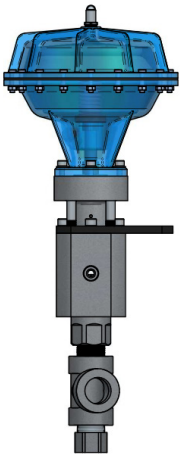
Jetstream®
Subsidiary of Federal Signal Corporation

22K AIR-OPERATED REGULATOR

(PN 67158)

PRODUCT INSTRUCTIONS

PI-199



The 22K Air-Operated Regulator maintains constant system pressure when operating one or more guns or tools in a shut-in system. After supplying it with a source of regulated low-pressure air, it will automatically adjust its bypass flow to maintain a constant system pressure. This system pressure will be maintained even through changes in the operation of the guns or tools, nozzle wear, or changes in engine speed. Once supplied with an initial charge of air, the regulator does not consume any air during operation. Because of this, a very small compressor can be used.

Read these instructions thoroughly before installing, connecting, or using the 22K Air-Operated Regulator. 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 22K Air-Operated Regulator 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

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 28.)

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 22K Air-Operated Regulator maintains constant system pressure when operating one or more guns or tools in a shut-in system. After supplying it with a source of regulated low-pressure air, it will automatically adjust its bypass flow to maintain a constant system pressure. This system pressure will be maintained even through changes in the operation of the guns or tools, nozzle wear, or changes in engine speed. Once supplied with an initial charge of air, the regulator does not consume any air during operation. Because of this, a very small compressor can be used.

Features of the 22K Air-Operated Regulator include:

- High-strength ceramic valve components for long life and low maintenance.
- High flow capacity (up to 60 gpm).
- Outstanding control properties.
- Can be retrofitted to any unit.

Theory of Operation

System pressure places an upward force on the plunger, which makes the valve open. This force is opposed by low-pressure air on the top of the diaphragm in the air chamber. A balance is maintained between these two forces. Any change in these forces causes the plunger to move until a new balance is achieved.

As an example, consider a system with a pump unit and 2 shut-in guns. The system is configured so that while both guns are blasting, the system pressure is 18,000 psi and about 1 gpm is flowing through the dump port on the regulator. When one operator releases the gun trigger, system pressure will begin to rise slightly. This will cause the plunger to open, allowing more water to flow through the dump port. A new balance is achieved with the plunger open farther and system pressure slightly higher, perhaps 18,200 psi. When the operator again squeezes the gun trigger, the plunger closes again and the system returns to 18,000 psi.

In a “perfect regulator,” the system pressure would not change at all from one operating point to another. In a real system, this small error is accepted to ensure system stability.

Product Specifications

Model Name	22K Air-Operated Regulator (PN 67158)
Maximum Operating Pressure (psi)	22,000
Minimum Operating Pressure (psi)	6,000
Maximum Flow (gpm)	60
Maximum Operating Pressure (bar)	1,517
Minimum Operating Pressure (bar)	414
Maximum Flow (l/min)	227
MP Connection Ports	3/4” MP AE Female
Number of MP Ports	2
Diameter (in)	11.9
Height (in)	30.8
Weight (lbs)	80
Diameter (mm)	303
Height (mm)	782
Weight (kg)	36.3

SECTION 3: PREPARATION FOR USE

3.0 Visually inspect the regulator assembly and replace any missing or damaged components before use.

3.1 If the regulator has been used previously and the condition of wear components is unknown, disassemble the regulator to inspect the wear parts, including the valve plunger, valve seat, high pressure seal, and target plug.

