

# SUPERPRESSURE

## AIR-OPERATED PISTON PUMPS FOR LIQUID SERVICE

46-13715-2	SINGLE ENDED	50K PSI
46-13720-2	SINGLE ENDED	30K PSI
46-13725-2	SINGLE ENDED	10K PSI
46-13730-2	DOUBLE ENDED	50K PSI
46-13735-2	DOUBLE ENDED	30K PSI
46-13740-2	DOUBLE ENDED	10K PSI
46-13745	DOUBLE ENDED	10K & 30K PSI

### THIS MANUAL IS FOR:

**PUMP PART NO.:** \_\_\_\_\_

**SALES ORDER NO.:** \_\_\_\_\_

**SERIAL NO.:** \_\_\_\_\_

**DATE MANUFACTURED :** \_\_\_\_\_

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## I. INSPECTION

If damage is discovered upon unpacking the equipment, an immediate request should be forwarded to the delivering carrier to perform an inspection and prepare a concealed-damage report. Concurrently, the nature and extent of damage should be reported to Newport Scientific, Inc.(NSI), giving pump catalog and serial number, so that action may be initiated to replace damaged parts or instructions issued for the return of the apparatus.

## II. INTRODUCTION

- A. Described herein are the theory of operation, application, operating instructions, trouble shooting guide, repair, adjustments, accessories, and a detailed description of each pump.
- B. The pumps described are categorized by: 1) air-driver size, 2) number of heads, and 3) maximum pressure rating.

Catalog Number	Air-Driver Size (inches)	Number of Heads	Maximum Pressure (psi rating)
46-13725-2	8	1	10,000
46-13720-2	8	1	30,000
46-13715-2	8	1	50,000
46-13740-2	8	2	10,000
46-13735-2	8	2	30,000
46-13730-2	8	2	50,000
46-13745	8	2	1 @ 10,000/ 1 @ 30,000

## III. THEORY OF OPERATION

- A. Air under pressure from the Filter-Pressure-Regulator-Lubricator Unit, Cat. No. 46-13753, is introduced to the air driver through the air-transfer valve mounted on the side or top of the operator section. This air causes the air-operator piston to move in one direction with the hydraulic piston, imparting pressure to the hydraulic section and displacing oil in the pump body. Upon reaching the end of the stroke, the cam on the piston rod energizes the ball pilot-valve, causing the air-transfer valve to shift, and reversing the direction of air flow and the air-drive piston. On the double-head unit, the end previously under pressure is now filling, and the opposite side is displacing oil and building pressure.
- B. The hydraulic pump inlet lines from the reservoir to the pump are equipped with check-valves in the pump body to prevent flow-back on the pressure stroke. The pump discharge line is also equipped with an outlet check-valve at the pump body to prevent flow-back of oil under pressure.

#### IV. EQUIPMENT PURPOSE AND APPLICATION

- A. These pumps are used to pressurize liquids from atmospheric to desired pressure at a relatively constant, and to some extent adjustable, flow rate.
- B. Pumps are supplied with self-energizing packing. The medium being pumped should have some lubricity and be free of solid particles. For pressures above 50,000 psi, for example, a mixture of one part oil (equivalent to SAE 5) to one part of white kerosene by volume should be used. For pressures above 75,000 psi, use one part SAE 10W oil to two parts kerosene. These mixtures are for use at 70°F and above. At lower temperatures, dilution should begin at a lower initial pressure, and proportionately larger amounts of kerosene should be used than recommended for 70° and above.

The effect of pressure on the viscosity of any organic medium is roughly the same as lowering the temperature. Always suspect the medium being pumped is either solidifying or reaching a very high viscosity when a pump which works satisfactorily at some lower pressure either operates with unusual reluctance or does not reach its maximum pressure rating with an adequate supply of air. **DO NOT** increase the air pressure until the following test is made:

Relieve the pressure on the pump discharge line and with the pump reduce the air supply pressure until the pump operates at one stroke (not cycle) every 2-3 seconds. Note this pressure (about 10-15 psi) which represents the frictional loss for the pump. Next run the pump at some 25% to 50% of its rated pressure (at which it operates properly) and about at the same speed, again noting the air pressure required to operate the pump. If the air pressure representing the frictional loss is subtracted from the air pressure required to operate against a known back pressure, the difference will be proportional to that back pressure and the ratio will hold (roughly) over the entire pressure range for the pump when pumping fluids of normal viscosity range at higher pressures and the same stroke rate as before. Some additional packing friction will develop, but this should not exceed 10%.

