Orifice Diameter

Model	Motor Horsepower Rating		Maximum Operating Pressure	Maximum Single Orifice Diameter (*at full pressure*)
	HP	Kw		
H2O Jet	50	37	60,000 psi (4,137 bar)	0.014 inch (0.36 mm)

Table 11-6
Horsepower Requirements

Orifice Size inches (mm)	45,000 psi (3,103 bar)	50,000 psi (3,447 bar)	55,000 psi (3,792 bar)	60,000 psi (4,137 bar)
0.003 (0.076)	1.7	2.0	2.3	2.6
0.004 (0.102)	3.0	3.5	4.0	4.6
0.005 (0.127)	4.6	5.4	6.2	7.1
0.006 (0.152)	6.7	7.8	9.0	10.2
0.007 (0.178)	9.1	10.6	12.2	13.9
0.008 (0.203)	11.8	13.9	16.0	18.2
0.009 (0.229)	15.0	17.5	20.2	23.0
0.010 (0.254)	18.5	21.6	25.0	28.5
0.011 (0.279)	22.4	26.2	30.2	34.4
0.012 (0.305)	26.6	31.2	36.0	41.0
0.013 (0.330)	31.2	36.6	42.2	48.1
0.014 (0.356)	36.2	42.4	48.9	55.8
0.015 (0.381)	41.6	48.7	56.2	64.0
0.016 (0.406)	47.3	55.4	63.9	72.8
0.017 (0.432)	53.4	62.6	72.2	82.2
0.018 (0.457)	59.9	70.1	80.9	92.2

The horsepower requirements for operating multiple orifices are determined by adding the requirements in Table 11-6 for each orifice. Examples are shown below.

Orifice Size inches (mm)	Number of Orifices	Operating Pressure	Calculation	Total Horsepower
0.005 (0.127)	3	55,000	3 x 6.2	18.6
0.012 (0.305) 0.009 (0.229)	1 1	50,000	31.2 + 17.5	48.7

Torque Specifications

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

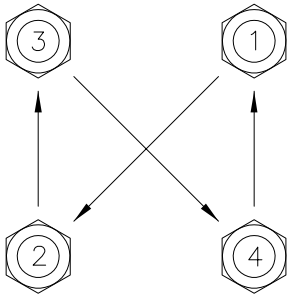
WARNING

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

Torque Specifications

End Bell Lock Nuts	
1st Stage	Finger-tight
2nd Stage	40 ft-lbs (27 Nm) Crossing Pattern
3rd Stage	60 ft-lbs (43-47 Nm) Crossing Pattern
4th Stage	80 ft-lbs (43-47 Nm) Crossing Pattern
5th Stage	100 ft-lbs Crossing Pattern
6th Stage	120 ft-lbs Crossing Pattern

Crossing Pattern



Torque Specifications

Proximity Switch	
Torque	140-160 in-lbs (16-18 Nm)
Sealing Head	
Discharge Gland Nut	30-50 ft-lbs (41-67 Nm)
Pneumatic Control Valve	
3/8-inch HP Gland	50 ft-lbs (68 Nm)
1/4-inch Outlet to Drain	25 ft-lbs (34 Nm)
Pneumatic Actuator	5 ft-lbs (7 Nm)
HP Adapter	25 ft-lbs (34 Nm)
High Pressure Fittings	
1/4” HP Gland Nut	25 ft-lbs (34 Nm)
3/8” HP Gland Nut	50 ft-lbs (68 Nm)
9/16” HP Gland Nut	110 ft-lbs (149 Nm)

SECTION 12
PARTS LIST

12.1 Overview

This section contains a comprehensive list of all parts for the KMT H2O Jet 50. To facilitate the ordering of replacement parts, item numbers in each table correspond to the identifying numbers in the accompanying figures.

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

USA

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

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

Europe

Spare Parts Manager
KMT Waterjet Systems GmbH
Wasserstrahl Schneidetechnik
Auf der Laukert 11
D-61231 Bad Nauheim
Germany

Phone +49-6032-997-119
Fax +49-6032-997-271
Email order.spares@kmt-waterjet.com

12.2 Index

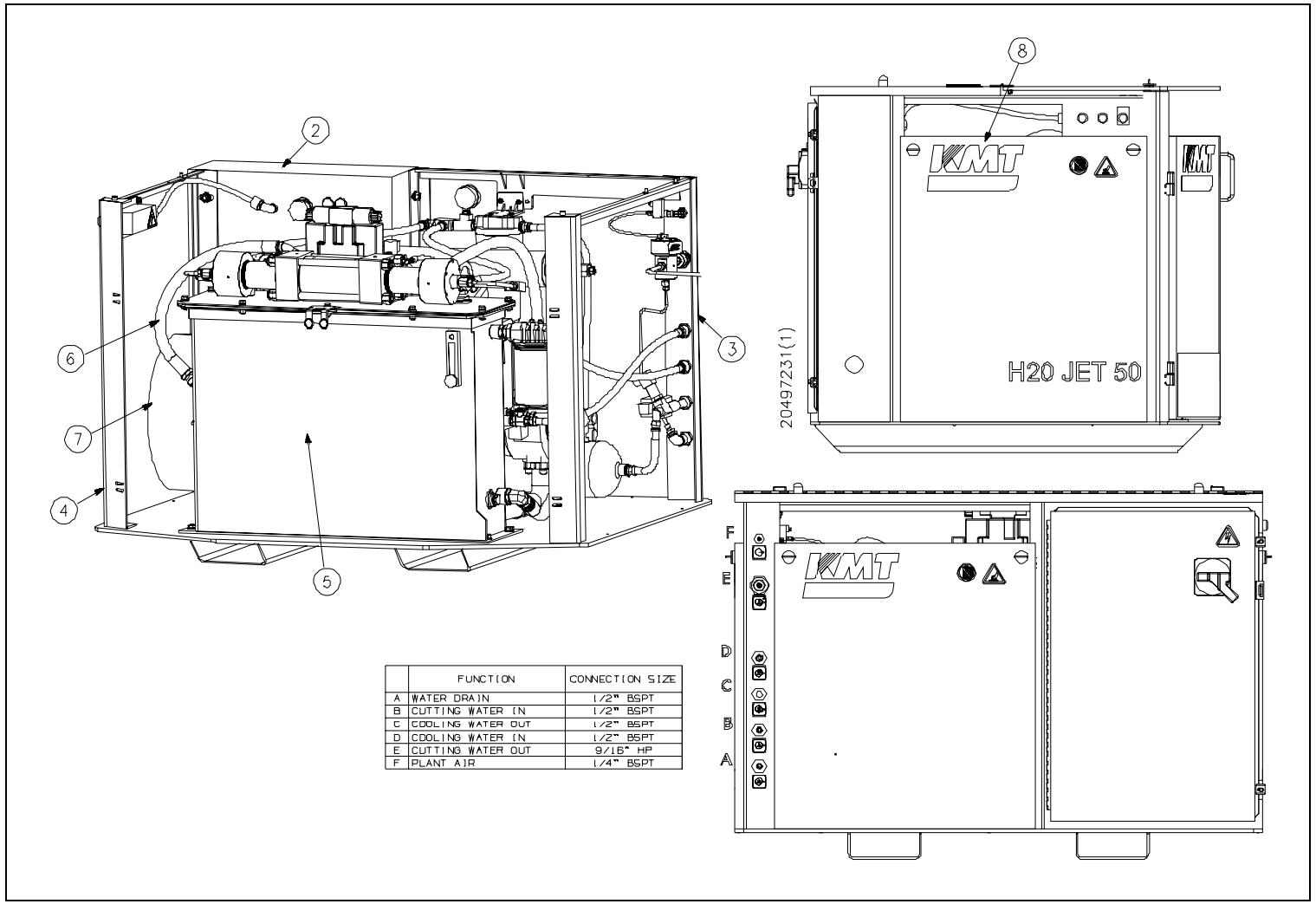
Part lists are arranged in the following sequence.

Parts List Index

Table 12-1
KMT H2O Jet 50 Intensifier Unit

Item	Part Number	Description	Quantity
1	20497330	High Pressure Piping	1
2	72102411	Electrical Assembly	1
3	20497372	Bulkhead Pipe Assembly	1
4	20498074	Frame Assembly	1
5	20498197	Reservoir Assembly	1
6	20497379	Hydraulic Hose Connections	1
7	20497413	Hydraulic Power Package	1
8	20497395	Decal Package	1

Figure 12-1: KMT H2O Jet 50 Intensifier Unit



	FUNCTION	CONNECTION SIZE
A	WATER DRAIN	1/2" BSPT
B	CUTTING WATER IN	1/2" BSPT
C	COOLING WATER OUT	1/2" BSPT
D	COOLING WATER IN	1/2" BSPT
E	CUTTING WATER OUT	9/16" HP
F	PLANT AIR	1/4" BSPT

Table 12-2
Intensifier Assembly
20458728

Item	Part Number	Description	Quantity
1	20458305	End Cap	2
2	20457399	High Pressure Cylinder	2
3	20458299	End Bell, LH	1
4	20458302	End Bell, RH	1
5	20458191	Tie Rod	4
6	20460489	Hex Nut	8
7	20457414	Hydraulic Cylinder	1
8	20458161	Backup Sleeve	2
9	20458773	Rebuild Kit, High Pressure Seal Assembly	1
	20457990	Seal Buttress	
	20458113	High Pressure Seal	
	20457393	Seal Hoop	
	20460108	O-Ring	
10	20458797	Rebuild Kit, Hydraulic Seal Assembly	1
11	20457912	Plunger	2
12	20458062	Plunger Retainer	2
13	20458869	Hydraulic Piston Assembly	1
	20457966	Hydraulic Piston	
	20458821	Rebuild Kit, Piston Rings	
	20460216	Seal	
14	20458170	Spacer, Hydraulic Seal	2
15	20458908	Sealing Head Assembly	2
16	20460252	Snap Ring	2
17	05202930	Snap Ring	2
18	20457267	Inlet Water Nipple	2
	20457159	Adapter, Quick Disconnect	
	20459025	O-Ring, Quick Disconnect	

