Jetstream®
Subsidiary of Federal Signal Corporation

40K MULTI-MODE VALVE

(PNs 53905, 54695)

PRODUCT INSTRUCTIONS

PI-121

The 40,000 psi Multi-Mode Valve™ is a combination air-actuated control valve and air-flow regulator. It is to be used in conjunction with the Jetstream Tornado Gun. The Multi-Mode Valve also controls the quality and flow of air into the gun's air motor. This tool utilizes a self-contained, easily-removable cartridge that includes all necessary parts to overhaul the control valve. The cartridge can be easily replaced in the field within one minute. The 40K Multi-Mode Valve is rated for operation at 40,000 psi maximum working pressure.

Read these instructions thoroughly before installing, connecting, or using the 40K Multi-Mode Valve. If any questions remain, call JETSTREAM at (800) 231-8192 or (832) 590-1300. Also read the yellow JETSTREAM SAFETY WARNING pamphlet included with the shipment of your new 40K Multi-Mode Valve and reproduced inside this publication. This product is sold with the understanding that the purchaser agrees to thoroughly train all operators and maintenance personnel in the correct and safe installation, operation and maintenance of the product and to provide adequate supervision of personnel at all times. Retain these instructions for future reference. If this product is resold or otherwise conveyed, purchaser must pass on the instructions to the new user.

TABLE OF CONTENTS

SECTION 1: SAFETY

⚠ DANGER

Incorrect Use of High Pressure Waterblast Equipment May Cause Serious Injury
Read these instructions in their entirety before using any JETSTREAM products.

This information was prepared to aid in the identification of potentially unsafe conditions when using high pressure waterblast equipment. It should be noted that other potential hazards may exist which might have not been mentioned in this brochure.

In all cases, JETSTREAM products are sold with the understanding that the purchaser agrees to thoroughly train all operating and maintenance personnel in the correct and safe installation, operation of maintenance of waterblast equipment and to provide adequate supervision of personnel at all times.

Read the following in its entirety before connecting, operating or repairing equipment. Purchasers and operators also should be familiar with the current version of the “Industry Best Practices for the Use of High Pressure Waterjetting Equipment” published by the Waterjet Technology Association, as well as any applicable OSHA regulations, standards and guidelines.

Should any questions arise concerning safe and proper procedure, contact JETSTREAM prior to the installation or use at (800) 231-8192 or (832) 590-1300.

GENERAL WATERBLAST

1. Use only clear, clean water in high pressure system.

2. Place barricades with warning signs or barricade tape around work area.

3. Outfit all operators with Personal Protective Equipment (PPE). Hard hat with plastic face shield, rainsuit, non-skid knee boots **with metatarsal protection,** gloves, ear protection and body armor rated for operating pressures are considered minimum safety equipment. Proper respiratory protection is required where dangerous fumes or dust is present or created by the waterblasting operation. Follow applicable OSHA regulations, standards and guidelines regarding the use of respiratory protection if harmful fumes or dust is present during, or created by the waterblasting operation.

4. Use products intended for high pressure waterblasting only.

5. No product should be altered without written consent of the manufacturer.

6. Read and follow all manufacturer's instructions prior to using any waterblast product. Contact manufacturer.

7. Thoroughly review alternative methods before initiating any potentially dangerous waterblasting operation. Fully automated, semi-automated, and/or mechanized methods should all be considered first. Contact the applicable waterblasting manufacturers for assistance and recommendations.

8. The operator handling the cleaning device (with nozzle) must always have control of water pressure. A surface cleaning operator should operate a trigger style control gun capable of instantaneously stopping pressure to nozzle. A tube cleaning lance operator should operate a foot gun capable of instantaneously stopping pressure to the lance.

9. Inspect the condition of all components prior to use. Use no items which are in questionable condition.

10. Check the condition of thread connections prior to the make-up of any high pressure connection. Use Teflon tape and anti-seize on male pipe (NPT) thread for sealing purposes. Do not let tape overlap the male pipe thread end. Tape fragments may enter system water stream and clog nozzle's orifices.

Do Not use a component with missing or damaged threads on the high pressure connections.

⚠ CAUTION Use wrench flats (when available) or a properly adjusted smooth jaw plier wrench (JS PN 64119) for tightening components. Avoid using pipe wrench as wrench marks will cause high pressure components to crack and fail.

11. All high pressure hose connections require a hose restraint (whip check), including connection at fluid end discharge.

12. Before attaching a nozzle to the control gun or tube cleaning lance, **operate the pump at low speed to purge** dirt and debris from system. **Dirt and debris can clog nozzle orifice(s) and cause excessive system pressure which could lead to a lance failure.**

13. With nozzle installed, **operate the pump at a low speed (low pressure) for test**. Should system repairs or adjustments be necessary, stop pump and relieve all pressure before making required repairs or adjustments. The pump operator should watch the nozzle operator at all times in case any difficulty arises and it becomes necessary to depressurize system. If the pump operator does not have a clear line of sight to the nozzle operator, it may be necessary to have another employee available to communicate between the nozzle and pump operators.

14. With the system operating properly, **increase pump speed slowly until operating pressure is reached**-and adjusted. Pressure adjustments should always be made slowly. The nozzle operator shall be warned before any pressure adjustment is made by the pump operator. A sudden change in reaction force may cause the nozzle operator to lose balance.

15. Use **minimum pressure required**-for cleaning. Do not exceed the operating pressure of the system's lowest pressure-rated component. All equipment pressure rating markers and warning tags should be left intact.

16. Waterblast operators must be made aware that the **cleaning nozzle's discharge jets(s) can inflict serious body wounds.** Supervisors should demonstrate the potential danger of discharge jet(s) by showing all new operators the effect of a waterjet by cutting a scrap piece of wood such as a 2" x 4".

17. If equipment malfunctions or a system malfunction is suspected, immediately stop cleaning activity and relieve the pressure in the system before attempting any repairs. Always follow the manufacturer's repair instructions.

18. Only trained persons should be authorized to perform any maintenance or repair.

19. Following any repairs, the system should be operated at low pressure for test. Bring equipment up to operating pressure slowly.

20.For shutdown in freezing conditions, even for brief periods, drain water from all components. Prior to starting operations in freezing conditions, the operation of all equipment components must be checked carefully to make sure components are not frozen and can be operated.

21. Store components properly by protecting them from damage when not in use. Be sure all safety warning tags and markers remain intact.

CONTROL GUNS AND DEVICES

1. Read General Safety section before connecting or using control guns or control devices.

2. Thoroughly review alternative methods before initiating any potentially dangerous shotgunning or hand lancing operation. Fully automated, semi-automated, and/or mechanized methods should all be considered first. Contact the applicable waterblasting manufacturers for assistance and recommendations.

⚠WARNING As described in the Industry Best Practices for the Use of High Pressure Waterblasting Equipment published by the Waterjet Technology Association, the standard shotgun barrel length shall be a minimum length of 48” to minimize the risk of nozzle discharge accidentally striking the operator’s feet, legs, or body. See Section 11.10.6. The WJTA has recognized that deviations or variances from these best practices may be acceptable under certain circumstances. See Section 2.7. If users believe deviation from this 48” standard is acceptable, they should follow procedures outlined in Section 2.7 to minimize risk to the operator. Among other things, users should ensure that other measures to perform the work have been considered and exhausted, senior safety management and customers have considered and approved the deviation, operators have been properly trained and warned about any increased risk associated with the deviation, and operators are wearing all appropriate PPE, including body armor rated for the operating pressure.

3. Prior to use, thoroughly check control gun or control device for smooth and proper operation. Control guns and control devices should also be checked for proper operation before each operating shift. Do not use any control gun or control device that has not been checked before your operating shift.

4. A control gun operator using a hand-held gun should position and brace his body for the gun's rearward reaction force before depressing gun trigger. Gun's rearward reaction should be a maximum force of 40 to 50 lbs. (or 1/3 body weight of operator.) The control gun operator should maintain firm, solid footing to counter gun's rearward reaction.

