Jetstream®
Subsidiary of Federal Signal Corporation

SWIVEL X15™

(PNs 52820/64272-XXX*)

PRODUCT INSTRUCTIONS

PI-173

Swivel X15 is a self-powered rotating swivel that uses two or more hard-hitting tungsten carbide nozzles rotated at a controlled speed while producing concentrated streams to provide more cleaning production. Swivel X15 has an internal oil pump assembly which allows adjustment of rotational speed of the nozzle head for maximum cleaning and minimum wear.

Read these instructions thoroughly before installing, connecting, or using the Swivel X15. 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 Swivel X15 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.

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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 38.)

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. For 15,000 psi models - Apply 3 - 4 wraps of Teflon tape to male connection thread on the barrel. 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. Special nozzles requiring a thread locking pin must have the pin installed prior to use or the nozzle may unscrew from the lance while in service and cause the lance to blow back toward the operator.

8. With nozzles requiring adjustment, always read applicable instructions.

9. 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 control gun or lance and clean immediately.

10. 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.

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

Swivel X15 is a self powered rotating swivel that uses two or more hard-hitting tungsten carbide nozzles rotated at a controlled speed while producing concentrated streams to give you more cleaning production. Swivel X15 has an internal oil pump assembly which allows adjustment of rotational speed of your nozzles for maximum cleaning and minimum wear.

The speed can be instantly adjusted from 50 to 1000 RPM using a standard 3/16" hex key without having to disassemble the swivel or change the swivel oil. Rotating the adjusting screw clockwise will lower the swivel speed while rotating it counter-clockwise will increase the swivel speed.

The swivel seal cartridge is easily removable. Maintenance cost is reduced by integrating a portion of the swivel shaft into the seal cartridge, preventing wear to the main shaft. The rebuild kit allows five minute overhaul of the wear cartridge in the field using standard wrenches.

Product Specifications

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

Model Name	Swivel X15
Maximum Operating Pressure (psi)	15000
Maximum Flow (gpm)	50
Maximum Operating Pressure (bar)	1000
Maximum Flow (l/min)	189
Inlet Connection	3/4” NPT
Speed Range (RPM)	50-1000
Nozzle Types Accepted	HHTC0, P4TC
Diameter (in)	3-5/8”
Length (in)	9-5/8”
Weight (lbs)	11
Diameter (mm)	92
Length (mm)	241
Weight (kg)	5

Swivel X15 available in hard case kit form:

- PN 64234-XXX Premium Kit
- PN 64233-XXX Starter Kit

See Appendix A for kit layout and list of all kit options

SECTION 3: PREPARATION FOR USE

3.0 BEFORE PUTTING SWIVEL X15 INTO SERVICE

NEW SWIVEL X15

3.1 Check the Swivel X15 carefully upon removal from its shipping container for damage. DO NOT use the Swivel X15 if any damage is apparent. Notify Jetstream immediately if damage is apparent or the condition of any component is questionable.

3.2 New Swivel X15s are shipped assembled with the exception of the nozzles and extensions. The tool is ready upon installation of the nozzles per instructions in Section 4: Setup.

3.3 Review nozzle charts in Appendix B to determine proper flow rates for each application.

⚠ **DANGER** Improper use of the Swivel X15 could result in severe injury or death.

PREVIOUSLY USED SWIVEL X15

Before installing the Swivel X15 onto the Hydro-mower, hose, or lance:

3.4 Inspect all components. The shaft of the Swivel X15 (if not connected to the nozzle head) should turn by hand with some resistance.

3.5 The nozzles and the spray bar should be inspected and cleaned to ensure no debris has entered the orifice that could plug the nozzle and over-pressurize the system.

3.6 Remove the Swivel X15 from service if the body, oil seal, or any of the internal components show signs of cracking or excessive abrasion.

SECTION 4: SETUP

4.0 CONNECTING SWIVEL X15

The Swivel X15 is used in large pipe cleaning applications. It can also be used with Jetstream Hydro-mower for surface cleaning purposes. It is extremely important to follow the proper installation procedure in order to prevent nozzle discharge from accidently striking the operator's feet, legs or body.

4.1 Prior to installing the Swivel X15 on the waterblast unit, engage the pump to clear any debris from the system.

1. First apply 3-4 wraps of Teflon thread sealant tape to the male connection thread on the hose or lance.

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

3. The connection should then be wrenched 1 ½ - 2 turns past hand tight. All NPT pipe connection should have a minimal thread engagement of four (4) threads.

4.2 Use the nozzle selection process in Flow Charts section to determine the size and number of nozzles.

1. Determine spray pattern to be used and remove the appropriate plugs.

2. Apply 3-4 wraps of Teflon thread sealant tape to the male connection thread on the nozzles or plugs.

3. Apply anti-seize compound over the sealant tape.

4. The connection should then be wrenched 1-½ - 2 turns past hand tight.

4.3 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.

4.4 For operator safety, the high pressure hose should be in good condition and free of leaks and cover damage.

SECTION 5: OPERATION

5.0 OPERATING SWIVEL X15

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.

⚠WARNING The temperature of the Swivel X15, immediately after its operation, can get as high as 200°F. It is strongly advised to let the temperature drop to ambient before handling or troubleshooting. Use of thermally protective gloves is highly recommended. Be advised: the oil temperature takes longer to cool down compared to the temperature of Swivel X15 body. Disassembly of any parts while the oil temperature is still hot can be extremely dangerous.

