

Operation and Maintenance Manual

AIR OPERATED GAS BOOSTERS (Single, Double & Dual Ended)

PRINCIPLE OF OPERATION

The **P4B** gas booster is a reciprocating, single or double acting or dual stage air-operated design. It uses an air piloted unbalanced type air selector valve to cycle the booster.

The booster employs the differential piston area principle. A large area piston, driven at low air pressure drives a small area compression piston, which converts input gas to higher pressure lower volume output gas.

The booster gas output or discharge pressure developed by the compression piston/pistons is determined by the ratio between the area of the drive piston, the operating air pressure and the available precharge pressure. The function of the precharge pressure to the booster is to charge the high-pressure cylinder inside the booster with gas, reducing the time required to reach higher pressures. In double-ended models, the precharge gas adds power to the compression stroke.

The booster works rapidly at first, then slower and stops at a pressure balance. The booster will hold the pressure balance indefinitely with minimal energy consumption, heat buildup or parts movement. When a pressure imbalance occurs, the booster will automatically restart to restore the pressure balance. The high pressure or pumping sections are cooled by exhaust air from the air drive section.

1.0 INSTALLATION

- 1.1 The **PowerStar™4B** gas booster, with or without accessories, requires securing in a selected area, connection to a 25 – 100 psi max air supply connection to a precharge gas source and to the work piece to ready it for operation.

WARNING!

No lubricator is needed. Do not run high-pressure boosters with lubricated air. Oil leaking into the compression chamber could cause an explosion.

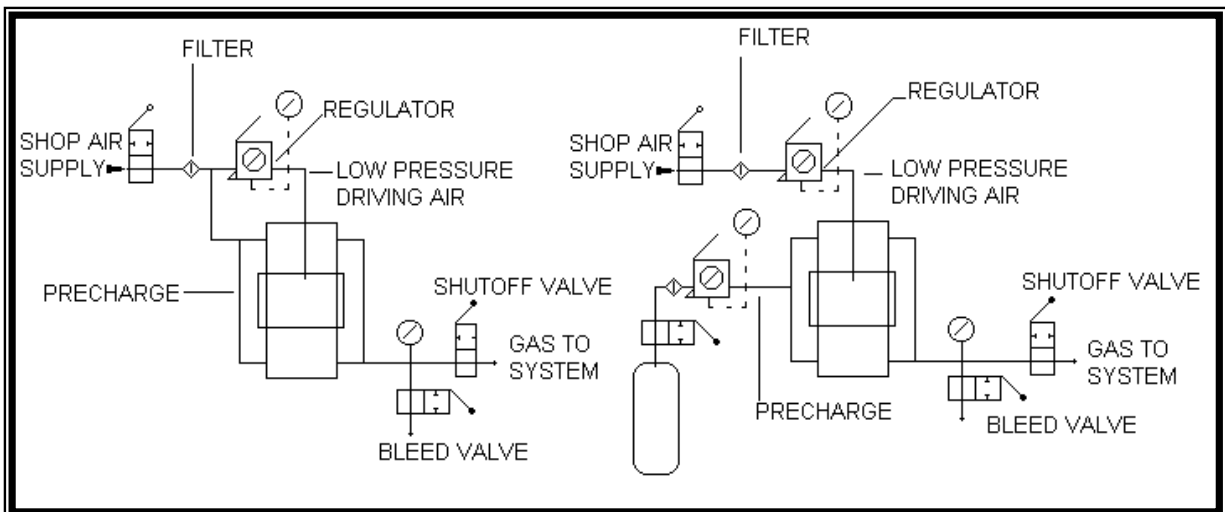


Figure 1. Booster in typical installation circuit with recommended accessories.

Note: Accessories may be purchased through your local Sprague Distributor.

