

GritWizard™
PNEUMATICALLY OPERATED
ABRASIVE METERING VALVE
O. M. 31199

DATE OF ISSUE: 08/22
REVISION:

! WARNING

Do not use this equipment before READING this MANUAL and UNDERSTANDING its contents.

These WARNINGS are included for the health and safety of the operator and those in the immediate vicinity. Failure to read and understand these warnings can result in injury or death.

Electronic files include a preface containing the same important information as in the orange cover.

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WARNING

- Employers are responsible for identifying all job site hazards, educating and training all persons who will operate and maintain these products, and ensuring that all blast operators and their assistants understand the warnings and information contained in these instructions relating to safe and proper operation and maintenance of this equipment.
- Serious injury or death can result from failure to comply with all Occupational Safety and Health Administration (OSHA) regulations and all manufacturer's instructions.
- This equipment is not intended for use in any area considered hazardous per National Electric Code NFPA 70 2011, Article 500.
- Read this document and follow all instructions before using this equipment.

OSHA regulations relating to abrasive blasting are contained in the Code of Federal Regulations, Title 29 (29 CFR 1910 General Industry; 1915 Maritime; 1926 Construction). The most pertinent include: 1910.94 Ventilation, 1910.95 Occupational Noise Exposure, 1910.132 Personal Protective Equipment, 1910.133 Eye and Face Protection, 1910.134 Respiratory Protection, 1910.135 Head Protection, 1910.244 (b) Remote Controls. Consult www.osha.gov for complete information.

NOTICE TO PURCHASERS AND USERS OF OUR PRODUCTS AND THIS INFORMATIONAL MATERIAL

Clemco proudly provides products for the abrasive blast industry and is confident that industry professionals will use their knowledge and expertise for the safe and efficient use of these products.

The products described in this material, and the information relating to these products, are intended for knowledgeable, experienced users.

No representation is intended or made as to: the suitability of the products described here for any purpose or application, or to the efficiency, production rate, or useful life of these products. All estimates regarding production rates or finishes are the responsibility of the user and must be derived solely from the user's experience and expertise, not from information contained in this material.

It is possible that the products described in this material may be combined with other products by the user for purposes determined solely by the user. No representations are intended or made as to the suitability of or engineering balance of or compliance with regulations or standard practice of any such combination of products or components the user may employ.

Abrasive blast equipment is only one component of an abrasive blasting job. Other products, such as air compressors, air filters and receivers, abrasives, scaffolding, hydraulic work platforms or booms, equipment for lighting, painting, ventilating, dehumidifying, parts handling, or specialized respirators or other equipment, even if offered by Clemco, may have been manufactured or supplied by others. The information Clemco provides is intended to support the products Clemco manufactures. Users must contact each manufacturer and supplier of products used in the blast job for warnings, information, training, and instruction relating to the proper and safe use of their equipment.

GENERAL INSTRUCTIONS

This material describes some, but not all, of the major requirements for safe and productive use of blast machines, remote controls, respirator systems, and related accessories. All equipment and accessories must be installed, tested, operated and maintained only by trained, knowledgeable, experienced users.

The blast operator and all workers in the vicinity must be properly protected from all job site hazards including those hazards generated by blasting.

Work environments involving abrasive blasting present numerous hazards. Hazards relate to the blast process from many sources that include, but are not limited to, dust generated by blasting or from material present on the surface being blasted. The hazards from toxic materials may include, but are not limited to, silica, cyanide, arsenic, or other toxins in the abrasives or in the coatings, such as lead or heavy metals. Other hazards from toxins include, but are not limited to, fumes from coating application, carbon monoxide from engine exhaust, contaminated water, chemicals or asbestos. In addition, physical hazards that may be present include, but are not limited to, uneven work surfaces, poor visibility, excessive noise, and electricity. Employers must identify all job site hazards and protect workers in accordance with OSHA regulations.

Never modify Clemco equipment or components or substitute parts from other manufacturers for any Clemco components or parts. Any unauthorized modification or substitution of supplied-air respirator parts violates OSHA regulations and voids the NIOSH approval.

IMPORTANT

Contact Clemco for free booklets:

Blast Off 2 – Guide to Safe, Productive, and Efficient Abrasive Blasting, and Abrasive Blasting Safety Practices – Guide to Safe Abrasive Blasting.

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OPERATIONAL INSTRUCTIONS

OPERATOR SAFETY EQUIPMENT

WARNING

- OSHA regulation 1910.134 requires appropriate respiratory protection for blast operators and workers in the vicinity of blasting. These workers must wear properly-fitted, properly-maintained, NIOSH-approved, respiratory protection that is suitable for the job site hazards. Blast respirators are to be worn only in atmospheres not immediately dangerous to life or health from which wearers can escape without use of the respirator.
- The employer must develop and implement a written respiratory protection program with required worksite- specific procedures and elements for required respirator use. The employer must provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually, and more often if necessary.
- NEVER use abrasives containing more than one percent crystalline silica. Fatal diseases, such as silicosis, asbestosis, lead or other poisoning, can result from inhalation of toxic dusts, which include, but are not limited to, crystalline silica, asbestos, and lead paint. Refer to NIOSH Alert 92-102; and OSHA CPL 03-00-007: “National Emphasis Program – Crystalline Silica”, in which OSHA describes policies and procedures for implementing a national emphasis program to identify and reduce or eliminate health hazards from exposure to crystalline silica. Numerous topics associated with the hazards of crystalline silica in silica blasting sand can be found on [http:// osha.gov/](http://osha.gov/). Clemco urges users of silica blasting sand to visit this website, and read and heed the information it contains.
- Always make sure the breathing air supply (respirator hose) is not connected to plant lines that supply gases that include, but are not limited to, oxygen, nitrogen, acetylene, or other non-breathable gas. Never modify or change respirator air line connections without first testing the content of the line for safe breathing air. Failure to test the line may result in death to the respirator user.

- Breathing air quality must be at least Grade D, as defined by the Compressed Gas Association specification G-7.1, per OSHA Regulation 29 CFR 1910.134. When compressed air is the breathing air source, a Clemco CPF (suitable sorbent bed filter) should be used. Respirator hose connecting the respirator to the filter must be NIOSH approved. Non- approved hose can cause illness from chemicals employed to manufacture the hose.

- All workers must always wear NIOSH-approved respirators when any dust is present. Exposure to dust can occur when handling or loading abrasive, blasting, cleaning up abrasive, or working in the vicinity of blasting. Before removing the respirator, test the air with a monitoring device to ensure it is safe to breathe.

- Clemco respirators DO NOT remove or protect against carbon monoxide or any other toxic gas. Monitoring devices must be used in conjunction with the respirator to ensure safe breathing air. Always locate compressors and ambient air pumps where contaminated air will not enter the air intake.

- Always use Clemco lenses with Clemco respirators; installing non-approved lenses voids the NIOSH approval. Respirator lenses are designed to protect the wearer from rebounding abrasive; they do not protect against flying objects, heavy high-speed materials, glare, liquids, or radiation.

INDUSTRY ORGANIZATIONS

For additional information, consult:

Occupational Safety and Health Administration (OSHA) - www.osha.gov

Compressed Gas Association (CGA) - www.cganet.com

The Society for Protective Coatings (SSPC) - www.sspc.org

National Association of Corrosion Engineers (NACE) - www.nace.org

American Society for Testing and Materials (ASTM) - www.astm.org

National Institute of Occupational Safety and Health (NIOSH) - www.niosh.gov

American National Standards Institute (ANSI) - www.ansi.org

PREFACE

BLAST MACHINES AND REMOTE CONTROLS

⚠ WARNING

OSHA regulation 1910.169 describes the necessity of pressure relief valves on compressed air equipment. Do not operate blast machines with air compressors that are not equipped with properly functioning pressure relief valves.

OSHA regulation 1910.244(b) requires the use of remote controls on blast machines.

Serious injury or death can result from many sources, among them:

- Involuntary activation of the remote controls. Never modify or substitute remote control parts; parts are not compatible among different manufacturers. Welding hose is not suitable for remote control hose. Its ID and material composition make it unsafe for remote control use.
- Exceeding the maximum working pressure. Clemco blast machines are built to ASME-code and carry a 'U' or 'UM' stamp, and National Board/serial number. Every machine is marked with its maximum working pressure. Never exceed the maximum working pressure limits of the blast machine.
- Uncontrolled blast stream. High-velocity abrasive particles will inflict serious injury. Always point the blast nozzle in the direction of the blast surface only. Keep unprotected workers out of the blast area.
- Welding on the blast machine. Never weld on the blast machine; welding voids the National Board approval and may affect the dimensional integrity of the vessel.
- Moving the blast machine. Never manually move a blast machine containing abrasive, any machine containing abrasive must be moved with appropriate mechanical lifting equipment.

HOSES, COUPLINGS, AND NOZZLE HOLDERS

- The inside diameter (ID) of air hoses, fittings, and connections should be at least four times larger than the nozzle orifice size. Blast hose ID should be three to four times the size of the nozzle orifice. Example: a #6 nozzle (3/8" diameter orifice) calls for 1-1/2" ID blast hose and 1-1/2" ID or larger compressor hose. All hose runs should be kept as short as possible and run in as straight a line as possible to reduce pressure loss.
- To install, squarely cut the end of the hose so that it fits snugly against the coupling or hose end shoulder. Always use the screws recommended by the manufacturer ensuring that they do not penetrate the inner wall. Make sure the couplings tightly fit the hose. Install cotter pins at every connection or use couplings with built-in lock-springs to prevent disengagement. Install safety cables at all connections to prevent whipping if hoses disengage or blow out.

MAINTENANCE AND REPAIR

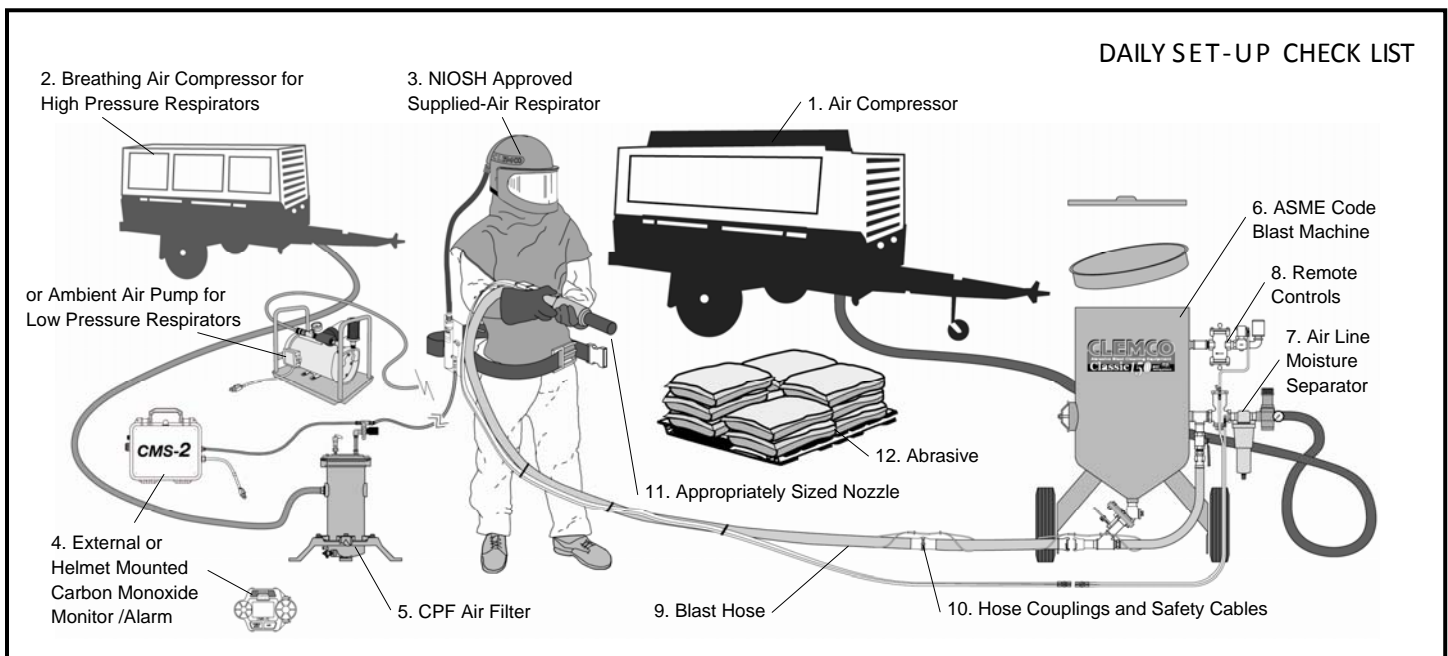
- Completely read and follow all service instructions and recommended maintenance intervals. Always shut off compressor and depressurize blast machine before performing any maintenance. At every service interval, clean all filters, screens, and alarm systems. If spring-loaded abrasive valves are used, always cage spring before disassembly.

