MPS
MIDWEST
PRESSURE
SYSTEMS

Technical Manual

S42A5

5:1 Air Pressure Booster System
with 5.5 Gallon Tank

Manufacturer - Midwest Pressure System, Inc.

Order Number -

Customer -

Customer Purchase Order -

System Serial Number(s) -

Booster Serial Number(s) -

Prepared February 12, 2015, Revision 1

Table of Contents

1. Design Specifications

Midwest Pressure Systems, Inc. (MPS) gas pressure boosters are designed for ease of operation and maintenance. Experience has shown that an MPS booster will normally provide years of satisfactory performance with minimal maintenance. Carefully review this manual which is designed to provide information on installation, start up, operation and maintenance. If you have questions, please contact Midwest Pressure Systems, Inc.

Model S42A5 Engineering Specifications	
Maximum gas discharge pressure - psi (bar)	590 (40.6)
Boosted supply air temperature range - ˚F (˚C)	-15 to 250 (-26 to 121)
Maximum cycle rate - cycles per minute (Note 1)	100
Boosted supply air displacement per cycle - cf (liters)	.016 (.453)
Maximum boosted supply air displacement - cfm (liters per minute)	1.6 (45.3)
Pressure boost (multiple of regulated drive air pressure) (Note 2)	3.2
Discharge connection FNPT	1/2
Tank drain connection FNPT	1/4
Maximum regulated drive pressure - psi (bar) (Note 3)	125 (8.6)
Regulated drive air temperature range - ˚F (˚C)	32 to 167 (0 to 75)
Regulated drive air displacement per cycle - cf (liters)	.069 (1.95)
Maximum regulated drive air displacement - cfm (liters per minute)	6.9 (195)
Inlet connection FNPT	1/2
Drive air exhaust connection FNPT	1/2
Drive air cylinder bore diameter - inches (millimeters)	4 (102)
Gas boost cylinder bore diameter - inches (millimeters)	2 (50.8)
Piston rod diameter - inches (millimeters)	.625 (15.9)
Stroke - inches (millimeters)	4.8 (122)
ASME receiver tank capacity - gallons (liters)	5.5 (20.8)
Safety relief valve (located on receiver tank) set point - psi (bar)	600 (41.4)
Overall dimensions (LxWxH) - inches (cm)	29x16x20 (74x41x53)
Weight - pounds (kilograms)	81 (36.7)
Ambient Temperature - ˚F (˚C) (Note 4)	-15 to 167 (-26 to 75)

Note 1: A cycle consists of a forward and reverse stroke.

Note 2: This is a nominal operating pressure boost ratio, not the maximum pressure boost ratio.

Note 3: Nitrogen may also be used as the drive and supply gas.

Note 4: Where ambient temperatures fall below 0˚C (32˚F) a heater is required for the drive air.

2. Materials of Construction and Torque Specifications

Boost air wetted materials

Anodized Aluminum

Pneumatic drive materials exposed to the environment

Anodized aluminum for excellent general environmental corrosion resistance

External bolts, nuts, and washers

18-8 SS for excellent marine and general environmental corrosion resistance

Dynamic seal material

Carbon-fiber-filled Teflon® piston rings and rod seals

Boost air wetted static seals

Viton

Air drive seals

Buna-N

5.5 gallon ASME receiver tank, 600 psig rated maximum discharge pressure

Carbon steel, Exterior black powder-coated

Pipe fittings and components

Brass and aluminum (air filter and regulator)

Tubing

Copper (3/8", 0.049" wall) and nylon (1/2", 0.062" wall)

Material specifications for individual components are listed in Sections 11, 12, and 13.