2.0 OPERATION

GAS BOOSTER CONNECTION

- 2.1 Install accessory components in the operating air supply, precharge and high-pressure systems in accordance with the installation in which the booster is being used.
- 2.2 Connect operating air supply.
- 2.3 Connect precharge source to precharge inlet. If shop air is used, it should be filtered to a minimum of 10 microns.
- 2.4 Connect high-pressure system. Be sure to leave provisions for safely relieving high-pressure gas such as shutoff and bleed valves.

TO START

- 2.5 Connect high-pressure outlet to work situation.
- 2.6 Slowly turn on precharge.
- 2.7 Adjust air pressure regulator counter clockwise for 0 output pressure.
- 2.8 Open operating air shutoff valve.
- 2.9 Slowly adjust air pressure regulator clockwise until booster starts operating. Continue increasing pressure until desired output pressure is reached.
- 2.10 Lock regulator in this position.
- 2.11 Slowly open discharge shut-off valve. The booster will resume operation until the desired pressure is achieved at the work station. The booster will then come into a pressure balance condition and stop. It will automatically resume operation when leakage occurs at the work station.

TO SHUTDOWN

- 2.12 Close driving air shut-off valve.
- 2.13 Close precharge gas shut-off valve.
- 2.14 Open manifold bleed valve. For safety leave open.
- 2.15 Disconnect from work.

3.0 MAINTENANCE

- 3.1 **SPECIAL TOOLS** – None are required to service booster. Use Standard tools.
- 3.2 **INSPECTION AND MAINTENANCE** – Refer to Chart 3.1 as a guide to general maintenance. Recommended inspection periods may require adjustment to comply with local conditions or as determined by experience.
- 3.3 **TROUBLE SHOOTING** – Chart 3.2 aids in checking the booster and outlines corrective action. To eliminate unnecessary disassembly of the booster, probable causes of malfunction are listed in the following order.
- A. Causes that can be corrected without disassembly of the booster.
 - B. Causes that can be corrected with partial disassembly of the booster.
 - C. Causes that require complete disassembly of the booster.
- The number in parentheses following the part name corresponds to the item number on the **PowerStar™4B** Illustrated Parts Breakdown (IPB) figure 3.3.*
- 3.4 For disassembly, inspection, repair and assembly of the **PowerStar™4B** booster, refer to Sections 4.0, 5.0, 6.0 and 7.0 following.

| ITEM | INSPECTION PERIOD | REQUIRED MAINTENANCE |
|------------------------------------|--------------------------|--|
| (1) Driving Air Filter | 10 hours 50 hours | Check for & drain liquid accumulated in filter from condensation. Check filter elements and other components for clogging. Clean as required. |
| (2) Driving Air Pressure Regulator | Periodic | Check for air leaks and repair as required. |
| (3) Driving Air Gauge | 10 hours 50 hours | Shut off inlet air pressure and check for zero reading. Calibrate against master gauge. |
| (4) Booster | 10 hours | Check booster and fittings for air or gas leakage. Repair as required. |

Chart 3.1, Schedule of inspection and maintenance.

| TROUBLE | PROBABLE CAUSE | CORRECTION |
|---|--|--|
| (1) BOOSTER IS NOT DELIVERING GAS (booster running) | (A) Precharge gas to booster not connected or line is blocked. (B) Outlet check clogged or faulty. | Connect precharge gas line to booster. Remove & clean line. Check O Ring & Seat. |
| (2) BOOSTER IS NOT DELIVERING GAS (booster not running) | (A) Driving air supply disconnected air shut off valve closed or air filter clogged. (A) Air press regulator not adjusted. (B) Air directional valve sticking. (B) Air pilot valves damaged or sticking. (B) Air pilot valve springs broken. | Reconnect line. Open valve. Clean air filter. Adjust regulator. Replace. Remove and clean or replace as needed. Replace. |
| (3) BOOSTER RUNNING RAPIDLY GAS FLOW IS REDUCED | (B) Air pilot valves damaged or sticking. (B) Air pilot valve O-ring damaged. (B) Air pilot valve springs broken. (B) Air directional valve interface seals damaged or missing. (B) End plate air seals damaged or missing. | Remove and clean or Replace. Replace. Replace. Replace. Replace. |
| (4) BOOSTER FAILS TO GENERATE FLOW OR PRESSURE (5) GAS LEAKING | (B) Leakage or blockage at inlet or outlet check valves. O Ring blown off poppet. (B) Damaged high pressure seal. | Remove & clean check valves. Look for foreign matter lodged in seating areas. Replace poppet O Ring. Replace. |
| | | |

