Jetstream
Subsidiary of Federal Signal Corporation

3” J-FORCE™

JF3X15 (PN 67859, 70331)
JF3X22 (PNs 67860, 67861, 67862, 67863, 67864)

PRODUCT INSTRUCTIONS

PI-198

The 3” J-Force™ is a self-powered rotating nozzle designed to easily navigate and clean 3” pipes with up to 90° bends. The 3” J-Force has front, side, and rear jets that clear blockages, clean, and provide thrust to propel the tool down the pipe. The nozzle comes equipped with an eddy-current braking system which controls rotation speed for maximum cleaning power and minimum wear.

Read these instructions thoroughly before installing, connecting, or using the J-Force tool. 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 J-Force 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.

11. Properly tighten all high pressure connections. All NPT connections must have a minimum engagement of four (4) threads. Pipe (NPT) connections should be made up hand tight plus two (2) full wrenched turns. Do not tighten NPT threads past two (2) wrenched turns.

⚠ 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.

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

13. 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.**

14. 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.

15. 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.

16. 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.

17. 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".

18. 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.

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

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

21. 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.

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

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 27.)

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.

FLEXIBLE TUBE CLEANING LANCES

1. **Read General Safety** section and Nozzle Safety Warnings prior to connecting flex lances.

2. **Do not** use a flex lance with a burst rating less than 2.25 times the pressure at which it will operate. 10,000 psi operating pressure flex lances **must** have a **minimum** 22,000 psi burst rating. 8,000 psi operating pressure flex lances **must** have a **minimum** 18,000 psi burst rating.

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

4. Never use a lance which is kinked, worn, frayed or whose abilities to hold pressure is questionable.

5. Do not use a lance which has damaged or missing threads.

6. Clearance between lance and tube deposits **must be sufficient** to allow unrestricted backflow of water and debris. With tubes containing hard deposits this clearance should be 1/8" **minimum** on the diameter (or 1/16" per side) of the lance. With tubes containing soft, pliable deposits this clearance should be greater. **Insufficient side clearance may cause lance to blow back toward operator.**

7. ⚠ **WARNING** Serious injury may occur should a lance with live nozzle exit tube. Use anti-withdrawal device to prevent lance from exiting tube unexpectedly.

8. The following **JETSTREAM** lance accessories are **strongly recommended** for safer lance operation:

A. Lance Strain Relief -Helps prevent lance inlet end fitting failure.

B. Lance Stinger - Affords the operator greater control of nozzle. Establishes a "safety zone" so operator knows when nozzle is about to exit tube; will eliminate possibility of nozzle and lance "double back" toward operator within large diameter pipe.

C. Anti-withdrawal device prevents the lance from exiting the tube or pipe. Contact JETSTREAM for additional information regarding these products.

9. Use only nozzles designed for use with flex lances (i.e. nozzle drilled with sufficient rearward orifices so nozzle pulls lance through tube.)

10. If lance end fittings do not have wrench flats, use properly adjusted smooth jaw plier wrench (JS PN 64119) to connect lance to pressure source and nozzle onto lance. Apply wrench on lance and fitting **directly behind end fitting thread (not on fitting ferrule or collar)** when installing nozzle on lance. Do not clamp on the lance hose itself with vise when installing nozzle.

11. Avoid rough handling, stretching or straining of lance.

12. Never attempt to "ramrod" flex lance through blockages or to repair or recouple lances.

13. After use, drain, coil and store lance properly. Be sure safety tags remain intact.

RIGID TUBE CLEANING LANCES

1. **Read General Safety** section and Nozzle Safety Warnings prior to connecting rigid lances.

2. Do not use a rigid lance with a burst rating less that 3.0 times the pressure at which it will operate. 10,000 psi operating pressure rigid lances must have a minimum 30,000 psi burst rating. Do not use a rigid lance that has an unknown burst or unknown manufacturer's operating pressure rating.

3. Clearance between lance and tube must be sufficient to permit the unrestricted backflow of water and debris. With tubes containing hard deposits this clearance should be 1/8" minimum on the diameter (or 1/16" per side) of the lance. With tubes containing soft, pliable deposits this clearance should be greater. Insufficient side clearance may cause lance to blow back toward operator.

4. Be sure nozzle, lance and adapter thread sizes are compatible before installing nozzle and adapter on lance. Do not use a rigid lance that has damaged or missing threads.

5. Use wrench flats (when available) or a properly adjusted smooth jaw plier wrench (JS PN 64119) to connect lance. Do not use pipe wrench as wrench marks will cause high pressure components to crack and fail.

6. A rigid lance over 4 ft long requires two men for support and safe operation. Operator at tube should use a foot control gun so he can instantly relieve system pressure in case of emergency.

7. When using and moving lance, support it in a manner to avoid stress and possible breakage at inlet end connection.

8. Never "ramrod" lance into tube blockage.

9. Transport and store lances in tubes or racks to avoid bending, corrosion or other damage. Damaged lances (bends, mars) should be removed from service.

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 3” J-Force™ is a self-powered rotating nozzle that uses up to 8 P1 nozzles.

The 3” J-Force has many features, including:

- Spins on a film of high pressure water and has no ball bearings to replace. No oil or grease is needed for lubrication.
- Comes equipped with an eddy-current braking system which controls rotation speed for maximum cleaning power and minimum wear.
- Completely field repairable (in less than 5 minutes)
- 10° forward, 45° forward, 100° radial, 135° rearward nozzle angles
- Designed to easily navigate and clean 3” pipes with 90° bends.

⚠WARNING This system contains several high-energy, rare-earth magnets that produce a magnetic field. Persons with a pacemaker or other electronic medical device must use extreme caution when handling or in close proximity. It is recommended that a minimum distance of 6 inches (152mm) be maintained at all times between the J-Force and any electronic medical devices.

⚠CAUTION The use of gloves is recommended when handling the tool after operation as the body may reach temperatures greater than 200°F.