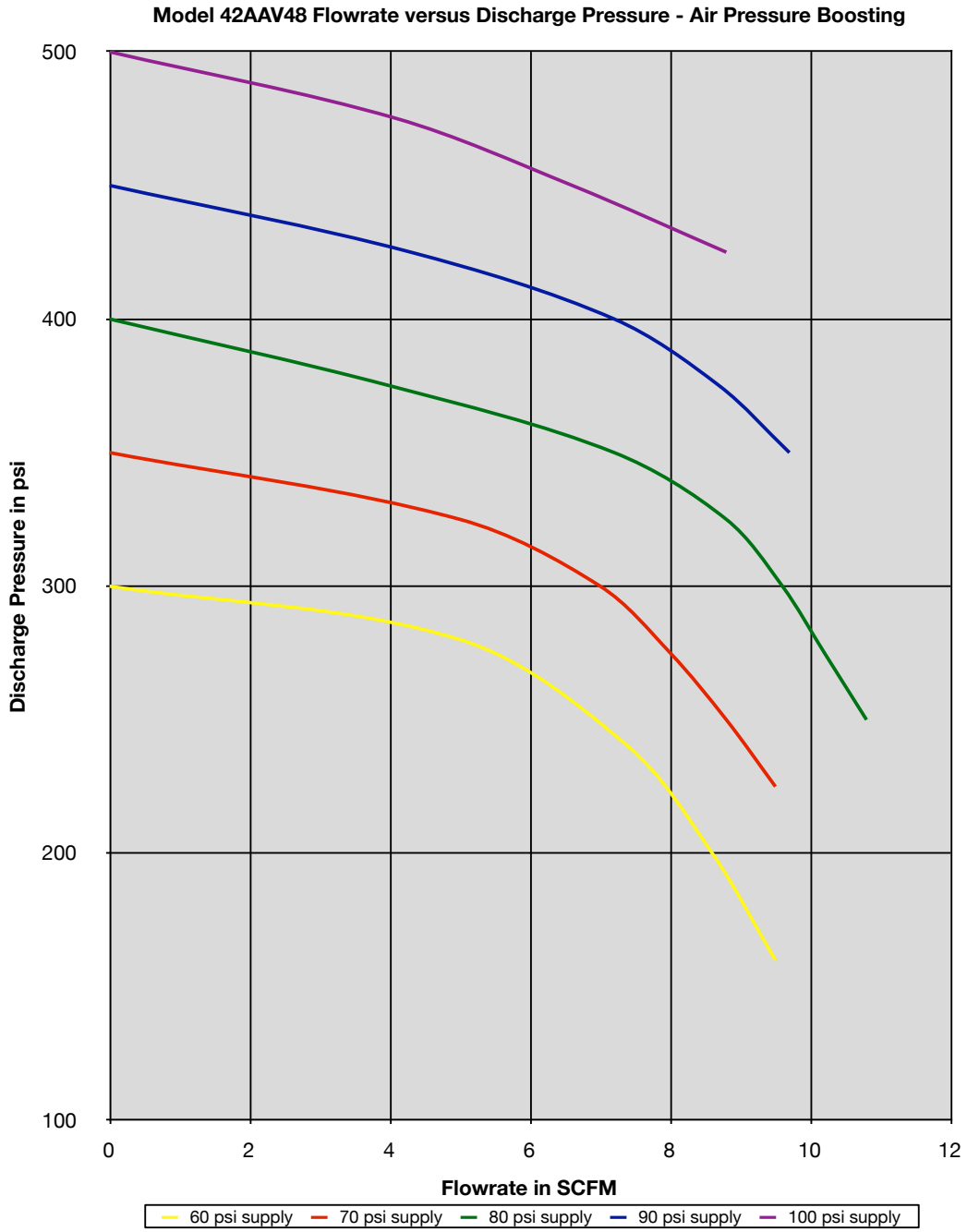
Fastener Torque Specifications

⚠ This booster utilizes high strength fasteners. Replacement fasteners must be of the same grade and material or the booster could fail and cause a fire, explosion or toxic gas release.

Fastener Description	Size Inch TPI	Type	Torque Lb-Ft (N·m)
Piston Rod Nuts	3/8-16 UNC	18-8 SS hex head locknut • 11/16 wrench	20 (27)
1" Long SHC Screws	3/8-16 UNC	18-8 SS socket head cap screw • 5/16 wrench	25 (34)
7" Long SHC Screws	3/8-16 UNC	18-8 SS hex head nut • 5/16 wrench	15 (20.3)
Air Manifold Mounting Screws	10-32 UNC	18-8 SS socket head cap screw • 5/32 wrench	3 (4.1)
Control Valve Mounting Screws	1/4-20 UNC	18-8 SS socket head cap screw • 3/16 wrench	4 (5.4)

