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TOOLING & MACHINERY

COMPLETE METALWORKING SOLUTIONS

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MACH 100 SYSTEM MANUAL

Includes Ancillary Options

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About this content

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Other notes

- Safety information for all products is consolidated into the applicable safety sections.
- If you see a reference to the number of "pages" included in a section, it is referring to the number of articles in that section. It is not a physical page count. Similarly, footnotes are at the end of an article, not always at the end of a physical page.

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Service and Support

We've committed ourselves to the success of our customers for over 40 years. As a result, nearly 1 out of every 3 systems built is delivered to repeat customers. We are proud to provide the largest and most highly trained support team, with the experience to ensure your success.

United States & Canada
23500 64th Avenue South · Kent, Washington 98032 · USA
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Safety

Important! Read carefully before use. Keep for future reference.

Safety

Part 1 of 3.

Pages: 5

- **How we show safety messages in content**
  How we show safety messages in content.
- **Intended use statement**
  Review of what the intended use is, who the intended user is for systems—including ancillary options—and modifications.
- **Emergency medical information**
  Vital information to be given to medical personnel in case of emergency.
- **Lockout/Tagout (LOTO)**
  Supplemental instructions to your facility Lockout/Tagout procedures. Includes instructions for systems and CF900 hopper.
- **Personal Protective Equipment (PPE)**
  Recommendations for PPE.

How we show safety messages in content

In our content, safety messages are highlighted with the safety alert symbol and a signal word, only a signal word, or only a signal word panel. Pay attention to these safety messages—they alert you to hazardous situations!

Safety alert symbol

 This is the safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Signal words

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

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

Signal word panels

DANGER

DANGER indicates a hazardous situation, which if not avoided, will result in death or serious injury.

NOTICE

NOTICE indicates a non-hazardous situation, which if not avoided, could result in property damage.

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Intended use statement

Intended use

The machine is used to cut virtually any type of material, including metal, stone, glass, and composites, across various industrial sectors.

Additional applications may be possible, but only with appropriate adjustments to the machine, which must be discussed with the manufacturer. A new Conformity Evaluation may be required and additional guidelines may then apply.

Any other use of the machine is not in accordance with its intended use and therefore not permissible.

In particular, the machine is not meant for the processing of explosive materials or materials that release explosive emissions. The machine may not be operated in areas that are vulnerable to explosions. In addition, the machine is not designed for food processing.

During normal operation of the machine, the operator shall maintain a minimum safe distance of 1200 mm (48 in.) from each side of the machine.

Intended use for ancillary items

- The PASER CF900 Abrasive Delivery System (ADS) is designed for the continuous transport of abrasive to the abrasive metering system located above the cutting head.
- Spreader bars allow a simple means of cutting small repetitive parts quickly, by duplicating the same cutting action simultaneously across multiple cutting heads.

Intended user

System operation and maintenance should be done by Flow-trained personnel. However, other suitably trained personnel may also operate the system and do maintenance on it.

We recommend that all service work be done by Flow Service. However, other suitably trained personnel may do service work on the system.

Work on the electrical or control system may only be done by trained, certified electricians.

Modifications

Modifications to the system, including all machine, pump, cutting head, software, and ancillary components, is prohibited after the manufacturer distributes the system. If the system is altered after distribution, conformity of the machine to the EC directives and standards no longer applies and the CE mark must be removed.

We recommend the exclusive use of original replacement parts.

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Emergency medical information

WARNING! Obtain medical treatment immediately for ANY high-pressure waterjet injuries. Even minor injuries that are painless or inconspicuous can lead to grave health problems.

It is vital that medical personnel have information about this type of injury. We recommend that anyone who works with high-pressure waterjet equipment carry a waterproof medical alert card. This card should describe their work and the nature of injuries inherent in using waterjets. You should also inform medical personnel what type of abrasive you used and the type of material you cut.

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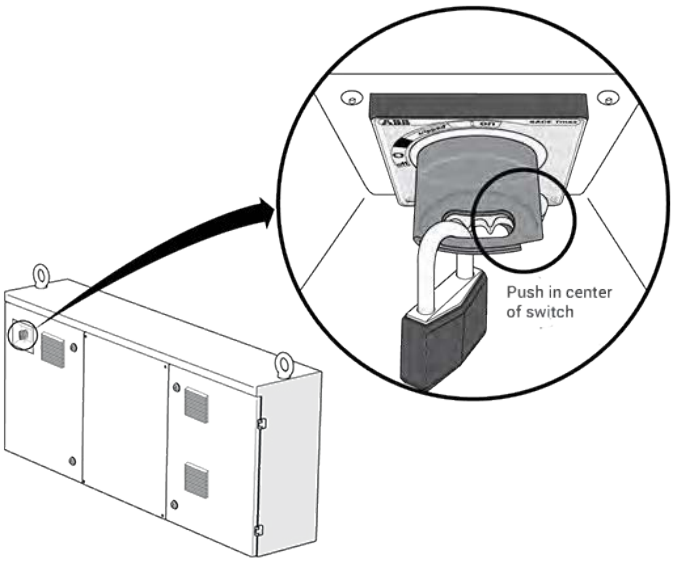
Lockout/Tagout (LOTO)

Only trained personnel can do Lockout/Tagout. These instructions are supplemental to your facility Lockout/Tagout procedures. We recommend your safety personnel approve all Lockout/Tagout instructions for anyone who works around high-pressure waterjet equipment.

HOW-TO

1. Jog the cutting head to a loading or safe position.
2. Exit all programs.
3. Press the E-stop.
4. Click **Start**, and then click **Shut down** to turn off the machine PC.
5. Wait until the machine PC is completely shut down, and then turn off the main power to the machine (pump and machine disconnect).
6. Lock the interface enclosure, and then put an appropriate tag on the enclosure.



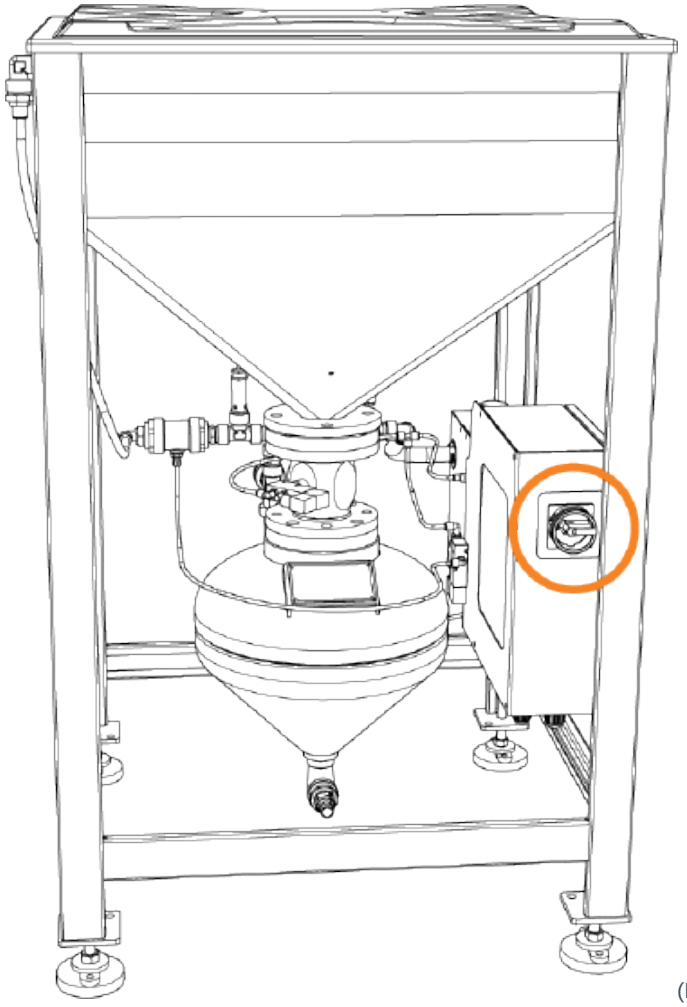
(Picture shown for general reference only and may vary from your machine model.)

7. Turn off the air and water supply.

Lockout/Tagout for the CF900 hopper

HOW-TO

1. Turn off the power switch, lock it, and then put an appropriate tag on it.



(Picture shown for general reference only.)

2. Turn off the air supply to the ADS, lock it, and then put an appropriate tag on it.

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Personal Protective Equipment (PPE)

Personal protective equipment (PPE) is equipment worn to minimize exposure to serious workplace injuries and illnesses. All PPE clothing and equipment should be of safe design and construction, and should be maintained in a clean and reliable fashion.

We recommend your safety personnel approve all PPE for anyone who works around high-pressure waterjet equipment.

	**Wear a mask!** Wear a dust mask to reduce particle or dust inhalation when you fill the abrasive delivery system with abrasive.
	**Wear eye protection!** Wear safety glasses with side shields or safety goggles to shield your eyes from flying debris and spray, including pressurized abrasive that may leak from the hopper silo or hose.
	**Wear ear protection!** Wear ear protection while the machine is in operation.
	**Wear protective clothing!** Wear protective clothing to shield your body from flying debris and spray.

	**Wear protective gloves!** Wear protective gloves when you handle sharp catcher tank slats or have to work around dirty water in the catcher tank. When you clean a hopper (ADS), wear gloves to prevent abrasive particles from penetrating any skin abrasions.
	**Wear protective footwear!** Wear steel or composite toe footwear.

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Safety precautions

Safety precautions

Part 2 of 3: Articles in this section refer to safety precautions to follow when using Flow equipment.

Pages: 7

- **Electrical safety**
  Includes instructions for the electrician.
- **Exceptional or emergency situations**
  What to do if you come across these exceptional or emergency situations.
- **Safety during cleaning**
  Safety precautions to follow during cleaning.
- **Safety during maintenance**
  Follow these safety precautions while doing maintenance.
- **Safety during operation**
  Safety precautions to follow during operation.
- **Safety for transport**
  Recommendations to follow if you have to transport the machine.
- **Transporting the CF900**
  Recommendations for how-to transport the ADS.

Electrical safety

DANGER Life threatening danger due to surge! Always assume that electrical components are live. Always turn the main switch to the system off when working on the electrical system. Post a sign “Maintenance in Progress—Do Not Energize.” Work on the electrical or control system may only be done by trained, certified electricians. Work must be done in accordance with respective guidelines.

Instructions for the electrician

- If it necessary to work on live components, then a second person must be available to turn the unit current off at the main switch in case of emergency.
- The main switch must always be turned off during maintenance work and service work on the machine. It must be secured against unintentional activation with a lock for the length of the work.
- To protect sensitive components in the machine control, the electrician must ground themselves before working at the control computer and the PLC control.
- Only specified safety mechanisms of equal power and inertia should be used.
- Only measuring tools in accordance with respective guidelines should be used.
- Always take great care when the electrical system is being worked on.
- Only use insulated tools when working on the electrical system.
- All replacement wires or cables must conform to the manufacturer’s specifications, including color coding, wire numbers, and size.

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Exceptional or emergency situations

Contact with special materials

Note the safety datasheets of the manufacturer when you handle colors, solvents or special substances. Such substances must be stored in accordance with applicable ordinances (Operational Facility Ordinance). Note the local wastewater regulations.

Electrostatic discharges

During cutting, the high flow rate of water and abrasive could cause electrostatic charging. Discharges could lead to the ignition of flammable substances, dust, or gases. Ground all components so that static electricity does not form a spark.

The machine comes with the appropriate grounding cables. If the cables are defective, replace them immediately.

Emissions

Always pay attention to the data sheets of the material being cut! Although rare, flammable gases could develop in the water if you cut materials (such as aluminum) that lead to aggressive oxide formation. Work in a well-ventilated area to minimize exposure to vapors that could occur.

To avoid deflagrations, lower the water level in the catcher tank until the water is under the bottom of the material.

Explosions

Do not operate the machine in areas that are vulnerable to explosions.

If you weld, do flame cutting, or use an angle grinder in close proximity to the machine, clean the surrounding area and remove flammable materials. Under certain conditions, material dust can lead to deflagration or explosion.

Fire

If you cut flammable or difficult-to-extinguish materials, pay particular attention to fire prevention/ extinguish protocols.

Familiarize yourself with the exit routes at your facility. Know how to trigger a fire alarm. Know where fire extinguishers/blankets are located and how to use them. Know what the appropriate extinguisher is to use for the materials you process.

In the event of a fire, keep calm. Call the fire department, and follow evacuation protocols.

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Safety during cleaning

Follow these safety precautions during cleaning:

- Do not clean any part of your machine with the high-pressure water stream.
- Only use recommended cleaners (or equivalents) to clean your machine. Follow the safety instructions given by the manufacturer of the cleaner.
- Only use cleaners in well-ventilated areas. Avoid prolonged breathing of fumes and contact with skin or eyes.

Keep a clean work environment

- Keep the area around the machine clean and free of obstacles.
- Keep the floor clean and dry—abrasive residue, material dust, and water make the floor slippery. We recommend that you use grid plates or anti-slip mats to reduce the risk of slipping.
- Do not use any part of the machine as a place to store things.

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Safety during maintenance

General

- Do a Lockout/Tagout on the system—including the machine, high-pressure pump, and all ancillary equipment—before you do any maintenance. (Electrical and pneumatic air).
- Be alert at all times when doing maintenance on the machine.
- Do not patch damaged hoses—replace them.
- High-pressure water can remain in the system for an extended time after shutting down the water source. Always bleed-down system pressure before servicing any part of the system.
- Do not exceed specified pressure setting limits for pneumatic or hydraulic components. Exceeding these limits may result in serious injury to personnel or damage to the equipment.
- Torque all fittings to the manufacturer's torque specifications.
- Follow the manufacturer's recommendations for maintaining the equipment, and use only original manufacturer replacement parts.
- Follow the manufacturer's system startup procedure to ensure safe operation.
- Use care when lifting equipment covers during operation.

High-pressure system safety

- Do not patch high-pressure tubing—replace it.
- Welding on high-pressure component or high-pressure tubing is forbidden.
- Do not step on or lean against high-pressure tubing. Doing so could cause leaks.
- Do not touch weep holes with your bare hands or try to stop water by plugging the holes.
- Only use high-pressure fittings, valves, and tubing that are rated for the pressure of your equipment [4150 bar (60,000 psi) or 6000 bar (87,000 psi)], depending on your configuration].
- Do not exceed specified operating pressures for high-pressure water system components.

Tools

- Special tools could be provided for certain work. Only use these special tools for the work intended. Follow the procedures for using the tool(s) to avoid injury or damaged components.
- If instructions call for the use of a certain tool, only use the tool specified to avoid injury or damage components.

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Safety during operation

General

- The waterjet stream can sever or severely injure human extremities. Do not allow the waterjet stream to touch any part of your body. Do not point the waterjet stream at anyone. Do not put anything in its path that you do not intend to cut.
- Don’t start the system unless you know how to stop it.
- Do not leave the machine unattended. Be alert at all times while the machine is in operation. If there are people in the vicinity of the waterjet system, make sure they are clear of the hazard area before the waterjet it activated or the part program is run. Clear communication helps prevent unexpected movement/activation of the waterjet.
- Do not touch high-pressure components when they are pressurized.
- Never try to support the workpiece by holding it with your fingers, either above or below the workpiece—the jet retains almost all of its cutting power below the work.
- Never put your hands in the tank when the machine is operating. Plan material clamping—in advance—so that you don't handle material or parts while the machine is in operation.
- Never climb on or around the equipment on makeshift devices. Use only approved catwalks, ladders, or platforms.
- Never walk directly on the catcher tank slats to remove parts. Slats can weaken over time fail.
- Always use the appropriate lifting equipment to move material on and off the work platform.

For the CF900 hopper

- Never operate the ADS unless the abrasive outlet hose is connected to the waterjet machine.
- Always keep the lid on, except when adding abrasive. The lid prevents abrasive from spraying from the silo when the vessel releases pressure before entering the fill cycle.

For machines with a spreader bar

- Using the spreader bar increases the likelihood of a pinch point hazed with the side of the catcher tank.
- Make sure that the ultra-high pressure water is off and that a part program is not running before you toggle the on/off switch on the spreader bar.
- Use of the spreader bar allows the user the ability to cut over the water level adjustment bladder via positioning of the cutting head(s) on the spreader bar. Severe damage to the machine will

result if the water level adjustment bladder is cut by the high-energy waterjet. Before you run a part program, confirm that the position of the cutting head(s) will not cut the water level adjustment bladder.

