GlobalMAX®
MAXIEM Pump

Operator Guide

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Contents

Safety

Equipment Labels

The following safety labels may appear on the equipment. If ignored, physical injury, death, or equipment damage may occur. Read the safety information before installing, operating, or maintaining the equipment.

WARNING! Electrical shock hazard
This symbol indicates the presence of life-threatening voltages. Never access areas labeled as such without first taking appropriate safety precautions: locking out power, verifying no voltage is present on circuits prior to maintenance activities, etc.

Flying debris/loud noise
Eye and ear protection are required during operation. Removing the abrasive feed tube from the nozzle while under pressure will blow abrasive particles into the air, getting into eyes and could contaminate tools and machines.

Keep hands away from jet
Never place your hands in the vicinity of the nozzle while cutting. Seek immediate medical attention in the event of a waterjet injury. Injuries caused by high-pressure abrasive waterjets are serious. Do not delay!

Watch hands and fingers
Never place your hands or fingers in areas where they are in danger of being pinched or crushed during equipment operation. Never operate the OMAX while handling material in the tank. Always stop the abrasive jet before making any adjustments to the material or the abrasive jet. With time, support slats will also be cut by the abrasive jet. The edges of these support slats can get quite sharp. Always be careful when handling material in the tank. Fingers can be caught between a heavy part and the support slats.

Watch hands and fingers
Keep the motor guards in place at all times during operation. Keep hands way from belts and pulleys when performing maintenance.

Keep fingers and hands away from moving parts!
Fingers and hands can be crushed and cut by a moving parts hazard whenever the table is powered. Keep hands and fingers out of the path of moving parts. Never reach into moving machinery.

Lockout power!
Never do maintenance on the equipment with the main AC disconnect ON, unlocked, or with the pump in operation. Always follow standard lockout/tagout procedures.

Wear ear protection
Always wear hearing protection while in the vicinity of the equipment. When cutting in air, noise levels can exceed 120 dB.

Wear eye protection
Always wear approved safety glasses whenever cutting. Regular glasses do not provide sufficient eye protection! The garnet abrasive is not a chemical irritant, but if not quickly washed out, it can injure an eye just as any sand would. In addition, tank water could contain particles from the material or chemical irritants. Have an eyewash station located near the work area in the event abrasive spray splashes into your eyes.

Wear gloves
Bacteria in the tank water can build up. A minor break in the skin can introduce harmful bacteria into a wound. Always wear protective gloves if you have cuts or open wounds on your hands. When setting up material for cutting, wear gloves that provide protection against sharp metal edges.

Wear mask
Wear appropriate breathing mask. Be aware of dust hazards associated with all types of materials. Dust created while operating can cause cancer or other long-term respiratory damage.

Read manual
Read the equipment operator's guide for specific operator instructions and additional safety requirements. Do not attempt to operate this machine until you have read and understand all safety precautions and operating instructions.

Step hazard
Never step, stand or walk on the support slats. They are weakened with cutting and may collapse under your weight.

Electrostatic discharge
Attention! Observe precautions for handling electrostatic sensitive devices.

Stay clear!
Never operate the equipment with protective guards or covers removed or rendered inoperative.

Read manual first!/Do not adjust
Never make adjustments to equipment prior to reading the manual. Special instructions may be required.

Safety Precautions

The following safety instructions must be followed when installing, operating, or maintaining the equipment. If ignored, physical injury or death may follow, or damage may occur to the equipment. Always observe applicable safety precautions when working with this equipment.

Do not make modifications

- Never make unauthorized alterations to the equipment or components
- Modification to the equipment may pose risk of physical injury to the operator and/or others and may cause damage to the equipment or other property. Modifications to the equipment will invalidate the warranty.
- Do not modify, defeat, or bypass any equipment safety features.

Never operate equipment without safety guards or covers

- Do not modify, bypass, defeat, or render safety guards, covers, or switches inoperable.
- Never remove any safety cover or guard while the equipment is running.
- Know the location of the ON/OFF and E-stop switch.
- Know how to disconnect the main power supply to the equipment.

Never place hands in vicinity of nozzle while cutting

- Seek immediate medical attention in the event of a waterjet injury. Injuries caused by high-pressure abrasive waterjets are serious. Do not delay!
- See the WaterJet Technology Association (WJTA) warning card for important medical alert information.
- The abrasive waterjet head can crush hands or fingers. Keep hands away from the area between the head and the slats on the machining table.

Use care when handling material in the tank

- Never operate the equipment while handling material in the tank.
- Always stop the abrasive waterjet before making any adjustments to the material or the abrasive jet.
- Always be careful when handling material in the tank. Fingers can be caught between a heavy part and the support slats.
- Use caution around the support slats. Support slats are also cut by the abrasive waterjet; the edges can become very sharp and cause cuts, or collapse.

Do not touch live electrical components or parts

- Always use a licensed electrician for installing the main power source.
- Inspect the equipment power and control cables regularly. Replace any damaged cable or bare wire. Exposed and bare wires can kill!
- Ensure the equipment is properly grounded in accordance with national, state, and local codes. If equipped with a three prong plug, never remove the third prong.
- Always plug three-prong plugs into a three-hole electrical receptacle. If using a two-prong adapter, the adapter must connect to a good, known ground.
- Always disconnect the equipment from the main power before performing maintenance.