5.1 Use only thoroughly trained operators to perform cleaning operations with the Swivel X15.

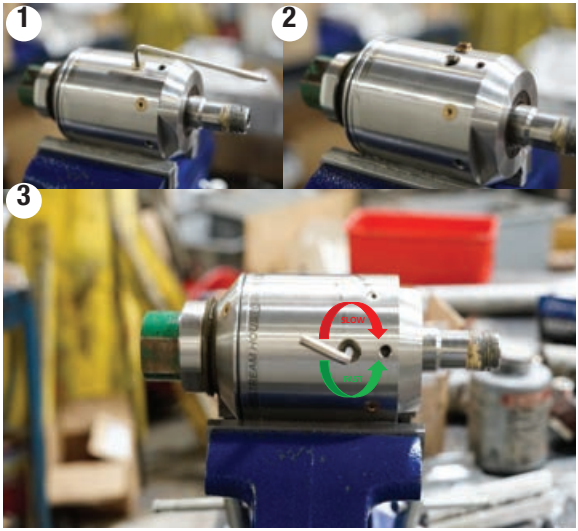
5.2 SWIVEL X15 RPM VS SCREW ADJUSTMENT

5.3 Swivel X15 has an internal oil pump assembly which controls the rotational speed of your nozzles for maximum cleaning and minimum wear. The speed can be instantly adjusted from 50 to 1000 rpm. A standard 3/16" allen wrench is used to adjust speed without having to disassemble the Swivel X15. Rotating the adjusting screw clockwise will lower the Swivel X15 speed while rotating it counter-clockwise will increase the speed.

5.4 Gently turn the adjusting screw in the clockwise direction until it stops. This is regarded as fully closed. Gently turn the screw in

the counter clockwise direction to increase the Swivel X15 rpm. The adjustment screw should turn 2.5 complete turns before it stops.

5.5 The Appendix B: Flow Chart shows the recommended adjustment to achieve the desired average Swivel X15 rpm at different pressure using different nozzles. Please be advised, this is an estimated average Swivel X15 rpm at the given configuration. The rotational speed of the Swivel X15 not only depends on the adjustment of the set screw but also on the quality of oil, size of the nozzles, number of nozzles, seal life, and the Swivel X15 temperature.



SECTION 6: SERVICE

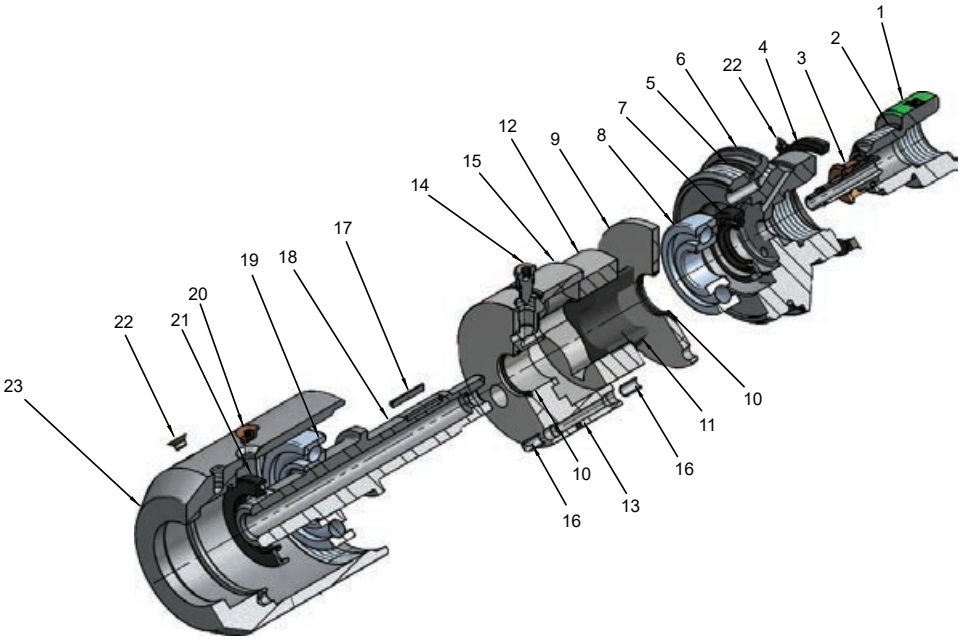


Figure A

Assembly PN 52820 Swivel X15 Body							
Item	**Qty**	**Part #**	**Description**	**Item**	**Qty**	**Part #**	**Description**
1	1	53397	Seal Cap	13	1	27204	O-ring
2	1	25229	O-ring	14	1	52757	Speed Adjustment Screw
3	1	53410	15K Seal Assy	15	1	52764	Oil Pump Body
4	1	27042	V-ring Seal	16	2	52958	Hollow Dowel
5	1	27045	O-ring	17	1	27038	Dowel Pin
6	1	53395	Swivel Cap	18	1	53398	Swivel Shaft
7	1	27044	Inner Oil Seal	19	1	27049	Thrust Bearing
8	1	27048	Radial Bearing	20	1	52819	Seal Screw
9	1	52756	Pump Cover Plate	21	1	27043	Outer Oil Seal
10	2	27046	O-ring	22	2	64054	Seal Screw
11	1	52762	Inner Rotor	23	1	52753	Swivel Body
12	1	27040	Outer Rotor	24	6 oz	27195	Oil

NOTE: Part numbers and descriptions are subject to change without notice.

6.0 SWIVEL X15 MAINTENANCE

The Swivel X15 uses an internal oil pump that regulates the rotational speed. The Swivel X15 takes about 6 oz of ISO Grade 680 gear oil. It is recommended that the oil be changed every 50 hours of run time.

See YouTube for videos showing the Swivel X15.

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

6.1 CHANGING OIL

This following procedure allows the operator to change oil without having to disassemble the Swivel X15.

1. Pre-fill the oil syringe with approximately 6 oz (180 ml) of new oil and purge as much air as possible from the syringe and tubing. Heating the oil by immersing the bottle of new oil in hot water will make this easier.

2. Place the Swivel X15 in an inverted position in a vise (rotating shaft up). Remove the seal screw (20) covering the speed adjustment screw. Turn the speed adjustment screw counter-clockwise until it stops turning.

3. Carefully remove the seal screw (22) from the Swivel X15 cap. Connect the pre-filled syringe with tubing to the oil port in the cap. Carefully remove the other seal screw from the Swivel X15 body and install the second oil tube as drain.