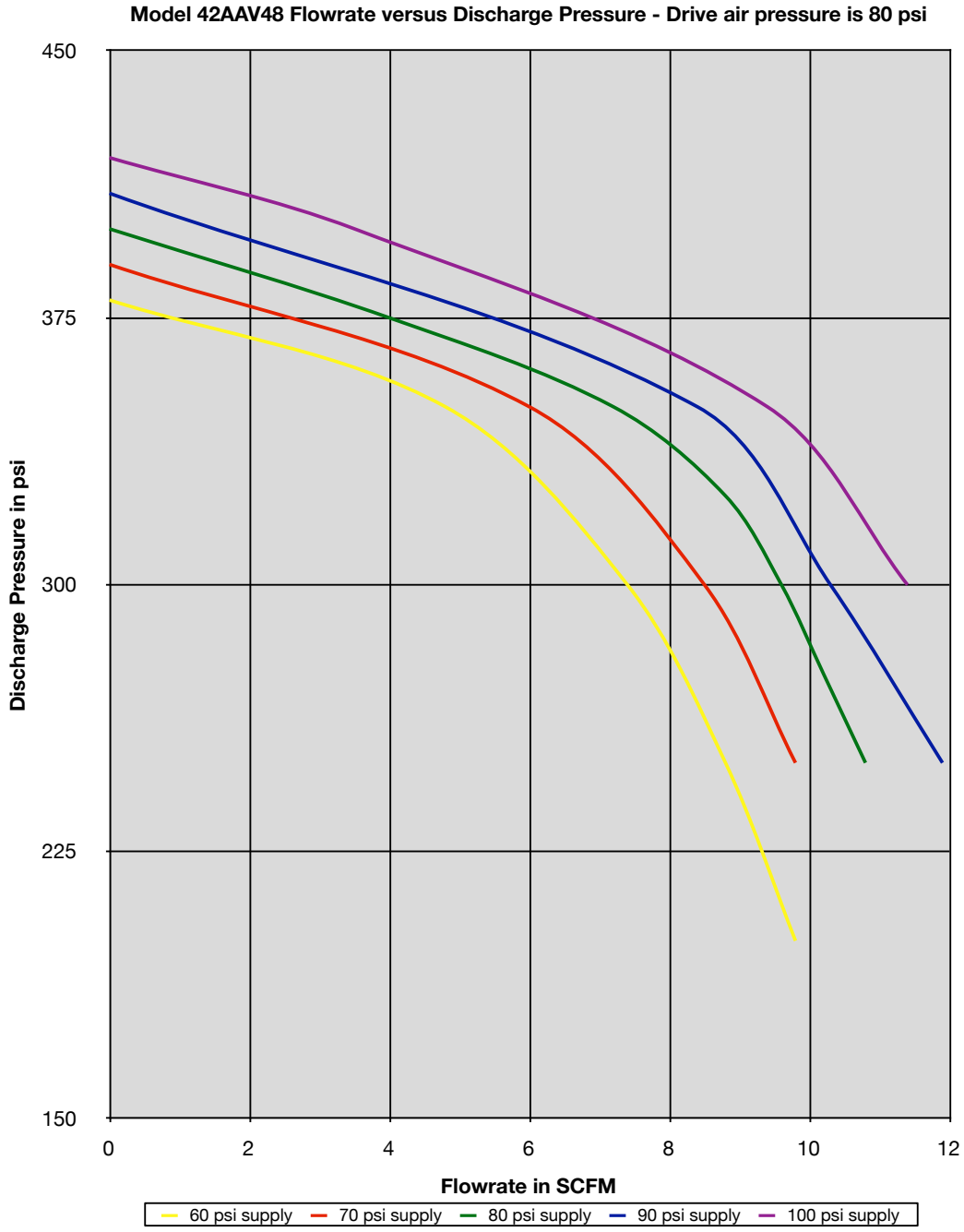
3. Flow Curves

The S42A5 air booster system incorporates the model 42AAV48 pressure booster. The graph below shows the performance curve of the 42AAV48 booster. In the graph, the drive and supply pressures are equal. Use this curve to appropriately size the model S42A5 booster system for a given application.



3. Flow Curves

The S42A5 air booster system incorporates the model 42AAV48 pressure booster. The graph below shows the performance curve of the 42AAV48 booster. In the graph, the regulated drive air pressure is held constant at 80 psi and the air supply pressures vary as shown below.. Use this curve to appropriately size the model S42A5 booster system for a given application.



4. Boost Cylinder Operation

The piston in the drive cylinder is attached to the piston in the boost cylinder. As the drive piston reciprocates, it compresses the air in the boost cylinder. The controls which cause the drive cylinder to reciprocate are described in Section 5 entitled, “Drive Air System Operation”.