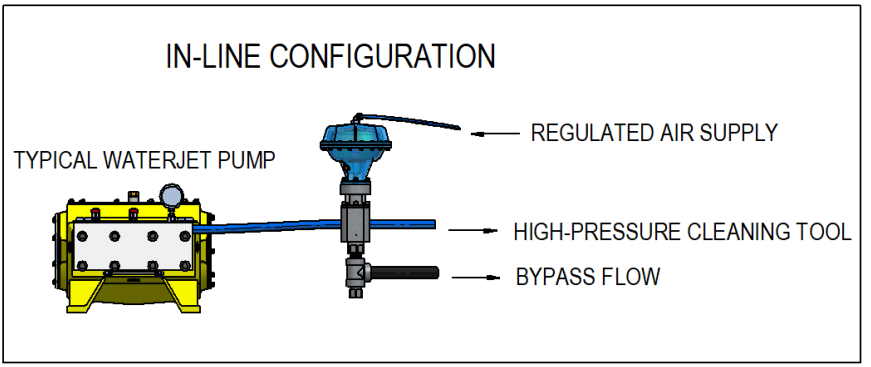
SECTION 4: SETUP

4.0 Connect a regulated air supply to the 3/8” tube push-to-connect fitting at the top of the air diaphragm.

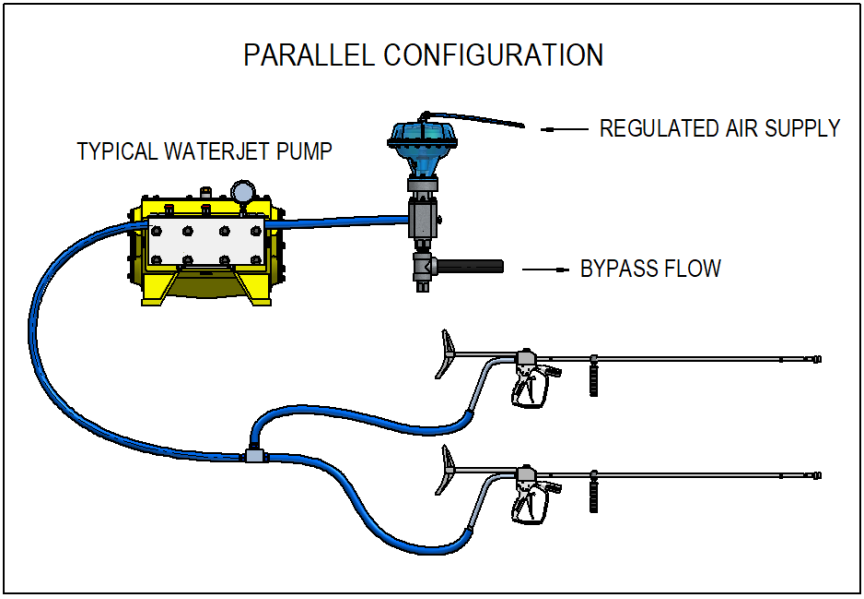
4.1 Mount the regulator by using 3/4” bolts to fasten the mounting bracket to a secure location.

4.2 The regulator may be connected in either of the following configurations:

- In-line: High pressure flow passes through the regulator to a tool.



- Parallel: Regulator is connected to the manifold separately from the tool(s). In this configuration, only one of the high pressure inlet ports on the regulator body needs to be connected. A 3/4” medium pressure plug is used to plug the other medium pressure port.



SECTION 5: OPERATION

5.0 Before initiating flow to a tool, open the air pressure regulator fully counter-clockwise to ensure that no water pressure will build at start up.

⚠WARNING Watch the system pressure gage during this step. Excessive system pressures can be attained if a pressure gage is not observed. Do not operate the regulator at pressures higher than the maximum pressure rating of the lowest rated component in the system.

5.1 Next, slowly increase pump speed while activating all tools (for example, squeezing the triggers of all guns). Slowly adjust air pressure regulator clockwise to increase blast pressure. See Appendix B for expected air pressure settings. Pump flow should be adjusted until at least 1-2 gpm are exiting bypass of the regulator.

> **NOTE:** Regulator will not function properly unless at least 1-2 gpm of water is dumping through the bypass port while all tools are blasting.