4. Using a 7/8" or adjustable wrench, slowly turn the Swivel X15 shaft while depressing the plunger to force new oil into the Swivel X15 and the old oil out. Catch the old oil in a container for proper disposal.

5. When the syringe is empty, remove the tubing and syringe and reinstall the seal screws.

Figure B: Proper Orientation for Oil Change

6.2 DISASSEMBLY

1. Remove the nozzle head and place the Swivel X15 in a vise in an upright position. Remove seal screw (20) to expose the speed adjustment screw (14). Using the 3/16" hex key, rotate the speed adjustment screw clockwise until it stops turning.

2. Carefully remove the seal cap housing assembly (1) from the Swivel X15 body.

3. Remove the 15K seal assembly (3) and the o-ring (2) from the seal cap housing assembly.

4. Using the 1/8” hex key, remove the seal screw (22) from the Swivel X15 cap (6). Remove the Swivel X15 cap (6) exposing the internal components of the Swivel X15.

5. Carefully loosen the vise and reposition the Swivel X15 on its side to drain oil. Have a container readily available to catch the old oil.

6. Remove the inner oil seal (7), o-ring (5) and v-ring seal (4) from the Swivel X15 cap.

7. Remove the radial bearing (8) and the pump cover plate (9) from the assembly. Remove the o-ring (10) from the pump cover plate.

8. Remove the inner rotor (11), outer rotor (12), the hollow dowel (16) and dowel pin (17) from the Swivel X15.

9. Remove the oil pump body (15) and the second hollow dowel (16).

10. Remove the shaft (18), thrust bearing (19) and the outer oil seal (21).

11. Remove the seal screw (22) from the Swivel X15 body, speed adjustment screw (14) and o-rings (10, 13) from the oil pump body and cap.

6.3 SEAL ASSEMBLY REPLACEMENT

1. Remove the nozzle head and place the Swivel X15 in a vise in an upright position.

2. Carefully remove the seal cap (1) from the Swivel X15 body.

3. Remove the 15K seal assembly (3) and the o-ring (2) from the seal cap housing assembly.

4. Remove the mandrel from the swivel body.

5. Apply o-ring lube to the mandrel prior to installation.

6. The mandrel should be secured on the shaft with the o-ring and the backup ring sitting completely inside the hex broach on the shaft.

7. Install the seal cap (1).

6.4 ASSEMBLY

1. Install the outer oil seal (21) in the Swivel X15 body (23) using the seal installation tool in the Swivel X15 Service Kit. Gently lubricate the inner diameter of the seal lip with oil before installing the shaft. Install one small seal screw (22) into the Swivel X15 body.

2. Install the thrust bearing (19) with the thick inner race flange facing the oil pump.

Correct Orientation

Incorrect Orientation

3. Install the shaft (18). The 1.5" OD flange on the shaft sits on the installed bearing race. Caution should be taken while installing the shaft so as not to deform the inner lip of the oil seal.

4. Install two smaller oil sealing plugs (22).

5. Add oil to the Swivel X15 until the bearing is covered with a thin layer of oil. Install the oil pump assembly in the following order

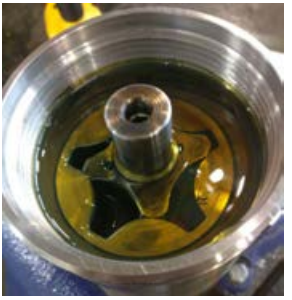
- Place one dowel (16) before installing the oil pump.
- Install the o-rings (13, 10) in the oil pump body (15).
- Install the adjustment screw (14). For simplicity, the set screw should be initially installed all the way closed (0° adjustment).
- Install the o-ring (10) in the oil pump cover plate.
- Install the oil pump body in the Swivel X15 body.
- Carefully align the speed adjustment screw with the open port in the side of the swivel body to ensure the pump is properly installed.

Correct

Incorrect

- Apply o-ring lube to the pin (17) to secure it.
- Install the inner and outer rotors (11 and 12).
- Install the large seal screw (20) into the Swivel X15 body.

6. Add oil into the spaces between the rotors until there is a thin layer on top of the oil pump.



7. Install oil pump cover plate with the second dowel (16). Gently press cover plate (9) into oil pump. Oil will extrude through dowel.

8. Install the radial bearing (8) onto the shaft. The bearing should sit on the cover plate.

9. Install the inner oil seal (7) on the Swivel X15 cap (6) using the seal installation tool.

10. Carefully add the remaining oil around the bearing OD.

11. Disassemble the mandrel from the seal assembly (3) to install the mandrel into the hex broach on the shaft.

- O-ring lube should be applied to the mandrel prior to installation.
- The mandrel should be secured on the shaft with the o-ring and the backup ring sitting completely inside the hex broach on the shaft.

12. Use o-ring lube to lubricate the o-ring, and then gently install the o-ring (5) to the Swivel X15 cap (6). Install the swivel cap onto the swivel body. As the cap is tightened, some oil may be expelled from the cap vent hole.

13. Gently push the rest of seal assembly onto the OD of the mandrel.

14. Install the o-ring (2) in the seal cap (1). Install the seal cap (1).

15. Install the third sealing plug (22) and the v-ring seal (4).

16. The Swivel X15 is now ready to be assembled to the nozzle head.

SECTION 7: TROUBLESHOOTING

7.0 SWIVEL X15 TROUBLESHOOTING

Problem	Possible Cause	Remedy
Will not spin	Adjustment screw position	Adjust counter-clockwise
	Low pressure/ undersized nozzles	Reference flow chart / Replace nozzles
	High Pressure Seal not seating	Cycle pressure on/off to seat the seal[5]
	High Pressure Seal worn	Inspect / Replace seals[2]
	Debris	Clean[3]
	Bearing problem	Disassemble the swivel, inspect bearings, ensure thrust bearing is installed with inner race flange facing oil pump.
Spins slowly	Adjustment screw position	Adjust counter-clockwise
	Low pressure/ undersized nozzles	Reference flow chart / Replace nozzles
	Oil cold	Warm swivel up[4]
	New seal cartridge	“Break in” cartridge for 10 minutes
	Damaged high pressure seals	Inspect / Replace seals[2]
	Bearing problem	Disassemble the swivel inspect bearings, ensure thrust bearing is installed with inner race flange facing oil pump.