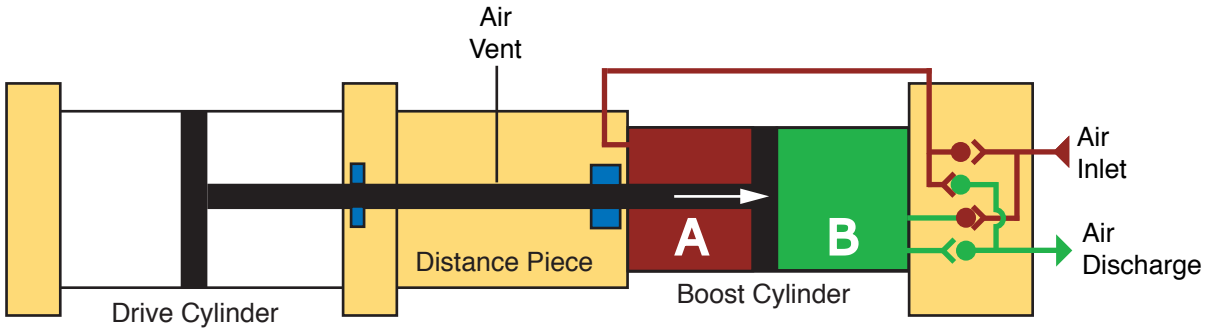
The boost cylinder is double-acting, i.e., it pulls air in on one side while pumping it out on the other. The maximum pressure boost ratio is equal to the drive piston area divided by the boost piston area. This booster has a four inch diameter drive piston and a two inch diameter boost piston resulting in a maximum pressure boost ratio of 4. The maximum discharge pressure (MDP) is equal to the maximum boost ratio (MBR) times the regulated drive air pressure (DAP) plus the supply air pressure (SP), see Equation 1 below.

$$MDP = (MBR * DAP) + SP$$

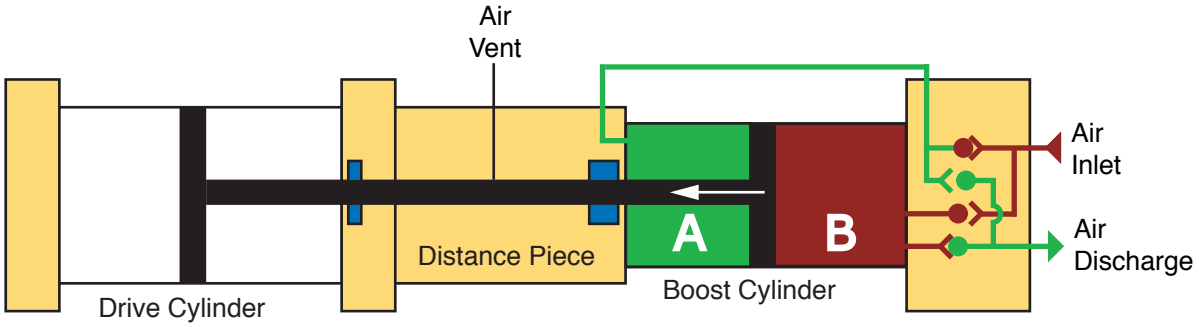
Equation 1: Maximum Discharge Pressure Equation

For example, with 60 psi regulated drive air pressure and 60 psi air supply pressure, the maximum discharge pressure would be 300 psi. With 60 psi regulated drive air pressure and 80 psi air supply pressure, the maximum discharge pressure would be 320 psi. When the booster attains the maximum discharge pressure, the forces in the booster are balanced and the booster stalls (stops cycling). When the discharge pressure drops below the maximum pressure, the booster automatically restarts.

The pistons below are traveling to the right and compressing the air in chamber “B” while pulling air into chamber “A”.



The pistons below are traveling to the left and compressing the air in chamber “A” while pulling air into chamber “B”.

