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# OPERATING AND MAINTENANCE MANUAL

**Model Numbers: 26968**

**Serial Number:**

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Fluid Power
Technology

Haskel

03/31/97

# OPERATION AND MAINTENANCE MANUAL

# OXYGEN BOOSTER SYSTEM MODEL: 26968

Supplied by:

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Industrial Technologies Division
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Burbank, CA 91502 USA

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# Contents

# Introduction

This Oxygen Booster System was manufactured by Haskel International, Inc. It is based on the Haskel model 27187, AGT-15/30, two stage booster which has been specially modified for oxygen use. It comes complete with an air line filter, air pressure regulator with pressure gauge, and a speed control/shut-off valve. The oxygen supply is piped to and from the booster via 5 micron stainless steel filters. The entire system is mounted inside a tubular aluminum frame with sloping control panel. Mounted on the control panel are the high pressure oxygen pressure gauges indicating both inlet and outlet pressures.

Connected to the oxygen supply line is a Haskel air pilot switch. This switch is normally closed and does not allowing the booster to cycle until supply pressure is provided to the unit allowing the switch to open and the booster to cycle. When the oxygen supply drops below the minimum set point (factory set at 150 psi, 10 bar), the booster will shut off so as to maintain efficient compression.

A Haskel air pilot switch is also connected to the outlet pressure line and automatically shuts off the booster when the preset outlet pressure is reached (factory set at 2,500 psi, 172 bar). All components, fittings, and tubing that come in contact with oxygen are 300 series stainless steel.

The high pressure outlet is protected with a Haskel relief valve (factory set at 2,500 psi (182 bar), as a safety to prevent over pressurization.

The system is a self contained automatically reciprocating positive displacement drive assembly. The drive is a large piston/valve assembly and is directly connected to dry running, hydrocarbon free, dual pistons fitted with special compression seals running in stainless steel cylinders with integral check valves. The area of the drive piston is larger than the area of the gas pistons thereby providing the mechanical force to "boost" the gas pressure using relatively low air drive pressure.

The booster is pneumatically powered and its performance is dependent on the following factors:

| | |
|---|---|
| Ps | The Oxygen Supply Pressure. |
| Pa | The Compressed Air Drive Pressure. |
| Po | The Oxygen Delivery/Outlet Pressure. |
| Qa | The Compressed Air Drive Volume. |
| Pr | The Residual Pressure in the cylinder(s) to be filled. |

The intake volume per stroke is actually less than the "piston displacement" since part of the available space is filled by re-expansion of the high pressure oxygen remaining in the "undisplaced" area at the end of the compression stroke.

A very important feature of this booster is the cooling system. At the end of each drive stroke, the exhaust is channeled through a system of cooling jackets around the gas barrel and interstage cooler. This release of compressed air pressure causes the air to chill (adiabatic expansion) and cool the gas barrels and interstage. This results in lower oxygen delivery temperature into the second stage and the outlet.

This booster has the capacity to pump oxygen at pressures up to 5,000 psi (345 bar). However, this particular unit is fitted with control devices which are factory set to limit the fill pressure to 2,500 psi (172 bar).

# Specifications

1. **Gas Booster:** Model 27187 (28881-AGT-15/30 modified for oxygen service). Air driven, two stage, reciprocating air motor, balanced opposed piston type. The high pressure oxygen barrels are triple sealed, non-lubricated, hydrocarbon free, and separated from the air drive. Air drive section: NO OILING required, factory lubricated, corrosion resistant. Cooling with air exhaust to both stages and intercooler.

   This model booster (AGT-15/30) is capable of gas outlet pressures equal to 30 X the Air Drive Pressure, plus 2 X the Gas Inlet Pressure.

   *E.g.: With 75 psi air drive (5 bar) and 500 psi gas inlet (34 bar), the booster will only produce or "stall" at 3,250 psi (224 bar). 30 X 75 psi + 2 X 500 psi = 3,250 psi outlet.*

   - Minimum Air Drive Quantity: 70 SCFM for full cycling speed. Lower volumes will cause the booster to cycle slower and result in slower fill times.
   - Air drive pressure range: 40 - 150 psi (3 - 10 bar).
   - Maximum gas inlet: 2500 psi (172 bar) (First Stage X Max. Air Drive, 15 X 150=2500).
   - Maximum gas outlet: 5000 psi (345 bar).
2. **Air Drive Pressure Regulator:** This is located beneath the panel near the boosters air drive connection. This can be adjusted from 40 to 150 psi (3-10 bar) to control the boosters performance. Maximum inlet 200 psi (14 bar).
3. **Air Drive Speed Control Valve:** This is located beneath the panel near the boosters air drive connection. A round handled low pressure brass valve used to control the air drive "flow" thus controlling the booster cycle rate.
4. **High Pressure Gas Tubing:** Stainless steel seamless tubing. Maximum oxygen working pressure: 4,900 psi (338 bar)
5. **Particulate Filters:** Located at the back of the unit clamped to the side strap mounting brackets on each side. Oxygen gas inlet and outlet: 5 micron. All stainless steel, Maximum rated pressure: 5,000 psi (345 bar).
6. **Oxygen Inlet and Outlet Gauges:** Located on the control panel and labeled with black metal tags. Stainless steel tube, solid front, blow-out back, 4-1/2" dial size (114 mm).
7. **Air Pilot Switch, Inlet:** Located on the right underside of the panel. This switch is normally closed and is adjustable from 140 to 750 psi (9 - 52 bar).
8. **Remoteset Air Pilot switch:** Located on the left underside of the panel. This switch is normally closed and is adjustable from 1,800 - 4,750 psi. This is factory set at 2,500 psi (172 bar).
9. **Remoteset Regulator:** The adjustment control knob is located in the center of the control panel just below the "Air Signal Pressure" gauge. This is adjustable from 5 to 150 psi (3 - 10 bar), depending on the air supply pressure. The ratio of air drive to oxygen pressure is: 110 : 1. This is factory set to shut-off the booster at approximately 23 psi, 2,500 psi outlet pressure (172 bar).
10. **Remoteset Regulator Pressure Gauge:** The "Air Signal Pressure" is located towards the top-center of the control panel. A list of pressure settings to reach desired outlet pressures are stamped on the label on the panel.
11. **Relief Valve:** This is located on the left side of the frame clamped to the base frame. The relief valve is factory set at 2,650 psi (182 bar). This is adjustable from 500 - 5,000 psi (35 - 345 bar).
12. **Noise:** 80 db range pulses, depending on working pressure (measured at 30 inches (762 mm) from the unit).

# Operating Instructions

1. Connect air drive supply to the air drive inlet (Air Filter) connection, 1/2" NPT female using 1/2" minimum pipe, tubing, or hose rated for 150 psi (10 bar).

   Note: **Ensure all connections, pipework, hoses, etc. that will come in contact with oxygen, have been thoroughly cleaned for Oxygen service.**

   Note: **Make sure ALL tubing, hoses, piping, and connections are capable of the specified maximum pressures indicated on the drawing.**

2. Check that all cylinder, manifold, and/or isolation valves are closed.

3. Connect oxygen supply to the gas inlet filter, 1/4" NPT female. using 1/4" minimum pipe, tubing, or hose rated for 2400 psi (165 bar). Make sure all cylinder/hose connections and piping are oxygen clean and free of dust, oil, and grease.

4. Connect the cylinder(s) to be filled to the gas outlet filter. Again, make sure all cylinder/hose connections and piping are oxygen clean and free of dust, oil, and grease.

5. Slowly open outlet cylinder.

6. Slowly open oxygen supply to allow oxygen to flow through the booster and equalize into the bottle to be filled.

7. Verify the oxygen supply is above the minimum pressure setting.
   Note: **If the supply pressure is low (200 psi, 14 bar) change the supply cylinder. The air pilot switch will shut-off the booster when the oxygen supply pressure drops to 150 psi (10 bar).**
8. Check the result regulator pressure to verify it is at the correct setting.

9. Open the air drive speed control valve on the booster and allow the booster to cycle at a rate of 50 cycles per minute.
   **Note: The booster is capable of operating at a much faster rate but the cylinders should not be filled too quickly or they may overheat and not provide a complete fill. The slower cycle rate also prolongs the seal life.**

10. After the cylinder(s) have reached the fill pressure the booster will shut-off.

11. Close the air drive speed control valve.

12. Close the oxygen supply valve.

13. Close the cylinder shut-off valve and vent the remaining oxygen in the line. Disconnect the bottle.

14. If filling is completed vent all oxygen and air from the system and verify all valves are closed.

**Note: Never disconnect hoses unless all pressures has been vented.**

# Maintenance

This booster system comprises a number of different components which are exposed to high pressure oxygen.

Depending on the frequency of usage, condition of the air/oxygen supply, cycle rate, pressures, or any other conditions that may be detrimental to seal life. The following is a suggested scheduled maintenance index.

**Note: Full precaution should be taken with regard to cleanliness of the oxygen system. Please refer to the oxygen safety sheet included in this manual.**

***Moderate to Heavy Usage (for light usage, double intervals).***

| *Performance Interval* | *Maintenance Action* |
|---|---|
| Before/After each use. | a. Perform overall visual check of system.<br>b. Drain and clean the air filter bowl.<br>c. Clean oxygen cylinder connections. |
| Every 20,000 booster cycles. (or 3-6 months) | a. Inspect and re-lubricate air cycling valve o-rings. (replace if necessary)<br>b. Check booster for oxygen leaking from vents external leakage, overall performance.<br>c. Check tie rod bolts, relief valve and air pilot switch lock nuts for loosening. |
| Every 6 months. | a. Test all pressure gauges.<br>b. Inspect and clean/replace oxygen and air filters. |
| Every 12 Months.<br>Every 500 hours of use. | a. Inspect piping at full system pressure.<br>b. Test relief valve.<br>c. Reseal Booster. |

**Tools and Material Required:**

- SAE wrench set, combination.
- Clean working surface, no oil, grease, dust, or moisture.
- Clean, Lint Free rags.
- Oxygen compatible cleaning solvent - "Blue-Gold", etc.
- Teflon Tape
- Halocarbon or other oxygen compatible grease.

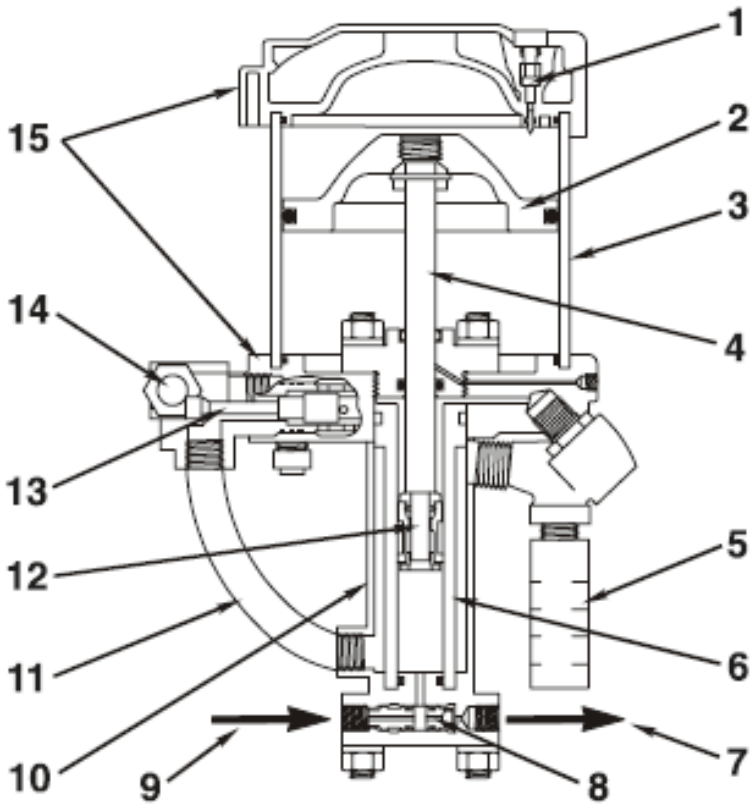
Remember the importance in maintaining the highest level of cleanliness of the tools and work bench. When any assembly is dismantled, it is recommended they be cleaned with a residue free, approved oxygen compatible agent to make sure they are oil, grease, and dust free.

It is well known that ordinary oils and greases contain hydrocarbons which can which can react violently in the presence of oxygen. Any other foreign material permitted to enter the booster circuit may also ignite spontaneously in high oxygen concentrations. Cotton particles and "fluff" from cleaning rags should be prevented from remaining on components prior to reassembly. A blow gun with clean oil free nitrogen is recommended to help prevent particles from remaining on/in components during reassembly.

# Operating and Maintenance Instructions

- Air Driven Gas Booster Compressors
  5-3/4” Drive AG, AGD & AGT Series

www.haskel.com




1. Pilot Valve
2. Air Piston
3. Air Drive Barrel
4. Connecing Rod
5. Exhaust Muffler
6. High Pressure Barrel
7. Pump Outlet
8. Check Valves
9. Pump Inlet
10. Cooling Jacket
11. Air Exhaust Tube
12. Pump Piston
13. Air Cycling Valve
14. Air Drive Inlet Port
15. Upper & Lower Caps

# Introduction

The Haskel “Oil Free” gas booster compressor is an air driven, non-lubricated, reciprocating piston type gas compressor available in single acting single stage, double acting single stage, and two stage configurations. Individual models may also be used in series for multiple staging. The model number is the approximate ratio of the air drive piston(s) area to the gas piston(s) area.

CAUTION: High pressure gas can be dangerous if improperly handled.

# Description

## General

The air drive piston(s) in all models are automatically cycled by a non-detented, unbalanced air valve spool that is alternately pressurized and vented by the pilot air system. This drive is directly connected to the booster section piston(s) which are designed to run dry without lubrication to supply gas free of hydrocarbon contamination. Exhaust air from the drive is used to cool the gas barrels and in 2 stage units, the gas intercooler. Some models depend on the cold air exhausting from the muffler slots directly against the gas barrel (without benefit of a cooling jacket). Therefore, the position of the exhaust muffler on these models should not be disturbed. Mufflers on models with cooling jackets may be relocated for noise or configuration convenience.

## Air Drive Section

**Refer to detailed assembly drawing of the air drive section provided with each unit.** The air drive section consists of one or more air drive piston assemblies, an unbalanced spool type cycling control valve and pilot valves (one mounted in the valve end cap and one in the opposite end cap), a flow tube to direct drive air flow from the valve end cap to the opposite end cap, and pilot tube to connect the two pilot valves, which are in series. The drive control valve operates without springs or detents and is cycled by the pilot valves alternately pressurizing and venting the large area on the inside end of this spool valve.

The control valve, pilot valves and drive cylinder are lubricated with Haskel air drive grease, part no. 50866, at assembly. Occasional relube of the easily accessible control valve and pilot valves with this grease may be needed depending on the duty cycle of the installation.

It is recommended that only o-rings and seals of proper compounds and hardness for low friction be used in the air drive section. Haskel replacement seals are recommended.

If not otherwise installed by the factory, always install a conventional bowl type shop air filter/water separator of the same or larger pipe size on the incoming air drive plumbing. Drain and maintain it regularly. **Do not use an airline lubricator of any kind.**

## Gas Section

**Refer to the detailed assembly drawing on the gas section(s) provided with each unit.** These sheets cover the individual parts and their installation for the gas section of the individual models. **Note that no lubrication of any kind is ever used on the dynamic seals of the gas pumping sections.** They are designed to run dry supported on the inherent low friction properties of the seal and bearing materials. The life of the gas section also depends on the cleanliness of the gas supply. Therefore, micronic filtration is suggested at the gas inlet port. If compressed air or other moisture containing gas is to be pumped, the initial dew point should be low enough to prevent saturation at booster output pressure, and if any carry over of oil from the compressed air source is evident, special coalescing type filtration may be necessary. Over the life of the moving parts, some migration of inert particles into the gas output should be expected. Therefore, a small particle filter on the high pressure line may be advisable for critical applications.

#### COMPRESSION RATIO-VOLUMETRIC EFFICIENCY

The compression ratio is the ratio of output pressure to gas supply pressure. (To calculate, use psi absolute values.) The gas pumping sections are designed to have minimum unswept or clearance volume at the end of the compression stroke. On the return (suction) stroke of the piston, output pressure in the

unswept volume expands to inlet pressure. This reduces the amount of potential fresh gas intake on the suction stroke. Volumetric efficiency therefore decreases rapidly with an increase in compression ratio until the volumetric efficiency reaches zero when the unexpelled (expanded) gas completely fills the cylinder at the end of the intake stroke. A cylinder with a 4% unswept volume will reach zero efficiency at a compression ratio of approximately 25:1.

Production models of Haskel gas boosters are tested in the laboratory. Results of these tests indicate that compression ratios of up to 40:1 are possible for some models under ideal conditions. However, for satisfactory operation under production conditions in industrial applications, we recommend compression ratios (per stage) of about 10:1 or less. Operation at higher ratios may not damage the gas booster but because output flow and efficiency will be low, the use should be limited to pressurizing small volumes such as pressure gauge testing, etc.

#### COOLING

Effective cooling of the gas pumping section is of paramount importance as service life of piston seals, bearings, and static seals are dependent upon proper operating temperatures. Haskel gas boosters use the exhaust air from the driving system to cool the gas barrel (and gas intercooler on the two stage models). Driving air expands during the work cycle with a significant reduction in temperature. Therefore, the exhaust air is a very efficient cooling medium.

In theory, compression ratios above 3:1 with most gases produce temperatures above the allowable limits for the seals. In practice, however, the heat of compression is transferred to the air cooled gas barrel and adjacent metal components during the relatively slow speed of the piston on the compression stroke and these components will stay within allowable temperature limits. Laboratory tests indicate that maximum temperatures occur between compression ratios of 5:1 and 10:1 and have shown that exhaust air cooling is adequate even when the booster is running at full speed.

The gas discharge temperature may run as high as approximately 150°F above ambient temperature. Under certain severe operating conditions, it may be necessary to slow down the cycling of the gas booster to prevent overheating. It is very difficult to predict exactly when overheating may occur. To test, install a thermocouple approximately 1 inch from the discharge port of the gas pumping section. Temperatures above 300°F at this point will shorten piston seal life considerably.

# Maintenance

## Air Valve Section

Remove spool or sleeve in the following manner:

1. Remove air exhaust fitting located in cycling valve end cap. Pull out spool; inspect 568017 o-rings. **Relube; reinstall; retest before further disassembly.**
2. If necessary, remove sleeve and bumper (rubber faced spacer at inside end of sleeve) with tool P/N 28584 as shown in figures 1, 2, and 3.