5. The use of a Safety Shroud and a Safety Whip Hose with handheld control guns is strongly recommended for additional operator protection against a burst occurring in the high pressure hose connected to the gun. Use of Hand Grip and Shoulder Stock in hand-held control guns will provide greater operator comfort and safety.

6. Fall protection should be provided when blasting on scaffolding or sloping surface per OSHA guidelines. Do not operate a hand-held gun while standing on slippery surfaces.

7. The control gun operator should always start blasting with a low system pressure and slowly increase blasting pressure. Depress and release control gun trigger/pedal several times at operating pressure to check the control gun's operation before starting cleaning operations.

8. A dump type control gun should always open fully and reduce the system pressure to near zero immediately when its trigger/pedal is released. If this type of control gun does not relieve system pressure immediately or system pressure does not fall below 200 psi when trigger/pedal is released, do not use the control gun.

9. The control gun operator should never pass a control gun to another operator without first stopping the pump and water flow to the control gun. Passing off a control gun without first stopping system waterflow is dangerous because of possible accidental trigger actuation.

10. Do not use a control gun or control device that has malfunctioned or you suspect malfunctioned without having it repaired and/or thoroughly checked for proper operation by a qualified high pressure maintenance mechanic or your supervisor.

11. Do not use a control gun that does not have a trigger guard.

12. Never tie, wedge or clamp a control gun's trigger in the closed

position.

13. All electric throttle control cords should be rated for wet conditions. All cord connections and switches should be kept out of water.

14. Any hose used for transporting dump water back to pump should have a large enough diameter and short enough length so that potentially dangerous back pressure is kept low. Protect hose from traffic.

15. Hand-operated control guns should never be used as foot-operated devices.

PRESSURE RELIEF DEVICES

1. Read General Safety section prior to installing Relief Valve and/or Pressure Relief Devices.

2. A waterblast system should include both primary and secondary pressure relief protection:

A. For primary protection a primary rupture disc assembly or spring-loaded relief set at 1.2 times, maximum operating pressure is recommended (i.e. relief valve is set at 12,000 psi if maximum operating pressure is 10,000 psi)

B. For secondary protection a rupture disc assembly containing a manufacturer's approved disc having a burst rating of 1.4 times maximum operating pressure is recommended.

⚠ WARNING Only use a rupture disc holder which will NOT permit the use of coins or other objects in place of discs.

3. Relief devices should never be mounted so the discharge could strike personnel.

4. Never install a shut-off valve between the pump and relief device.

5. "Set pressure" must be prominently displayed on all relief devices. Never install or use a relief device unless its "set pressure" is known.

6. Do not attempt to correct a leaking relief valve by increasing spring tension as this will increase its set pressure.

7. Do not use a pressure relief valve as a combination relief and throttling device.

8. Keep relief valve dry during freezing conditions.

NOTE: Pressure relief devices are imperative for the protection of both operator and equipment from dangerous over-pressurization.

HIGH PRESSURE HOSE

1. **Read General Safety** section prior to connecting high pressure hose.

2. Do not use a high pressure hose with a burst rating less that 2.5 time the pressure at which it will operate. 10,000 psi operating pressure high pressure must have a minimum 25,000 psi burst rating. 8,000 psi operating hose must have a minimum 22,000 psi burst rating.

3. Do not use a high pressure hose that has an unknown burst rating or manufacturer's operating pressure rating.

4. Use of a Safety Shroud is strongly recommended for added safety where hose connects to control gun.

5. Use of hose restraint (whip check) is required at all hose connections, including connections at fluid end.

6. Always apply wrench to wrench flats when making threaded connections. Do not apply wrench on the end fitting ferrule (collar).

7. **Remove hose from service if:**

   A. Cover is damaged and reinforcing wires are exposed to rust and corrosion;

   B. Cover is loose, has blisters or bulges;

   C. Hose has been crushed or kinked;

   D. End fitting shows evidence of damage, slippage, or leakage.

   E. Hose has been exposed to pressures greater than 50% of burst rating; or

   F. Hose is three or more years old, regardless of condition.

8. Disconnect, drain, coil and store hose properly after use.

9. Never attempt to repair or recouple high pressure hoses in field. High pressure hose end fittings are the permanently crimped type and can only be properly installed with hydraulic crimping equipment.

NOZZLES

1. **Read General Safety** section.

2. Nozzle flow ratings must be compatible with pump discharge and pump pressure rating. (See Nozzle Flow Rating Chart on page 42.)

3. Use only nozzles with a manufacturer's pressure rating of at least the operating pressure or a burst rating or no less than 3.0 times the

desired operating pressure.

4. Prior to installation, make sure the nozzle has no clogged orifices.

5. Apply 3 - 4 wraps of Teflon tape to male connection threads on the nozzle. Apply anti-seize compound over the sealant tape for additional protection against galling in connection threads. Wrench connection 1 1/2 - 2 turns past hand tight. A minimal thread engagement of four (4) threads should exist on all Jetstream NPT pipe connections.

6. ⚠ **CAUTION** Use wrench flats (when available) or a properly adjusted smooth jaw plier wrench (JS PN 64119) to tighten nozzle. Avoid using pipe wrench as wrench marks will cause nozzles to crack and fail.

7. Blocked orifice(s) can cause excessive system pressure and failure. If orifice(s) appear clogged or partially blocked with dirt or debris, remove nozzle from J-Force and clean immediately.

8. Remove nozzle from service if:

A. Nozzle is split or damaged;

B. Nozzle sidewall is worn by more than 25% at any point;

C. Nozzle's ability to hold pressure is questionable

D. Threads are missing or damaged

HIGH PRESSURE FITTINGS

1. Read General Safety section prior to installing fittings in system.

2. Use non-brass or non-cast iron fittings which are made for high pressure waterblast use.

3. Use only high pressure fittings which are clearly marked with the operating pressure.

4. High pressure fittings should have a known burst rating of not less than 3.0 times system operating pressure. Never use a damaged or corroded fitting or one with damaged or missing threads.

5. Use only high pressure rated fittings and hose in the waterblast system. For 10,000 psi waterblast service all fittings and hose should have a minimum burst rating of 25,000 psi; for 15,000 psi service they should have a minimum burst rating of 37,500 psi; for 20,000 psi service they should have a minimum burst rating of 50,000 psi.

6. Use wrench flats (when available) or a properly adjusted smooth jaw plier wrench (JS PN 64119) to tighten fittings. Avoid using pipe wrench as wrench marks will cause high pressure fittings to crack and fail.

REPLACEMENT PARTS

1. **Read General Safety** section prior to repairing equipment and installing replacement parts.

2. Only trained persons should be authorized to perform maintenance or repairs to equipment.

3. Read and follow all manufacturer's repair instructions. All tool, torque, clearance and lubrication recommendations should be followed.

4. During replacement of any part, inspect mating part for wear and replace if necessary.

5. Do not attempt to install or use a part whose dimensions, clearances, function or use are suspect.

6. Test repaired equipment carefully and thoroughly before putting it into service. Do not put any piece of repaired equipment into service if its performance is questionable. If repaired equipment performance is questionable, call manufacturer of repair parts for assistance.

This section concludes all the same information included in the yellow JETSTREAM SAFETY WARNING pamphlet (PI-082).

SECTION 2: PRODUCT DESCRIPTION

The 40,000 psi Multi-Mode Valve™ is a combination air-actuated control valve and air-flow regulator. It is to be used in conjunction with the Jetstream Tornado Gun. The Multi-Mode Valve can be configured three ways: Dump Mode, Shut-In Mode, and Constant Pressure Mode. (Refer to the Product Configuration section for specific details on each configuration).

The Multi-Mode Valve also controls the quality and flow of air into the gun's air motor. This valve can be used with other manufacturer's rotary blast guns and used in multiple gun operations by configuring the valves for Constant Pressure or Shut-In Mode.

The Multi-Mode Valve utilizes a self-contained, easily removable cartridge that includes all necessary parts to overhaul the control valve. The cartridge can be easily replaced in the field within one minute. Refer to the chart on the next page for the replacement cartridge part number, or see a complete list of replacement parts in Replacement Parts Section. Section 6 describes cartridge field replacement.