WARRANTY

The following is in lieu of all warranties, express, implied or statutory, and in no event shall seller or its agents, successors, nominees or assignees, or either, be liable for special or consequential damage arising out of a breach of warranty. This warranty does not apply to any damage or defect resulting from negligent or improper assembly or use of any item by the buyer or its agent or from alteration or attempted repair by any person other than an authorized agent of seller. All used, repaired, modified, or altered items are purchased "as is" and with all faults. In no event shall seller be liable for consequential or incidental damages. The sole and exclusive remedy of buyer for breach of warranty by seller shall be repair or replacement of defective parts or, at seller's option, refund of purchase price, as set forth below

1. Seller makes no warranty with respect to products used other than in accordance hereunder.
 2. On products seller manufactures, seller warrants that all products are to be free from defects in workmanship and materials for a period of one year from date of shipment to buyer, but no warranty is made that the products are fit for a particular purpose.
 3. On products which seller buys and resells pursuant to this order, seller warrants that the products shall carry the then standard warranties of the manufacturers thereof, a copy of which shall be made available to the customer upon request.
 4. The use of any sample or model in connection with this order is for illustrative purposes only and is not to be construed as a warranty that the product will conform to the sample or model.
 5. Seller makes no warranty that the products are delivered free of the rightful claim of any third party by way of patent infringement or the like.
 6. This warranty is conditioned upon seller's receipt within ten (10) days after buyer's discovery of a defect, of a written notice stating in what specific material respects the product failed to meet this warranty. If such notice is timely given, seller will, at its option, either modify the product or part to correct the defect, replace the product or part with complying products or parts, or refund the amount paid for the defective product, any one of which will constitute the sole liability of the seller and a full settlement of all claims. No allowance will be made for alterations or repairs made by other than those authorized by seller without prior written consent of seller. Buyer shall afford seller prompt and reasonable opportunity to inspect the products for which any claim is made as above stated.
- Except as expressly set forth above, all warranties, express, implied or statutory, including implied warranty of merchantability, are hereby disclaimed.

PREFACE



DAILY SET-UP CHECK LIST

Make sure all blast operators are properly trained and suitably attired with a blast suit, safety boots, leather gloves, respiratory and hearing protection. Every day before start up, check all equipment components, including piping, fittings, and hoses, and valves, for leaks, tightness, and wear. Repair or replace as needed. Use the following checklist.

- 1. PROPERLY-MAINTAINED AIR COMPRESSOR** sized to provide sufficient volume (cfm) at given pressure for nozzle and other tools. ADD 50% volume (cfm) reserve to allow for nozzle wear. Use large compressor outlet and air hose (at least 4 times the nozzle orifice diameter). For oil-lubricated compressors, the employer shall use a high- temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm. Follow the manufacturer's checklist and maintenance instructions.
- 2. BREATHING-AIR COMPRESSOR** (or oil-less ambient air pump) capable of providing Grade D quality air, located in a dust free area. Read # 1 above.
- 3. CLEAN, PROPERLY-MAINTAINED NIOSH-APPROVED SUPPLIED-AIR RESPIRATOR** worn by blast operators, and other workers exposed to blast dust. Make sure all respirator components are in place — all lenses, inner collar, and cape. Thoroughly inspect all components for wear. The NIOSH approval (approval number is listed in the owner's manual) is for a complete assembly from point of attachment on the CPF (sorbent bed) filter to the complete respirator. Substitution of any part voids the NIOSH approval.
- 4. CARBON MONOXIDE MONITOR/ALARM** installed at the CPF filter or inside the supplied-air respirator for monitoring for the presence of deadly CO gas and warning the operator(s) when the CO level reaches an unacceptable level. When an ambient air pump is used for breathing air, a CO monitor provides a measure of safety. Read # 1 above.
- 5. BREATHING-AIR FILTER (OSHA-REQUIRED sorbent bed filter)** for removal of moisture and particulate matter in the compressed air breathing-air supply. Monitor the condition of the cartridge and replace when odor is detected or at 3 month intervals, whichever comes sooner. The breathing air filter does NOT detect or remove carbon monoxide (CO). Always install a CO monitor/alarm.
- 6. BLAST MACHINE** (bearing U or UM stamp, National Board Number, and Maximum Working Pressure) sized to hold a 30-minute abrasive supply. Examine pop-up valve for alignment. Check piping, fittings, screens, valves for tightness, leaks, and wear. Always ground the machine to eliminate hazard of static shock. Install a blast machine screen to keep out foreign objects. Use a blast machine cover if left outdoors overnight. Never exceed the maximum working pressure of the vessel.
- 7. AIR LINE FILTER** (moisture separator) installed as close as possible to the blast machine inlet and sized to match the size of the inlet piping or larger air supply line. Clean filter and drain often. Damp abrasive causes operational problems.
- 8. REMOTE CONTROLS** are required by OSHA and must be in perfect operating condition. Test and check all components to ensure all parts are present and fully functional. Use genuine replacement parts. NEVER mix parts from different manufacturers. Never use welding hose for remote control hose.
- 9. BLAST HOSE** should have an inside diameter sized to suit the blast nozzle. The ID should be three to four times the size of the nozzle orifice diameter. Blast hose should be arranged in as straight a line as possible from the blast machine to the work area, avoiding sharp bends.
- 10. COUPLINGS AND NOZZLE HOLDERS** should fit snugly on the hose and be installed with manufacturer recommended screws. Coupling lugs must snap firmly into locking position. Gasket must always be used to form a positive seal, and cotter pins must be installed. Replace gasket when wear, softness or distortion is detected. Check nozzle holder for thread wear; replace at any sign of wear. Install safety cables at all connections.
- 11. NOZZLE** orifice size should be checked and nozzle replaced when worn 1/16" from original size. (No. 5 nozzle has 5/16" orifice diameter; replace when it measures 3/8"). Threads should be inspected daily for wear and nozzle should be replaced when wear is detected. Always use a nozzle washer.
- 12. ABRASIVE** must be a material specifically manufactured for blasting. It should be properly sized for the job. Check material safety data sheet for free-silica, cyanide, arsenic, lead and other toxins and avoid use when these toxic, harmful substances are present.
- SURFACE TO BE BLASTED** should be examined for hazardous substances. Take appropriate protective measures as required by OSHA to ensure the blast operator, other workers in the vicinity, and any bystanders are properly protected.

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1.0 INTRODUCTION

1.1 Scope of Manual

1.1.1 These instructions cover the setup, operation, maintenance, and replacement parts for Clemco's GritWizard™ (GW) Pneumatically Operated Abrasive Metering Valves.

1.1.2 This manual contains important safety information. All operators and personnel involved with the abrasive blasting process must read and understand the contents of these instructions, including the orange cover. It is equally important that the operator is trained and qualified to safely operate the blast machine, remote controls, and all other equipment used with the blast machine.

1.1.3 All personnel involved with the abrasive blasting process must be made aware of the hazards associated with abrasive blasting. The Clemco booklet "Abrasive Blasting Safety Practices" is included with every blast machine; the booklet contains important safety information about abrasive blasting that may not be included in equipment operations manuals. To request additional copies, email info@clemcoindustries.com.

1.2 Safety Alerts

1.2.1 Clemco uses safety-alert signal words, based on ANSI Z535.4-2011, to alert the user of a potentially hazardous situation that may be encountered while operating this equipment. ANSI's definitions of the signal words are as follows:



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

NOTICE

Notice indicates information that is considered important, but not hazard-related, if not avoided, could result in property damage.

⚠ CAUTION

Caution indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

⚠ WARNING

Warning indicates a hazardous situation that, if not avoided, could result in death or serious injury.

⚠ DANGER

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

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1.4 Pressure Specifications

- Pressure to fully open the valve 80 psi
- Maximum working pressure 175 psi

1.5 Components and Operating Principles

1.5.1 Main components of the metering valve assembly are shown in Figure 1 and include the metering valve and a 1-1/2" nipple to connect the valve to the blast machine. There are two valve options as noted below:

- Metering valve with a flanged (shutoff) ball valve.
- Metering valve without the flanged ball valve and includes a flanged inlet nipple.

Retrofit valves (when the GritWizard Valve replaces another type of valve) include hose, tubing, and fittings to convert the control plumbing.

1.5.2 Operating Principles

The GritWizard is a normally closed, pneumatically operated, abrasive metering valve. When the valve is idle (the control handle is up), air assisted spring pressure keeps the valve closed. When control air is applied (the control handle is pressed), the air-assist vents and control-air pressure overcomes the spring pressure and opens the valve to a specific point set by turning the metering knob. When the control handle is released, control pressure vents and spring pressure closes the valve, stopping abrasive flow.