Noise emission precautions

The relationship between noise levels and exposure time is not accurate enough to provide information needed to determine hearing precautions. Other environmental factors, such as room or building construction, machines and/or power tools, and other noise sources, affect the environments true noise level. Therefore, it is recommended the operator wear hearing protection during the operation of the equipment.

Treat all injuries with caution!

Injuries involving contact with the water should receive immediate attention.

Seek immediate medical attention in the event of an abrasive waterjet injury. Inform the physician of the cause of the injury, what type of waterjet project was being performed at the time of the accident, and the source of the water.

Because of the stagnant water within the tank, even a seemingly minor break in the skin can introduce harmful bacteria into the wound. Any injury involving contact with the water should be attended to immediately.

Unusual infections with aerophilic microorganisms occurring at lower temperatures have been reported. These may be gram-negative pathogens, such as those found in sewage. Bacterial swabs and blood cultures may therefore be helpful in assisting a physician's diagnosis.

An injury caused by high-pressure waterjets can be serious. In the event of any waterjet injury:

- Seek medical attention immediately. Do not delay!
- Inform the doctor of the cause of the injury.
- Tell the physician what type of waterjet project was being performed at the time of the accident and the source of the water.

- Communicate the following information to the medical personnel:

  This patient may be suffering from a waterjet injury. Evaluation and management should parallel that of a gunshot injury. The external manifestations of the injury cannot be used to predict the extent of internal damage. Initial management should include stabilization and a thorough neurovascular examination. X-rays can be used to assess subcutaneous air and foreign bodies distant from the site of injury. Injuries to the extremities can involve extensive nerve, muscle, vessel damage, as well as cause a distal compartment syndrome. Injuries to the torso can involve

internal organ damage. Surgical consultation should be obtained. Aggressive irrigation and debridement is recommended. Surgical decompression and exploration may also be necessary. Angiographic studies are recommended pre-operatively if arterial injury is suspected. Bandages with a hygroscopic solution (MgSO4) and hyperbaric oxygen treatment have been used as adjunctive therapy to decrease pain, edema and subcutaneous emphysema. Unusual infections with uncommon organisms in immunocompetent patients have been seen; the source of the water is important in deciding on initial, empiric antibiotic treatment, and broad-spectrum intravenous antibiotics should be administered. Cultures should be obtained.

Lockout/tagout procedure

Implement standard practices and procedures to shut down equipment, isolate it from its energy source(s), and prevent the release of potentially hazardous energy while maintenance and servicing activities are being performed.

Do not operate equipment in an explosive atmosphere

Machining certain types of material such as titanium with a waterjet will produce sparks. Do not operate the equipment in an explosive atmosphere. Do not allow explosive or flammable vapors to accumulate in the area of the equipment.

Waste material disposal

Dispose of cutting wastes properly and in accordance with all local and federal regulations. The abrasive waterjet produces two types of waste: the water used for cutting, and the solid material that accumulates in the catcher tank. Although the garnet abrasive itself is inert, the waste deposited from the material being cut may require special handling.

In abrasive waterjet cutting, garnet particles are accelerated with high-pressure water to strike the material creating a residue of abrasive grit and eroded particles from the cut material. Eventually, this residual sludge settles to the catcher tank bottom and accumulates until it must be removed for disposal. Depending upon the material makeup of this sludge, different disposal constraints will be imposed by the various local and federal regulations. For example, when cutting toxic materials, such as lead or radioactive metals, appropriate measures for the safe disposal of this type of contaminated water and sludge must be rigidly followed. Always consult with your local utilities company about sewage or water treatment requirements and proper sludge disposal procedures.

Adequate shop ventilation

Proper ventilation in your job shop will assist in dissipating the accumulation of gas, vapor, and fumes. Your machine contains a significant amount of water that will evaporate depending on the ambient temperature in your shop and the temperature of the water in the tank itself. In order to reduce impact on other equipment in your shop you should maintain adequate ventilation in your shop. Even when cutting under water you should expect fine garnet dust to be present around the machine. Additionally some materials (esp. aluminum particles) in water are known to produce hydrogen in water.

When you cut aluminum, the fine particles of aluminum dust in the tank react with the water to generate flammable hydrogen gases. Normally, hydrogen bubbles to the surface and escapes into the shop in harmless, low concentrations.

However, thick layers of aluminum and garnet in the catcher tank can trap pockets of hydrogen gas. Periodically check on equipment operation during lengthy continuous use (e.g., checking for smooth operation during a long job). Always, take care that no ignition source (e.g., open flame, electrostatic discharge) is nearby when operating any feature on the abrasive waterjet system.

⚠WARNING

Watch for hydrogen bubbles when machining aluminum. If you cut a lot of aluminum, you will create aluminum powder from the removed material. This powder will accumulate at the bottom of the tank along with your garnet. The aluminum then reacts with the water, releasing Hydrogen gas in the process. If you cut a lot of aluminum on a regular basis, then this is something to take into consideration. Do not allow smoking near the machine, and keep the garnet levels in your tank low to prevent bubbles from accumulating within. Be especially careful when cutting materials that create sparks such as titanium and

can ignite gases in the tank. Always cut sparking materials under water to suppress the sparks and prevent ignition.