Abrasive

Garnet is the most frequently used abrasive. It is generally considered inert and has no known health hazards. NEVER use silica sand as an abrasive—the dust produced causes silicosis, a lung disease.

Never disconnect abrasive feed lines while under pressure. This can cause abrasive to spray into eyes.

Noise emission

During the normal cutting operation—with the bottom of the material to be cut under water—the distance of the nozzle exit to the material smaller than 2.5 mm – the noise emission is under 85 dB(A).

However, under certain circumstances, the machine causes higher noise emissions. At the start of material drilling or cutting above the water, the noise level can climb over 115 dB(A). Always wear hearing protection. The longer the jet, the higher the noise level.

Under certain circumstances, the area surrounding the machine can amplify sound effects, which must be noted.

If the surrounding area becomes noisy, the sound from the adjacent areas must be monitored and the necessary measures taken.

For the CF900 hopper

Sound levels were measured 1 m (3 ft) from the front of the ADS and 1.6 m (5 ft) from the ground, during the following actions:

Conveying abrasive……69.6 dBa
Pressurization……79.4 dBa
De-pressurization……98 dBa

Safety for transport

We recommend the following:

- Always disconnect the power supply and empty the catcher tank—even if the machine is only moved a short distance.
- Load and unload all equipment with a properly rated forklift in accordance with local regulations. Make sure that you have flaggers and spotters present while you load or unload equipment. Never walk under a hanging load.
- Secure the load so that it does not move during transport.

Disposal or recycling

Dispose of or recycle the machine and its components in accordance with all local regulations.

Transporting the CF900

If you plan to connect the ADS to a different voltage power supply in the new location, please contact Flow Service.

To transport the ADS

1. Lift the ADS with a forklift or pallet jack. Place the forks under a pair of lower beams on the frame (accessible from all four sides).

    **WARNING!** If you leave abrasive in the silo, it could cause an unsafe high center of gravity during transport.

2. Lift the ADS with a forklift or pallet jack. Place the forks under a pair of lower beams on the frame (accessible from all four sides).

    **WARNING!** Load and unload all equipment with a properly rated forklift or pallet jack in accordance with local regulations. We recommend that you have flaggers and spotters present while you load or unload equipment

3. Secure the load so that it does not move during transport.

To set up the ADS after transport

Put the equipment in position, and then level the ADS with the level pads. If required, use anchor bolts to attach it to the floor.

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Safety labels

Safety labels alert you to a hazard. Do not remove the labels from your system. If a label becomes illegible or damaged, replace it immediately. Cross reference the labels shown on the equipment and/or in the diagrams to the applicable label key.

Safety label cross reference

Part 3 of 3: Cross reference the labels shown on the equipment and/or in the diagrams to the applicable label key.

Pages: 3

- **Key: Hazard Alert labels**
  These labels warn you of hazards which could result in personal injury.
- **Key: Mandatory and Prohibited Action labels**
  These labels inform you of actions to take to avoid hazards that could result in personal injury.
- **Diagram: CF900 ADS**
  Diagram showing the location of the safety labels on the Paser CF900 ADS. (Ancillary option for all new Mach series systems)

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Key: Hazard Alert labels

Hazard Alert labels warn you of hazards which could result in personal injury.

Label	Hazard
	General warning
	Risk of electrical shock.
	Protective Earth Ground
	Risk that you could slip or fall due to wet or slick surfaces.
	Risk that you could sever your fingers due to pressurized water.

	Risk that you could crush your hand(s) due to moving parts.
	Pinch point hazard
	Risk that you could crush your body due to force from the side.
	Risk that you could entangle your hand(s) in machinery due to belt drive.
	Risk of flying debris. Wear eye protection.

Key: Mandatory and Prohibited Action labels

Mandatory Action labels

Mandatory action labels convey actions you must take to avoid hazards that could result in personal injury.

Label	Action to take
	Read the manual before operation. Save all instructions for use.
	Wear a dusk mask.
	Wear eye protection.
	Wear ear protection.

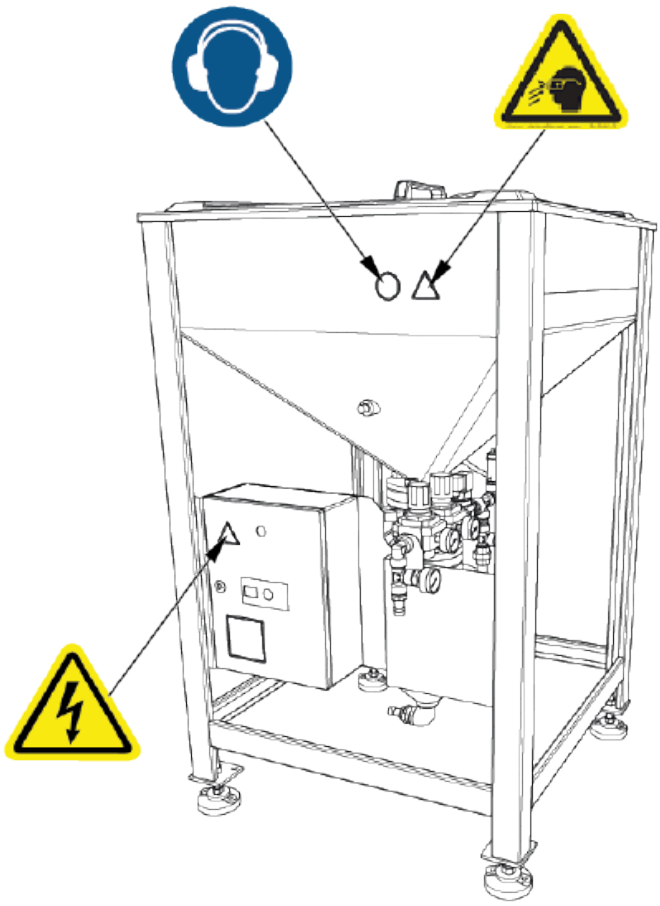
	Wear protective clothing.
	Wear protective gloves.
	Wear safety footwear.
	Lockout/Tagout

Prohibited Action labels

Prohibited Action labels convey actions that are prohibited because it could result in personal injury.

Label	Prohibited action
	Do not step in this area.
	Do not enter. Authorized personnel only.

Diagram: CF900 ADS



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Introduction to Mach 100

The Mach 100 is the essential waterjet that gives you the fundamental versatility of waterjet cutting with no frills. Engineered with the same components as Flow's premium cutting solutions, the Mach 100 features robust cutting capabilities and a programmable Z-axis for added flexibility. Everything you want, exactly what you need.

Options

Some options may not be available in your area or for a particular configuration. Please contact your regional office for more information.

Table sizes
- Bridge at 1.3 m, 3 m, or 4 m
- Base at 1.3 m or 2 m

Ultrahigh-pressure pumps
- HyPlex Prime rated at 4150 bar (60,000 psi)
- ESL Intensifier rated at 4150 bar (60,000 psi)
  - – 30SA or 7X

Software
- FlowMaster Standard
  - – Includes FlowCUT 7, FlowPATH 7, and FlowNEST
- FlowMaster Premium
  - – FlowCUT 7, FlowPATH 7, FlowNEST, and FlowCODE
- FlowXpert 3D CAD/CAM package

Cutting head options
- Pure Waterjet
- Standard Waterjet

Ancillary options

For the cutting head
- UltraPierce Vaccum Assist

For the machine
- Final Filter System
- Light curtains
- Xtractor Abrasive Removal System

Hoppers
- 100 lb hopper
- 2200 lb hopper
- Paser CF900 Abrasive Delivery System (Continuous-fill hopper)

Accessories
- Laser pointer
- Low-profile clamps
- ProXtract part removal wand
- Supersack stand for hopper

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Facility requirements

Facility requirements

Pages: 5

- **Clearances**
  Minimum clearances required vary by machine type. View the minimum clearances required for Mach 100, Mach 200, Mach 300, and Mach 500 systems.

- **Environment**
  View the facility environment requirements for systems.

- **Ethernet connection**
  Be aware of these things when it comes to the Ethernet connection.

- **Foundation requirements for Mach 100**
  Everything starts with a great foundation and your waterjet is no exception! Learn what the foundation requirements are for a Mach 100 machine.

- **Plumbing for Mach 100**
  Plumbing requirements—including air and drain—for a Mach 100 machine.

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Clearances

Local codes and regulations will determine the actual distance that is required for clearances. Obstructions include lights, sprinkler heads, or HVAC.

Cross reference your machine type and model with the list below to determine how much clearance you'll need.

Mach 100

1313 models
Recommended clearance each side ……1000 mm (39 in.)
Minimum vertical clearance, unobstructed ……4000 mm (157.5 in.)

3020 or 4020 models
Recommended clearance each side ……1000 mm (39 in.)
Minimum vertical clearance, unobstructed ……4270 mm (168 in.)

Mach 200

1313 models
Recommended clearance each side ……1000 mm (39 in.)
Minimum vertical clearance, unobstructed …… 3033 mm (119 in.)

3020, 4020, or 7320 models
Recommended clearance each side ……1000 mm (39 in.)
Minimum vertical clearance, unobstructed …… 4286 mm (169 in.)

Mach 300

All models
Recommended clearance each side ……1000 mm (39 in.)
Minimum vertical clearance, unobstructed …… 3810 mm (150 in.)

Mach 500

All models with a 305 mm vertical axis

Recommended clearance each side ……1000 mm (39 in.)
Minimum vertical clearance, unobstructed …… 3810 mm (150 in.)

All models with a 610 mm vertical axis

Recommended clearance each side ……1000 mm (39 in.)
Minimum vertical clearance, unobstructed …… 4110 mm (162 in.)

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Environment

Ambient temperature
15.5°–38°C (60°–100°F)

Recommended temperature
20°±3°C (68°± 5°F)

Relative humidity
up to 90% @ 38°C (100°F), non-condensing

Airborne dust/contaminants
minimal

Radio frequency interference
minimal

Lighting
adequate to operate and service the machine

If large temperature changes occur within an undefined period, length variances exceeding specified tolerances could occur over the entire work envelope. The tolerances of parts cut in extreme heat will differ from those cut in extreme cold because of variances produced in both the machine's structure and expansion of the actual part.

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Ethernet connection

The maximum cable length for Ethernet connection is 76 m (250 ft). If a longer length of cable is required, you must install a switch near the interface enclosure to amplify the signal. Otherwise, it may not be possible to connect the machine to your network, and this will limit our ability to support the machine via VPN.

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Foundation requirements for Mach 100

Everything starts with a great foundation and your waterjet is no exception! If you do not have an adequate foundation, the accuracy of your machine is affected.

Your foundation must be:

- Able to support the weight of the machine when the catcher tank is filled with dirty water.
- Free of expansion joints in the area that you plan to put your machine. (The purpose of expansion joints is to concentrate foundation movement and imperfections to these specific areas.)
- Level to 13 mm (1/2 in.) across the span of the machine.
- Structurally reinforced and undivided to ensure even settling, should any settling occur.

In abnormal cases where a poor foundation or unusual soil conditions are present, your machine could require an isolated monolithic foundation of adequate mass to resist both static and dynamic loads imposed by the machine. Consult a local structural engineer to obtain design input based upon your particular soil bearing and floor conditions.

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Plumbing for Mach 100

Air

Air supply ..... dry and filtered to 10 microns
Capacity ..... 0.42 cubic meters @ 6.2 bar (15 scfm @ 90 psi)

Drain

Capacity ..... 8 L/min @ 0 bar (2 gpm @ 0 psi) minimum per cutting head
Interface type ..... 3/4 PT

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Get started: Operation Basics

Get Started: Operation Basics

Pages: 6

- **Specifications for Mach 100**
  Key specifications, including operating parameters for a Mach 100 system.
- **Learn the machine interface for Mach 100**
  Information on the indicator lights and buttons for the Mach 100 roll-around console.
- **Start-up inspection**
  The purpose of a start-up inspection is twofold: it ensures that your machine is safe to operate, and helps your operators find small problems before they become big ones.
- **Start the machine**
  Follow these steps to start the machine from a cold start (no power).
- **Stop or end the part program**
  Learn how to stop, end, restart, or resume the part program.
- **Shut down the machine**
  If you have to shut down the machine, follow these steps to do so.

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Specifications for Mach 100

Machine specs and operating parameters are as follows:

Z-axis travel
178 mm [7 in.]

Catcher tank load rating [1]
400 kg/m² [82 lb/ft²]

Repeatability
± 0.0635 mm [0.0025 in.]

Traverse speed
up to 10 m/min [400 in./min]

Linear straightness accuracy
± 0.127 mm/m [0.005 in./3 ft]

Operating parameters
Mixing tube length……4 in.

Electrical
Power supply……3-phase
Main circuit breaker size [2]……20 amp for 380-480 VAC or 30 amp for 220 VAC

Air
Air supply……dry and filtered to 10 microns
Capacity……0.42 cubic meters @ 6.2 bar (15 scfm @ 90 psi)

Drain
Capacity……8 L/min @ 0 bar (2 gpm @ 0 psi) minimum per cutting head
Interface type……3/4 PT

1. Ratings assume a full table of slats that are in good, like-new condition.
2. For machine only; does not include the high-pressure pump.

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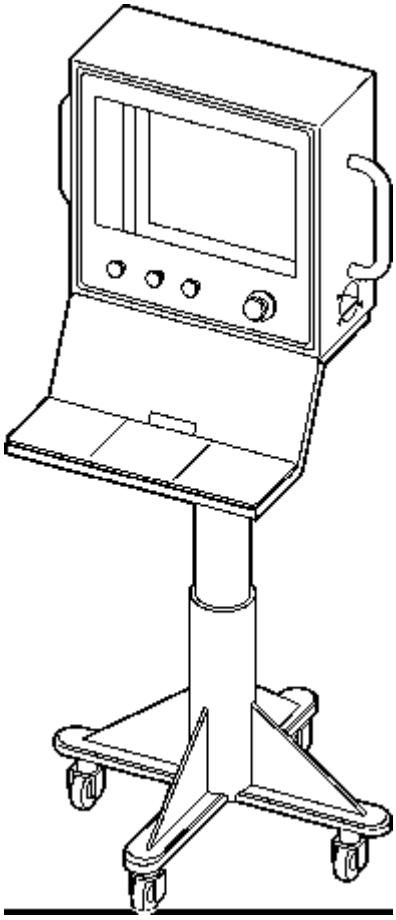
Learn the machine interface for Mach 100



Power on (white lamp)

This lamp is lit whenever power is applied to the control circuitry of the machine. It will remain lit, even if an E-stop is activated. When the lamp it lit, it indicates that the ventilation fans are running, and that 24VDC is provided to the E-stop/interlock circuitry.

System ready (green lamp)

This lamp is lit whenever the E-stop/interlink circuit is complete, and the machine is ready to have 3-phase power applied to the servos.

Driver power (green pushbutton/lamp)

This illuminated pushbutton supplies 3-phase power to the servo amplifiers, enabling axis motion.

Emergency stop (red mushroom switch)

The E-stop stops machine motion and shuts down the pump. It also removes 3-phase and 24VDC power from servo amplifiers and I/O circuits; however, Power On indicator will remain lit, and 24VDC power to the panel PC will not be interrupted. The lubrication system will remain functional when the machine is in E-stop mode.

Fault indicators

The safety light that is integrated into the buttons of the PC monitor enclosure alerts the operator of machine faults. The light will flash during a Warning condition, and remain steady for a Shutdown condition. The operator can determine the specific fault condition by viewing messages on the FlowCUT screen.

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Start-up inspection

The purpose of a start-up inspection is twofold: it ensures that your machine is safe to operate, and helps your operators find small problems before they become big ones. This means less unscheduled downtime and fewer repairs which ultimately improves your bottom line!

- □ There is nothing on or around the table that will impede movement of the axes.
- □ All cover, panels, and doors on the machine are in place or closed.
- □ The catcher tank slats are in good, like new condition.
- □ The air and water supply to the machine are on.
- □ The inlet water and cooling water supply to the pump are on.
- □ There is an adequate amount of oil in the pump.
- □ There is an adequate amount of abrasive in the hopper.
- □ Inlet water pressure is acceptable.
- □ Ancillary equipment is on.
- □ The pump is at the correct pressure.
- □ The pump is not leaking.