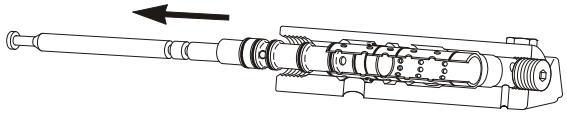


**Figure 1: Insert tool in second row of holes in sleeve and if necessary, pry out with screwdriver.**

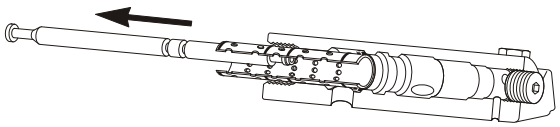


**Figure 2: Pull straight out.**

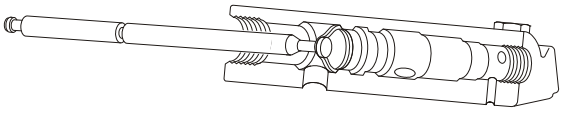


**Figure 3: Insert bumper hook through center of bumper and pull straight out.**

3. Replace any 568020 o-rings or the bumper/spacer if damaged, worn or swollen.
4. Lubricate o-rings with light coat of Haskel 50866 lubricant.
5. Use lubricant liberally to hold bumper/spacer to sleeve with rubber side facing sleeve.
6. Push lubricated sleeve and bumper into end cap bore, all the way in one quick motion. (If bumper drops off sleeve too soon, remove, regrease and repeat.)
7. Install spool.
8. Replace exhaust fitting.

## Pilot System

1. Remove hex o-ring sealed plug.
2. Remove spring and 27375 pilot stem (figure 4).
3. Inspect pilot stem and seat for foreign material. Replace stem if shank is bent or scratched.
4. Replace stem if molded seat is damaged.
5. Apply 50866 lubricant and reassemble in the reverse manner.

NOTE: Unless excessive leakage occurs, it is not advisable to replace the o-ring seal for the shank of the stem. This requires disassembly of the air section. If replacement is required, care must be taken in installing the Tru-Arc retainer concentrically as shown in figure 5. Use the 27375 pilot stem valve as seating tool. Place the rubber valve face against the retainer and tap the top of the valve lightly with a light hammer to **evenly** bend the legs of the retainer.

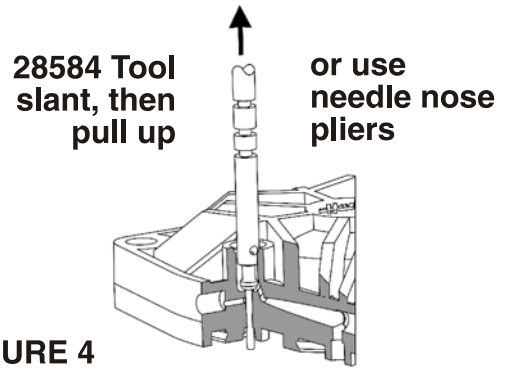
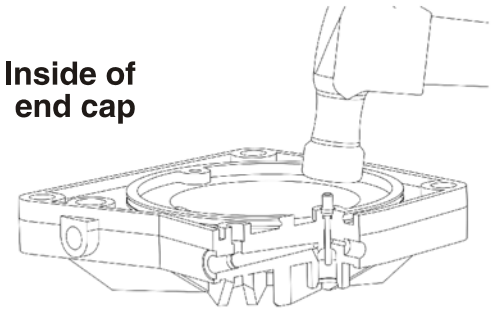



**FIGURE 4**




**Seating the Retainer** **FIGURE 5**

## Test Procedure for Pilot Control Valves - 27375:

After relube of the spool and reassembly, if the drive cycles erratically, the following test procedure will determine which of the pilot valves is faulty.

1. Remove the 17658-2 1/8" pipe plug in the upper end cap.
2. Install 0-160 psi pressure gauge.
3. Apply air pressure to the air drive inlet. Gauge will read zero pressure if **lower** pilot valve has not been actuated. Gauge will read full pilot air pressure if **upper** pilot valve has not been actuated. Correct pilot valve action will cause gauge to immediately rise or fall from zero to pilot air pressure. A slow **increase** in gauge reading indicates leakage past the seat of the pilot valve in the valve end cap. A slow **decrease** in pressure indicates leakage past the seat of the opposite pilot valve. Examine and replace as required. Check also for external air leaks at plugs.
4. If drive takes 1 stroke and stops, this is probably due to either pilot valve stem being too short. See the assembly drawing for description of procedure to determine proper stem length.

## For Disassembly and Repair of Air Drive Section and Air Piston:

1. Remove (4) tie bolts.
2. Remove air barrel and static seal o-rings.
3. Remove seal on air piston.
4. Remove air piston and rod assembly in air drive section.
5. See applicable assembly drawing. Note that the air drive seals and bearings **for the rods** are part of the **gas section** seal kit.
6. Inspect, replace and install all internal parts in air drive section per assembly drawing.

Relubricate air barrel with 50866 Haskel lubricant. Re-assemble drive in reverse order of disassembly instructions. Care must be taken in disassembly and assembly that the flow and pilot tube o-rings be on the flow and pilot tubes prior to assembly. Alternately (crosswise) torque tie rods to a maximum

# Operating and Maintenance Instructions

## CE Compliance Supplement

### SAFETY ISSUES

a. Please refer to the main section of this instruction manual for general handling, assembly and disassembly instructions.

b. Storage temperatures are 25°F – 130°F (-3.9°C – 53.1°C).

c. Lockout/tagout is the responsibility of the end user.

d. If the machine weighs more than 39 lbs (18 kg), use a hoist or get assistance for lifting.

e. Safety labels on the machines and meanings are as follows:

**General Danger**

**Read Operator’s Manual**

f. In an emergency, turn off the air supply.

g. Warning: If the pump(s) were not approved to ATEX, it must NOT be used in a potentially explosive atmosphere.

h. Pressure relief devices must be installed as close as practical to the system.

i. Before maintenance, liquid section(s) should be purged if hazard liquid was transferred.

j. The end user must provide pressure indicators at the inlet and final outlet of the pump.

k. Please refer to the drawings in the main instruction manual for spare parts list and recommended spare parts list.

***Our products are backed by outstanding technical support, and excellent reputation for reliability, and world-wide distribution.***

LIMITED WARRANTY

Haskel manufactured products are warranted free of original defects in material and workmanship for a period of one year from the date of shipment to first user. This warranty does not include packings, seals, or failures caused by lack of proper maintenance, incompatible fluids, foreign materials in the driving media, in the pumped media, or application of pressures beyond catalog ratings. Products believed to be originally defective may be returned, freight prepaid, for repair and/or replacement to the distributor, authorized service representative, or to the factory. If upon inspection by the factory or authorized service representative, the problem is found to be originally defective material or workmanship, repair or replacement will be made at no charge for labor or materials, F.O.B. the point of repair or replacement. Permission to return under warranty should be requested before shipment and include the following: The original purchase date, purchase order number, serial number, model number, or other pertinent data to establish warranty claim, and to expedite the return of replacement to the owner.

If unit has been disassembled or reassembled in a facility other than Haskel, warranty is void if it has been improperly reassembled or substitute parts have been used in place of factory manufactured parts.

Any modification to any Haskel product, which you have made or may make in the future, has been and will be at your sole risk and responsibility, and without Haskel's approval or consent. Haskel disclaims any and all liability, obligation or responsibility for the modified product; and for any claims, demands, or causes of action for damage or personal injuries resulting from the modification and/or use of such a modified Haskel product.

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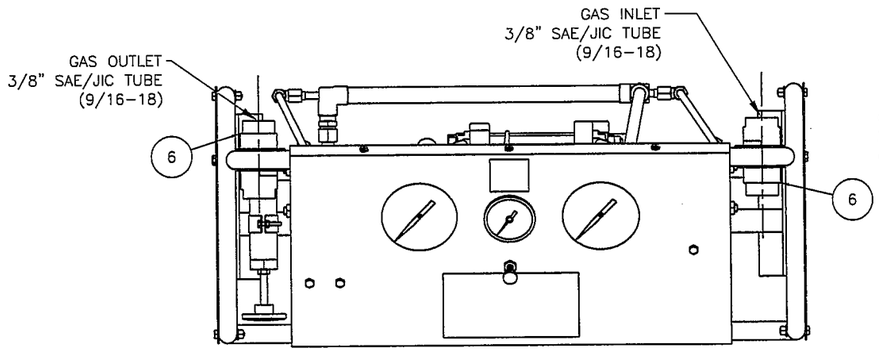
ISO 9001 Q05225 ISO 14001 EMS511920

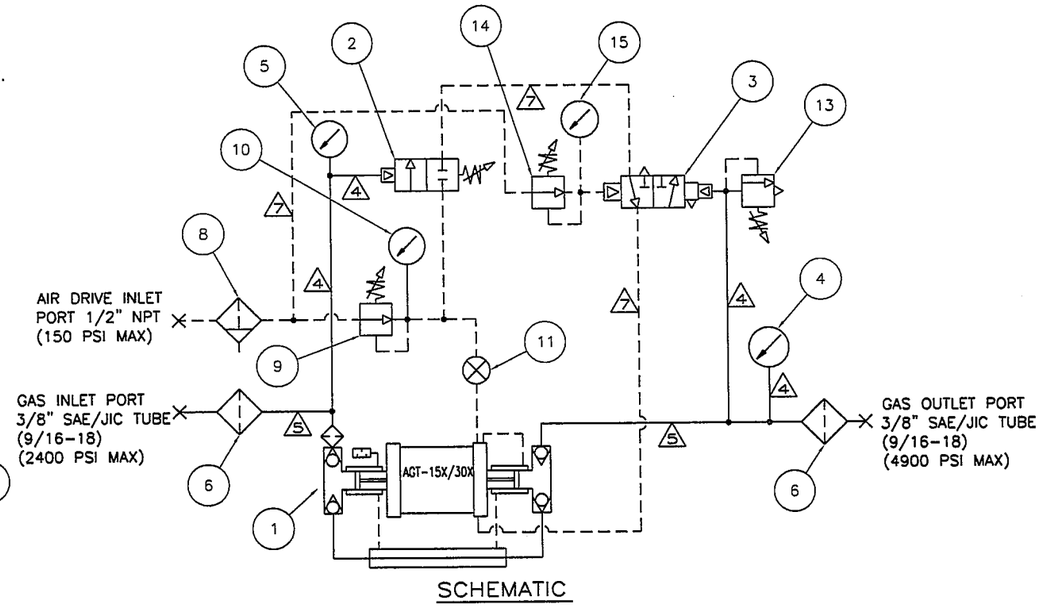
26968

| REVISIONS | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| AF | REVISED PER ECO 28821 | 3/27/04 | MK |

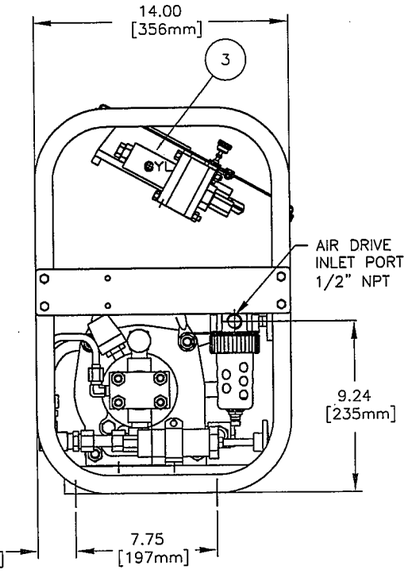
NOTES:
1. ALL PLUMBING, FITTINGS & COMPONENTS IN OXYGEN SECTION TO BE CLEANED FOR OXYGEN SERVICE.
2. 26968 AS SHOWN 26968-1 WITHOUT FILTERS (ITEM 6)
3. ALL DIMENSIONS SHOWN ARE APPROXIMATE IN INCHES, WITH MILLIMETERS IN PARENTHESES.
4. 1/4" OD X .049 WALL THICKNESS, 304 C'RES SEAMLESS TUBING (MAX GAS WORKING PRESSURE 6500 PSI) (P/N CNM00020)
5. 3/8" OD X .049 WALL THICKNESS, 304 C'RES SEAMLESS TUBING (MAX GAS WORKING PRESSURE 4900 PSI) (P/N CNM00072)
6. RECORD THE AIR SIGNAL PRESSURES AND ADD TO REMOTESET LABEL USING THE FOLLOWING ACTUATION PRESSURES: 1800, 2500 & 4750 PSI A MININUM DOWNSTREAM RECEIVER VOLUME OF 134 CU. IN. IS REQUIRED.
7. 1/4" OD X .180" I.D. BLACK NYLON 11 TUBING (MAX AIR WORKING PRESSURE 150 PSI) (P/N PB0754100)
8. GOVT. NSN #3655-01-042-3633.

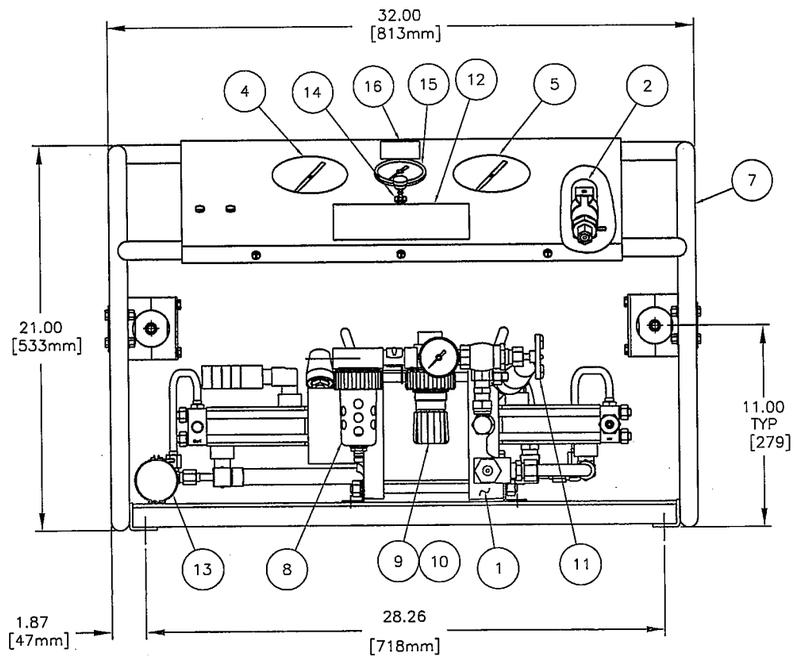
TEST PROCEDURE:
1. ATTACH OUTLET RECEIVER VOLUME 134 CU. IN. MIN.
2. CONNECT INLET SUPPLY GAS NOMINALLY 1300 PSI (N2) (±800 PSI).
3. ATTACH AIR DRIVE 150 PSI MAX.
4. BUBBLE CHECK SYSTEM AT NOMINAL 1000 PSI (N2).
5. SET ALL SYSTEM RELIEF VALVES PER SCHEMATIC OR P/L AS SHOWN (+0 PSI -50 PSI).
6. SET INLET AIR PILOT SWITCH AT DECREASING SETTING, PER SCHEMATIC OR P/L AS SHOWN (+25 PSI -0 PSI).
7. SET REMOTESET AIR PILOT SWITCH AND NOTE SIGNAL PRESSURE AS REFERENCED BY NOTE 6 OF THIS DRAWING (+0 PSI -50 PSI).
8. RECHECK SYSTEM (BUBBLE CHECK) FOR LEAKAGE AT FULL SYSTEM PRESSURE.
9. VENT CIRCUIT AND PREPARE FOR SHIPMENT.




SCHEMATIC




| | | | | | |
|---|---|---|---|---|---|
| 1 | 1 | 57876 | REMOTESET NAMEPLATE | HASKEL | 16 |
| 1 | 1 | 85420-1.6 | REMOTESET PRESSURE GAUGE 0-160 PSI | HASKEL | 15 |
| 1 | 1 | 58537 | REMOTESET PILOT REGULATOR | HASKEL | 14 |
| 1 | 1 | 27741-12 | RELIEF VALVE SET @ 2650 PSI | HASKEL | 13 |
| 1 | 1 | 54205 | OXYGEN NAMEPLATE | HASKEL | 12 |
| 1 | 1 | 27745 | SPEED CONTROL VALVE | HASKEL | 11 |
| 1 | 1 | 27997 | AIR PRESSURE GAUGE 0-160 PSI | HASKEL | 10 |
| 1 | 1 | 27991 | AIR REGULATOR | HASKEL | 9 |
| 1 | 1 | 27990 | AIR FILTER (40 MICRON) | HASKEL | 8 |
| 1 | 1 | 55820-30G | ROLL BAR FRAME (GREEN) | HASKEL | 7 |
| | 2 | 87260-12 | GAS FILTER BRASS (10 MICRON) | HASKEL | 6 |
| 1 | 1 | 59560-30 | PRESSURE GAUGE 0-3000 PSI | HASKEL | 5 |
| 1 | 1 | 59560-60 | PRESSURE GAUGE 0-6000 PSI | HASKEL | 4 |
| 1 | 1 | 55790-10 | REMOTESET AIR PILOT SWITCH NO INCR SEE NOTE 6 | HASKEL | 3 |
| 1 | 1 | 28755-13 | AIR PILOT SWITCH NO SET @ 150 PSI DECR | HASKEL | 2 |
| 1 | 1 | 27187 | OXYGEN BOOSTER W/EXT PILOT MOD (AGT-15X/30X) | HASKEL | 1 |
| -1 | BASIC | PART NUMBER | DESCRIPTION | MANUFACTURE | ITEM |



NEXT ASSY (REF ONLY): B-8312

| APPROVALS | DATE |
|---|---|
| DRAWN RTG | 7/13/71 |
| CHECKED | |
| APPROVED FJB | |
| CAD FILE NAME 26968 | |

Haskel International, Inc.
Burbank, California 91502

TITLE: SYSTEM, OXYGEN BOOSTER (AGT-15X/30X

SIZE D | FSCM NO. 81400 | DWG NO. 26968 | REV AF

SCALE 1/4 | NO MANUAL REVISIONS ALLOWED | SHEET 1 OF 1

REV A 10/27/2004 ECO 25659

L

27187



## REVISIONS

1. MUST BE REWORKED
2. USE EXISTING PART AS IS
3. NOW SHOP PRACTICE
4. RECORD CHANGE

DISPOSITION OTHER THAN ABOVE TO BE DESCRIBED IN DESCRIPTION COLUMN

| REV | DESCRIPTION | DATE | DISP | BY | APPD |
|---|---|---|---|---|---|
| L | Redrawn to cad format. Clarified drawing. Title and body of drawing was modified AGT-15/30 which is a 28007. See ECO 4209 | 11/26/96 | | PS | D/A |