Product Specifications

Model Name	JF3X15	JF3X22
Maximum Operating Pressure (psi)	15,000	22,000
Minimum Operating Pressure (psi)	2,500	
Maximum Flow (gpm)	30	
Maximum Operating Pressure (bar)	1000	1550
Minimum Operating Pressure (bar)	170	
Maximum Flow (l/min)	114	
Inlet Connection	3/8" NPT 3/8” BSPP	9/16" Type M 3/8” MP LH/RH 9/16” MP LH/RH
Tube or Pipe I.D. (in)	3	
Tube or Pipe I.D. (mm)	76	
Speed Range (rpm)	1000 - 2000	
Nozzle Types Accepted	P1	
Nozzle Pattern	2 @ 10°, 2 @ 45°, 2 @ 100°, 2 @ 135°	
Diameter (in)	1.98	
Length (in)	2.87	
Weight (lbs)	1.45	
Diameter (mm)	50	
Length (mm)	73	
Weight (kg)	.066	

SECTION 3: PREPARATION FOR USE

3.0 The 3" J-Force is mounted to a flexible rubber waterblast hose that allows it to navigate 3" pipes with bends up to 90°.

3.1 Check that the 3" J-Force is free of debris and rotates smoothly. If not, disassemble the 3" J-Force and inspect the mandrel and bushing for wear, damage, o-ring condition, etc. and repair or rebuild as necessary.

3.2 Check the condition of the wear ring and attaching screws. Replace if worn excessively.

3.3 See Flow Charts in Appendix C to choose nozzle configuration, flow rate, and desired operating pressure. The 3" J-Force is equipped with two forward-facing ports at 10°, two forward-facing ports at 45°, two radial ports at 100°, and two rearward-facing ports at 135°. Choose the nozzle configuration based on the type of cleaning application and desired operating pressure and flow.

> **NOTE:** Nozzle configurations must be carefully selected to ensure that they provide the necessary pull and torque. If a non-standard configuration is required, contact a Jetstream representative to verify that it is safe and that the tool will function properly.

3.4 Install P1 nozzles into the rotor. Apply Loctite 545 Thread Sealant to seal and retain the P1 nozzles. Torque nozzles to 100 lb-in. For leak free operation, wait 12-24 hours for thread sealant to cure.

SECTION 4: SETUP

4.0 CONNECTING 3” J-FORCE

Prior to installing the 3” J-Force onto the hose, flush the system to clear any debris.

For 22,000 psi operation (9/16” Type M Male, 3/8”MP LH/RH, 9/16”MP LH/RH Inlet)

1. Apply anti-seize compound to the threads of the Type M connection or to the male MP hose/lance end.

2. Install the JF3X22 and tighten to 30 lb-ft. (9/16” Type M Male), 25 lb-ft. (3/8”MP LH/RH) or 30 lb-ft. (9/16”MP LH/RH).

For 15,000 psi operation (NPT Female Inlet)

1. Apply 3-4 wraps of Teflon thread sealant tape to the male NPT hose end.

2. Apply anti-seize compound over the sealant tape for protection against galling in connection threads.

3. Tighten the connection 1-1/2 to 2 turns past hand tight. All NPT pipe connections should have a minimum thread engagement of 4 threads.

4.1 An anti-withdrawal device (backout preventer) should be used to prevent the tool from accidentally exiting the pipe under high pressure. Hose restraints (whip checks) should be used at all high pressure hose connections including the fluid end discharge. See Appendix B for a list of backout preventers.

4.2 Contact Jetstream representative for assistance.

SECTION 5: OPERATION

5.0 OPERATING J-FORCE

As per the WJTA-IMCA Recommended Practices, all operators shall follow the OSHA regulations for personal protective equipment. (OSHA guidelines for Personal Protective Equipment are available in document number 3151-12R 2004, which can be obtained from www.osha.gov.) All operators shall be issued suitable head protection, eye protection, hearing protection, body protection, hand and foot protection and respiratory protection (if needed). For detailed specifications on all protections required, refer to the WJTA-IMCA 'Recommended Practices for the Use of High Pressure Waterjetting Equipment' Section 6, Protective Equipment For Personnel.

⚠ CAUTION The 3" J-Force can be used for minimum service temperature of -20°C (-4°F) and a maximum service temperature of 115°C (240°F). Use at lower or higher than recommended temperatures may result in premature o-ring seal failure.

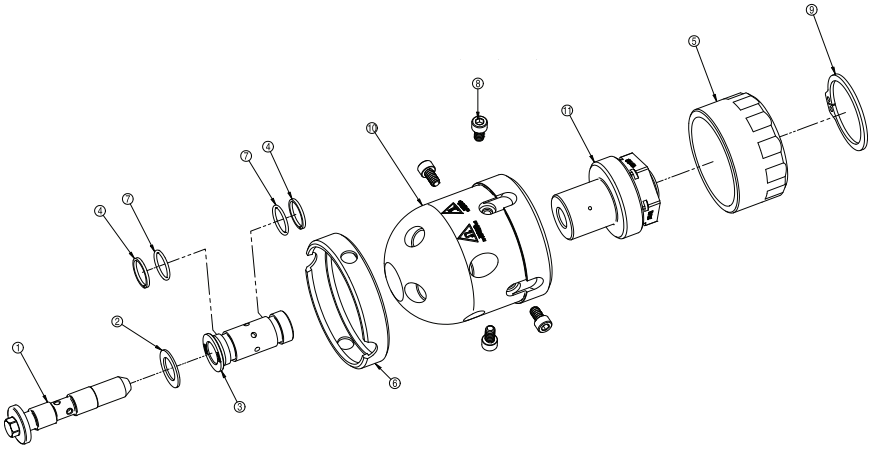
5.1 Start by slowly increasing pressure to 500 psi and check the entire system, including all connections, for leaks. Increase pressure in increments, pausing at each to inspect system for leaks, proper rotation of tool, temperature, and other operational anomalies. If any problems are discovered, lower pressure back to zero and turn off source of power before making any adjustments.