Start the machine

To start the machine from a cold start (no power), make sure that main air and main water supplies are turned on to the machine, then follow these steps:

1. Turn on main power disconnect located on the far right side of the electrical enclosure. If there is an additional disconnect on the wall that feeds power to the machine, make sure this is turned on as well.
2. Turn on power to the machine PC.
3. Let the PC boot up to the basic Windows start screen, where the FlowMaster icons are located.
4. Disengage all E-Stop switches.
5. Push the E-Stop reset button. The button will light up.
6. Push the Control On button. The button will light up.
7. Start FlowCUT by double-clicking the FlowCUT icon.
8. At this point, you can load a part file (ORD file) and set the proper Jet Setup and material/ thickness properties, but this is not necessary.
9. Click on the Run Machine icon. The screen should change to show the machine controls (Water, Abra- sive, Pump, and so on).
10. Home the Z-axis. Click on the Home Z,A,B-axis icon.
11. Home the X,Y-axes. Click on the Home X,Y-axes icon, then choose Go to Machine Home from the selection list. The machine should then move to the front left corner of the work envelope and is ready to run at that point.

Stop or end the part program

To stop the part program

When you stop the part program, the high-pressure water stream and abrasive flow also stop.

To	Do this
Stop the part program	Choose one of three ways: • Click **Cycle Stop**. • Press the Spacebar. • For Mach 200, 300, or 500 only: Push the **Cycle Stop** button on the roll-around console.
Restart the part program after it was stopped	Click **Cycle Start**.
Resume the part program after it was stopped	1. On the **Cutting** menu, click **Cut from a point**. 2. Click the point in the drawing "just before" the location where the program stopped. 3. When you receive the “Jet will move to this point and start the cut by USING CURRENT HOME POSITION” message, click **Yes**.

To end the part program

When you end the part program, the high-pressure water stream and abrasive flow stop. If you selected the **Automatically turn off pump after cutting** check box in FlowCUT during setup, the pump also stops.

To	Do this
End the part program	Press the Esc key.
Restart the part program after you end it	1. Start the pump. 2. Click **Cycle Start**.
Resume the part program after you end it	1. Start the pump. 2. On the **Cutting** menu, click **Cut from a point**. 3. Click the point in the drawing "just before" the location where the program stopped. 4. When you receive the “Jet will move to this point and start the cut by USING CURRENT HOME POSITION” message, click **Yes**.

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Shut down the machine

The machine should be shut down if it will not be run for an extended period of time (e.g., overnight). To shut down the machine normally, follow these steps:

1. Jog the machine manually so that the X and Y axes are near the HOME position (X0, Y0). This is not a necessary step, but it will make it more convenient to HOME the machine next time you start up the machine.
2. Manually jog the Z-axis to its highest position off of the cutting surface.
3. Exit FlowCUT and shut down Windows so that the message ‘It is now safe to shutdown your computer’ is visible on the screen.
4. Push the CONTROL ON button on the right side of the display monitor enclosure.
5. Engage the E-stop button on the right side of the display monitor enclosure.
6. Turn off the power. If you need to leave the Main Power Disconnect switch on in order to continue to supply power to peripheral equipment, turn off power to the PC using the switch on the front of the PC. Otherwise, turn off power to the machine using the Main Power Disconnect switch.

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Preventative maintenance

Preventative maintenance is done on the equipment at regular intervals to minimize unscheduled production down time and premature parts failure. As a general best practice, we strongly recommend that you keep detailed maintenance and service records.

Preventative maintenance

Refer to articles in this section for general information about Mach 100 preventative maintenance, including various how-to articles, preventative maintenance schedule, and spare parts.

Pages: 9

- **Preventative maintenance schedules**
  Reference this chart for Mach 100, Mach 200, Mach 300, Mach 500 preventative maintenance schedules.
- **Flow Parts**
  Parts shown are grouped by cutting type and are for Mach 100, Mach 200, Mach 300, and Mach 500 unless otherwise noted. Includes part numbers for cutting heads and on/off valves.
- **Recommended cleaners and lubricants**
  For the best results, use these recommended cleaners and lubricants.
- **Torque specification**
  If a torque value for a gland nut is not specified, reference this table to determine torque value.
- **Clean the diamond orifice and nozzle nut**
  Clean the diamond orifice and nozzle nut every 250 hours or any time you experience degraded waterjet quality.
- **Clean the linear rails**
  Clean the linear rails every 120 hours of operation.
- **Inspect and clean the bellows**
  Inspect and clean the bellows monthly.
- **Inspect the mixing tube**
  Inspect your mixing tube daily so you can monitor and limit ID growth.
-

Replace the diamond orifice

Replace the diamond orifice as needed.

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Preventative maintenance schedules

We recommend that you keep a log of all maintenance work that is done on your machine.

What do I do?	When do I do it?	Mach 100	Mach 200	Mach 300	Mach 500
Start-up inspection	Daily	✓	✓	✓	✓
Inspect the mixing tube.	Daily	✓	✓	✓	✓
Spray the mixing chamber vent with clean water.	Every four hours of operation	✓	✓	✓	✓
Clean the cutting head with air.	Weekly	✓	✓	✓	✓
Dynamic Waterjet height sensor calibration	Weekly	—	—	✓	✓
Dynamic Waterjet straightness adjustment	Weekly (See FlowCUT help files for instructions.)	—	—	✓	✓
Dynamic XD calibration	Monthly	—	—	—	✓
Clean and inspect the bellows for rips.	Monthly	✓	✓	✓	✓
Lubricate the bearings and linear rails.	Every 120 hours of operation	✓	✓	✓	✓
Clean the linear rails.	Every 120 hours of operation	✓	✓	✓	✓
Clean the diamond orifice and nozzle nut.	Every 250 hours of operation	✓	✓	✓	✓
Replace the diamond orifice.	As required	✓	✓	✓	✓
Call Flow to schedule a ballbar test.	Every six months	✓	✓	✓	✓

Flow Parts

Parts shown are grouped by cutting type and are for Mach 100, Mach 200, Mach 300, and Mach 500 unless otherwise noted.

Cutting head

Cutting head assembly [1, 2]
- Standard or Dynamic Waterjet……041136-1
- Dynamic XD……045160-3
- Pivot+ Waterjet……060009-1

Blast disk
- Standard or Dynamic Waterjet……711933-1
- Dynamic XD……048151-1
- Pivot+ Waterjet……058211-1

Collet
- Standard or Dynamic Waterjet……A-23161-8
- Dynamic XD……710806-1
- Pivot+ Waterjet……710806-1

Mixing chamber
- Standard or Dynamic Waterjet……041138-2
- Dynamic XD……041138-2
- Pivot+ Waterjet…… 060017-1

Mixing chamber cap
- A-11080

Mixing tube | DELTA NXT Premium
- Standard or Dynamic Waterjet……1000003-XX-40
- Dynamic XD……1000003-XX-40
- Pivot+ Waterjet…… 1000004-XX-30

Mixing tube | DELTA Standard
- Standard or Dynamic Waterjet……1000001-XX-40
- Dynamic XD……1000001-XX-40
- Pivot+ Waterjet…… 1000002-XX-30

Mixing tube spacer
- Standard or Dynamic Waterjet……712265-1
- Dynamic XD……712265-1

Nozzle body
Standard or Dynamic Waterjet……041137-1
Dynamic XD……044837-1
Pivot+ Waterjet……060010-1

Nozzle nut
Standard or Dynamic Waterjet……711589-1
Dynamic XD……711589-1
Pivot+ Waterjet……014241-1

Orifices | Abrasive cutting
Diamond……015849-XX
Ruby (60K only)……041759-XX

Orifices | Water-only cutting
Diamond……D-5071-XX
Sapphire……004519-XX

O-ring | Buna-N; 70 Durometer
A-15034-1

O-ring | -108
Pivot+ Waterjet……A-0275-108

O-ring | -209
Pivot+ Waterjet……A-0275-209

Spray shield
Standard or Dynamic Waterjet……040411-1
Dynamic XD……048149-1
Pivot+ Waterjet……058212-1

V-ring seal
Standard or Dynamic Waterjet……A-22752-11
Dynamic XD……A-22752-11

On/off valve

On/off valve
Standard Waterjet for Mach 100……014553-1
Standard or Dynamic Waterjet……014660-2
Dynamic XD……014660-2
Pivot+ Waterjet……060647-1

On/off valve seal kit
014988-1

On/off valve seal kit installation tool
019623-1

Other

Blue Lubricant
A-2185

Food grade O-ring grease
A-4689

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1. Cutting head assemblies do not include a mixing tube or orifice.
2. For Dynamic XD and Pivot+ Waterjet, the on/off valve is included in the cutting head assembly.

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Recommended cleaners and lubricants

We recommend that you use the following lubricants and cleaners for your machine.

Rails
CRC Technical Grade 3-36® Multi-purpose Precision Lubricant or equivalent cleaner

Bellows and painted surfaces
Johnson Envy Instant Cleaner or equivalent

Bearings and linear rails
Mach 100 …… Shell Tonna S2 M 68
Mach 200, Mach 300, or Mach 500 …… AFF Grease

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Torque specification

If a torque value for a gland nut is not specified, reference this table to determine torque value. Always leave 3–4 threads showing between the end of the high-pressure tubing and gland nut collar.

If the high-pressure tubing OD is…	Then torque the gland nut to…
1/4 in.	20–34 N-m (15–25 ft-lb)
3/8 in.	47–60 N-m (35–45 ft-lb)
9/16 in.	80–100 N-m (60–75 ft-lb)

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Clean the diamond orifice and nozzle nut

Clean the diamond orifice and nozzle nut every 250 hours or any time you experience degraded waterjet quality.

TOOLS & SUPPLIES

- Clean, lint-free cloth
- Detergent/cleaning agent (Fisher Scientific, FL-70 alkaline detergent, #SF105-1)
- Distilled water
- Isopropyl alcohol
- Plastic forceps (Fisher Scientific #10-309)
- Three 100 ml graduated polypropylene beakers (Fisher Scientific #02-591-10B)
- Two 1-liter bottles with airtight, nonmetallic caps
- Ultrasonic cleaner, 70–80 kHz frequency

GOOD TO KNOW!

- We recommend that you put your parts in beakers instead of directly into the ultrasonic cleaner. Why? Parts have to cycle through three different solutions during the cleaning process. By using beakers, you will save time and use less solvent!

Mix the cleaning solution

1. Put 720 ml of distilled or de-ionized water into a 1-liter bottle, and then slowly add 80 ml of isopropyl alcohol to make a 10% solution.
2. Put a cap on the bottle, swirl to mix, and then put a label and a date on the bottle.
3. Put 440 ml of distilled water into a 1-liter bottle, and then slowly add 440 ml of FL-70 detergent to make a 50% solution.
4. Put a cap on the bottle, swirl to mix, and then put a label and a date on the bottle.
5. Put labels on the three beakers as follows: 10% isopropyl alcohol, 50% distilled water, Distilled water.
6. Put 50 ml of each solution into the applicable beaker.
7. Put the beakers in the ultrasonic cleaner (from left to right) in this order: 10% isopropyl alcohol, 50% distilled water, Distilled water.
8. Put distilled water into the ultrasonic cleaner until it is just below the 50 ml mark on the beakers.

Clean the parts

CAUTION! Parts are cycled through chemical solutions. Always handle the parts with plastic forceps.

1. Switch on the ultrasonic cleaner.
2. Put the orifice in the beaker of isopropyl alcohol, and then let it soak for five minutes.
3. Move the orifice to the beaker of detergent, and then let it soak for five minutes.
4. Move the orifice to the beaker of distilled water, and then let it soak for five minutes.
5. Remove the orifice from the beaker, set it on a clean, lint-free cloth, and then let it air dry.
6. Examine the orifice to make sure that it did not dislodge from its mount during cleaning. Make sure that all the parts are clean and free of debris and abrasive.
7. Keep the orifice in a clean container.
8. Repeat steps 1–7 for the nozzle nuts.

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Clean the linear rails

Clean the linear rails every 120 hours of operation.

SUPPLIES

- Clean, lint-free cloth
- CRC Technical Grade 3-36® Multi-purpose Precision Lubricant or equivalent cleaner

HOW-TO

1. Pull back all the bellows.
2. Spray a light, even layer of cleaner on the rails.
3. Allow time for the cleaner to penetrate the dirt and grease, and then remove it with a clean, lint-free cloth.
4. Put the bellows back in place.

Inspect and clean the bellows

Inspect and clean the bellows monthly.

SUPPLIES

- Clean, lint-free cloth
- Johnson Envy Instant Cleaner or equivalent

HOW-TO

1. Inspect the bellows for rips and tears.
2. Spray a light, even layer of foam cleaner on the surface of the bellows.
3. Allow time for the cleaner to penetrate the dirt and grease, and then remove it with a clean, lint-free cloth.
4. Repeat steps 2– 3 as necessary.

Inspect the mixing tube

Inspect your mixing tube daily so you can monitor and limit ID growth. Note that the mixing tube is brittle carbide. Do not bend, drop, or twist it.

Examine the mixing tube. Replace it if the mixing tube shows any of the following conditions:

- Prominent, off-center wear at the nozzle exit tip ID.
- Chips in the downstream end, outside edge of the nozzle that originate at the outside diameter and leave less than 0.020 in. (0.508 mm) nozzle wall thickness.
- Cracks that extend radially from the nozzle ID to OD, or that extend down the length of the nozzle.
- Chips in either end of the nozzle that originate at the inside diameter.

Replace the diamond orifice

Replace the diamond orifice as needed.

TOOLS

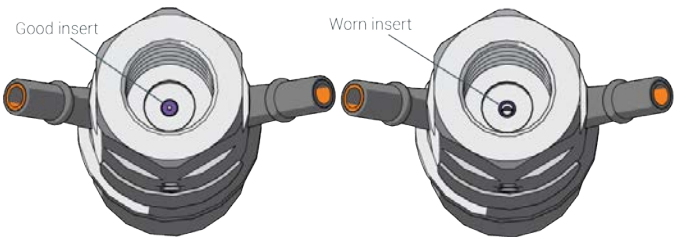
- Torque wrench with crows foot attachment

SUPPLIES

- Blue Lubricant
- Clean, lint-free applicator (such as small paintbrush)
- Clean, lint-free cloth

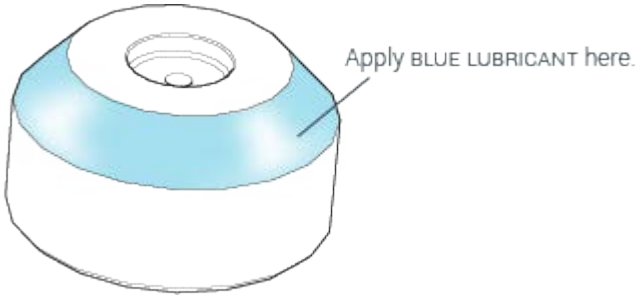
HOW-TO

1. Make sure that the high-pressure pump is off and bleed down all pressure from the system.
2. Pull firmly on the abrasive feed line to remove it from the cutting head, and then open the cutting head clamp.
3. Using a 1-1/8 in. wrench on the mixing chamber and a 7/8 in. wrench on the nozzle body, separate the mixing chamber and nozzle body.
4. Tap the mixing chamber upside down on a table to remove the orifice assembly. If necessary, lightly pry on the mount with a screwdriver.
5. Clean the mixing chamber to remove abrasive and debris.
6. Examine the carbide insert that is in the mixing chamber. Replace the mixing chamber if you find the following:
    - Evidence of erosion, wear, or other damage such as pitting
    - Hole is oblong shape instead of round
    - Diameter of the hole is larger than 1.8 mm (0.07 in.)

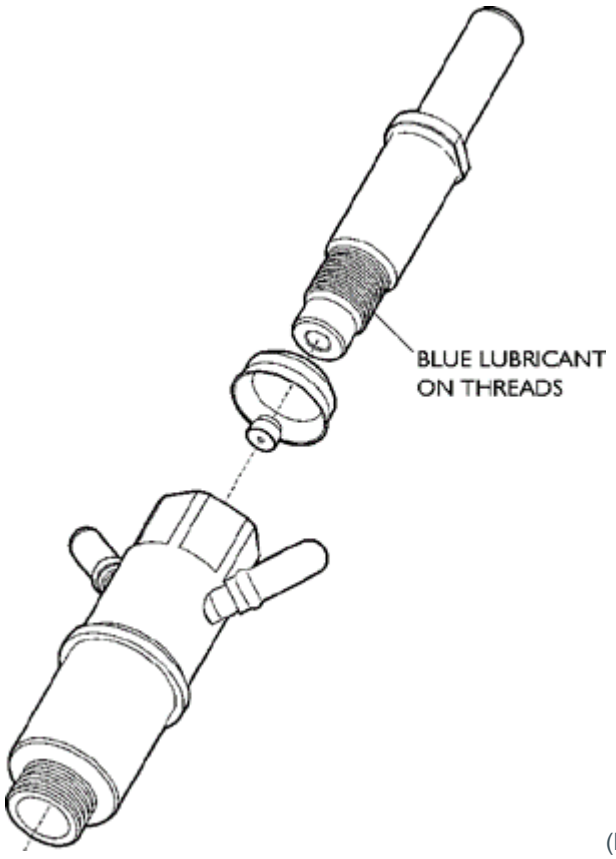


7. Apply a thin, even layer of BLUE LUBRICANT on the angled surface of the orifice assembly with a clean, lint-free applicator.