The Multi-Mode Valve is rated for operation at 40,000 psi and features the Jetstream Port Connection for connecting hoses to the valve. Depending on the assembly purchased, hose adapters are included to connect hoses with either type M or HP end fittings.

Front

Back

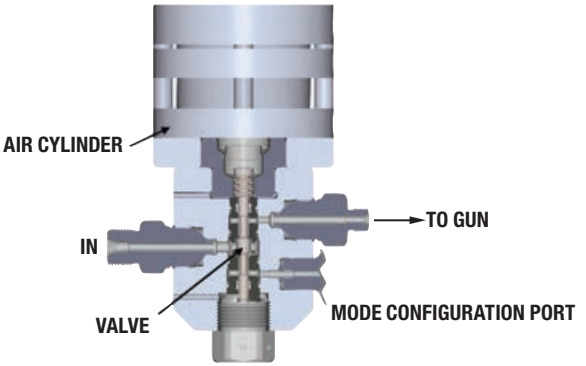
Product Specifications

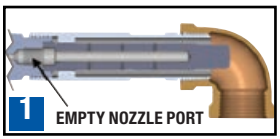
Model Name	PN 53905	PN 54695
Maximum Operating Pressure (psi)	40,000	
Minimum Operating Pressure (psi)	10,000	
Maximum Inlet Air Pressure (psi)	125	
Minimum Inlet Air Pressure (psi)	80	
Maximum Flow (gpm)	6.8	
Maximum Operating Pressure (bar)	2,758	
Minimum Operating Pressure (bar)	689	
Maximum Inlet Air Pressure (bar)	8.6	
Minimum Inlet Aire Pressure (bar)	4.8	
Maximum Flow (l/min)	25.7	
Inlet Connection	7/8” Type M Male	9/16” HP Fml.
Outlet Connection	9/16” Type M Male	3/8” HP Fml.
Nozzle Types Accepted	UHPX, UHPXi, UHPXD	
Width (in)	17	
Depth (in)	13	
Height (in)	15	
Weight (lbs)	28.5	
Width (mm)	431	
Depth (mm)	330	
Height (mm)	381	
Weight (kg)	13	
Replacement Cartridge PN	54014	
Air Filter	40 Micron	
Lubricator Oil	SAE 10W	

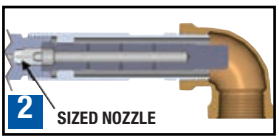
Product Configuration

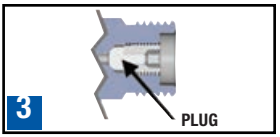
The 40K Multi-Mode Valve can be configured in three different modes depending on the equipment used and the needs of the user. Mode is determined by the installation of a nozzle, a plug, or nothing in the mode configuration port.

Figure 1 shows a cross section of the high-pressure valve assembly used on the Multi-Mode Valve.









1) DUMP MODE:

For use with single gun systems. Reduces pressure to near atmospheric pressure upon release of gun trigger. This mode is selected by removing the nozzle from the mode configuration port. Releasing gun trigger will cause valve to shift water from blast gun to open atmospheric dump port, making system act much like a standard dump style gun.

⚠WARNING Operating in Dump Mode with frequent short cycles will reduce the life of all components in the system, specifically hoses and pressure gauges. All HP components will eventually fail due to fatigue and frequent cycling from zero pressure to high pressure will shorten the life of fluid end manifold and stuffing boxes. Consider running in constant pressure mode instead.

2) CONSTANT PRESSURE MODE:

For multiple gun operation where system pressure must remain constant. This is achieved by installing a properly-sized orifice in the diffuser tube. Releasing gun trigger causes valve to shift from blast gun to fixed orifice, maintaining system pressure. Orifice must be sized using the nozzle selection chart so that its flow is equivalent to the total flow of all the blast nozzles in the attached gun.

⚠ DANGER When operating in Constant Pressure Mode, it is absolutely necessary to have the diffuser, diffuser tube, and elbow installed over the nozzle to contain the dangerous waterjet, which exits the fixed orifice.

Use the Nozzle Selection Chart under the Flow Chart Section to select a nozzle for constant pressure mode operation. Chart assumes that all blast nozzle orifices are the same diameter. If this is not the case for a particular operation, the nozzle must be sized by determining the total flow of all nozzles used in the blast gun and then selecting a single nozzle with an equivalent flow to be installed in the mode configuration port.

3) SHUT-IN (DRY SHUTOFF) MODE:

For single or multiple gun systems which utilize intensifier or Flow type pumps where stopping water flow is desired. This mode is selected by installing a plug (UHPX-PLUG) in place of the orifice in the diffuser tube. Releasing gun trigger causes valve to shift from blast gun to plugged diffuser port, stopping water flow.

⚠ DANGER Never plug the mode configuration port of the Multi-Mode Valve when using a plunger pump unless an approved pressure regulation device is installed to prevent the system from exceeding the maximum operating pressure.

SECTION 3: PREPARATION FOR USE

3.0 BEFORE PUTTING 40K MULTI-MODE VALVE INTO SERVICE

NEW 40K MULTI-MODE VALVE

3.1 Check the Multi-Mode Valve carefully upon removal from its shipping container for damage. DO NOT use the product if any damage is apparent. Instead, notify Jetstream immediately if the condition of any component is questionable.

3.2 Fill air lubricator with oil per Section 6.2.

3.3 Remove cartridge from packaging and check condition of seals. Before installing according to the instructions in Section 6.1, check the bore into which the cartridge is to be installed and verify that it is free of packaging materials or other debris that could result in improper or inconsistent operation or plugging of nozzles which could cause system overpressurization.

3.4 Determine the mode in which the valve will be used from the Product Configuration section and configure the dump port accordingly based on Figure 1.

3.5 Follow all pre-startup procedures prior to putting a new Multi-Mode Valve into service.

⚠ IMPORTANT Do not use a Multi-Mode Valve that has not had the following procedures and inspection previously performed on it.

PREVIOUSLY USED 40K MULTI-MODE VALVE

For safety reasons, the following cleaning and inspections must be performed on the control valve before the start of each working shift.

3.6 Remove the valve cartridge from the control valve body for inspection. The cartridge's valve stem surface should be smooth and the valve should move freely in cartridge. The cartridge seals should be free of damage. Replace the cartridge if damage or wear to any component is apparent.

3.7 If necessary, clean cartridge in a mineral-based solvent (diesel fuel, kerosene, paint thinner, etc).

3.8 Clean the control valve body internal cavities and the actuator cylinder mechanism and cavities, if necessary, to remove all dirt and debris from these areas.

3.9 Apply grease to the external seals and reinstall the cartridge. Wrench tighten the valve plug to at least 30 ft-lbs. torque.

3.10 Verify that lubricator is filled to the recommended fill line with air tool oil

3.11 Connect the Multi-Mode Valve to the waterblast system as instructed in Section 4 with water and air supplied, but make sure that there are no nozzles or plugs installed in the control gun or the Multi-Mode Valve. Adjust air pressure to between 80 psi and 90 psi using the control valve regulator knob.

3.12 Engage the waterblast pump with the control gun triggers released. At that point, the system pressure should be below 200 psi, and all flow should be exiting the system through the mode configuration port (dump port) of the Multi-Mode Valve. No water should be travelling through the control gun.

3.13 Briefly squeeze both gun triggers to divert all flow from the dump port to the control gun. No water should be exiting the system through the dump port of the Multi-Mode Valve. The system pressure should still remain below 200 psi.

3.14 Check the system for any air leaks by squeezing the gun triggers for two or three seconds at a time while another person places a hand around each air connection to ensure that there is no escaping air.

3.15 All air hoses should be intact and free of cracks or holes.

3.16 Air regulator and oiler should be secured to the base and fully operational.

3.17 All frame components should be tight.

3.18 Inlet and outlet connection fittings should be rated for 40,000 psi.

3.19 Inlet and outlet connection fittings should be tight and in good condition.

3.20 The control valve body should be tight on control valve base.

3.21 If intending to operate in Constant Pressure Mode, unscrew the diffuser housing and remove the diffuser. Inspect the hole through the diffuser center with a flashlight. If there appears to be significant wear inside, replace it before beginning operation. This component will eventually wear out, and it should be replaced after every two hundred hours of operation. If it is allowed to wear excessively, the waterjet exiting though the fixed nozzle may wear a hole through the end of the diffuser, leaving the low pressure elbow exposed to the waterjet. If this occurs, the valve's waterjet will quickly cut through the elbow on the dump port, exposing the operators to a dangerous waterjet.