5.2 During operation, it is normal for water to leak out of the front of the head from around the front nozzle (or front plug). This leak-by water comes from the water-bearing that the tool operates on.

5.4 After use, used compressed air to blow out as much water from the tool as possible. Then spray the tool with a water-displacing lubricant (e.g. WD-40). Make an effort to get the lubricant inside the tool. This prevents corrosion from starting internally, which could affect the tool's ability to spin the next time it is used. For greatest protection, place the lubricated tool in a plastic bag.

SECTION 6: SERVICE

JF3X15 (PN 67859, 70331) & JF3X22 (PN 67860, 67861, 67862, 67863, 67864)



PART BREAKDOWN

ITEM	PART NO.	DESCRIPTION
1	67088	Mandrel
2	67089	Thrust Bearing
3	67090	Bushing
4	67091	Backup Ring
5	67093	Brake
6	67094	Wear Ring
7	67107	O-Ring
8	67822	Capscrew
9	67823	Retaining Ring
10	68130	Rotor Assembly
11	67856	Inlet Nut, 3/8" NPT,15K (67859)
	70330	Inlet Nut, 3/8" BSPP,15K (70331)
	70434	Inlet Nut, 9/16" TYPE M,22K (67860)
	67100	Inlet Nut, 3/8"MP LH,22K (67861)
	67491	Inlet Nut, 3/8"MP RH,22K (67862)
	67095	Inlet Nut, 9/16"MP LH,22K (67863)
	67821	Inlet Nut, 9/16"MP RH,22K (67864)

NOTE: Part numbers & descriptions subject to change without notice.

6.0 3” J-FORCE MAINTENANCE

The 3” J-Force utilizes water-bearing technology coupled with an eddy-current braking system to control the rotation speed. No oil is required, allowing for a quick and pain-free rebuild of the tool.

See YouTube for videos showing the 3” J-Force.

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

⚠ CAUTION The use of gloves is recommended when handling the tool after operation as the body may reach temperatures greater than 200:F.

6.1 DISASSEMBLY FOR MAINTENANCE (See Figure A)

1. While holding the inlet nut (4) stationary in a vice or with a 15/16” wrench, unscrew the mandrel (8a) by turning it counterclockwise with a 1/4” socket wrench.

2. Once the mandrel is unthreaded from the inlet nut, the inlet nut and adjuster (3) will separate from the head assembly (7). Once the magnets in the back of the head assembly are exposed, take care to protect them from mechanical damage. The magnets are fragile and will crack upon any significant impact.

3. Remove the mandrel (8a) and thrust bearing (8c) from the head assembly (7).

4. Remove the flange bushing (8b) from the head assembly (7) by pushing it out from the back side. The bushing removal tool (PN 67883) may be used to make contact with the back edge of the flange bushing to push it out, as shown below. Note orientation of tool.

6.2 ASSEMBLY (See Figure A)

1. Ensure the new mandrel (8a), flange bushing (8b), and head assembly (7) are clean.

2. Install new o-rings (8e) and backup rings (8d) onto the flange bushing (8b). Apply a light coat of o-ring lube to o-rings to reduce friction and ease installation. See Figure B for proper orientation of o-rings when installed.

Figure B

3. Wet o-rings (8e) on the flange bushing (8b) very lightly with water or grease. Slide the flange bushing (8b) into the head assembly (7) from the front side.

4. Thread the adjuster (3) onto the inlet nut (4) until the inlet nut (4) seats fully into the adjuster (3).

5. Insert the assembled adjuster and inlet nut into the back of the head assembly. The adjuster (3) should slide in easily without binding between the OD of the magnet ring and ID of the groove in the head.

6. Insert the thrust bearing (8c) into the front bore of the head assembly (7) so that it sits flat against the flange of the flange bushing (8b).

7. Apply 1-2 drops of Loctite 242 Blue Medium-Strength Threadlocker to the thread at the end of the mandrel (8a). Hold the inlet nut (4) hex stationary in a vise or with a 15/16" wrench and push the mandrel (8a) through the flange bushing (8b) into the inlet nut (4). Use a 1/4" socket wrench to torque to approximately 22 lb-ft.

8. Slide the wear ring (5) onto the head assembly (7) with the nozzle installation clearance cutouts facing the front end of the head assembly. Attach the wear ring (5) to the head assembly (7) by rotating the wear ring (5) so that the holes in the wear ring (5) line up with the holes in the head assembly (7) and threading the wear ring screws (6) into the head assembly (7).

9. Use retaining ring pliers to install the retaining ring (1) into the groove closest to the adjuster (3) on the inlet nut (4).

SECTION 7: TROUBLESHOOTING

7.0 3” J-FORCE TROUBLESHOOTING

Problem	Possible Cause	Remedy
Will not spin	Nozzles worn, plugged, or wrong size	Replace nozzles
	O-ring / backup ring failure	Replace o-rings / backup rings
	Galling between mandrel and flange bushing	Replace damaged components (rebuild kit)
	Debris	Clean*
Spins slowly	Incorrect nozzle size or worn nozzles	Replace nozzles
	Debris	Clean*
Low pressure	Nozzles worn, plugged, or wrong size	Replace nozzles
	O-ring / backup ring failure	Replace o-rings / backup rings
	Connections not tight, leak	Find and repair leak
Low Pull	Nozzles worn, plugged, or wrong size	Replace Nozzles
Two-piece Adapter stuck in hose end		Replace with single-piece inlet (see pg 23)

*** To clean the J-Force follow 6.1 DISASSEMBLY FOR MAINTENANCE**
If the mandrel and bushing surfaces are free from high spots and major scratches during inspection and cleaning, and the problem is not resolved, the parts must be replaced. Reassemble according to 6.2 ASSEMBLY.