NOTICE Do not over-tighten the cutting head—it will damage mating surfaces and the orifice mount. Such damage is not covered by warranty.



8. Make sure that the seating surface that is in the mixing chamber is free of abrasive and debris, and then drop the orifice assembly—flat face down, taper side up— into the recess of the body.
9. Apply a thin, even layer of BLUE LUBRICANT to the threads of the nozzle body. Attach the mixing chamber body to the nozzle body, and then tighten to 41–48 N-m (30–35 ft-lb).



(Picture shown for general reference only and may vary from your machine model.)

10. Clean the top surface of the cutting head clamp with a clean, lint-free cloth to remove abrasive and debris.

11. Put the cutting head assembly in the clamp. Before you close the clamp, make sure that the flat on the cutting head sits flush with the top of the clamp.
12. Connect the abrasive feed line.

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Troubleshooting

Troubleshooting
Troubleshooting for Mach 100 systems.

Pages: 4

- **Cut part quality issues**
  Troubleshoot based on cut part quality.

- **Troubleshooting the Mach 100**
  Troubleshooting the Mach 100 XY table by symptom.

- **Troubleshooting the on/off valve**
  Troubleshoot the on/off valve by symptom.

- **How to install the on/off valve seal kit: Standard or Dynamic Waterjet**
  Step-by-step instructions on how to install on/off valve seal kit # 014988-1 for machines with Standard or Dynamic Waterjet.

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Cut part quality issues

Cutting speed is slower than it should be for a given surface finish and kerf width

Possible cause	Solution
Insufficient abrasive flow	Make sure the abrasive flow rate is set correctly.
Insufficient water pressure	Make sure the pump is providing proper pressure.
Mixing tube standoff is too great	Check standoff; it should be set to 0.10-in.
Different target material properties	Check for consistency of target material.
Abrasive is too fine	Use a coarser grade of abrasive.
Damaged or worn orifice	Check integrity of the waterjet stream. Inspect orifice; replace if needed.

Cutting speed is lower than normal; kerf is too wide

Possible cause	Solution
Mixing tube standoff is too great	Check standoff; it should be set to 0.10-in.
Mixing tube's ID is too large or the mixing tube is worn out	Make sure that the correct size mixing tube is installed. Replace worn mixing tubes.
Damaged or worn orifice	Check for a flaring waterjet stream. Inspect orifice; replace if needed.

Inconsistent kerf width

Possible cause	Solution
Inconsistent abrasive flow rate	Metering disk may be too large. Change disk and/or reduce cutting speed.
Inconsistent water pressure	Check for steady water pressure; correct any pump problems.
Inconsistent material being cut	Check material.

Kerf has pronounced "V" shape

Possible cause	Solution
Cutting speed is too fast	Reduce cutting speed.
Mixing tube standoff is too great	Check standoff; it should be set to 0.10-in.
Abrasive flow rate is too low	Increase abrasive flow rate.
Water pressure is too low	Increase water pressure.

Rough surface finish

Possible cause	Solution
Cutting speed is too fast	Reduce cutting speed.
Mixing tube standoff is too great	Check standoff; it should be set to 0.10-in.
Abrasive is too coarse	Use a finer grade of abrasive.
Damaged or worn orifice	Inspect orifice; replace if needed.

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Troubleshooting the Mach 100

Abnormal noise

✓ Check the mechanical mounting. Tighten mounting screws and center and balance the coupling.
✓ If the noise and/or vibration is near a bearing, please call Flow Service. There could be a defective bearing.
✓ If the machine causes vibrations, please call Flow Service.

Rough cuts

✓ Make sure there is enough clearance between the pump/motor plate and the frame.
✓ Make sure that the machine frame is level and steady and that the catcher tank and grate are secure.
✓ Make sure workpiece is secure.

Servomotor does not start

✓ Make sure the power is connected. Correct the power circuit and check fuses.
✓ There could be a loose connections. Tighten any loose parts.
✓ Refer to connection diagram and verify the external wiring is correct.
✓ If the servomotor is disconnected, connect wiring or replace cable.
✓ If an alarm tripped, reset the servo amplifiers.

Servomotor overheated

✓ Make sure the ambient temperature is no more than 40°C (104 °F).
✓ If the servomotor surfaces are dirty, remove the dust and oil from the surfaces.
✓ Overloaded: Run under no load. If that is ok, look for mechanical binding.

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Troubleshooting the on/off valve

There are two main failure modes for the on/off valve: leaking water (most common) or an on/off valve that does not open or close correctly. Pay special attention to the utility connections and air lines—the high-pressure water supply could be partially blocked, or there could be bends, holes, or loose connections in the air lines.

Water leaks past the high-pressure assembly (top of high-pressure seal)

Drips every few cycles
This indicates seal and backup ring wear. It's OK to continue to operate the machine, but if the leak causes problems, install the seal kit now. (Part #014988-1)

Steady trickle
This indicates moderate seal and backup ring wear. Install the seal kit next time the machine is down.

Shooting stream
This indicates a failed O-ring or severe seal and backup ring wear. Install the seal kit immediately!

Water leaks from the tubing/valve body (high-pressure inlet)

Streaming
This indicates the ¼ in. gland is not tight. Turn off the high-pressure pump, and then tighten the ¼ in. gland.

Shooting stream
This indicates there is a crack in the high-pressure port of the valve body or tubing. You must replace the valve body or the tubing.

Water leaks from the valve body or seat, or from the seat or nozzle body interface.

Streaming
This indicates the nozzle body gland is not tight. Turn off the high-pressure pump, and then tighten the gland.

Shooting stream

This indicates there is a cracked valve body, seat, or nozzle body. You must replace the cracked parts.

On/off valve does not open

- Make sure the shop air supply is on, correctly connected, and the pressure is 90–100 psig (6–7 bar) at the actuator. Check for kinks, breaks, and holes in the air line. Pull the line off the fitting, and then manually turn the air on in FlowCUT to make sure that air is coming through.
- Make sure the controller signals the valve to open.
- Lack of high-pressure water can cause the on/off valve to not open. Make sure the pump is running and if installed, all manual shut-off valves are open.
- Check for a blockage in the lines:
    1. Turn off the pump, and if installed, close the manual shut-off valves.
    2. Disconnect the high-pressure water line from the valve, aim it into the catcher tank, and then secure it.
    3. If installed, open the manual shut-off valves. Turn the pump on.
    4. If there is a steady stream of high-pressure water going into the catcher tank, there is no blockage. If the water stream is erratic, this indicates there is a blockage in the lines.
- Check for a failed actuator or valve seal. Keep the high-pressure water on and manually switch the air on and off. If the fitting or cap on top of the actuator does not move up and down, there is a problem with the actuator. Call Flow Service! If the fitting or cap does move up and down, but the valve still does not open, it could be a failed valve seal. Replace the seal assembly.

On/off valve does not close

- Try manually switching the air on and off or disconnecting the air line to see if the valve will close. There may be a problem with your software program or controller command to turn the air off.
- Check for a failed valve seal. If the fitting or cap on the actuator moves up and down, but the valve still does not open, it could be a failed valve seal. Replace the seal assembly.

How to install the on/off valve seal kit: Standard or Dynamic Waterjet

After you troubleshoot the on/off valve, it could seem like you only have to replace one or two parts from the seal kit. However, all seal kit components have similar expected life times. **If one component failed, the others are also likely to fail very soon!** We recommend that you install all seal kit components at the same time to reduce maintenance time and machine downtime.

To repair the on/off valve, you will need the following:

PARTS

- 014988-1, On/off valve seal kit

TOOLS

- On/off valve tool kit (019623-1)
- Crescent wrenches (standard sizes)
- Soft-jaw vise

SUPPLIES

- Blue Lubricant
- White Food Grade Grease

PRECAUTION

- When working on high-pressure components, it is critical that you use backup wrenches. Excessive torque on the cutting head can damage the wrist motors. Such damage will void your warranty.

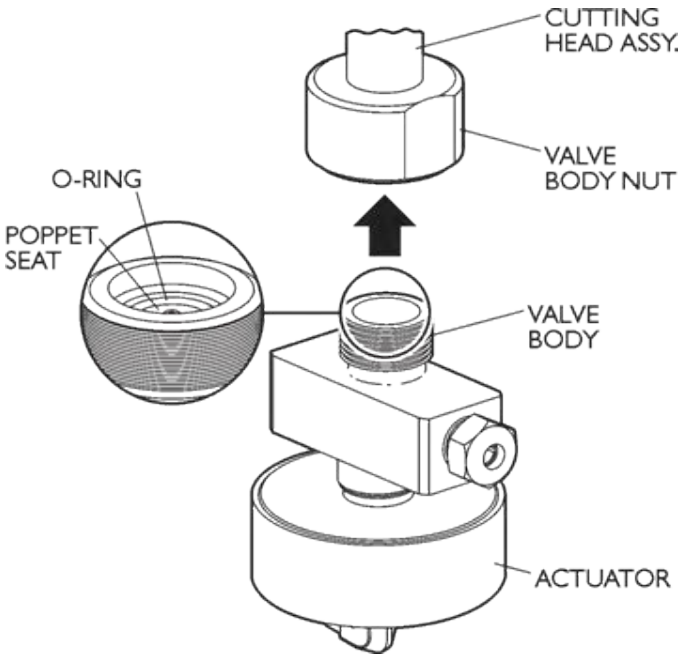
Remove the on/off valve

1. Shut down the system.

    **WARNING!** Shut down the system and bleed all high-pressure from the system. Turn off the high-pressure water and high-pressure water pump.
2. Switch off the air to the valve and disconnect the pneumatic line.
3. Disconnect the high-pressure plumbing from the valve body.
4. Open the clamp and remove the entire cutting head assembly, including the valve and actuator. Take the assembly to a clean workbench for any repair procedures.

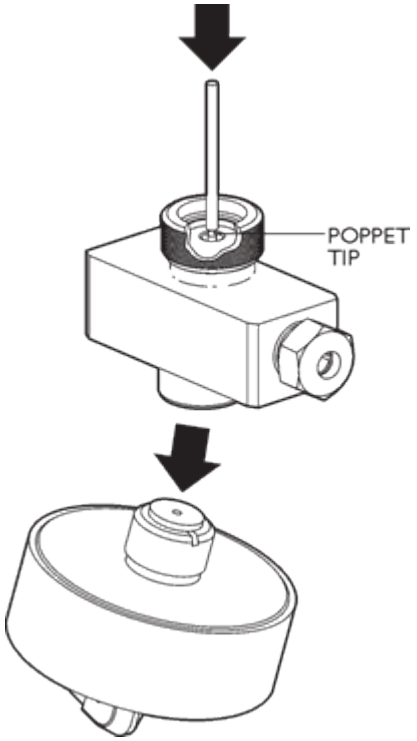
Repair the on/off valve

1. Apply shop air (80 psi min.) to valve actuator assembly to open the valve.
2. Place the assembly in the soft-jaw vise. Unscrew the valve body nut from the valve body. This will separate the valve and actuator from the cutting head and expose the poppet seat.



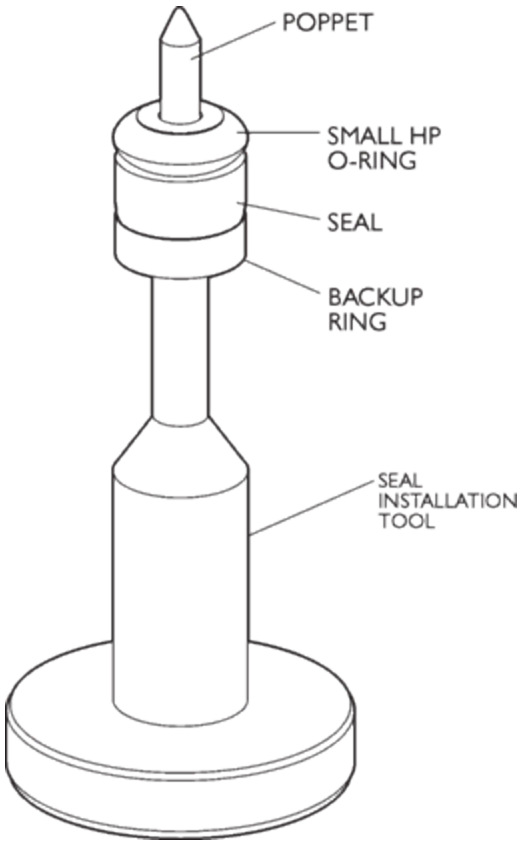
3. An O-ring helps hold the poppet seat in place. Remove the O-ring, and the poppet seat should fall out of the valve body. Discard the seat and O-ring.
4. If the seat does not fall out when you tap the nozzle body, use the seal installation tool to help loosen the seat.
5. Unscrew the valve body from the actuator assembly. Set the actuator assembly aside.

6. Place the assembly tool (from the tool kit) against the poppet tip and push it out from the valve body.

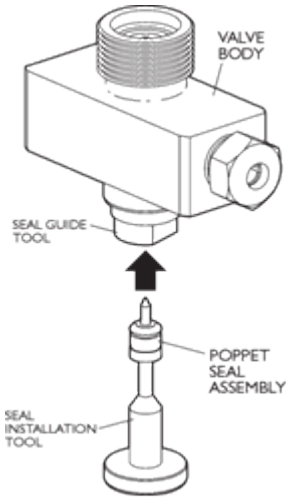


7. The bearing, high-pressure seal, and backup ring should come out with the poppet. If not, push the bearing, seal, and backup ring out of the valve body in the same direction as you pushed the poppet.
8. Discard the poppet, seal, O-ring, and backup ring.
9. Clean any foreign material from the inside and outside of the valve body. Thoroughly clean the valve body, gland, collar, and poppet seat with solvent and dry with shop air.
10. Apply a thin film of white food grade O-ring lube to the new poppet, O-rings, seal, bearing, and backup ring (from the seal kit)
11. Thread the seal guide tool into the valve body.
12. Put together the new seal assembly on the seal installation tool.
    a. Slide the bearing onto the poppet.
    b. Place the small high-pressure O-ring on the high-pressure seal.
    c. Push the seal onto the poppet with the O-ring toward the point of the poppet.
    d. Slide the backup ring into place against the high-pressure seal.

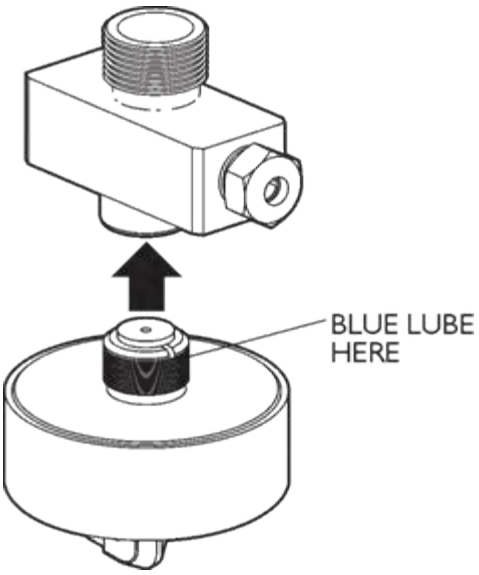
    The seal assembly should be approximately centered on the length of the poppet.