⚠WARNING

Powder created from cutting aluminum will react with water and create flammable hydrogen bubbles. The aluminum powder will collect at the bottom of the tank along with the garnet. Large pockets of hydrogen gas can form and be trapped in the catcher tank if excessive amounts of aluminum and garnet are allowed to accumulate. When machining large amounts of aluminum it is a good idea to regularly remove powder from the bottom of the tank. Do not allow smoking or other sources of ignition near the machine. It is especially important to clean aluminum powder from the tank before cutting materials that spark such as titanium.

Equipment Safety Features

The abrasive waterjet provides several built-in safety features:

- **Emergency stop switch (E-stop):** The pump and table controller are equipped with emergency stop (E-stop) switches. The E-stop is engaged by pushing it in. Once engaged, it immediately shuts down the pump unit and abrasive waterjet.
- **Overpressure protection:** During operation, pump pressure is monitored to prevent an overpressure condition. If the pump exceeds the factory set maximum pressure limit, the control shuts down the pump unit. In addition to the software maximum pressure limit, all pumps are equipped with a factory set safety valve to provide a hard-plumbed, overpressure relief valve.
- **Electrical protection:** The variable frequency drive (VFD) provides electrical protection as well as speed control for the pump's main drive motor. The DIN rail-mounted contactor and circuit breaker provide short-circuit protection to the charge pump motor. Circuit breakers protect the internal transformer.
- **Electrical disconnect:** An electrical disconnect that cuts off and isolates the equipment from its main electrical supply is provided as standard equipment on all machines sold in countries where installation of this electrical disconnect is mandatory. This disconnect is provided as an optional accessory in other countries where installation of this device is not a requirement.

Safety Legend

The following safety signal-word panels and paragraph notifications may appear throughout this guide. Each provides safety-issue identification and recommended actions to avoid the hazard. Be alert! Follow the recommended safety actions and precautions to prevent injury or damage to the equipment.

⚠WARNING

Indicates a hazardous situation which, if not avoided could result in death or serious injury.

⚠CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Used to address practices not related to physical injury — property damage only.

NOTE: *Used to provide supplementary information, emphasize a point, or give a tip for easier operation.*

Introduction

High-Pressure Pump Components

This pump provides high-pressure water required to cut parts. The pump's major drive components include the Variable Frequency Drive (VFD), the main electric motor, the belt drive between the motor and the pump, and the crankshaft to drive the high-pressure pump. The VFD varies the electric motor speed and therefore the pump output flow.

There are two pump sizes available for the GlobalMAX abrasive waterjet, all capable of producing up to 45,000 psi. Refer to the globalmax.omax.com website for additional information.

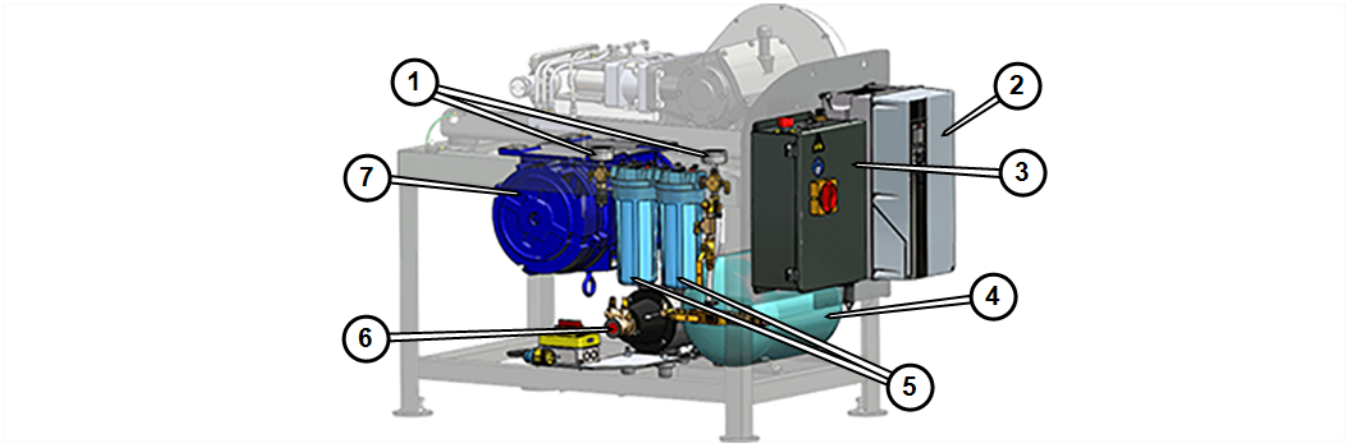

Figure 1

[1] Filter pressure gauges [3] Pump control box [5] Water filters [7] Electric motor