Problem	Possible Cause	Remedy
Spins too fast	Adjustment screw position	Adjust clockwise
	Nozzle worn or wrong size	Replace nozzles
	Contaminated oil	Perform oil change
	Oil low level	Perform oil change
Pump will no longer come up to pressure	Nozzle worn or wrong size	Reference flow chart / Replace nozzles
	High pressure seal worn	Replace seals[1]
	Pump problem	Inspect pump
Water coming from V-ring seal	Swivel seal cartridge leaking	Inspect/replace swivel seal cartridge
Oil leaking	Seals worn	Inspect / Replace seals[1]

[1] Make sure the outer oil seal is in proper condition. The inner lip of the seal could obstruct the rotation of the shaft.

[2] Remove the swivel cap from the swivel body to expose the radial bearing and swivel seal cartridge. Inspect the swivel seal cartridge and mandrel seals. Check for any noticeable wear, damaged or missing o-rings.

[3] To clean, remove the Swivel X15 cap from the body to expose the radial bearing. Check for any noticeable damage. Significant noticeable damage has to occur in order for the swivel to not spin at all.

[4] At ambient temperature, the viscosity of the oil in the swivel provides a significant braking friction. Allow the swivel some time at pressure to come up to operating temperature.

[5] Cycle from zero to full pressure 3 to 5 times. If the Swivel still does not spin, check for additional issues.

⚠ WARNING Do not handle the Swivel X15 while the system is pressurized.

APPENDIX A

Exploded Views

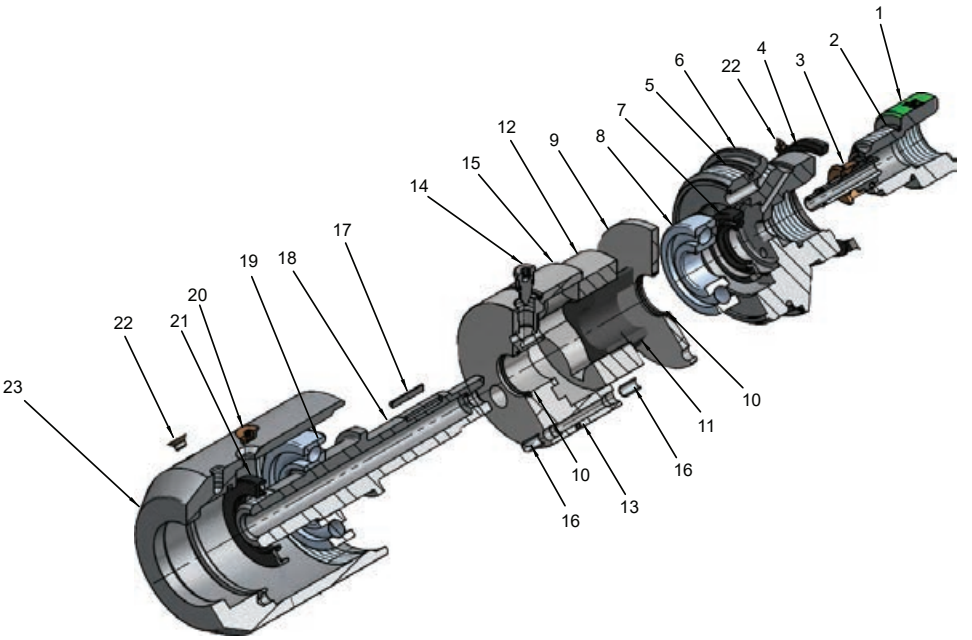


Figure C

Assembly PN 52820 Swivel X15 Body							
Item	**Qty**	**Part #**	**Description**	**Item**	**Qty**	**Part #**	**Description**
1	1	53397	Seal Cap	13	1	27204	O-ring
2	1	25229	O-ring	14	1	52757	Speed Adjustment Screw
3	1	53410	15K Seal Assy	15	1	52764	Oil Pump Body
4	1	27042	V-ring Seal	16	2	52958	Hollow Dowel
5	1	27045	O-ring	17	1	27038	Dowel Pin
6	1	53395	Swivel Cap	18	1	53398	Swivel Shaft
7	1	27044	Inner Oil Seal	19	1	27049	Thrust Bearing
8	1	27048	Radial Bearing	20	1	52819	Seal Screw
9	1	52756	Pump Cover Plate	21	1	27043	Outer Oil Seal
10	2	27046	O-ring	22	2	64054	Seal Screw
11	1	52762	Inner Rotor	23	1	52753	Swivel Body
12	1	27040	Outer Rotor	24	6 oz	27195	Oil

NOTE: Part numbers and descriptions are subject to change without notice.