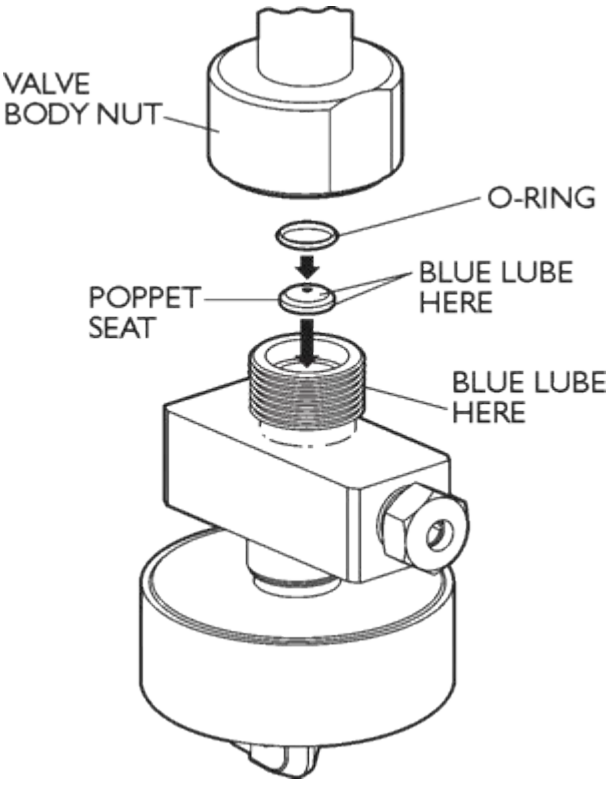
13. Slide the poppet seal assembly into the actuator end of the high-pressure valve body, pointed end first.



14. Apply a thin layer of blue lubricant to the threads of the actuator. Reinstall the actuator assembly to the valve body.



15. Apply a thin layer of blue lubricant to both sides of the new poppet seat. Install the poppet seat into the valve body with the small hole facing to- ward the poppet. Push the O-ring into the groove to hold the poppet seat in place.
16. Apply a thin layer of blue lubricant to the external threads of the valve body and thread it onto the nozzle body by tightening the valve body nut. Leave this connection hand tight for now.



17. Reinstall the cutting head and on/off valve assembly to its original location on the machine by clamping the cutting head in place.

Install the on/off valve

1. Attach the pneumatic control line to the valve actuator assembly and turn on the air (80 psi min.) to open the valve.
2. With the valve in the open position, align the valve with the high-pressure tubing so that the weep tube and high-pressure tubing point to- ward the front of the machine.
3. Tighten the connection between the nozzle body and the valve body nut to 35–40 ft-lb (47–54 N-m). Once the connection is tight, turn off the air to close the valve.

> Opening the valve before tightening this connection reduces the possibility of galling between the poppet and seat interface and reduces the force required as you are not working against the high spring force of the actuator.

4. Attach the high-pressure tubing to the valve. Be careful not to over-torque this connection.
5. Turn on the high-pressure water source and slowly raise the pressure while checking for leaks. Manually actuate the valve a few times to make sure it is operating correctly.

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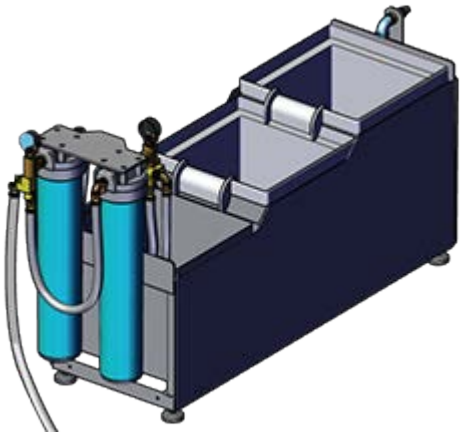
Final Filter System

The Final Filter System is designed to reduce the level of spent garnet and swarf in the overflow water stream to a level that can be safely discharged into sewers or septic systems. The system consists of the following components:

- three stepped weir tanks
- two 50 micron filters
- a sump pump
- a steel frame

The overflow water from the catcher tank flows through the weir tanks, then is pumped through the filters. As the water passes through the tanks, the larger particles settle out. Any suspended particles larger than 50 microns are trapped by the filters. Operation of the Final Filter System is automatic. Make sure power is supplied to the sump pump.



Specification

Capacity
53 L/min (14 gpm)

Interface type
½ in. JIC

Empty the tanks

How often to empty the weir tanks depends on the nature and amount of cutting being performed, but we recommend that you empty them when the level of solids in the tanks reaches half full.

To empty the tanks, do the following:

1. Adjust the overflow to stop the flow of water into the final filter.
2. Transfer the water remaining in the weir tanks to the third tank, where it can be removed by the sump pump.
3. Remove the tanks from the frame and dump out the accumulated solids.
4. Replace the tanks in the frame

Replace the filter elements

Replace the 50 micron filter elements (Part #A-00750-6) when the pressure drop across the filters exceeds 5 psig. To determine the pressure drop, subtract the pressure reading obtained from the gauge on the outlet side of the filters from the reading obtained from the inlet side of the filters. **Readings must be taken while the pump is operating.**

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PASER CF900 Abrasive Delivery System

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Get started: CF900 hopper operation basics

The PASER CF900 Abrasive Delivery System (ADS) is designed for the continuous transport of abrasive to the abrasive metering system located above the cutting head.

Get started: CF900 hopper operation basics
Refer to articles in this section to learn the fundamentals of CF900 hopper operation.

Pages: 7

- **Component ID for CF900 hopper**
  Identifies components of the CF900.
- **Facility requirements**
  Includes information for recommended clearance, environment, and plumbing for the CF900 hopper.
- **Specifications**
  Specs—including operating parameters—for the CF900 ADS.
- **Using the display panel during operation**
  Overview of the CF900's display panel functionality and operation.
- **Understand the warning indicators/audible signal**
  During operation, the yellow warning indicator and the audio signal identify specific conditions pertinent to operation. Learn what to do when you see and/or hear communications from the warning indicator and audible signal.
- **Recommended pressure settings for CF900 pressure regulators**
  Recommended pressure settings for CF900 pressure regulators, including schematic.
- **Fill, start, stop, or shut down the hopper**
  How to fill, start, stop, or shut down the ADS.

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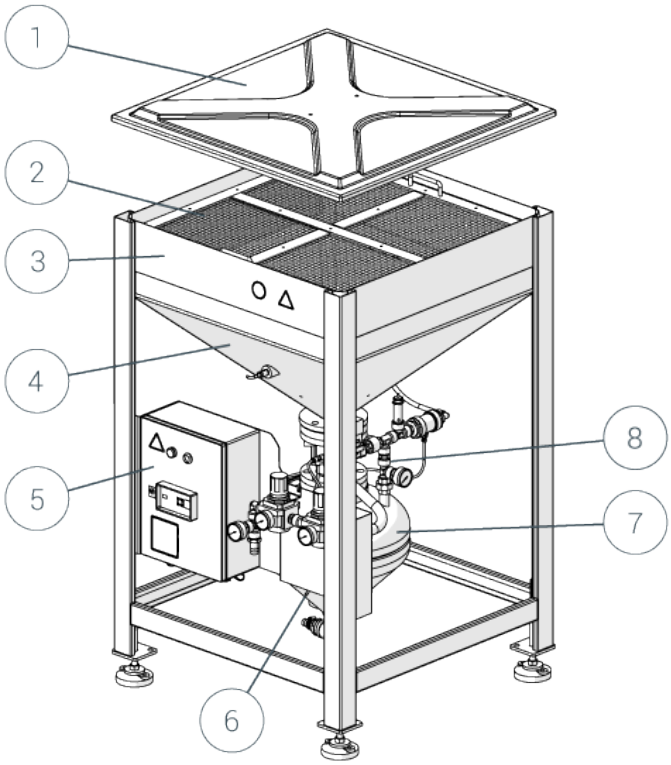
Component ID for CF900 hopper



1 Lid
The lid prevents abrasive from spraying from the silo when the vessel releases pressure before entering the fill cycle.

2 Sieve
When you fill the ADS with abrasive, it goes through the sieve to its temporary storage place—the silo.

3 Silo
Temporary storage place for abrasive. You can fill the silo without stopping the ADS. During a vessel fill cycle, abrasive moves from the silo through a pinch valve, and then into the vessel.

4 Silo low-abrasive switch
If this switch does not sense abrasive, the yellow warning indicator flashes continuously and the audible signal sounds in a rhythmic pattern. Also, the display panel shows the *Silo Empty* notice.

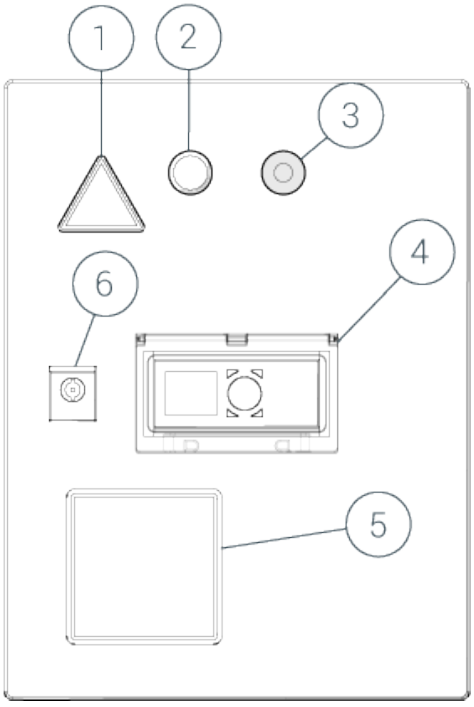
5 Control panel
The control cabinet contains the PLC, which monitors operating conditions and sends control signals to the solenoid valves, the yellow warning indicator, and the audible signal.

6 Vessel low-abrasive switch
If this switch does not sense abrasive for 20 seconds, the yellow warning indicator illuminates continuously and the audible signal sounds continuously. Also, the display panel shows the Vessel Empty notice. In FlowCUT, the part program stops and a message is displayed.

7 Vessel
After a vessel fill cycle, the vessel is pressurized and pushes the abrasive through a hose to the machine’s abrasive metering valve.

8 Pinch valve pneumatic

Control cabinet



1 Electrical hazard warning label
Indicates there is a risk of electrical shock.

2 Yellow warning indicator
Identifies specific conditions pertinent to operation. See *Understand the warning indicators/audible signal* article.

3 Audible signal
Identifies specific conditions pertinent to operation. See *Understand the warning indicators/audible signal* article.

4 Display panel
See *Using the display panel during operation* article.

5 CE label

6 Panel lock
The PLC and terminal strip are located behind the panel lock. Keep this panel closed and locked at all times.

7 Power switch (not shown)
When the power switch is disengaged, no pressure is supplied to the vessel and PV1 stays closed.

Pneumatics

Pneumatic controls include:

- Two pinch valves (PV1 & PV2)
- Two pressure regulating valves (PR1 & PR2)
- Two N/C solenoid valves (SOL311 & SOL319)
- One N/O solenoid valve for venting (SOL351)
- Two check valves (CV1 & CV2)

The pinch valve pressure controls the pinch valve. The conveying pressure controls the vessel. A safety valve opens at 7 bar (102 psi) and limits the maximum pressure in the vessel.

PV1 is operated by compressed air and controlled by SOL351.

Proximity switch PS219 (inside vessel) sends a signal to the PLC to indicate presence of abrasive. If there is no abrasive, the PLC sends a signal to release the pressure from the vessel, and then sends a signal to open the pinch valve. When the proximity switch senses abrasive during refilling, a delay timer starts. When the delay timer ends, the pinch valve closes, and the vessel pressurizes.

When SOL319 opens pinch valve PV2, pressure is released from the vessel.

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Facility requirements

Clearance

Local codes and regulations will determine the actual distance that is required for clearance. However, we recommend that you have at least 1000 mm (39 in.) on each side of the abrasive delivery system.

Environment

Ambient temperature ..... 0°–55°C (32°–131°F)
Relative humidity 5–95%
Elevation ..... 0–2500 m (0–8200 ft) above sea level

Plumbing: Air

Air supply ..... dry and filtered to 10 microns
Air pressure/volume ..... 6.9–8.3 bar @ 566 L/min (100–120 psi @ 20 scfm)
Air line size ..... ≥ 20 mm (3/4 in.)
Interface type size ..... 3/4 in. NPT

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Specifications

Electrical

Supply voltage	100–240 VAC, 50/60 Hz or 24VDC2
AC frequency	50/60 Hz
Full-load current	0.48 A @ 100 VAC 0.20 A @ 240 VAC 2.0 A @ 24 VDC
Largest- load current	2.0 A
Short-circuit current rating (SCCR)	2.5 kA

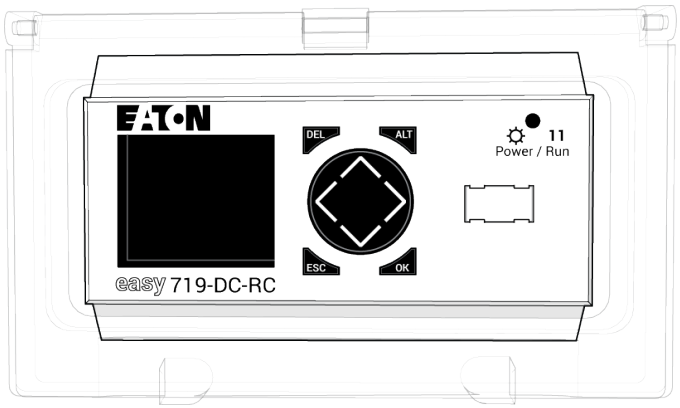
Operating parameters

Abrasive compatibility	50–120 mesh
Air pressure/volume	6.9–8.3 bar @ 566 L/min (100–120 psi @ 20 scfm)
Required pressure difference between PR1 & PR2	3.45 bar (50 psi)

Physical

Dimensions (Height × Width × Depth)	1420 × 850 × 850 mm (56 × 33.5 × 33.5 in.)
Approximate weight	112 kg (247 lb) empty 537 kg (1184 lb) full
Abrasive capacity	425 kg (937 lb)

Using the display panel during operation



Display panel buttons

Button	To	Do this
	View the software version, operating hours (h), and switching cycles (c).	Press and hold the **P1** button for five seconds.
	Release pressure from the vessel.	Press the **P2** button.
	Set the cycle counter to zero.	Press and hold the **P3** button for five seconds.
	Switch the potential free contacts for a warning message from N/O to N/C. You can accept the selected signal in the ADS and use it there for an additional alarm or as a way to stop the cutting process.	Press and hold the **P4** button for 10 seconds.
ALT	No functionality.	—
DEL	No functionality.	—
ESC	No functionality.	—
OK	Functional from the "Running" screen only.	**Password**: Functionality disabled. **Stop/Run**: A check mark show what state the unit is in. Press the OK button to toggle between states. When you switch from Run=>Stop, the pressure vessel depressurizes. **Password**: Appears twice in menu, but functionality is disabled. **Info**: Displays information about the PLC from the manufacturer. **Set clock**: Sets the correct time and date for the PLC; however, this is unnecessary for operation as the unit counts relative time from a "zero" point.

Display panel notices

The display panel's screen shows the following notices:

Notice	What does it mean?
Filling	Fill cycle.
Bleed	Release of the pressure vessel.
Running	ADS is conveying abrasive.
Silo Empty	Silo is empty.
Vessel Empty.	Vessel is empty.
Replace Insert of Pinch Valve Reset P3 =>	Displays after 6000 cycles. When you see this notice, it’s time to replace the PV1 pinch valve seal.

Understand the warning indicators/audible signal

During operation, the yellow warning indicator and the audio signal on the control cabinet identify specific conditions pertinent to operation.

If this happens...	Do this
Yellow warning indicator flashes continuously + audible signal sounds in a rhythmic pattern.	Fill the silo with abrasive—you have reached the minimum level of abrasive required for operation. Recover from the error in FlowCUT/FlowSENSE.
Yellow warning indicator illuminates continuously + audible signal sounds continuously.	Fill the silo with abrasive—you are out of abrasive and the ADS will remain stopped until filled. Recover from the error in FlowCUT/FlowSENSE.

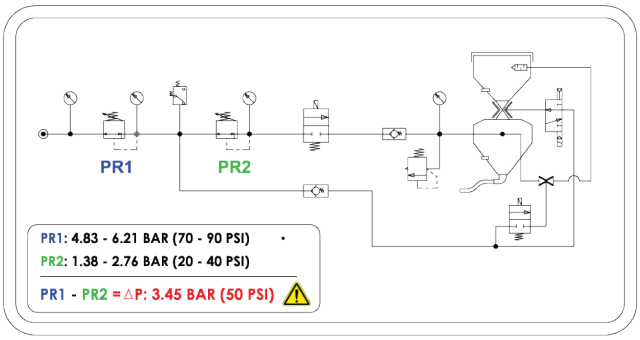
Recommended pressure settings for CF900 pressure regulators

To ensure the pinch valve closes all the way and to help prevent early pinch valve failure, make sure you use the following settings:

PRI pressure …… 4.83–6.21 bar (70–90 psi)
PR2 pressure ……1.38–2.76 bar (20–40 psi)
Required pressure differential between PR1 & PR2 ……3.45 bar (50 psi)

Initially, set PR1 to 5.5 bar (80 psi) and PR2 to 2 bar (30 psi). Next, adjust the pressure for PR2 since this is what pushes abrasive to the metering valve. Pressure may be ok at 2 bar (30 psi), but if you have to make adjustments, keep it between 1.39–2.76 bar (20–40 psi). After you've established the correct pressure for PR2, adjust PR1 to 3.45 bar (50 psi) more than PR2. This ensures the pressure differential of 3.45 bar (50 psi) is maintained.