[2] VFD [4] Water pressure tank [6] Charge pump

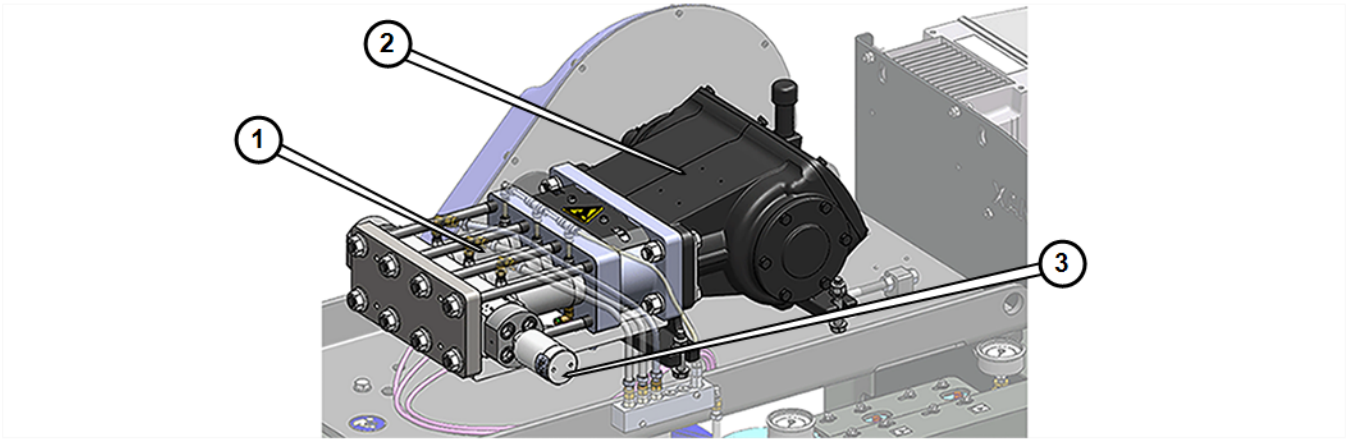

Figure 2

[1] High-pressure wet end [2] Crankcase [3] Safety valve

Operator Controls

Variable Frequency Drive

The VFD control is usually commanded at the operator workstation.

Emergency Stop

Immediately shuts down the high-pressure water pump and stops all abrasive jet operations. Computer remains ON.

Pump On/Off Switch

Rotate to ON to enable power up of the pump unit.
Rotate to OFF to power down the pump unit.

High-Pressure Adjustment (HP)

Adjusts cutting pressure by controlling motor rpm monitored in the keypad display . To increase rpm, adjust the knob clock-wise; adjust counterclockwise to decrease.

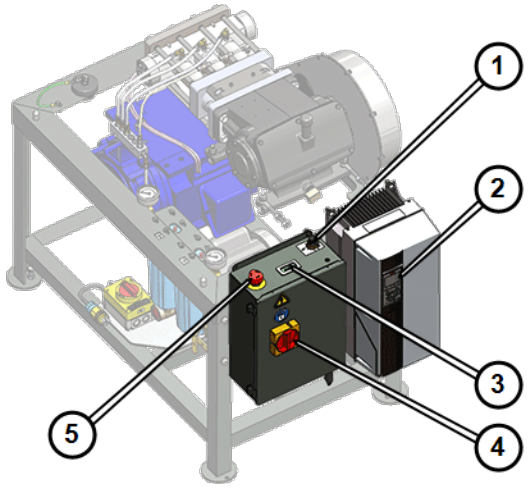

Figure 3

[1] High-pressure adjustment
[2] VFD keypad
[3] Pressure display
[4] Power switch
[5] E-stop

Charge Pump Controls

The **charge pump** [2] boosts incoming water pressure to 125 psi. This input pressure is required for either the 20- or 30-hp pump to operate properly. The charge pump is also responsible for circulating water through the system cooling lines to purge any warm water and cool wet end components before the high-pressure pump is started. Cooler water increases the life of the high-pressure pump seals. The charge pump must be running for the high-pressure pump to start.

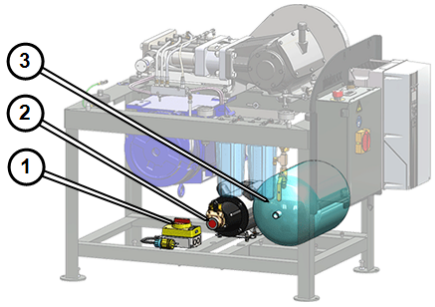

Figure 4

[1] Power switch [2] Charge pump [3] Water pressure tank

The **charge pump** [8] circulates water through the cooling lines to purge warm water and cool wet end components. Water from the shop source enters through the water input **supply line** [5], then flows to **charge pump** [8] and boost the output pressure. The charge pump is equipped with a built-in relief valve that never needs adjusting. Once filled, the water pressure tank helps to maintain consistent water pressure by releasing additional water when there is an intermittent pressure decrease in the supply water. (Figure 10).

NOTICE

The last 6 in. (15.24 cm) of water line to the charge pump must be straight to prevent pump cavitation for proper pump operation.