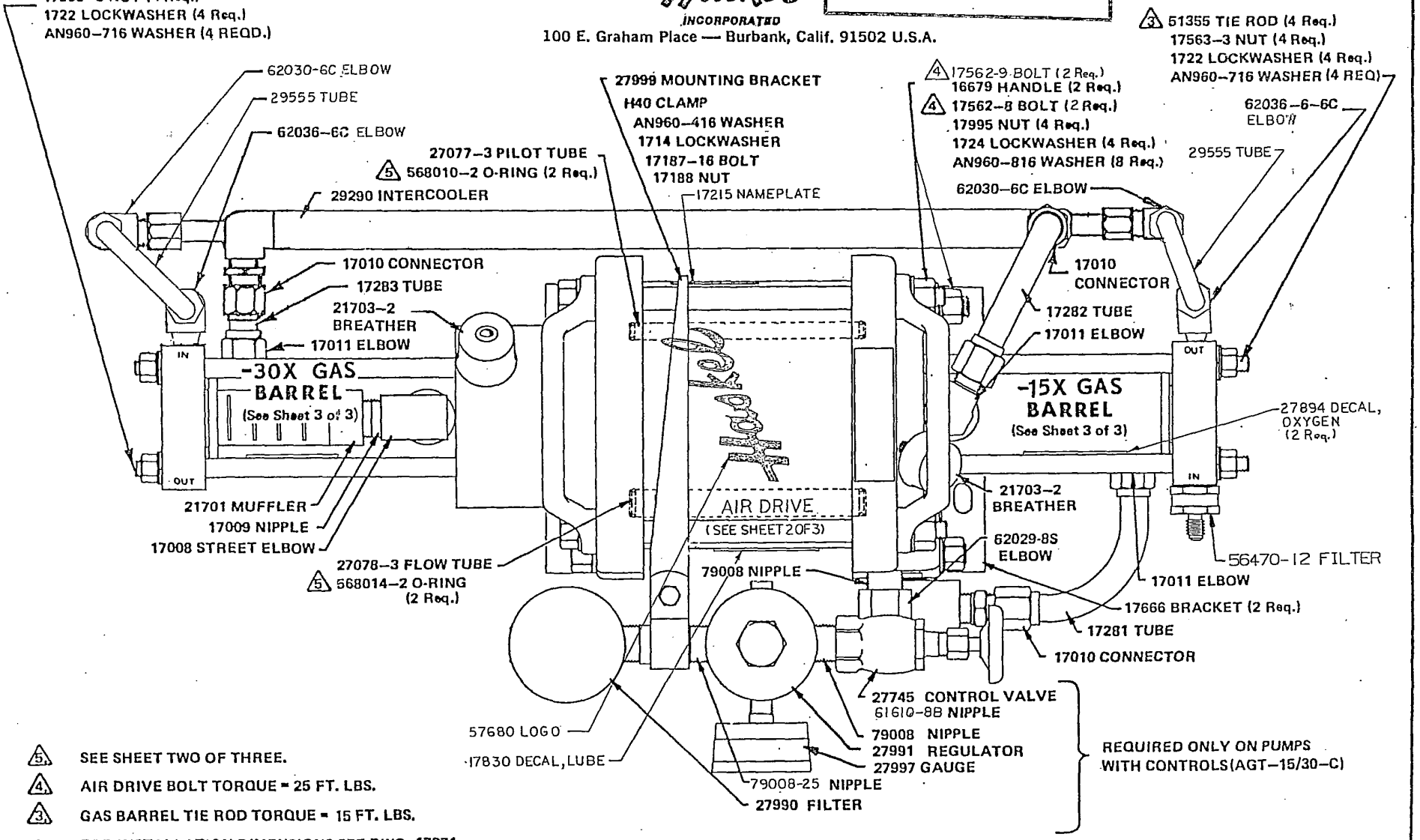
**THIS IS A STANDARD 28007 OXYGEN BOOSTER WITH 28881 EXTERNAL PILOT MOD.**

CONTROL COPY
LOCATION # 1

| | | | | | |
|---|---|---|---|---|---|
| MACH. TOLERANCES<br>UNLESS OTHERWISE SPECIFIED<br>DECIMAL DIM. .XX± .030 .XXX± 010<br>ANGULAR DIM .X°± .1° .X°XX' ±0°10'.<br>BREAK SHARP EDGES .006 .030 INTERNAL RADII .030<br>MACHINE FINISH 250 | | | Haskel | HASKEL, INT'L<br>100 E. GRAHAM PLACE<br>BURBANK, CALIFORNIA 91502 U.S.A. | |
| | DRAWN P. SPEED | 11/26/96 | TITLE: 28007 OXYGEN BOOSTER W/28881 EXTERNAL PILOT MOD | | |
| MATERIAL | CHECK D/A | 11/26/96 | | | |
| TREATMENT | APPD D/A | 11/26/96 | SIZE A | CODE IDENT. NO. 81400 | DWG NO. 27187 |
| FINISH | | | SCALE | WT. | SHEET 1 OF 1 |

LOCATION # 1

Haskel INCORPORATED
100 E. Graham Place — Burbank, Calif. 91502 U.S.A.




5. SEE SHEET TWO OF THREE.
4. AIR DRIVE BOLT TORQUE = 25 FT. LBS.
3. GAS BARREL TIE ROD TORQUE = 15 FT. LBS.
2. FOR INSTALLATION DIMENSIONS SEE DWG. 17271
1. ALL PARTS (1) REQ. UNLESS SHOWN IN PARENTHESES.

NOTES:



# PARTS LIST
# AGT - 15/30 (FOR OXYGEN SERVICE)

28007

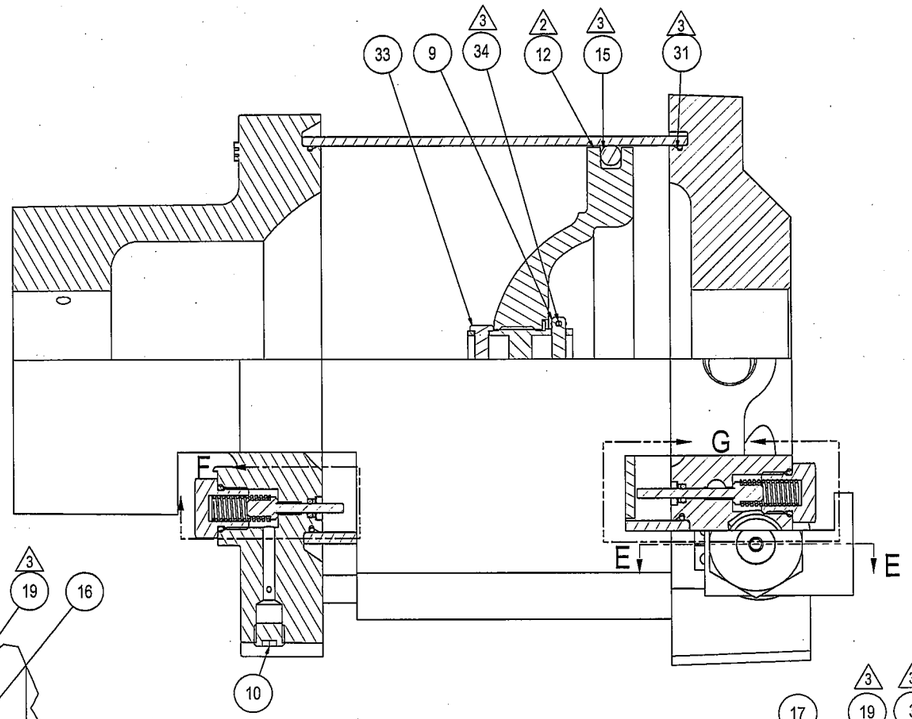
Sheet 1 of 3

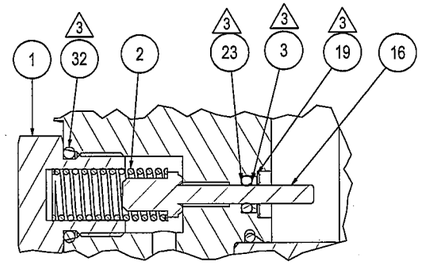
| REV | DESCRIPTION | DATE | DISP | BY | APPR. |
|---|---|---|---|---|---|
| F | SEE ECO 2197 | 5-15-95 | | JP | DH |

AD-7

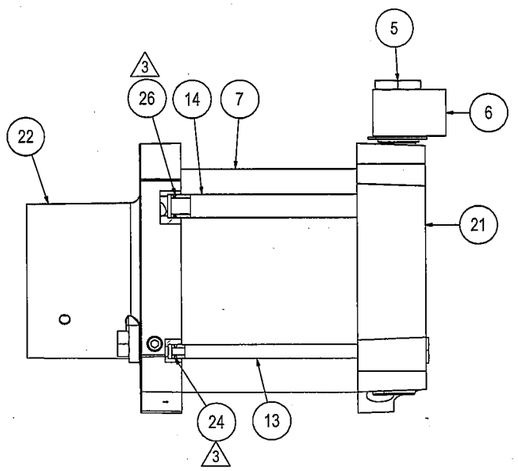
| REVISION | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| P | REVISED PER ECO 28348 | 7/15/09 | SAP |

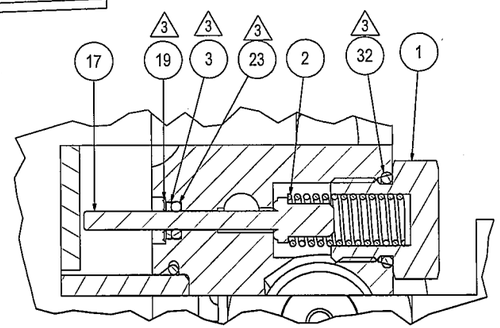
| PARTS LIST | | | |
|---|---|---|---|
| ITEM | PART NUMBE | DESCRIPTION | QTY |
| 1 | 16510 | PLUG | 2 |
| 2 | 16513 | SPRING | 2 |
| 3 | 16517 | SPACER | 2 |
| 4 | 16648 | SLEEVE | 1 |
| 5 | 16788 | RETAINER | 1 |
| 6 | 16789 | FITTING | 1 |
| 7 | 17339-2 | BARREL | 1 |
| 8 | 17524 | SPACER | 1 |
| 9 | 17554 | PIN | 1 |
| 10 | 17568-2 | PLUG | 2 |
| 11 | 17568-5 | PIPE PLUG | 1 |
| 12 | 17580 | PISTON ASSEMBLY | 1 |
| 13 | 27077-3 | TUBE, PILOT | 1 |
| 14 | 27078-3 | FLOW TUBE | 1 |
| 15 | 27272 | O-RING | 1 |
| 16 | 27375-6V | STEM | 1 |
| 17 | 27375-7V | STEM | 1 |
| 18 | 28088 | SPOOL ASSEMBLY | 1 |
| 19 | 5005-31H | RETAINER RING | 2 |
| 20 | 5100-112H | RETAINER | 1 |
| 21 | 51356 | LOWER CAP | 1 |
| 22 | 51357 | CAP-UPPER | 1 |
| 23 | 568006-2 | O-RING | 2 |
| 24 | 568010-2 | O-RING | 2 |
| 25 | 568013-2 | O-RING | 1 |
| 26 | 568014-2 | O-RING | 2 |
| 27 | 568015-21 | O-RING | 1 |
| 28 | 568017-21 | O-RING | 8 |
| 29 | 568020-2 | O-RING | 5 |
| 30 | 568021-2 | O-RING | 2 |
| 31 | 568050-2 | O-RING | 2 |
| 32 | 568906-9 | O-RING | 2 |
| 33 | MS20392-2C25 | PIN | 1 |
| 34 | MS24665-151 | COTTER PIN | 3 |



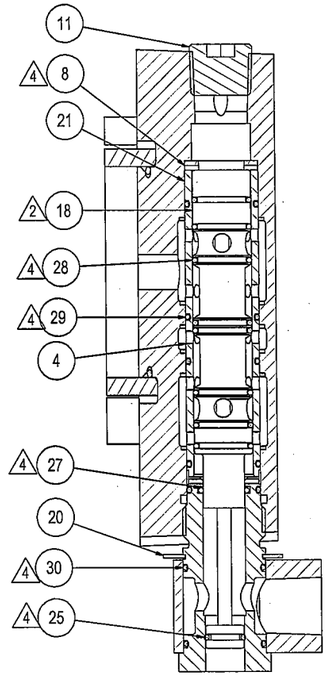




DETAIL F




DETAIL G




SECTION E-E

NOTES:

1. LUBRICATE AIR CYCLING VALVE, AIR DRIVE BARRELS & SEALS PER HPS-3.14.
2. PISTON ASSEMBLIES AND SPOOL ASSEMBLY ARE NON-SEPARABLE ASSEMBLIES, SEPARATE PARTS OF THESE ASSEMBLIES ARE NOT OBTAINABLE.
3. "AIR DRIVE SEALS KIT", P/N 51545-1.
4. "AIR CYCLING VALVE SEALS KIT", P/N 17329, PLUS A TUBE OF HASKEL SILICONE LUBE, P/N 50866.
5. ALL CARBON FILLED TFE SEALS SHOULD BE ASSEMBLED DRY **(DO NOT LUBRICATE).**

# AIR DRIVE (SINGLE HEAD, DOUBLE ACTING)

| SINGLE STAGE | TWO STAGE |
|---|---|
| AGD-15, AGD-30, AGD-50, AGD-75 | AGT-15/30, AGT-15/50, AGT-15/75, AGT-30/50, AGT-30/75, AGT-32/102, AGT-62/105 |

NEXT ASSY (REF ONLY)

Haskel International, Inc.
Burbank, California 91502

| APPROVALS | | DATE |
|---|---|---|
| DRAWN | JAN | 10/04/07 |
| CHECKED | DL | 4/21/08 |
| APPROVED | SDQ | 4/22/08 |
| CAD FILENAME | | AD-7 |

TITLE: AIR DRIVE

| SIZE | CAGE CODE | DWG NO. | REV |
|---|---|---|---|
| D | 81400 | AD-7 | P |

SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 1

| REVISION | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| U | REVISED PER ECO31531 | 9/19/2014 | P D |

**ASSEMBLY PROCEDURE FOR GAS PISTON: (USE 17246 ASSEMBLY TOOL)**

WITH PISTON ROD HELD SECURELY AND EXTENDING 1/4" BEYOND THE END OF THE GAS BARREL, ASSEMBLE THE PARTS IN THE ORDER SHOWN USING THE FLAT END OF THE ASSEMBLY TOOL TO COMPACT THE SEALS. BE SURE THAT THE BELLEVILLE SPRINGS ARE ASSEMBLED IN SETS OF TWO, CUPPED ALTERNATIVELY IN OPPOSITE DIRECTIONS. USE THE OTHER END OF ASSEMBLY TOOL TO TORQUE THE NUT DOWN UNTIL SNUG AND THEN BACK OFF UNTIL A SLOT IN THE NUT LINES UP WITH THE HOLE IN THE ROD. INSERT AND SECURE THE COTTER PIN.

*NOTE: WHEN PROPERLY TIGHTENED, THE 51373 NUT SHOULD SOLIDLY CONTACT THE 51371 PISTON AND BE APPROXIMATELY FLUSH WITH THE END OF THE 51375 ROD. (IF NECESSARY, USE FEWER 16719-6 SPRINGS TO ACHIEVE THIS.)

**ASSEMBLY PROCEDURE FOR GAS CHECK VALVES: (USE 16675 ASSEMBLY TOOL)**

1. PLACE OUTLET PORT IN THE UPRIGHT POSITION. INSERT SEAT, BALL, RING, SMALL SPRING, SHANK AND LARGE SPRING UNTIL SEATED PROPERLY. IT IS IMPORTANT THAT THESE PARTS ARE IN PROPER POSITION BEFORE CONTINUING. SLIDE ONE SET OF PACKINGS (BRONZE, THIN TFE BACK-UP, O-RING, THICK TFE BACK-UP) IN THE ORDER SHOWN ONTO SEAT FITTING THE THICK TFE BACK-UP TFE BACK-UP WILL PROVIDE SUFFICIENT GRIP TO RETAIN THE PACKINGS DURING INSERTION.

   THEN, USING ASSEMBLY TOOL, SCREW SEAT IN UNTIL IT IS SNUG (APPROXIMATELY 5/8" BELOW END CAP FACE). USING A THIN ROD, DEPRESS BALL THROUGH INLET PORT TO VERIFY PROPER MOVEMENT.
2. PLACE INLET PORT IN UPRIGHT POSITION. INSERT LARGE SPRING, SHANK, RING, SMALL SPRING, BALL AND SEAT INTO PORT UNTIL SEATED. IT IS IMPORTANT THAT THE PARTS ARE IN PROPER POSITION BEFORE CONTINUING. SLIDE ONE SET OF PACKINGS (BRONZE, THIN TFE BACK-UP, O-RING, THICK TFE BACK-UP) IN THE ORDER SHOWN ONTO SEAT FITTING. THE THICK TFE BACK-UP WILL PROVIDE SUFFICIENT GRIP TO RETAIN THE PACKINGS DURING INSERTION. THEN, USING THE ASSEMBLY TOOL.

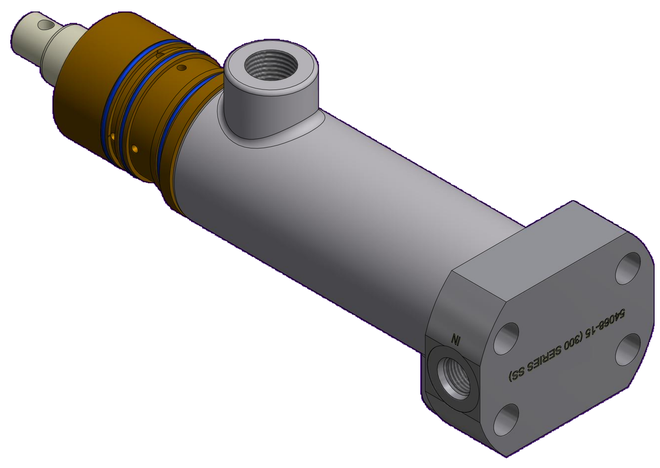
   SCREW THE SEAT IN UNTIL IT IS SNUG (APPROXIMATELY 5/8" BELOW END CAP FACE). CHECK THAT THE BALL IS FREE TO MOVE BY DEPRESSING IT WITH A THIN ROD FROM THE INLET END.