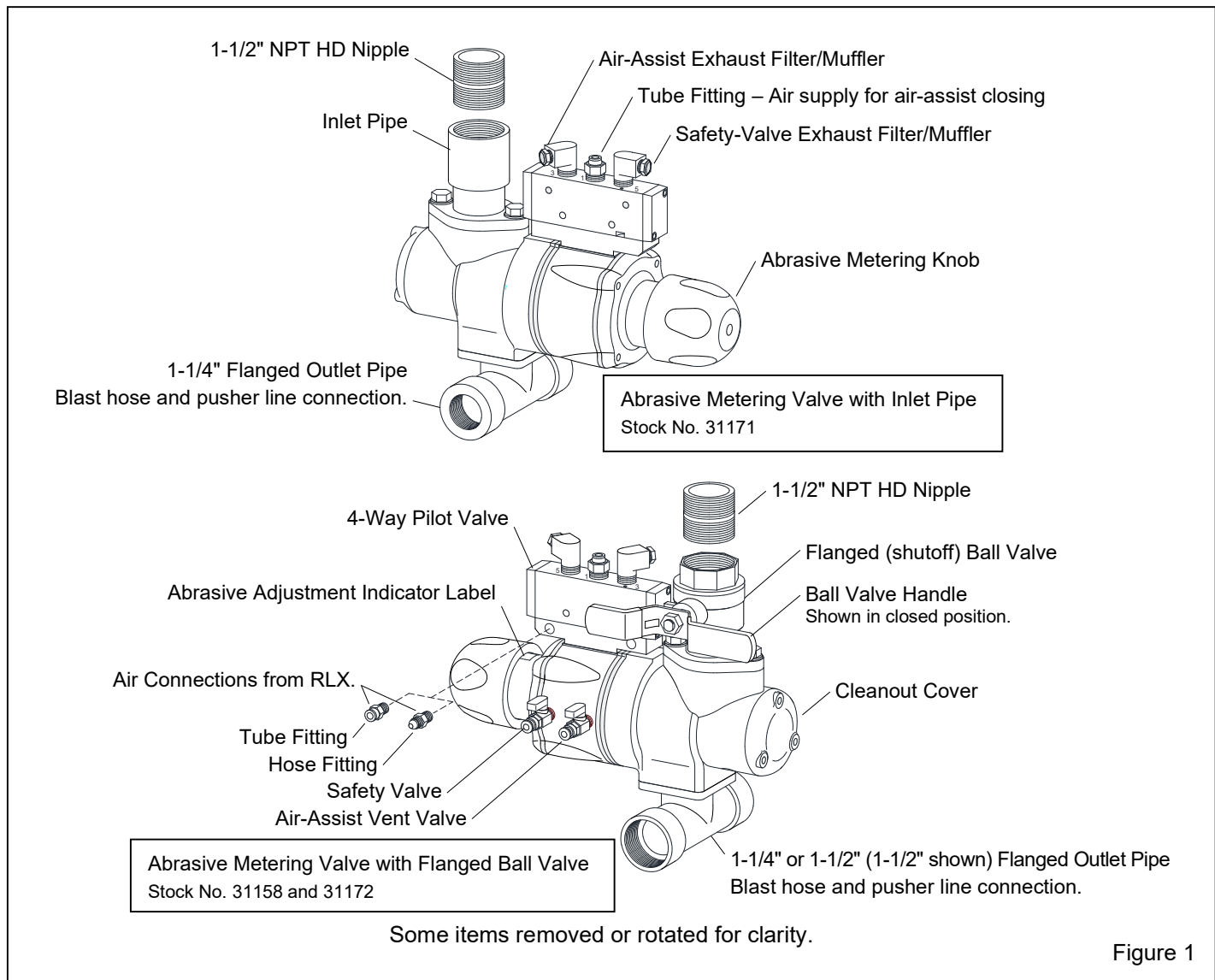


Figure 1

1.6 Abrasives

⚠ WARNING

Abrasives and dust from blasting may contain toxic materials (e.g., lead paint, silica) that are hazardous to workers. Before blasting, obtain a safety data sheet (SDS) for the blast abrasive and identify all substances removed by the blasting process:

- **Silica sand (crystalline) can cause silicosis, lung cancer, and breathing problems in exposed workers.**
- **Slags can contain trace amounts of toxic metals such as arsenic, beryllium, and cadmium and have the potential to cause lung disease.**

NO DUST IS SAFE TO BREATHE. DUST PRODUCED FROM ANY ABRASIVE OR FROM THE BLASTING PROCESS CAN CAUSE SERIOUS LUNG DISEASE AND DEATH WHEN INHALED. It is the employer's responsibility to train employees to identify hazardous substances and to provide suitable policies, procedures, monitoring, recordkeeping, and personal protective equipment.

NOTICE

Use only abrasives specifically manufactured for blasting that are compatible with the surface being blasted. Abrasives produced for other applications may be inconsistent in size and shape and produce an unsatisfactory finish, contain particles that can jam the abrasive metering valve, or cause irregular wear.

1.6.1 Selection of blasting abrasive can play a significant part in worker health risk, job productivity, and maintenance of the blast machine. DO NOT USE abrasives containing more than 1% crystalline (free) silica. Obtain safety data sheets (SDS) for the blasting abrasive prior to blasting, paying particular attention to worker health risks and presence of any hazardous/toxic substances.

1.6.2. Abrasive size: The GritWizard™ is designed to be used with most common abrasives ranging in sizes from 16-mesh to 220-mesh. However, the blast

machine or accessories may limit the size and type of abrasive to something between the coarse and fine limitations of the valve. The choice of abrasive size depends on the desired profile, cleaning rate, nozzle size, and availability of clean dry air. Generally, larger and denser abrasive provide a deeper profile, while smaller abrasives clean faster. Most abrasive blasting is done with abrasive sizes between 16-and 80-mesh. Abrasive for cabinet use is generally between 50-mesh and 180-mesh. Coarse mesh sizes may be used if the nozzle orifice is large enough to prevent multiple particles to pass without jamming. Finer abrasive requires clean dry air to prevent bridging in the blast machine or metering valve.

1.6.3 Sand: Sand should never be used because of the respiratory hazards associated with abrasive containing free silica.

1.6.4 Slags: Slag abrasives are compatible with the valve. Obtain a safety data sheets (SDS) to identify hazardous substances.

1.6.5 Steel: Steel shot and steel grit may be used but attention must be given to moisture in the compressed air, the recovery process, and weight of the abrasive. Steel abrasive rusts under humid conditions, especially with day and night temperature changes, or when compressed air supplied to the vessel is damp with condensation. Steel abrasives weigh approximate 250 lbs per cuft. Steel abrasives are normally used in blast rooms with recovery systems and protected from the elements.

1.6.6 Silicon carbide, aluminum oxide, and garnet: These are the most aggressive of the commonly used abrasives. Although aggressive abrasives such as these may be used, the service life of any equipment components which come in contact with these abrasive will be reduced. To avoid unscheduled downtime, periodically inspect the metering valve, hoses, and nozzles for abrasive wear. Use nozzles lined with boron carbide with aggressive abrasives.

1.6.7 Glass bead and crushed glass: are compatible with the GritWizard Metering Valve.

1.6.8 Lightweight Abrasive: Plastic media and agricultural media are compatible with the GritWizard Valve, but generally require a blast machine with 60 degree conical bottom for continuous, uninterrupted media flow.

2.0 INSTALLATION

2.1 Remove Existing Metering Valve from Blast Machine

2.1.1 Empty the blast machine of abrasive and depressurize the machine.

⚠ WARNING

Failure to observe the following before performing any maintenance on the blast machine could cause serious injury or death from the sudden release of trapped compressed air:

- Depressurize the blast machine.
- Bleed the compressed-air supply line to the blast machine.
- Lockout (be certain the air supply is off and that it cannot be started while work is in process) and tagout (make sure the air supply is clearly marked to prevent re-starting while work is in process) the compressed-air supply.

2.1.2 Shut down the compressed-air source, lockout and tagout the air supply, and drain the air-supply line.

2.1.3 Before removing the existing metering valve, refer to Figure 2 to determine the ground clearance required for each of the valve options. Besides the height of the GritWizard Valve, an additional 1-3/4" is needed to allow for the installation nipple and blast hose coupling. Measure the distance from the bottom of the blast machine to ground level to make sure the blast machine has the clearance to accommodate the valve.

NOTE: A 1-1/2" x 1-1/4" bushing may be required on the blast machine, depending on the vintage of the machine. The bushing increases the clearance to needed to install the valve.

2.1.4 Make a note of the connections on the existing metering valve because connections shown in the illustrations can differ based on remote control options. Remove control hose(s). If the type of control connections are different from those supplied with the GritWizard Valve, save the connections and hoses from the existing valve for reuse.

2.1.5 Remove all blast machine piping (pusher line adaptors, and blast hose fittings) from the metering valve. Save them as some will be reused.

2.1.6 Remove the existing metering valve from the blast machine.

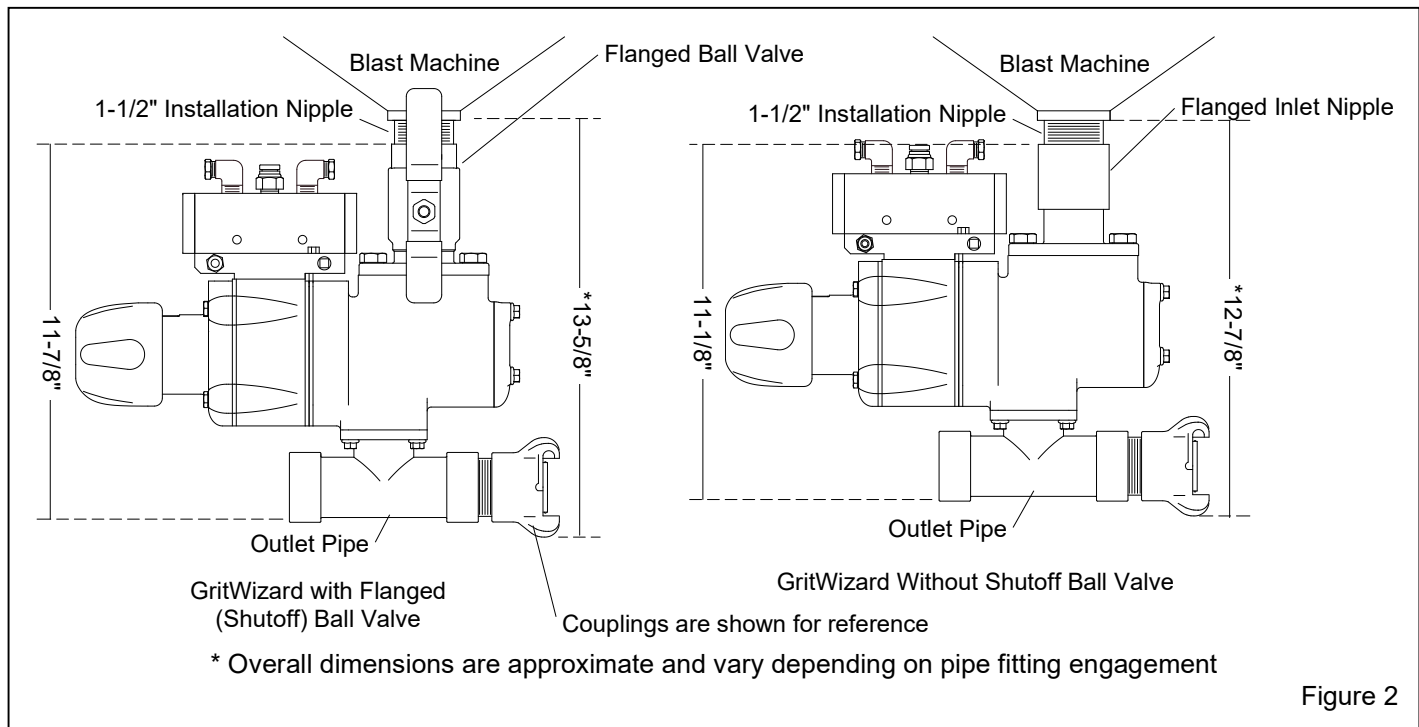


Figure 2

2.2 Install the GritWizard™ Valve onto the Blast Machine – Figure 3

Installation Notes:

Tighten and align the valve by using a wrench on the flanged inlet nipple or ball valve only, as shown in Figure 3. Avoid applying pressure on the valve body or outlet pipe (lower flange) to tighten or align the valve. Doing so could damage the upper or lower flanges.

NOTICE

Avoid tightening the valve to the blast machine or aligning the valve by using a wrench or applying leverage on any part of the valve at or below the upper flange. Doing so could damage the flanges.

To ensure airtight seals and make assembly easier, apply pipe-thread sealant to all male pipe threads.

Additional fittings may be required to connect the valve to some blast machines and piping configurations.

The GritWizard Valve is nondirectional; air flow can enter through either end of the outlet pipe, and the pipe can be rotated 90 degrees in either direction.

Note: The illustrations show the installation onto a portable blast machine. Installation on a bulk blast machine is slightly different but the process is the same.

2.2.1 The upper flange (inlet pipe or flanged ball valve, depending on the option ordered), 1-1/2" NPT close nipple, O-ring, and two flange bolts are packaged separately in a plastic bag. The upper flange will be installed onto the blast machine before attaching the valve section.