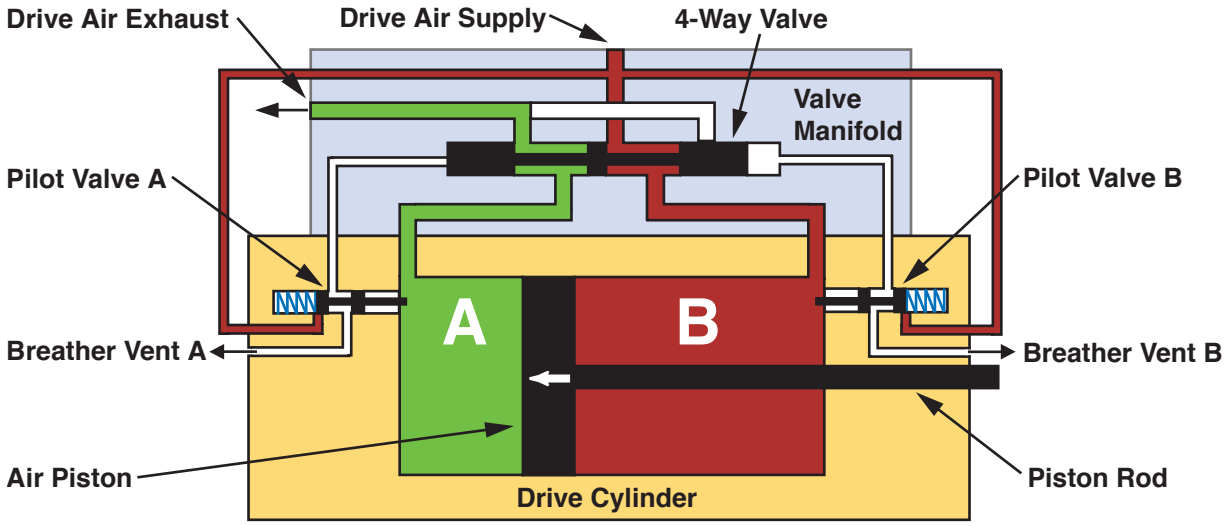


The distance piece is designed to ensure that the gas in the boost cylinder is isolated from the air in the drive cylinder (for nitrogen driven applications). There are piston rod seals at each end of the distance piece, and the distance between the rod seals is greater than the stroke length of the booster. Consequently, the section of piston rod which penetrates the drive cylinder never penetrates the boost cylinder and vice versa.

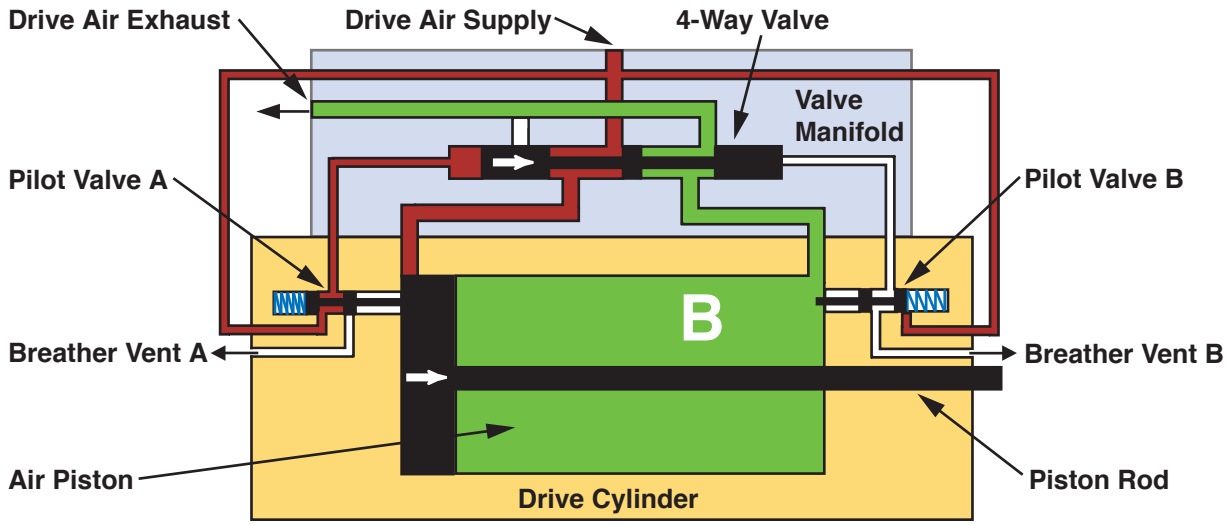
There is one 1/8 NPT air vent port with a breather installed. Any air that leaks past the air drive seal, or air which leaks past the boost side rod seal will flow out of this vent. The unit is supplied with breathers, which vent to atmosphere.