△7 INDICATES PARTS IN SEAL KIT 51548-15

△8 INDICATES PARTS IN SEAL KIT 17677

△9 INDICATES PARTS IN END CAP ASSEMBLY 53632-15X

10. ALL PARTS IN OXYGEN SECTION TO BE CLEANED FOR OXYGEN SERVICE PER HPS-4.11




| QTY | PART NUMBER | DESCRIPTION | MATERIAL | ITEM |
|---|---|---|---|---|
| 1 | 54068-15 | END CAP -AG SERIES (-15) | 300 SERIES SS | 42 |
| 1 | 51367 | BARREL, GAS PUMP, -15 | 15-5 SS | 41 |
| 2 | 568012-31 | O-RING | VITON | 40 |
| 2 | 17421 | BACKUP RING | PTFE | 39 |
| 2 | 17422 | BACK-UP | ALUM BRONZE | 38 |
| 2 | 54067 | SEAT, CHECK VALVE | 15-5 SS | 37 |
| 2 | 56228 | BACKUP RING | PTFE | 36 |
| 2 | 26130-8 | BALL | 316 SS | 35 |
| 2 | 26685 | SPRING | 316 SS | 34 |
| 2 | 28083-1 | RING | 316 SS | 33 |
| 2 | 28083-2 | RETAINER CHECK VALVE | 316 SS | 32 |
| 2 | 28082 | SPRING | 316 SS | 31 |
| 1 | 28081-3 | SEAT | PTFE, VIRGIN | 30 |
| 1 | 28081-1 | SEAT | PTFE, VIRGIN | 29 |
| 8 | 16719-6 | BELLEVILLE SPRING | 17-7PH SS | 28 |
| 2 | 568028-7 | O-RING | VITON | 27 |
| 1 | 568119-7 | O-RING | VITON | 26 |
| 1 | 51368 | BEARING | RYTON 134 | 25 |
| 1 | 51374 | RETAINER | 303 SS | 24 |
| 1 | MS24665-90 | COTTER PIN | SS | 23 |
| 1 | 51373 | NUT | 300 SERIES SS | 22 |
| 1 | 568013-31 | O-RING | VITON | 21 |
| 1 | MS28774-013 | BACKUP | PTFE | 20 |
| 1 | 51372-2 | BEARING, AG-15 | COPPER, ALLOY | 19 |
| 1 | 568216-31 | O-RING | VITON | 18 |
| 1 | 17566 | SEAL, AA-15 | CARBON FILLED TEFLON | 17 |
| 1 | 17225-15 | BACK-UP | BRONZE, B-4 | 16 |
| 1 | 16704-15 | SEAL-TEFLON, AG PUMPS | TEFLON | 15 |
| 1 | 16705-15 | BACKUP BRONZE | BRONZE | 14 |
| 1 | 51371 | PISTON | 303 SS | 13 |
| 2 | 17254-15 | BACKUP RING | PTFE-GLASS FIBER FILLED | 12 |
| 1 | 51369 | SPACER | 300 SERIES SS | 11 |
| 1 | 51366 | BUSHING | 303 SS | 10 |
| 1 | 51351-4 | GLIDER RING | CARBON FILLED PTFE | 9 |
| 1 | 51375 | ROD, PISTON | 15-5 PH SS | 8 |
| 4 | 568031-7 | O-RING | VITON | 7 |
| 1 | 568032-2 | O-RING | BUNA-N | 6 |
| 1 | 568123-31 | O-RING | VITON | 5 |
| 1 | 568213-7 | O-RING | VITON | 4 |
| 1 | 5008-156H | RETAINING RING | 15-7PH SS | 3 |
| 1 | 51370 | SEAL-ROD | CARBON FILLED TEFLON | 2 |
| 1 | 16659 | COOLING BARREL | 6061-T6 AL | 1 |

PARTS LIST

NEXT ASSY (REF ONLY)

Haskel International, LLC
Burbank, California 91502

| APPROVALS | | DATE |
|---|---|---|
| DRAWN | CW | 9/16/2014 |
| CHECKED | P D | 9/19/2014 |
| APPROVED | S D Q | 9/19/2014 |
| CAD FILENAME | GS-15X | |

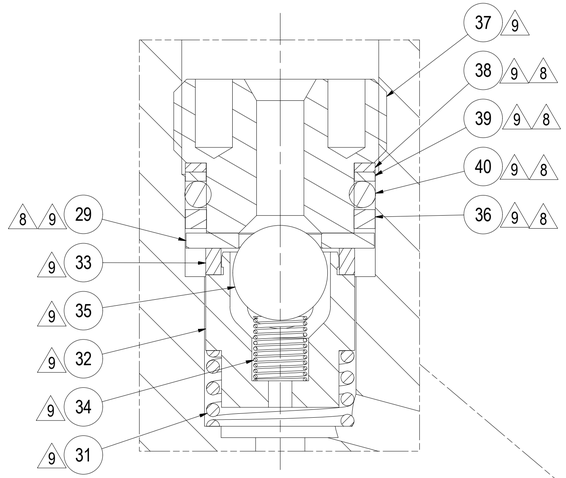
TITLE: GS-15X GAS SECTION (FOR OXYGEN SERVICE)

| SIZE | CAGE CODE | DWG NO. | REV |
|---|---|---|---|
| D | 81400 | GS-15X | U |

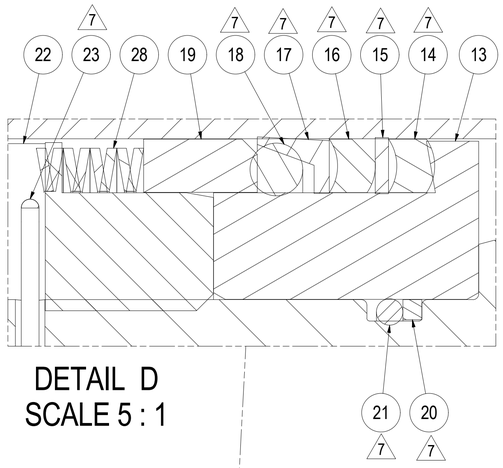
SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 2

GS-15X

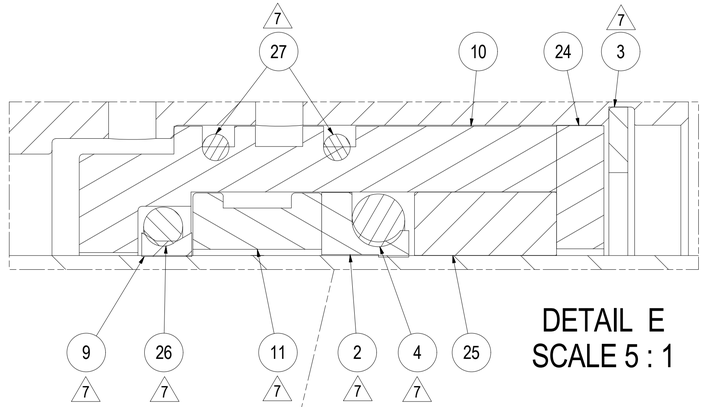
| REVISION | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| | SEE SHEET 1 | | |



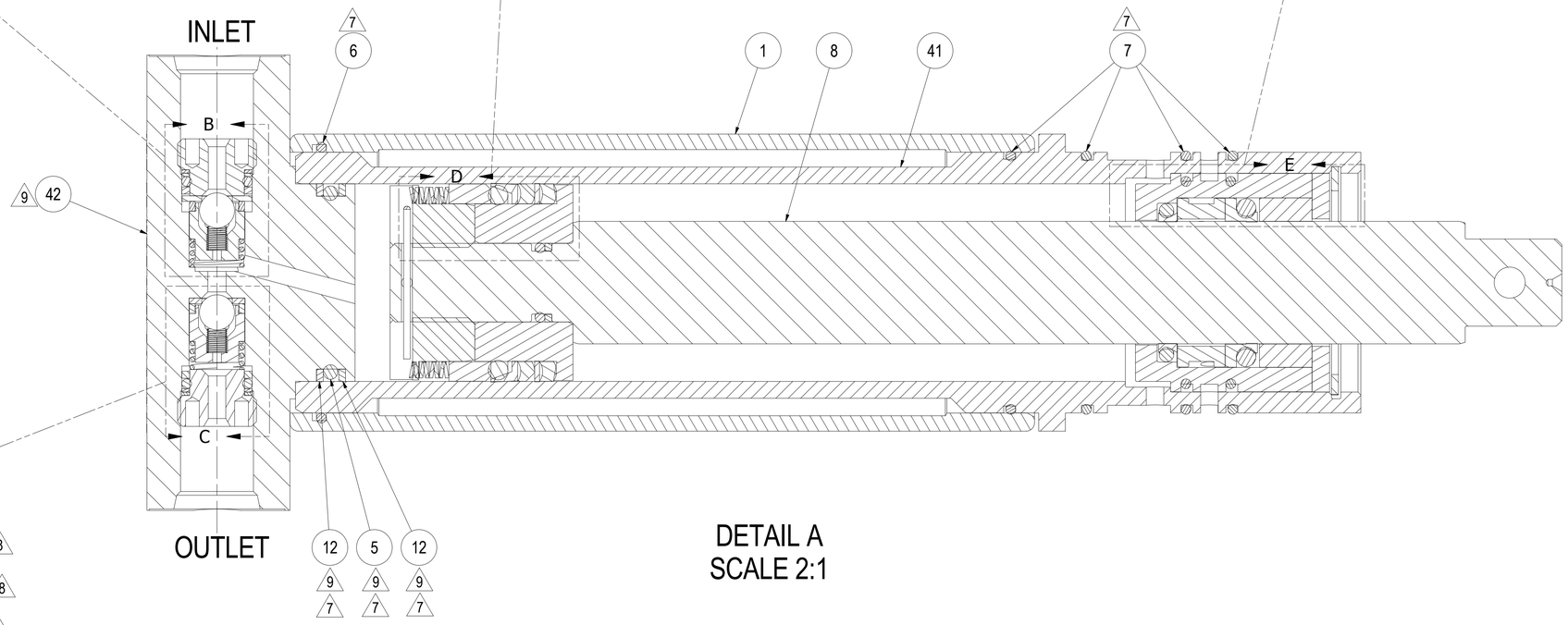

DETAIL B
SCALE 5 : 1
INLET



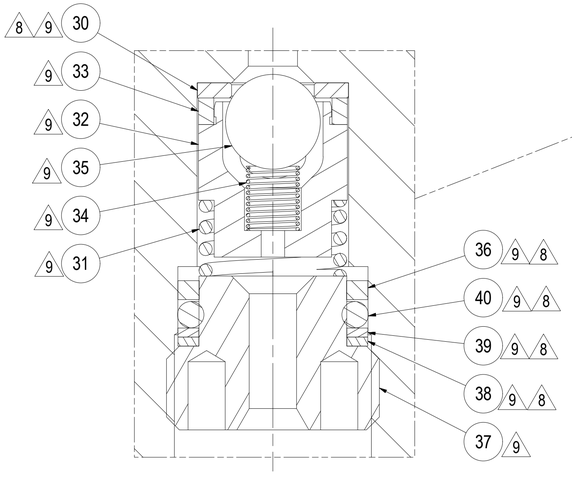

DETAIL D
SCALE 5 : 1




DETAIL E
SCALE 5 : 1




DETAIL A
SCALE 2:1




DETAIL C
SCALE 5 : 1
OUTLET

## -15 GAS SECTION



Haskel International, LLC
Burbank, California 91502

| | | | | | |
|---|---|---|---|---|---|
| DRAWN | CW | SIZE D | CAGE CODE 81400 | DWG NO. GS-15X | REV U |
| CHECKED | P D | SCALE: NONE | INVENTOR DRAWING | | SHEET 2 OF 2 |

REV. 08/15/2013, D. MACH

| REVISION | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| U | REVISED PER ECO 29952 | 4/17/2012 | P D |

**ASSEMBLY PROCEDURE FOR GAS PISTON: (USE 17246 ASSEMBLY TOOL)**

WITH PISTON ROD HELD SECURELY AND EXTENDING ¼" BEYOND THE END OF THE GAS BARREL.
ASSEMBLE THE PARTS IN THE ORDER SHOWN USING THE FLAT END OF ASSEMBLY TOOL TO COMPACT THE SEALS.
BE SURE THAT THE BELLEVILLE SPRINGS ARE ASSEMBLED IN SETS OF TWO.
CUPPED ALTERNATIVELY IN OPPOSITE DIRECTIONS.
USE THE OTHER END OF ASSEMBLY TOOL TO TORQUE THE NUT DOWN UNTIL SNUG AND THEN BACK OFF UNTIL A SLOT
IN THE NUT LINES UP WITH THE HOLE IN THE ROD. INSERT AND SECURE THE COTTER PIN.

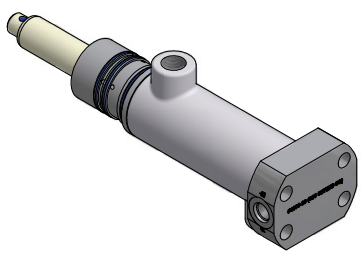
NOTE: WHEN PROPERLY TIGHTENED THE 51364 NUT SHOULD SOLIDLY CONTACT THE 17937-1
ROD AND BE APPROXIMATELY FLUSH WITH THE ROD END.
(IF NECESSARY, USE FEWER 16719-5 SPRINGS TO ACHIEVE THIS).

**ASSEMBLY PROCEDURE FOR GAS CHECK VALVES: (USE 16675 ASSEMBLY TOOL)**

1. PLACE OUTLET PORT IN THE UPRIGHT POSITION INSERT SEAT, BALL, RING, SMALL SPRING, SHANK AND LARGE SPRING UNTIL SEATED.
   IT IS IMPORTANT THAT THESE PARTS ARE IN THE PROPER POSITION BEFORE CONTINUING.
   SLIDE ONE SET OF PACKINGS (BRONZE BACK-UP, THIN TFE BACK-UP, O-RING AND THICK TFE BACK-UP) IN THE ORDER SHOWN ONTO THE SEAT FITTING.
   THE THICK TFE BACK-UP WILL PROVIDE SUFFICIENT GRIP TO RETAIN THE PACKINGS DURING INSERTION.
   THEN, USING THE ASSEMBLY TOOL, SCREW SEAT IN UNTIL IT IS SNUG (APPROXIMATELY 5/8" BELOW END CAP FACE).
   USING THIN ROD DEPRESS BALL THROUGH INLET PORT TO VERIFY PROPER MOVEMENT.

2. PLACE INLET PORT IN UPRIGHT POSITION, INSERT LARGE SPRING, SHANK, RING, SMALL SPRING, BALL AND SEAT INTO PORT UNTIL SEATED.
   IT IS IMPORTANT THAT THESE PARTS ARE IN THE PROPER POSITION BEFORE CONTINUING.
   SLIDE ONE SET OF PACKINGS (BRONZE BACKUP, THIN TFE BACK-UP, O-RING, AND THICK TFE BACK-UP) IN THE ORDER SHOWN ONTO THE SEAT FITTING.
   THE THICK TFE BACK-UP WILL PROVIDE SUFFICENT GRIP TO RETAIN THE PACKINGS DURING INSERTION.
   THEN, USING THE ASSEMBLY TOOL, SCREW THE SEAT IN UNTIL IT IS SNUG (APPROXIMATELY 5/8" BELOW END CAP FACE).
   CHECK THAT THE BALL IS FREE TO MOVE BY DEPRESSING IT WITH A THIN ROD FROM THE INLET END.

⚠7 INDICATES PARTS IN SEAL KIT 51548-30
⚠8 INDICATES PARTS IN SEAL KIT 17677
⚠9 INDICATES PARTS IN END CAP ASSEMBLY 53632-30X
10 ALL PARTS IN OXYGEN SECTION TO BE CLEANED FOR OXYGEN SERVICE PER HPS-4.11



| QTY | PART NUMBER | DESCRIPTION | MATERIAL | ITEM |
|---|---|---|---|---|
| 1 | MS24665-90 | COTTER PIN | SS | 36 |
| 1 | 51364 | NUT | 303 SS | 35 |
| 12 | 16719-5 | SPRING WASHER | 17-4 PH SS | 34 |
| 1 | 51365-2 | BEARING AG-30 | BRONZE, SOFT TIN | 33 |
| 1 | 568117-31 | O-RING | VITON | 32 |
| 1 | 27065 | SEAL | TEFLON | 31 |
| 1 | 17225-30 | BACKUP, GAS PACKING | BRONZE, SOFT TIN | 30 |
| 1 | 16704-30 | SEAL, TEFLON | TEFLON | 29 |
| 1 | 16705-30 | BACKUP BRONZE | BRONZE, SOFT TIN | 28 |
| 1 | 17937-1 | ROD, PISTON | 15-5 PH SS | 27 |
| 1 | 568215-7 | O-RING | VITON A | 26 |
| 1 | 51361 | ROD SEAL | CARBON FILLED TEFLON | 25 |
| 1 | 5008-131H | RETAINER RING | 300 SERIES SS | 24 |
| 1 | 51360 | BEARING | RYTON | 23 |
| 1 | 51359 | SPACER | 300 SERIES SS | 22 |
| 1 | 568121-7 | O-RING | VITON | 21 |
| 1 | 51351-3 | GLIDER RING | CARBON FILLED TEFLON | 20 |
| 1 | 568032-2 | O-RING | BUNA-N | 19 |
| 1 | 16659 | COOLING BARREL | 6061-T6 AL | 18 |
| 4 | 568031-7 | O-RING | VITON | 17 |
| 1 | 51358 | BARREL, AG-30 | 15-5 PH OR 17-4 (H925) | 16 |
| 2 | 17254-30 | BACK-UP RING | GLASS FIBER FILLED TEFLON | 15 |
| 1 | 568117-7 | O-RING | VITON | 14 |
| 1 | 28081-3 | SEAT | VIRGIN TEFLON | 13 |
| 2 | 54067 | SEAT, CHECK VALVE | 15-5 SS | 12 |
| 2 | 17422 | BACK-UP | ALUM BRONZE | 11 |
| 2 | 17421 | BACKUP RING | PTFE | 10 |
| 2 | 568012-31 | O-RING | VITON | 9 |
| 2 | 56228 | BACKUP RING | PTFE | 8 |
| 1 | 28081-1 | SEAT | VIRGIN TEFLON | 7 |
| 2 | 26130-8 | BALL | 316 SS | 6 |
| 2 | 26685 | SPRING | 316 SS | 5 |
| 2 | 28083-1 | RING | 316 SS | 4 |
| 2 | 28083-2 | RETAINER CHECK VALVE | 316 SS | 3 |
| 2 | 28082 | SPRING | 316 SS | 2 |
| 1 | 54068-30 | END CAP, AG-30 | 300 SERIES SS | 1 |

PARTS LIST

NEXT ASSY (REF ONLY)

Haskel International, Inc.
Burbank, California 91502

| APPROVALS | DATE |
|---|---|
| DRAWN CGW | 12/20/2011 |
| CHECKED P D | 4/17/2012 |
| APPROVED S D Q | 4/18/2012 |
| CAD FILENAME GS-30X | |

TITLE: GS-30X GAS SECTION ( O2 SERVICE)

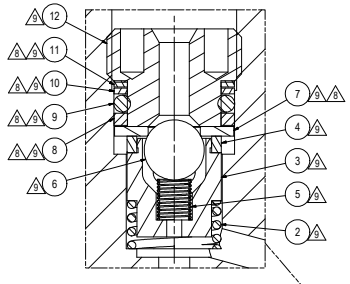
SIZE D | CAGE CODE 81400 | DWG NO. GS-30X | REV U

SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 2

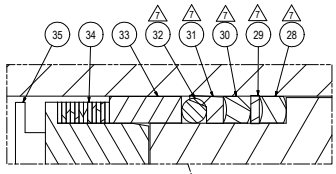


REV. 10/26/2011, D.M.

| REVISION | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| | SEE SHEET 1 | | |