⚠ DANGER When operating in Constant Pressure Mode, the diffuser must be replaced after 200 hours of operation to prevent component failure, which would result in waterblast operators being exposed to a dangerous waterjet from the dump port.

3.23 For operator safety, all high pressure hose sections connected to the gun and 40K Multi-Mode Valve should be in good condition and free of leaks and cover damage.

3.24 Drain hoses connected to the 40K Multi-Mode Valve dump port should have a minimum of 3/4" inner diameter and should be no longer than 25 feet. The hose should be free of blockages that can create dangerously high pressures in diffuser housing, which could result in component failure.

⚠ DANGER Never plug the low pressure elbow located on the dump port of the Multi-Mode Valve, even when operating in Shut-In Mode. This can result in component failure and/or possible operator injury.

SECTION 4: SETUP

4.0 CONNECTING 40K MULTI-MODE VALVE

4.1 Use only fittings and hose that are related for at least 40,000 psi and have a minimum burst rating of at least 100,000 psi.

4.2 Before connecting the gun and Multi-Mode Valve, all high-pressure hoses should be purged by pumping water through the system to ensure that dirt or other debris does not enter the system and cause damage or overpressurization (plugged nozzle).

4.3 Check air lubricator oil level and fill if necessary to prevent damage to control gun air motor.

4.4 Connect system components according to figures, but do not install nozzles until step 5.11.

⚠WARNING In Constant Pressure Mode or Shut-In Mode, each gun operator must be connected to a Multi-Mode Valve in order to have independent control of gun nozzle pressure at their location.

4.5 Apply anti-seize compound liberally to all stainless steel threads as well as the cones and seats of all cone/seat connection types.

4.6 Consult chart below for replacement or additional components needed to connect Multi-Mode Valves to system. In the chart, Type M fittings and hoses for use with valve assembly 53905 are listed first. High pressure (HP) fittings for use with assembly 54695 are shaded in gray.

Assembly PN 53905/54695

Item	Part Number	Description
1	53672	Adapter, 7/8" Type M Male
	53988	Adapter, 9/16" HP Male
2*	27626-XXX41411	Hose, XXX ft, 7/8" Type M
	27626-XXX33331	Hose, XXX ft, 9/16" HP Male
3	27528	Adapter, 7/8" Type M Male
	27607	Coupling, 9/16" HP
4	54482	Y-Adapter, 7/8" Type M Male
	28672	Y-Adapter, 9/16" HP Female
5**	53570	Adapter, 7/8" Type M Male
	53572	Adapter, 9/16" HP Male
6	53905	Multi-Mode Valve (Type M)
	54695	Multi-Mode Valve (HP)
7**	53571	Adapter, 9/16" Type M Male
	54056	Adapter, 3/8" HP
8	27731-02539393	Hose, 9/16" Type M
	27731-02532323	Hose, 3/8" HP
9***	27530	Adapter, 9/16" Type M Male
10	53880	Tornado Gun, 36" Barrel
	53710	Tornado Gun, 48" Barrel
11**	28066	Air Control Hose
12	53970	3 Orifice Tornado Nozzle
	53971	4 Orifice Tornado Nozzle

NOTE: Part numbers and descriptions are subject to change without notice.
* When ordering hose, length must be specified in feet. For example, a fifty foot hose would be 27626-05041411
** Item included with Multi-Mode Tumble Box
*** Item included with Tornado Gun

SECTION 5: OPERATION

⚠ IMPORTANT Water cleanliness is very important. Use only clear, clean, cold water that has been filtered to a minimum of three microns before the high-pressure pump.

5.1 Use only thoroughly trained operators to perform cleaning operations with the waterblast setup.

5.2 The person controlling the blast nozzle must be the gun operator. Do not allow a secondary or remote operator to be the control gun operator.

5.3 The waterblast operator must be made aware that the blast nozzle's discharge jet(s) can inflict serious body wounds.

5.4 Place barricades with warning signs or barricade tape around work area. This includes the waterblast unit and all high pressure hoses.

5.5 Before starting to blast, check for adequate hose length. The waterblast operator should get into blasting position and move around to make sure that all hoses (air and high-pressure) from the Multi-Mode Valve are free from obstructions and are not tangled.

5.6 Make sure that the oil flow through the system from the oiler is set correctly. To set the oiler, close off the flow control knob by turning it clockwise; then turn the adjustment knob counter-clockwise approximately 2 turns.

5.7 Once the system is completely connected, adjust outlet air pressure to between 80 psi and 90 psi using regulator knob. (90 psi is the maximum inlet air pressure of the air motor for the Tornado Spinner Gun).

5.8 With no nozzles installed in the gun or the Multi-Mode Valve, start the waterblast unit and engage the pump according to the unit startup procedures. Allow the pump to run for a minute or two with water exiting through the Multi-Mode Valve dump port. Verify that no water is exiting the gun.

5.9 With no nozzles installed in the gun or the Multi-Mode Valve, have the gun operator squeeze both triggers to shuttle the Multi-Mode Valve cartridge and direct flow to the gun. Verify that all flow now exits the system through the gun. Also, check the air pressure gage on the Multi-Mode Valve and adjust, if necessary, so that the air pressure through the valve assembly is between 80 psi and 90 psi while the control gun is engaged. Also, check the drip sight located on top of the air lubricator to verify that the oil drip rate is at least one drop every two seconds. Adjust drip rate if necessary. Gun operator should keep the gun engaged for at least one full minute to purge any debris that may be in the water lines.

5.10 Disengage pump and shut down waterblast unit. Turn off water supply.

5.11 NOZZLE INSTALLATION

Follow instructions for specific mode of operation:

CONSTANT PRESSURE MODE

- Install nozzles in control gun and Multi-Mode Valve.
- Verify that fixed orifice located in Multi-Mode Valve has an equivalent flow to the total flow of the gun nozzles. Consult flow charts for specific manufacturer's nozzles.
- Install diffuser and diffuser housing over Mode Configuration Port and tighten securely.

DUMP MODE

- Install nozzles in control gun.
- Unscrew diffuser housing, install nozzle in mode configuration port, and reinstall diffuser housing.

SHUT-IN (DRY SHUTOFF) MODE

- Install nozzles in control gun.
- Install plug in mode configuration port.

5.12 Once gun operator(s) have established control of their gun(s) and taken positions for waterblasting operations to begin, start unit and engage waterblast pump per unit startup procedures.

5.13 Follow instructions for specific mode of operation:

CONSTANT PRESSURE and SHUT-IN MODE

1. With all gun triggers squeezed to engage all guns in the system, unit operator should build to about 1/4 of desired operating pressure.

2. One operator at a time, and then both at the same time, should disengage and engage their guns to ensure that the system pressure remains near constant. There may be small differences due to inexact flow characteristics between the fixed orifices and the gun nozzles (Constant Pressure Mode).

3. Each operator should squeeze and release gun triggers two or three times to ensure proper operation of gun and Multi-Mode Valve. During this cycling, pressure should remain nearly constant.

4. Repeat steps 1, 2, and 3 at each of the following pressures without exceeding the maximum operating pressure of the system:

- 1/2 of desired operating pressure
- 3/4 of desired operating pressure
- 2,500 psi below desired operating pressure
- Full operating pressure

⚠WARNING Do not exceed maximum operating pressure of the lowest rated component of the system. In Constant Pressure Mode, the possibility of variations in pressure at a specific flow between the gun nozzles and the fixed orifice nozzle within the Multi-Mode Valve may require either the gun(s) or the Multi-Mode Valve(s) fixed nozzle to operate below the desired operating pressure. If this difference exceeds 2,000 psi or is unacceptable for a particular application, resize or replace nozzles.