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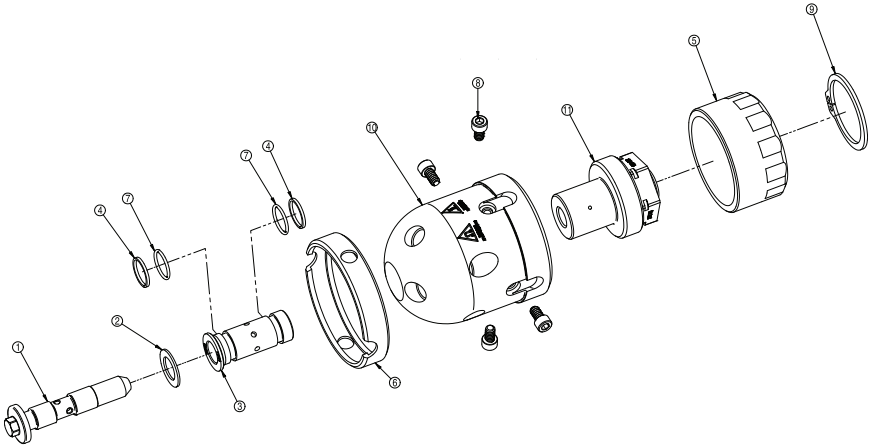
APPENDIX A

Exploded Views

JF3X15 (PN 67859, 70331) & JF3X22 (PN 67860, 67861, 67862, 67863, 67864)



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NOTE: Part numbers & descriptions subject to change without notice.		

Parts Placement

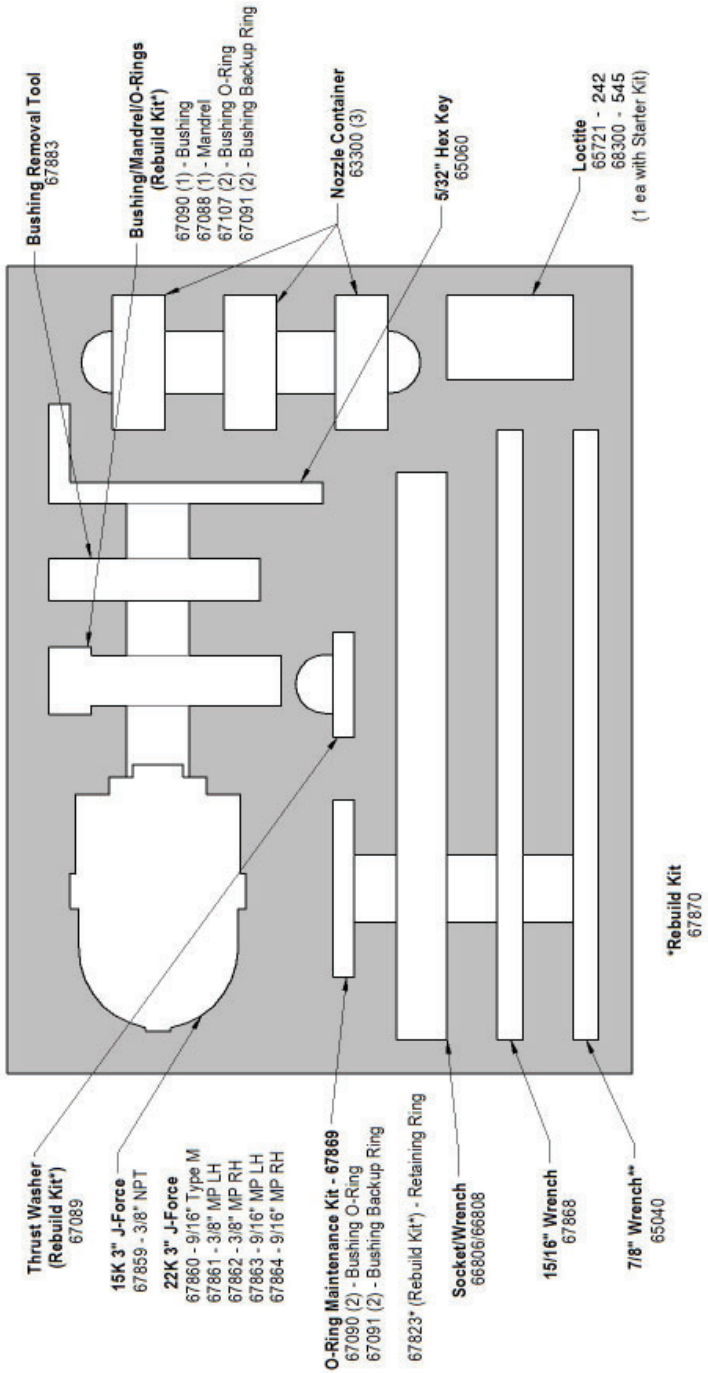


Figure D

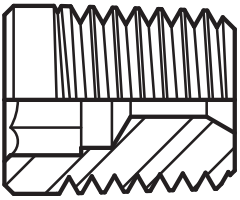
KIT PN	TOOL PN	INLET CONNECTION	KIT TYPE	MAX PSI
67871	67859	3/8” NPT	STARTER	15K
70342	70331	3/8” BSPP	STARTER	15K
67872	67859	3/8” NPT	PREMIUM	15K
70343	70331	3/8” BSPP	PREMIUM	15K

KIT PN	TOOL PN	INLET CONNECTION	KIT TYPE	MAX PSI
67873	67860	9/16” TYPE M Male	STARTER	22K
67875	67861	3/8” MP Tube LH	STARTER	22K
67877	67862	3/8” MP Tube RH	STARTER	22K
67879	67863	9/16” MP Tube LH	STARTER	22K
67881	67864	9/16” MP Tube RH	STARTER	22K
67874	67860	9/16” TYPE M Male	PREMIUM	22K
67876	67861	3/8” MP Tube LH	PREMIUM	22K
67878	67862	3/8” MP Tube RH	PREMIUM	22K
67880	67863	9/16” MP Tube LH	PREMIUM	22K
67882	67864	9/16” MP Tube RH	PREMIUM	22K