5. Drive Air System Operation

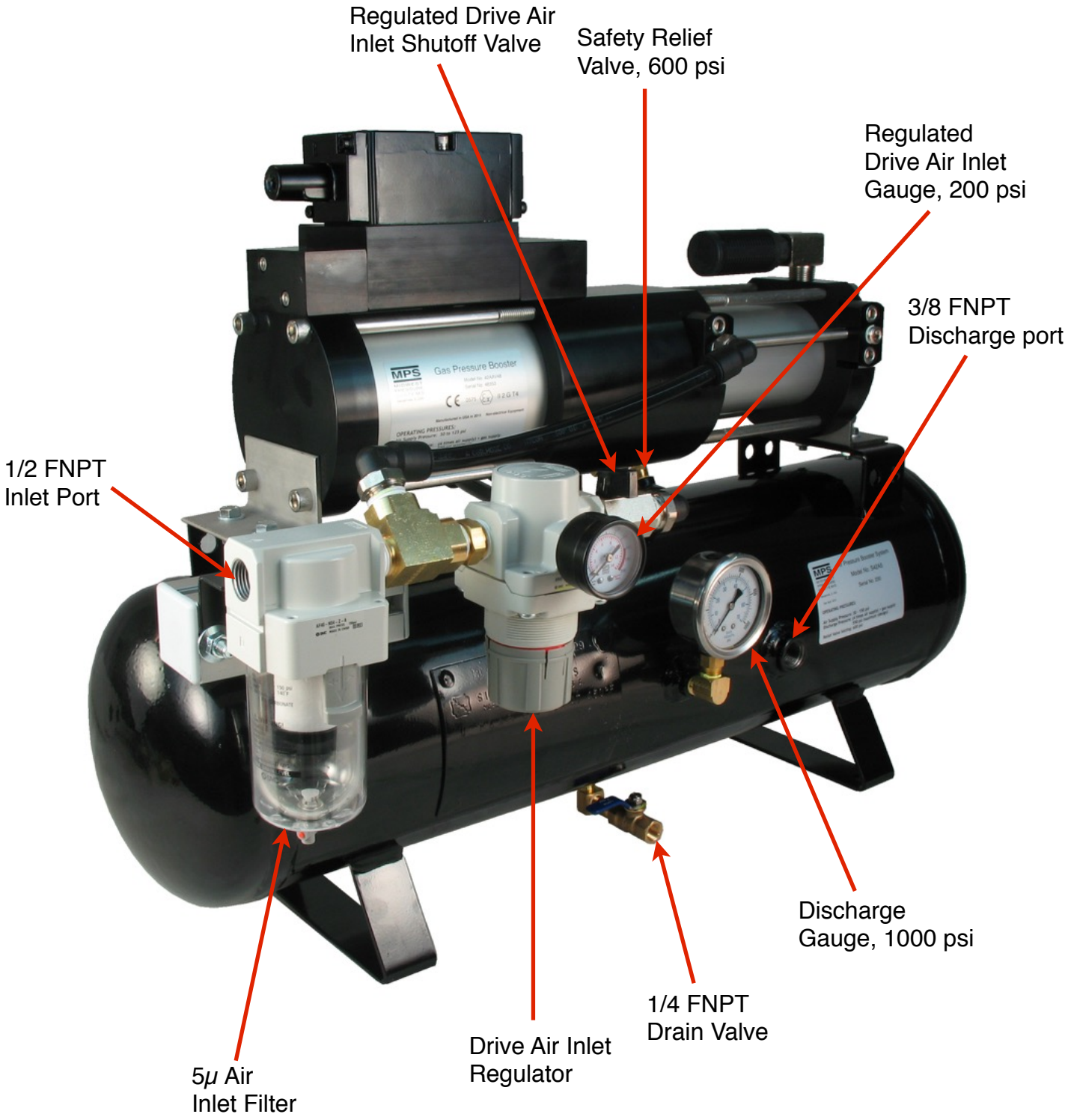
The sketch below shows the 4-way valve extended to the left. This causes the regulated drive air to fill drive cylinder chamber “B” and opens chamber “A” to exhaust. The air piston is driven to the left. The regulated drive air supply also feeds pilot valve “A” and pilot valve “B”. Both of these valves are closed, and the pilot ports at the end of the 4-way valve are open to atmosphere through breather vent “A” and breather vent “B”. All of the piping connections shown in the sketch are machined into in the valve manifold and cylinder end caps. There is no external tubing.



In the sketch below, the air piston has reached the end of its stroke and opened pilot valve “A”. This closes breather vent “A” and sends pilot air to the left pilot port on the 4-way valve. The 4-way valve shifts to the right, opens chamber “B” to exhaust and supplies drive air to chamber “A”. The air piston moves to the right. When the piston moves off the end cap a spring returns pilot valve “A” to its normal position which closes off the air supply and vents the pilot air from the 4 way valve. This process is repeated on the right end of the drive cylinder which causes the air piston to reciprocate automatically.