Figure 12-2: Intensifier Assembly

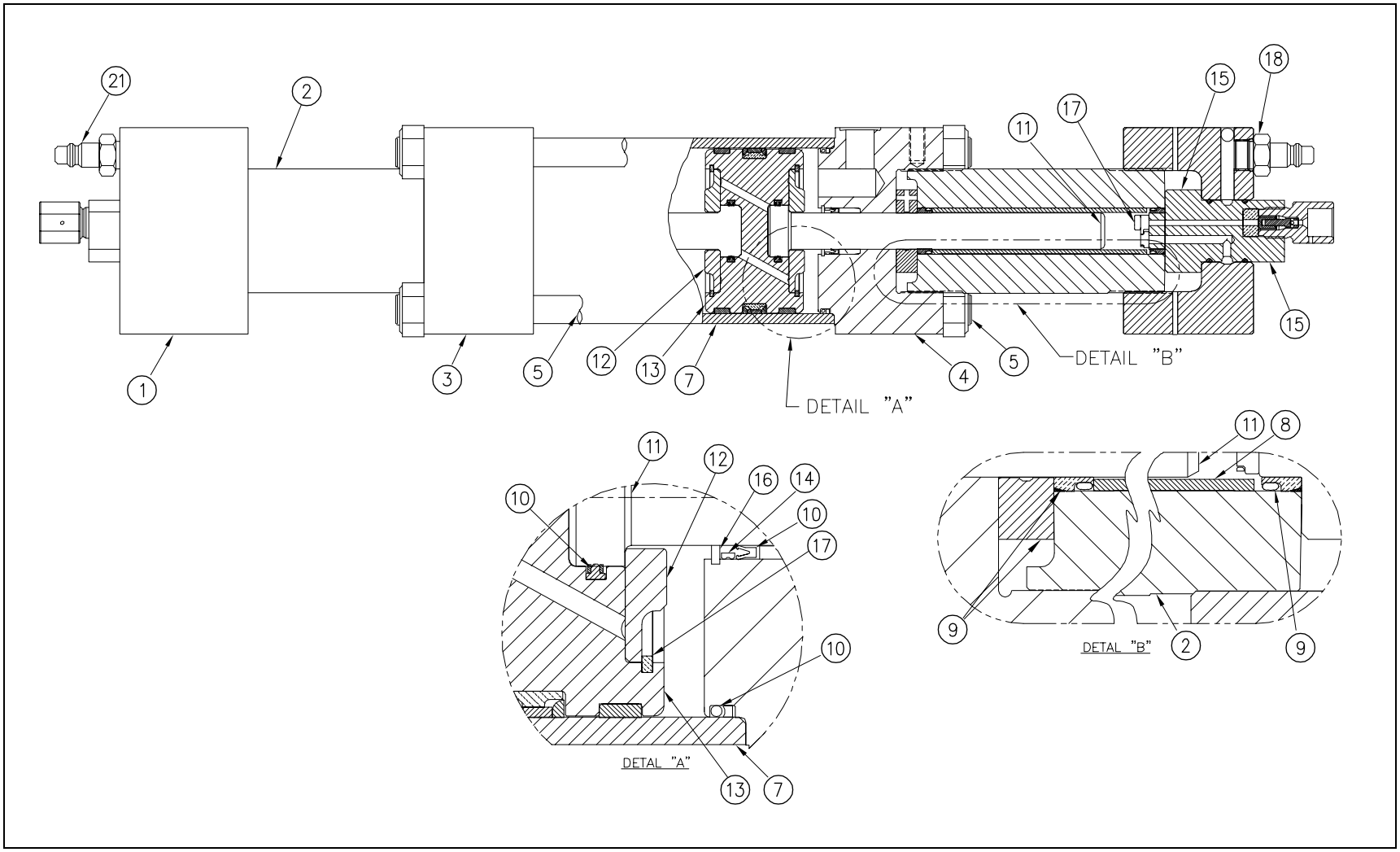


Table 12-3
Sealing Head Assembly
20458908

Item	Part Number	Description	Quantity
1	20458098	Body	1
2	20457381	Gland	1
3	20458140	Seat	1
4	20458089	Poppet Retainer Screw	1
5	20457948	Inlet Poppet	1
6	20460048	Discharge Poppet	1
7	05116751	Poppet Pin	1
8	20458896	Poppet Retainer	1
9	80077241	O-Ring	2
10	20460033	Compression Spring	1
	20458830	**Repair Kit**	
		Includes items 3, 4, 5, 6, 8, 9 and 10	

Figure 12-3: Sealing Head Assembly

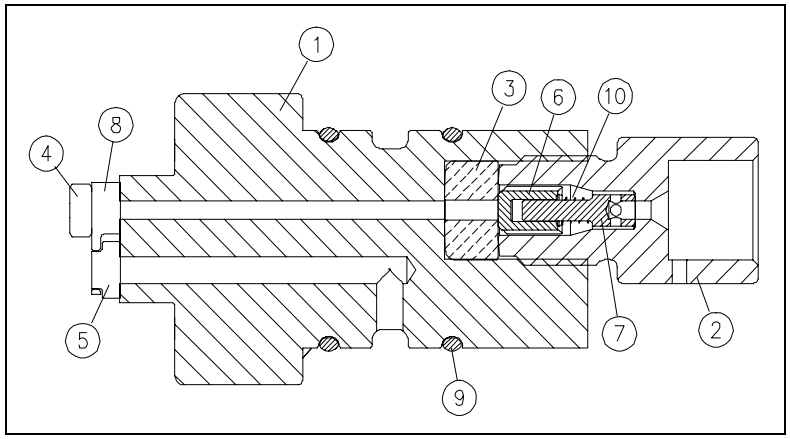


Table 12-4
High Pressure Piping
20497330

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
2	20498314	Attenuator Assembly, .96L	1	13	20498280	U-Bolt, 3.50	2
3	49830581	Coupling, HP Bulkhead, .56 x .38	1	14	49883499	Lock Washer, M12	4
4	10094704	HP Tube, .38 x 3.0	1	15	49898729	Flat Washer, M12	4
5	10078715	HP Collar .38	4	16	10078780	Elbow, HP, .38 x .38	1
6	10078129	HP Gland, .38	4	17	20498585	HP Tube, Bent, .38	2
7	20427739	Pneumatic Valve/Actuator Assembly	1	18	20499594	Socket Head Screw, M14 x 2 x 20MM	3
8	20498577	HP Tube, Bent, .38	1	19	20499610	Lock Washer, M14	3
9	10078426	HP Collar, .25	1	20	05045497	Pressure Gauge, 0-5000 psi	1
10	10078459	HP Gland, .25	1	21	20498610	HP Tube, .38	1
11	20498652	HP Tube, Bent, .25	1	22	20498618	HP Tube, Bent, .38	1
12	10079531	Coupling, HP/HP, .56 x .38	2	23	10078590	Tee, HP, .38	1