2.2.2 Apply thread sealant to both ends of the 1-1/2" NPT installation nipple and use the nipple to attach the upper flange to the machine as, shown in Figure 3.

2.2.3 Use a pipe wrench or strap wrench to grip the valve body or body of the inlet nipple to tighten it onto the blast machine. Do not use a wrench on or below the flanges, as noted in Figure 3. Doing so could damage the flanges.

2.2.4 The valve body may be rotated 90 degrees in either direction. Rotate the body to the inlet flange, as needed to provide the best access to the metering knob, and cleanout cover. Make sure the O-ring is in place before bolting the body onto the inlet flange.

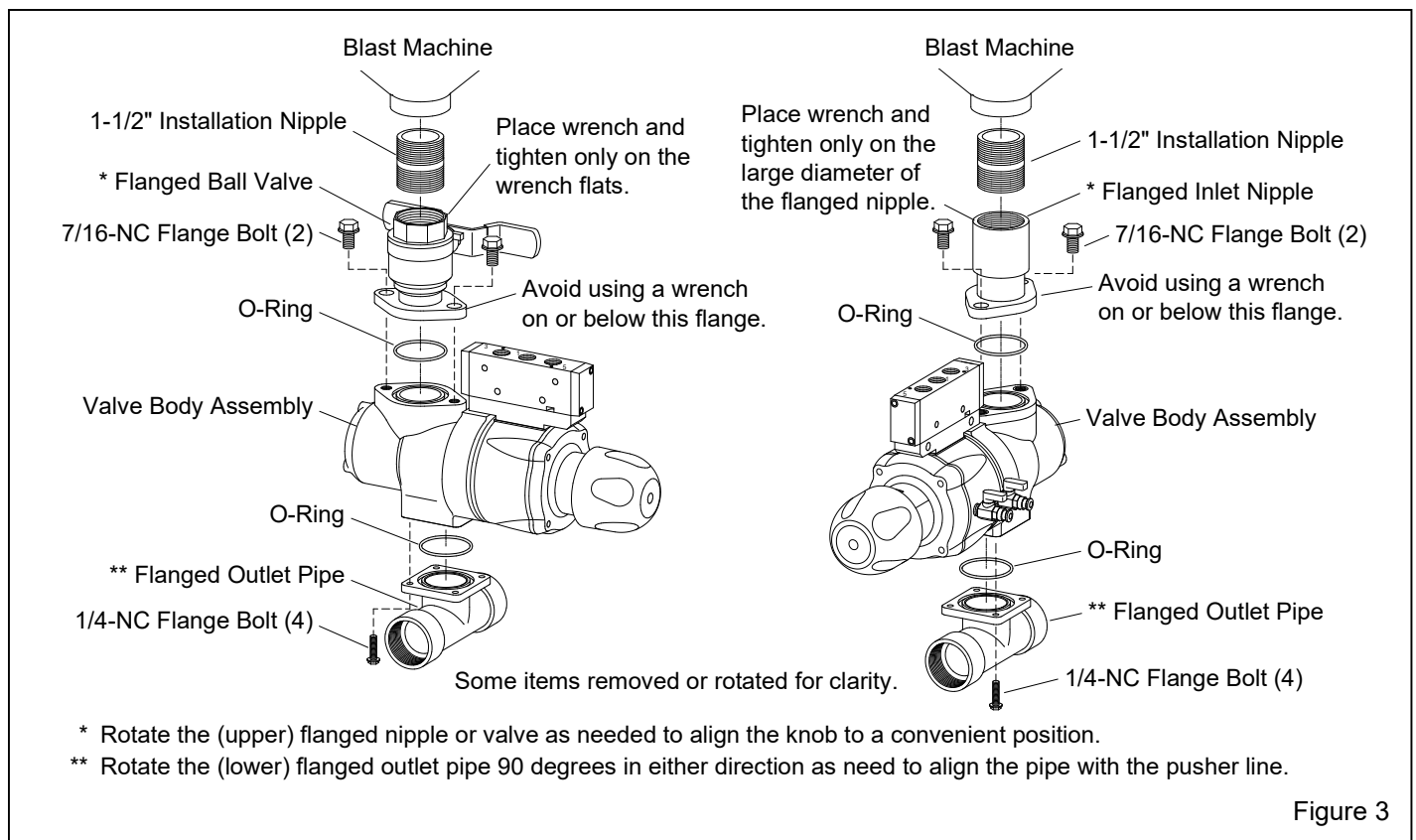


Figure 3

2.2.5 The outlet pipe flange may be rotated 90 degrees in either direction. Rotate the outlet pipe to the valve body, as needed to provide the best alignment with the pusher line and blast hose connection. Make sure the O-ring is in place before reconnecting the outlet pipe to the valve body.

2.3 Connect Piping to the Metering Valve – Figure 4

2.3.1 Apply pipe thread sealant to the male threads of a new 1-1/4" NPT nipple (1-1/2" NPT when using the

1-1/2" outlet pipe) and connect the blast hose coupling to the outlet pipe, as shown in Figure 4.

2.3.3 Apply pipe thread sealant to the male threads of the pusher line and connect the pusher line to the outlet pipe, as shown. NOTE: The old pusher line may be too long or too short to connect to the fittings without it stretching or kinking. Some adjustment can be done by lengthening or shortening the nipples between the side-piping tee and choke valve. **If the pusher line does not fit correctly, a shorter or longer pusher line is required.**

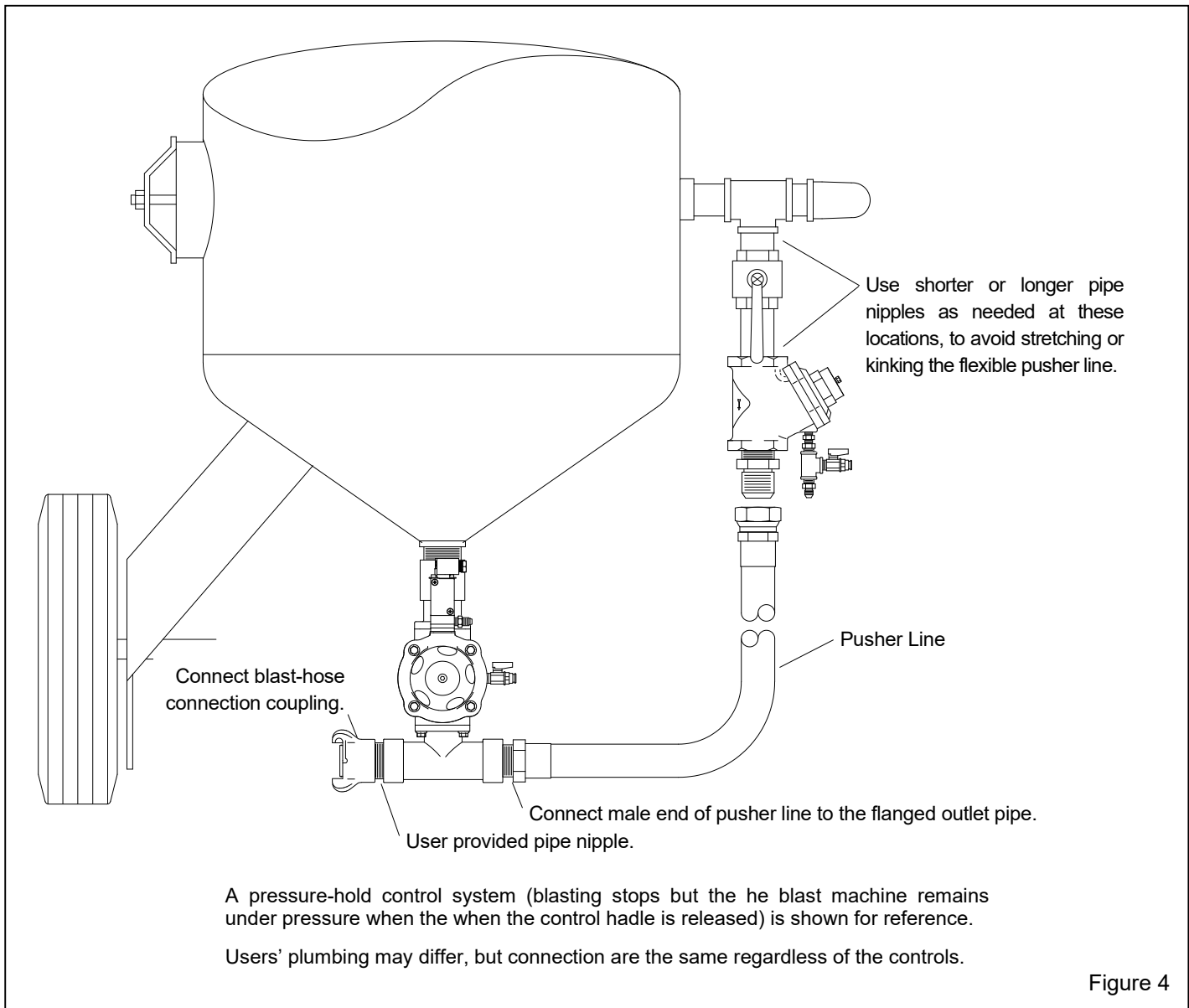


Figure 4

2.4 Connect Control Hoses – Figure 5

2.4.1 The GritWizard Valve uses compressed air to assist in closing the valve. A separate air line, upstream of the inlet valve, is required to supply air to the 4-way pilot valve, as shown in Figure 5.

- The upper illustration in Figure 5 shows connections for a pressure-release remote control system.
- The lower illustration shows connections for a pressure-hold remote control system.

2.4.2 Refer to Figure 5 and assemble a tee, that is no smaller than the inlet valve, and fittings, as shown. The necessary fittings come with field-installed retrofit kits. Clemco pressure-hold systems already include a

tee. Note that the illustrations in Figure 5 are typical and shown for reference; connect control fittings and hose(s) in the same manner as was used with the previous metering valve, and as noted in Paragraph 2.1.4. If necessary, use the old fittings from the valve the GW is replacing.

Summary: The GW connections are adding fittings and tubing to accommodate the air-assist feature.

2.5 Test for Leaks and Operation: Test the machine and piping for air leaks and check the operation of the machine before filling with abrasive.