Schematic



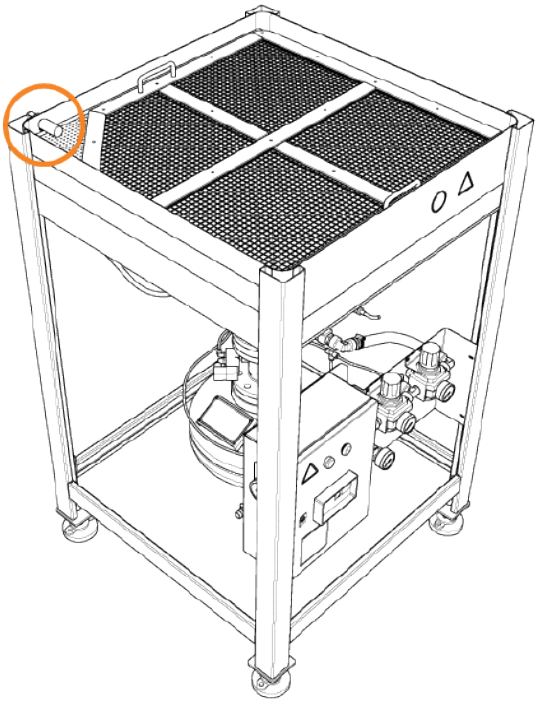
Fill, start, stop, or shut down the hopper

To fill the ADS

Remove the lid, fill the silo with abrasive, and then put the lid on.

CAUTION!

- Wear safety goggles to prevent eye injuries caused by pressurized abrasive leaking from the silo.
- Wear a dust mask or respirator to reduce particle or dust inhalation when you fill the abrasive delivery system with abrasive.
- Observe proper lifting techniques when lifting abrasive bags.
- Avoid adding abrasive near the pressure valve muffler.



To start the ADS

See *Start the machine* article.

To stop the ADS

In FlowCUT, under **Abrasive**, click  , click  , and then verify the abrasive has stopped flowing.

To shut down the ADS

Shut down the machine, and then turn off the power switch to the ADS.

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CF900 hopper maintenance

CF900 hopper maintenance

Refer to articles in this section for general information about CF900 hopper maintenance, including how-to articles.

Pages: 2

- **Preventative maintenance schedule for CF900 hopper**
  PM schedule for the CF900 hopper.

- **Replace the PV1 pinch valve seal**
  Replace the CF900 hopper's PV1 pinch valve seal after approximately 6000 switching cycles. This article gives step-by-step instructions on how to replace it.

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Preventative maintenance schedule for CF900 hopper

Preventative maintenance schedule for the Paser CF900 Abrasive Delivery System.

What do I do?	When do I do it?
Examine the pressure regulating valves and solenoid valves for damage.	Daily
Examine the solenoid valve on the pinch valve for damage.	Daily
Examine the pressure gauges for functionality.	Daily
Ensure the pressure difference between PR1 and PR2 is at least 3.45 bar (50 psi).	Daily
Replace the PV1 pinch valve seal.	Every 6000 cycles

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Replace the PV1 pinch valve seal

Replace the PV1 pinch valve seal after approximately 6000 switching cycles.

PARTS

- A-31850-1, Pinch valve seal (hose insert)

TOOLS

- Adjustable wrenches: 6 in. & 12 in.

SUPPLIES

- Clean, lint-free rag
- Wooden blocking

PERSONNEL

- An assistant is required during some steps of this procedure.

SAFETY PRECAUTIONS

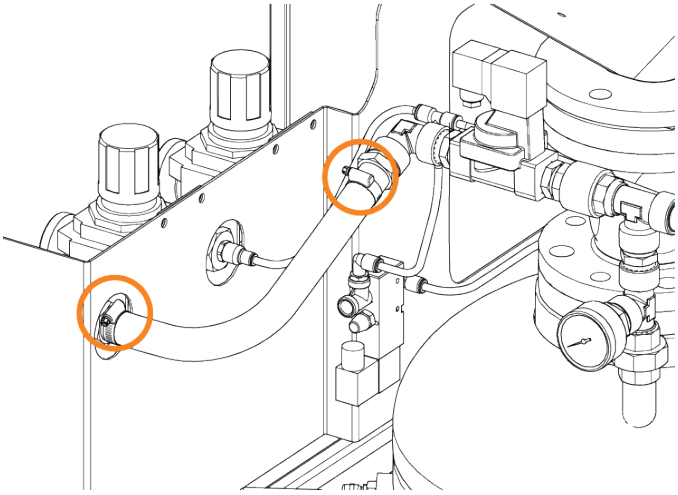
- The vessel could weigh up to 91 kg (200 lb) when full. Support the vessel if it is not empty.

Remove the PV1 pinch valve

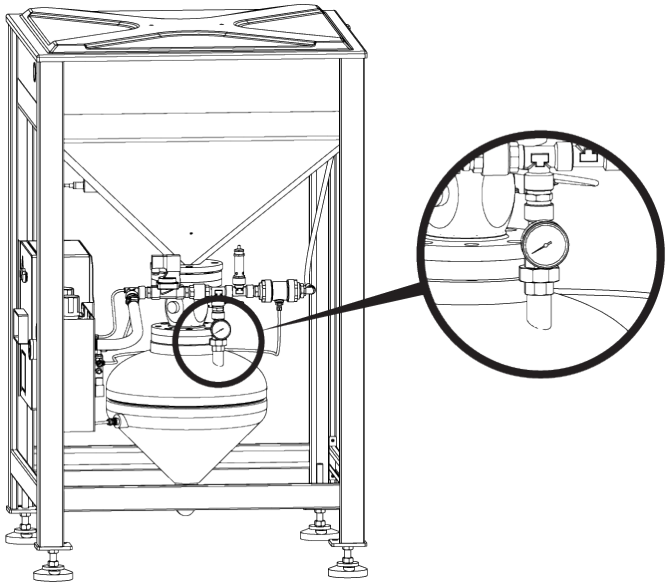
1. Empty the abrasive from the silo and, if possible, from the vessel.
2. Record the pressure settings for PR1 and PR2, and then set PR1 0 bar (0 psi).
3. Do the Lockout/Tagout procedure.
4. Disconnect all abrasive and air hoses from the vessel, pinch valve, and pneumatic controls.
5. Disconnect the cables from the manifold pressure sensors.

> Label the cables so that it is easier to connect the cables later!

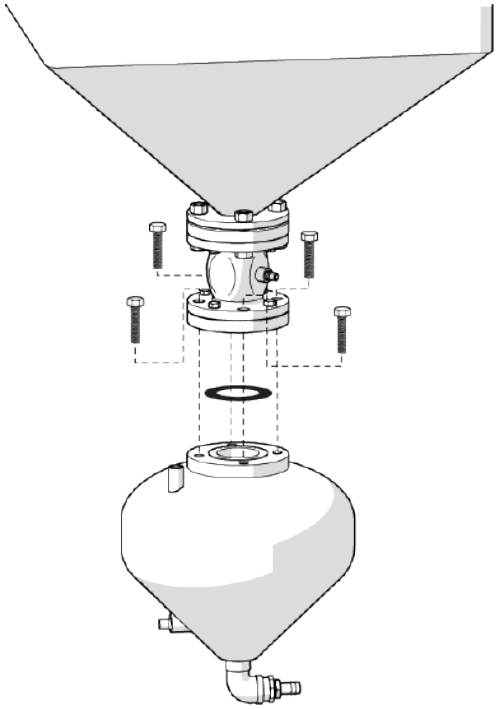
6. Loosen the hose clamp, and then disconnect the hose.



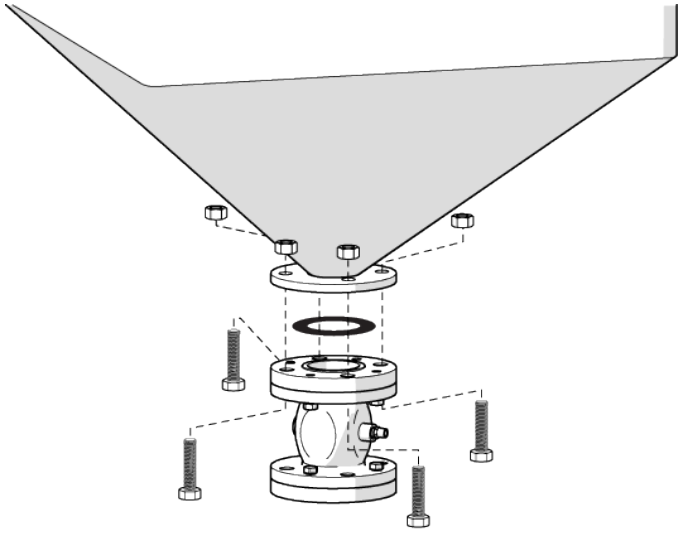
7. Loosen the coupling that attaches the pneumatic manifold to the vessel, and then set the manifold aside.



8. Disconnect the cable from the solenoid mounted on the pinch valve.
9. Position wooden blocking between the floor and the abrasive outlet port to support the vessel during removal.
10. **Use an assistant for this step!** Remove the four M16 hex screws, and then lower the vessel onto the wooden blocking.



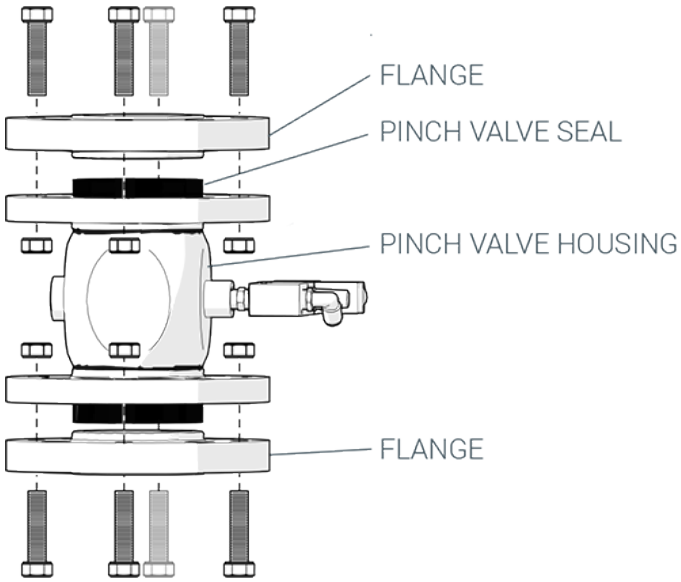
11. Move the vessel and the wooden blocking away from the pinch valve.
12. Remove the gasket from between the vessel and the pinch valve housing. Clean the gasket with a lint-free rag, and then set it aside.
13. Remove the M16 hex screws and nuts, and then remove the pinch valve.



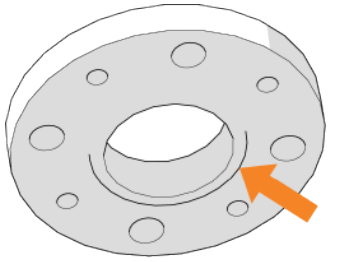
14. Remove the gasket. Clean the gasket with a lint-free rag, and then set the gasket aside.

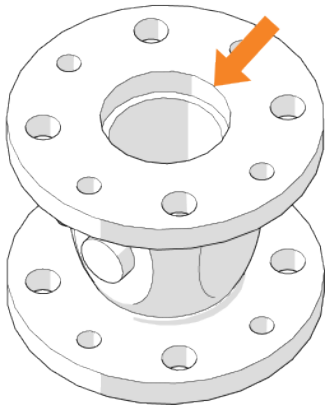
Replace the PV1 pinch valve seal

1. Remove the eight M12 screws and nuts, and then remove the two flanges from the pinch valve housing.



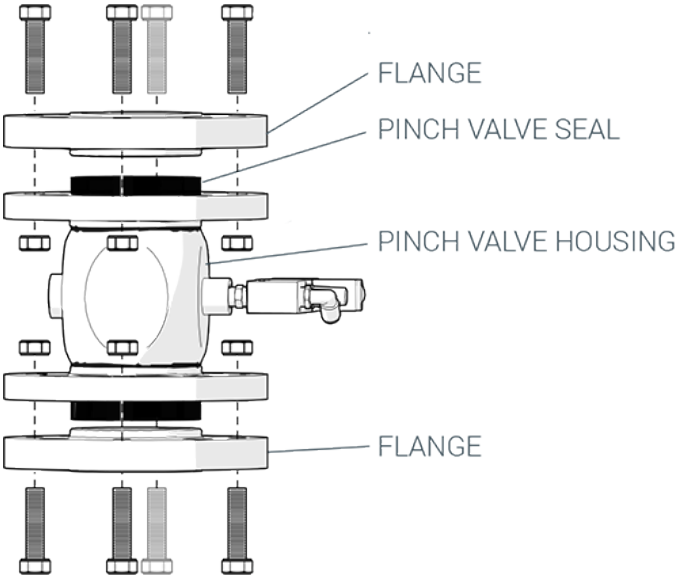
2. Pull the pinch valve seal out of the pinch valve housing.
3. Examine the tapered surfaces on the pinch valve flanges and housing. Replace the pinch valve if needed.





Tapered surfaces should be smooth (paint discoloration is okay) with no grooves or pitting. Replace the pinch valve flange if the tapered surfaces have damage.

4. Clean the tapered surfaces with a lint-free rag. The surfaces must be clean before installing the new pinch valve seal.
5. Push the pinch valve seal into the pinch valve housing. Adjust the pinch valve seal so that both ends extend equally from the pinch valve housing.



6. For each flange, apply a small amount of tension to the flanges with two opposing M12 screws and nuts. Guide the tapered surfaces of the flanges to the interior of the pinch valve seal. Do not allow the pinch valve seal to twist during tensioning.

> If the screws cannot engage the flange threads, use M12 70 mm screws to seat the flanges until the stock flange bolts are engaged.

7. Loosely install the remaining M12 screws and nuts. Evenly tighten them in a circular pattern until they are tight. The gap between the tapered flanges and the pinch valve housing flanges must be even.

Install the PV1 pinch valve

1. Loosely attach the pinch valve to the silo with three of the four M16 screws and nuts. Position the pinch valve so that the solenoid points away from the manifold and towards the corner of the silo where the pressure valve muffler is.
2. Install the gasket between the silo and the top of the pinch valve through the gap caused by the missing screw.
3. Loosely install the last M16 screw and nut.
4. Position the gasket around the center of the inner raised surface of the pinch valve, and then evenly tighten the four M16 screws and nuts. The gap between the silo flange and the upper pinch valve flange must be even after all of the screws are tight.
5. Position the gasket around the center of the vessel opening.
6. **Use an assistant for this step!** Position the vessel under the pinch valve, and then attach it to the pinch valve with four M16 screws.
7. Evenly tighten the four M16 screws. The gap between the vessel flange and the lower pinch valve flange must be even after all of the screws are tight.
8. Install the new coupling in the vessel.
9. Attach the pneumatic manifold to the vessel coupling.
10. Attach the hose and hose clamp.
11. Install the abrasive hoses and the air hoses to the vessel, pinch valve, and pneumatic controls.
12. Connect the cables to the sensors and solenoids.
13. Connect the air source to the ADS.

    CAUTION! Wear safety glasses during the test cycle and remain clear of the pinch valve.
14. Gradually increase air pressure of PR1 to 5.5 bar (80 psi) and then do a check for leaks.
15. Set PR1 and PR2 to the previous recorded pressures.
16. Fill the silo with abrasive.
17. Remove the lock from the power switch.

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Troubleshooting the CF900 hopper

Troubleshooting the CF900 hopper

Refer to articles in this section for CF900 hopper basic troubleshooting.

Pages: 2

- **Troubleshooting the hopper with FlowSENSE**
  Troubleshooting the hopper using FlowSENSE.

- **Troubleshoot the CF900 hopper by symptom**
  Basic troubleshooting for the CF900 hopper.

Troubleshooting the hopper with FlowSENSE

Reference the applicable error number/message below to find the troubleshooting steps to take.

P394 » System: Abrasive Bulk Transfer Empty Shutdown
Fill the silo with abrasive—you are out of abrasive and the ADS will remain stopped until filled.