Figure 12-4: High Pressure Piping

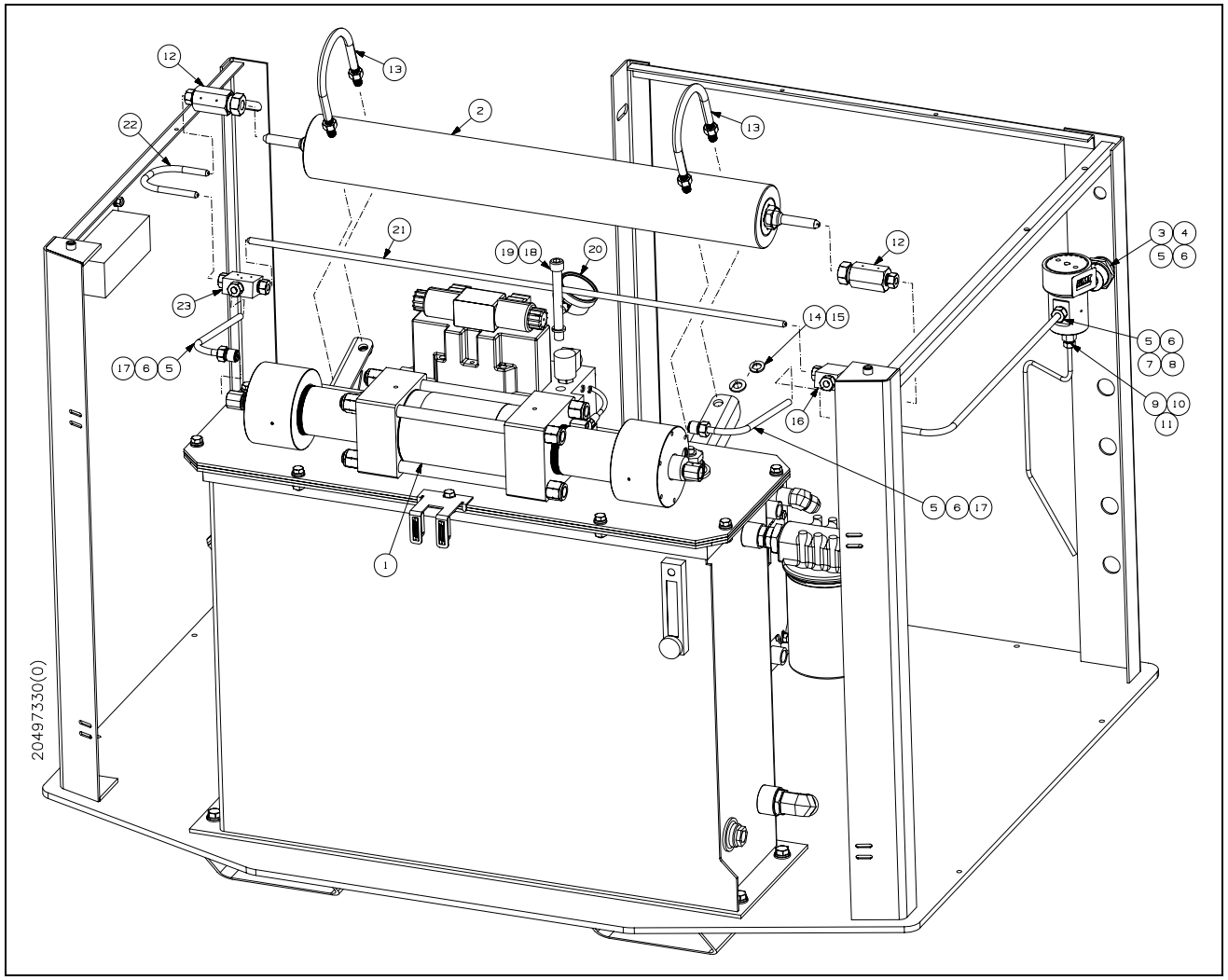


Table 12-5
Pneumatic Valve/Actuator Assembly, Normally Open
20427739

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	20427648	Valve Body	1		10189553	Actuator Assembly, Normally Open	
2	10178697	Valve Seat	1	7	BV401184	Pneumatic Cylinder	1
3	49830904	Adapter, HP Water Valve	1	8	BV601184	Cylinder Head	1
4	20435636	Valve Stem	1	9	BV501184	Piston	1
5	10188233	Backup Ring, Brass	1	10	10187250	Backup Ring, SST	1
6	20428052	Seal Assembly		11	10074714	O-Ring, 2.44 x 2.63 x .09	1
				12	10074565	O-Ring, 2.25 x 2.38 x .06	2

Figure 12-5: Pneumatic Valve/Actuator Assembly, Normally Open

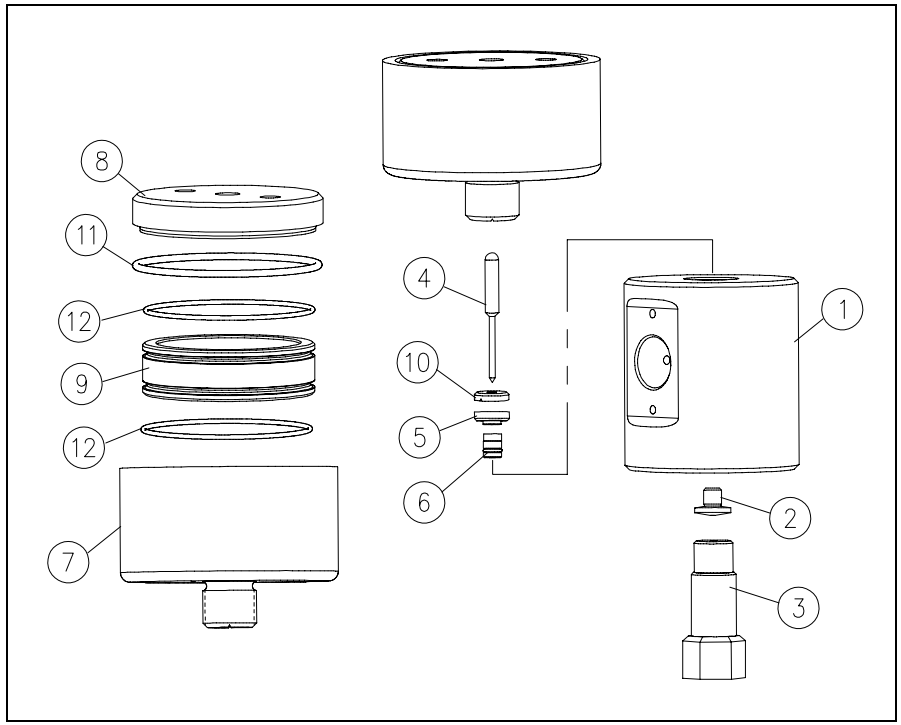


Table 12-6
Hydraulic Power Package
20497413

Item	Part Number	Description	Quantity
1	20498147	Electric Motor, 50HP	1
2	20498155	Coupling, Flexible Drive	1
3	20498173	Flange, Motor/Pump	1
4	20477284	Vibration Isolation Mount	2
5	49892375	Hex Head Screw, M16 x 2 x 60MM	6
6	49892359	Lock Washer, M16	6
7	49892342	Flat Washer, M16	6
8	49833072	Lock Washer, .63	4
9	20498660	Socket Head Screw, M16 x 2 x 25MM	4
10	20477807	Hex Nut, M18	8
11	20477803	Lock Washer, M18	8
12	20477800	Flat Washer, M18	8
13	20477758	Hex Head Screw, M18	8
Ref 1	10091510	Arrow Decal	--

Figure 12-6: Hydraulic Power Package

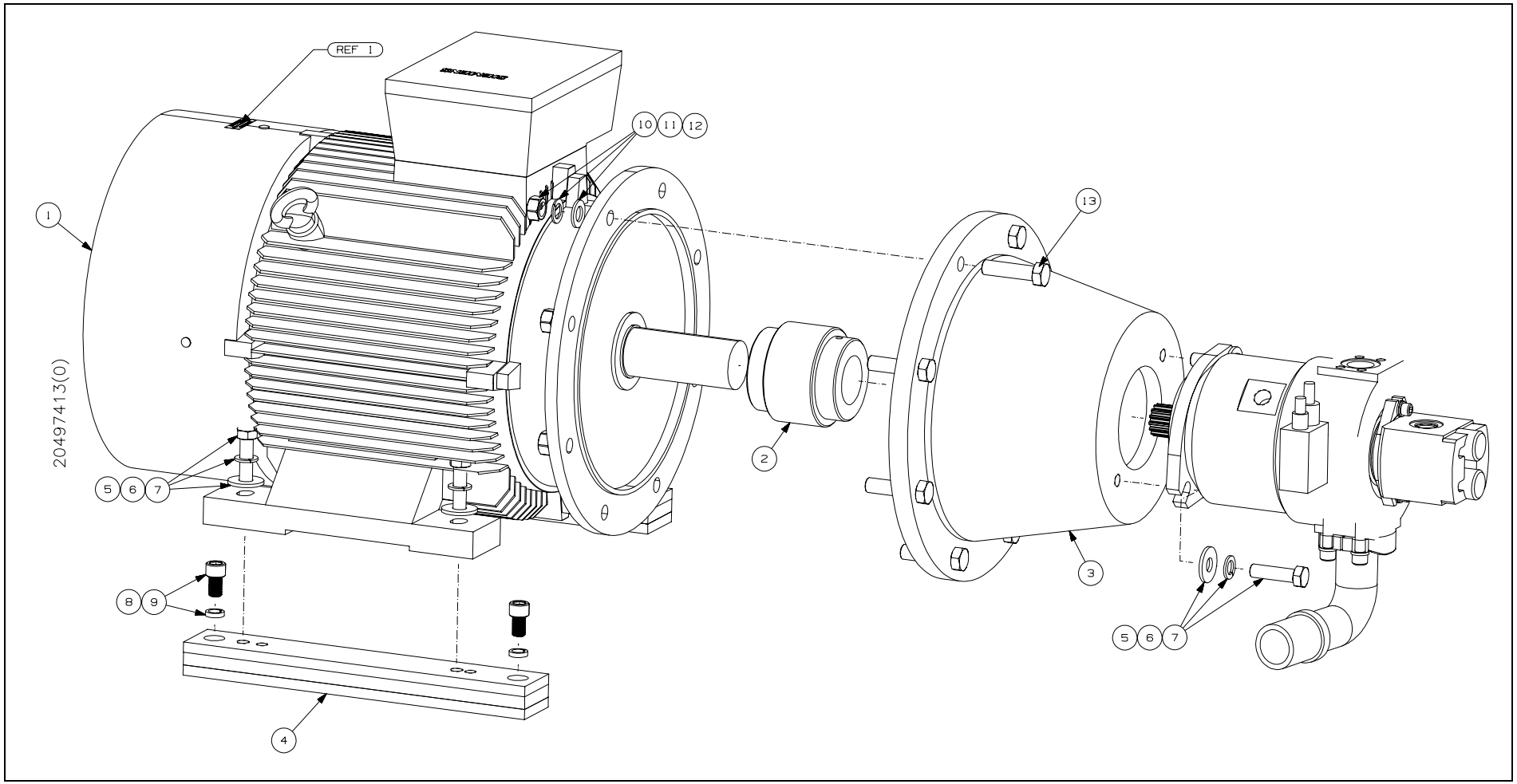


Table 12-7
Hydraulic Pump Assembly
20498668

Item	Part Number	Description	Quantity
1	05045505	Piston Pump	1
2	20498626	Gear Pump	1
3	05139720	O-Ring, 85MM x 3MM	1
4	49883580	Flat Washer, M10	2
5	10064715	Lock Washer, M10	2
6	05037593	Socket Head Screw, M10 x 1.50 x 25MM	2
7	05048780	Split Flange Kit, 2.0	1
8	05048806	Adapter, Flange/Hose, 2.0 x 2.0	1