APPENDIX B

Accessories

P1 Nozzles/Plug



- Low profile design for unobstructed pipe cleaning
- Stainless steel, corrosion-resistant
- Precision-drilled orifice
- Tapered geometry provides highly cohesive, distortion-free waterjets for concentrated, work saving cleaning and cutting power
- Straight (0°) pattern
- 1/16” NPT male connection

Backout Preventer

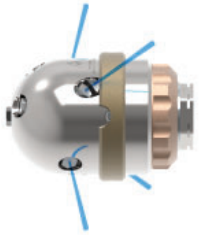
- Prevents nozzle from exiting pipe
- 4” - 8” (100-200mm) pipes
- Includes clamp for securing backout preventer to pipe
- Diameter of nozzle must be at least 1-1/2” (38mm)

Bushing Removal Tool (PN 67883)

- Aids in bushing removal during rebuild

APPENDIX C

Flow Charts



3" J-Force, Polisher (Forward Nozzles Plugged)									
Flow (gpm)	2500 psi			5000 psi			7500 psi		
	Pull (lbf)	Side x 2	Rear x 2	Pull (lbf)	Side x 2	Rear x 2	Pull (lbf)	Side x 2	Rear x 2
10							-25	0.018	0.042
11							-26	0.022	0.042
12				-25	0.020	0.052	-30	0.018	0.046
13	-21	0.022	0.067	-28	0.018	0.055	-27	0.032	0.042
14	-22	0.032	0.067	-29	0.026	0.055	-38	0.018	0.052
15	-22	0.038	0.067	-30	0.032	0.055	-29	0.038	0.042
16	-25	0.029	0.073	-36	0.018	0.062	-42	0.018	0.055
17	-23	0.046	0.067	-37	0.029	0.062	-44	0.026	0.055
18	-25	0.046	0.070	-42	0.018	0.067	-44	0.029	0.055
19	-29	0.038	0.078	-45	0.018	0.070	-42	0.038	0.052
20	-30	0.042	0.078	-46	0.026	0.070	-46	0.038	0.055
21	-30	0.046	0.078	-49	0.018	0.073			
22	-31	0.052	0.078	-34	0.055	0.055	-47	0.042	0.055
23	-31	0.055	0.078	-48	0.038	0.070	-49	0.046	0.055
24	-27	0.067	0.070	-49	0.042	0.070	-46	0.052	0.052
25	-32	0.062	0.078	-49	0.046	0.070	-37	0.062	0.042
26	-30	0.070	0.073	-47	0.052	0.067	-47	0.055	0.052
27	-33	0.067	0.078	-48	0.055	0.067	-42	0.062	0.046
28	-33	0.070	0.078	-44	0.062	0.062	-39	0.067	0.042
29	-34	0.073	0.078	-39	0.070	0.055	-50	0.062	0.052
30							-41	0.070	0.042

3" J-Force, Polisher (Forward Nozzles Plugged)									
Flow (gpm)	10000 psi			12500 psi			15000 psi		
	Pull (lbf)	Side x 2	Rear x 2	Pull (lbf)	Side x 2	Rear x 2	Pull (lbf)	Side x 2	Rear x 2
9	-24	0.018	0.035	-25	0.018	0.032	-25	0.018	0.029
10	-28	0.018	0.038	-26	0.022	0.032	-27	0.024	0.029
11	-28	0.022	0.038	-35	0.018	0.038	-32	0.024	0.032
12	-34	0.018	0.042	-32	0.026	0.035	-42	0.018	0.038
13	-35	0.024	0.042	-42	0.018	0.042	-38	0.026	0.035
14	-40	0.018	0.046	-38	0.029	0.038	-39	0.029	0.035
15	-42	0.026	0.046	-44	0.026	0.042	-45	0.029	0.038
16	-42	0.029	0.046	-45	0.029	0.042	-42	0.035	0.035
17	-43	0.032	0.046	-46	0.032	0.042	-47	0.033	0.038
18	-32	0.046	0.035	-41	0.038	0.038	-48	0.035	0.038
19	-45	0.038	0.046	-48	0.038	0.042	-49	0.038	0.038
20				-40	0.046	0.035	-45	0.042	0.035
21	-47	0.042	0.046	-45	0.046	0.038	-42	0.046	0.032
22	-48	0.046	0.046	-40	0.052	0.033	-48	0.046	0.035
23	-44	0.052	0.042	-43	0.052	0.035	-41	0.052	0.029
24				-48	0.052	0.038	-46	0.052	0.032
25	-46	0.055	0.042	-45	0.055	0.035	-43	0.055	0.029
26	-39	0.062	0.035	-50	0.055	0.038	-48	0.055	0.032
27									
28	-44	0.062	0.038	-45	0.062	0.032			
29	-49	0.062	0.042	-46	0.062	0.033			
30	-42	0.067	0.035				-49	0.062	0.029