P395 » System: Abrasive Bulk Transfer Low Warning
Abrasive level is low; fill the silo with abrasive soon.

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Troubleshoot the CF900 hopper by symptom

KEY

PR1 = Pinch valve pressure (Pinch valve)

PR2 = Conveying pressure (Vessel)

No abrasive delivery even though there is enough abrasive in the ADS for operation

- PR2 may be set too low. Increase the pressure to PR2, but maintain at least a 3.45 bar (50 psi) difference between PR1 and PR2.
- Air and electrical supply connections may be interrupted. Inspect all air and electrical supply connections.
- The silo or vessel low-abrasive switch is malfunctioning. Test the function of the switches. If they do not function correctly, call Flow Service.

No abrasive delivery, and the yellow warning indicator and/or the audible signal is not on

- The bulb to the yellow warning indicator may have burned out. Test the function of the indicator, and then replace the bulb if needed.
- Test the function of the audible signal, and then replace it if needed.
- If the container is empty and the indicator and audible signal are not on, call Flow Service.

The abrasive metering valve runs dry between fill cycles

- PR2 may be set too low. Increase the pressure to PR2, but maintain at least a 3.45 bar (50 psi) difference between PR1 and PR2.
- Flowrate demand from metering valve exceeds 1.2 lb/min. Order a high flowrate kit for the valve. Call Flow Service for more information.

Abrasive ejects from the top of the abrasive metering valve during normal operation or before a fill cycle

- Check the mesh size of your abrasive. The minimum size that can be used with the ADS is 120 mesh.
- PR2 may be set too high. Decrease the pressure to PR2, but maintain at least a 3.45 bar (50 psi) difference between PR1 and PR2

ADS continuously vents

- There may not be enough of a pressure difference between PR1 and PR2. Adjust the pressure until there is at least a 3.45 bar (50 psi) difference between PR1 and PR2.
- The venting valve may be malfunctioning. Clean the valve. If this does not work, it may have to be replaced. Call Flow Service!

Air and/or abrasive leaks from the silo

- PR2 may be set too high. Decrease the pressure to PR2, but maintain at least a 3.45 bar (50 psi) difference between PR1 and PR2.
- The PV1 pinch valve seal is defective. Install a new seal.

Air leaks from the silo after a fill cycle and the vessel is unable to pressurize

- Make sure your air supply is at least 6.9 bar @ 566 L/min (100 psi @ 20 scfm).
- Increase your air supply to 8.3 bar (120 psi) maximum.
- Install an air receiver tank just before the ADS. A 56 liter (15 gallon) receiver should be sufficient.

ADS does not convey enough abrasive

- The abrasive demand may be too high.
- The outlet opening on the vessel may be contaminated or blocked. Examine the outlet opening in the vessel for contamination and foreign objects. Look for restrictions in the hose between the vessel and the waterjet machine. Look for restrictions in the abrasive metering system.

Air continually vents from the pressure regulators

- Your air supply pressure may be too high. Ensure you air supply is 6.9–8.3 bar (100–120 psi).

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UltraPierce Vacuum Assist

UltraPierce Vacuum Assist

Reference articles in this section for information about UltraPierce Vacuum Assist.

Pages: 10

- **Component ID**
  Identifies key components and views of UltraPierce installed with various cutting heads.
- **How UltraPierce works**
  Introduction to how UltraPierce works.
- **Set up UltraPierce in FlowCUT**
  Learn how to set up UltraPierce in FlowCUT.
- **What settings should I choose in FlowCUT?**
  Learn about settings in FlowCUT.
- **Calibrate UltraPierce**
  Learn how to calibrate UltraPierce.
- **Preventative maintenance schedule**
  PM schedule for UltraPierce.
- **Flow Parts for UltraPierce**
  Spares and consumables for UltraPierce.

- **Replace the exhaust hose**
  Learn how to replace the UltraPierce exhaust hose.

- **Replace the pinch valve tubing**
  Learn how to replace the UltraPierce pinch valve tubing.

- **Troubleshooting UltraPierce by symptom**
  Troubleshoot UltraPierce by symptom.

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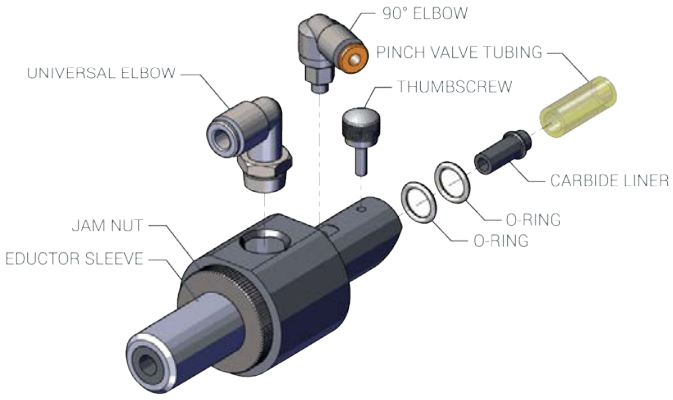
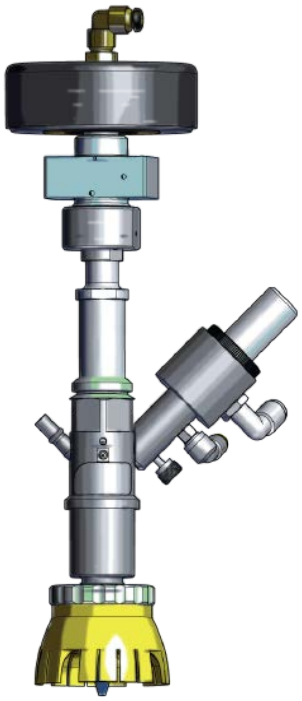
Component ID

View 1: UltraPierce Vacuum Assist



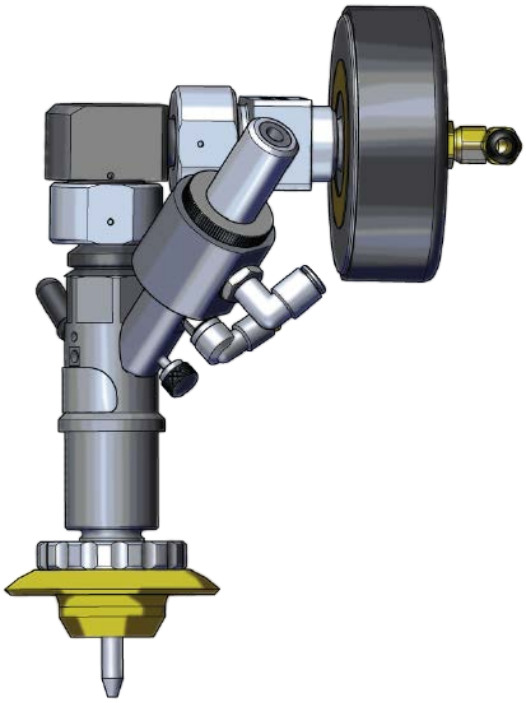
View 2: Standard or Dynamic Waterjet with UltraPierce

(View 2 is applicable to Mach 300 and Mach 500 machines only.)



View 3: Dynamic XD with UltraPierce

(View 3 is applicable to Mach 500 machines only.)



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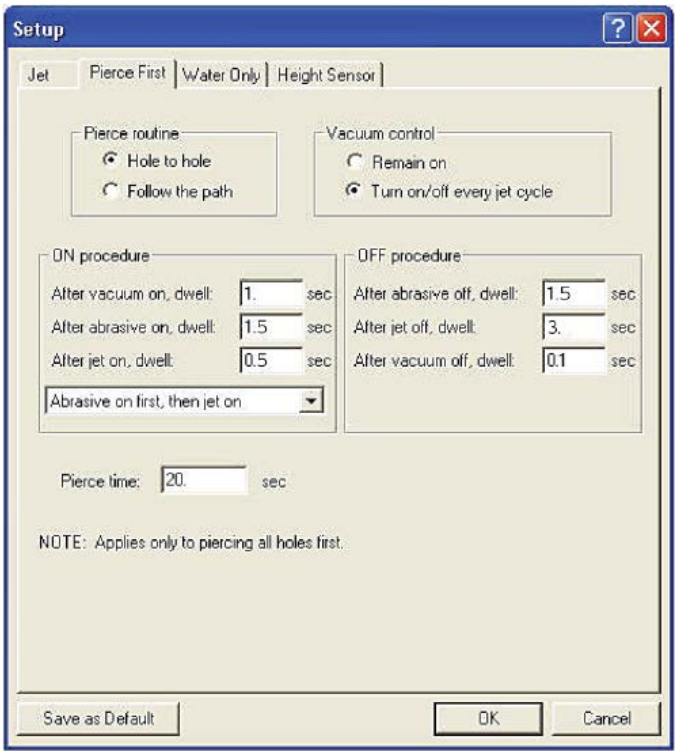
How UltraPierce works

UltraPierce Vacuum Assist works on a simple principle—create a vacuum in the cutting head, then use this vacuum to draw abrasive into the mixing chamber before turning on the high-pressure water.

A compressed air-driven eductor supplies the vacuum, and a pinch valve opens and closes the port that connects the educator to the cutting head. The system uses a vacuum to remove the abrasive pulled through the head by the vacuum eductor.

When the vacuum assist is off, there is no air supplied to the eductor. However, air is supplied to the pinch valve in order to close it and isolate the chamber. When the vacuum assist is on, air is supplied to the eductor to generate a vacuum. No air is supplied to the pinch valve, allowing it to remain open.

Set up UltraPierce in FlowCUT



HOW-TO

1. In FlowCUT, on the **Setup** menu, click **Jet**.
2. In the **Setup** dialog box, click the **Pierce First** tab.
3. Under **Pierce** routine, choose a routine.
4. Under **Vacuum** control, choose an option.
5. Under **ON procedure**, enter the time (in seconds) of each dwell, and then select **Abrasive on first, then jet on** to minimize delamination.
6. Under **OFF** procedure, enter the time (in seconds) of each dwell.
7. In the **Pierce time** box, enter the length of time.
8. Click **Save as Default** or **OK**.

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What settings should I choose in FlowCUT?

Pierce routine

To	Do this	Recommended
Pierce a hole and do a rapid move in the shortest path possible to the next hole	Click **Hole to hole**.	Yes
Follow the path as it travels from hole-to-hole	Click **Follow the path**.	Only if you have to avoid fixtures

Vacuum control

To	Do this	Recommended
Keep the vacuum on throughout the pierce routine	Click **Remain on**.	Yes
Turn the vacuum on/off at the end of the jet cycle	Click **Turn on/off every jet cycle**.	No. Pinch valve tubing life and overall reliability of UltraPierce will decrease.

ON procedure

Dwell	Recommended starting point
After vacuum on	1 second, and then increase as needed based on the length of the abrasive feed line.
After abrasive on	1.5 seconds, and then increase as needed based on the length of the abrasive feed line. Too short of a dwell could damage the material's top surface. Too long of a dwell pulls too much abrasive through the eductor.
After jet on dwell	0.5 seconds

OFF procedure

Dwell	Recommended starting point
After abrasive off	1.5 seconds, and then increase as needed based on the length of the abrasive feed line.
After jet off	3 seconds
After vacuum off	0.1 seconds

Pierce time

Enter the pierce time in seconds. Only use when doing piercing first. This does not affect water or abrasive cutting times.

Save settings

To	Do this	Result
Save the settings for the current FlowCUT session only	Click **OK**.	Settings are applied to every file opened until you exit FlowCUT. The next time you start FlowCUT, settings revert to the default.
Save the settings for all future FlowCUT sessions	Click **Save as default**.	Settings are applied to every file opened. However, if a file was saved with a particular setup, that setup is applied to that file.

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Calibrate UltraPierce

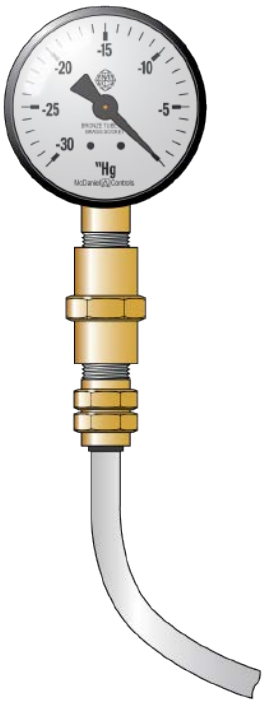
Calibrate UltraPierce when the vacuum unit does not produce enough vacuum for correct operation.

TOOLS

- UltraPierce tool kit, including:
  - Adapter, 3/8 × 1/4 in. NPT
  - Coupling, 1/4 in. NPT
  - Tubing, 1/4 × 3/8 in.
  - Vacuum gauge

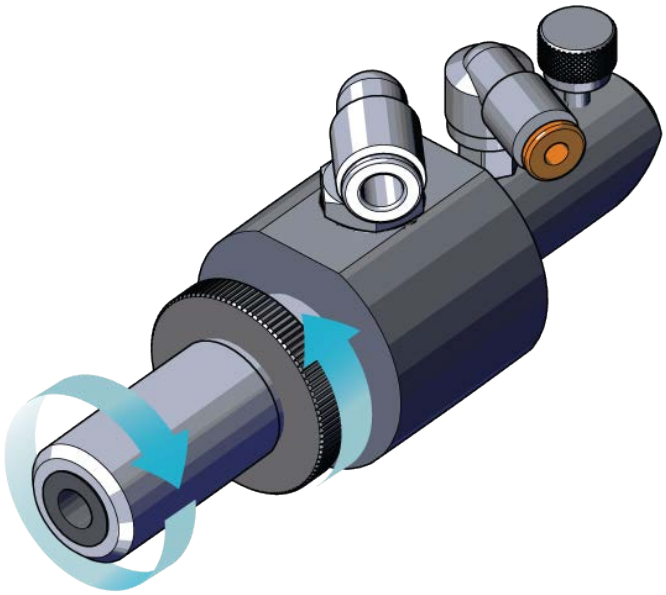
HOW-TO

1. Shut down the machine.
2. Disconnect the abrasive line from the abrasive inlet port.
3. Assemble vacuum gauge (including adapter, coupling, and tubing) and then connect it to the open abrasive inlet port.



4. Disconnect the exhaust hose from the eductor sleeve.

5. Loosen the jam nut on the eductor sleeve, and then turn the eductor sleeve clockwise until it bottoms out in the vacuum unit.



6. Start the vacuum unit and check for leaks. Air will still exit the eductor sleeve, but the vacuum gauge must measure no more than 5 Hg.
7. Slowly turn the eductor sleeve counterclockwise to increase the vacuum level to 10–12 Hg.

> Some applications may require more than 10–12 Hg. This is acceptable, but higher vacuum levels will shorten the life of the vacuum unit.

8. Tighten the jam nut, and then connect the exhaust hose to the eductor sleeve.
9. Disconnect the vacuum gauge and tubing from the abrasive inlet port.
10. Connect the abrasive line to the abrasive inlet port.

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Preventative maintenance schedule

What do I do?	When do I do it?
Rotate the exhaust hose 45°	Daily

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Flow Parts for UltraPierce

Eductor hose
Part # A-18883-3.5

Pinch valve tubing
Part # A-23920-17

Vacuum Assist maintenance kit
Part # 014579-1
Includes carbide liner, O-rings, and pinch valve tubing.

Vacuum Assist tool kit
Part # 014578-1
Includes installation tool and vacuum gauge with tubing and fittings.

Replace the exhaust hose

Replace the exhaust hose when it has worn thin or if there are any holes in it.

PARTS

- A-18883-3.5, Tubing (hose)

TOOLS

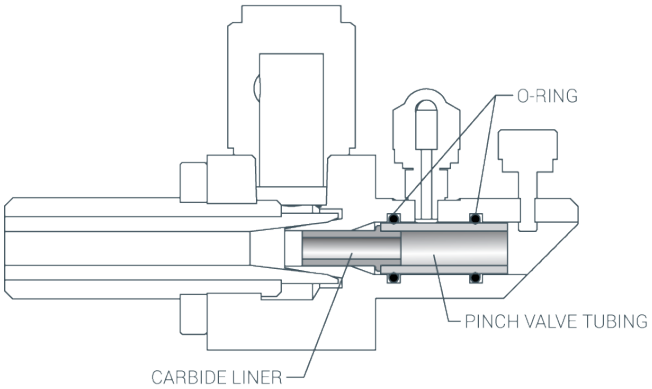
- Sharp shears or hose cutter

HOW-TO

1. Shut down the machine.
2. Remove the exhaust hose and discard it.
3. Cut a new exhaust hose with a pair of sharp shears or a hose cutter.
4. Connect the exhaust hose to the eductor sleeve.