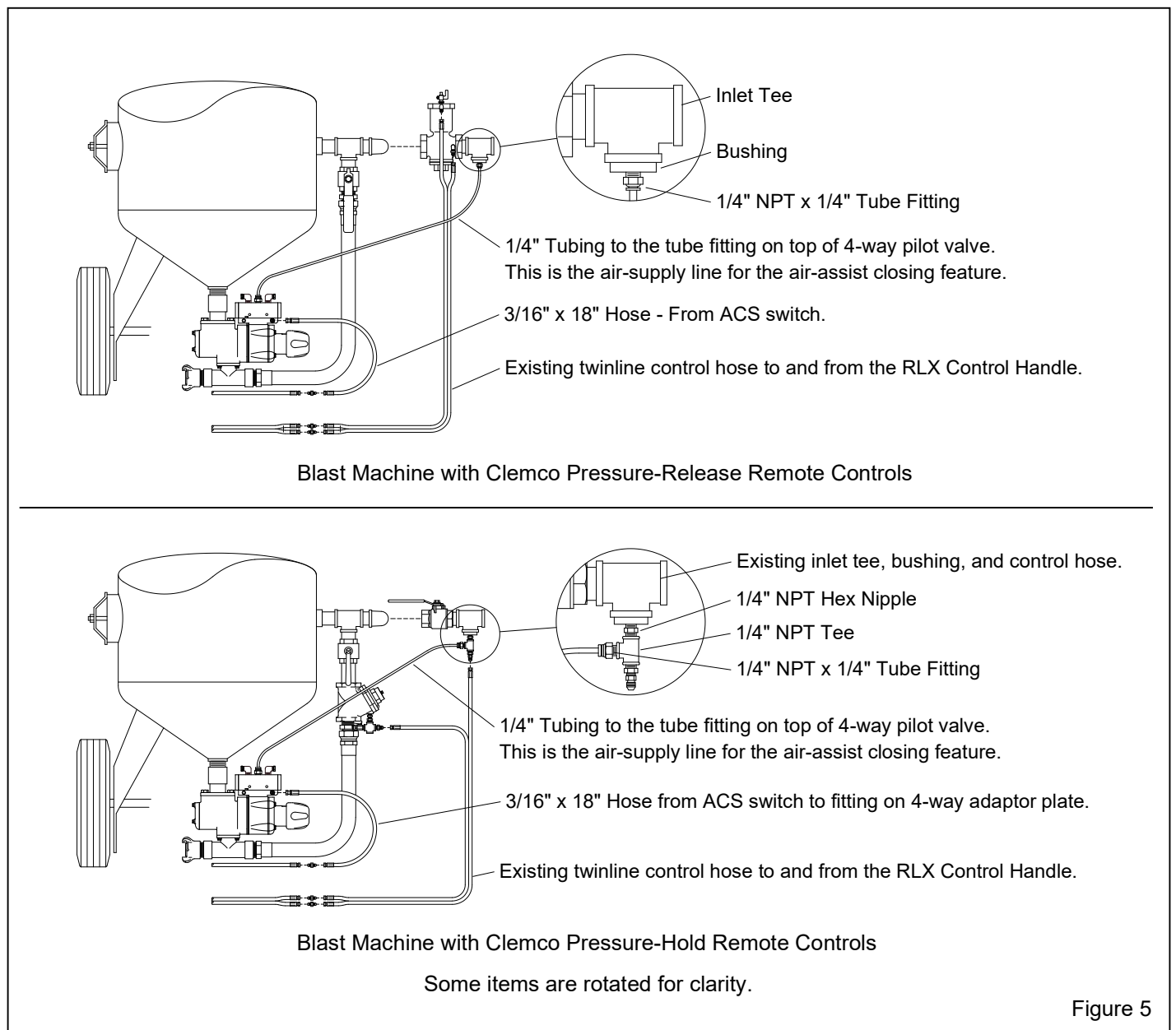


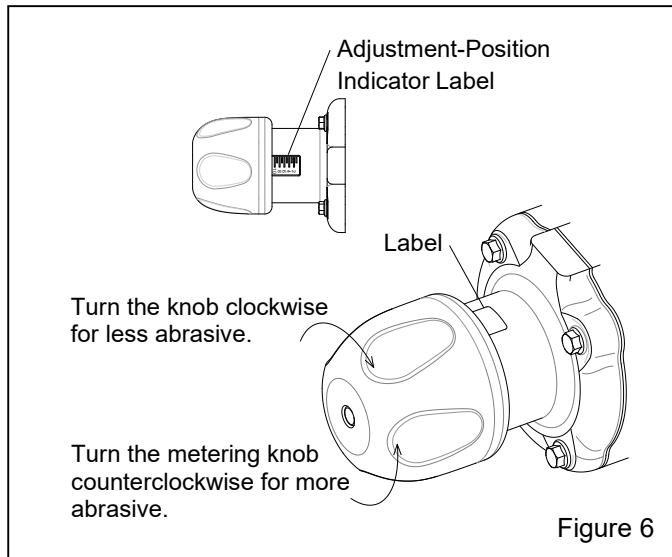
Figure 5

3.0 ADJUST ABRASIVE FLOW – Figure 6

3.1 Optimum abrasive flow depends on the type and size of abrasive and blasting pressure, and can best be determined by experience. Use as little abrasive as possible while maintaining the maximum cleaning rate. The air-abrasive mixture should be mainly air. As a rule, the stream of abrasive coming out of the nozzle should barely discolor the air when seen against a contrasting background.

3.2 The valve is closed when the knob is fully clockwise. Increase abrasive flow by turning the knob counterclockwise and decrease abrasive flow by turning the knob clockwise, as shown in Figure 6. Begin with the knob set two turns from fully closed. Increase flow by turning the knob no more than 1/4 turn counterclockwise. Allow 10 to 15 seconds for the flow to stabilize before readjusting. Continue adjusting as described until the correct flow is attained.

3.3 The indicator label behind the knob shows how far the metering valve is open. When the knob is turned in or out it moves over the label, allowing the operator to reset the valve to the same position when abrasive flow is temporarily changed.



4.0 SERVICE MAINTENANCE

⚠ WARNING

To avoid serious injury from the sudden release of compressed air, observe the following before performing any maintenance:

- Depressurize the blast machine.
- Turn OFF the compressed-air supply.
- Lockout and tagout the compressed-air supply.
- Bleed the air-supply line to the blast machine.

4.1 Servicing Notes

- **Valves with flanged ball valve:** If the flanged shutoff valve and main body housing do not need to be replaced, the metering valve may be serviced while on the machine by closing the flanged shutoff valve and closing the choke valve, located on the pusher line.
- **Valves without flanged ball valve:** Follow instructions in the blast machine operations manual, and empty abrasive from the machine before servicing the valve.
- Remove the tubings and control hoses (mark them to make sure they are reconnected correctly) from the top of the 4-way pilot valve and the side of the adaptor plate.
- Many of the fasteners are secured with removable thread lock, such as Blue Loktite®. Using an impact wrench with hex bit sockets and hex sockets makes disassembly and assembly easier.
- If the valve has a flanged shutoff valve and the shutoff does not require service, close the valve and separate the metering valve housing by removing the two 7/16-NC flange bolts securing the housing to the ball valve.

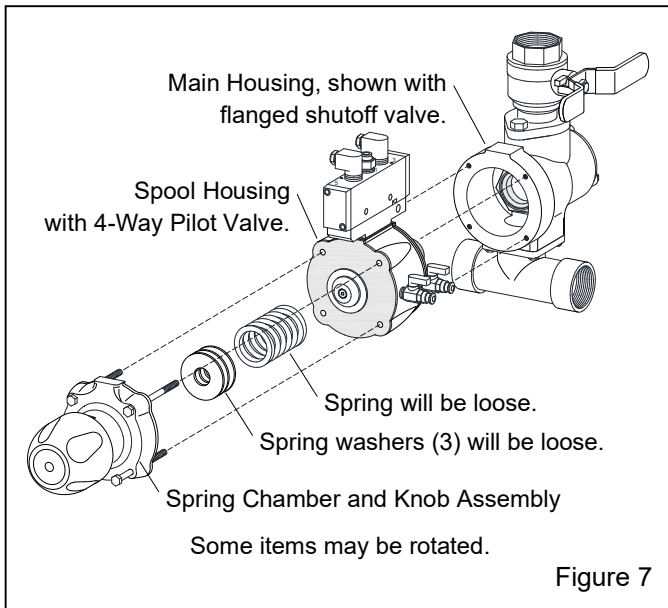
4.2 Disassemble Valve Sections – Figure 7

4.2.1 Use a 3/8" wrench to remove the four thru-bolts and separate the sections, as shown in Figure 7. The spring will be loose when the spring chamber is removed from the spool housing.

4.2.2 Once the four thru-bolts are removed, the valve is separated into three distinct sections:

- Spring chamber and knob assembly.
- Spool housing with 4-way pilot valve assembly
- Main housing with flanged ball (shutoff) valve and outlet pipe.

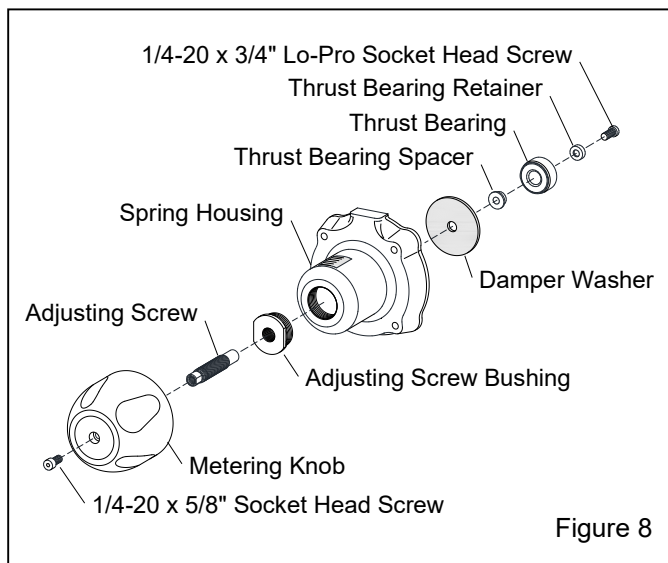
Service of the valve sections can be done in any order and as needed.



4.3 Spring Chamber and Knob Assembly – Figure 8

4.3.1 Disassemble the spring chamber

1. Hold the metering knob and use a 1/8" hex bit socket and impact wrench to remove the 3/4" long screw and thrust bearing. Once the screw is removed, the thrust bearing, spacer, and retainer will be loose and can be removed.



2. Inspect the damper washer. It should be at the end of the bore in the spring housing. Replace it if damaged.

3. If the metering knob turns freely and does not require service there is no need to disassemble it. Skip to Section 4.3.2 to reassemble the spring chamber.

4. If the metering knob does require service, use a 3/16" hex bit socket to remove the 5/8" long socket head screw. Pull the adjusting screw to remove it from the metering knob. Rocking the screw may be needed to loosen it from the knob.

5. Inspect the adjusting screw and bushing and replace either if worn or damaged.

4.3.2 Reassemble the spring chamber

1. Clean all parts that are to be reused and replace any worn or damaged parts. Make sure all male and female threads are clean and free of abrasive.

2. If the adjusting screw bushing was removed, apply a drop of removable thread lock to the first few male end-threads. Use an adjustable wrench to tighten the bushing into the spring housing.

3. Insert the adjusting screw into the knob and use a 3/16" hex bit socket to tighten the 5/8" long socket head screw.

4. Screw the adjusting screw into the adjusting screw bushing.

5. Make sure the damper washer is in place; the adjusting screw should pass through the center hole and the washer should be at the end of the bore in the spring housing.

6. Assemble the thrust bearing as shown in Figure 9. Insert the small end of the spacer into the rotating side of the bearing. The retainer is on the fixed housing-side of the bearing and the recessed side faces toward the socket head screw.

7. Insert the 1/4-20 x 3/4" socket head screw through the bearing assembly, as shown.

8. Apply a small drop of removable thread lock to the end threads of the screw and use a 1/8" hex bit socket and impact wrench to tighten the screw into the adjusting screw.

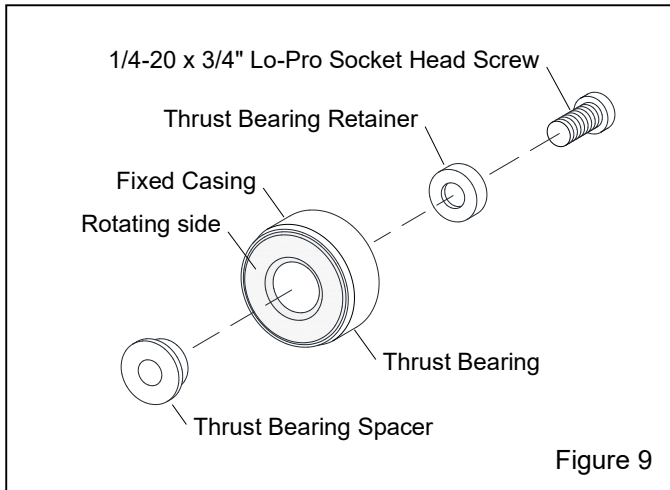


Figure 9

9. If no service is needed on the spool housing assembly or main body assembly, the valve sections may be reassembled, per Sections 4.4 and 4.6.