DUMP MODE

1. Gun operator should squeeze triggers to engage control gun.

2. Pump operator should build system to 1/4 of desired operating pressure.

3. Operator should squeeze and release gun triggers two or three times to ensure proper operation of gun and Multi-Mode Valve. Each time either gun trigger is released, system pressure should drop to below 200 psi.

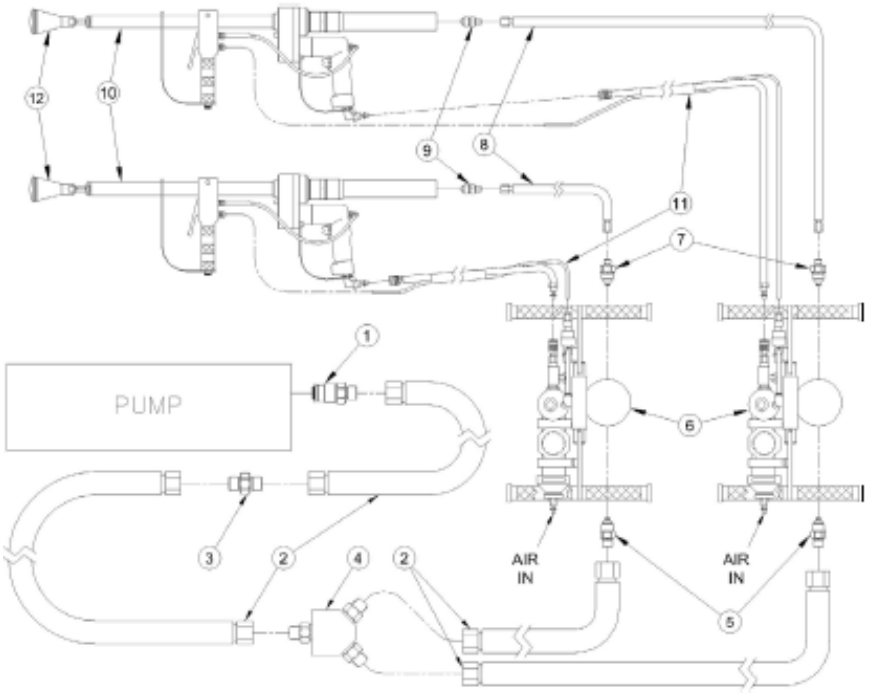
4. Repeat steps 1, 2, and 3 at each of the following pressures without

exceeding the maximum operating pressure of the system:

- 1/2 of desired operating pressure
- 3/4 of desired operating pressure
- 2,500 psi below desired operating pressure
- Full operating pressure

⚠WARNING During all waterblast operations, a “safety watch” operator should observe the waterblast operator(s) at all times from a safe, but proximate, distance. The safety watch should have both voice and sight communication with the waterblast operator at all times. The safety watch must have the ability to instantly shut the waterblast system down (from his location) with the use of a shutdown device (such as Jetstream’s Emergency Shut-Down Package, PN 53120) if the gun operator encounters problems or if a problem is suspected. Call Jetstream for system specific recommendations.

MULTIPLE GUN CONNECTION DIAGRAM

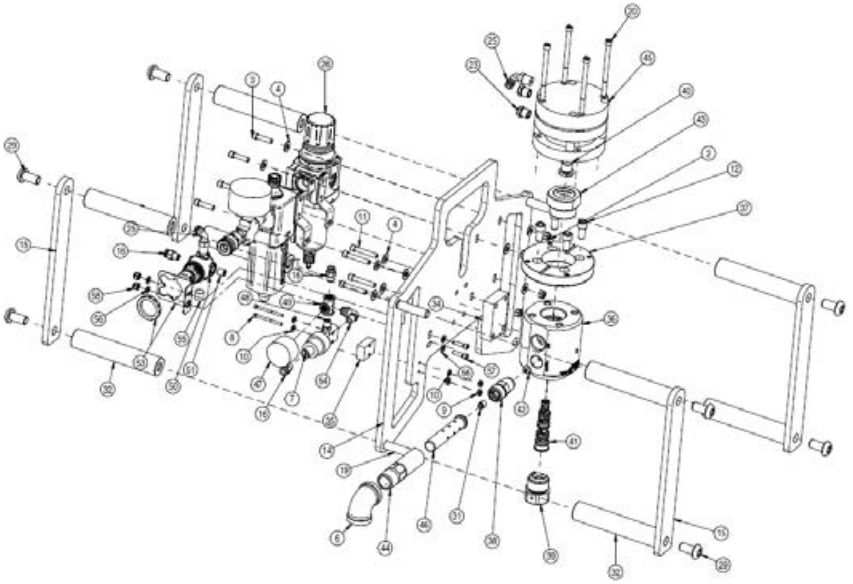


ITEM	PART NO.	DESCRIPTION
1	53672	Adapter, 7/8" Type M Male
	53988	Adapter, 9/16" HP Male
2[1]	27676-XXX41411	Hose, XXX ft., 7/8" Type M
	27676-XXX33331	Hose, XXX ft., 9/16" HP Male
3	27528	Adapter, 7/8" Type M Male
	27607	Coupling, 9/16" HP
4	54482	Y-Adapter, 7/8" Type M Male
	28672	Y-Adapter, 9/16" HP Female
5[2]	53570	Adapter, 7/8" Type M Male
	53572	Adapter, 9/16" HP Male
6	53905	Multi-Mode Valve, Type M
	54695	Multi-Mode Valve, HP

ITEM	PART NO.	DESCRIPTION
7[2]	53571	Adapter, 9/16" Type M Male
	54056	Adapter, 3/8" HP Female
8	27731-02539393	Hose, 9/16" Type M Male
	27731-02532323	Hose, 3/8" HP
9[3]	27530	Adapter, 9/16" Type M Male
10	66211	Tornado Gun, 36" Barrel
	66210	Tornado Gun, 48" Barrel
11[2]	28066	Air Control Hose
12	53970	Tornado Nozzle Assy, 3-Jet
	53971	Tornado Nozzle Assy, 4-Jet

NOTE 1: When ordering hose, length must be specified in feet. For example a fifty-foot hose would be 27626-5041411.
NOTE 2: Item included with Multi-Mode Tumble Box.
NOTE 3: Item included with Tornado Gun.

SECTION 6: SERVICE



ITEM	PART NO.	DESCRIPTION
2	25314	Nut
3	62778	Capscrew
4	26709	Washer
6	27645	Elbow
7	27670	Pilot Valve
8	27671	Capscrew
9	27673	Nut
10	27674	Washer
11	27680	Capscrew
12	27714	Capscrew
14	66774	Mounting Plate
15	27725	Guard
16	27732	Tubing Adapter
17	27740	Tubing (Order in Feet)
18	27740	Tubing (Order in Feet)
19	27763	Stud
20	28222	Capscrew
23	28364	Exhaust Muffler
25	28367	Elbow
26	62696	Regulator/Oiler Assy
29	28436	Capscrew
31	53502	UHP Nozzle Retainer
32	53747	Guard Rod
34	53788	Mounting Block
35	53789	Mounting Block
36	53852	Body
37	53853	Air Cylinder Mounting Plate
38	53863	Nozzle Holder
39	53868	Cartridge Plug
40	53869	Pusher
41	54014	Cartridge
42	54059	Button Seal
43	54233	Cartridge Plug
44	54264	Diffuser Housing
45	54343	Air Cylinder
	54343-KIT	Air Cylinder Repair Kit
46	54404	Diffuser
47	63907	Gauge
48	26465	Nipple
49	63903	Tee
50	28363	Regulator
51	63946	Plug
52	27740	Tubing (Order in Feet)
53	64016	Mounting Kit
54	28365	Elbow
55	28369	Plug
56	28387	Washer
57	27716	Capscrew
58	28437	Nut
59	28066	Air Control Hose
60	27749	Air Tool Oil
61*	53570	Adapter, 40K Port Male x 7/8" Type M
62*	53571	Adapter, 40K Port Male x 9/16" Type M
63**	53572	Adapter, 40K Port Male x 3/8" HP Female
64**	54056	Adapter, 40K Port Male x 9/16" HP Female

NOTE: Part numbers and descriptions are subject to change without notice.
* Not Shown (used with model 53905).
** Not Shown (used with model 54695).