It may be necessary to operate the pump at higher than room temperature to avoid solidification of the medium being pumped. Benzene, for example, has a 42°F melting point at one atmosphere, but must be heated above room temperature to pump at 1000 atmospheres. The liquid ends of the air-operated pump may be heated to 150°F without damage to the packing, etc., except possibly somewhat more rapid wear if this becomes necessary. (For higher temperatures, consult Newport Scientific, Inc.)

**CAUTION:** Standard pump packing are not acceptable for unlubricated water. When water is the medium being pumped, the following steps must be performed:

1. Check with NSI Superpressure Engineering to assure that the pump materials are acceptable.
2. Filter all dirt and rust from the water.
3. Add rust inhibitor to the water, if feasible, or a lubricant such as automotive antifreeze or soluble oil.
4. After pumping water, flush the pump thoroughly to remove all traces of water to prevent rusting.

## V. SYSTEM PROTECTION

- A. In accordance with ASME practice, Newport Scientific, Inc. recommends the installation of a pressure-relief valve or rupture-disc assembly in the discharge line from the pump. (For suitable relief devices see NSI Superpressure Catalog.)

**NOTE: OIL IS INTRODUCED INTO THE DRIVE AIR TO LUBRICATE THE DRIVE CYLINDER. TO AVOID ATMOSPHERIC CONTAMINATION, VENT EXHAUST OUT OF THE ROOM OR THROUGH A FILTER DESIGNED FOR THIS SERVICE, AND OF ADEQUATE SIZE TO AVOID ANY SUBSTANTIAL BACK PRESSURE.**

## VI. PUTTING INTO SERVICE

- A. All NSI air-operated piston pumps are tested to specifications prior to shipment. The inlet and discharge oil lines and air-supply connection are sealed with plastic plugs after test is concluded.

- B. To place unit in service:

**NOTE: PUMPS MAY BE OPERATED WITHOUT HOLD-DOWN BOLTS; HOWEVER, THE UNIT MAY BE SECURED THROUGH THE MOUNTING HOLES. (SEE SPECIFICATIONS FOR MOUNTING DATA.)**

1. Remove plastic plugs from oil inlet, discharge, and air-supply connection line.
2. An Air-Filter-Pressure-Regulator-Lubricator, Catalog No. 46-13753, is installed on the pump. It may be installed remotely in the air supply line. Connect the air-supply line from a dry air source to the air filter. Maximum operating pressure should not exceed 125 psig.
3. Air-exhaust ports are fitted with mufflers which exhaust to the atmosphere. If desired, exhaust may be piped away from the unit; however, back pressure must be kept to a minimum by using at least 3/4-inch pipe, not over 10 feet long, so the exhaust back-pressure will not interfere with the air-cycling valve.
4. Fill lubricator to correct level with a good grade of oil (equivalent to SAE-15) to provide necessary lubrication for the air-transfer valve and air-drive unit.
5. Connect oil suction line to inlet valve situated on the pump head. Connect high-pressure oil discharge line from discharge valve on the pump head to point of use. (Use Newport Scientific, Inc. Superpressure Tubing.)
6. Start unit by turning regulator adjusting screw IN to allow air pressure to flow slowly to driver unit. Observe oil-discharge pressure; if unit fails to build pressure, shut down and prime (see below). If unit still fails to build pressure, refer to trouble-shooting section.