Figure 12-7: Hydraulic Pump Assembly

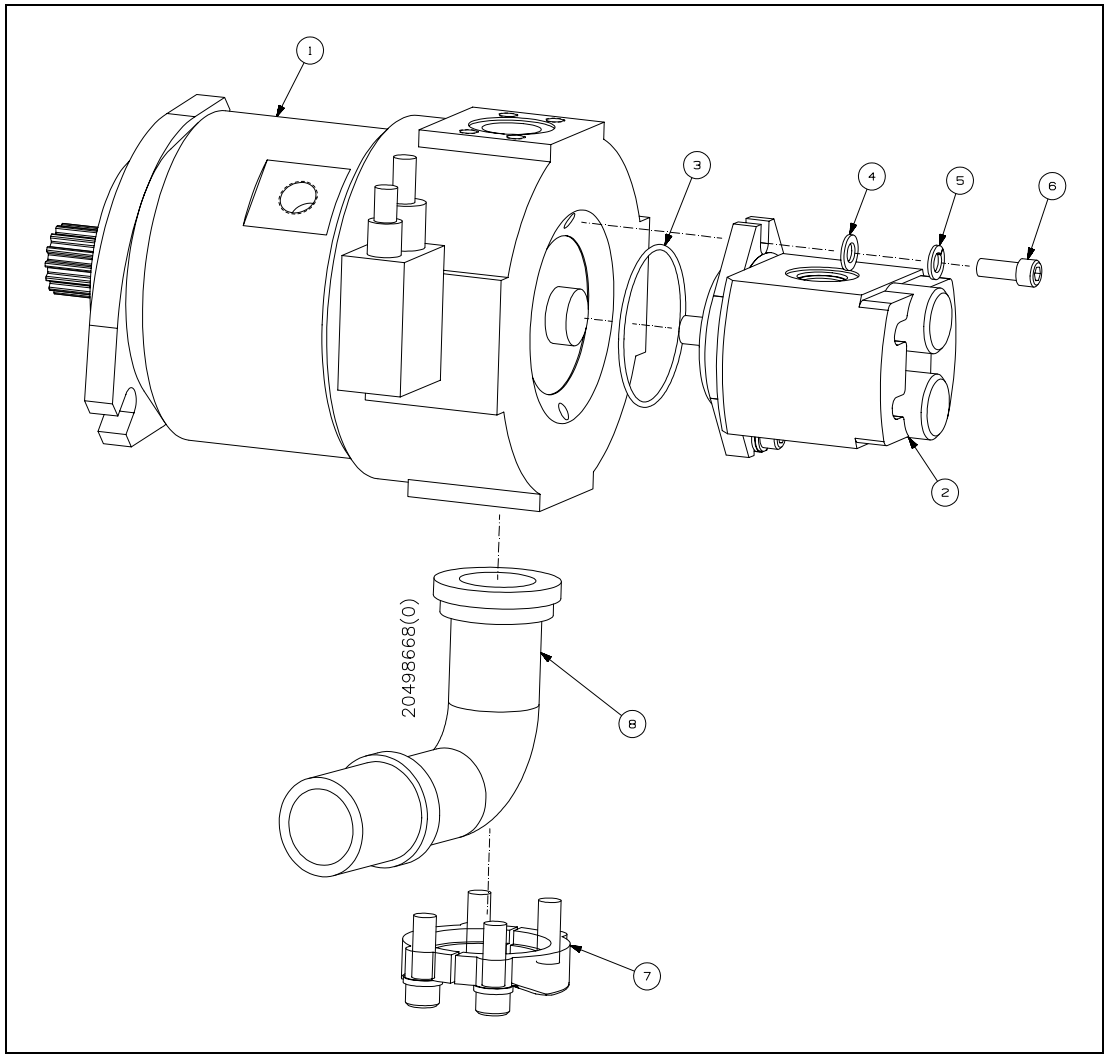


Table 12-8
Electronic Shift Assembly

Item	Part Number	Description	Quantity
1	20457897	Firing Pin	2
2	72106179	Hydraulic Manifold Assembly	
2.1	20499180	Manifold	1
2.2	10187052	HP Relief Valve	1
2.3	10187060	LP Relief Valve	1
2.4	10185585	Solenoid Valve	1
2.5	05122650	Plug, ORB, #8	3
2.6	05104559	Plug, ORB, #4	1
2.7	80085756	Check Valve	1
2.8	72106187	Relief Valve	1
2.9	72104336	Ring Spacer	1
3	20457264	Actuator Assembly, Shift Sensor	2
	20458050	Magnet Retainer	
	20457372	Plunger, Spring Guide	
	20457501	Nut, Spring Guide	
	05203013	Spring, Sensor	
	05203021	Spring, Sensor	
	20493661	Magnet	
4	20458290	Shift Sensor Housing and Cable Assembly	2
	20457402	Housing	
	05202782	O-Ring	
	05202873	O-Ring	
	20459037	Socket Head Screw, 10-24 x 1	
	20493669	Cable, Electronic Sensor	
	20493677	Cord Connector	
5	20458941	Pilot Shift and Main Valve Assembly	1
	20458173	Hydraulic Spool	
	20493695	Shift Valve	
6	20493396	Adapter, JIC/SAE, 1.0 x 1.0	2
7	95159513	Socket Head Screw, 1/4-20 x 2	2
8	95119038	Socket Head Screw, 3/8-16 x 2-1/4	4
9	95308508	Hex Head Screw, 3/8-16 x 2-1/4	4
10	95277109	Flat Washer, .38	4

Figure 12-8: Electronic Shift Assembly

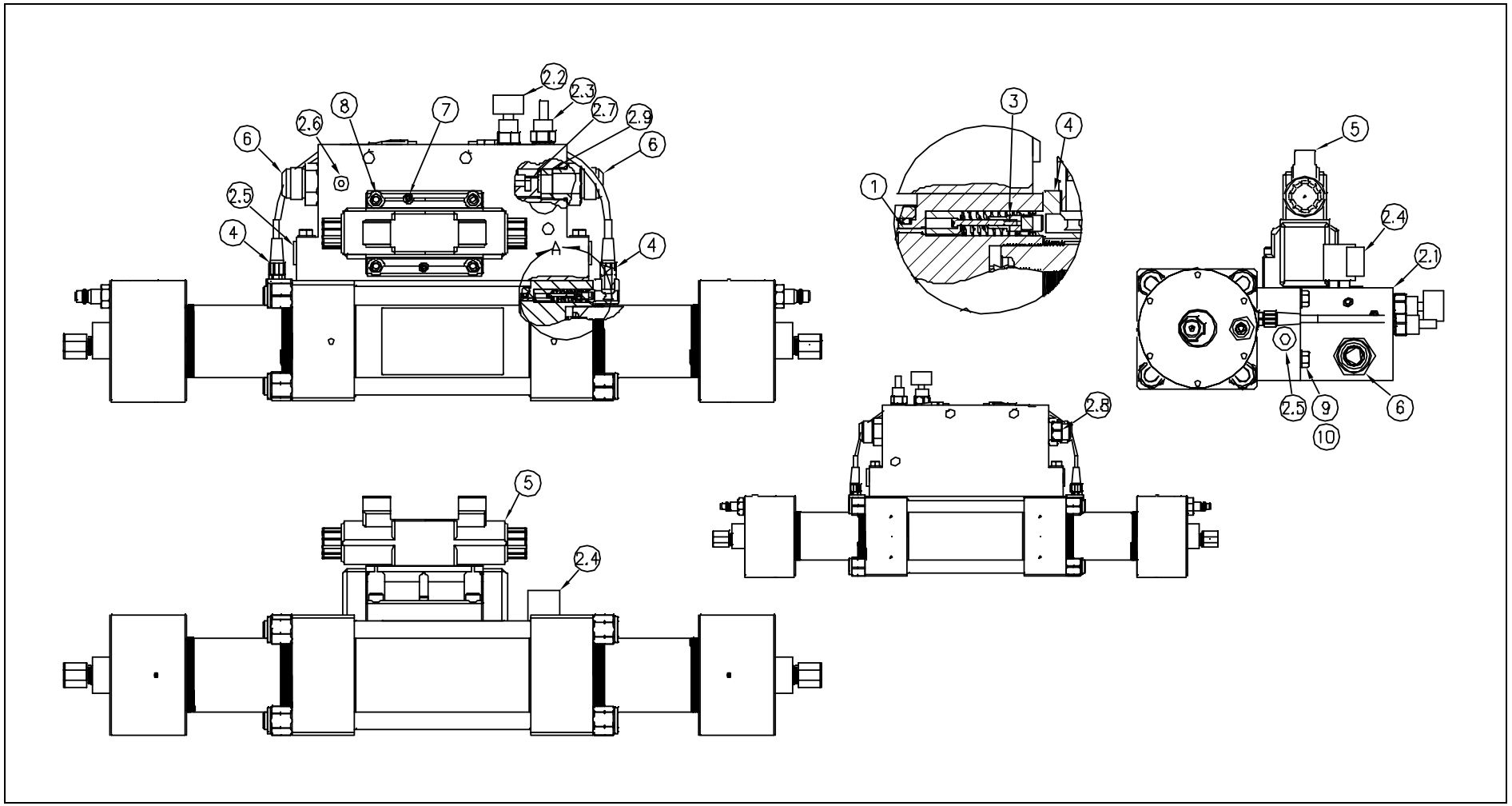


Table 12-9
Hydraulic Hose Connections
20497379

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	10142644	Adapter, JIC/ORB, .25 x .25	3	11	20499576	Hydraulic Hose Assembly, .25 x 27.0	1
2	20497437	Hydraulic Hose Assembly, .75 x 20.50	1	12	20499644	Hydraulic Hose Assembly, .25 x 15.50	1
3	10083517	Hose Clamp	2	13	20497429	Hydraulic Hose Assembly, .75 x 28.50	1
4	10179018	Radiator Hose, 2.0	8.0"	14	20426972	Adapter, ORB/JIC, 1.0 x .75	1
5	20499618	Hydraulic Hose Assembly, 1.0 x 16.50	1	15	05122650	Plug, ORB, .63	3
6	80086192	Adapter, JIC/ORB, 1.0 x 1.0	1	16	05104559	Plug, ORB, .38	1
7	05052493	Adapter, JIC/ORB, .75 x .63	1	17	05045497	Pressure Gauge, 0-5000 psi	1
8	20499652	Hydraulic Hose Assembly, .75 x 14.0	1	18	20499626	Hydraulic Hose Assembly, .75 x 10.0	1
9	05073168	Adapter, JIC/ORB, .75 x .75	1	19	86300018	Split Flange Kit, 1.0	1
10	20497421	Hose, 1.0 x 1.0 x 33.0,FLANG/JIC,90D	1	20	10142594	Adapter, ORB/JIC, 1.0 x .75	1