3" J-Force, Polisher (Forward Nozzles Plugged)									
Flow (gpm)	17500 psi			20000 psi			22000 psi		
	Pull (lbf)	Side x 2	Rear x 2	Pull (lbf)	Side x 2	Rear x 2	Pull (lbf)	Side x 2	Rear x 2
8	-24	0.018	0.026	-24	0.018	0.024	-26	0.018	0.024
9	-29	0.018	0.029	-28	0.020	0.026	-28	0.022	0.024
10	-31	0.022	0.029	-34	0.018	0.029	-37	0.018	0.029
11	-36	0.020	0.032	-31	0.026	0.026	-38	0.022	0.029
12	-37	0.024	0.032	-42	0.022	0.032	-45	0.020	0.032
13	-49	0.018	0.038	-38	0.029	0.029	-47	0.024	0.032
14	-44	0.026	0.035	-50	0.024	0.035	-37	0.032	0.026
15	-46	0.029	0.035	-36	0.035	0.026	-44	0.032	0.029
16	-47	0.032	0.035	-38	0.038	0.026	-37	0.038	0.024
17	-35	0.042	0.026	-49	0.033	0.033	-41	0.038	0.026
18	-44	0.038	0.032	-37	0.042	0.024	-48	0.038	0.029
19	-41	0.042	0.029				-45	0.042	0.026
20	-38	0.046	0.026	-40	0.046	0.024			
21	-43	0.046	0.029	-44	0.046	0.026	-44	0.046	0.024
22	-49	0.046	0.032	-50	0.046	0.029	-48	0.046	0.026
23									
24				-45	0.052	0.024			
25	-48	0.052	0.029	-49	0.052	0.026	-50	0.052	0.024
26				-48	0.055	0.024			

3" J-Force, Unplugger (Side Nozzles Plugged)												
Flow (gpm)	2500 psi				5000 psi				7500 psi			
	Pull (lbf)	Nozzle Diameter (inches)			Pull (lbf)	Nozzle Diameter (inches)			Pull (lbf)	Nozzle Diameter (inches)		
		Fwd 10° x 2	Fwd 45° x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Rear x 2
11					-12	0.018	0.018	0.046				
12	-13	0.020	0.020	0.062					-12	0.018	0.020	0.042
13	-17	0.018	0.018	0.067	-18	0.018	0.018	0.052	-18	0.018	0.018	0.046
14	-19	0.018	0.018	0.070	-21	0.018	0.018	0.055	-15	0.020	0.022	0.046
15	-21	0.018	0.018	0.073	-17	0.022	0.022	0.055	-11	0.018	0.029	0.046
16	-19	0.025	0.018	0.073	-16	0.018	0.029	0.055	-26	0.018	0.018	0.052
17	-24	0.018	0.018	0.078	-28	0.018	0.018	0.062	-31	0.018	0.018	0.055
18	-23	0.020	0.022	0.078	-25	0.018	0.026	0.062	-27	0.020	0.022	0.055
19	-22	0.018	0.029	0.078	-34	0.018	0.018	0.067	-24	0.018	0.029	0.055
20	-19	0.018	0.038	0.078	-38	0.018	0.018	0.070	-42	0.018	0.018	0.062
21	-18	0.018	0.042	0.078	-35	0.018	0.022	0.070	-14	0.029	0.029	0.055
22	-16	0.018	0.046	0.078	-42	0.018	0.018	0.073	-35	0.022	0.024	0.062
23	-12	0.035	0.042	0.078	-38	0.022	0.022	0.073	-35	0.018	0.029	0.062
24	-12	0.018	0.055	0.078	-37	0.018	0.029	0.073	-29	0.022	0.032	0.062
25					-48	0.018	0.018	0.078	-44	0.022	0.024	0.067
26					-44	0.022	0.024	0.078	-41	0.022	0.029	0.067
27					-41	0.026	0.026	0.078	-49	0.018	0.029	0.070
28					-38	0.018	0.038	0.078	-45	0.026	0.026	0.070
29					-35	0.018	0.042	0.078	-40	0.029	0.029	0.070
30					-17	0.035	0.042	0.073	-35	0.038	0.018	0.070

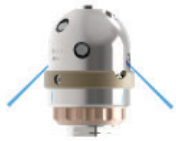
3" J-Force, Unplugger (Side Nozzles Plugged)												
Flow (gpm)	10000 psi				12500 psi				15000 psi			
	Pull (lbf)	Nozzle Diameter (inches)			Pull (lbf)	Nozzle Diameter (inches)			Pull (lbf)	Nozzle Diameter (inches)		
		Fwd 10° x 2	Fwd 45° x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Rear x 2
12	-12	0.018	0.018	0.038	-10	0.018	0.018	0.035				
13	-18	0.018	0.018	0.042	-15	0.018	0.018	0.038	-10	0.018	0.02	0.035
14	-15	0.020	0.020	0.042	-12	0.018	0.022	0.038	-18	0.018	0.018	0.038
15	-24	0.018	0.018	0.046	-23	0.018	0.018	0.042	-13	0.02	0.02	0.038
16	-21	0.018	0.022	0.046	-16	0.020	0.022	0.042	-27	0.018	0.018	0.042
17	-16	0.022	0.024	0.046	-31	0.018	0.018	0.046	-22	0.02	0.02	0.042
18	-35	0.018	0.018	0.052	-24	0.020	0.022	0.046	-37	0.018	0.018	0.046
19	-30	0.020	0.022	0.052	-20	0.022	0.024	0.046	-13	0.018	0.029	0.042
20	-41	0.018	0.018	0.055	-44	0.018	0.018	0.052	-27	0.02	0.024	0.046
21	-22	0.024	0.026	0.052	-40	0.018	0.022	0.052	-17	0.029	0.018	0.046
22	-32	0.018	0.029	0.055	-36	0.018	0.026	0.052	-17	0.024	0.026	0.046
23	-26	0.026	0.026	0.055	-45	0.020	0.022	0.055	-10	0.029	0.024	0.046
24	-22	0.024	0.032	0.055	-25	0.026	0.026	0.052				
25	-49	0.022	0.022	0.062	-18	0.032	0.022	0.052				
26	-43	0.029	0.018	0.062								