Chart 3.2, Trouble-shooting booster operation

- 4.1 This procedure describes the complete disassembly of the booster. The number following the name in parentheses corresponds to the item number in the Illustrated Parts Breakdown (IPB).

When the booster is disassembled, parts should be kept together and handled carefully to prevent damage or loss. To wash metal parts, use Stoddard dry cleaning solvent per Fed. Spec. # P-D-680 of MIL-F-7024, Type II or use any quality solvent that is available.

The booster disassembly and reassembly can be done with the following standard hand tools:

- a. Phillips head screwdriver
- b. Blade type screwdriver
- c. Ratchet wrench and SAE socket set
- d. 5/8" extension hex socket
- e. Standard Allen wrench set
- f. Small adjustable (crescent) wrench
- g. Retainer pliers
- h. Torque wrench

Power Equipment and special tools may be used at user's discretion. See Single, Double End and Dual Ratio Illustrations.

- 4.1.1 **Double ended boosters.** Remove all external plumbing including low and high-pressure transfer tubes and exhaust transfer tube.
- 4.1.2 Unscrew the 3 Round Head Screws (23) to remove Muffler Enclosure (1). Repeat this procedure for double-ended boosters.
- 4.1.3 Unscrew the 4 Hex Nuts (3) and remove the 4 Washers (4). Repeat this procedure for double-ended boosters.
- 4.1.4 Remove the High-Pressure Plate (11) and Cylinder (5) as an assembly and set aside for further disassembly and inspection. Repeat this procedure for double-ended boosters.
- 4.1.5 Remove the 4 Studs (2). Repeat this procedure for double-ended boosters.
- 4.1.6 Remove the Enclosure Spacer (22). Repeat this procedure for double-ended boosters.
- 4.1.7 **Single ended boosters only.** Remove Truss Head Screws (14), Remove Plug(10) and O-Ring (25). **These parts are shown in Air Motor Assembly P4B Illustrated Parts Breakdown.**
- 4.1.8 Remove Ring, Retainer or Mach. Screw (9); remove Seal (7) and Seal Retainer (8).

4.1.9 **Single ended boosters only.** Push High Pressure Piston (6) towards Air Motor of booster, insert 5/8" extension socket through port in End Plate (2 **see P4B IPB**) engaging hex connection on Air Piston (4 **see P4B IPB**). Use adjustable wrench to grasp High Pressure Piston (6). Turn High Pressure Piston counter clockwise to remove. **Note: The High Pressure Piston is a precision part that must be kept clean and protected from dust or contamination of any kind. Additionally, it should be handled carefully and wrapped with a soft cloth after removal to prevent scratching of piston rod surfaces.**

4.1.12 **Double ended boosters.** Repeat 4.1.9 except grasp each High Pressure Piston (6) by the wrench flats, remove one side then repeat the process.

4.1.10 Remove the Exhaust Muffler (21).

4.2 **HIGH PRESSURE PLATE/S:** Use bench vise to hold high-pressure plate/s when assembling and disassembling.

4.2.1 Outlet Check Valve: Remove Retaining Ring (19) with snap ring pliers. Remove Spring (18), Poppet (17) and O-Ring (16).

Inlet Check Valve: Remove E-Ring (15), Spring (14), Poppet & O-Ring (12) & (13).

Repeat this procedure for double-ended pumps.

This completes disassembly of the high-pressure section/s of the booster.