SECTION 6: SERVICE

PN 67158

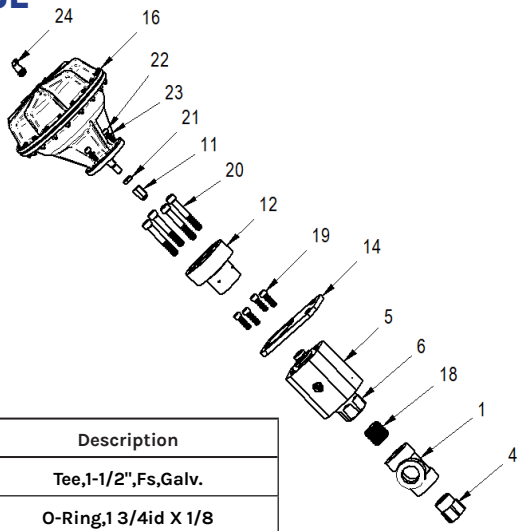


Figure A

Item	Qty	Part Number	Description
1	1	08282	Tee,1-1/2",Fs,Galv.
2	1	25165	O-Ring,1 3/4id X 1/8
3	1	25638	O-Ring,1 1/2id X 1/8
4	1	62413	Plug,High Flow Bypass
5	1	64149	Body,Valve
6	1	64150	Adapter,Outlet
7	1	64153	Guide Bushing
8	1	64154	Seal
9	1	64158	Ring,Seal Support
10	1	65857	Disc,Support
11	1	66957	Tip,Pusher
12	1	66958	Spacer,Regulator
13	1	67143	Plunger,Valve
14	1	67148-008	Bracket,Mounting
15	22	67328	Spring,Disc
16	1	67329	Pressure Cylinder,Diaphragm
17	1	67681	Seat,Cartridge
18	1	67844	Nipple,1-1/2",Close,Sch 80
19	4	68158	Capscrew .5 F X 1.5
20	4	68159	Capscrew M16 X 2 X 100mm
21	1	68160	Nut,M16 X 1.5 X 8mm Hx Jam
22	4	68161	Capscrew M10 X 1.50 X 30mm
23	4	68162	Washer M10 Flat
24	1	68166	Adapter,Push-To-Connect Tube

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

6.0 22K AIR-OPERATED REGULATOR MAINTENANCE

See YouTube for videos showing 22K Air-Operated Regulator.

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

⚠ CAUTION TBD.

6.1 REMOVING VALVE BODY AND WEAR COMPONENTS

1. Separate the air diaphragm assembly (Item 16) from the spacer (Item 12) by removing four M10 socket head cap screws (Item 22).

2. Remove the spacer (Item 12) from the valve body (Item 5) by removing four M16 cap screws (Item 20). The mounting bracket (Item 14) does not need to be removed from the body.

3. Use a wrench to remove the outlet adapter (Item 6) from the body.

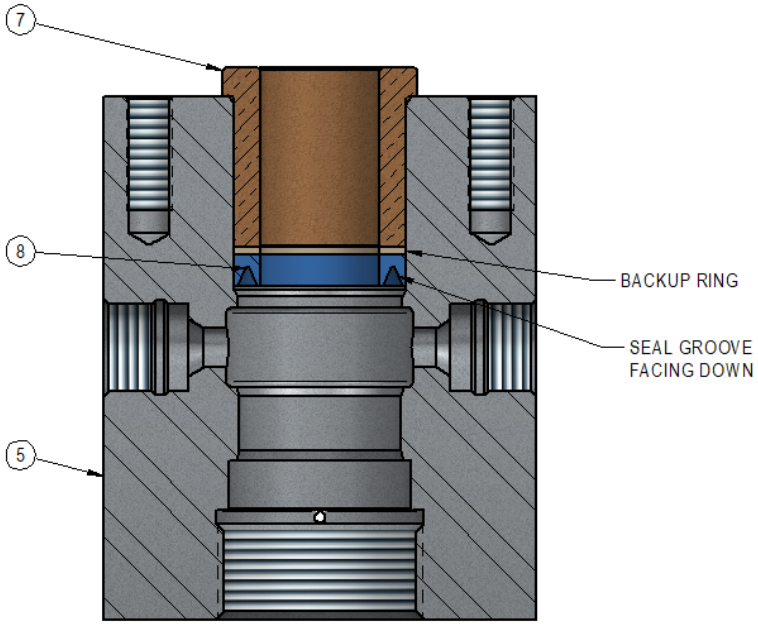
4. Push the plunger (Item 13) toward the outlet side to remove the seat (Item 17) and plunger from the body (Item 5).

5. Press the seal (Item 8) and guide bushing (Item 7) toward the air diaphragm side to remove them from the body. When pressing them out, using a tool made from a soft material such as plastic or wood that will not scratch the body is preferred.