Parts Placement

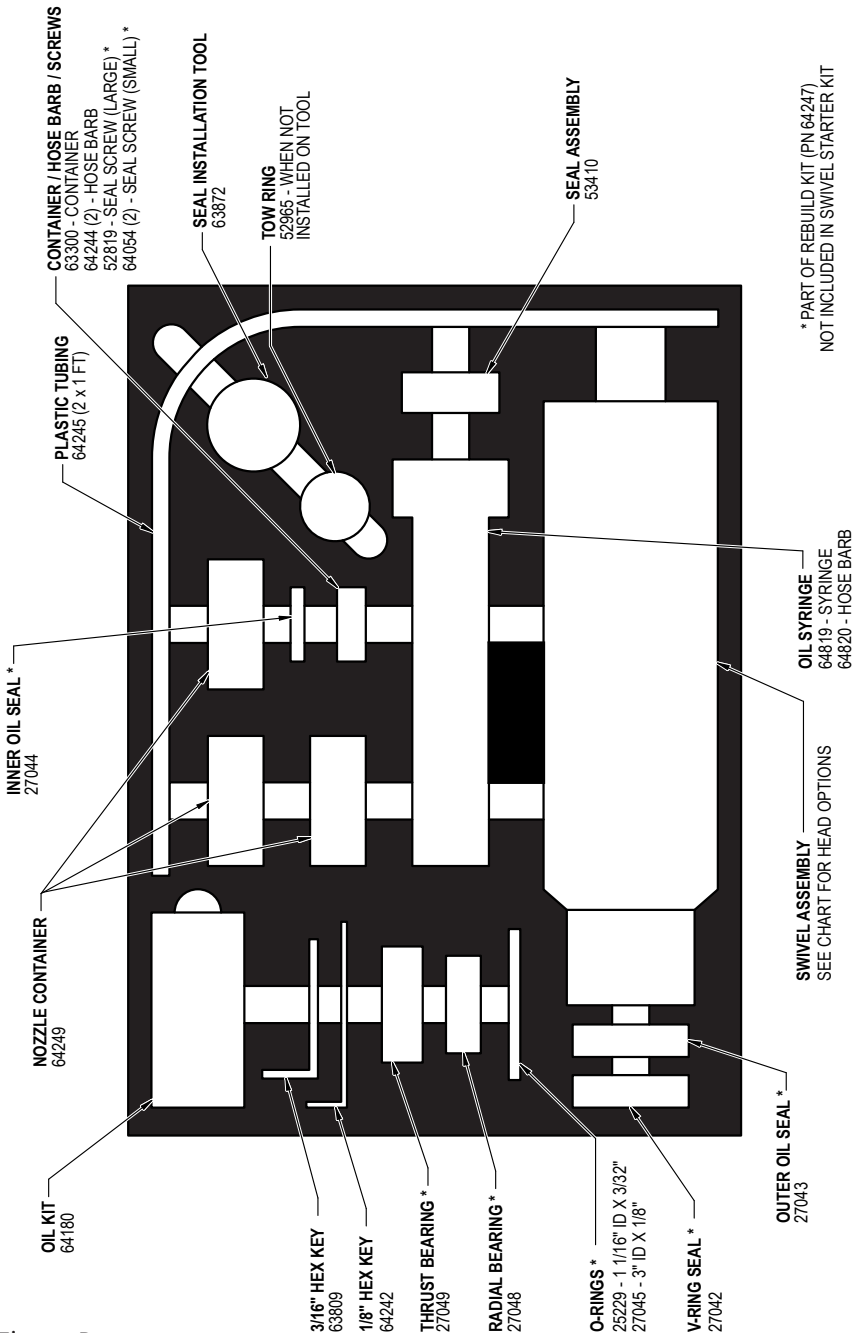


Figure D

Kits

SWIVEL X15 KITS				
KIT PN	**KIT TYPE**	**ASSEMBLY PN (Swivel with Nozzle Holder)**	**NOZZLE HOLDER (Head) PN**	**HEAD DESCRIPTION**
64233-6P422	STARTER	64272-6P422	65326	6 PORT, P4, R22
64233-7P422	STARTER	64272-7P422	65328	7 PORT, P4, R22
64233-6P444	STARTER	64272-6P444	52963	6 PORT, P4, R44
64233-7P444	STARTER	64272-7P444	65323	7 PORT, P4, R44
64233-6FS1222	STARTER	64272-6FS1222	65327	6 PORT, 3/4" ORS, R22
64233-6FS1244	STARTER	64272-6FS1244	65162	6 PORT, 3/4" ORS, R44
64234-6P422	PREMIUM	64272-6P422	65326	6 PORT, P4, R22
64234-7P422	PREMIUM	64272-7P422	65328	7 PORT, P4, R22
64234-6P444	PREMIUM	64272-6P444	52963	6 PORT, P4, R44
64234-7P444	PREMIUM	64272-7P444	65323	7 PORT, P4, R44
64234-6FS1222	PREMIUM	64272-6FS1222	65327	6 PORT, 3/4" ORS, R22
64234-6FS1244	PREMIUM	64272-6FS1244	65162	6 PORT, 3/4" ORS, R44

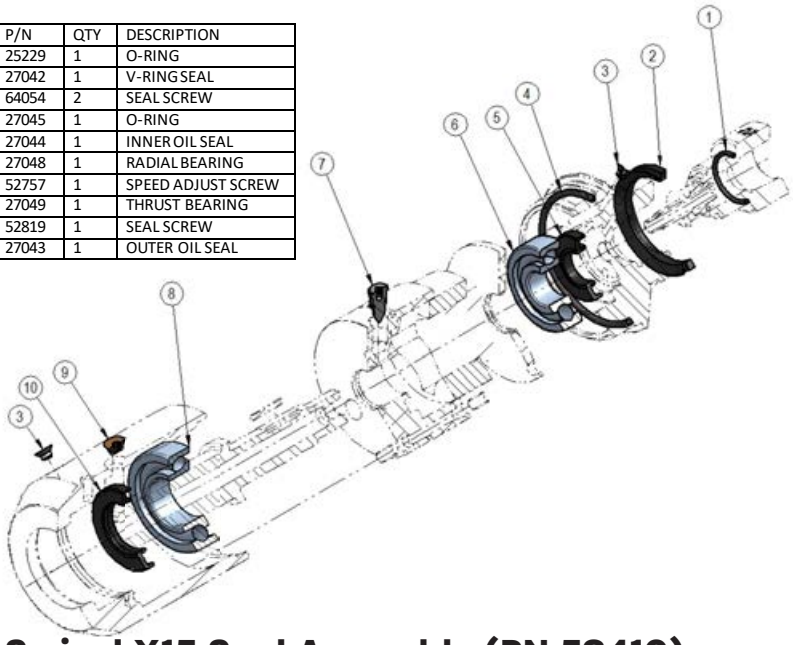
NOTE: 3/4" ORS nozzle holders require some form of extensions to allow ¼" NPT nozzles. Tool assemblies come with two 2" nozzle extensions (PN 65456-02).