**NOTE: WHEN REMOVING OR INSTALLING TUBING, KEEP ALL LINES AND FITTINGS CLEAN AND FREE OF DIRT TO PREVENT FAULTY OPERATION.**

## VII. PRIMING, REPLACING PARTS, ADJUSTING EQUIPMENT

### A. Priming

1. Shut off air to stop unit. This can be done at the air supply shut-off valve, or by unscrewing the adjust screw on the regulator unit. The latter is not intended for start-stop control, but is used to regulate the maximum pressure of the pump, or to control the stroking rate.
2. Loosen oil discharge line and oil inlet line at pump to permit all trapped air to escape. Remove plug at center of pump body (only on 8 inch Pumps for operation at 50,000 PSI or lower).
3. Fill port exposed by removed plug with oil equivalent to SAE 15. Replace but do not tighten plug.
4. Start pump by slowly opening air-supply valve.
5. Continue cycling until no air bubbles are evident, and tighten loose connections. Unit is now primed.
6. If necessary, fill lubricator (regulator assembly) to correct level with lubricating oil (equivalent to SAE 15), and adjust lubricator screw to give 1-2 drops per minute, running free. (If pump has been idle for several days, feed 6 to 10 drops per minute for the first few minutes. Also, lubricate the air drive piston rods and the high pressure piston rods.)

**NOTE: IF DIFFICULTY IS EXPERIENCED IN PRIMING, OBSERVE ACTION OF OIL CHECK-VALVES. PROPER ACTION OCCURS WHEN OIL IS ADMITTED AT INLET-VALVE TUBE OPENING ON DOWNSTROKE AND EJECTED FROM DISCHARGE-VALVE OPENING ON UPSTROKE.**

7. If there is excessive oil leakage at the piston packing, stop the unit by shutting off the air-drive supply.
  - a. **For 8 inch air-drive units operating at 50,000 psi or lower:** Screw in the piston gland nut with special wrench supplied until slight pressure is felt against the packing. **DO NOT TIGHTEN EXCESSIVELY.**

**NOTE: ADDITIONAL TIGHTENING OF THE GLAND NUTS MAY BE NECESSARY AS THE UNIT IS USED. A VERY THIN OIL FILM SHOULD ALWAYS BE NOTICEABLE ON THE PISTON SURFACE DURING OPERATION.**

### B. Oil Check-Valve Replacement

1. Shut off air to unit; close off oil-inlet and discharge line.
2. Carefully crack check-valves or plug in center of pump body to release trapped pressure.
3. Remove check-valve seats and examine for wear or damage. (See drawing for check-valve

assembly.)

4. Replace damaged valves. (Spare check-valves are available from Newport Scientific, Inc.)

### **C. Stroke Adjustment Procedures - Single Head**

**NOTE: PILOT-VALVE ASSEMBLY IS SITUATED ON THREADED SUPPORTS AND A PLATE. THE PLATE HAS ELONGATED HOLES TO ALLOW ADJUSTMENT OF THE PILOT-VALVES TOWARD, OR AWAY FROM THE CAM FOR FINE-STROKE ADJUSTMENTS. THE STROKE ADJUSTMENT AT THE PILOT-VALVE ASSEMBLY IS MADE AT THE FACTORY AND SHOULD NOT NORMALLY REQUIRE CHANGING; HOWEVER, IF IT BECOMES NECESSARY TO RESET, PROCEED AS FOLLOWS:**

1. Position the ball valve so that the space between the bottom face of the mounting plate and the upper face of the spacer is approximately 1-1/6 inch. Lock in place.
2. Loosen the screws holding the ball-valves to the mounting plate. Slide both ball-valves in toward the piston. Tighten both screws to hold valves in place.
3. Start pumping free-flow very slowly.
4. Hold a finger over the exhaust port of the upper ball-valve and let the piston go to the very bottom of the bore.
5. Measure the distance between the face of the body (not the packing nut) and the face of the coupling, using inside calipers.
6. Remove finger from the ball-valve exhaust. The piston will return. Let the pump continue to run slowly.
7. Open the calipers 1/16; i.e., if the measurement was 5/16-inch, increase this to 3/8-inch.
8. Loosen screws slightly on ball-valves. Insert calipers between body face and coupling.
9. Slide both ball-valves out until the coupling touches the calipers while running. This must be done in very small increments.
10. Tighten the screws on the ball-valves and measure stroke again. Repeat procedure as necessary.