6.0 MULTI-MODE VALVE MAINTENANCE

6.1 REPLACING THE CARTRIDGE

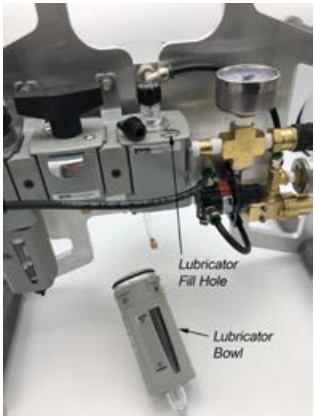
1. Shut down unit and turn off water and air to the Multi-Mode Valve.
2. Unscrew cartridge plug with a wrench.
3. Pull the plug away from the body to remove cartridge. It may be necessary to wiggle the plug back and forth to work the cartridge seals through the bore.
4. Slide the cartridge over the retaining ball of the plug to remove.
5. Apply a thin film of grease or O-ring lubricant to the external seals of the new cartridge.
6. Slide the new cartridge into slot of the plug.
7. Apply anti-seize thread lubricant to the threads of the plug.
8. Slide cartridge and plug into Multi-Mode Valve body. It may be necessary to wiggle the plug back and forth to work the cartridge seals through the bore.
9. Tighten to at least 30 ft-lbs. and make sure plug shoulder seats against valve body.

⚠WARNING Use only the correct valve/seat cartridge to repair your 40,000 psi Remote Control Valve. Failure to use the correct pressure-rated cartridge could result in cartridge failure and possible BI-MODE valve damage and operator injury.

6.2 FILLING LUBRICATOR WITH OIL

1. Disconnect air supply to Multi-Mode Valve or rotate shut-off valve handle.

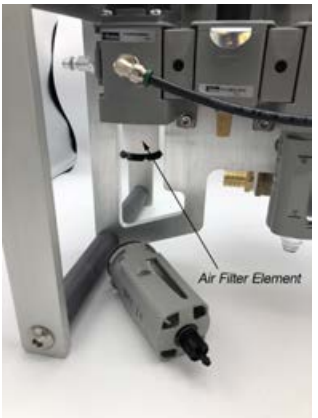
2. Remove fill plug or twist off bowl.



3. Add oil to fill line.
4. Replace fill plug or reinstall bowl.

6.3 REPLACING AIR FILTER

1. Disconnect air supply to Multi-Mode Valve.
2. Twist off and remove bowl.
3. Unscrew baffle.
4. Slide filter out and install a new one.
5. Replace baffle and tighten with fingers. Do not overtighten.
6. Replace bowl.



6.4 DIFFUSER REPLACEMENT

1. Remove high-pressure hose to gun from Multi-Mode Valve.
2. Unscrew diffuser housing from nozzle holder.
3. Tilt diffuser housing to allow diffuser to slide out.
4. Check inside diffuser housing to ensure that there are no deposits that could cause a buildup of pressure. Clean in solvent if necessary.
5. Slip new diffuser into diffuser housing so that blind end (no hole) goes in first.
6. Apply anti-seize to nozzle holder threads.
7. Install diffuser housing onto nozzle holder and wrench tighten.
8. Apply anti-seize to threads of adapter for hose to gun.
9. Reinstall hose.

6.5 ORIFICE OR PLUG REPLACEMENT

1. Remove high-pressure hose to gun from Multi-Mode Valve.
2. Unscrew diffuser housing from nozzle holder.
3. Remove nozzle or plug from nozzle holder.
4. Apply anti-seize to nozzle threads (UHPX nozzle) and reinstall nozzle (or plug).
5. Tighten nozzle (or plug) with hex key wrench (UHPXi nozzle) or 5/16" socket (UHPX nozzle).
6. Apply anti-seize to nozzle holder threads.
7. Install diffuser housing onto nozzle holder and wrench-tighten.
8. Apply anti-seize to threads of adapter for hose to gun.
9. Reinstall hose.

See YouTube for videos showing the 40K Multi-Mode Valve.

YouTube https://www.youtube.com/user/JetstreamWaterblast

SECTION 7: TROUBLESHOOTING

7.0 40K MULTI-MODE VALVE TROUBLESHOOTING

Problem	Remedy
Constant Pressure Mode or Shut-In Mode: No high pressure water flows to gun when triggers are squeezed, but the system pressure is unchanged, or nearly unchanged.	To diagnose exact cause: 1. If air pressure gauge on Multi-Mode Valve is below 80 psi when gun is rotating, increase air pressure by turning regulator knob clockwise, or increase pressure from the air supply source. 2. If air escapes from anywhere other than the exhaust port below the handle of the gun's air motor, or a small amount of exhaust from the air motor through its front, check that all hoses are correctly connected or repair any air leaks that are found. 3. If no air leaks are found, or if the problem persists, disconnect one end of the air tubing that connects the top of the brass pilot valve and the rear of the aluminium air cylinder by pushing the ring of the fitting down while pulling the tubing away from the fitting. Squeeze gun triggers and check to see if air begins to escape out of the top port of the brass pilot valve. If air does not begin to flow, this indicates that either insufficient air pressure is returning from the gun to the end of the pilot valve, or the pilot valve is not functional. If this is the case: • Check that air pressure gauge reads at least 80 psi while gun triggers are squeezed. • Check thoroughly for air leaks. • Disconnect tubing from pilot port of the brass pilot valve and install a pressure gauge. Squeeze gun triggers and check pressure reading. Air pressure returning through the signal line from the gun to the Multi-Mode Valve should be at least 25 psi. • If pressure is 25 psi or above but the pilot valve still fails to shift, then the valve is defective. Replace brass pilot valve.

Problem	Remedy
...continued	• If the pressure is below 25 psi (but the pressure reading on the Multi-Mode Valve gauge is at least 80 psi), either an air leak or flow restriction exists in the air lines (check or replace air lines) or there is a problem with the control gun (consult instructions for specific gun). 4. If air does begin flow out from the top port of the brass pilot valve when gun triggers are squeezed, it indicates a problem with either the air cylinder or the Multi-Mode Valve cartridge. If this is the case: • Remove four capscrews that connect the air cylinder to mounting plate on top of the valve body, but do not remove the four capscrews that hold the air cylinder together. • Reconnect the air line between the top port of brass pilot valve and the air cylinder. • If the piston on the underside of the cylinder does not extend outward and retract quickly when the gun triggers are squeezed and released, replace air cylinder. • If the air cylinder does not function as it should, and all above checks have been performed, the problem must be with the Multi-Mode Valve cartridge. Remove and check for any restriction to movement. Replace if necessary.
Dump Mode: No water flows to the gun when the triggers are squeezed, but the gun begins to rotate.	This is the same problem as the previously discussed issue for Constant Pressure or Shut-In Mode in that the actuation mechanism of the valve is not working properly. To diagnose exact cause, see previous issue.

Problem	Remedy
Dump Mode: System pressure does not build to desired level.	This is the same problem as the next discussed issue for Constant Pressure or Shut-In Mode in that water is escaping somewhere other than through the gun nozzles or the gun nozzles are worn or incorrectly sized. To diagnose exact cause, see next issue.
Constant Pressure Mode or Shut-In Mode: Some water flows to gun when gun triggers are squeezed, but the total system pressure drops drastically.	1. Check all hoses, connections, and control gun for high-pressure water leaks. 2. Check gun nozzles for leaks and worn or blown orifices. If operating in Constant Pressure Mode, be sure they are sized correctly to match the flow of the fixed orifice in the Multi-Mode Valve dump port. If operating in Shut-In Mode, check that the nozzles selected to not exceed flow capabilities. 3. Check that water is not leaking through Multi-Mode Valve dump port. If it is leaking: • Verify that at least 80 psi air pressure is read on Multi-Mode Valve gauge while triggers are squeezed. Increase if necessary, but do not exceed maximum air pressure of the gun's air motor. • Remove and check cartridge from Multi-Mode Valve for seal wear and debris or wear of valve and seat metal-to-metal sealing surfaces. Replace if necessary. • If neither of the actions above correct the problem, remove the four capscrews that connect the air cylinder to the mounting plate on top of the valve body, but do not remove the capscrews that hold the air cylinder together, and do not disconnect the air line that connects the cylinder to the brass pilot valve. • Check for evidence of rubbing by the piston of the air cylinder against the bore inside the plate that is mounted above the Multi-Mode Valve body. If any is visible, center the cylinder over the plate, reattach, and re-check system operation. • If the piston on the underside of the cylinder does not extend outward and retract when the gun triggers are squeezed and released, replace air cylinder.