3" J-Force, Unplugger (Side Nozzles Plugged)												
Flow (gpm)	17500 psi				20000 psi				22000 psi			
	Pull (lbf)	Nozzle Diameter (inches)			Pull (lbf)	Nozzle Diameter (inches)			Pull (lbf)	Nozzle Diameter (inches)		
		Fwd 10° x 2	Fwd 45° x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Rear x 2
8	-11	Plug	0.018	0.026					-10	Plug	0.018	0.024
9	-17	Plug	0.018	0.029	-10	Plug	0.02	0.026	-14	Plug	0.018	0.026
10	-14	Plug	0.02	0.029	-19	Plug	0.018	0.029	-21	Plug	0.018	0.029
11	-20	Plug	0.02	0.032	-25	Plug	0.018	0.032	-28	Plug	0.018	0.032
12	-26	Plug	0.02	0.035	-20	Plug	0.022	0.032	-25	Plug	0.020	0.032
13	-36	Plug	0.018	0.038	-30	Plug	0.020	0.035	-18	Plug	0.024	0.032
14	-31	Plug	0.022	0.038	-24	Plug	0.024	0.035	-30	Plug	0.022	0.035
15	-21	0.018	0.018	0.038	-35	Plug	0.022	0.038	-18	0.018	0.018	0.035
16	-16	0.02	0.020	0.038	-24	0.018	0.018	0.038	-15	0.018	0.020	0.035
17	-32	0.018	0.018	0.042	-22	Plug	0.029	0.038	-27	0.018	0.018	0.038
18	-26	0.02	0.020	0.042	-36	0.018	0.018	0.042	-20	0.018	0.022	0.038
19	-23	0.018	0.024	0.042	-33	0.018	0.020	0.042	-13	0.024	0.018	0.038
20	-43	0.018	0.018	0.046	-22	0.029	Plug	0.042				
21	-12	0.024	0.024	0.042								

3" J-Force, Universal															
Flow (gpm)	2500 psi					5000 psi					7500 psi				
	Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)			
		Front,Fwd x 2,Side x 2			Rear x 2		Front,Fwd x 2,Side x 2			Rear x 2		Front,Fwd x 2,Side x 2			Rear x 2
12						-13	0.018	0.018	0.018	0.046	-10	0.018	0.018	0.018	0.038
13	-13	0.018	0.026	0.018	0.062	-14	0.018	0.018	0.026	0.046	-15	0.018	0.018	0.018	0.042
14	-17	0.018	0.018	0.018	0.067	-18	0.018	0.018	0.018	0.052	-15	0.018	0.018	0.024	0.042
15	-19	0.018	0.018	0.018	0.070	-21	0.018	0.018	0.018	0.055	-19	0.018	0.018	0.018	0.046
16	-21	0.018	0.018	0.018	0.073	-22	0.018	0.018	0.026	0.055	-21	0.018	0.018	0.026	0.046
17	-21	0.018	0.018	0.026	0.073	-22	0.018	0.018	0.029	0.055	-27	0.018	0.018	0.018	0.052
18	-25	0.018	0.018	0.018	0.078	-29	0.018	0.018	0.018	0.062	-32	0.018	0.018	0.018	0.055
19	-25	0.018	0.018	0.029	0.078	-29	0.018	0.018	0.026	0.062	-29	0.018	0.018	0.029	0.052
20	-24	0.020	0.022	0.029	0.078	-35	0.018	0.018	0.018	0.067	-33	0.018	0.018	0.026	0.055
21	-26	0.018	0.018	0.038	0.078	-35	0.018	0.018	0.026	0.067	-34	0.018	0.018	0.029	0.055
22	-26	0.018	0.018	0.042	0.078	-38	0.018	0.018	0.018	0.070	-43	0.018	0.018	0.018	0.062
23	-27	0.018	0.018	0.046	0.078	-42	0.018	0.018	0.018	0.073	-44	0.018	0.018	0.026	0.062
24	-27	0.018	0.018	0.052	0.078	-43	0.018	0.018	0.026	0.073	-45	0.018	0.018	0.029	0.062
25	-28	0.018	0.018	0.055	0.078	-43	0.018	0.018	0.029	0.073	-41	0.020	0.022	0.029	0.062
26	-26	0.018	0.018	0.067	0.073	-49	0.018	0.018	0.018	0.078	-47	0.018	0.026	0.018	0.067
27	-29	0.018	0.018	0.062	0.078	-50	0.018	0.018	0.026	0.078	-48	0.018	0.026	0.026	0.067
28	-29	0.018	0.018	0.067	0.078	-47	0.018	0.026	0.026	0.078	-49	0.018	0.026	0.029	0.067
29	-30	0.018	0.018	0.070	0.078	-48	0.018	0.024	0.032	0.078	-49	0.018	0.018	0.046	0.062
30	-27	0.018	0.029	0.067	0.078	-43	0.026	0.026	0.029	0.078	-48	0.026	0.024	0.024	0.070