4.4 Spool Housing Assembly – Figure 10

4.4.1 Disassemble the spool housing assembly

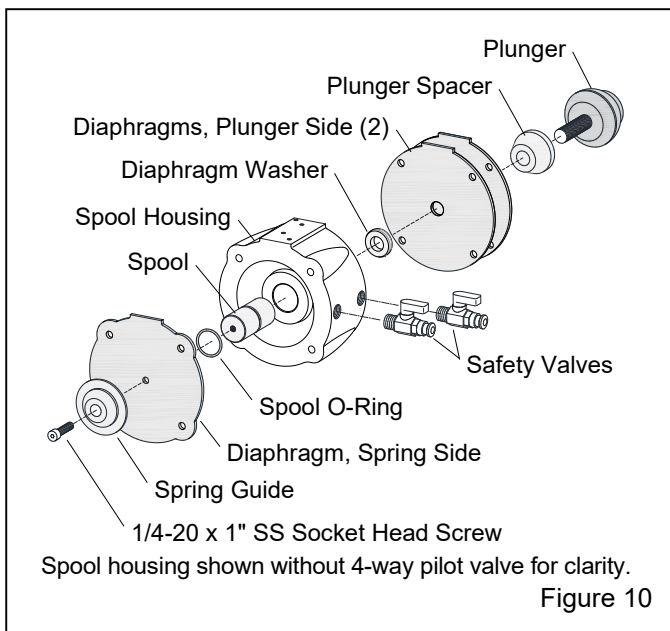


Figure 10

1. To prevent the diaphragms and internal parts from turning while removing the plunger, temporarily place the four thru-bolts through the diaphragm and spool housing mounting holes.

2. Hold the housing securely and turn the plunger counterclockwise to remove it.

3. Remove the plunger, plunger spacer, both diaphragms, and diaphragm washer from the housing.

4. Remove the spring guide, diaphragm, and spool assembly from the other end of the housing.

5. Use a 3/16" hex bit socket and impact wrench to remove the socket head screw from the spool.

4.4.2 Reassemble the spool housing assembly

1. Clean all parts that are to be reused and replace any worn or damaged parts. Make sure all male and female threads are clean and free of abrasive. Use new O-rings and diaphragms.

2. Put a new O-ring into the spool groove.

3. Push the 1" socket head screw through the recessed side of the spring guide and through the spring-side diaphragm, as shown in Figure 10.

4. Apply a small drop of removable thread lock to the end threads of the socket head screw and screw it into the smaller hole (1/4-20 threaded hole) in the spool.

5. Use a 3/16" hex bit socket and impact wrench to tighten the screw into the spool.

6. Apply a generous amount of multipurpose lubricant to the O-ring and push the spool through the bore in the spool housing.

7. Push the plunger stem through the plunger spacer. The stem goes into the larger side of the spacer, and the smaller diameter faces toward the diaphragms.

8. Push the plunger stem (with spacer) through two plunger-side diaphragms.

9. Place the diaphragm washer over the plunger stem. The washer is symmetrical, so it does not matter which side faces toward the diaphragms.

10. Apply a drop of removable thread lock to the end threads of the plunger shaft and loosely screw it into the larger hole (1/2" threaded hole) in the spool.

11. Keep the holes in the diaphragms and spool housing aligned by temporarily inserting the four thru-bolts through the four holes.

12. Hold the housing securely and tighten the plunger by turning it by hand as tight as you can get it.

13. If the safety valves were removed from the housing, apply thread sealant tape or other thread compound to the male threads before reinstalling them.

14. If the 4-way pilot valve requires service, skip to Section 4.5.

15. If no service is needed on the spring chamber, main body assembly, or 4-way pilot valve, the valve sections may be reassembled, per Section 4.7.

4.5 4-Way Pilot Valve Assembly – Figure 11

4.5.1 Disassemble 4-way pilot valve assembly

- 1.** Use a 7/64" hex key to remove the two 2-1/4" socket head screws and washers to separate the 4-way valve from the adaptor plate.
- 2.** Use a 7/64" hex key to remove the two 1" socket head screws to separate the adaptor plate from the spool housing.
- 3.** If the 4-way valve is being replaced, remove the mufflers (with bushing) and 3/8" NPT tube fitting for reuse, or replace them as needed.

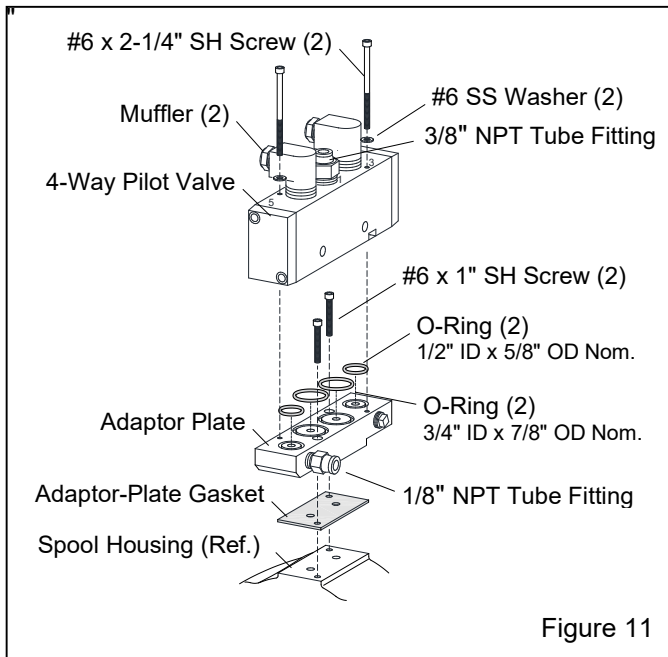


Figure 11

4.5.2 Reassemble 4-way pilot valve assembly

- 1.** Clean all parts that are to be reused and replace any worn or damaged parts. Make sure all male and female threads are clean and free of abrasive. Use new O-rings and adaptor-plate gasket.
- 2.** Insert the two 1" long socket head screws through their respective holes in the adaptor plate.
- 3.** Hold the screws in place while aligning the adaptor plate gasket and pushing it over the screws.
- 4.** Place the adaptor plate and gasket on the spool housing, making sure all the holes line up before tightening the screws to secure it.
- 5.** Place the two larger and smaller O-rings into their respective grooves on the top of the adaptor plate.
- 6.** Set the 4-way valve onto the adaptor plate and secure it with the two 2-1/4" long socket head screws and washers.
- 7.** If any of the fittings were removed, apply thread sealant tape or other thread compound to the male threads before reinstalling them.

4.6 Main Housing Assembly – Figure 12

4.6.1 Disassemble main housing assembly

Note: If the GritWizard Valve has a flanged ball valve) the housing may be serviced without removing abrasive from the machine unless the ball valve needs to be replaced. The following instructions cover the complete disassembly and reassembly of all main body parts. If service is not required in an area, skip to the next.

- 1.** Remove the pusher line and the blast-hose coupling pipe from the flanged outlet pipe.
- 2.** Remove the main housing from the machine by either one of the following methods:
 - 1.** Unscrew the flanged ball valve or inlet pipe (with main housing attached) from the blast machine.
 - 2.** Separate the metering housing from the ball valve/inlet pipe by removing the two 7/16" flange bolts that secures it to the housing.

Note: If the ball valve or inlet pipe require service, they (it) must be removed from the machine.

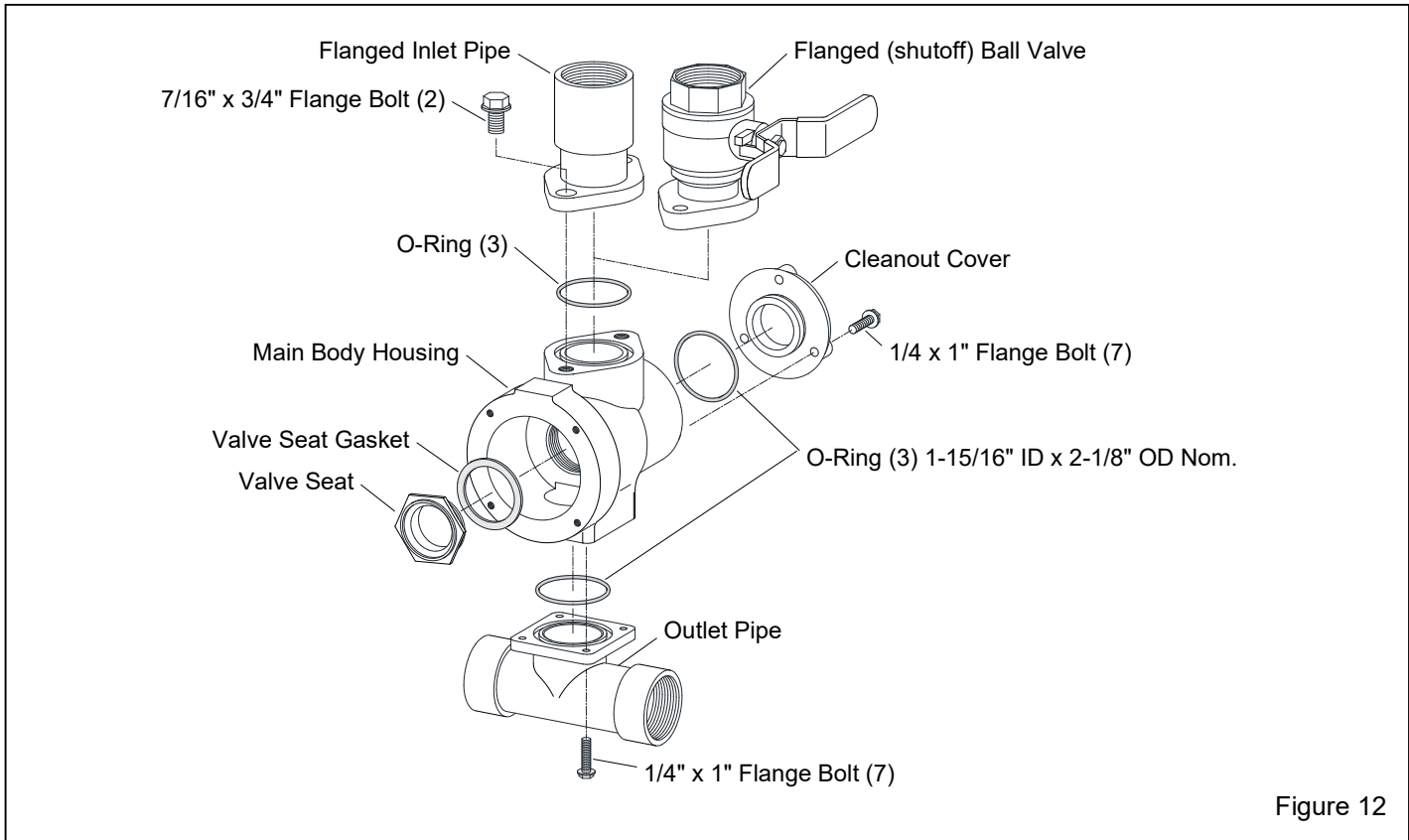


Figure 12

3. Use a 2" socket to remove the valve seat from the housing.
4. Remove the seat gasket from the valve seat.
5. Remove the flanged outlet pipe from the housing by using a 3/8" wrench to remove the four flange bolts that secure it to the bottom of the housing.
6. Remove the cleanout cover from the housing by using a 3/8" wrench to remove the three flange bolts, securing it to the housing.
7. Remove the two flange bolts, securing the housing to the flanged ball valve/inlet pipe.
8. Remove the O-rings from the top of the housing, cleanout cover, and outlet pipe.