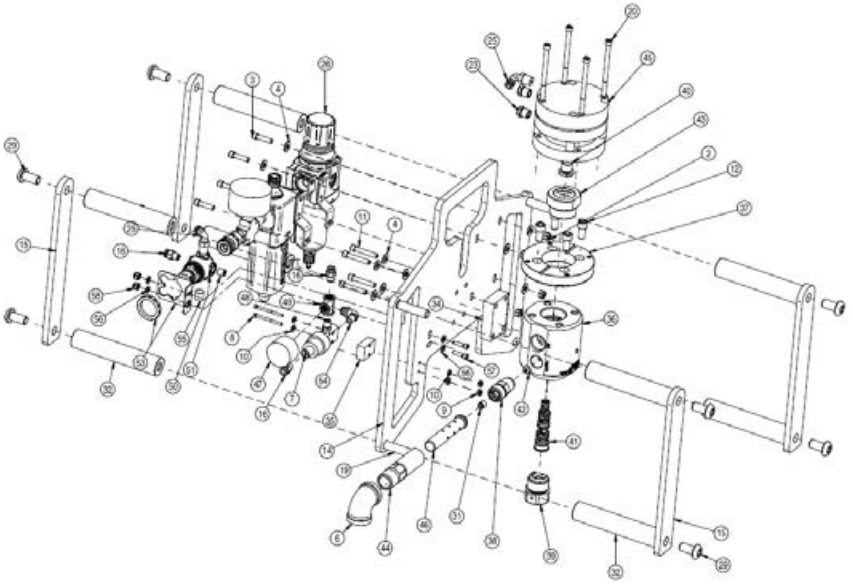
Problem	Remedy
Constant Pressure Mode or Dump Mode: Water leaks from dump port when gun triggers are squeezed.	1. If the air pressure gauge on Multi-Mode Valve reads below 80 psi when gun is rotating, increase air pressure by turning regulator knob on Multi-Mode Valve clockwise, or increase the pressure from the air supply source. 2. Remove and check cartridge from Multi-Mode Valve for seal wear and debris or wear on metal-to-metal sealing surfaces of cartridge valve and seats. Replace if necessary.
Water flows through gun nozzles when triggers are not squeezed.	1. Remove and check cartridge from Multi-Mode Valve for seal wear and debris or wear on metal-to-metal sealing surfaces of cartridge valve and seats. Replace if necessary. 2. Remove the four capscrews that connect the air cylinder to the mounting plate on top of the valve body, but do not remove the capscrews that hold the air cylinder together, and do not disconnect the air line that connects the cylinder to the brass pilot valve. Check for evidence of rubbing by the piston of the air cylinder against the bore inside the plate that is mounted above the Multi-Mode Valve body. If any is visible, center the cylinder over the plate, reattach, and re-check system operation. If the piston on the underside of the cylinder does not extend outward and retract quickly when the gun triggers are squeezed and released, or if the piston doesn't extend fully to 3/8" (10 mm), replace air cylinder. ⚠ **DANGER** Do not operate a control gun if water through the gun does not shut off completely when triggers are released. If this problem is encountered, shut down system immediately and correct malfunction before continuing. Operating a gun without the ability by the operator to shut off high pressure water to the gun "at will" could result in serious injury.

Problem	Remedy
Constant Pressure Mode: System pressure drops excessively when gun triggers are released, but no water is exiting through the gun nozzle.	Fixed nozzle located in Multi-Mode Valve dump port has become worn, blown out, or was sized too large and does not match the flow rate of the gun nozzles, or one or more gun nozzles have become fully or partially plugged. Resize and/or replace nozzle(s) as needed.
Constant Pressure Mode: System pressure drops excessively when gun triggers are squeezed, but no water is escaping through the dump port and no water leaks are present anywhere in the system.	One or more of the gun nozzles has become worn or has blown out, or the nozzles were sized too large and do not match the flow rate of the fixed orifice nozzle, or the fixed nozzle has become fully or partially plugged. Resize and/or replace nozzle(s) as needed.
Water is leaking from one or more of the weep holes on the Multi-Mode Valve body	1. One or more of the cartridge seals are leaking. Remove cartridge and check condition of seals. Replace seals or entire cartridge if necessary. 2. If replacing the cartridge does not solve the problem, it is possible that the valve body is cracked. Contact a Jetstream technical support representative to arrange for verification and repair.
A waterjet cut through the elbow of the Multi-Mode Valve dump port while operating in Constant Pressure Mode	Diffuser has failed due to improper maintenance. Shut down system immediately and replace diffuser and low pressure elbow. **⚠ DANGER** When operating in Constant Pressure Mode, the diffuser must be replaced after every 200 hours of operation to prevent component failure, which would result in waterblast operators being exposed to a dangerous waterjet from the dump port.

Problem	Remedy
Air pressure through Multi-Mode Valve is above 80 psi when gun is not engaged, but drops below 80 psi when guns are in use.	1. Increase pressure by adjusting regulator on Multi-Mode Valve. Do not exceed the maximum rated air pressure of the control gun air motor (the Jetstream Tornado Gun has a maximum inlet air pressure of 90 psi. Check manufacturer specs if using another model of control gun). 2. Check for air leaks throughout system. 3. Air supply source may be insufficient. Try increasing pressure from air compressor, but do not exceed 125 psi. 4. Replace regulator air filter according to instructions in Section 6.3. 5. Check hoses and fittings between air source and Multi-Mode Valve for restrictions to air flow.

APPENDIX A

EXPLODED VIEW



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6	27645	Elbow
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17	27740	Tubing (Order in Feet)
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19	27763	Stud
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31	53502	UHP Nozzle Retainer
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38	53863	Nozzle Holder
39	53868	Cartridge Plug
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41	54014	Cartridge
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45	54343	Air Cylinder
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47	63907	Gauge
48	26465	Nipple
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62*	53571	Adapter, 40K Port Male x 9/16" Type M
63**	53572	Adapter, 40K Port Male x 3/8" HP Female
64**	54056	Adapter, 40K Port Male x 9/16" HP Female

NOTE: Part numbers and descriptions are subject to change without notice.
* Not Shown (used with model 53905).
** Not Shown (used with model 54695).

Replacement Parts

Use the drawings and charts in this section to purchase replacement parts or identify components of the Multi-Mode Valve.