Figure 12-9A: Hydraulic Hose Connections

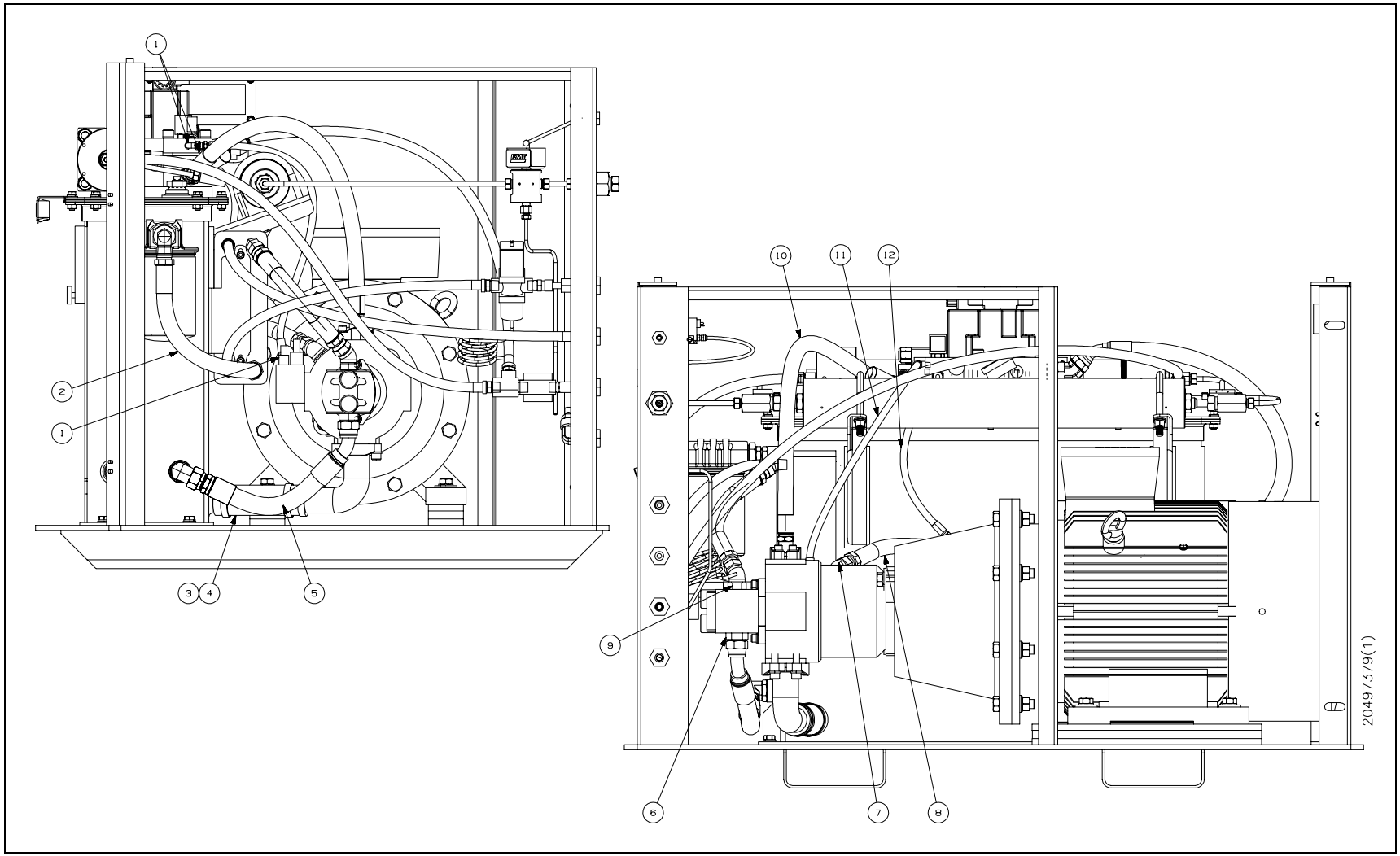


Figure 12-9B: Hydraulic Hose Connections

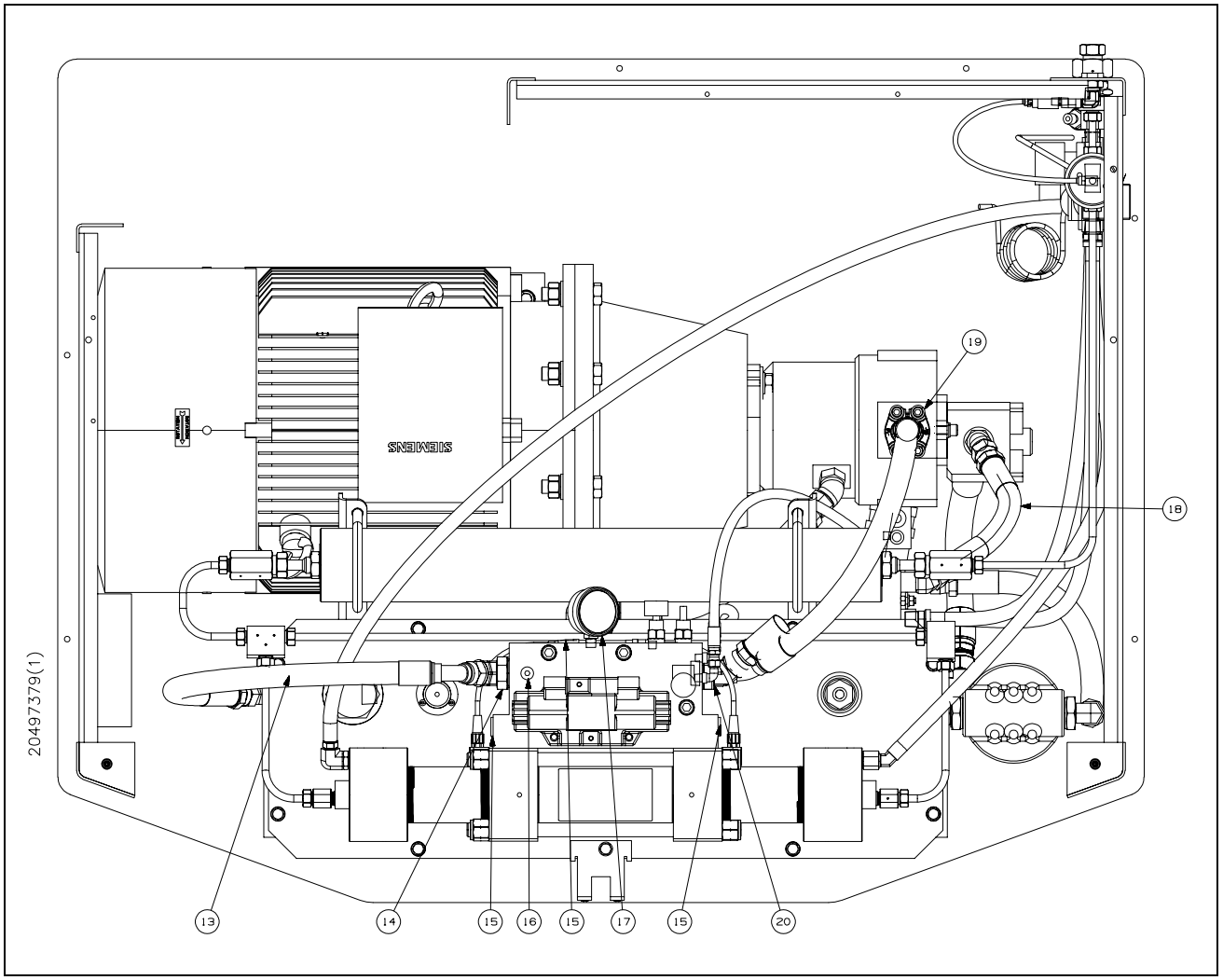


Table 12-10
Reservoir Assembly
20498197

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	20498181	Reservoir Weldment	1	17	20470406	Hose Barb, .50 x .50	2
2	20498272	Gasket, Reservoir	1	18	10070191	Hex Nut, M8	4
3	20498189	Lid, Reservoir	1	19	10069672	Lock Washer, M8	2
4	61149739	Pipe Plug, 2.0	1	20	20477570	Adapter, JIC/BSPT, .75 x .50	1
5	20468736	Air Breather	1	21	20499717	Adapter, JIC/BSPT, .75 x .50	1
6	10191484	Pan Head Screw, M5 x 10MM	3	22	20499743	Plug, BSPT, .75	1
7	72118248	Temperature/Level Switch	1	23	20468704	Adapter, BSPT/JIC, 1.0 x 1.0	1
8	49892466	Flat Washer, M10	9	24	20498264	Hex Head Screw, M12 x 1.75 x 20MM	4
9	49891948	Lock Washer, 10MM	10	25	49883499	Lock Washer, M12	4
10	80089410	Hex Head Screw, M10 x 1.50 x 30MM	10	26	49898729	Flat Washer, M12	4
11	20468655	Temperature/Level Gauge	1	27	20479720	Adapter, BSPT/JIC, .25 x .25	1
12	20468728	Adapter, BSPT/JIC, .75 x .75	2	28	20468695	Plug, BSPT, .50	1
13	20468740	Bushing, BSPT, 1.25 x .75	2	29	20499725	Adapter, BSPT/JIC, .75 x .75	1
14	20468662	Filter Head	1	30	20498205	Bracket, Door Latch	1
15	20468666	Filter Element	1	31	20499750	Magnet	2
16	20476941	Adapter, BSPT/ORB, .75 x .75	1	32	20468732	Heat Exchanger	1
				33	86700007	Ball Valve	1