Water from the **charge pump** [8] is then routed to the **filters** [1] (filters removed from photo for clarity) to the high-pressure wet-end or supply plumbing. Water from the relief valve returns to the charge pump pressure tank through the **bypass valve** [2] or is routed through the **flush ON/OFF valve** [3] to the catcher tank or **drain** [4]. The bypass valve is used to set the systems operational pressure, water not consumed by the wet-end is sent back to the water supply circuit. Water from the incoming supply and pressure tank can be shut OFF at the **input water On/off valve** [7]. Excess water can be flushed from the lines into the catcher tank by turning the **flush On/off valve** [3] to ON.

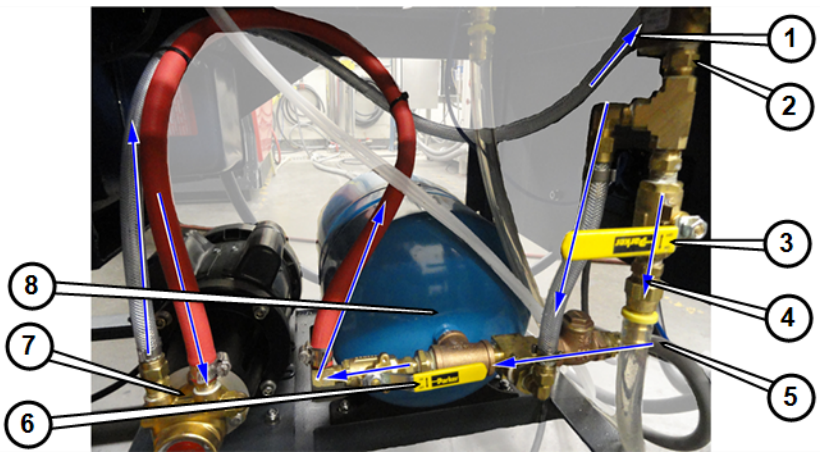

Figure 5

[1] Filter supply line
[2] Bypass valve
[3] Flush ON/OFF valve
[4] Drain line
[5] Supply line
[6] Input water ON/OFF valve
[7] Charge pump
[8] Water pressure tank

Chapter 1: Operation

Before Starting the Pump

Pump control is shared between Intelli-MAX® MAKE (Auto On) and the Variable Frequency Drive (VFD) keypad (Hand On). Ensure the VFD is in the Auto On mode for cutting operation. Make these checks first:

- Visually inspect external pump components for damaged parts, leaks, and other conditions that could prevent safe and proper operation.
- Ensure the area around the pump is clear of tools and other objects that could obstruct immediate access to controls, hindering safety.
- Verify the oil level in the pump crankcase is sufficient for operation (three quarts required).
- Ensure the pump cover and belt cover are in place and properly secured.
- Ensure the nozzle and mixing tube are the correct sizes and installed properly.
- Ensure you are familiar with the location and function of the controls.

Start the Pump

⚠CAUTION

Before powering up this equipment, ensure operators have access to the required protection devices (safety glasses, ear plugs, and gloves).

1. Turn the main power **ON** at breaker box.
2. Open the air supply valve.
3. Open the water supply valve.
4. Turn the **charge pump** power **ON**.
5. Open the charge pump **water inlet valve**.
6. Verify the **E-stop** on **pump** is pulled out.
7. Verify **E-Stop** [1] on **pendant** is pulled out (Figure 6).
8. Turn the table main power **ON**.
9. On the control pendant (Figure 6), press the **power ON button** [3] *before* Windows fully starts. If not done, press the **Reset** [4] button to activate the **drive motors**.
10. Turn the **pump** power **ON**.

NOTICE

If an error message appears at this point, press the RESET button on the VFD to recover.

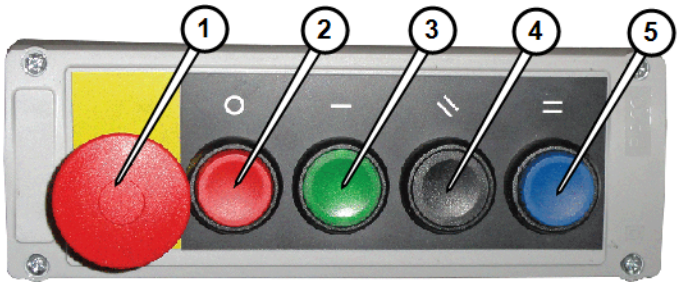

Figure 6

[1] E-stop [2] Power OFF [3] Power ON [4] Reset [5] Pause

Cooling Water

1. Verify cooling water flows from the **cooling return lines**.
2. Open the **water flush valve** to purge warm water from the **charge pump** plumbing.
3. Run the **charge pump** until the temperature of the water exiting the **coolant return lines** is below 70° F. The water temperature must be maintained between 40° F (4.4° C) and 70° F (21.1° C).

NOTICE

If the inlet water is above 60° F (15.6° C), pump seal life is shortened. If the temperature is above 70° F (21.1° C), a chiller is required for pump operation.

4. When the water exiting the **coolant return lines** is below 70° F (21.1° C), close the **charge pump water flush valve**.