### **D. Stroke Adjustment Procedures - Double Head**

1. Position the ball valve so that the space between the bottom face of the mounting plate and the upper face of the spacer is approximately 1-1/16 inch. Lock in place.
2. Loosen the screws holding the ball-valves to the mounting plate. Slide both ball-valves in toward the piston. Tighten both screws to hold valves in place.
3. Perform steps 1 and 2 on both ends of pump.

4. Start pumping free flow. Operate very slowly.
5. Hold a finger over the exhaust port of one of the ball-valves and let the piston on the opposite end go to the very bottom of the bore.
6. Measure the distance between the face of the body (not the packing nut) and the face of the coupling with inside calipers.
7. Remove finger from the ball-valve exhaust. The piston will return. Let the pump continue to run slowly.
8. Open the calipers 1/16-inch; i.e., if the measurement was 5/16-inch, increase this to 3/8-inch.
9. Loosen screws slightly on ball-valves and insert calipers between body face and coupling.
10. Slide the ball-valve out until the coupling touches the calipers while pump is running. This must be done in very small increments.
11. Tighten the screws on the ball-valve and measure the stroke again. Repeat as necessary.
12. Repeat steps 2 through 11 for the other ball-valve adjustment.

### VIII. GENERAL DESCRIPTION

1. **Catalog 46-13715-2:** This vertical unit has a 1/4 inch diameter hydraulic piston; otherwise, the unit is the same as the 46-13725-2 unit. The maximum discharge pressure rating is 50,000 psi. The theoretical displacement per stroke is 0.049 cubic inches.
2. **Catalog 46-13720-2:** This vertical unit has a 3/8 inch diameter hydraulic piston; otherwise, the unit is the same as the 46-13725-2 unit. The maximum discharge pressure rating is 30,000 psi. The theoretical displacement per stroke is 0.110 cubic inches.
3. **Catalog 46-13725-2:** This vertical unit consists of a 8 inch single-end air operator directly connected to a 9/16 inch diameter hydraulic piston which transmits pressure to the fluid medium in the pump head. The hydraulic piston has a nominal stroke of one inch under pressure. The stroke is factory-set and should require no adjustment. This unit is rated for maximum discharge pressure of 10,000 psi. The theoretical displacement per stroke is 0.249 cubic inches.
4. **Catalog 46-13730-2:** This horizontal unit consists of a double-ended, 8 inch air drive, with two 1/4-inch diameter hydraulic pistons; otherwise the unit is the same as the 46-13740-2 unit. The maximum discharge pressure rating is 50,000 psi. The theoretical displacement per stroke cycle is 0.098 cubic inches.
5. **Catalog 46-13735-2:** This horizontal unit consists of a double-ended 8 inch air drive, with two, 3/8 inch diameter hydraulic pistons; otherwise, the unit is the same as the 46-13740-2 unit. The maximum discharge pressure rating is 30,000 psi. The theoretical displacement per stroke cycle is 0.220 cubic inches.



6. **Catalog 46-13740-2:** This horizontal unit consists of a double-ended, 8 inch air drive, with two, 9/16-inch diameter hydraulic piston; otherwise, the unit is the same as the 46-13725-2 unit. The maximum discharge pressure rating is 10,000 psi. The theoretical displacement per stroke cycle is 0.498 cubic inches.
7. **Catalog 46-13745:** This horizontal unit consists of a double ended, 8 inch air drive, with one, 9/16 inch diameter hydraulic piston and one 3/8 inch diameter hydraulic operating as independent pumps; otherwise, the unit is the same as the 46-13725-2 unit. The maximum discharge pressure rating is 10,000 PSI with a 9/16 inch diameter piston with a theoretical displacement per stroke of 0.110 cubic inches. The unit is primarily designed to operate two remote heads, one (1) 10,000 PSI and one (1) 30,000 PSI in a two stage set up.