APPENDIX B

Accessories

Swivel X15 Rebuild Kit (PN 64247)

ITEM	P/N	QTY	DESCRIPTION
1	25229	1	O-RING
2	27042	1	V-RING SEAL
3	64054	2	SEAL SCREW
4	27045	1	O-RING
5	27044	1	INNER OIL SEAL
6	27048	1	RADIAL BEARING
7	52757	1	SPEED ADJUST SCREW
8	27049	1	THRUST BEARING
9	52819	1	SEAL SCREW
10	27043	1	OUTER OIL SEAL

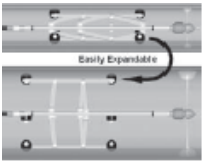


15K Swivel X15 Seal Assembly (PN 53410)

Swivel X15 Oil Kit, 6 oz. (PN 64180)

Replacement Syringe Assembly (PN 66199)

Centralizers



- Several models are available for a variety of applications.
- Required for use of extensions in horizontal pipe runs.
- Used with the Swivel 15 to provide even, thorough cleaning and ease of movement.

Cage Style:

Part No	Diameter	
	in	mm
63843-SWVL	18.75	475

- Recommended for navigating complex piping arrangements to clean built-up debris.

Scissor Style:

- Designed for straight pipe runs only.
- Adjustable frames allow for an effective pipe clean anywhere from 9-60 inches (230-1500 mm) in diameter, depending on the centralizer size chosen.
- Compatible with any tool using proper fittings.
- Comes with central lance for mounting tools.

Skid Style:

- Used in pipes with and without elbows up to 10” (250 mm) in diameter.

Part No	Diameter	
	in	mm
63842-SWVL-6	6.0	150
63842-SWVL-8	8.0	200
63842-SWVL-10	10.0	250

REPLACEMENT RUNNERS
Three plastic runners and six screws.

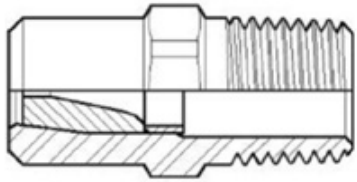
Part No	Diameter	
	in	mm
66104-06	6.0	150
66104-08	8.0	200
66104-10	10.0	250

15K Swivel X15 Nozzle Holder

Part Number	Inlet Size	No. of Ports	Port Size	Offset	Pressure
65327	3/4 NPT	6	3/4 ORS	R22	15KSI
65162	3/4 NPT	6	3/4 ORS	R44	15KSI
65326	3/4 NPT	6	1/4 NPT	R22	15KSI
52963	3/4 NPT	6	1/4 NPT	R44	15KSI
65328	3/4 NPT	7	1/4 NPT	R22	15KSI
65323	3/4 NPT	7	1/4 NPT	R44	15KSI

Tow Ring (PN 52965)

HHTC Nozzles

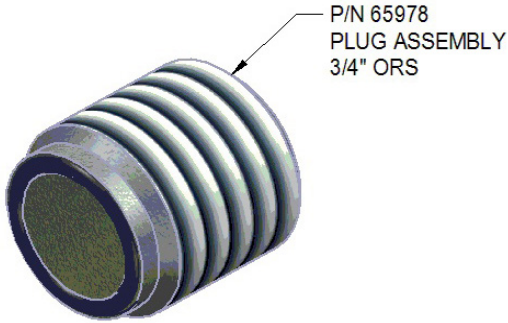


- Stainless steel
- Carbide Orifice
- 1/4” NPT male connection

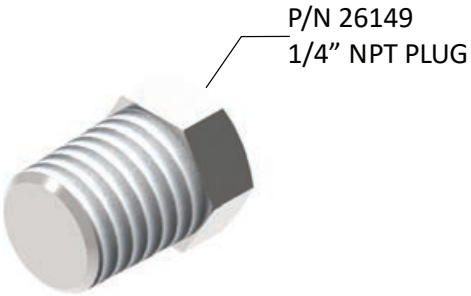
P4TC Carbide Nozzles

- High productivity tungsten carbide nozzles.
- Tapered geometry provides highly cohesive, distortion-free water-jets.
- Low profile design for unobstructed pipe cleaning.
- 1/4” NPT male connection.
- Select nozzles using the charts by choosing operating pressure, desired flow, and two, four, six, or eight nozzle operation.

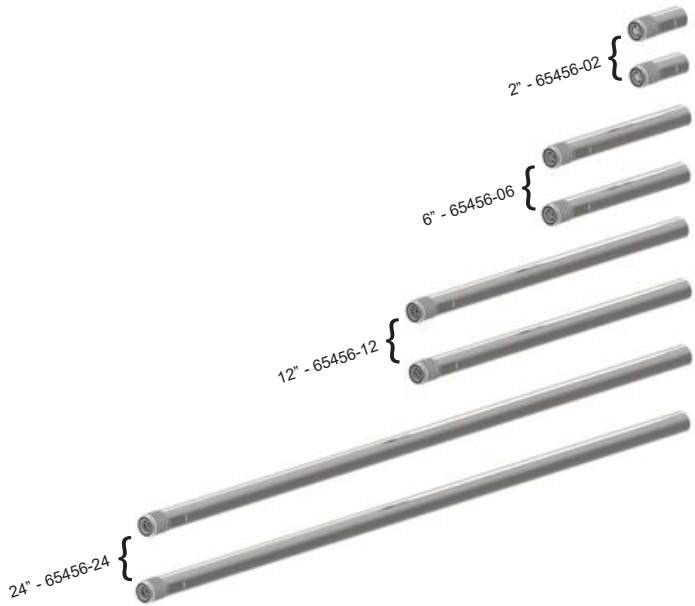
3/4” ORS Port Plug (PN 65978)



1/4” NPT Plug (PN 26149)



15K Nozzle Extensions (PN 65456-XX*)



*XX = length (inches)

- Nozzle extensions are 3/4” ORS male x 1/4” NPT female.
- Designed to work with 3/4” ORS nozzle holders.
- Sold in sets of 2.
- Available sizes: 2”, 6”, 12”, 24” (length of each extension).