Replace the pinch valve tubing

Replace the pinch valve tubing when it has worn thin or if there are any holes in it.



PARTS

- A-0275-012, O-ring (qty 2)
- 712251-2, Carbide liner
- A-23920-17, Tubing

TOOLS

- Needle nose pliers
- Shears
- UltraPierce installation tool

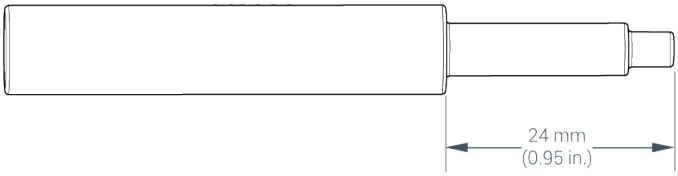
SUPPLIES

- Food grade O-ring Lube

HOW-TO

1. Shut down the machine.
2. Loosen the thumbscrew, and then remove the vacuum unit.
3. Pull the pinch valve tubing out of the vacuum unit with needle nose pliers. Discard the pinch valve tubing.
4. Remove the carbide liner from the vacuum unit, and then inspect it. If it is worn or damaged, discard it.
5. Pull the two o-rings out of the vacuum unit. If they are worn or damaged, discard them.

6. Apply a thin, even layer of FOOD GRADE O-RING LUBE to the two O-rings, and then install them into the inside grooves of the vacuum unit.
7. Insert the carbide liner—short end first—into the latex tubing, and then slide the assembly onto the installation tool.
8. When the tubing is flush with the end of the tool, cut the tubing with sharp shears.



9. Apply a thin, even layer of FOOD GRADE O-RING LUBE on the edge of the tubing that goes into the vacuum unit first, and then install the assembly into the vacuum unit.
10. Install the vacuum unit, and then tighten the thumbscrew.

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Troubleshooting UltraPierce by symptom

Delamination or breakage on the part's top surface

Abrasive is not getting to the cutting head before the the water turns on. Increase the **After abrasive on** dwell time.

Delamination or breakage on the surface around the pierced exit hole

Damage at the exit hole is a function of the pressure used to pierce the material—it is not related to vacuum assist operation. Decrease the pierce pressure.

Clog during normal cutting

- UltraPierce is leaking—this causes insufficient vacuum levels in the cutting head, so that it cannot draw abrasive properly. Find the leak and repair it.
- Abrasive feed rate it too high—lower the feed rate.
- Check the pinch valve tubing for holes or tears and replace if needed.

Clog during piercing

- Increase the air pressure to 5.5 bar (80 psi) or greater.
- Check the pinch valve tubing for holes or tears and replace if needed.

During calibration, vacuum gauge does not read 0–5 Hg.

The eductor sleeve has worn out—replace the vacuum pump.

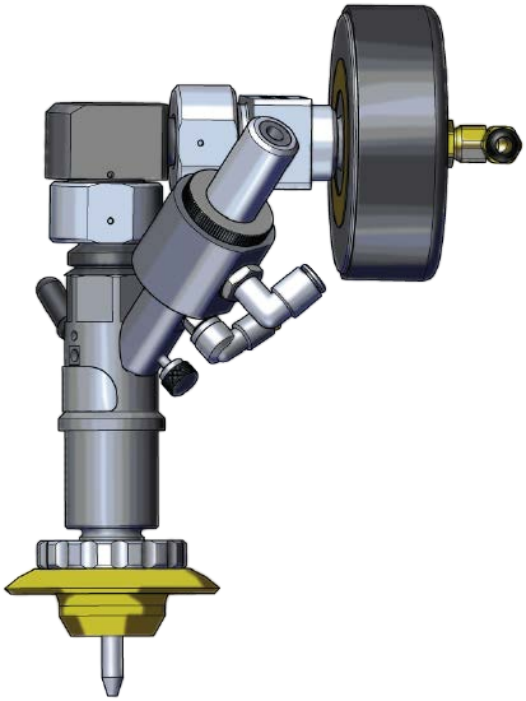
Pinch valve supply is always on

The pinch valve is always getting air—even when the machine is not in operation. If the accessory won't be in use for a long period of time, you can do one of the following:

- Turn the regulator down to zero for the pinch valve
- “Kink” the pinch valve air line and secure it with a cable tie
- Insert a small, two-way valve in the pinch valve line for convenience

Dynamic XD: interference with the C-motor arm or contact with the material

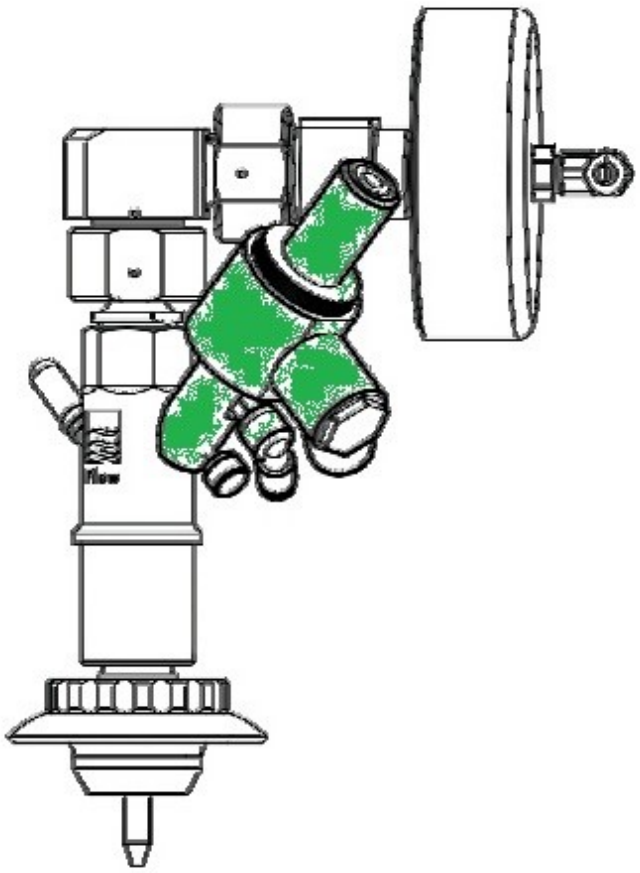
Verify UltraPierce is pointed in the correct direction. If there is damage to the vacuum assist or Dynamic XD wrist, call Flow Service.



Dynamic XD: On an XD wrist, the eductor collides with the C arm or tubing

Make sure that the vacuum module is in the correct position with respect to the cutting head, and adjust the “clocking” if it is not in the correct position.

The protective cover that is below the C-axis MUST be installed at all times for safety.



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Xtractor Abrasive Removal System

Xtractor Abrasive Removal System
Includes specifications and operating instructions for the VacBOX 2200 and 4400.

Pages: 9

- **Specifications**
  Specs for VacBOX 2200 and VacBOX 4400.
- **Install the bulk bag**
  To install the bulk bag, follow these steps.
- **Set up the hoses**
  Follow these step-by-step instructions to set up the hoses for use on the Xtractor Abrasive Removal System.
- **Cross-flow separation**
  Follow these steps for cross-flow separation.
- **Xtractor startup**
  Make sure to follow these steps for startup.
- **Extraction**
  To begin extraction, follow these steps.
- **Bag dewatering**
  Follow these steps for bag dewatering.
- **Remove the bulk bag**
  To remove the bulk bag from the VacBOX, follow these steps.
- **Cleaning the pump**
  During cross flow separation and dewatering operations, mud flowing through the pump may build up on the internal parts and can harden (particularly if left overnight or weekends). To prevent the buildup of mud from interfering with the operation of the pump, clean the pump.

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Specifications

Dimensions (W × H × D)
VacBOX 2200 ..... 1171 × 1494 × 1538 mm (46 × 59 × 60.5 in.)
VacBOX 4400 ..... 1285 × 1597 × 1652 mm (51 × 63 × 65 in.)

Air requirements
Supply ..... dry and filtered to 10 microns
Capacity ..... 441 L/min @ 4.1 bar (15.6 scfm @ 60 psi)
Interface ..... 3/8 in. NPT quick disconnect female socket

Sandpiper HDF2 diaphragm pump
removes up to 100 lb/min of garnet

10-channel radial diffuser
24 in. with rotation stopper

Hydraulic hand pump
double-acting; opens lid

Hoses
Dewatering hose ..... 1 in. x 6 ft; with quick release brass cam lock fittings/debris screen
Discharge hose ..... 1.5 in. x 16 ft; with quick release brass cam lock fittings
Suction hose ..... 1.5 in. x 16 ft; with quick release brass cam lock fittings
Garden hose to pump flush out adapter

Casters
Fixed (2) and Swivel (2)
Rated to 1100 lb

Bulk bag with corner straps
10,000 lb burst rating
91 × 91 × 91 cm (36 × 36 × 36 in.)

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Install the bulk bag

PARTS

- A-32611-1, Bulk bag with corner straps

HOW-TO

1. Raise the top of the VacBOX:
    a. Loosen the two door lock pivot bolts, and then rotate both bolts off the door lock tabs.
    b. Turn the directional control valve on the hand pump clockwise, and then use the hand pump to raise the lid.

2. Insert the bulk bag into the bag frame:
    a. Offset the corners of the bag from the corners of the bag frame so that the lifting straps do not line up directly on the corners.

b. Push down the lifting straps into the channel between the bag cage and the outer wall of the VacBOX, making sure they do not come into direct contact with the rubber seal on the lid. If the lifting straps are trapped between the top of the bag cage and the rubber lid seal, loss of vacuum will occur and machine performance will decrease.

c. Spread the bag evenly across the top of the bag support frame to ensure a good seal when the door is closed.

3. Close the VacBOX lid:

a. Turn the directional control valve counterclockwise, and then use the hand pump to secure the door.

b. Secure the two door lock pivot bolts.

NOTICE! Do not overtighten the door lock bolts as damage to the door tabs may result.

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Set up the hoses

To set up the hoses, do the following:

1. Attach the clear suction line to the inbound side of the cross-flow separator.

2. Attach the clear discharge hose to the outlet manifold of the pump.

3. Attach the hose set to the filter nozzle.

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Cross-flow separation

The process of cross-flow separation will dislodge and remove settled solids from a catcher tank or slurry pit. During cross-flow separation, the pump will operate at approximately 110 strokes per minute which will move 50-60 gallons per minute through the machine. Operating the VacBOX in this configuration will pull settled material through the cross-flow separator and deposit them into the bulk bag. The clean water (free of settled material) is returned through the discharge hose back into the catcher tank or slurry pit. Cross-flow separation operation is a closed loop process that does not consume any water.

1. Attach shop air hose to the VacBOX pump. Air setting should read between 50-60 psi.
2. Set the directional 3-way diverter valve for cross-flow separation by rotating the yellow ball valve handle until it is parallel to the pump suction manifold.

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Xtractor startup

For Xtractor startup, do the following:

1. Check the air supply hose fitting for dirt and/or garnet prior to attaching the air hose to the diaphragm pump.
2. Make sure that all fittings are secure on the top of the VacBOX and are tightened down.
    - Check to ensure that the 2 inch poly dewatering cap is secure.
    - Ensure hydraulic pump is set to the close position and tie rod cylinder is pushing down on the lid (i.e. hydraulic pump handle meets firm resistance when pumped).
    - Snug both lock bolts.
3. Place the suction nozzle assembly into the catcher tank or slurry pit. Make sure that the suction nozzle is below the surface of the water but does not settle into the garnet or mud in the catcher tank. If you do not have enough water in the catcher tank to pre-charge the VacBOX, use a water hose to fill the machine before you begin to remove the garnet.
4. Open the air valve slightly on the supply side of the diaphragm pump. Ideal operating speed is approximately 100–116 strokes per minute. This will give you approximately 50 gpm.

    IMPORTANT! You must run the pump on a slow stroke. Periodically, you may have to make slight adjustments to the air regulator to keep the pump operating at the most efficient speed.
5. Once the pump has been activated, air will begin to purge from the machine and bubbles will be visible in the catcher tank or slurry pit. Once the machine is full of water, it is "pre-charged." Air bubbles should no longer be visible and now it is okay to remove the garnet by lowering the nozzle assembly into the heavy sediment.

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Extraction

The desired vacuum on the Extractor holding tank is -8 to -12 hg. on the gauge located on the top of the VacBOX. Any less than this could indicate that the lock bolts should be snugged up more (try ¼ turn on each one and observe the change in vacuum). If low vacuum persists, it could indicate a problem with the diaphragm or a flapper valve in the pump. Vacuum that exceeds -12 hg could indicate a plug in the suction line or debris stuck to the face of the nozzle.

The VacBOX does not need to run continuously. It can be operated only as needed to prevent the accumulation of garnet in the catch tank.

To begin extraction, do the following:

1. Move the suction nozzle assembly to a place on the catcher tank where it can be pushed down into the garnet to begin the extraction process.
2. Move the nozzle assembly around the tank as often as needed to keep a continuous supply of garnet flowing into the machine.
3. Once the VacBOX holding chamber is full (as checked with a dip stick inserted through the 2 inch dewatering port), proceed with bag dewatering and removal.

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Bag dewatering

The *Bag Dewatering* setting reroutes the flow of water into the suction end of the pump. In this configuration, water is pulled from around the outside of the bulk bag instead of pulling from the top of the cross-flow separator as it does in cross-flow mode. This creates a vacuum outside of the bag, which pulls water through the bag membrane. It also removes the water from the void between the bag frame and the outer chamber wall, and returns clean water to the catcher tank or slurry pit.

For bag dewatering, do the following:

1. While the machine is operating, remove the suction and discharge hoses from below the water level, but leave them over the catcher tank or settling pit to remove any excess water from the cross-flow separator. After several seconds, the discharge hose should stop discharging water. It is now okay to raise the lid on the VacBOX to continue manual dewatering.

2. Purge excess water from the machine before you remove the bulk bag. To remove the water and silt surrounding the bag, set the directional 3-way diverter valve to the *Bag Dewatering* setting by rotating the yellow ball valve handle until it is perpendicular to the pump suction manifold, and then restart the machine.

   ❖ Lid can be in either the open or closed position for this step.

3. Remove the water from the top of the bag:
    a. Disconnect the suction hose from the top of the pump and connect the 1” X 6’ dewatering hose into the CAM fitting on the pump inlet.
    b. Turn on the air supply to the pump, and then use the dewatering hose to vacuum the remaining water from the top of the bulk bag and remove excess water and silt from the channel between the bag cage and outer chamber of the machine.

Remove the bulk bag

To remove the bulk bag from the VacBOX, do the following:

1. Expose the lifting straps from all four corners.

2. Connect the four straps to the lifting device (i.e. Crane, Forklift) and lift the bulk bag from the VacBOX chamber.

   CAUTION! Ensure the straps are protected from any sharp edges on the lifting device to avoid cutting the straps and dropping the load. Immediately transfer a fully loaded bulk bag to a pallet for safe transportation to storage/disposal area. If you are using a forklift, carefully approach from the side to avoid damage to the VacBOX lid and/or seals.

3. Use a garden hose to rinse all garnet/mud from the bottom of the machine (under the floor of the bag). Use the *Bag Dewatering* setting to pump the residual mud out of the VacBOX and back into the catcher tank or slurry pit.

❖ Mud build up on the bottom of the cage will interfere with operating the machine in the dewatering configuration. Ensure the inside is rinsed clean with every bag change.

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Cleaning the pump

During cross flow separation and dewatering operations, mud flowing through the pump may build up on the internal parts and can harden (particularly if left overnight or weekends). To prevent the buildup of mud from interfering with the operation of the pump, use the supplied hose rinse adapter to connect a standard garden hose to the CAM lock inlet (top) of the pump. Performing the steps below will ensure trouble free operation of your pump for many years.

To clean the pump, do the following:

1. Connect a garden hose to the pump rinse adapter.
2. Disconnect the cross-flow separator (or the dewatering) hose from the top of the pump.
3. Connect the pump rinse adapter to the inlet of the pump, and then turn on the water to the hose.

   ❖ Make sure the suction/discharge nozzle is placed in the catcher tank as the water discharged from the pump will flow out the end of the discharge line (along with any material being flushed from the pump)
4. Run the hose until clear water flows from the discharge hose into the catcher tank.

   ❖ Turn on the air supply valve enough to cycle the pump a few times to ensure a complete flush.
5. Turn off the water and reconnect the cross-flow separator hose to the pump inlet.