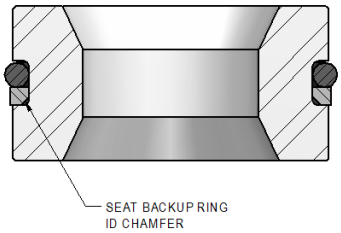
6. Inspect the internal components of the valve and obtain replacement parts for damaged or worn components.

6.2 INSTALLING NEW VALVE WEAR COMPONENTS

1. The high pressure seal (Item 8) is a two-piece seal with a soft plastic grooved seal and a hard plastic backup ring. Use the guide bushing (Item 7) to press the grooved seal and hard backup ring into the valve body (Item 5) as shown. The groove seal is installed first, groove down, followed by the backup ring and guide bushing. If the seal is difficult to push in by hand, the guide bushing may be tapped lightly with a soft mallet until it fully seats against the body.

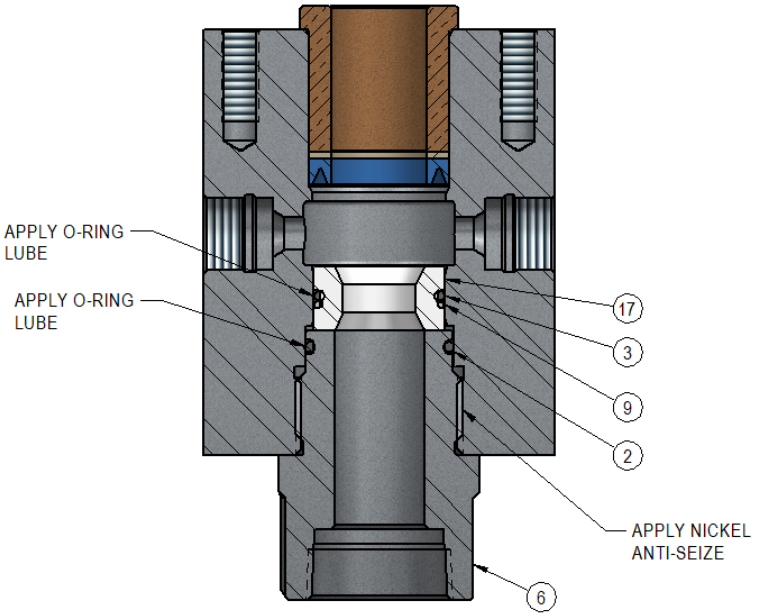


2. Install the o-ring (Item 3) and backup ring (Item 9) onto the seat (Item 17). The ID chamfer on the backup ring should be on the side opposite the o-ring. Apply o-ring lube to the o-ring.

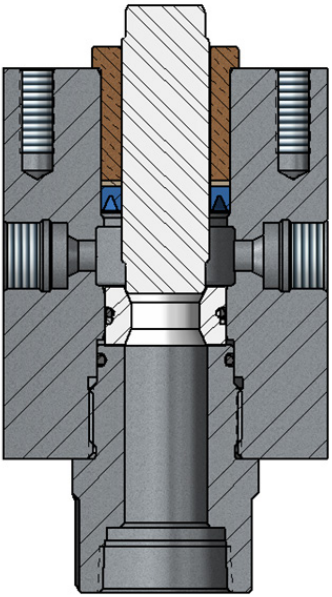


3. Install the seat (Item 17) into the body (Item 5) with the o-ring on the side closest to the center of the body as shown. The seat does not need to be pushed down into its final position in this step, but it should be centered in the body to prepare it to be pushed into position.

4. Install the o-ring (Item 2) onto the outlet adapter (Item 6). Apply o-ring lube to the o-ring and nickel anti-seize compound to the threads of the adapter. Thread the outlet adapter into the body until it makes contact with the seat. Tighten the outlet adapter until it seats onto the body. Tightening the outlet adapter will push the seat into place.



5. Install the valve plunger (Item 13) by pushing it through the guide bushing (Item 7) and seal (Item 8) until it contacts the seat (Item 17).