AIR MOTOR DISASSEMBLY

4.3 *Remove optional Relief Valve Assembly* items (34), (35) and (36) as an assembly. Remove Truss Head Screws (19) 12 places to remove Enclosure (28) and O-Rings (17) 2 and (18) 2 **See P4B IPB.**

4.3.1 Remove Socket Head Bolts (12) 2 ea. & (15) 4 ea.

4.3.2 Gently tap Housing Assemblies (1) and (2) with rubber or leather mallet to remove from Air Cylinder (3) and Air Valve Assembly & Spacer (8) & (34) taking care not to lose O-Rings (29) or damage Air Valve Assembly (8). Remove Air Piston (4) and Seal System (21) from Air Cylinder (3).

This completes disassembly of the Air Motor.

4.3.3 Remove Plug (9), Spring (6), Piston (5) and O-Ring (7) from End Plates (1) and (2).

Rotate plate and using a small blade type screwdriver, remove Push-On Ring (26). Using an O-Ring removal tool remove O-Ring (24).

5.0 CLEANING AND INSPECTION

**WARNING:
NO PARTS REWORK ALLOWED
USE ONLY GENUINE SPRAGUE REPAIR PARTS & KITS**

- 5.1 Remove remaining O-Rings from sub-assemblies and wash all metal parts in solvent with the exception of Air Valve Assembly (8). Dry parts thoroughly with soft lint free cloth or clean compressed air.
- 5.2 Check Air Valve Assembly (8) for free movement and cleanliness. If contaminated, Air Valve may be soaked in filtered kerosene to remove contamination and air dried. If free movement is not restored, air valve must be replaced.
- 5.3 Inspect all parts under a strong light for any evidence of distortion (springs), cracks, pitting, scoring or galling.
- 5.4 Inspect all threaded parts for chipped, crossed or stripped threads.
- 5.5 Inspect inlet and outlet poppets and seating areas for nicks, scratches, burrs, excessive wear or corrosion.

6.0 REPAIR AND REPLACEMENT

- 6.1 Polish metal parts to remove minute imperfections, minor scratches or scoring. Use wet or dry paper grit # 600.
- 6.2 High Pressure Piston (6) and Cylinder (5). Carefully polish Piston to remove Minor nicks or scratches. Use grit #600. Polish cylinder with hone to remove minor imperfections. Use a very fine polishing stone. Replace Piston and Cylinder if there is any evidence of galling or if imperfections cannot be easily removed.
- 6.3 Clean all repaired parts in solvent as described in paragraph 5.1 preceding.
- 6.4 Replace all metal parts that fail to pass inspection or are damaged or worn beyond simple repair.
- 6.5 Replace all O-Rings, Seals, Seal Retainers and Springs at each overhaul. Overhaul kits from TFS contain all the necessary parts to properly overhaul the booster.

7.0 REASSEMBLY

Before reassembling booster, wash metallic parts thoroughly in solvent and dry. Booster should be assembled on a clean work bench in a dust free area to prevent contamination.

- 7.1 Reassemble End Plates (1) and (2) by installing O-Ring (24) and Push-On Ring (26) with a straight steel pin.