Test and Adjust Pump Pressure

Pump rpm determines cutting pressure. The rpm can be adjusted up or down in Hand On (local) mode or in Auto On (remote) mode. In Hand On mode, rpm adjustment is done using the **VFD keypad buttons** [2]. In Auto On mode, rpm adjustment is done using the pump's **high pressure knob** [1] while MAKE is operating in Test mode.

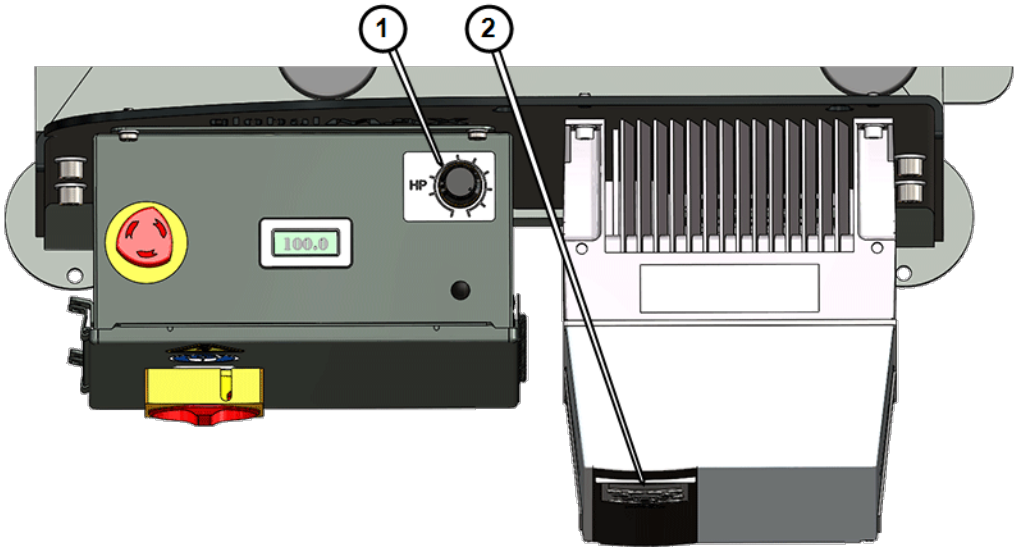

Figure 7

Adjust Pump RPM Value in Auto On Mode

Preset the pump psi value for high-pressure cutting or piercing in Auto On mode.

1. Remove the hopper end of the **abrasive feed tube** from the **abrasive flow gate**.
2. Press the **Auto On button** [1] on the **VFD keypad**.

Figure 8

NOTE: *Make sure the nozzle is in a safe position.*

3. Conduct the high-pressure test per the operator's guide.
4. Increase the high-pressure value displayed by turning the **high-pressure knob** [1] clockwise.
5. To decrease the high-pressure value displayed, turn the **high-pressure knob** [1] counterclockwise.

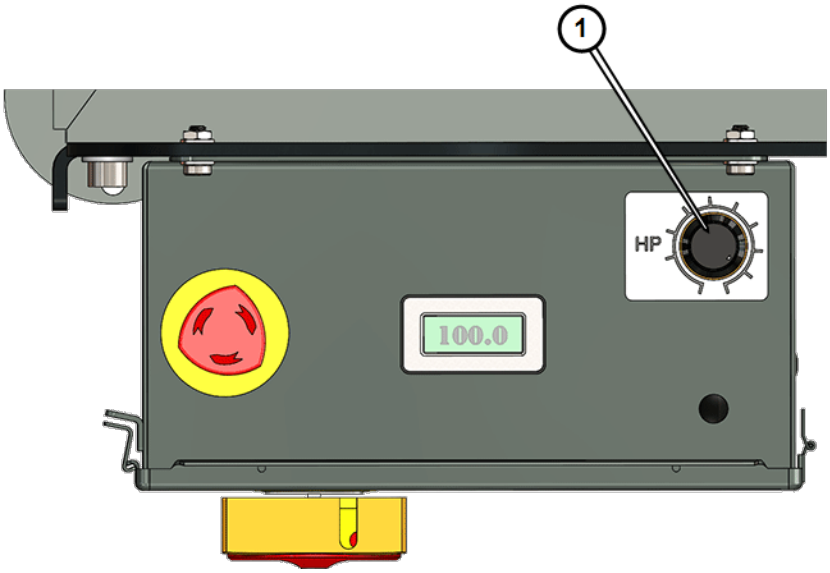

Figure 9

Stop the Pump

During normal cutting operation, MAKE automatically starts and stops the high-pressure pump as required. The pump can also be stopped using the keypad when in Hand On mode by pressing the Stop button or by pressing the **Pause button** [5] located on the pendant controller (Figure 6).

The pump can be immediately stopped at any time by pressing any of the emergency stop switches located on the pump control box or the pendant controller.

Adjust Pump RPM in Hand On Mode

NOTE: *Hand On Mode is typically only used in troubleshooting.*

NOTE: *Must have the nozzle in a safe position.*

NOTE: *Pump overpressure protection is disabled when operating in Hand On mode.*

1. Press the **Hand On** button on the **VFD keypad** to start the **pump**.
2. To increase the high-pressure value displayed, turn the **high-pressure knob** clockwise.
3. To decrease the high-pressure value displayed, turn the **high-pressure knob** counterclockwise.
4. When finished, press **OFF** on the **VFD keypad** to shut down the **pump**.