DETAIL B
SCALE 5 : 1
INLET



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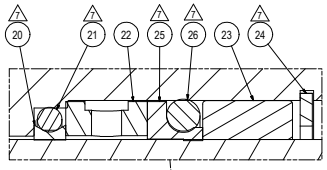
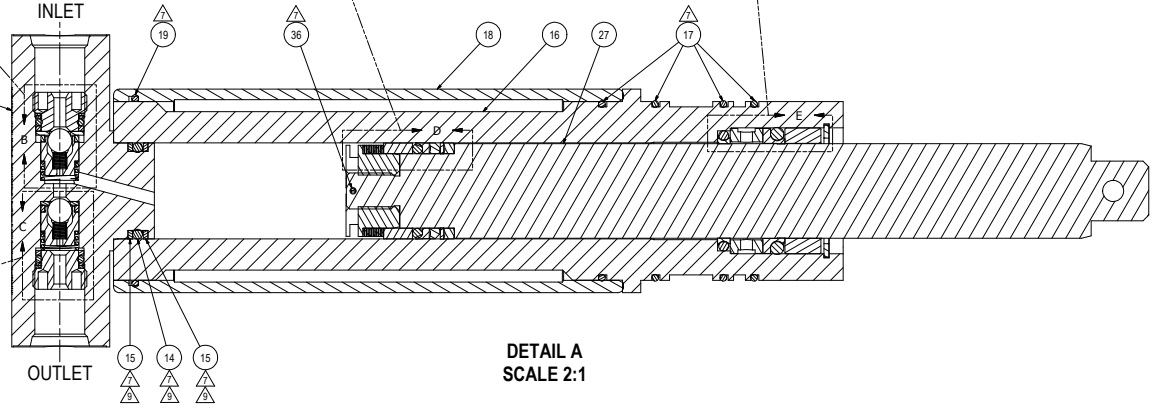
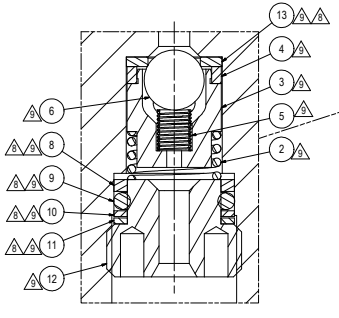
SCALE 5 : 1



DETAIL E
SCALE 5 : 1




**DETAIL A**
**SCALE 2:1**



DETAIL C
SCALE 5 : 1
OUTLET

**-30X GAS SECTION**
**(FOR OXYGEN SERVICE)**



Hamilton Sundstrand
Hastel International, Inc.
Burbank, California 91502

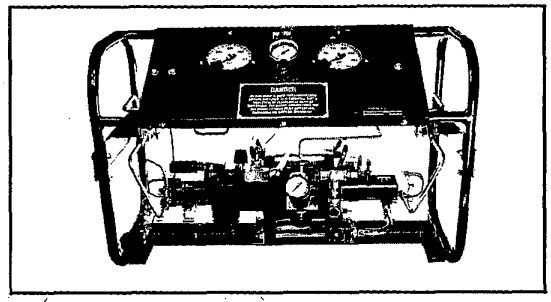
| DRAWN | CGW |
|---|---|
| CHECKED | PD |

| SIZE | CAGE CODE | DWG NO. | REV |
|---|---|---|---|
| D | 81400 | GS-30X | U |
| SCALE: NONE | INVENTOR DRAWING | SHEET 2 OF 2 | |

Haskel

# Air Driven OXYGEN BOOSTER Unit Model 26968

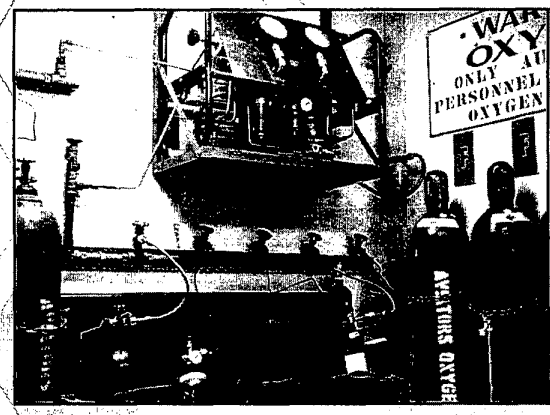
## For life support depend on Haskel Oxygen Boosters



32" long x 14" wide x 24" high – Approx. weight: 115 lbs.

Filling aircraft on-board $O_2$ cylinders for commercial, military and private fleets. Transferring $O_2$ into various high pressure receivers for deep ocean diving support, commercial or military. These are just two examples of the uses for **Model 26968** oxygen boosters that have provided cost savings and increased safety for many years.

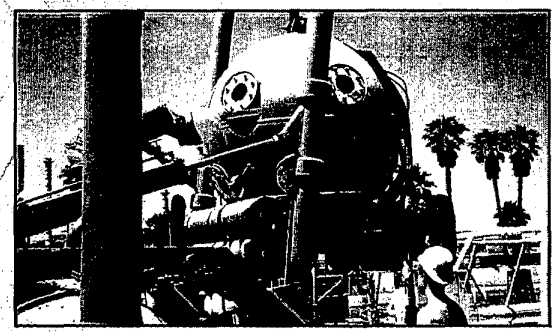
This model will pump from high or medium pressure sources and will also function effectively to collect and transfer the gas from partially depleted supply cylinders to "top off" other cylinders to maximum pressure. Conventional industrial, shipboard or contractor type compressed air sources are normally used for power. All motive power and controls are completely pneumatic with no electrical connections required.




Model 26968 in oxygen bay of major U.S. airline.

The basic booster is two-stage, rated for continuous duty compression ratios of over 15:1, intermittent to 40:1

A pneumatic control package continually monitors both inlet cylinder pressure and outlet receiver pressure, stopping the booster automatically when desired outlet or minimum inlet pressure is reached, permitting unattended operation.

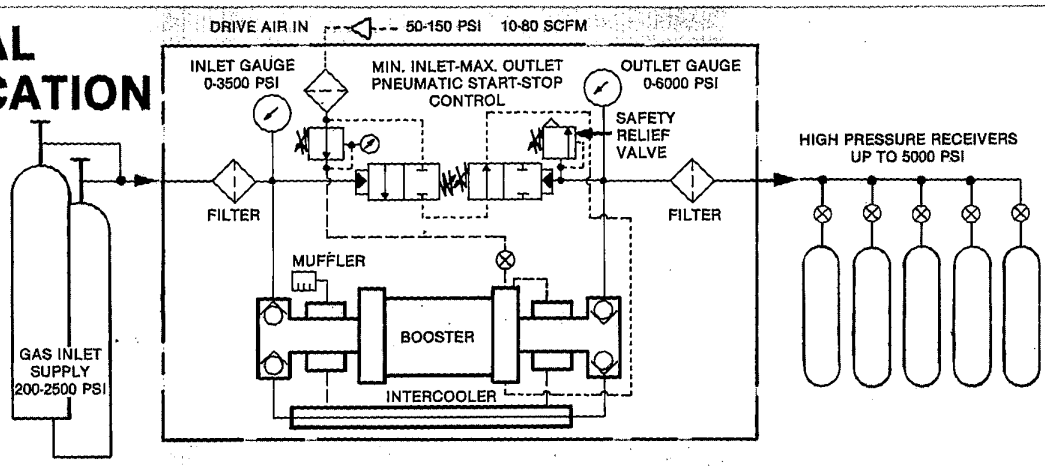


Deep submersible vehicle with breathing gas cylinders. This large diving contractor is a major user of Haskel 26968 units.

**CAUTION:** High pressure gas can be dangerous if improperly handled

***Our products are backed by outstanding technical support, an excellent reputation for reliability, and world-wide distribution.***

# TYPICAL APPLICATION




**BASIC SCHEMATIC HASKEL OXYGEN BOOSTER UNIT MODEL 26968**

# Features of 26968 Oxygen Booster Unit

1. Drive is a low friction, slow speed cycling air cylinder, designed for continuous duty without airline lubrication. Vented distance pieces insure hydrocarbon-free gas section operation. High pressure oxygen seals are wear compensating, immune to sudden failure and operate completely non-lube, oil free.

2. Very cold air (as low as —20°F) is a natural by-product from the air powered drive exhaust. This frigid exhaust air is channeled through a system of cooling jackets and interstage cooler, resulting in high pressure cylinder temperatures well below limits needed for long life of critical parts.

3. Inlet gas supply pressure acts directly through the opposed piston construction to assist the air drive during the compression stroke, conserving power required by the drive in direct proportion to the gas supply pressure.

# Performance

**EXAMPLES OF PERFORMANCE WITH AIR DRIVE POWER OF 50 SCFM (C) AIR FLOW AT AIR DRIVE PRESSURE INDICATED**

| OXYGEN GAS PRESSURE — PSI | | OXYGEN OUTLET GAS FLOW — SCFM | | |
|---|---|---|---|---|
| | | Air Drive PSI | | |
| INLET | OUTLET (B) | 60 | 80 | 100 |
| 250 | 1500 | 3.5 | 4.0 | 4.0 |
| 250 | 2000 | 2.1 | 3.6 | 3.6 |
| 250 | 3000 | (A) | (A) | 2.5 |
| 1000 | 1500 | 8.7 | 14.7 | 15 |
| 1000 | 2500 | (B) | 9.7 | 13.7 |
| 1000 | 3500 | (B) | 9.6 | 13.6 |
| 1500 | 2000 | (B) | 14.7 | 20.7 |
| 1500 | 2500 | (B) | (B) | 16.1 |
| 1500 | 3000 | (B) | (B) | (B) |
| 2000 | 2500 | (B) | (B) | 21.6 |

(A) Outlet stall (maximum **outlet** pressure is: Air drive psi x 30 plus 2 x gas inlet psi).

(B) Interstage stall (maximum gas **inlet** pressure is air drive psi x 15 **if** outlet exceeds air drive psi x 30. If it does not, maximum gas inlet is air drive psi x 30).

(C) If less air flow is available, outlet gas flow rates will decrease about in proportion.

# Specifications

- **Booster:** Air driven, balanced opposed piston type, two stage.
- **High Pressure Oxygen Chambers:** Non-lube, hydrocarbon-free, triple sealed and vented from the drive air chest.
- **High Pressure Sections, Tubing & Fittings:** Stainless steel, 5,000 psi maximum oxygen working pressure.
- **Air Drive Section:** No oiling required, corrosion resistant factory lubed at assembly, 150 psi max. drive pressure.
- **Particle Filters:** Inlet and outlet gas: 5 micron. All stainless steel.
- **Gauges:** Stainless steel tube, solid front 4-1/2" dial size.
- **Port Sizes:** Inlet and outlet gas: 1/4" NPT female; Air Drive: 1/2" NPT female.
- **Control Range Adjustment:**
  Inlet minimum: 150 to 850 psi cutout
  Outlet maximum: 800 to 5,000 psi cutout
  Safety relief (outlet): 800 to 5,000 psi
- **Cooling:** With air exhaust to both stages and intercooler.
- **Noise:** 80 db range pulses, depending on working pressure (measured at 30 inches from booster).
- **Maintenance:** Simple seal kit replacement.
- **Installation:** No special foundation, no tie down required, and no electrical connections.

**Haskel, Inc. ■ Burbank, CA 91502 ■ U.S.A. ■ (818) 843-4000**
**FAX: (818) 841-4291**

**Haskel Energy Systems, LTD. ■ Sunderland SR5 3JD ■ England**
**91-549-1212 TLX : 53624 HIENGY G ■ FAX : 91-549-0911**

**General Pneumatic S.A. ■ Groupe Haskel ■ Lille 59650, France**
**(20) 04.66.00 ■ FAX : (20) 33.31.95**

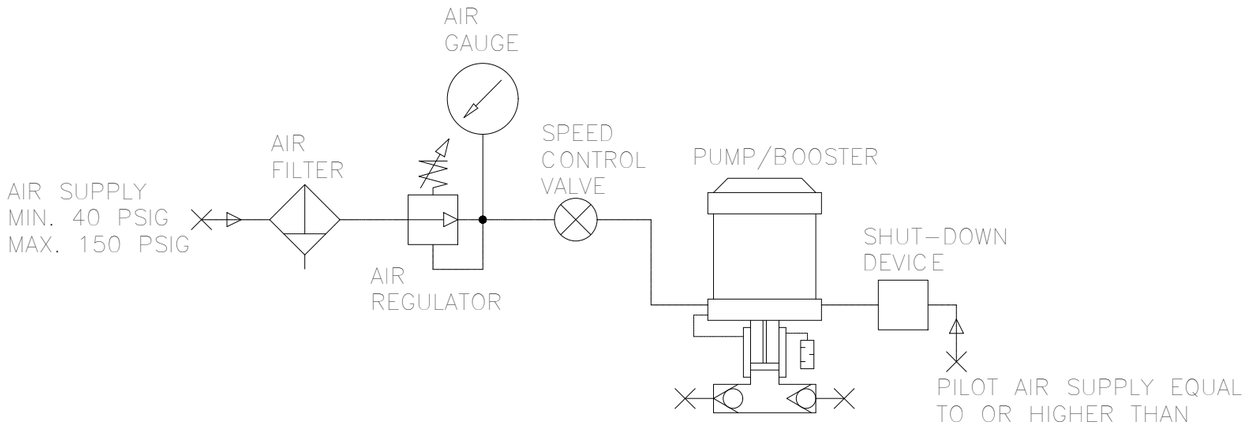


3.93 1.5M Printed in U.S.A. 860305

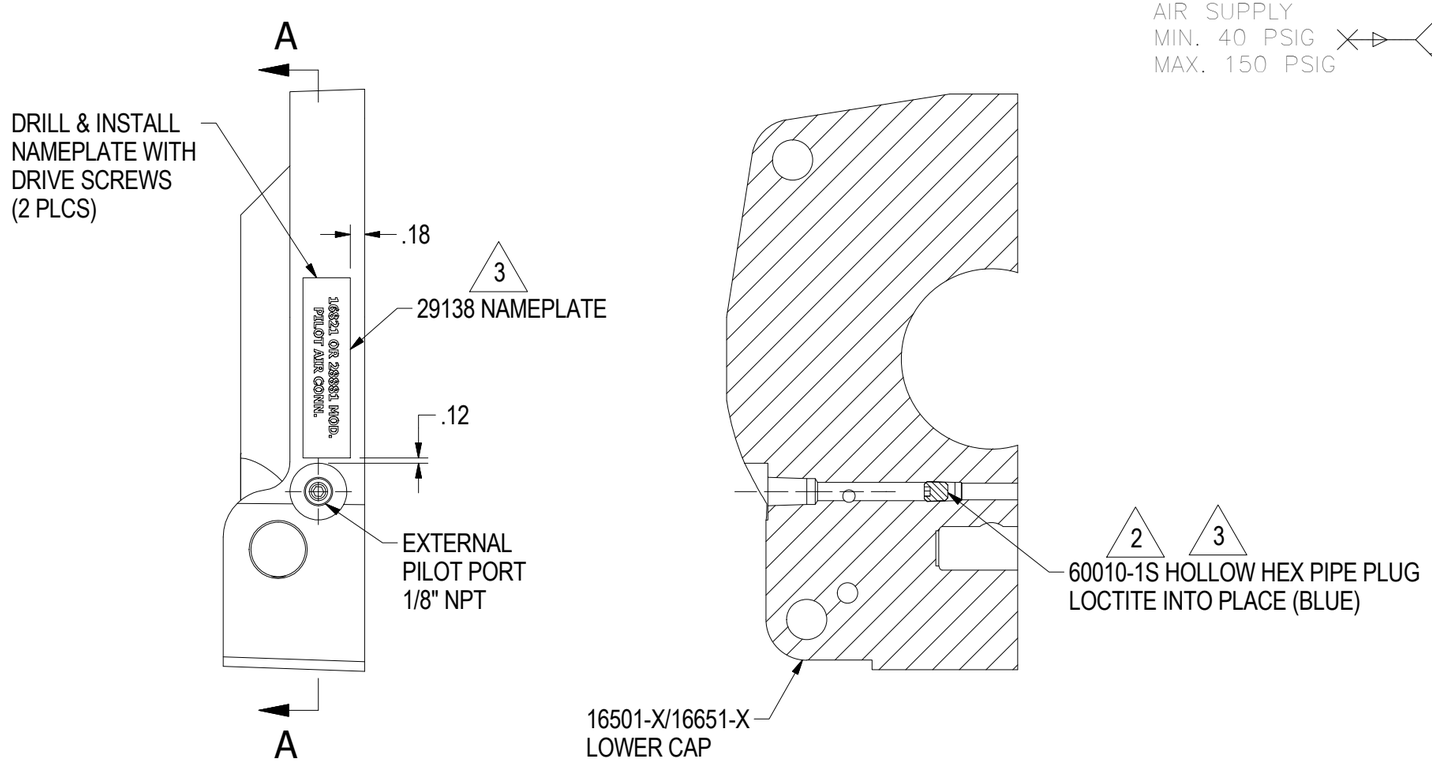
NOTES:

1. THIS DRAWING DEPICTS THE MODIFICATION TO A STANDARD PUMP ASSEMBLY FOR EXTERNAL PILOT. WITH THIS MODIFICATION THE PUMP CYCLING MAY BE STOPPED BY USING A DEVICE TO SHUT-OFF PILOT AIR SUPPLY AS SHOWN IN TYPICAL SCHEMATIC BELOW.
2. CAPS MFG'D. BETWEEN AUGUST 1976 AND APRIL 1983 HAD 1/4-28 UNF-2B THREAD AND SHOULD BE PLUGGED WITH 1/4-28 X .50 LONG SET SCREW AND SET WITH LOCTITE SEALANT.
3. THESE PARTS ARE INCLUDED IN 28881-2 FIELD CONVERSION KIT.

| REVISIONS | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| J | RELEASE PER ECO32408 | 4/18/2017 | BB |




## TYPICAL SCHEMATIC




## SECTION A-A
## SCALE 1 / 2



THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING
REMOVE BURRS
FILLETS & RADII .005-.030
MACHINE FINISH 125
TOLERANCES ARE:
DECIMALS: .XX ± .01
.XXX ± .005
FRACTIONS: ± 1/16
ANGLES: ± 1°
CONCENTRICITY .010 DIA
FABRICATE PER HPS-10.4

NEXT ASSY (REF ONLY)

| APPROVALS | DATE |
|---|---|
| DRAWN A. NELSON | 1/30/1975 |
| CHECKED | |
| APPROVED | |
| CAD FILE NAME 16501-3-28881 | |

Haskel International, LLC
Burbank, California 91502

TITLE: PUMP MODIFICATION EXTERNAL PILOT

| SIZE | CAGE CODE | DWG NO. | REV |
|---|---|---|---|
| B | 81400 | 28881-TAB | J |

SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 2

REV. 08/15/2013, D.M.

| REVISIONS | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| | SEE SHEET 1 | | |

## 28881 EXTERNAL PILOT MODIFICATION

**BRIEF SUMMARY:** THE EXTERNALI PILOT MODIFICATION IS USED TO STOP THE PUMP/BOOSTER FROM CYCLING BY USE OF AN EXTERNAL SHUTDOWN DEVICE (PRESSURE SWITCH, PILOT SWITCH, ETC.). THIS MODIFICATION IS USED IN LIEU OF SHUTTING OFF THE MAIN AIR DRIVE SUPPLY.