4.6.2 Reassemble main housing assembly

1. Clean all parts that are to be reused and replace any worn or damaged parts. Make sure all male and female threads are clean and free of abrasive. Use new O-rings and valve seat gasket.

NOTE: If the flanged ball valve or inlet pipe was removed from the machine, using a new 1-1/2" NPT nipple and reattaching it to the machine now will make it easier to reattach the metering housing later.

2. Place a new valve seat gasket on the valve seat and use a 2" socket to tighten the seat into the housing. **Torque the seat to 35 ft lb.**
3. Place a new O-ring into the groove on the outlet pipe flange and use four flange bolts to attach the pipe to the bottom of the housing. Use a 3/8" wrench to tighten the flange bolts.
4. Place a new O-ring into the groove at the top of the housing and use two flange bolts to attach the housing to the flanged ball valve or inlet pipe. Tighten the bolts securely.
5. Place a new O-ring on the cleanout cover and use three flange bolts to attach the cover to the housing. Use a 3/8" wrench to tighten the flange bolts.
6. Make sure all fasteners are tight, as leaks will cause the valve to malfunction.

7. If no service is needed on the spring chamber, spool housing assembly, or 4-way pilot valve, the valve sections may be reassembled, per Section 4.7.

4.7 Reassemble Valve Sections – Figure 13

4.7.1 Make sure all fasteners and fittings are tight. Leaks will cause the valve to malfunction. Make sure all male and female threads are clean and free of abrasive.

4.7.2 Push the four 4" long thru-bolts through the spring housing.

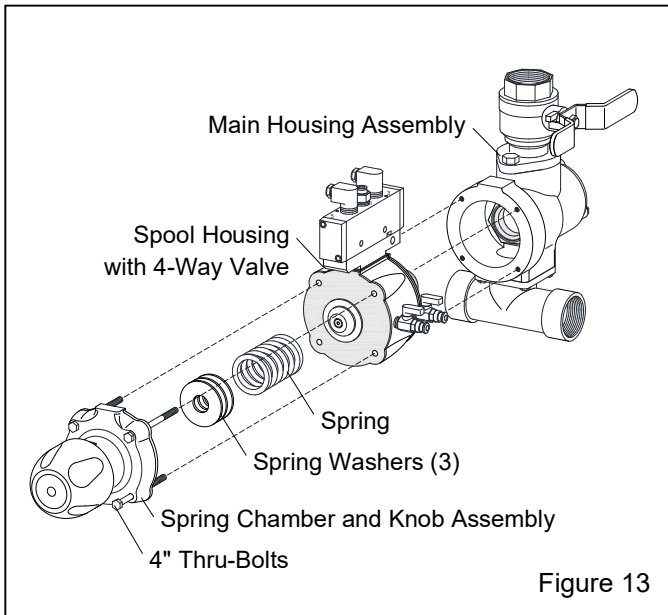


Figure 13

4.7.3 Place the three spring washers and spring into the housing and while holding them in place, insert the four thru-bolts through the spool housing and diaphragms.

4.7.4 Align the thru-bolts with the mounting holes in the main housing and screw the bolts in to secure all the valve sections.

4.7.5 Tighten the thru-bolts with a 3/8" wrench.

4.8 Reconnect Piping and Control Tubing

4.8.1 Apply thread sealant compound to male NPT pipe threads before reconnection the pusher line and blast-hose coupling piping.

4.8.2 Reconnect the control tubing to the 4- way valve and adaptor plate.

4.8.3 Test the valve for leaks and function before returning it to service.

4.9 Cutting Control Hose and Reusing Control-Hose Fittings – Figure 14

⚠ WARNING

Failure to observe the following procedure before performing any maintenance can cause injury from the sudden release of trapped compressed air:

- Bleed all compressed air-supply lines.
- Lockout and tagout the compressed-air supply.

NOTE: Control hoses may be shortened and cut to length as follows:

4.9.1 Remove the hose end by placing the sleeve in a vise or use a backup wrench on the sleeve to prevent it from turning. Unscrew the insert by turning it counterclockwise.

4.9.2 Turn the sleeve clockwise to remove it from the hose.

4.9.3 Cut hose to the required length.

4.9.4 Turn the sleeve counterclockwise to install it onto the hose. Do not over-tighten the sleeve, stop tightening as soon as the hose bottoms against the sleeve's internal shoulder. Over-tightening will cause the hose to curl inward and could cause blockage.

4.9.5 Push the end of the insert into the sleeve, and turn it clockwise to tighten until the insert hex is against the sleeve.

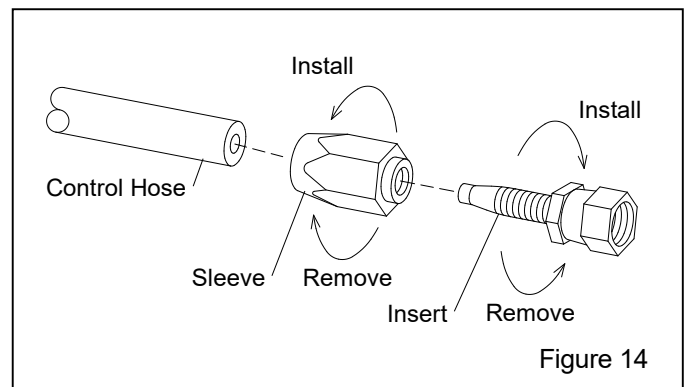


Figure 14

4.10 Using Tube-Lock Fittings – Figure 15

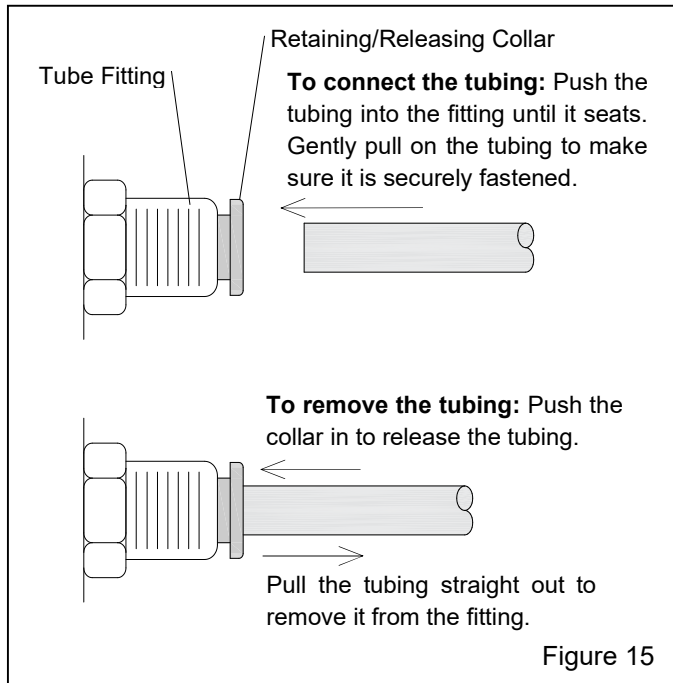
⚠ WARNING

Failure to observe the following procedure before performing any maintenance can cause injury from the sudden release of trapped compressed air:

- Bleed all compressed air-supply lines.
- Lockout and tagout the compressed-air supply.

4.10.1 To remove the tubing from tube-lock fittings, push the retaining collar toward the fitting, which releases the tubing so it can be easily removed by pulling it out. Do not force it, only a slight pull on the tubing is required if the retaining collar is pushed in correctly.

4.10.2 Reconnect the tubing by inserting it through the collar until it seats. Tug on the tubing to make sure it is tight.



5.0 TROUBLESHOOTING

NOTE: This section only identifies conditions and problems in the blast machine and remote control system. For service information, always refer to the appropriate section of this manual and accessory equipment manuals before servicing the equipment.

⚠ WARNING

To avoid serious injury from the sudden release of compressed air, observe the following when troubleshooting the machine and remote controls.

- Turn OFF the air supply, and lockout and tagout the air supply.
- Drain the air-supply line.
- When checking if the controls requires air, always enlist the aid of another person to operate the control handle, hold the nozzle securely, and point it in a safe direction.
- Never strap the remote control handle lever down in the operating position.

5.1 Air Flow Only – No Abrasive Flow

5.1.1 Metering valve closed or needs to be adjusted. Adjust abrasive flow, per Section 3.0.

5.1.2 Optional ACS switch is closed. Make sure the ACS is in the ON position with the ACS toggle pointing away from nozzle. Refer to the RLX Control Handle operations manual.

5.1.3 Leak or blockage in the control hose or fittings between the control handle and the GritWizard Metering Valve. Make sure control air is reaching the side port fitting on the 4-way pilot-valve adaptor plate. Refer to Section 5.8.

5.1.4 Blast machine is empty. Check abrasive level.

5.1.5 Obstruction in metering valve. Clear as follows:

⚠ WARNING

To avoid serious injury, depressurize the blast machine, and lockout and tagout the compressed-air supply before continuing.

Fully open the control valve. (It is fully open when the metering knob is turned fully counterclockwise.) While blasting, close the choke valve to force out small obstructions or wet abrasive.

For larger obstructions, shut the machine down to examine the abrasive valve. Remove the cleanout cover from the main body and clear obstruction.

5.1.6 Check the operation of the 4-way pilot valve, per Section 5.8.

5.1.7 The metering valve may require service. Refer to Section 4.0 to service the valve.

5.1.8 Abrasive bridging in the blast machine. Refer to the blast machine operations manual and inspect the inside of the machine for foreign material.

5.2 Heavy Abrasive Flow

5.2.1 Make sure the choke valve is fully open (handle in-line with the valve and piping).

5.2.2 Abrasive metering valve may be open too far. Refer to Section 3.0 to adjust the metering valve.

5.2.3 Inspect the metering valve for wear. The metering valve may require service. Refer to Section 4.0 to service the valve.

5.2.4 If the valve is used with a pressure-hold remote control system, check the diaphragm in the ACE Air Valve for damage.

5.3 Irregular Abrasive Flow

5.3.1 Check the abrasive metering valve and air-control lines for air leaks. The abrasive valve is a normally closed valve and requires air to open; any leak or fluctuation in pressure can cause the valve to close or partially close.

5.3.2 Damp abrasive. To clear minor blockage, close and opening the choke valve several times, per Section 5.1.5. Refer to Section 5.9 for additional information on moisture.

5.3.3 Check control line pressure. Pressure below 80 psi will cause the metering valve to begin to close. Pressure fluctuations causes the metering valve to partially close and reopen.

5.4 Abrasive or Air Flow Continues After Releasing the Control Handle

5.4.1 Control air may not be fully exhausting from the control handle. Refer to the control handle and remote control systems operation manuals.

5.4.2 Control air may not be fully exhausting from the metering valve. With the control lever UP, open the metering valve's safety valve (closest to the metering knob). If air vents and abrasive flow stops, there may be a blockage in the line between the side of the 4-way adaptor plate and control handle.

5.4.3 Open the air-assist vent valve (farthest from the abrasive metering knob) if air does not escape, check operation of the 4-way valve, per Section 5.8.

5.4.4 If the valve is used with a pressure-hold remote control system, inspect the metering valve plunger and seat for wear. Refer to service instructions in Section 4.0.