6.3 REINSTALLING VALVE BODY

1. Install the spacer (Item 12) onto the body (Item 5) using four M16 cap screws (Item 20). Torque to 120 ft-lb.

2. Mount the air diaphragm assembly (Item 16) to the spacer (Item 12) using four M10 flat washers (Item 23) and four M10 cap screws (Item 22). Torque to 40 ft-lb.

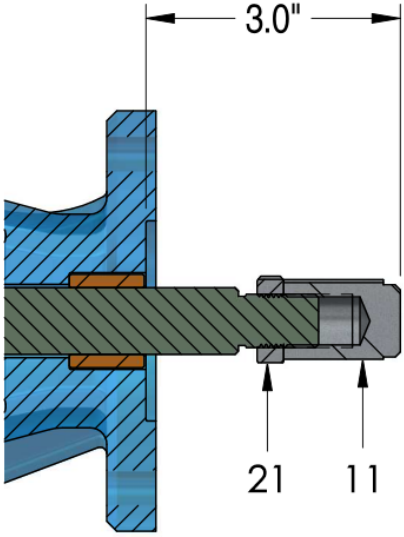
6.4 INSPECTING THE TARGET TEE AND PLUG

1. The target tee (Item 1) and target plug (Item 4) should be visually inspected approximately every week or every 50 hours of operation. Replace these components if cracks, holes, or excessive wear is noted.

6.5 ADJUSTING THE AIR DIAPHRAGM ASSEMBLY PUSHER TIP

1. Install the M16 jam nut (Item 21) and pusher tip (Item 11) onto the diaphragm plunger. Position pusher tip as shown and tighten the jam nut against the pusher tip.

PUSHER TIP POSITION



SECTION 7: TROUBLESHOOTING

Problem	Possible Cause	Remedy
Unable to build pressure and water is leaking from the weep holes in the body (Item 5).	Failed high pressure seal on the ceramic cartridge seat.	Replace the o-ring (Item 3) and backup ring (Item 9) of the ceramic cartridge seat.
Unable to build pressure and water is leaking from the weep holes in the spacer (Item 12) between the air diaphragm and body.	Failed high pressure seal on the air diaphragm side.	Replace the high pressure seal (Item 8).
Poor pressure regulation.	Flow required exceeds pump output.	Check bypass flow with all tools operating. If there is none, increase pump speed until at least 1 gpm is being bypassed with all tools operating.
Air leakage from pressure cylinder.	Loose connections.	Ensure that no pressure cylinder fittings are loose and that the bolts that attach the top half of the chamber are tight enough to form a seal.
	Failed high pressure diaphragm.	Replace air chamber.