Install O-Ring (7) on Pilot Valve Piston (5). Lightly lubricate Pilot Piston with Vaseline, hydraulic oil or petrolatum per Federal Specification W-P-236 and insert in pilot valve port in End Plates (1) and (2). Insert Spring (6) over Pilot Valve Piston (5). Install O-Ring (17) on Plug (9) and thread into port in End Plate over spring. Torque 30 to 40 inch pounds. Install O-Rings (27) onto End Caps (1) and (2).
- 7.2 Install Seal System (21) onto Air Piston (4) **Note: Seal may be heated by immersion in hot water to facilitate installation.** Insert air piston/seal assembly into air cylinder (3).
- 7.3 Install air piston/seal/air cylinder onto End Plate (1) assembly.
- 7.4 Lubricate Seal (29) with petrolatum jelly to hold in place and install in O-Ring groove on gasketed side of Air Valve (8).
- 7.5 Place End Plate (1) on bench with cylinder facing up and place Air Valve (8) gasketed side down over ports in End Plate making sure that gasket guides fit into holes in End Plate (1) and O-Ring (29) is in position.
- 7.6 Lubricate 1 each Seal (22) and (29) and place in O-Ring grooves in Air Valve. Place Spacer (34) over Air Valve (8). Lubricate remaining Seals (22) and (29) and place in O-Ring grooves of Spacer (34).
- 7.7 Place End Plate (2) over Cylinder (3) and Spacer (34) and press down to engage. Install socket head bolts (12) and tighten hand tight.
- 7.8 Rotate air motor to an upright position and install Bolts (15) and Nuts (16). Torque to **120 inch pounds**. Torque bolts (12) to **20 inch pounds**.
- 7.9 Lubricate O-Rings (17) 2 and (18) 2 and place in grooves in End Plates (1) and (2). Place Enclosure (28) over Air Module and fasten top first with 4 Screws (19). Torque to **20 inch pounds**. Install remaining screws (19) 8 ea. in side panels and torque to **10 inch pounds**.
- 7.10 Install optional Relief Valve Assembly (34), (35) and (36) into End Plate (1).
- 7.11 Install Muffler (21) into End Plate (1).

- 7.12** Insert Piston (6) carefully through End Plate (1) and screw lightly into air piston (4). **Note: If torque patch on Piston (6) is worn piston may be secured by using a drop of Loctite®.**

Loctite is a registered trademark of the Loctite Corporation

- 7.13** Push Piston (6) and Air Piston (4) toward End Plate (2). Insert 5/8" socket through port in End Plate (2) engaging hex connection on Air Piston (4). Using adjustable wrench on the flats of the Piston (6) torque to 120 inch pounds.
- 7.14** Install Seal (7), Wear Ring (25), Seal Retainer (8) and Ring Retainer or Machine Screw (9) onto Piston (6). **Note: Apply a drop of Loctite (272) to Screw (9) and torque to 18-25 inch pounds.**
- 7.15** Repeat procedures 7.10 through 7.14 on double ended boosters.
- 7.16** Install Studs (2) 4 ea. into End Plate (1). Repeat this procedure on double ended pumps.
- 7.17** Position Piston (6) so that it is extended about ½ of its total Stroke and gently install the Cylinder (5) with O-Rings (10) and (31) over the piston (6) so that the piston extends into the cylinder. Gently rocking or turning the cylinder during this procedure greatly reduces the risk of seal damage. Repeat this procedure for double ended boosters.
- 7.18** Install Enclosure Spacer (22).
- 7.19** Reassemble High-Pressure Plate (11) installing Inlet and Outlet Check Valves Items (12) through (20).
- 7.19** Slide High-Pressure Plate (11) over Studs (2) making sure that the holes for installing the Socket Head Screws and Washers (26) & (27) are aligned with the tapped holes in the Cylinder (5). Install Socket Head Screws and Washers (26) & (27) and torque to 12 inch pounds. Repeat procedures 7.18 through 7.20 for double-ended boosters.
- 7.20** Install Nut & Washer (3) & (4) 4 each onto Stud (2) and torque to 100 inch pounds. Repeat this procedure for double-ended boosters.
- 7.21** Install Muffler Enclosure (1) with 3 Screws (23) and torque to 10 inch pounds. Repeat this procedure for double-ended pumps.
- 7.22** **Single ended boosters only:** Install Plug (10) and O-Ring (25) onto End Plate (2) with Screws (14) and torque to 5 inch pounds.
- 7.23** Reinstall high and Low Pressure Transfer Tubes and in the case of double ended boosters Exhaust Transfer Tube onto booster.

This completes booster assembly

REFER TO SECTIONS 1.0 AND 2.0 FOR INSTALLATION AND TEST INSTRUCTIONS.