Emergency Stop (E-stop)

In case of emergency, press the E-stop switch on the pump, the table or the computer controller. This will immediately shut down the pump and the abrasive waterjet system. If the E-stop has been activated, all nozzle positioning information is lost. To resume operation after an E-stop, pull the E-stop switch back to its original position, press the Reset button and re-establish the machine limits and auto home positions.

Verify Pump and Nozzle Software Settings

NOTICE

It is critical the software settings match the actual MEASURED values for the pump pressures and abrasive flow rate, and the nozzle setup exactly matches the nozzle installed on the machine. If not properly matched, the cutting ability of the machine is compromised.

Refer to the operator's guide for your equipment to ensure the values in MAKE under Setup > Pump and Nozzle Settings match the actual measured values.

Startup Checklist

For GlobalMAX abrasive waterjet machines using the GlobalMAX MAXIEM pump, follow these steps to ensure that operational procedures specific to the GlobalMAX MAXIEM pump are completed correctly.

1	Turn main power **ON** at breaker box.
2	Open **air supply valve**.
3	Open **water supply valve**.
4	Turn **charge pump** power **ON**.
5	Open the **charge pump water inlet valve**.
6	Verify **E-stop** on **pump** is pulled out
7	Verify **E-stop** on **pendant** is pulled out.
8	Turn **table** main power **ON**.
9	Press **pendant** power **ON button** *before* Windows fully starts. If not done, press **Reset** button to activate the **drive motors**.
10	Turn **pump** power **ON**.
11	Verify cooling water flows from the **cooling return lines**.
12	Open **water flush valve** to purge warm water from **charge pump**.
13	Allow water to run for 15 minutes or until water temperature is 70 degrees Fahrenheit (21.1 Celsius) or less prior to operating the **pump** at high-pressure.
14	Refer to your abrasive waterjet operator's guide for remaining startup procedures specific to your equipment.

Water Filtration System Overview

Proper maintenance of the water filters in the low-pressure water system directly impacts the performance of the abrasive waterjet (see drawing 316752).

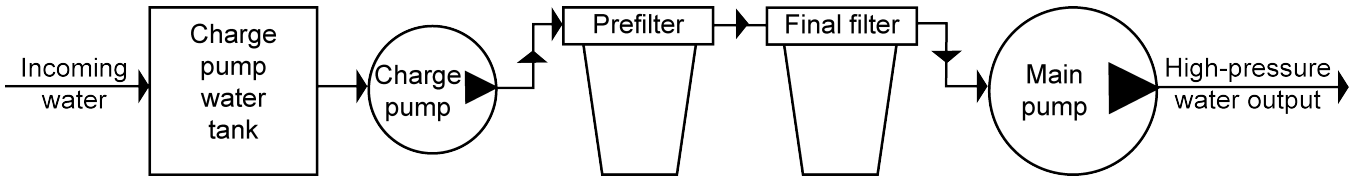

Figure 10

How the water-filtration system works

Incoming source-water is fed into the charge-pump water storage tank.

NOTE: *Additional filtering systems such as additional wall filters may be installed at this point for additional water treatment as needed.*

When the charge pump is ON, it pulls water from the charge pump water tank and routes it to the pump's prefilter.

NOTE: *The prefilter gauge reads the water pressure from the charge pump before the water enters the filters. The final-filter gauge reads the filtered water pressure after water has moved through both filters.*

The pre-filtered water then enters the final filter.

NOTICE

When the pressure difference between the gauges is more than 20 psi with the pump running at high rpm, the filters are becoming clogged and should be replaced (see 401074 Changing Water Filters).

The filtered water enters the high-pressure pump, then enters the high-pressure plumbing of the abrasive waterjet system.

Chapter 2: Troubleshooting

Troubleshoot Water Leaks in the Wet End Assembly

The following identifies the source of possible water leaks in the wet end assembly and suggests possible ways to correct them.