## IX. SPECIFICATIONS

### AIR-OPERATED PISTON PUMP SPECIFICATIONS CHART

ITEM	46-13715-2 SINGLE HEAD	46-13720-2 SINGLE HEAD	46-13725-2 SINGLE HEAD	46-13730-2 DOUBLE HEAD	46-13735-2 DOUBLE HEAD	46-13740-2 DOUBLE HEAD	46-13745 DOUBLE HEAD
Max. Air Drive Pressure	90 PSI						
Min. Air Drive Pressure for Max. Discharge	75 PSI						
Mounting Position	Vertical			Horizontal			
Air Consumption	45 SCFM						
Max. Speed Strokes/Minute	135-140						
Exhaust Air Vent/Air Lubrication Oil	3/4" Pipe, 10 Feet Max., SAE 20						
Oil Feed/Lubrication to Drive	1-2 Drops/Minute Running Free						
Air Inlet Orifice	3/8" NPT						
Air Exhaust Orifice	3/8" NPT						
Oil Inlet Orifice	1/4" NPT Female						
Oil Discharge Orifice	1/4" HP NSI/Aminco						
Drive Air Line	3/8" Pipe Minimum (Recommended Size)						
Dimensions(in.)	15 x 12 x 14			24 x 15 x 16			
Weight Net/Shipping	53/80			64/95			
Mounting	4 Holes, 17/32" on 8" Center			4 Holes, 1/2"-13UNC-2B, 1/2" Deep on 5-3/4" Center			

## X. TROUBLE SHOOTING

<b>SYMPTON</b>	<b>PROBABLE CAUSE</b>	<b>CORRECTIVE ACTION</b>
Air Drive Inoperative	1. Low air pressure, clogged air line or filters.	1. Check air pressure, clean air line or filter, install proper size air line (3/8" pipe minimum.)
	2. Improper lubrication	2. Check lubricator adjustment. Set to 1-2 drops/minute running free.
	3. Loose or broken air	3. Tighten or replace.
	4. Malfunction of pilot valves or air-transfer valve	4. Replace pilot-valve, air-transfer valve, or both.
	5. Improper stroke adjustment	5. See Stroke Adjustments
Pump Stalls Before Pressure Develops	1. Insufficient air pressure	1. Obtain proper air pressure.
	2. Air line restriction	2. Remove restriction.
	3. Improper cylinder lubrication	3. Check lubricator as above.
	4. Pumped medium too viscous or solidifying	4. See section IV. B.
	5. Pressure limiting device locked in	5. Back-off pressure limiting device.
Pump Operative, Developing Less than Maximum Pressure	1. System leakage	1. Check pump (isolate from system) to see if pump is at fault
	2. Air pressure too low	2. Check air pressure
	3. Pumped medium too viscous or solidifying	3. See Section IV. B.
	4. Faulty oil-inlet valve, discharge check-valve or both	4. Clean or replace valve(s).
	5. Not primed	5. Prime according to procedure
	6. Improper stroke adjustment	6. See Stroke Adjustment
Pump Operative, Pressure Correct, Output Volume Incorrect	1. External leaks on check-valve	1. Tighten as necessary; check for abrasion on sealing surfaces
	2. Malfunction in inlet valves	2. Clean or replace valve(s).
	3. Improper stroke adjustment	3. See Stroke Adjustment

**General:** When failure occurs and the symptoms are not among those listed above, proceed as follows:

1. Check incoming air line for leaks, etc., to make sure that air pressure is reaching the driver.
2. Check oil-supply reservoir.
3. Check incoming oil-supply line.
4. Check discharge lines for leaks.
5. Examine check-valves for proper functioning.