NOTE: 3/4” ORS nozzle holders require some form of extensions to allow 1/4” NPT nozzles. Tool assemblies come with two 2” nozzle extensions (PN 65456-02). 1” ORS extensions do not work with Swivel nozzle holders. 1/4” NPT nozzles holders not designed for use with extensions.

APPENDIX C

Flow Charts

1. Choose desired head/ nozzle configuration. 45°, 90°, and 135° nozzles MUST be installed in matched pairs.

2. Using the flow table, calculate total flow for the tool. Flow in excess of 50GPM will cause excessive pressure loss.

3. Using appropriate torque table for the head in use, calculate the total torque for the 45°, 90°, and 135° nozzles. 15° nozzles do not create torque.

⚠WARNING Total torque exceeding 60 in-lb can cause the tool to overspeed, leading to seal damage and oil leaks.

4. Use the speed table to determine approximate head RPM and speed adjustment screw setting.

FLOW (gpm) per nozzle											
ORIFICE DIA	**PRESSURE (PSI)**										
(in)	**5000**	**6000**	**7000**	**8000**	**9000**	**10000**	**11000**	**12000**	**13000**	**14000**	**15000**
0.018	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1
0.020	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3
0.022	0.9	1.0	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.6
0.024	1.1	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.8	1.9
0.026	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.2
0.029	1.6	1.8	1.9	2.0	2.2	2.3	2.4	2.5	2.6	2.7	2.8
0.032	2.0	2.1	2.3	2.5	2.6	2.8	2.9	3.0	3.2	3.3	3.4
0.035	2.3	2.6	2.8	3.0	3.1	3.3	3.5	3.6	3.8	3.9	4.1
0.038	2.8	3.0	3.3	3.5	3.7	3.9	4.1	4.3	4.4	4.6	4.8
0.042	3.4	3.7	4.0	4.3	4.5	4.8	5.0	5.2	5.4	5.6	5.8
0.047	4.2	4.6	5.0	5.3	5.7	6.0	6.3	6.5	6.8	7.1	7.3
0.052	5.2	5.7	6.1	6.5	6.9	7.3	7.7	8.0	8.3	8.6	8.9
0.057	6.2	6.8	7.3	7.8	8.3	8.8	9.2	9.6	10.0	10.4	10.7
0.063	7.6	8.3	9.0	9.6	10.2	10.7	11.2	11.7	12.2	12.7	13.1
0.067	8.6	9.4	10.1	10.8	11.5	12.1	12.7	13.3	13.8	14.3	14.8
0.069	9.1	10.0	10.8	11.5	12.2	12.9	13.5	14.1	14.7	15.2	15.7
0.073	10.2	11.1	12.0	12.9	13.6	14.4	15.1	15.8	16.4	17.0	17.6
0.075	10.7	11.8	12.7	13.6	14.4	15.2	15.9	16.6	17.3	18.0	18.6
0.078	11.6	12.7	13.7	14.7	15.6	16.4	17.2	18.0	18.7	19.4	20.1
0.082	12.8	14.1	15.2	16.2	17.2	18.2	19.0	19.9	20.7	21.5	
0.090	15.5	16.9	18.3	19.6	20.7	21.9	22.9				
0.093	16.5	18.1	19.5	20.9	22.2	23.4	24.5				
0.098	18.3	20.1	21.7	23.2	24.6						
0.106	21.5	23.5									
0.110	23.1										

Note: Part numbers for HHTC0 and P4TC nozzles are HHTC0-XXX and P4TC-XXX, where XXX is the orifice size (i.e. HHTC0-018)

TORQUE (in-lb) per nozzle PAIR - 0.22" Offset											
ORIFICE	**PRESSURE (PSI)**										
DIA (in)	**5000**	**6000**	**7000**	**8000**	**9000**	**10000**	**11000**	**12000**	**13000**	**14000**	**15000**
0.018	1.01	1.21	1.42	1.62	1.82	2.02	2.23	2.43	2.63	2.83	3.04
0.020	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75
0.022	1.51	1.81	2.12	2.42	2.72	3.02	3.33	3.63	3.93	4.23	4.54
0.024	1.80	2.16	2.52	2.88	3.24	3.60	3.96	4.32	4.68	5.04	5.40
0.026	2.11	2.53	2.96	3.38	3.80	4.22	4.65	5.07	5.49	5.91	6.34
0.029	2.63	3.15	3.68	4.20	4.73	5.26	5.78	6.31	6.83	7.36	7.88
0.032	3.20	3.84	4.48	5.12	5.76	6.40	7.04	7.68	8.32	8.96	9.60
0.035	3.83	4.59	5.36	6.12	6.89	7.65	8.42	9.19	9.95	10.72	11.48
0.038	4.51	5.41	6.32	7.22	8.12	9.02	9.93	10.83	11.73	12.63	13.54
0.042	5.51	6.61	7.72	8.82	9.92	11.02	12.13	13.23	14.33	15.43	16.53
0.047	6.90	8.28	9.66	11.04	12.42	13.80	15.18	16.56	17.94	19.33	20.71
0.052	8.45	10.14	11.83	13.52	15.21	16.90	18.59	20.28	21.97	23.66	25.35
0.057	10.15	12.18	14.21	16.24	18.27	20.30	22.33	24.36	26.39	28.42	30.45
0.063	12.40	14.88	17.36	19.84	22.32	24.80	27.28	29.76	32.24	34.72	37.20
0.067	14.03	16.83	19.64	22.44	25.25	28.05	30.86	33.66	36.47	39.27	42.08
0.069	14.88	17.85	20.83	23.80	26.78	29.75	32.73	35.70	38.68	41.65	44.63
0.073	16.65	19.98	23.31	26.64	29.97	33.30	36.63	39.96	43.29	46.62	49.95
0.075	17.57	21.09	24.60	28.12	31.63	35.15	38.66	42.18	45.69	49.21	52.72
0.078	19.01	22.81	26.61	30.41	34.22	38.02	41.82	45.62	49.42	53.23	57.03
0.082	21.01	25.21	29.41	33.61	37.82	42.02	46.22	50.42	54.62	58.82	
0.090	25.31	30.37	35.43	40.49	45.55	50.62	55.68				
0.093	27.02	32.43	37.83	43.24	48.64	54.05	59.45				
0.098	30.01	36.01	42.01	48.01	54.01						
0.106	35.11	42.13									
0.110	37.81										

