OPERATING AND MAINTENANCE MANUAL

Model Numbers: *26968* **Serial Number:**

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

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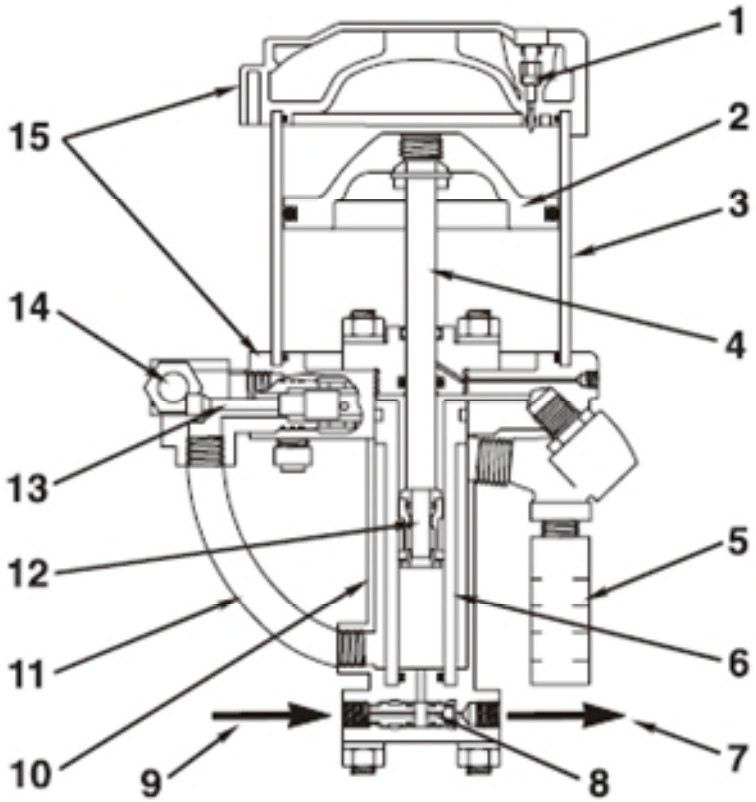
Operating and Maintenance Instructions

- 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. Connecting 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.

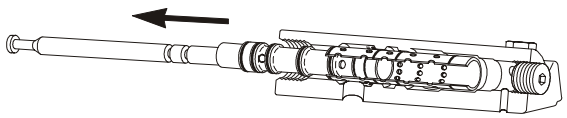


Figure 1: Insert tool in second row of holes in sleeve and if necessary, pry out with screwdriver.

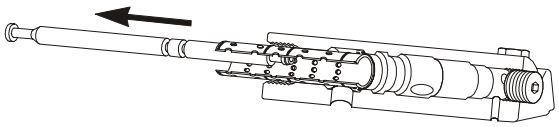


Figure 2: Pull straight out.

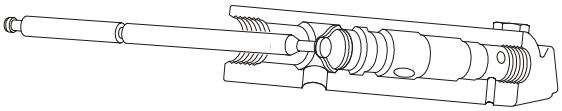


Figure 3: Insert bumper hook through center of bumper and pull straight out.

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.

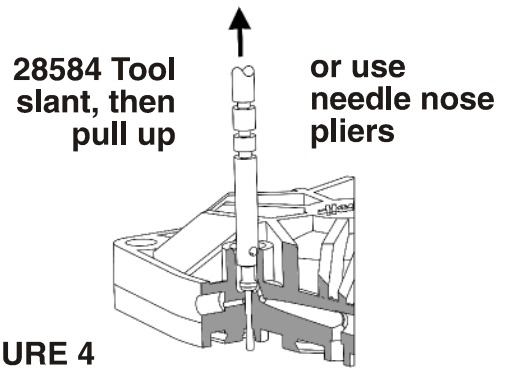
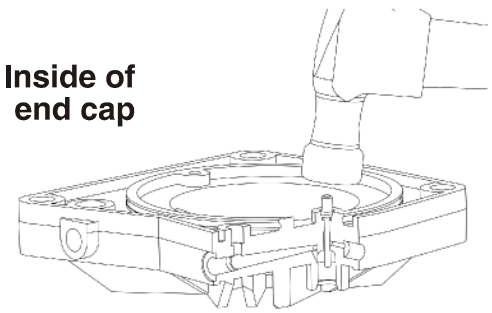


FIGURE 4



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

When labeled with IECEx marking, gas booster models AGD-14, AGD-62, AGD-152 have a specific condition of use.

SPECIFIC CONDITIONS OF USE:

1. The maximum operating air temperature shall be limited to 40°C at the Gas Booster.
2. The maximum temperature range of the pumped gas/air shall be between -29°C and 40°C
3. The Gas Booster compression ratio shall never be allowed to exceed the following:

Model letter ref. relating to area ratio	Compression ratio
-1 to -15	**5:1**
-62	**9:1**
-152	**20:1**

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.

End of Product Life Statement:

Haskel is an ISO14001 certified company and we continually work to minimize our impact on the environment. We offer the highest quality spare parts (seal kits) to extend the life of your pump, gas booster or air amplifier. When our products reach the end of their useful life, we encourage consumers to properly clean and dispose/recycle metal and plastic components in accordance with the federal, state, and local regulations.

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.