***CAUTION:*** HIGH PRESSURE AIR, GAS, OR LIQUID CAN BE DANGEROUS IF NOT PROPERTY HANDLED.

**FIELD CONVERSION:** FOR FIELD CONVERSION KIT, ORDER PART NO. 28881-2

## INSTALLATION INSTRUCTIONS

**REQUIRED TOOLS:** 3/16" & 5/32" ALLEN WRENCHES
11/16" SOCKET OR OPEN WRENCH
28584 HASKEL TOOL OR NEEDLE NOSE PLIERS

**PROCEDURE:**

1. VENT ALL PRESSURE FROM THE PUMP / BOOSTER.
2. REMOVE THE 17568-2 PLUG (1/8" NPT). IT IS LOCATED ON THE LOWER AIR CAP (AIR CYCLING VALVE CAP) OPPOSITE THE AIR DRIVE INLET PORT.
3. REMOVE THE 16510 PIOT STEM PLUG (11/16"), 16513 SPRING, AND THE PILOT STEM. THEY ARE LOCATED ON THE LOWER AIR CAP. USE THE 28584 HASKEL TOOL OR NEEDLE NOSE PLIERS TO REMOVE THE PILOT STEM.
4. USE THE 5/32" ALLEN WRENCH TO INSTALL 60010-1S HOLLOW HEX PLUG. APPLY A THREAD LOCKING ADHESIVE (BLUE LOCTITE OR EQUIVALENT) TO THE THREADS. TIGHTEN THE PLUG SECURELY TO PREVENT LEAKAGE. ALLOW SUFFICIENT TIME FOR THE ADHESIVE TO DRY.
5. RE-INSTALL THE PILOT STEM, SPRING AND PLUG (REMOVED IN STEP 3)
6. CONNECT AN AIR SUPPLY, WITH PRESSURE EQUAL TO OR GREATER THAN THAN THE MAIN DRIVE PRESSURE, UP TO 150 PSIG, TO THE 1/8" NPTF PORT. THIS WILL ALLOW PILOT AIR TO STOP THE PUMP / BOOSTER. IF THE PILOT PRESSURE IS LESS THAN THE MAIN AIR SUPPLY PRESSURE THE PUMP / BOOSTER MAY OPERATE ERRATICALLY.



Haskel International, LLC
Burbank, California 91502

DRAWN A. NELSON
CHECKED

SIZE B | CAGE CODE 81400 | DWG NO. 28881-TAB | REV J
SCALE: NONE | INVENTOR DRAWING | SHEET 2 OF 2

REV 08/15/2013, D.M.

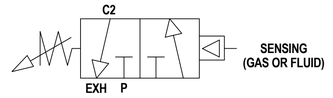
28755-TAB

NOTES:

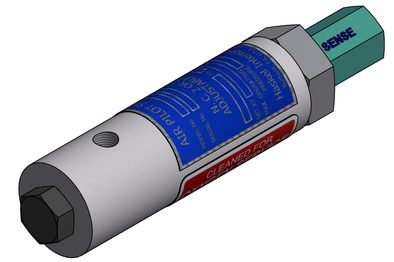
1. LUBRICATE THESE SEALING SURFACES SPARINGLY WITH CN002487.
2. REFER TO TAB BLOCK FOR PRESSURE RANGES.
3. INDICATES PARTS IN SEALS KIT NO. 55007-1 (GENERAL SERVICE).
4. INDICATES PARTS IN SEALS KIT NO. 55007-11 (OXYGEN SERVICE).
5. TO BE OXYGEN CLEANED PER HPS 4.11, *DO NOT EXCEED 5,000 PSI WITH OXYGEN.*
6. ALL DIMENSIONS IN INCHES, FOR REFERENCE ONLY.

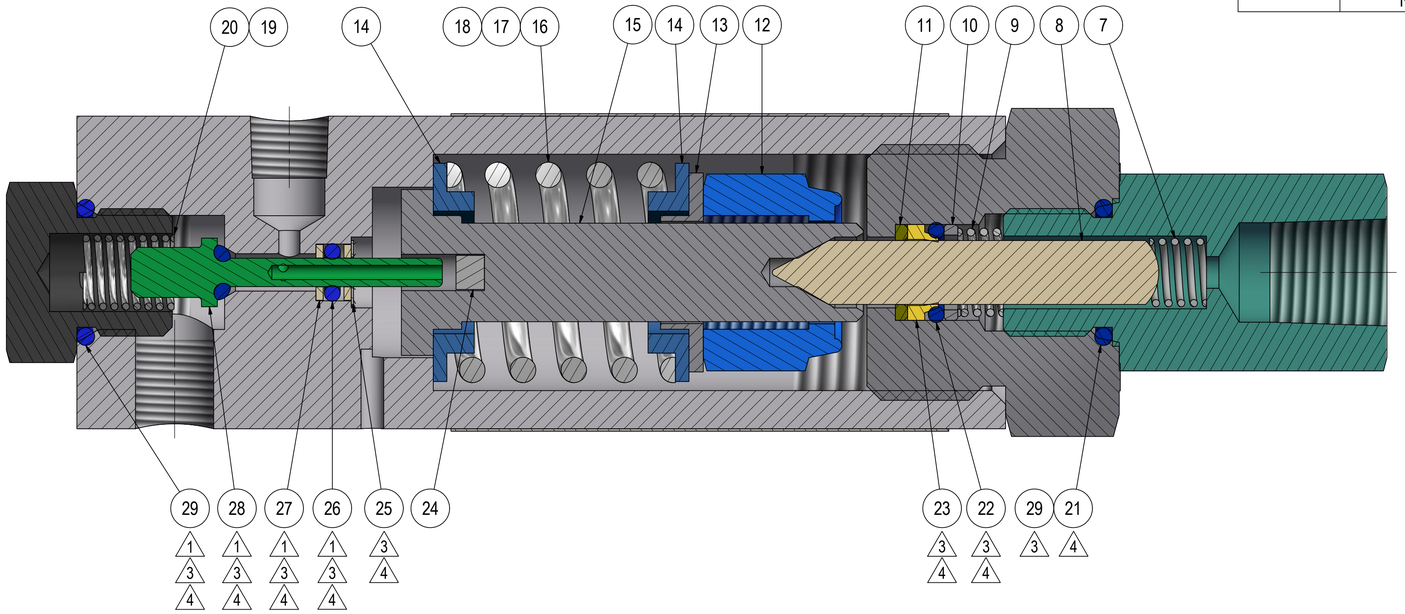
| DASH NO | SENSING RANGE (PSIG) | SERVICE |
|---|---|---|
| -1 | 1,500 - 10,000 | GENERAL |
| -2 | 300 - 3,500 | GENERAL |
| -3 | 150 - 700 | GENERAL |
| -8 | 800 - 9,500 | GENERAL |
| 5 -11 | 1,500 - 5,000 | OXYGEN |
| 5 -12 | 300 - 3,500 | OXYGEN |
| 5 -13 | 150 - 700 | OXYGEN |
| 5 -18 | 800 - 5,000 | OXYGEN |

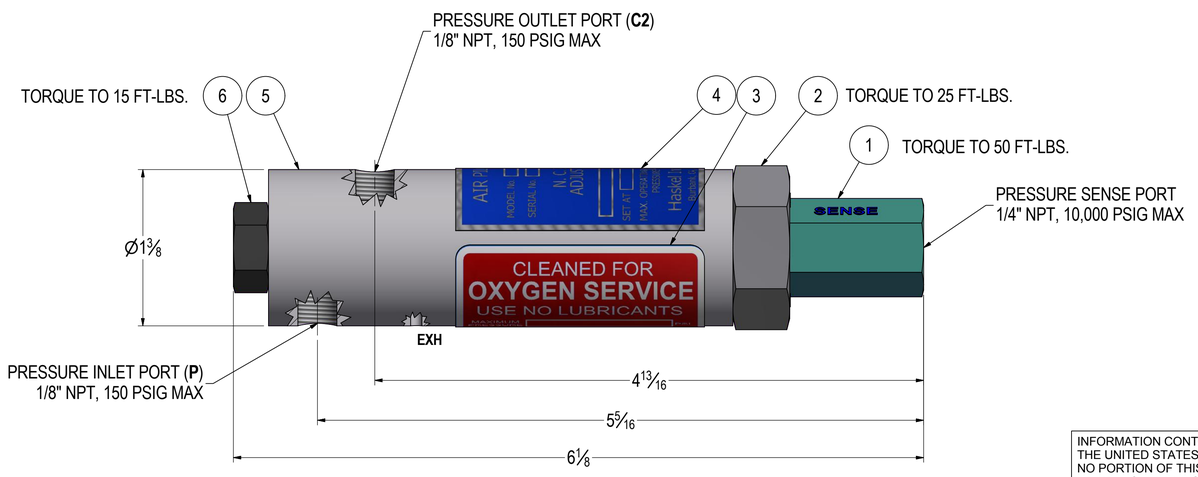
| | |
|---|---|
| ABOVE SET POINT | P TO C2 EXH BLOCKED |
| TRANSITION | P, C2 & EXH BLOCKED |
| BELOW SET POINT (NORMAL) | P BLOCKED C2 TO EXH. |
| SENSING PRESSURE | AIR VALVE FLOW PATHS OFFSET POSITIONS 3 WAY N.C. |




SCHEMATIC




| REVISION | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| Y | REVISED PER ECO 32328 | 6/7/2017 | PM |

PARTS LIST

| ITEM | PART NO. | DESCRIPTION | MATERIAL | QTY-1 | QTY-2 | QTY-3 | QTY-8 | QTY-11 | QTY-12 | QTY-13 | QTY-18 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 52155 | FITTING | 303 SS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 28787-2 | CAP, AIR PILOT SWITCH | 303 SS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 27894 | DECAL, OXYGEN | ALUMINUM | -- | -- | -- | -- | 1 | 1 | 1 | 1 |
| 4 | 28617 | NAMEPLATE | ALUMINUM | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | 28789 | DESCRIPTION | ALUMINUM | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 6 | 16510 | PLUG | AL 2024-T351 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 7 | 28768 | SPRING | 304 SS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 8 | 15574 | POPPET | 15-5 PH SS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 9 | 28082 | SPRING | 316 SS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 | 27747 | SPRING FOLLOWER | 303 SS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 11 | 26461-2 | BACK UP | 303 SS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 12 | MS20364-720C | 1/2 Std NF Nylock Nut | STEEL | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13 | 53584 | GUIDE, SPRIING | AISI 1018 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 14 | 28792 | WASHER SPRING | AISI 1144 | -- | -- | 2 | -- | -- | -- | 2 | -- |
| 15 | 28790-2 | BOLT | 1213/1215 STL | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 16 | 28788 | SPRING | 302 SS | -- | -- | 1 | -- | -- | -- | 1 | -- |
| 17 | 15579-3 | SPRING | STEEL | 1 | -- | -- | 1 | 1 | -- | -- | 1 |
| 18 | 15579-2 | SPRING | STEEL | -- | 1 | -- | -- | -- | 1 | -- | -- |
| 19 | 28405 | SPRING | 316 SS | -- | -- | -- | 1 | -- | -- | -- | 1 |
| 20 | 51933 | SPRING | 316 SS | 1 | 1 | 1 | -- | 1 | 1 | 1 | -- |
| 21 | 568906-7 | O-RING | VITON | -- | -- | -- | -- | 1 | 1 | 1 | 1 |
| 29 | 568906-9 | O-RING | BUNA-N | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| 22 | 568011-7 | O-RING | VITON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 23 | 26462 | SEAL | TEFLON | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 24 | 28793 | SEAT | POLYURETHANE | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 25 | 5005-31H | RETAINER RING | 15-7 PH | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 26 | 568006-2 | O-RING | BUNA-N | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 27 | 16517 | SPACER | BRASS | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 28 | 28769 | STEM | 303 SS | 1 | 1 | 1 | -- | 1 | 1 | 1 | 1 |

NEXT ASSY (REF ONLY)

| APPROVALS | DATE |
|---|---|
| DRAWN AS | 10/23/1974 |
| CHECKED | |
| APPROVED D.HILL | 1/2/1975 |
| CAD FILENAME 28755-13 | |

Haskel International, LLC
Burbank, California 91502

TITLE: AIR PILOT SWITCH - THREE-WAY, NORMALLY CLOSED

| SIZE | CAGE CODE | DWG NO. | REV |
|---|---|---|---|
| D | 81400 | 28755-TAB | Y |

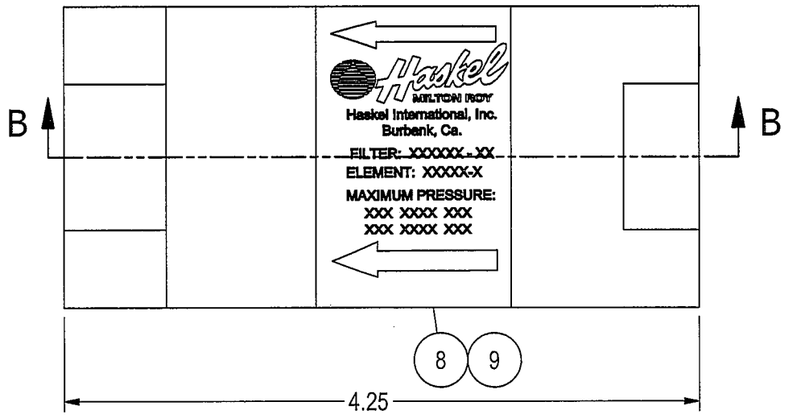
SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 1

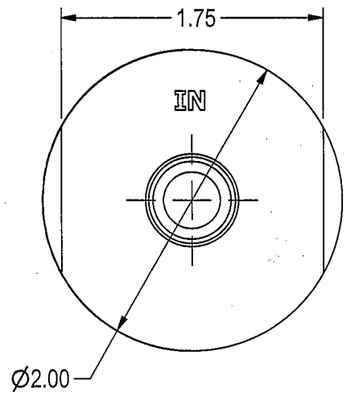


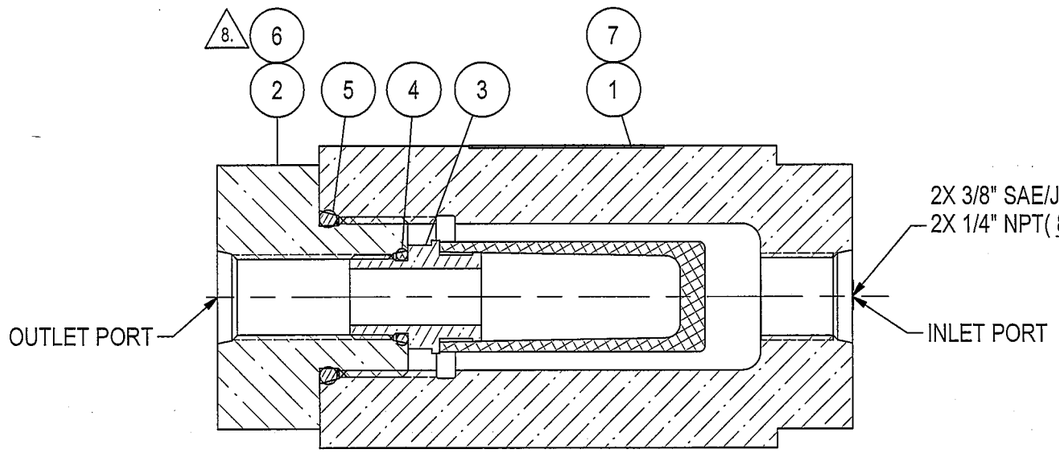
REV. 08/15/2013, D.M.

87260-TAB

| REVISIONS | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| B | REVISED PER ECO 28845 | 4/27/09 | MK |




## SECTION B-B

9. FILTER SHOWN IS 87260-12.
8. TORQUE RETAINER NUT TO 50 FT-LBS.
7. ELEMENT SEAL KIT: 87302 WITH ELEMENT, 87302-2 SEALS ONLY.
6. FILTER COMPONENT TO BE CLEANED OXYGEN SERVICE PER HPS-4.11 (MIL-STD-1330)
5. NOMINAL MICRON RATING: 10 MICRON.
4. HYDROSTATIC PROOF RATING 1.25 X MAOP (6250 PSIG).
3. MAX OPERATING DIFFERENTIAL: 1000 PSIG.
2. MAX OPERATING PRESSURE: 5000 PSIG.
1. FILTER IS FOR OXYGEN USE ONLY, DO NOT USE FOR OTHER GASES.

NOTE:

| QTY | QTY | PART NUMBER | DESCRIPTION | MATERIAL | ITEM |
|---|---|---|---|---|---|
| - | 1 | 28784-6 | STENCIL, OXYGEN FILTER | | 9 |
| 1 | - | 28784-5 | STENCIL, OXYGEN FILTER | | 8 |
| - | 1 | 87259-2 | BODY, FILTER, 3/8" TUBE | C36000, BRASS | 7 |
| - | 1 | 87258-2 | END FITTING, FILTER, 3/8 TUBE | C36000, BRASS | 6 |
| 1 | 1 | 568912-7 | O-RING | VITON | 5 |
| 1 | 1 | (568906-7) | O-RING (INCLUDED WITH 87256) | VITON | 4 |
| 1 | 1 | 87256 | SINTERED ASSEMBLY | SINTERED BRONZE | 3 |
| 1 | - | 87258-1 | END FITTING, FILTER, 1/4" NPT | C36000, BRASS | 2 |
| 1 | - | 87259-1 | BODY, FILTER, 1/4 NPT | C36000, BRASS | 1 |
| 87260-10 | 87260-12 | Parts List | | | |



NEXT ASSY (REF ONLY): FILTER, OXYGEN

| APPROVALS | | DATE |
|---|---|---|
| DRAWN | JAN | 12/12/08 |
| CHECKED | M.K. | 3/27/09 |
| APPROVED | S.D.Q. | 3/27/09 |
| CAD FILE NAME: | | |

Haskel International, Inc.
Burbank, California 91502

TITLE: ASSEMBLY, FILTER, OXYGEN, BRASS, 10 MICRON

| SIZE | CAGE CODE | DWG NO. | REV |
|---|---|---|---|
| B | 81400 | 87260-TAB | B |

SCALE: FULL | INVENTOR DRAWING | SHEET 1 OF 1

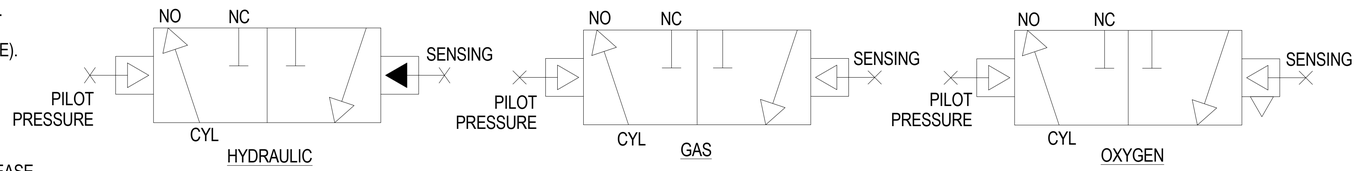
# 55790-TAB

NOTES:

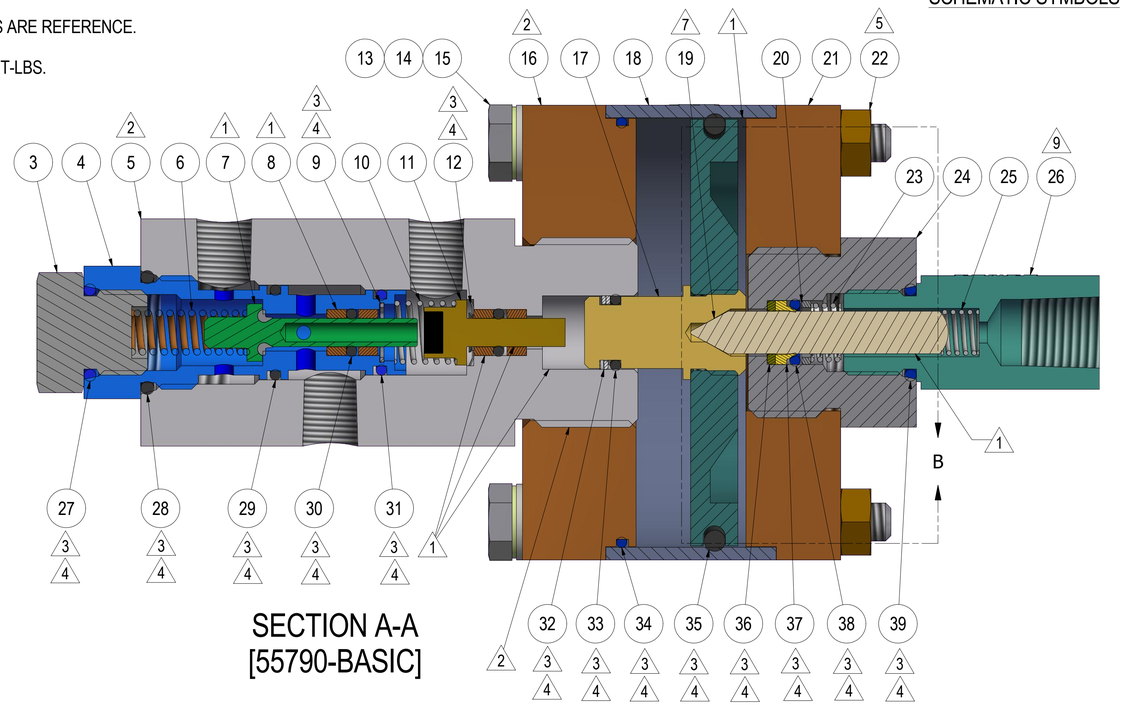
1. LUBRICATE THIS SEALING SURFACE LIGHTLY PER HSP 3.14.
2. ASSEMBLE WITH BLUE LOCTITE - 1/8" NPT PILOT PORT ORIENTED AS SHOWN.
3. INDICATES PARTS IN SEAL KIT PN 55793 (GENERAL SERVICE).
4. INDICATES PARTS IN SEAL KIT PN 55793-10 (OXYGEN SERVICE).
5. TORQUE TO 50 IN-LBS.
6. OXYGEN CLEAN PN 55793-10 PER HPS 4.11.
7. LUBRICATE LIGHTLY WITH KRYTOX 240AZ FLUORINATED GREASE.
8. ALL DIMENSIONS ARE REFERENCE.
9. TORQUE TO 50 FT-LBS.

| PART NO. | NOMINAL SENSING RANGE PSIG | MAX SENSING PRESSURE PSIG | SERVICE | RATIO | DEADBAND ON-OFF LESS THAN PSI | DEADBAND ON-OFF VENT LESS THAN PSI |
|---|---|---|---|---|---|---|
| 55790 | 2500-10000 | 10000 | GENERAL | 110:1 | 800 | 1000 |
| 55790-10 | 2500-5000 | 5000 | OXYGEN | 110:1 | 800 | 1000 |

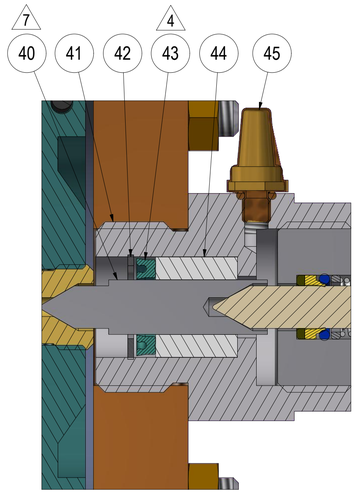
| REVISION | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| F | REVISED PER ECO 32328 | 9/14/2017 | BB |




SCHEMATIC SYMBOLS

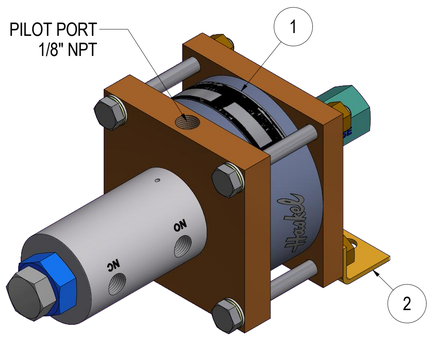


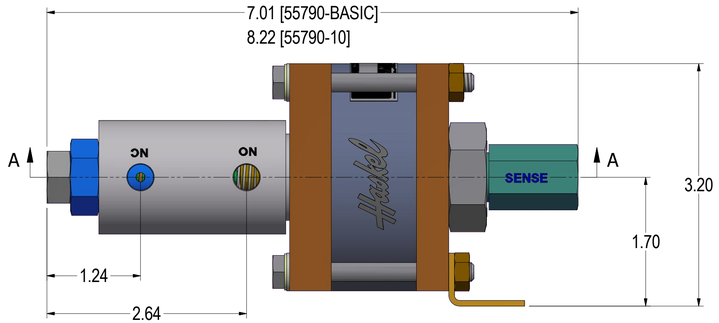

SECTION A-A
[55790-BASIC]

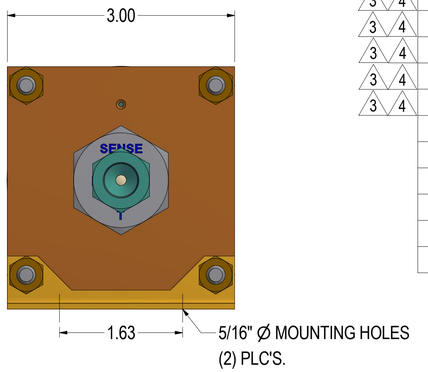


DETAIL B
[55790-10]

| PARTS LIST | | | | | |
|---|---|---|---|---|---|
| ITEM | PART NO. | DESCRIPTION | MATERIAL | QTY | QTY-10 |
| 1 | 28106 | NAME PLATE | FOIL | 1 | 1 |
| 2 | 29373 | BRACKET | AISI 1018 | 1 | 1 |
| 3 | 16510-1 | PLUG | AL 2024-T351 OR T4 | 1 | 1 |
| 4 | 53907 | SLEEVE | 2024-T4 AL | 1 | 1 |
| 5 | 55784 | BODY, AIR PILOT SW | 2024-T4 AL | 1 | 1 |
| 6 | 53963 | SPRING | MUSIC WIRE | 1 | 1 |
| 7 | 53906 | STEM | -- | 1 | 1 |
| 8 | 53905 | BEARING | 660 BRONZE | 4 | 4 |
| 3 4 | 9 N5000-37H | RETAINER, INTERNAL | 15-7PH SS | 1 | 1 |
| 10 | 53919 | SPRING | 300 SERIES SS | 1 | 1 |
| 11 | 53909 | STEM ASS'Y SEAT | -- | 1 | 1 |
| 3 4 | 12 5005-43H | RETAINING RING | 300 SERIES SS | 1 | 1 |
| 13 | CNF00021 | WASHER, 1/4 | STEEL | 4 | 4 |
| 14 | CNF00027 | LOCKWASHER, 1/4 | SS | 4 | 4 |
| 15 | 17187-12 | BOLT, 1/4-20 | 1018 STEEL | 4 | 4 |
| 16 | 55787 | LOWER CAP | 2024-T4 AL | 1 | 1 |
| 17 | 55788 | PISTON ASS'Y | -- | 1 | 1 |
| 18 | 51861-2 | BARREL | ALUM 6061-T6 | 1 | 1 |
| 19 | 15574 | POPPET | 15-5 PH SS | 1 | 1 |
| 20 | 27747 | SPRING FOLLOWER | 303 SS | 1 | 1 |
| 21 | 55786 | UPPER CAP | 2024-T4 AL | 1 | 1 |
| 22 | 17188 | NUT 1/4-20 UNC | STEEL | 4 | 4 |
| 23 | 28082 | SPRING | 316 SS | 1 | 1 |
| 24 | 28787-2 | CAP, AIR PILOT SWITCH | 303 SS | 1 | 1 |
| 25 | 28768 | SPRING | 304 SS | 1 | 1 |
| 26 | 52155 | FITTING | 303 SS | 1 | 1 |
| 27 | 568906-9 | O-RING | BUNA-N | 1 | 1 |
| 28 | 568908-2 | O-RING | BUNA-N | 1 | 1 |
| 29 | 568014-2 | O-RING | BUNA-N | 1 | 1 |
| 30 | 568008-2 | O-RING | BUNA-N | 2 | 2 |
| 31 | 568013-2 | O-RING | BUNA-N | 1 | 1 |
| 3 4 | 32 MS28782- | BACK-UP | PTFE | 1 | 1 |
| 3 4 | 33 568012-2 | O-RING | BUNA-N | 1 | 1 |
| 3 4 | 34 568038-2 | O-RING | BUNA-N | 1 | 1 |
| 3 4 | 35 27270 | O-RING | BUNA-N | 1 | 1 |
| 3 4 | 36 26461-2 | BACK UP | 303 SS | 1 | 1 |
| 3 4 | 37 26462 | SEAL | PTFE | 1 | 1 |
| 3 4 | 38 568011-7 | O-RING | VITON | 1 | 1 |
| 3 4 | 39 568906-7 | O-RING | VITON | 1 | 1 |
| 40 | 58747 | CONNECTING ROD | 303 SS | 0 | 1 |
| 41 | 58745 | ADAPTER | 2024-T351 | 0 | 1 |
| 42 | N5000-62H | RETAINER | STAINLESS STEEL | 0 | 1 |
| 43 | 17320-225 | SEAL | AISI 12L14 | 0 | 1 |
| 44 | 58746 | BEARING | CARBON FILLED TEFLON | 0 | 1 |
| 45 | 58571 | BREATHER | SINTERED BRONZE | 0 | 1 |




NEXT ASSY (REF ONLY)

| APPROVALS | | DATE |
|---|---|---|
| DRAWN | JAN | 9/25/1987 |
| CHECKED | DLA | 5/29/1988 |
| APPROVED | DLA | 5/29/1988 |
| CAD FILENAME | | 55790 |

Haskel International, LLC
Burbank, California 91502

TITLE: AIR PILOT SWITCH, "REMOTESET", MEDIUM PRESSURE

| SIZE | CAGE CODE | DWG NO. | REV |
|---|---|---|---|
| D | 81400 | 55790-TAB | F |

SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 1

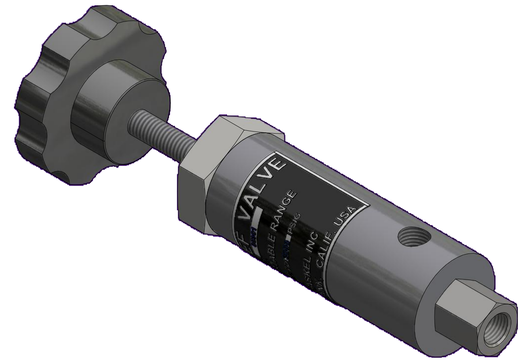
# 27741-TAB

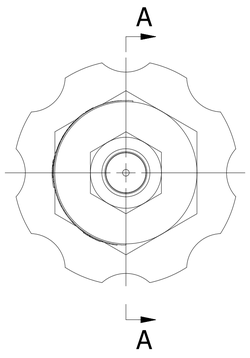
NOTES:

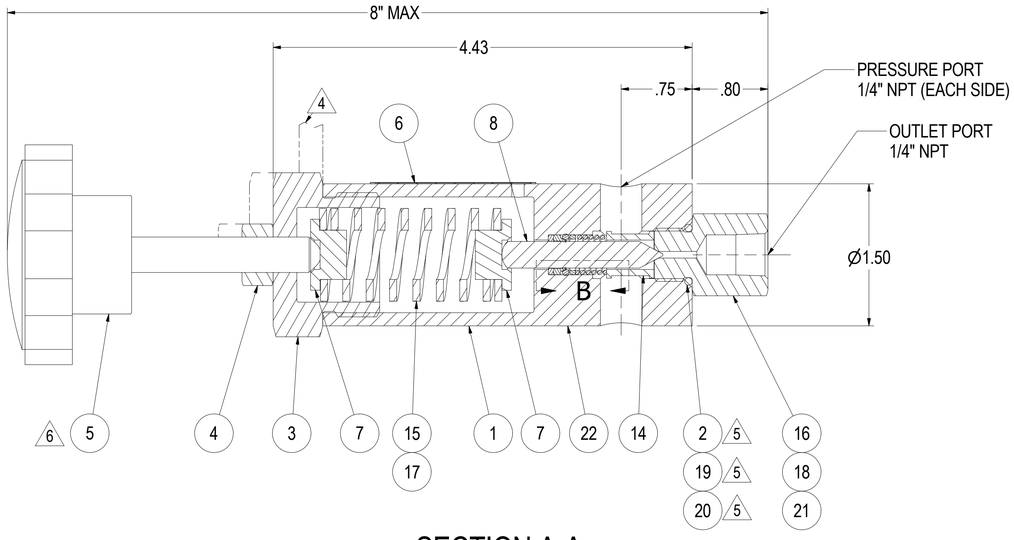
1. MATERIAL: STATIC SEALS AS SHOWN IN TABULATION DYNAMIC SEALS-MINERAL FILLED TEFLON WETTED MATERIAL-POPPET 444C SS POLISHED. ALL OTHER METALS 303 CONDITION B STAINLESS STEEL
2. PRESSURE RANGE: 300 TO 3,000 PSIG & 1,000 TO 10,000 PSIG AS SHOWN IN TAB. BLOCK
3. SERVICE SUITABLE FOR LIQUID OR GAS.
4. VALVE MAY BE PANEL MOUNTED BY REMOVING 15905 PLUG INSERTING BODY THRU Ø1-3/8" HOLE IN PANEL AND REASSEMBLING. MAX. PANEL THICKNESS 1/4"
5. PARTS INCLUDED IN SEAL KIT P/N 52051-XX (SEE TAB. BLOCK)
6. FOR ADJUSTING SCREW WITH LOCKNUTS (INPLACE OF HANDLE) SPECIFY P/N 28580-X
7. THESE ITEMS ARE TO BE CLEANED FOR OXYGEN SERVICE PER HPS-4.11 (5,000 PSIG MAX. SERVICE)

| TAB. BLOCK | | | | |
|---|---|---|---|---|
| PART NO. | RANGE PSIG | STATIC SEAL | SEAT | SEAL KIT P/N |
| 27741-1 | 300-3,000 | VITON | HARD SEAT | 52051-1 |
| 27741-2 | 1,000-10,000 | VITON | HARD SEAT | 52051-2 |
| 27741-3 | 300-3,000 | EPR | NYLON | 52051-3 |
| 27741-4 | 1,000-10,000 | EPR | NYLON | 52051-4 |
| 27741-5 | 200-4,000 | VITON | HARD SEAT | 52051-1 |
| 27741-6 | 1,000-10,000 | BUNA-N | NYLON | 52051-6 |
| 7 27741-11 | 300-3,000 | VITON | KEL-F | 52051-11 |
| 7 27741-12 | 1,000-5,000 | VITON | KEL-F | 52051-12 |

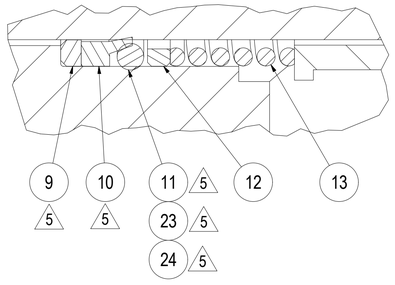
| REVISION | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | CHECKED |
| V | REVISED PER ECO 32567 | 8/25/2017 | BB |




SECTION A-A
SCALE 1.25 : 1




DETAIL B
SCALE 5 : 1

CLEANED FOR
OXYGEN SERVICE
USE NO LUBRICANTS
MAXIMUM PRESSURE 5,000 PSI
Haskel International, LLC., Ca., USA

OXYGEN LABEL
-11,-12 *ONLY*

| -12 | -11 | -6 | -5 | -4 | -3 | -2 | -1 | PART NUMBER | DESCRIPTION | ITEM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | PARTS LIST | | |
| | | | | 1 | 1 | | | 568011-13 | O-RING | 24 |
| | | 1 | | | | | | 568011-9 | O-RING | 23 |
| 1 | 1 | | | | | | | 27894 | NAMEPLATE OXYGEN | 22 |
| | 1 | | | | | | | 27746-3 | FITTING | 21 |
| 1 | 1 | | 1 | | | 1 | 1 | 568906-7 | O-RING | 20 |
| | | | | 1 | 1 | | | 568906-13 | O-RING | 19 |
| | | 1 | | 1 | 1 | | | 27746 | FITTING | 18 |
| 1 | | 1 | 1 | 1 | | 1 | | 15579-1 | SPRING | 17 |
| | | | | | | 1 | 1 | 27746-2 | FITTNG | 16 |
| | 1 | | | | 1 | | 1 | 15579 | SPRING | 15 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 26463 | TUBE | 14 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 17950 | SPRING | 13 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 27747 | SPRING FOLLOWER | 12 |
| 1 | 1 | | 1 | | | 1 | 1 | 568011-7 | O-RING | 11 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 26462 | SEAL | 10 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 26461-2 | BACK UP | 9 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 15574 | POPPET | 8 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 15577 | GUIDE | 7 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 25308 | NAME PLATE-IDENT | 6 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 21896 | HANDLE | 5 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 17834 | NUT, 3/8-24 | 4 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 15905 | PLUG | 3 |
| | | 1 | | | | | | 568906-9 | O-RING | 2 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 15716-2 | BODY | 1 |

NEXT ASSY (REF ONLY)

Haskel International, LLC
Burbank, California 91502

| APPROVALS | | DATE |
|---|---|---|
| DRAWN | STAN REHOR | 11/8/1972 |
| CHECKED | RJL | 11/8/1972 |
| APPROVED | RJL | 11/8/1972 |
| CAD FILENAME | 27741-1 | |

TITLE
BACK PRESSURE
REGULATOR & RELIEF VALVE

| SIZE | CAGE CODE | DWG NO. | REV |
|---|---|---|---|
| D | 81400 | 27741-TAB | V |

SCALE: N/A | INVENTOR DRAWING | SHEET 1 OF 1

# Oxygen Usage – Best Practice Guide

## 1. Introduction

Oxygen enriched systems possess a risk of fire and explosion since ignition and combustion hazards are present in all oxygen systems, and oxygen related fire incidents have occurred in many industries. Because ignition and combustion hazards are inherently present in most oxygen systems, a proper guidance for using Haskel oxygen service products is crucial to avoiding accidents and ensuring the safety of personnel and equipment.