APPENDIX A

Section View

PN 67158

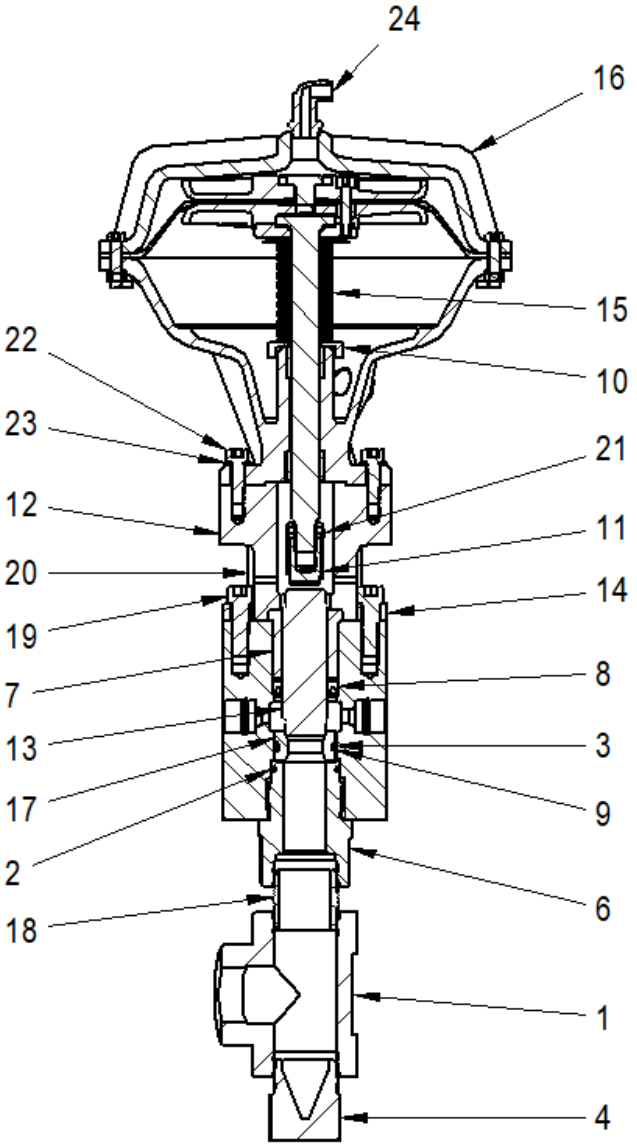


Figure C

Exploded Views

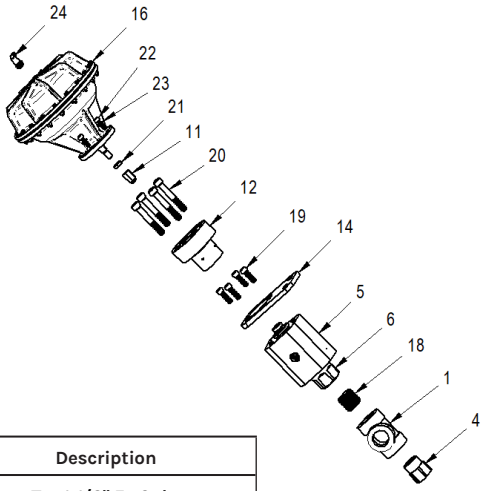


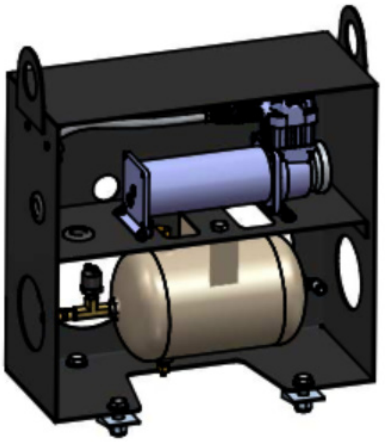
Figure D

Item	Qty	Part Number	Description
1	1	08282	Tee,1-1/2",Fs,Galv.
2	1	25165	O-Ring,1 3/4id X 1/8
3	1	25638	O-Ring,1 1/2id X 1/8
4	1	62413	Plug,High Flow Bypass
5	1	64149	Body,Valve
6	1	64150	Adapter,Outlet
7	1	64153	Guide Bushing
8	1	64154	Seal
9	1	64158	Ring,Seal Support
10	1	65857	Disc,Support
11	1	66957	Tip,Pusher
12	1	66958	Spacer,Regulator
13	1	67143	Plunger,Valve
14	1	67148-008	Bracket,Mounting
15	22	67328	Spring,Disc
16	1	67329	Pressure Cylinder,Diaphragm
17	1	67681	Seat,Cartridge
18	1	67844	Nipple,1-1/2",Close,Sch 80
19	4	68158	Capscrew .5 F X 1.5
20	4	68159	Capscrew M16 X 2 X 100mm
21	1	68160	Nut,M16 X 1.5 X 8mm Hx Jam
22	4	68161	Capscrew M10 X 1.50 X 30mm
23	4	68162	Washer M10 Flat
24	1	68166	Adapter,Push-To-Connect Tube

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

Accessories

Air Compressor Packages (150 psi, 1.8 cfm)



Part Number	Description
63285	12V Air Compressor
66317	24V Air Compressor
63284	Regulator/Gauge Panel