6. System Layout



7. Installation

1 Mounting

1a Mount the S42A5 air booster system on a horizontal and stable surface. Other mounting orientations are not recommended. The booster system vibrates while operating, so use the four 1/2 inch mounting holes spaced in a rectangular pattern of 18 inch (45.7 cm) long by 6.5 inch (16.5 cm) deep to bolt it to a solid surface.

2 Air Supply Connections

2a First remove the red port plugs on the drain port, inlet port, and discharge port (refer to the photo in Section 6 for these port locations). Connect your shop air pressure to the female 1/2 inch NPT port on the air inlet filter. A shutoff valve should be installed upstream of the 1/2 inch NPT port on the air inlet filter for convenient removal of the system for maintenance.

2b The booster inlet air must be ISO 8573.1 CLASS 2 or better. Lower quality air can cause the formation of ice in the cycling valve and exhaust muffler, which will cause the booster stop running, or run erratically. If ambient temperatures fall below freezing, the drive air must be dried or heated to prevent ice formation in the cycling valve and exhaust muffler. Maximum regulated drive air inlet pressure is 125 psi (8.6 bar).

2c The unit is permanently lubricated. Use of an inlet lubricator will void the warranty.

2d Make sure the drive air exhaust silencer is installed. Boosters without a silencer can produce sound levels above 85 decibels.

3 Discharge Connection

3a This system is protected by a safety relief valve set at 600 psi (41.4 bar). The maximum working pressure of the system is rated for 590 psi (40.6 bar). If the maximum working pressure can exceed the pressure rating of downstream components or piping, an additional safety relief valve must be installed.

3b Connect your discharge line to the female 3/8 inch NPT discharge port located on the font of the 5.5 gallon ASME receiver tank shown in the photo in Section 6. A discharge shutoff valve for the system should be installed downstream of the discharge port for easy removal of the system for maintenance.

3c A 5 μ or better filter should also be installed downstream of the system to protect downstream components from seal/booster wear particles and scale from the tank.

3d For more precise discharge pressure control, install a pressure regulator on the discharge line downstream of the discharge shutoff valve you installed on the 3/8 inch NPT discharge filter. Refer to step 3e below for how to calculate your discharge pressure, and the steps to set the pressure regulator for more precise discharge pressure control.

The booster must be well-supported. The booster vibrates during operation. Inadequate mounting supports can put stress on the piping connections. Piping stresses can cause a leak or component failure.

In hazardous environments, the booster must be mounted in a manner which enables electrical continuity to ground to prevent build-up of electrostatic charge which could trigger a fire or explosion.

The piping connections must be installed in a manner which prevents piping stresses from acting on the inlet and discharge connections. Stress on these connections can cause a leak or explosion.

Operation of the booster without drive air exhaust silencers may cause hearing damage to exposed workers.

7. Installation Continued…

3e The discharge pressure of the S42A5 booster system is calculated using Equation 1, found in Section 4. For example, with 40 psi regulated drive air and 60 psi supply air, your maximum discharge pressure would be calculated as: 4x(40 psi) + (60 psi) = 220 psi. Set the drive air regulator for a higher discharge pressure than desired (not to exceed 590 psi). For example, increase the regulated drive air pressure from 40 psi to 60 psi, resulting in a maximum discharge pressure of 300 psi. Then set the pressure regulator that was installed downstream of the system to your original desired discharge pressure of 220 psi. This method allows for greater accumulator storage capacity, and minimizes pressure fluctuations downstream of the system.

⚠ This booster system can reach a maximum design pressure of 590 psi (40.6 bar). Downstream components must be rated to meet this pressure or be protected by an additional safety relief device.

⚠ With discharge pressures above 590 psi (40.6 bar), the safety relief valve will open and make a loud noise. The loud noise may cause hearing damage to exposed workers.

4 Drain Valve Connection

4a The receiver tank has a 1/4 NPT drain valve located on the bottom to drain condensate, shown in the photo in Section 6. A drain line or automatic drain valve can be attached to this valve when needed.

8. Startup

1 Supply Air to the System

1a Close the discharge shutoff valve you installed downstream of the system. Make sure the regulated drive air inlet shutoff valve and drain valve are closed.