Cartridge (PN 54014)

Replacement OD Seals		
Item	**Part Number**	**Description**
1	54231	Backup Ring, Outside Lower
2	28213	O-Ring, Outside Lower
3	53911	Backup Ring, Inside Lower
4	28212	O-Ring, Inside Lower
5	28211	O-Ring, Upper
6	53909	Backup Ring, Inside Upper
7	53908	Backup Ring, Outside Upper

Related Items

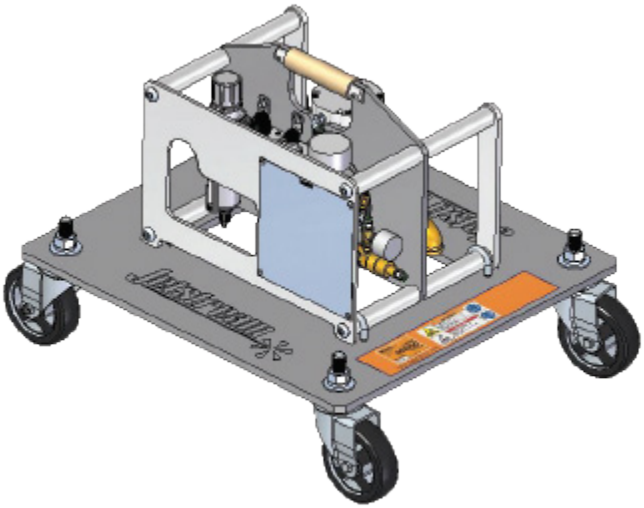
Not shown in drawings

Part Number	Description
27749	Air Tool Oil
UHPX-PLUG	UHPX Plug - used for operating in Shut-In Mode
67648	Air Filter, 5 micron
66211	Tornado Gun, 36” Barrel
66210	Tornado Gun, 48” Barrel
27731-02539393	Hose, 5mm ID, 25 ft long, 40,000 psi max working pressure, 9/16” Type M ends, features special burst shield cover designed for use between Multi-Mode Valve & Tornado Gun

APPENDIX B

Accessories

Rolling Cart (PN 64377)



- Raises multi-mode valve off the ground away from debris and potential for damage
- Cart created for improved mobility and longevity
- Reduces the possibility of the Multi-mode getting tipped over during use

APPENDIX C

Flow Charts

Nozzle Selection Chart						
Flow Rate (gpm)	Size of Fixed Orifice (in.)	Quantity and Size of Gun Nozzles				
		2 Nozzles	3 Nozzles	4 Nozzles	5 Nozzles	6 Nozzles
2.1	.023	.016	.013	.011	.010	.009
2.3	.024	.017	.014	.012	.011	.010
2.5	.025	.018	.014	.012	.011	.010
2.7	.026	.018	.015	.013	.012	.011
2.9	.027	.019	.016	.013	.012	.011
3.1	.028	.020	.016	.014	.012	.011
3.4	.029	.021	.017	.015	.013	.012
3.6	.030	.021	.017	.015	.013	.012
3.8	.031	.022	.018	.015	.014	.013
4.1	.032	.023	.018	.016	.014	.013
4.4	.033	.023	.019	.017	.015	.014
4.6	.034	.024	.020	.017	.015	.014
4.9	.035	.025	.020	.017	.016	.014
5.2	.036	.025	.021	.018	.016	.015
5.5	.037	.026	.021	.019	.017	.015
5.8	.038	.027	.022	.019	.017	.016

WJTA recommends maximum rear thrust of 60 lbs.

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WARRANTY

Limited Warranty. Each Waterblast Unit, Bareshaft Pump, and Fluid End manufactured by Jetstream is warranted against defects in material and workmanship for a period of 12 months or 1,000 hours, provided it is used in a normal and reasonable manner and in accordance with all operating instructions. If sold to an end user, the applicable warranty period commences from the date of delivery to the end user. If used for rental purposes, the applicable warranty period commences from the date of delivery to the party holding the equipment available for rent. This limited warranty may be enforced by any subsequent transferee during the warranty period. This limited warranty is the sole and exclusive warranty given by Jetstream.

Exclusive Remedy. Should any warranted product fail during the warranty period, Jetstream will cause to be repaired or replaced, as Jetstream may elect, any part or parts of such Waterblast Unit, Bareshaft Pump, or Fluid End that the examination discloses in Jetstream's sole judgment to be defective in material or factory workmanship. Repairs or replacements are to be made at Jetstream in Houston, Jetstream FS Solutions Rental Center, the customer's location, or at other locations approved by Jetstream. Labor is furnished only when the unit or part is returned to the factory or when travel and expenses are paid by the purchaser. Freight, travel and expenses incurred in connection with repair or warranty are excluded from this warranty and shall be paid by the purchaser. The foregoing remedies shall be the sole and exclusive remedies of any party making a valid warranty claim.

The Jetstream Limited Warranty shall NOT apply to (and Jetstream shall NOT be responsible for):

1. Major components or trade accessories that have a separate warranty from their original manufacturer, such as, but not limited to: diesel engines, electric motors, electronic soft starter and/or across the line starter panels, axles, PTO's, clutch packs, high pressure gauges, high pressure hoses, flex lances, etc.

2. Normal adjustments and maintenance services.

3. Normal wear parts such as, but not limited to: oil, clutches, belts, filters, packing, cartridges, univalves, face seals, diffusers, gland nut bushings, plungers, nozzles, rupture disks, etc.

4. Failures resulting from the machine being operated in a

manner or for a purpose not recommended by Jetstream including failures or malfunctions resulting from corrosion, misapplication, overpressurization, inadequate pump suction conditions, improper water quality, improper maintenance, or misuse.

5. Repairs, modifications or alterations which in Jetstream's sole judgment, have adversely affected the machine's stability, operation or reliability as originally designed and manufactured.

6. Items subject to misuse, negligence, accident or improper maintenance.

NOTE The use of any part other than ones approved by Jetstream may invalidate this warranty. Jetstream reserves the right to determine, in its sole discretion, if the use of non-approved parts invalidates the warranty. Nothing contained in this warranty shall make Jetstream liable for loss, injury, or damage of any kind to any person or entity resulting from any defect or failure in the machine or part.

THIS WARRANTY IS, AND SHALL BE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH ARE DISCLAIMED. THIS DISCLAIMER AND EXCLUSION SHALL APPLY EVEN IF ANY WARRANTY POSSIBLY ASSERTED FAILS OF ITS ESSENTIAL PURPOSE.

This warranty is in lieu of all other obligations or liabilities, contractual and otherwise, on the part of Jetstream. For the avoidance of doubt, Jetstream shall not be liable for any indirect, special, incidental or consequential damages, including, but not limited to, loss of use or lost profits. Jetstream makes no representation that the unit has the capacity to perform any functions other than as contained in Jetstream's written literature, catalogs or specifications accompanying delivery of the machine. No person or affiliated company representative is authorized to alter the terms of this warranty, to give any other warranties or to assume any other liability on behalf of Jetstream in connection with the sale, servicing or repair of any machine manufactured by Jetstream. Any legal action based hereon must be commenced within eighteen (18) months of the event or facts giving rise to such action.

Jetstream reserves the right to make design changes or improvements in its products without imposing any obligation upon itself to change or improve previously manufactured products.

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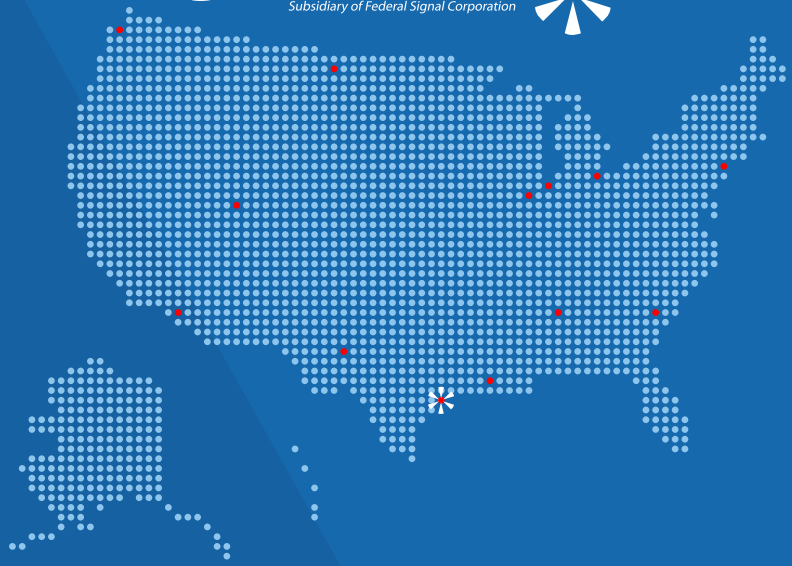

Jetstream products are also serviced by FS Solutions. With 13 convenient locations across the United States, FS Solutions provides high-performance parts, accessories, Jetstream rentals, repair, rebuild and safety training.

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Application Policy
Capacity ratings, features, and specifications vary depending upon the model and type of service. Application approvals must be obtained from Jetstream; contact your representative for application approval. We reserve the right to change or modify our product specifications, configurations, or dimensions at any time without notice.