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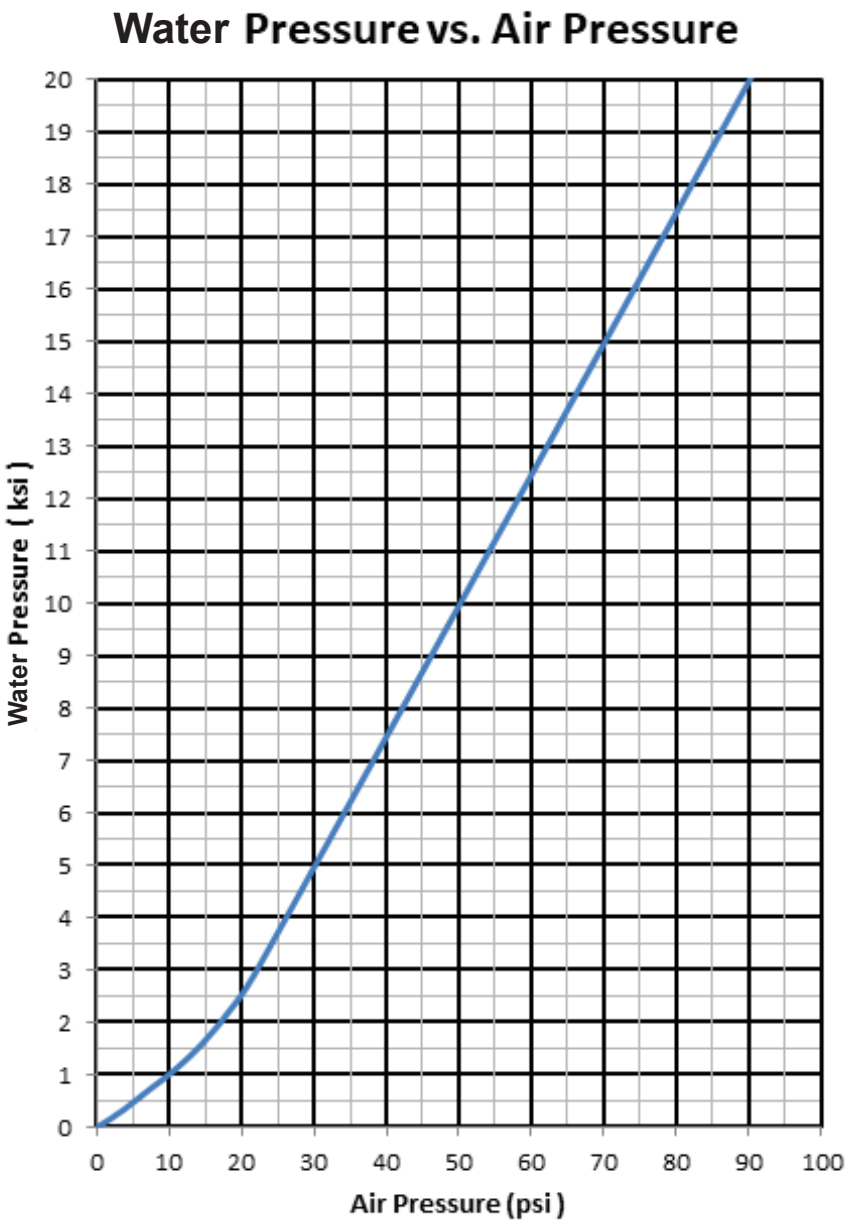
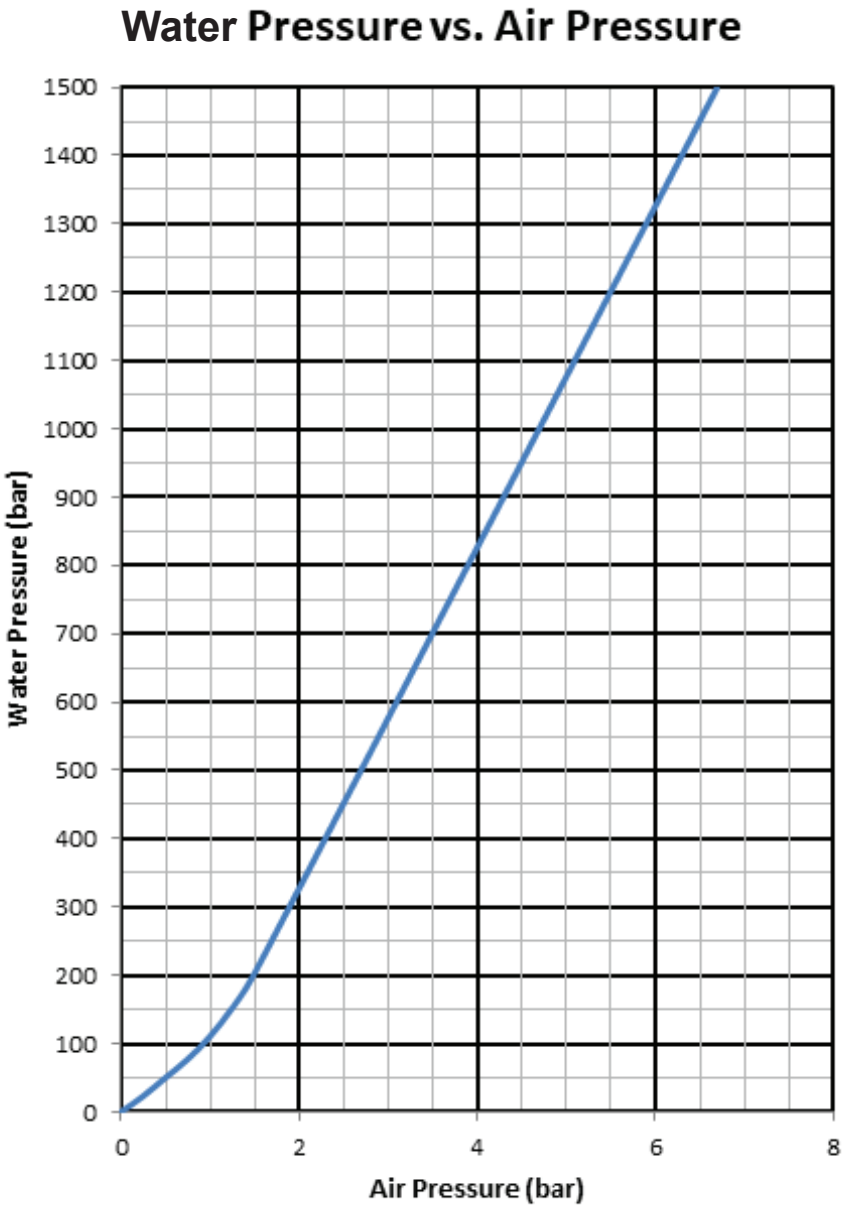
APPENDIX B