1b Set the drive air regulator pressure. The drive air regulator is located next to the drive air filter, seen in the photo in Section 6. To set the drive air regulator, pull down on the knob to unlock it. Look underneath the knob to find the direction of the increase/decrease arrows for the regulator. Turn the knob in the direction of the decrease arrow until the knob stops (at this position the regulated drive air pressure is set to 0 psi). Supply air to the system. Air will flow through the booster's check valves and pressurize the tank. Now set the drive air regulator to the desired drive air pressure, which is read on the 200 psi pressure gauge attached to the drive air regulator, seen in the photo in Section 6. Turn the knob in the direction of the increase arrow until the desired drive air pressure is reached. Push up on the regulator knob to lock it into position.

1c Open the regulated drive air inlet shutoff valve. The booster will start to cycle, and pressure in the tank will rise. The tank pressure can be read on the 1000 psi discharge gauge, seen in the photo in Section 6. The booster will start to slow down and stop as the maximum discharge pressure (calculated in Section 4) is reached. This is referred to as a stalled condition for the booster.

1d After the maximum discharge pressure is reached in the tank, check the entire booster system for leaks.

1e Open the discharge shutoff valve installed downstream of the system to supply the pressurized air to downstream components. If a pressure regulator was installed downstream of the system for more precise discharge pressure control, set that regulator to the desired discharge pressure.

⚠ The air controls and air drive portion of the booster are rated for a maximum pressure of 125 psi (8.6 bar). Drive air inlet pressures higher than 125 psi (8.6 bar) could result in an air leak, control malfunction, or an air component failure.

⚠ Operating temperatures or pressures outside the recommended range for the booster can cause a leak or the system to operate sporadically.

9. Operation

1 Operating Characteristics

1a The booster will reciprocate as long as drive air is supplied and process flow is required. The booster cycle rate will automatically adjust to meet the required flow rate.

1b Insulate the booster and piping if the operating temperature is high enough to create a burn or ignition hazard.

⚠ High operating temperatures may cause burns as workers come into contact with the booster and associated piping.

⚠ High operating temperatures may be an ignition source which could cause a fire or explosion.

2 Operating Life

2a The operating life of the booster seals is related to the distance the seals travel. At a 70 cycle per minute operating speed, the booster seals can provide over 2000 hours of service.

10. Maintenance and Warranty

1 Lubrication

1a All of the booster dynamic seals are carbon fiber filled Teflon and the control valve dynamic components are made from honed and lapped stainless steel with no elastomeric seals. No lubrication of any kind is required for the booster.

2 Filters

2a The air inlet supply filter should be checked and replaced as necessary.

3 Repairs

3a To isolate the booster from the system for repairs, first close the shutoff valves you installed upstream and downstream of the system. Vent the drive section of the booster using the drain on the bottom of the air inlet filter. Close the regulated drive air inlet shutoff valve. Vent the boost end of the booster, receiver tank, and discharge line by opening the drain valve on the bottom of the tank. Once the system has been completely depressurized, remove the 1/2 inch nylon tubing and 3/8 inch copper tubing from the booster. Remove the screws and nuts attaching the booster to the mounting plate. The booster can now be removed from the system for repairs.

3b The booster seals and valves can be replaced after they have worn out. Use seal repair kit Model Number K42AAV48. When rebuilding the booster, consult the 42AAV48 Repair Manual supplied with the repair kit. Always perform pressure, leak, and functional tests on a repaired booster before returning it to service.

3c When rebuilding the booster, use the torque values listed in Section 2.

3d The booster has been designed to utilize high strength fasteners. If it becomes necessary to replace any of the tie rods, tie rod nuts or socket head cap screws on the booster, the replacement fasteners must be of the same grade.

⚠ Improper torque values can cause a failure.

⚠ Use of the wrong fasteners on the booster could cause a gas leak or component failure.

10. Maintenance and Warranty Continued…

3e Use proper assembly and disassembly techniques. Socket head cap screws should be incrementally tightened and loosened using a cross-pattern. Static o-rings should be lightly greased to aid installation. Surfaces in contact with the filled-Teflon® rod seals and piston seals should not be greased.

⚠ An improperly assembled booster could cause a leak or component failure.

3f To reinstall the booster, fasten the booster back onto the mounting plate using the screws and nuts. Reinstall the 1/2 inch nylon tubing and 3/8 inch copper tubing. Refer to Section 8 for system startup.

4 Warranty

4a Midwest Pressure Systems, Inc. warrants these booster systems to be free of defects in material and workmanship for a period of one year after installation. We will either repair or replace a failed unit returned by the customer. No other warranty is expressed or implied. Proof of the installation date is required. This warranty does not apply to equipment which has been abused, and is voided by failure to use a well-maintained inlet filter.