Figure 12-10: Reservoir Assembly

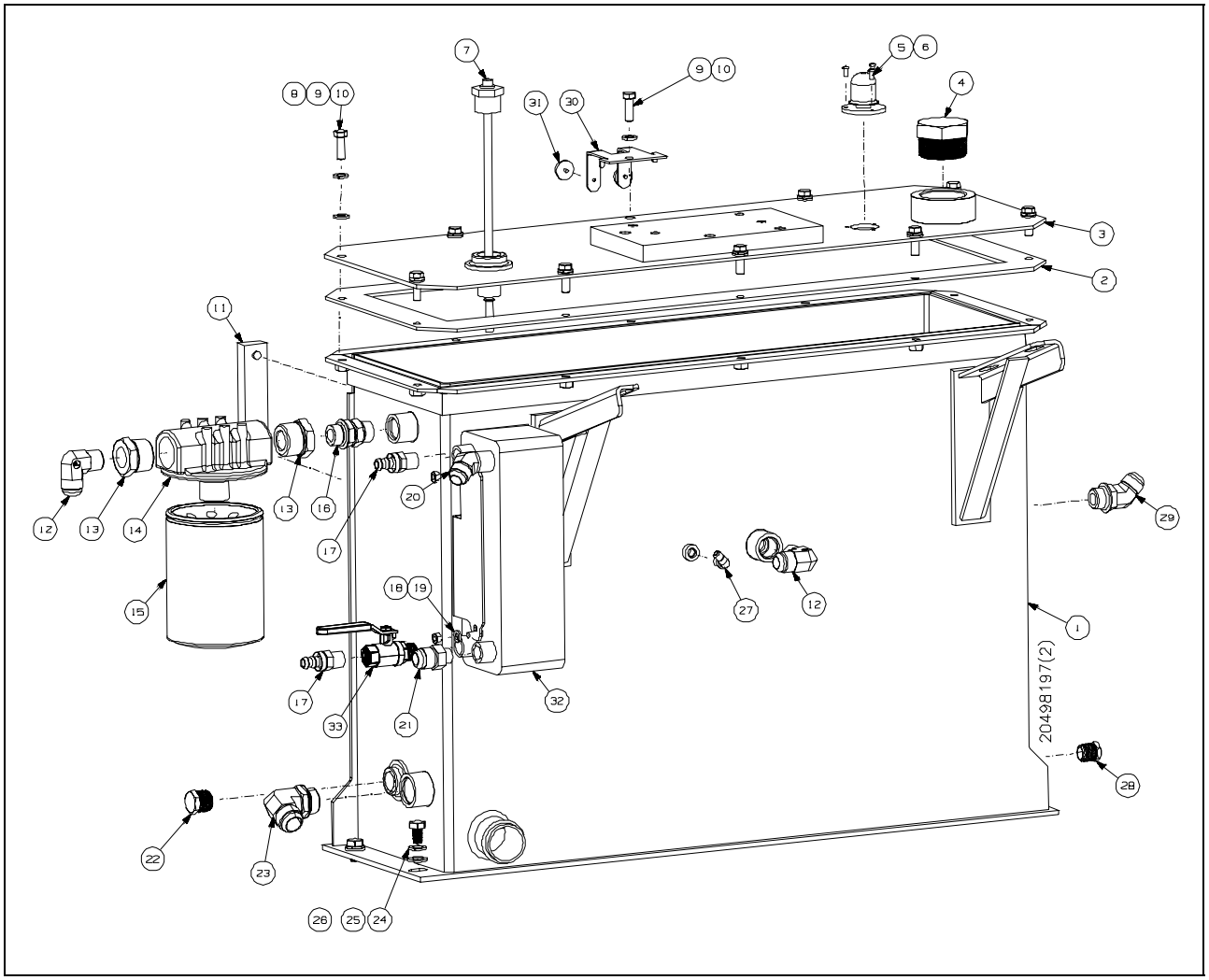


Table 12-11
Bulkhead Pipe Assembly
20497372

Item	Part Number	Description	Quantity
1	20469497	Coupling, Bulkhead, BSPT, .94 x .25	1
2	20469488	Coupling, Bulkhead, BSPT, 1.50 x .50	4
3	20469985	Jam Nut, 3/4-16	1
4	10070092	Jam Nut, 1-14	4
5	20468995	Elbow, BSPT, .12 x .25	1
6	20469007	Check Valve	1
7	20469989	Nipple, BSPT, .12 x .12	1
8	20469016	Solenoid Valve	1
9	20469020	Coupling, Tube, 6MM x .12	1
10	20469023	Poly Tube, 6MM	12.0"
11	20469027	Adapter, Tube/Pipe, 6MM x .13	1
12	20469031	Tee, BSPT,.50	1
13	86200011	Pressure Switch, 30 psi	1
14	20469066	Adapter, BSPT/JIC, .50 x .50	1
15	20468724	Hose Barb, .50 x .50	1
16	20470406	Hose Barb, .50 x .50	4
17	20469070	Nipple, BSPT, .50 x 3.0	1
18	20469074	Solenoid Valve	1
19	20469031	Tee, BSPT, .50 x .50	1
20	20498644	Adapter, BSPT/Pipe, .50 x .50	1
21	49834328	Adapter, Pipe/Tube, .50 x .25	1
22	20498569	Adapter, ORB/ipe, .50 x .38	1
23	10079036	Hose Barb, .50 x .38	1
24	20498603	Adapter, ORB/Pipe, .50 x .38	1
25	20498676	Adapter, Hose/Pipe, .50 x .38	1
26	20421272	Hose, Push-on, .50	200.0"
27	86200015	Water Pump Assembly	1
28	10078152	Bushing Pipe, .75 x .50	2
29	72110201	LP Water Filter Subassembly	1
30	05013313	Hex Head Screw, M6 x 1 x 20MM	2