3" J-Force, Universal															
Flow (gpm)	10000 psi					12500 psi					15000 psi				
	Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)			
		Front,Fwd x 2,Side x 2			Rear x 2		Front,Fwd x 2,Side x 2			Rear x 2		Front,Fwd x 2,Side x 2			Rear x 2
13	-14	0.018	0.018	0.018	0.038										
14	-14	0.018	0.018	0.020	0.038	-12	0.018	0.018	0.020	0.035	-11	0.018	0.018	0.018	0.033
15	-19	0.018	0.018	0.018	0.042	-17	0.018	0.018	0.018	0.038	-12	0.018	0.018	0.022	0.033
16	-16	0.018	0.018	0.029	0.038	-12	0.018	0.018	0.029	0.033	-20	0.018	0.018	0.018	0.038
17	-26	0.018	0.018	0.018	0.046	-24	0.018	0.018	0.018	0.042	-17	0.018	0.018	0.026	0.035
18	-27	0.018	0.018	0.024	0.046	-26	0.018	0.018	0.024	0.042	-29	0.018	0.018	0.018	0.042
19	-28	0.018	0.018	0.029	0.046	-32	0.018	0.018	0.018	0.046	-24	0.018	0.018	0.029	0.038
20	-37	0.018	0.018	0.018	0.052	-27	0.018	0.024	0.018	0.046	-39	0.018	0.018	0.018	0.046
21	-43	0.018	0.018	0.018	0.055	-35	0.018	0.018	0.029	0.046	-33	0.018	0.018	0.029	0.042
22	-39	0.018	0.018	0.029	0.052	-46	0.018	0.018	0.018	0.052	-24	0.018	0.020	0.035	0.038
23	-44	0.018	0.018	0.026	0.055	-42	0.020	0.020	0.020	0.052	-42	0.018	0.018	0.029	0.046
24	-45	0.018	0.018	0.029	0.055	-40	0.020	0.022	0.022	0.052	-33	0.018	0.020	0.035	0.042
25	-40	0.018	0.024	0.029	0.055	-49	0.018	0.018	0.029	0.052	-29	0.020	0.026	0.026	0.046
26	-40	0.018	0.025	0.032	0.055	-37	0.022	0.024	0.026	0.052	-23	0.029	0.018	0.029	0.046
27	-50	0.026	0.018	0.018	0.062	-38	0.020	0.026	0.029	0.052	-46	0.018	0.018	0.038	0.046
28	-49	0.018	0.018	0.042	0.055	-33	0.024	0.026	0.029	0.052	-28	0.018	0.022	0.046	0.038
29	-46	0.020	0.020	0.042	0.055	-34	0.024	0.026	0.032	0.052	-49	0.018	0.018	0.042	0.046
30	-43	0.018	0.026	0.042	0.055	-44	0.018	0.026	0.038	0.052	-25	0.018	0.029	0.042	0.042

3" J-Force, Universal															
Flow (gpm)	17500 psi					20000 psi					22000 psi				
	Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)			
		Front,Fwd x 2,Side x 2			Rear x 2		Front,Fwd x 2,Side x 2			Rear x 2		Front,Fwd x 2,Side x 2			Rear x 2
15	-11	0.018	0.018	0.020	0.032	-12	0.018	0.018	0.018	0.032					
16	-17	0.018	0.018	0.018	0.035	-13	0.018	0.018	0.020	0.032					
17	-24	0.018	0.018	0.018	0.038	-11	0.018	0.020	0.022	0.032					
18	-16	0.018	0.020	0.024	0.035	-27	0.018	0.018	0.018	0.038	-11	0.018	0.018	0.029	0.029
19	-34	0.018	0.018	0.018	0.042	-19	0.018	0.020	0.024	0.035	-30	0.018	0.018	0.018	0.038
20	-20	0.020	0.020	0.024	0.038	-29	0.018	0.018	0.024	0.038	-25	0.018	0.018	0.026	0.035
21	-36	0.018	0.018	0.024	0.042	-39	0.018	0.018	0.018	0.042	-20	0.018	0.018	0.032	0.032
22	-45	0.018	0.018	0.018	0.046	-32	0.018	0.018	0.029	0.038	-26	0.018	0.022	0.024	0.038
23	-38	0.018	0.018	0.029	0.042	-42	0.018	0.018	0.026	0.042	-35	0.018	0.018	0.029	0.038
24	-48	0.018	0.018	0.026	0.046	-44	0.018	0.018	0.029	0.042	-28	0.020	0.020	0.029	0.038
25	-49	0.018	0.018	0.029	0.046	-24	0.018	0.024	0.032	0.038	-14	0.020	0.024	0.032	0.035
26	-28	0.020	0.024	0.032	0.042	-42	0.018	0.020	0.032	0.042	-23	0.024	0.018	0.032	0.038
27	-43	0.018	0.018	0.038	0.042	-21	0.018	0.018	0.046	0.029	-41	0.018	0.018	0.038	0.038
28	-28	0.018	0.020	0.046	0.035	-49	0.018	0.018	0.038	0.042	-23	0.018	0.018	0.046	0.029
29	-45	0.018	0.018	0.042	0.042	-20	0.022	0.024	0.038	0.038	-28	0.020	0.020	0.042	0.035
30	-16	0.024	0.024	0.042	0.038	-11	0.029	0.018	0.038	0.038	-44	0.018	0.018	0.042	0.038



3" J-Force, Puller (Rear Jets)																
Flow (gpm)	2500 psi					5000 psi					7500 psi					
	Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)			
		Fwd 10° x 2	Fwd 45° x 2	Side x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Side x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Side x 2	Rear x 2
9											-24	Plug	Plug	Plug	0.042
10											-29	Plug	Plug	Plug	0.046
11															
12	-20	Plug	Plug	Plug	0.067	-25	Plug	Plug	Plug	0.052					
13	-22	Plug	Plug	Plug	0.070	-28	Plug	Plug	Plug	0.055	-37	Plug	Plug	Plug	0.052
14	-24	Plug	Plug	Plug	0.073						-41	Plug	Plug	Plug	0.055
15						-35	Plug	Plug	Plug	0.062					
16	-28	Plug	Plug	Plug	0.078										
17															
18						-41	Plug	Plug	Plug	0.067					
19						-45	Plug	Plug	Plug	0.070					
20															
21						-49	Plug	Plug	Plug	0.073					

3" J-Force, Puller (Rear Jets)																
Flow (gpm)	17500 psi					20000 psi					22000 psi					
	Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)				Pull (lbf)	Nozzle Diameter (inches)			
		Fwd 10° x 2	Fwd 45° x 2	Side x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Side x 2	Rear x 2		Fwd 10° x 2	Fwd 45° x 2	Side x 2	Rear x 2
7	-27	Plug	Plug	Plug	0.029	-31	Plug	Plug	Plug	0.029					
8	-33	Plug	Plug	Plug	0.032						-34	Plug	Plug	Plug	0.029
9						-41	Plug	Plug	Plug	0.032	-41	Plug	Plug	Plug	0.032
10	-39	Plug	Plug	Plug	0.035	-49	Plug	Plug	Plug	0.035	-49	Plug	Plug	Plug	0.035
11	-46	Plug	Plug	Plug	0.038										

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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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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.