Note: Part numbers for HHTC0 and P4TC nozzles are HHTC0-XXX and P4TC-XXX, where XXX is the orifice size (i.e. HHTC0-018)

TORQUE (in-lb) per nozzle PAIR - 0.44" Offset											
ORIFICE	**PRESSURE (PSI)**										
DIA (in)	**5000**	**6000**	**7000**	**8000**	**9000**	**10000**	**11000**	**12000**	**13000**	**14000**	**15000**
0.018	2.02	2.43	2.83	3.24	3.64	4.05	4.45	4.86	5.26	5.67	6.07
0.020	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50
0.022	3.02	3.63	4.23	4.84	5.44	6.05	6.65	7.26	7.86	8.47	9.07
0.024	3.60	4.32	5.04	5.76	6.48	7.20	7.92	8.64	9.36	10.08	10.80
0.026	4.22	5.07	5.91	6.76	7.60	8.45	9.29	10.14	10.98	11.83	12.67
0.029	5.26	6.31	7.36	8.41	9.46	10.51	11.56	12.61	13.66	14.71	15.77
0.032	6.40	7.68	8.96	10.24	11.52	12.80	14.08	15.36	16.64	17.92	19.20
0.035	7.65	9.19	10.72	12.25	13.78	15.31	16.84	18.37	19.90	21.43	22.96
0.038	9.02	10.83	12.63	14.44	16.24	18.05	19.85	21.66	23.46	25.27	27.07
0.042	11.02	13.23	15.43	17.64	19.84	22.05	24.25	26.46	28.66	30.86	33.07
0.047	13.80	16.56	19.33	22.09	24.85	27.61	30.37	33.13	35.89	38.65	41.41
0.052	16.90	20.28	23.66	27.04	30.41	33.79	37.17	40.55	43.93	47.31	50.69
0.057	20.30	24.36	28.42	32.48	36.54	40.61	44.67	48.73	52.79	56.85	
0.063	24.80	29.76	34.72	39.68	44.64	49.60	54.56	59.52			
0.067	28.05	33.66	39.27	44.88	50.49	56.10					
0.069	29.75	35.70	41.65	47.60	53.55	59.50					
0.073	33.30	39.96	46.62	53.28	59.94						
0.075	35.15	42.18	49.21	56.24							
0.078	38.02	45.62	53.23								
0.082	42.02	50.42	58.82								
0.090	50.62										
0.093	54.05										
0.098	60.01										

Note: Part numbers for HHTC0 and P4TC nozzles are HHTC0-XXX and P4TC-XXX, where XXX is the orifice size (i.e. HHTC0-018)

SPEED ADJ SCREW ANGLE	TURNS	TORQUE (IN-LB)								
		20	25	30	35	40	45	50	55	60
	0	0	0	0	0	0	0	0		
	0.25	11	12	14	16	18	20	22	38	50
	0.50	27	39	46	53	64	89	113	127	142
	0.75	44	69	78	104	132	169	199	216	234
	1.00	59	96	107	137	179	231	283	332	381
	1.25	71	118	135	165	207	272	351	423	495
	1.50	79	136	155	197	244	314	430	546	562
	1.75	84	149	162	207	261	248	464	562	661
	2.00	93	153	163	211	276	372	477	564	652
	2.25	94	153	171	219	289	389	640	950	
	2.50	98	153	175	227	295	397	804		

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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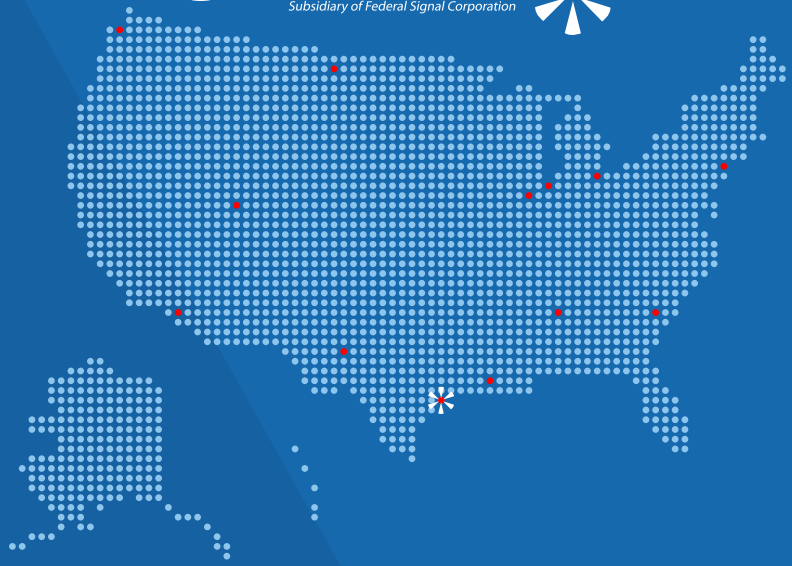

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Application Policy
Capacity ratings, features, and specifications vary depending upon the model and type of service. Application approvals must be obtained from Jetstream; contact your representative for application approval. We reserve the right to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