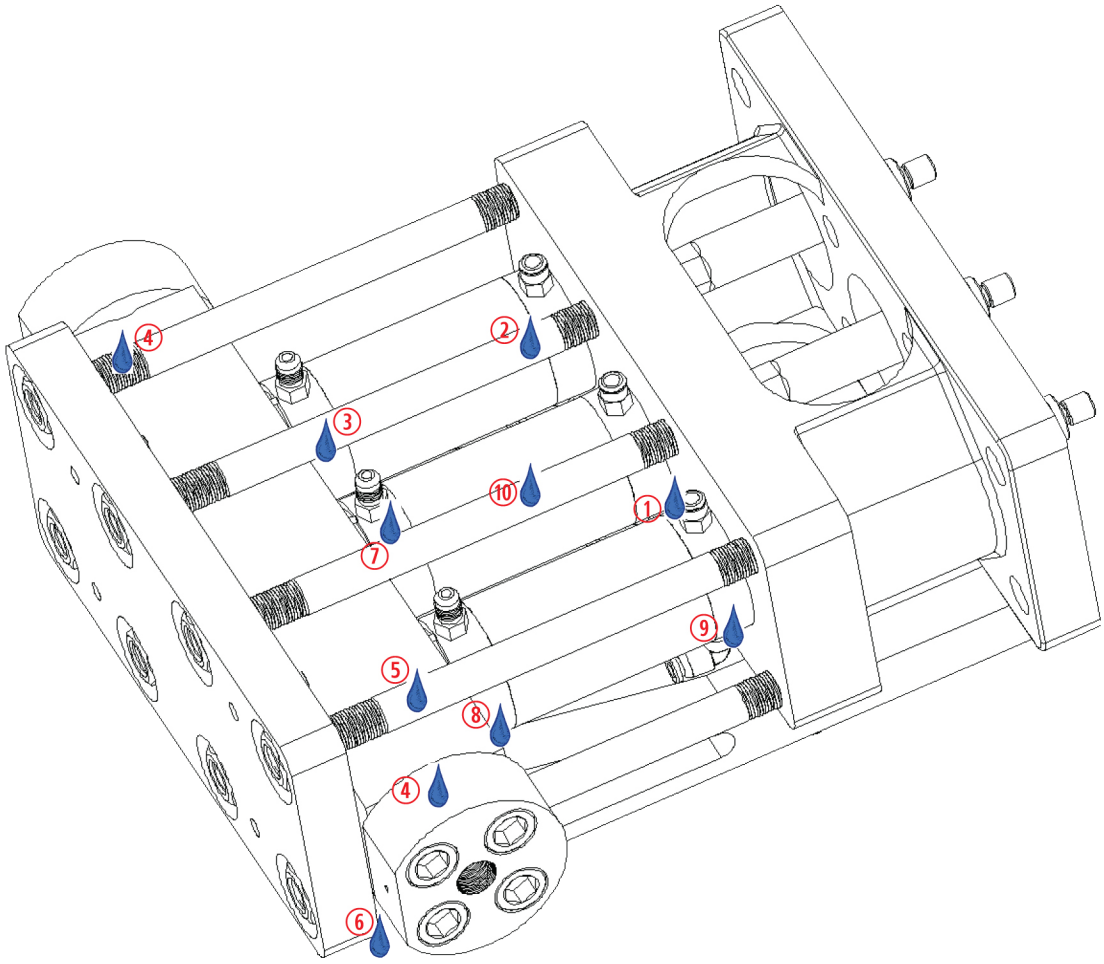

Figure 11

Leak	Leak Description	Suspected Causes	Recommended Action
1	Leak from coolant housing seal	Coolant housing seal failure	Replace coolant housing seal at next rebuild (this is coolant water and will not affect output pressure or pump life).

Leak	Leak Description	Suspected Causes	Recommended Action
2	Leak(s) between cylinder body and coolant housing (immediately after rebuild)	Insufficient torque on end-cap nuts; insufficient anti-seize on end-cap nuts	Check torque on clamp-plate nuts; apply fresh anti-seize to face of clamp-plate nuts and threads and tighten to 175 ft-lb (237 N·m)
	Leak between the cylinder and coolant housing	Cracked support ring; damage to the support ring that supports the ring seal; cracked cylinder	Rebuild wet-end assembly; inspect support rings for damage
3	Leak between check valve body and cylinder body (immediately after rebuild)	Liquid displacer installed upside down	Rebuild wet-end assembly; inspect liquid displacer for damage and to ensure it is within tolerance before re-installing in the cylinder. If damaged, replace
	Leak between the check valve body and cylinder	Cracked check-valve body; cracked support ring; damage to support ring that supports the ring seal; cracked cylinder	Rebuild wet-end assembly; inspect support rings for damage; inspect check-valve body for cracks and replace if cracked/damaged
4	Leak between port adapter and manifold	Port adapter seal failure	Replace port adapter seal
5	Leak between the check valve body and the manifold	Cracked check valve body; cracked manifold; seal has loose fit at stem of the check valve; damaged O-ring; extrusion of static ring seal	Rebuild wet end assembly; inspect manifold and check valve body for damage/cracks; inspect O-rings and seals for excessive extrusion, fit, and/or damage
6	Leak from weep hole on port adapter	Possible damage to seal surface of the port adapter; possible damage to tubing seat	Replace port adapter and seal; replace tubing
7	Warm fitting on check valve	Damaged check valve inlet seat or ball **Note:** There can be a damaged check valve inlet seat/ball with no noticeable heat	Rebuild wet end assembly; inspect for damaged check valve inlet seat or ball/replace as needed
8	Warm cylinder at check valve end	Damaged check valve outlet seat or ball	Rebuild wet end assembly; inspect for damaged check valve outlet seat or ball/replace as needed
9	Cylinder body warm at dynamic seal end only	NORMAL	NONE

Leak	Leak Description	Suspected Causes	Recommended Action
10	Sudden loss of pressure and cylinder body very warm or hot	Cracked check valve body between the high and low-pressure ports	Rebuild wet end assembly; inspect for cracks/damage in the check valve body (internal cracking–inspect, view (may require magnification) through the low-pressure port)

Customer Support

Refer to the **globalmax.omax.com** website for technical documents and distributor support.

Original Instructions in English
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