## 2. Oxygen Hazards and Risks

Oxygen is a serious fire hazard. It makes materials easier to ignite and their subsequent combustion more intense, more complete, and more explosive than in air alone.

### 2.1. Causes of Fires in Oxygen

Many common ignition mechanisms and causes of oxygen system fires are recognized and well understood.

#### 2.1.1. *Kindling Chain*

Ignition usually begins as a small event and grows into a fire through the kindling chain sequence. Once ignited, the material gives off enough heat to ignite bulk materials with higher ignition temperatures, which generate more heat, until the process is self-sustaining.

#### 2.1.2. *Ignition Mechanisms*

Oxygen fires require a source of energy to trigger ignition. The most common ignition energy sources are:

#### 2.1.3. *Mechanical Impact*

When one object impacts another, the absorbed energy appears as heat that can be sufficient to ignite materials at the point of impact.

#### 2.1.4. *Particle Impact*

Small particles carried by flowing gas in the oxygen system strike surfaces of the system, such as piping intersections or valve seats. The kinetic energy of the particle creates heat at the point of impact, which can ignite either the particle or the target material.

#### 2.1.5. *Friction*

The rubbing of two solid materials results in the generation of heat.

2.2. *Pneumatic Impact or Compression Heating*

When oxygen flows from high to low pressure through an orifice, such as when a valve is opened quickly, it often reaches sonic velocity and compresses the oxygen downstream against an obstruction, such as the seat of the next closed valve or regulator (Fig. 1). The gas temperature can reach the autoignition point of plastics, organic contaminants, or small metal particles.

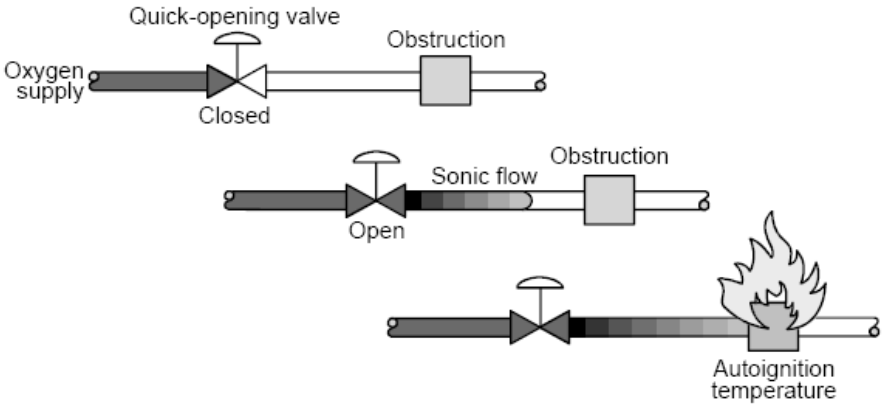



Figure 1

**<u>CAUTION:</u> DO NOT USE ¼" quarter turn ball valves on oxygen systems. Use needle valves only (Fig.1).**

## 3. <u>Special Precautions and Operating Parameters</u>

3.1. Do not exceed 5000 psig pressure output.

3.2. Do not use an oxygen booster for any other gas --even occasionally. Although other gases may be perfectly pure, we do not recommend this practice.

3.3. Service of the oxygen containing sections of the booster (or accessories) involves a more stringent procedure to insure cleanliness. It is strongly recommended that oxygen boosters to be returned to Haskel, Burbank for maintenance service. Factory training is available. Contact Haskel service department for details.

3.4. Maximum Compression Ratios (maximum output pressure psia, divided by minimum inlet pressure psia). The maximums shown in the following chart must be observed at all times to avoid excessive heat:

| | Maximum Compression Ratios | |
|---|---|---|
| | $O_2$ Inlet < 150 psig | $O_2$ Inlet 150 psig or Higher |
| Single Stage | 5 : 1 | 6 : 1 |
| Two Stage | 25 : 1 | 36 : 1 |
| Three Stage | 45 : 1 | |
| For heavy duty, continuously operating applications, we recommend that the above compression ratios be reduced even further, where feasible, with additional staging and/or plenum coolers (now a standard optional Haskel accessory). | | |

3.5. Design booster circuit cycling rate no greater than 50 Cycle/Minute (CPM).

3.6. Use valves that can be opened gradually to reduce adiabatic compression such as needle valve, **DO NOT use ¼ or 180° ball valves, globe valves or butterfly valves**, which may cause particle impact.

3.7. Isolate oxygen containers from booster system with proper distance (12 ~ 15 feet).

3.8. When connecting pipe to the system, visually inspect cleanliness at open ports. Use clean lint-free cloth, safe zone spray clean and wipe the opening. Use clean Latex gloves when contacting exposed plumbing. Cap or bag all connection ports when not in use.

## 4. System Set-up:

4.1. Check booster nameplates to confirm that all components, Haskel and other products, are certified for **OXYGEN SERVICE**.

4.2. Before operation, make sure **ALL** tubing, hoses, piping, and connections are capable of the specified maximum pressures indicated on the drawing. Make sure **ALL** connections, pipe work, hoses, and other parts that will come in contact with oxygen, have been thoroughly cleaned for oxygen service. Make sure **ALL** openings at cylinder hose connections and piping are clean and free of dust, oil, and grease, visual inspection or/and wipe test are recommended.

4.3. Make sure that oxygen supply and fill bottles are separated from oxygen booster section with 12 ~ 15 feet safe distance.

4.4. Do not install a valve between the supply cylinders and the booster system, or between outlet of booster and fill cylinders.

**Caution:** Do not use ¼ ball valves on Oxygen Section.
Needle valves only.

4.5. Connect air drive supply to the air inlet filter.

4.6. Connect oxygen supply to the oxygen inlet filter.

4.7. Connect fill cylinders to be pressurized.

## 5. Operation Instructions (Refer to Fig. 2 on Page 4)

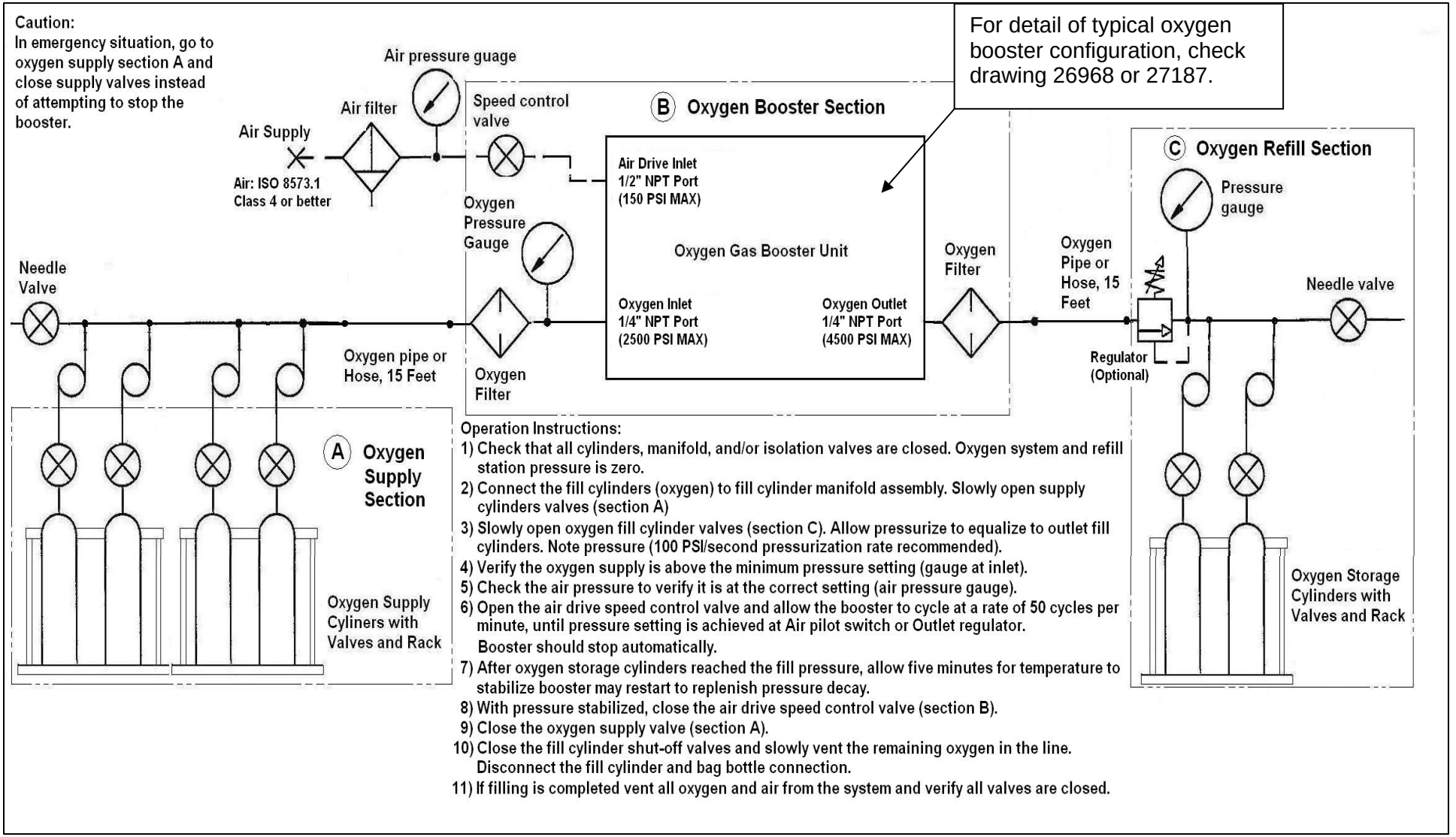



**Fig. 2**
**Typical Configuration of**
**Haskel Oxygen System and Operation Instructions**

## 6. Suggested Maintenance

| Performance Interval | Maintenance Action | |
|---|---|---|
| Before/After each use. | a. | Perform overall visual check of system. |
| | b. | Drain and clean the air filter bowl. |
| | c. | Clean oxygen cylinder connections, cap connections |
| Every 20,000 cycles. (Or 3-6 months) | a. | Inspect and re-lubricate air cycling valve o-rings in air drive section. (Replace if necessary) |
| | b. | Check Booster for oxygen leaking from vents, external leakage, and overall performance. |
| | c. | Check tie rod bolts, relief valve and air pilot switch, hex nuts for loosing. Re-torque if needed. |
| Every 6 months. | a. | Test and calibrate all pressure gauges. |
| | b. | Replace oxygen and air filters. |
| Every 12 Months. | a. | Inspect piping at full system pressure. |
| | b. | Test relief valve, reset as needed |
| Every 500 - 1000 hours of continuous use, or every 18 Months. | a. | Reseal booster – gas section, air drive section as needed |

**Referenced Documents**

**NFPA 53** Recommended Practice on Materials, Equipment and Systems Used in Oxygen-Enriched Atmospheres

**ASTM G128** Standard Guide for Control of Hazards and Risks in Oxygen Enriched Systems

**ASTM G88** Standard Guide for Designing Systems for Oxygen Service

**ASTM G-4** Standards Technology Training course *Controlling Fire Hazards in Oxygen Handling Systems*

**EIGA 8/76/E** Prevention of Accidents Arising from Enrichment or Deficiency of Oxygen in the Atmosphere

# SAFETY INFORMATION
## PUMPS, GAS BOOSTERS AND AIR PRESSURE AMPLIFIERS (LIQUID, AIR OR GAS DRIVEN)

## ➢CAUTION➣

**HIGH PRESSURE GAS OR LIQUID CAN BE DANGEROUS IF IMPROPERLY HANDLED.**
**EYE PROTECTION, RESPIRATORS AND GLOVES SHOULD BE USED PER MSDS**

1. **BEFORE INSTALLATION:**

   1.1 Study the technical data received with the unit. Do not hesitate to call your distributor or Haskel, Inc., on any question.

   1.2 Determine the maximum system pressure that might be encountered for the drive input, pump input, & pump output.

      1.2.1 Be certain that the data confirms the unit is rated for those pressures at all three connections.

      1.2.2 Be certain that your connecting piping, fittings, gauges, and accessories are rated properly at all three ports and that **relief valve or burst disc protection** is provided for any potential over pressure.

   1.3 Review the compatibility of the gas and/or liquids with all components and piping (particularly oxygen gas where each component exposed to the gas should be specifically cleaned, labeled, and designed for oxygen service).

   1.4 Do not use oxygen gas boosters to pump any other gas.

2. **INSTALLATION:**

   2.1 Inspect all connections for contaminants and clean as needed before tightening. If system is for oxygen gas, follow specific special inspection and cleaning procedures to ensure removal of any hydrocarbon contamination.

   2.2 Fasten unit securely to mounting surface before tightening piping connections.

   2.3 Use back up wrench to hold unit fitting while tightening connecting fitting.

   2.4 Stop and inspect for any indication of cross-threading or galling (particularly stainless steel to stainless steel fittings).

   2.5 Assure that system isolation valves are installed on the drive input, fluid input and fluid discharge lines. Also make sure that bleed down valves are installed so that pressure can be vented off from all connections to the pump.

3. **OPERATION:**

   3.1 Be certain you have an understanding of the complete system before operating. Question anything that is unclear.

   3.2 Equalize inlet & outlet pressures slowly first. Always open fluid inlet and outlet valves (to and from the pump sections) before opening drive valve. (Inlet gas will free flow through all pumps & boosters when inlet pressure exceeds outlet)

   3.3 Open all valves slowly. Do not use quick acting valves such as 1/4 turn type - particularly in oxygen gas systems.

   3.4 Presume that ALL installations will eventually leak due to vibration, wear or accident. Consider ALL fluids (except air & water) to be potentially hazardous if confined in a closed area. Therefore, operate only in a well ventilated area.

4. **MAINTENANCE:**

   4.1 Prior to performing any maintenance, close all three isolation valves and vent all pressure to zero. **THIS IS CRITICAL. INJURY MAY RESULT IF MAINTENANCE IS ATTEMPTED WHILE THE UNIT IS PRESSURIZED.**

   4.2 Perform maintenance in accordance with the Operating & Maintenance Manual. Make sure that replacement seals and O- rings are of fluid compatible material. Do not modify the unit in any way without contacting the factory.

**Haskel International, Inc.**
**100 East Graham Place, Burbank, CA 91502 USA**
**Tel: 818/843-4000 • Fax: 818/841-4291 • www.haskel.com**

**Haskel United Kingdom**
**North Hylton Road, Sunderland SR5 3JD, England, UK**
**Tel: 44-191-549-1212 • Fax: 44-191-549-0911**

**Haskel Asia**
**23 Tagore Lane #03-06, Tagore 23 Warehouse Complex, Singapore 787601**
**Tel: 65-6455-7559 • Fax: 65-6455-2841 • www.haskel.com.sg**

**Haskel Australia**
**P.O. Box 267, Salisbury, Qld. 4107 Australia**
**Tel: 61-7-3277-9118 • Fax: 61-7-3277-6129 • www.haskel.com.au**

881129 Rev B

LINDE

UNION CARBIDE INDUSTRIAL GASES

# Safety Precautions

# OXYGEN

Oxygen is a colorless, odorless, and tasteless gas. It makes up about 21 percent of our atmosphere.

# WARNING

**Oxygen supports and can greatly accelerate combustion.**

**Oxygen, as a liquid or cold gas, may cause severe frostbite to the eyes or skin. Do not touch frosted pipes or valves. If exposure to liquid oxygen or cold gas occurs, restore tissue to normal body temperature (98.6°F) as rapidly as possible, followed by protection of the injured tissue from further damage and infection. Call a physician Immediately. Rapid warming of the affected part is best achieved by using water at 108°F. Under no circumstances should the water temperature be over 112°F, nor should the frozen part be rubbed either before or after rewarming. The patient should not smoke or drink alcohol. Keep warm and at rest.**

**Use a pressure-reducing regulator when withdrawing gaseous oxygen from a cylinder or other high-pressure source.**

### Keep Combustibles Away From Oxygen and Eliminate Ignition Sources.

Many substances which do not normally burn in air and other substances which are combustible in air may burn violently when a high percentage of oxygen is present. DO NOT permit smoking or open flame in any area where oxygen is stored, handled, or used. Keep all organic materials and other flammable substances away from possible contact with oxygen, particularly oil, grease, kerosene, cloth, wood, paint, tar, coal, dust, and dirt which may contain oil or grease. Avoid spills of liquid oxygen. Do not walk on or roll equipment over spills.

### Keep All Surfaces Which May Come In Contact With Oxygen Clean to Prevent Ignition.

Even normal industrial soot and dirt can constitute a combustion hazard. Do not place liquid oxygen equipment on asphalt, or on any surface which may have oil or grease deposits. Use cleaning agents which will not leave organic deposits on the cleaned surfaces. In handling equipment which may come in contact with oxygen, use only clean gloves or hands washed clean of oil. Do not lubricate oxygen equipment with oil, grease, or unapproved lubricants.

### Maintain Adequate Ventilation.

To prevent accumulation of oxygen in areas containing oxygen equipment and to minimize combustion hazards, adequate ventilation must be provided.

### Liquid Oxygen Is Extremely Cold.

(297 deg. F. below zero)

COVER EYES AND SKIN.

Accidental contact of liquid oxygen or cold oxygen gas with the eyes or skin may cause severe frostbite. Handle liquid so that it will not splash or spill. Protect your eyes with safety goggles or face shield, and cover the skin to prevent contact with the liquid or cold gas, or with cold pipes and equipment. Clean, protective gloves without gauntlet that can be quickly and easily removed and long sleeves are recommended for arm protection. Cuffless trousers should be worn outside boots or over high-top shoes to shed spilled liquid. If clothing should be splashed with liquid oxygen or otherwise saturated with oxygen gas, air out clothing immediately. Such clothing should not be considered safe to wear for at least 30 minutes, since it will be highly flammable and easily ignited while the concentrated oxygen remains.

### Containers, Equipment, and Replacement Parts Must Be Suitable for Oxygen Service.

Use only equipment, cylinders, containers and apparatus designed for use with oxygen. Many materials, especially some non-metallic gaskets and seals, constitute a combustion hazard when in oxygen service, although they may be acceptable for use with other gases. Make no substitutions for recommended equipment, and be sure all replacement parts are compatible with oxygen and cleaned for oxygen service. Keep repair parts in sealed clean plastic bags until ready for use.

### Regulators.

Before attaching regulator to cylinder, inspect the regulator very carefully. Make visually certain that the regulator and the inlet filter are free of oil, grease or other hydrocarbon-type contaminants. These contaminants may be ignited when the cylinder valve is opened and would burn violently in an enriched oxygen atmosphere. Replace the inlet filter if broken, missing or found contaminated. When filter is missing or damaged, the regulator should also be reconditioned and the high pressure gauge replaced. Before attaching the regulator to the cylinder valve, crack the cylinder valve momentarily to blow out any dust or dirt that might have accumulated in the cylinder valve outlet. Connect the regulator to the valve, back out the pressure adjusting screw until it turns freely and then open the cylinder valve very slightly and very slowly so the inlet pressure gauge moves slowly to the Cylinder pressure. Then open the cylinder valve all the way. To minimize chance of injury, stand to one side of the regulator when opening the cylinder valve.