## XI. RECOMMENDED SPARE PARTS - 8 INCH DRIVE PUMPS

DESCRIPTION	CAT. NO. OR PART NO.	46-13715-2	46-13720-2	46-13725-2	46-13730-2	46-13735-2	46-13740-2	46-13745
SOFTGOOD PACKING KIT	P1615050000	1			2			
SOFTGOOD PACKING KIT	85001000900			1			2	1
SOFTGOOD PACKING KIT	85001000500		1			2		1
PACKING RETAINER	59060000700	1			2			
PACKING RETAINER	64042002500			1			2	1
PACKING RETAINER	65013002700		1			2		1
PACKING FOLLOWER	59060000800	1			2			
PACKING FOLLOWER	64042002200			1			2	1
PACKING FOLLOWER	65013002800		1			2		1
INLET CHECK VALVE	44-14110	1	1	1	2	2	2	2
DISCHARGE CHECK VALVE	44-14115	1	1	1	2	2	2	2
MASTER TRANSFER VALVE	77020022300	1	1	1	1	1	1	1
PILOT VALVE ASSEMBLY	63035001800	1	1	1				
PILOT VALVE ASSEMBLY	63035001400/ 62037005600				1	1	1	1
FILTER REGULATOR/ LUBRICATOR	46-13753	1	1	1	1	1	1	1
SPRING	50029003204	2	2	2	4	4	4	4
SPRING	50029003203	2	2	2	4	4	4	4
BALLS	P1500013300	2	2	2	4	4	4	4
LENS RINGS	63038000400	2	2	2	4	4	4	4
WRENCH TO PISTON GLAND NUT	P1869003600	1	1	1	1	1	1	1
OPEN END WRENCH FOR ¼" H.P. GLAND NUT	P1869000500	1	1	1	1	1	1	1

## XII. ACCESSORIES

46-15000	LUCITE RESERVOIR
46-15005	PYREX RESERVOIR
46-14134	REMOTE DIAPHRAGM HEAD 10,000 PSI
46-14136	REMOTE DIAPHRAGM HEAD 30,000 PSI
44-14210	INLET DOUBLE BALL CHECK VALVE
44-14215	DISCHARGE DOUBLE BALL CHECK VALVE
45-16705	SPECIAL INLET ADAPTER
44-19529	RELIEF VALVE
44-19538	SAFETY VALVE
44-19731	LITTLE RICHARD AIR-OPERATED ON/OFF VALVE
SPECIAL	ELECTRICAL CONTACT GAUGES WITH LITTLE RICHARD VALVE AND APPROPRIATE GAUGE AND CONTROL BOX

### NOTES:

1. Certain pump applications have double-ball check valves on special order only as follows: Inlet Double-Ball Check Valve (Cat. No. 44-14210). (One required for single head pump and two required for double-head pump. One recommended as spare.) Discharge Double-ball Check Valve (Cat. No. 44-14215). (One required for single-head pump and two required for double-head pump. One recommended as spare.)
2. 45-16705 Special Inlet Adapter 1/4" O.D. NSI/AMINCO (9/16"-18) to 1/4" NPT Female. Can be used with Inlet Double-Ball Check Valve 44-14210 only where a 1/4" NPT connection is desired. Adapter replaces Gland Nut and Sleeve (1/4" O.D. NSI Tubing Size) supplied with check valve.
3. Spare parts for Double-Ball Check Valves have the same Cat. No. as for the Single-Ball Check Valves shown above; the quantity required, however, are double those shown.

### **XIII. ASSEMBLY DRAWINGS**

#### **PUMP# 46-13715-2 AIR OPERATED SINGLE END 50K PSI**

46-13715-2	Assembly Sheet 1 & 2
62052000400	Pump Body Assembly
44-14110	Check Valve Inlet
44-14115	Check Valve Discharge
77053001000	Air Drive Single End

#### **PUMP # 46-13725-2 AIR OPERATED SINGLE ENDED 10K PSI**

46-13725-2	Assembly Sheet 1 & 2
63172001500	Pump Body Assembly
44-14110	Check Valve Inlet
44-14115	Check Valve Discharge
77053001000	Air Drive Single End

#### **PUMP # 46-13730-2 AIR OPERATED DOUBLE ENDED 50K PSI**

46-13730-2	Assembly Sheet 1 & 2
62052000400	Pump Body Assembly
44-14110	Check Valve Inlet
44-14115	Check Valve Discharge
77053000900	Air Drive Double End

#### **PUMP # 46-13745 AIR OPERATED DOUBLE ENDED 10K & 30K PSI**

46-13745	Assembly Sheet 1 & 2
62051000400	Pump Body Assembly 30K
63172001500	Pump Body Assembly 10K
44-14110	Check Valve Inlet
44-14115	Check Valve Discharge
77053000900	Air Drive Double End