Figure 12-11A: Bulkhead Pipe Assembly

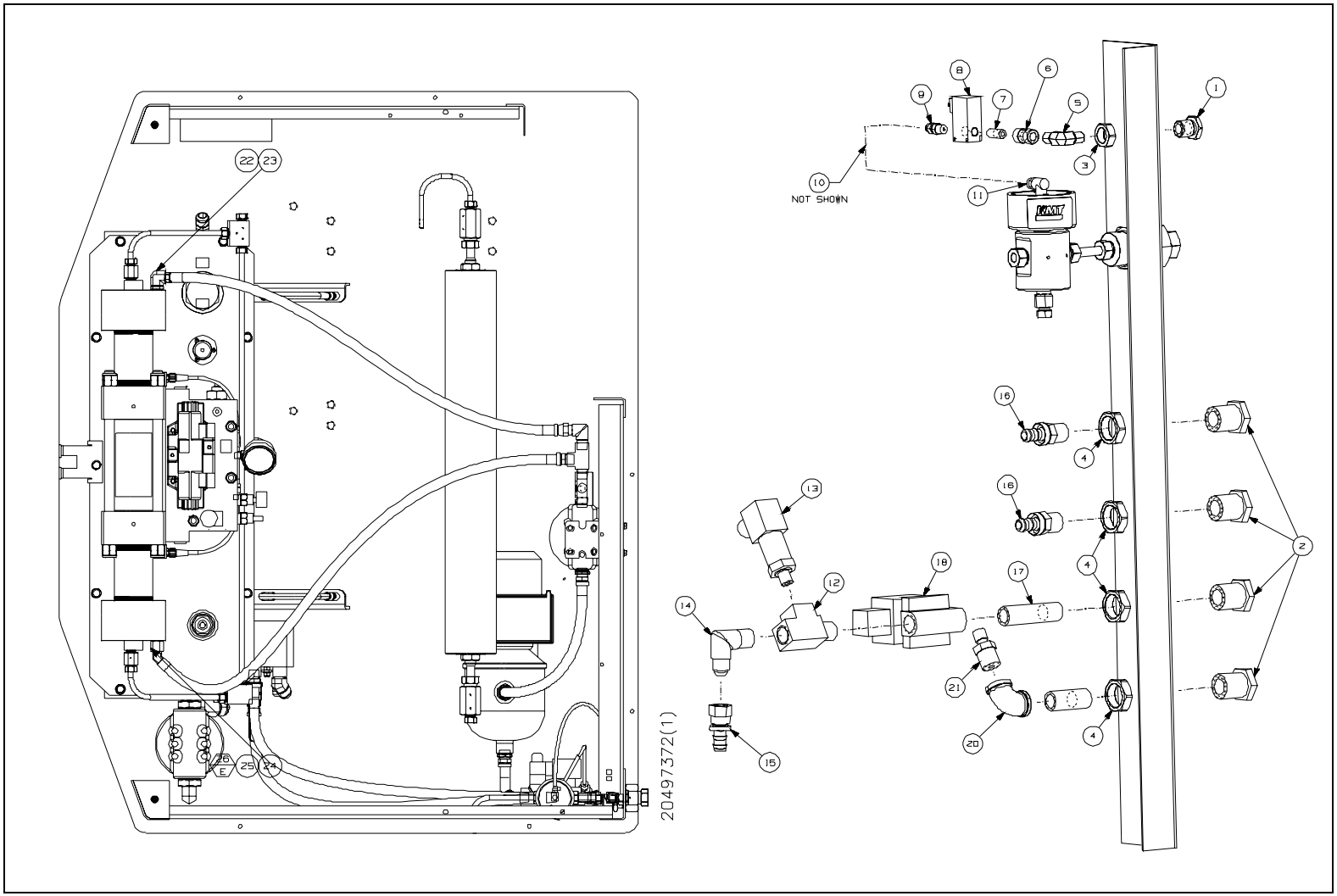


Figure 12-11B: Bulkhead Pipe Assembly

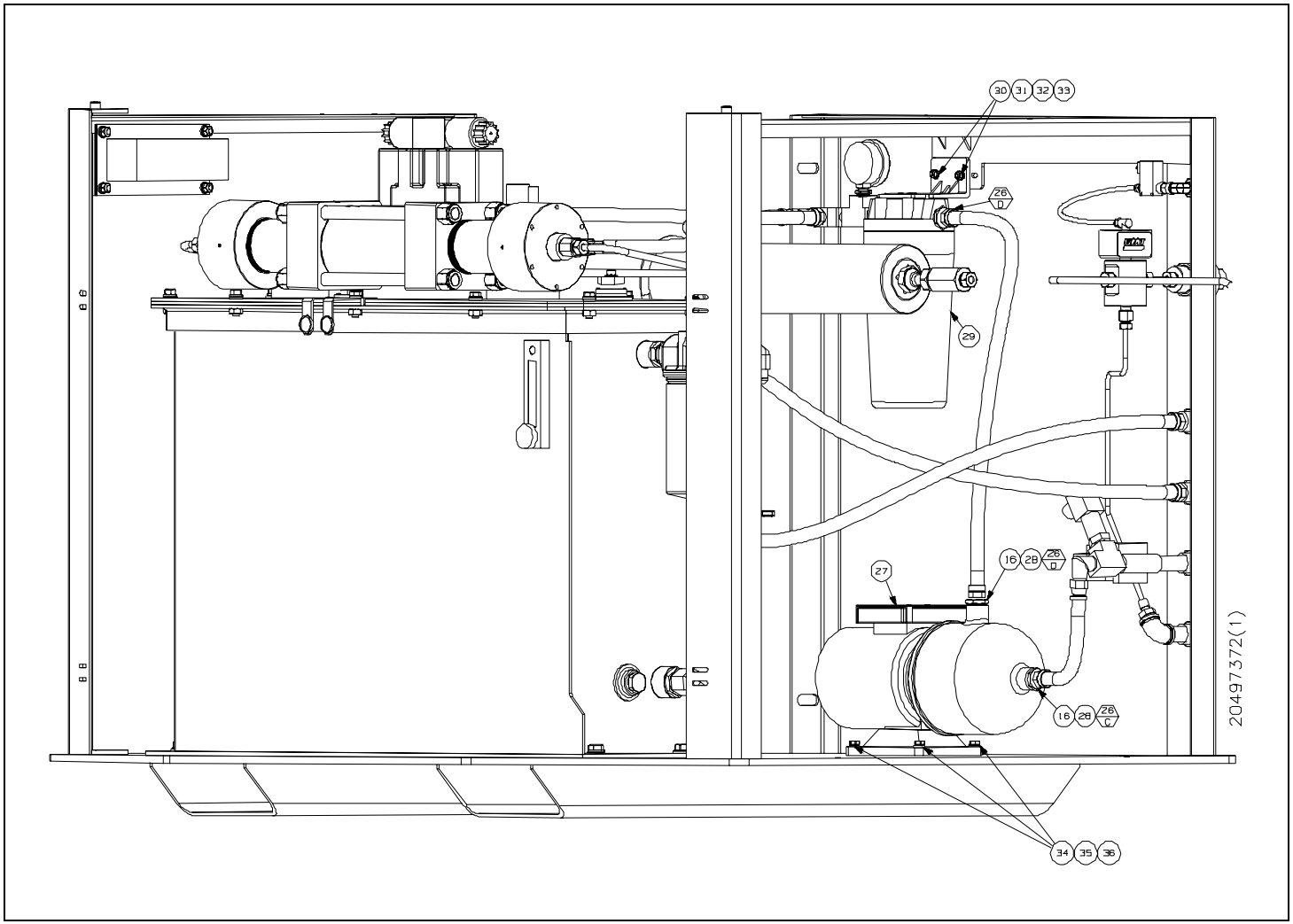


Table 12-12
Electrical Assembly
72102411

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	20498230	Enclosure	1	14	10085520	Connector, Flexible Conduit, 1.50	1
2	72102429	Electrical Configuration	1	15	20470325	Terminal Lug, #14-2/0	6
3	49898729	Flat Washer, M12	4	16	72109623	Pushbutton Switch, Red	1
4	49891922	Lock Washer, M12	4	17	72109615	Pushbutton Switch, Green	1
5	20499784	Hex Nut, M12	4	18	20468378	Legend Plate, Yellow	1
6	20499816	Harness	1	19	20468391	Switch, E-Stop	1
7	10125912	Cable Tie, .87	10	20	10124279	Connector, Cable, .50	1
8	10115830	Connector, Flexible Conduit, 1.50	1	21	80079775	Cable, #18	50.0"
9	05141700	Ring Terminal, #8	2	22	10122646	Connector, Cable, .50	1
10	20469132	Flexible Conduit, 1.50	30.0"	23	10082857	Gasket Assembly	2
11	20468875	Wire, 10MM, Black	300.0"	24	10083012	Lock Nut, .50	2
12	20477288	Cable, 9MM, Green/Yellow	100.0"	25	49874191	Hole Seal, .50	4
13	20468427	Connector, Crimp Ferrule, #8	18	26	72109649	Contact Block	1
				27	72109631	Contact Block	1

Figure 12-12: Electrical Assembly

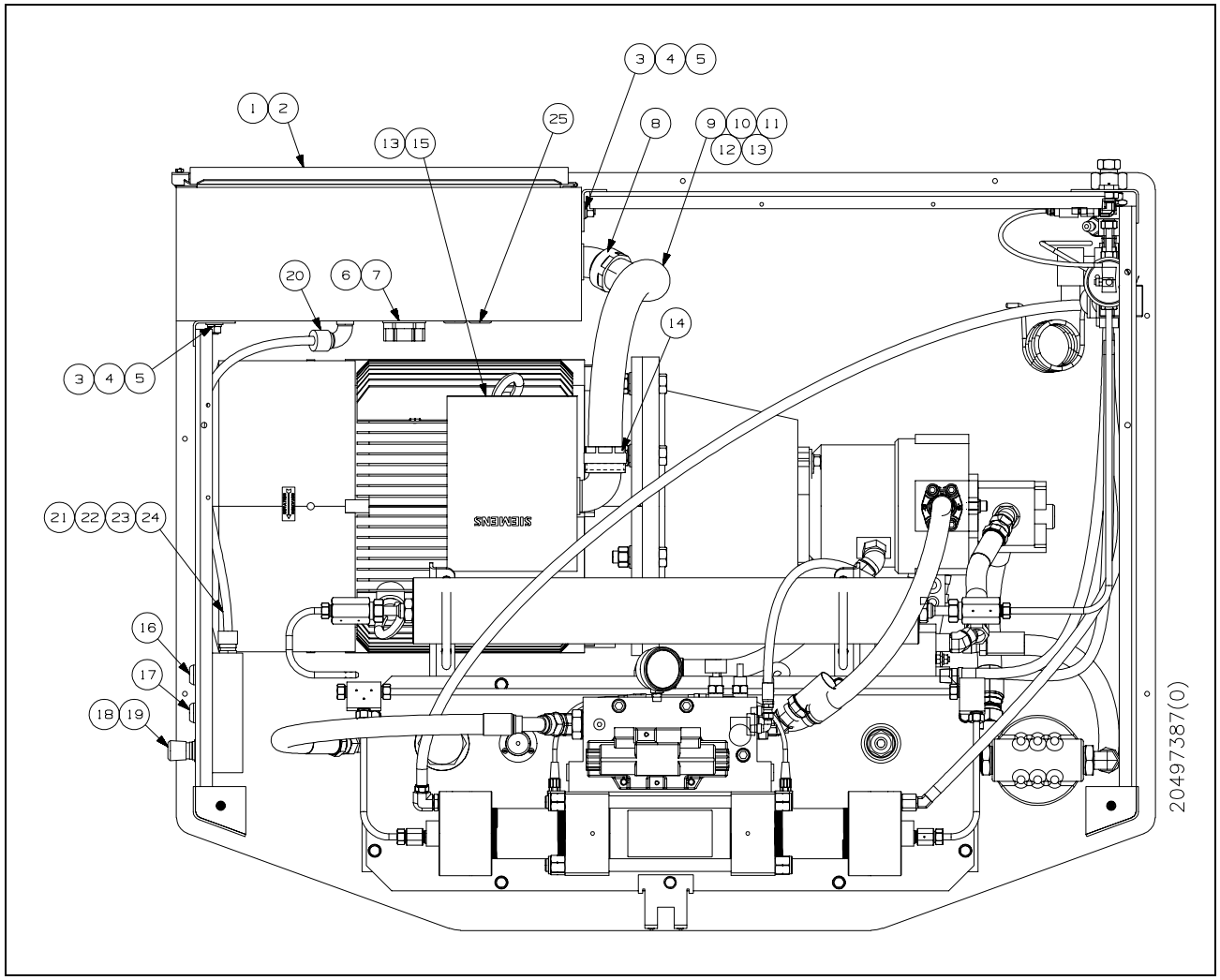


Table 12-13
Electrical Configuration
72102429

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
1	20477059	Circuit Breaker	1	18	20468416	Connector, Crimp Ferrule, #14	8
2	05081955	Socket Head Screw, 8-32 x 2	4	19	20468235	Circuit Breaker	1
3	20468452	Rotary Drive, Circuit Breaker	1	20	20468875	Wire, 10MM, Black	72.0"
4	20468448	Breaker, Terminal Cover	2	21	20468427	Connector, Crimp Ferrule, #8	6
5	05141650	Ground Lug, #4-#0	4	22	72102280	Contactor	1
6	20468420	Ground Lug	2	23	72102288	Overload Relay	1
7	10167070	Pan Head Screw, 8-32 x 1	8	24	80078223	End Block	11
8	10069607	Lock Washer, #8	8	25	20468239	Transformer	1
9	95146429	Hex Nut, #8-32	4	26	20468900	Wire, 1.5MM, Red	160.0"
10	20477288	Cable, 9MM, Green/Yellow	110.0"	27	20468424	Connector, Crimp Ferrule, #16	250
11	05141700	Ring Terminal, #8	4	28	20469108	Circuit Breaker	1
12	20468313	Terminal Block	1	29	20468403	Power Supply	1
13	20468440	DIN Rail	60.0"	30	20468896	Wire, 1.5MM, Blue	1,040.0"
14	10073492	Pan Head Screw, 8-32 x 1/2	33	31	20468904	Wire, 1.5MM, Blue/White	240.0"
15	10114627	Flat Washer, #8	33	32	20468883	Wire, 1MM, Green/Yellow	80.0"
16	20468346	Wiring Duct	150.0"	33	80078207	Terminal Block	5
17	20468892	Wire, 2.5MM, Black	60.0"	34	20468395	Circuit Breaker	1