5.5 Abrasive Flow Continues After the Optional ACS Is Switched OFF

5.5.1 While blasting, turn the ACS switch OFF (toggle pointing toward the nozzle). A short spurt of air should exhaust from the muffler. If it does, the ACS is working. If air does not exhaust, remove the muffler and try again. If it now exhausts, the muffler is plugged and should be replaced. If it still does not exhaust, check the ACS control line for blockage.

5.5.2 Worn plunger or plunger seat, or an obstruction between the plunger and seat. Service the valve as needed, per Section 4.0.

5.6 Abrasive Flow Decreases Shortly After Blasting Starts

5.6.1 Air leak in the blast machine causing pressure imbalance:

- Check for leaks in the blast machine and around the metering valve.
- Make sure the exhaust (outlet) valve is not leaking. Once the RLX Control Handle is pressed, there should be NO leaks anyplace on the blast machine, valves, or control lines.

5.6.2 Abrasive bridging in the blast machine. This is usually caused from using very fine abrasive, using spent abrasive, or from moist air. Refer to Section 5.9 for additional information on moisture.

5.7 Turning the Metering Knob Does Not Change Abrasive Flow

5.7.1 Inspect the seat and plunger for wear, per Sections 4.2, 4.4, and 4.6.

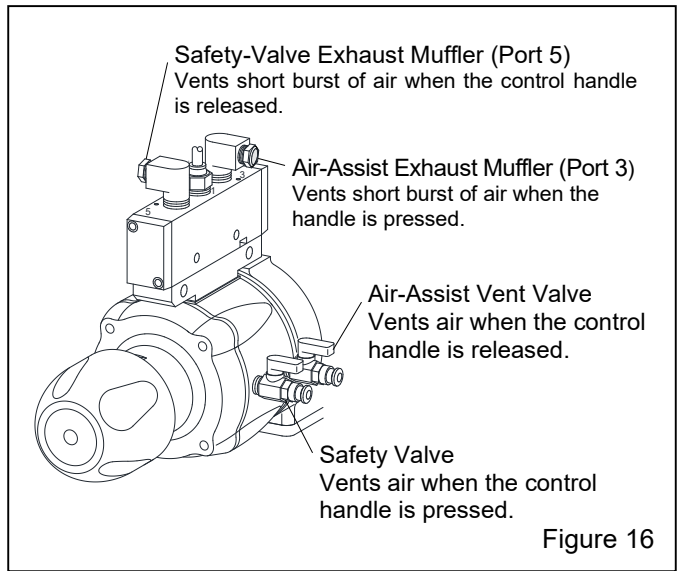
5.7.2 Inspect the spring chamber and knob assembly, per Sections 4.2 and 4.3.

5.8 Check the Operation and Function of 4-Way Pilot Valve – Figure 16

5.8.1 With air to the control circuit and the control handle UP, in the nonblast position, gradually open the air-assist vent valve (farthest from the metering knob) until air is barely noticeable coming from the valve.

5.8.2 Have someone hold the blast hose securely and press the control handle lever. A short burst of air should come from the air-assist exhaust muffler (Port 3), shown in Figure 16. Before releasing the control handle, gradually open the safety valve (closest to the metering knob) until air is barely noticeable coming from the valve.

5.8.3 Release the control handle lever. A short burst of air should come from the safety valve exhaust muffler (Port 5), and air should now come from the air-assist vent valve.



5.8.4 Summary

When the control handle is pressed, air should come from the safety valve and vent a short spurt of air from the air-assist muffler.

When the control handle is released, air should come from the air-assist valve and vent a short burst of air from the safety valve muffler.

Replace the 4-way valve if it does not operate as noted.

5.9 Abrasive Bridging from Moisture

5.9.1 Frequent bridging or blockage in the blast machine and metering valve can be caused by damp abrasive. Blast media becomes damp from moisture in the compressed-air line, from absorption from ambient air, and by blasting parts that are slightly oily (when using recycled abrasive).

5.9.2 Moist compressed air: Moisture in the air supply may be due to a faulty compressor that overheats, or pumps oil or moisture into the air line; an air line that is too long permitting moisture to condense on the inside; and from high humidity. Drain filters and receiver tank regularly. If moisture in the air is a recurring problem, a dryer or aftercooler may be required in the air-supply line.

5.9.3 Absorption: Some abrasive tends to absorb moisture from the air, especially fine-mesh abrasive in high-humidity areas. Empty abrasive from portable blast machines at the end of the workday and store the machine in an area protected from damp environment.

5.9.4 Condensation: When working in conditions of extreme temperature change or humidity, condensation may develop inside the machine. Condensation dampens abrasive and causes flow problems. To eliminate trouble from moist abrasive the next time the machine is started, empty abrasive from the machine before shutting down for the day.

6.0 REPLACEMENT PARTS

6.1 Replacement GritWizard™ Metering Valves

Description	Stock No.
Metering valve assembly with 1-1/2" outlet pipe with flanged ball valve	31158
Metering valve assembly with 1-1/4" outlet pipe with flanged ball valve	31172
without flanged ball valve	31171
GritWizard field retrofit kit: Includes the GW with flanged ball valve and parts to field-install the valve onto portable blast machines	
for 1-1/4"-NPT plumbed machines	31173
for 1-1/2"-NPT plumbed machines	31323

6.2 GritWizard Abrasive Metering Valve – Figure 17
Units are each unless otherwise noted

Item	Description	Stock No.
1.	Service kit, plunger and seat	31174
	a. Plunger	(1)
	b. Seat, valve	(1)
	c. Gasket, valve seat	(1)
2.	Service kit, O-rings and seals *	31175
	a. Diaphragm, spring chamber	(1)
	b. Diaphragm, main body	(2)
	c. Gasket, 4-way adaptor plate	(1)
	d. O-ring, 4-way valve, 3/4" ID x 7/8" OD	(2)
	e. O-ring, 4-way valve, 1/2" ID x 5/8" OD	(2)
	f. O-ring, spool, 7/8" ID x 1" OD	(1)
	g. Gasket, valve seat	(1)
	h. O-ring, valve, 1-15/16" ID x 2-1/8" OD	(3)
	i. Washer, rubber knob damper	(1)
3.	Service kit, thrust bearing assembly *	31176
	a. Spacer, thrust bearing	(1)
	b. Bearing, thrust	(1)
	c. Retainer, thrust bearing	(1)
	d. Screw, 1/4 x 3/4" LP socket head	(1)
4.	Service kit, metering knob assembly *	31187
	a. Knob, metering	(1)
	b. Screw, 1/4 x 5/8" LP socket head	(1)
	c. Flow indicator gauge (decal)	(1)
5.	Service kit, spool *	31211
	a. Spool	(1)
	b. O-ring, 7/8" ID x 1" OD	(1)
	c. Screw, 1/4-20 x 1" SS socked head	(1)

6.	Service kit, valve body flange bolts *	31210
	1/4-20 x 4" hex head	(4)
7.	Hardware kit, valve body *	31212
	a. Bolt, 1/4-20 x 1" hh flange	(7)
	b. Bolt, 7/16-14 x 3/4" flange	(2)
8.	Hardware kit, 4-way valve *	31213
	a. Screw, #6-32 x 2-1/8" SS socket hd	(2)
	b. Screw, #6-32 x 1" SS socket head	(2)
	c. Washer, #6 SS flat	(2)
9.	Cover, cleanout	31153
10.	Flanged outlet pipe	
	1-1/4" FNPT	31191
	1-1/2" FNPT	31155
11.	Valve adjusting screw	31104
12.	Spring	31105
13.	Guide, spring	31135
14.	Spacer, plunger	31112
15.	Valve, 1-1/2" NPT flanged ball	31134
16.	Adaptor plate, 4-way valve	31154
17.	Valve, 4-way pilot	31137
18.	Fitting, 3/8" MNPT x 1/4" OD tube	31097
19.	Muffler, 1/4" NPT	03988
20.	Valve, 1/4" NPT ball (safety valve) each	01993
21.	Fitting, 1/8" MNPT x 1/4" OD tube	11214
22.	Bushing, adjusting screw	31125
23.	Elbow, 3/8" MNPT x 1/4" FNPT reducing	31335
24.	Washer, diaphragm	31111
25.	Flanged inlet pipe, 1-1/2" NPT	31192
26.	Nipple 1-1/2" NPT x close schedule 80	01791
27.	Washer, 3/4 flat, 3 required	03815

* Quantities of kit items are shown in parentheses

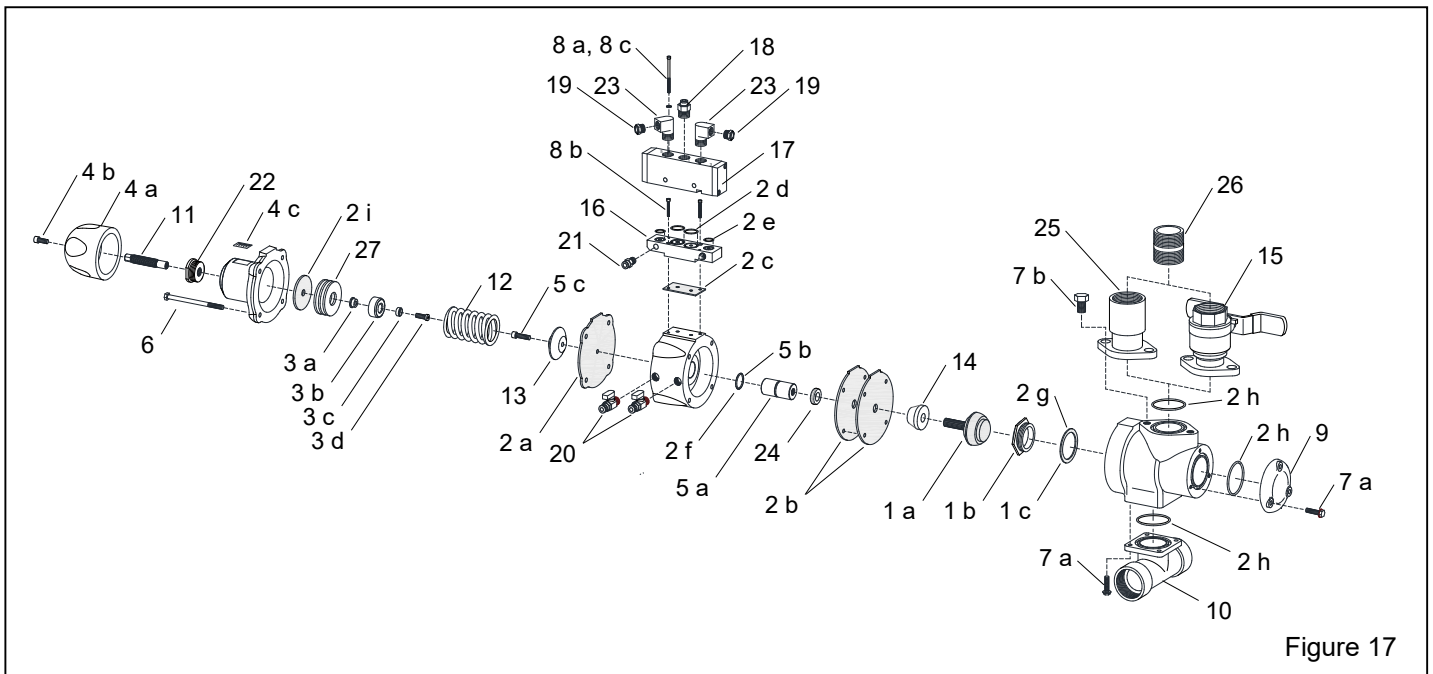


Figure 17