Operating Charts




Water Pressure vs. Air Pressure
Water Pressure (bar)
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
2
4
6
8
Air Pressure (bar)

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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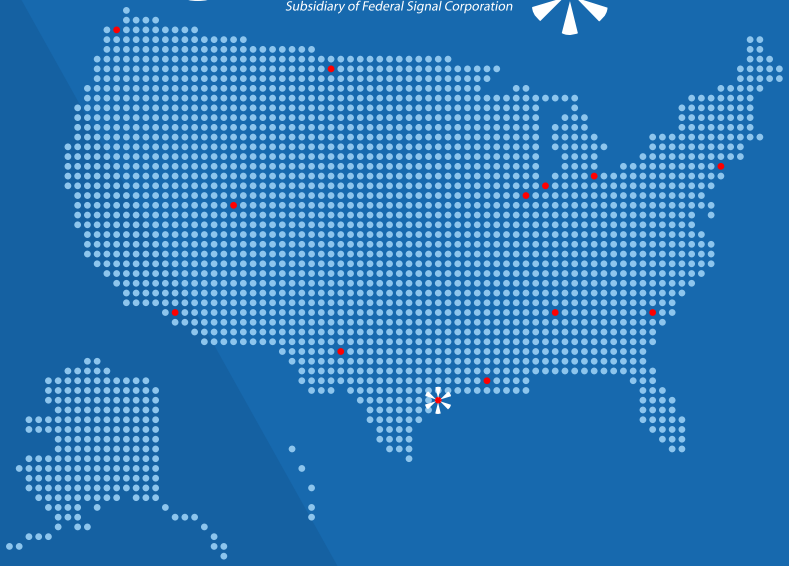

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Capacity ratings, features, and specifications vary depending upon the model and type of service. Application approvals must be obtained from Jetstream; contact your representative for application approval. We reserve the right to change or modify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