Table 12-13
Electrical Configuration
72102429

Item	Part Number	Description	Quantity	Item	Part Number	Description	Quantity
35	20468375	Terminal Block	32	39	20468305	Terminal Block	7
36	20468371	End Barrier	2	40	20498694	Subplate	1
37	20468367	Jumper, Terminal Block	2	41	20468288	PLC, S7200	1
38	20468358	Marker, Terminal Block	16	42	20468342	Battery, PLC	1
				43	20468248	Relay Base	3
				44	20468256	Tube Base Relay	3

Figure 12-13: Electrical Configuration

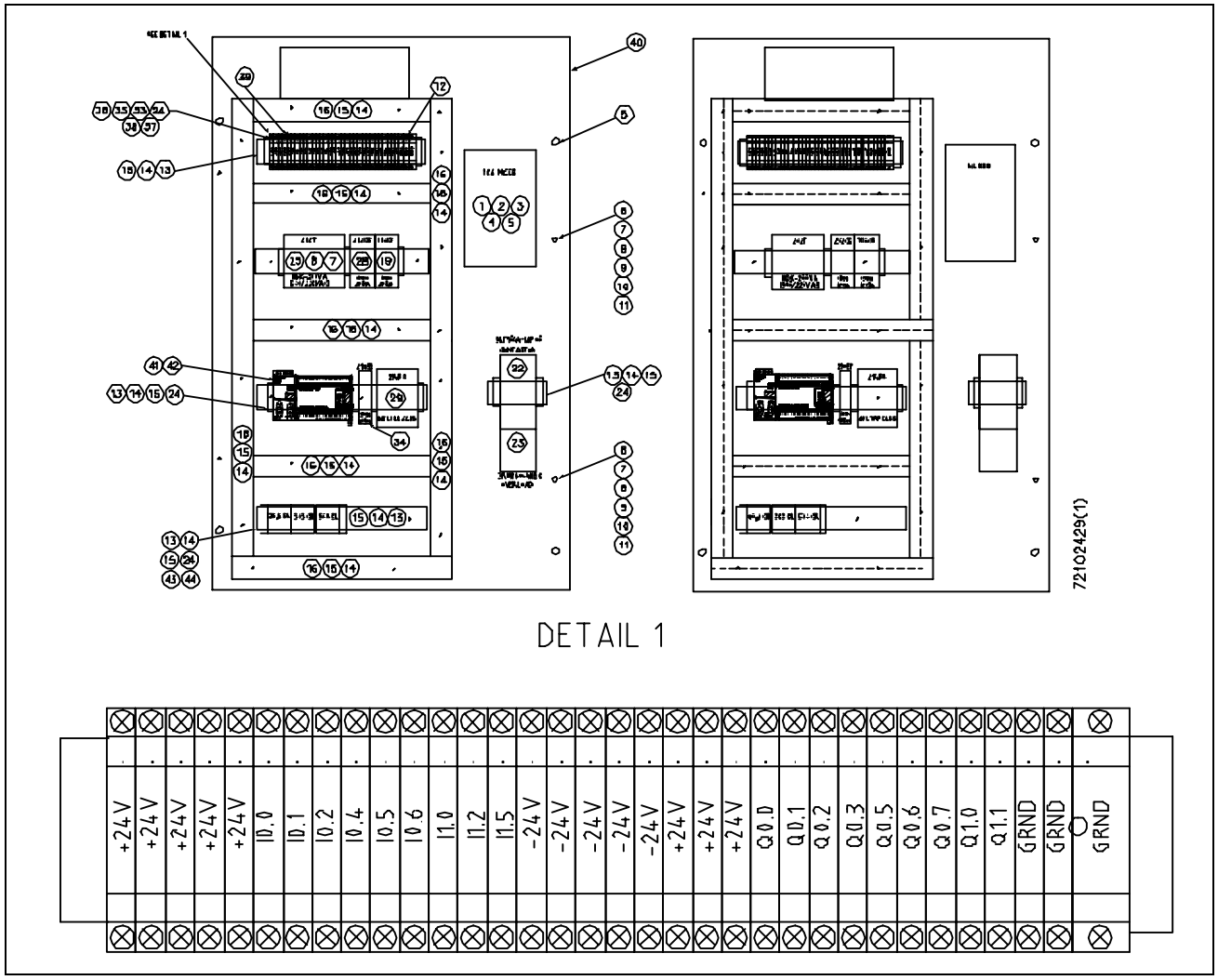


Table 12-14
Cover Assembly
20498048

Item	Part Number	Description	Quantity
1	20498007	Rear Cover	1
2	20497999	Front Cover	1
3	20468638	Rubber Bumper	2
4	10122067	Flat Washer, M8	5
5	10069672	Lock Washer, M8	5
6	10070191	Hex Nut, M8	2
7	05080841	Button Head Screw, M6 x 1 x 22MM	8
8	10107118	Flat Washer, M6	8
9	49892011	Lock Washer, M6	8
10	10070183	Hex Nut, M6	8
11	20498033	Latch	2
12	05014584	Hex Head Screw, M8 x 1.25 x 16MM	3

Figure 12-14: Cover Assembly

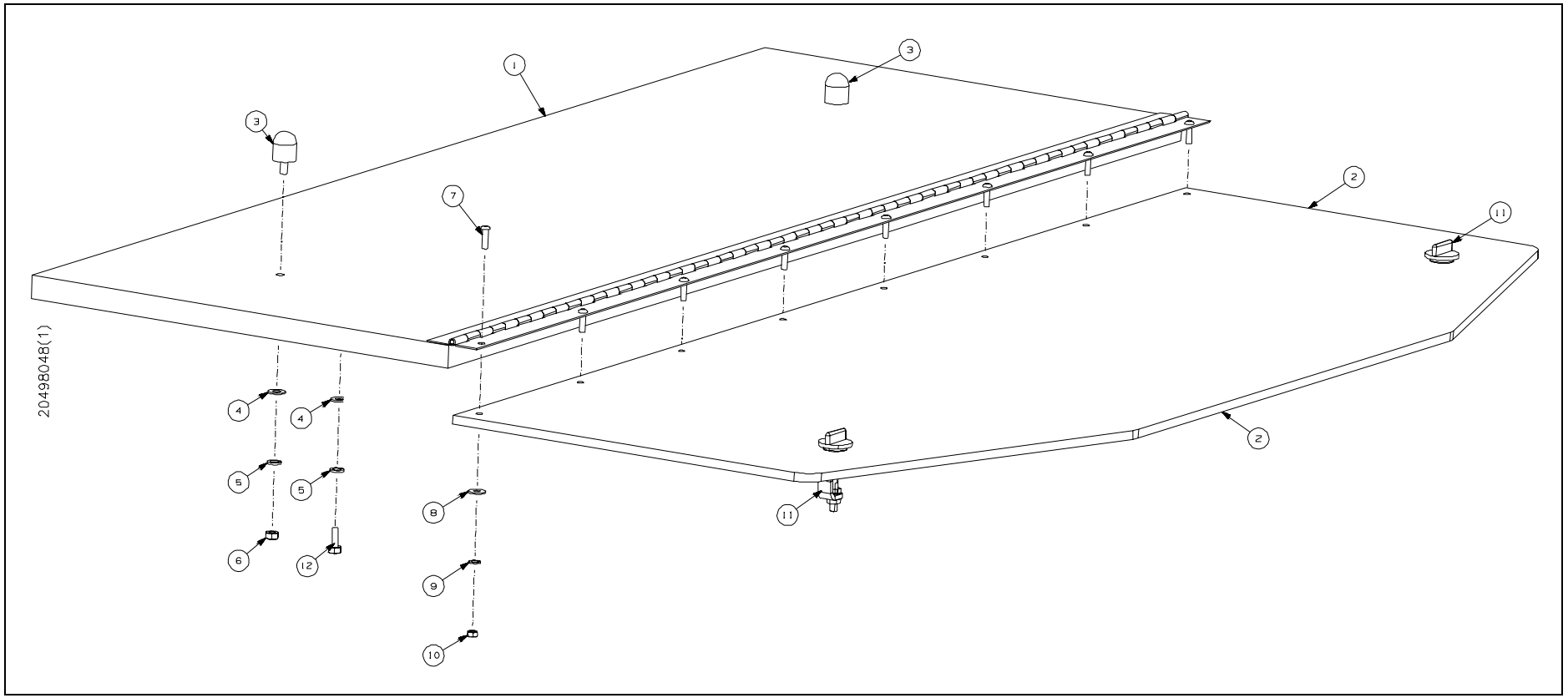


Table 12-15
LP Water Filter Assembly
72110201

Item	Part Number	Description	Quantity
1	20468978	Filter Housing Assembly	1
2	86800001	Filter Element, 10 Micron	1
3	72110219	Bushing, BSPT, .75 x .50	2
4	20470406	Hose Barb, .50 x .50	2
5	20469031	Tee, BSPT, .50 x .50	2
6	72110226	Bushing, BSPT, .50 x .25	1
7	20469501	Pressure Gauge	1
8	20469066	Adpater, BSPT/JIC, .50 x .50	1
9	20468724	Hose Barb, .50 x .50	

Figure 12-15: LP Water Filter Assembly