HASKEL'S OBLIGATION WITH RESPECT TO ITS PRODUCTS SHALL BE LIMITED TO REPLACEMENT, AND IN NO EVENT SHALL HASKEL BE LIABLE FOR ANY LOSS OR DAMAGE, CONSEQUENTIAL OR SPECIAL, OF WHATEVER KIND OR NATURE, OR ANY OTHER EXPENSE WHICH MAY ARISE IN CONNECTION WITH OR AS A RESULT OF SUCH PRODUCTS OR THE USE OF INCORPORATION THEREOF IN A JOB. THIS WARRANTY IS EXPRESSLY MADE IN LIEU OF ALL OTHER WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, OTHER THAN THOSE EXPRESSLY SET FORTH ABOVE, SHALL APPLY TO HASKEL PRODUCTS.

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Email: sales@haskel.com
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ISO 9001 Q05225 ISO 14001 EMS511920

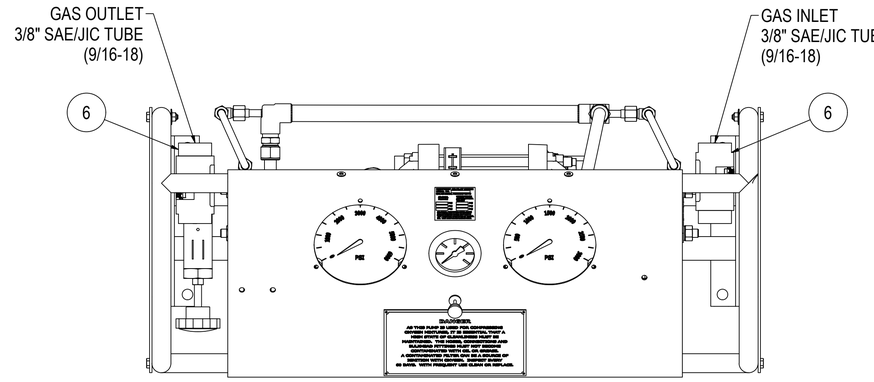
REVISION			
REV	DESCRIPTION	DATE	CHECKED
AG	REVISED PER ECO 33515	10/29/2021	SQ

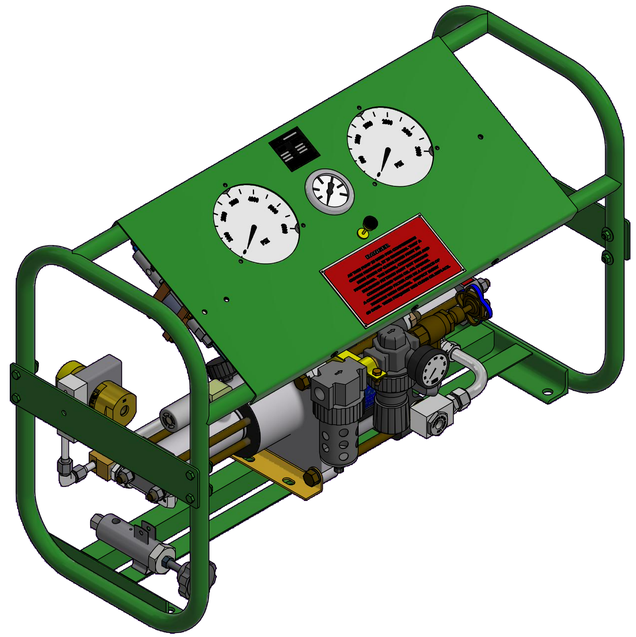
NOTES:

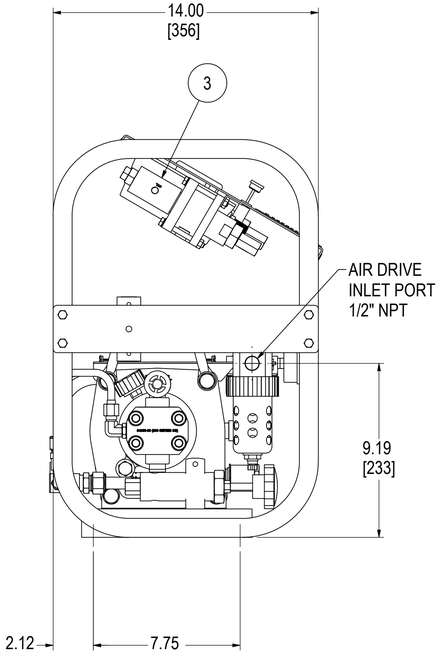
1. ALL PLUMBING, FITTINGS & COMPONENTS IN OXYGEN SECTION TO BE CLEANED FOR OXYGEN SERVICE.
2. 26968 AS SHOWN 26968-1 WITHOUT FILTERS (ITEM 6)
3. ALL DIMENSIONS SHOWN ARE APPROXIMATE IN INCHES, WITH MILLIMETERS IN PARENTHESES.
4. 1/4" OD X .049 WALL THICKNESS, 304 C'RES SEAMLESS TUBING (MAX GAS WORKING PRESSURE 6500 PSI/449 BAR) (P/N CNM00020)
5. 3/8" OD X .049 WALL THICKNESS, 304 C'RES SEAMLESS TUBING (MAX GAS WORKING PRESSURE 4900 PSI/338 BAR) (P/N CNM00072)
6. RECORD THE AIR SIGNAL PRESSURES AND ADD TO REMOTESET LABEL USING THE FOLLOWING ACTUATION PRESSURES: 1800 (125), 2500 (173) & 4750 (328) PSI (BAR) A MINIMUM DOWNSTREAM RECEIVER VOLUME OF 134 CU. IN. IS REQUIRED. FACTORY SET AT 2500 PSIG (173 BARG).
7. 1/4" OD X .180" ID BLACK NYLON 11 TUBING (MAX AIR WORKING PRESSURE 150 PSI/11 BAR) (P/N PB0754100)
8. GOVT. NSN #3655-01-042-3633.

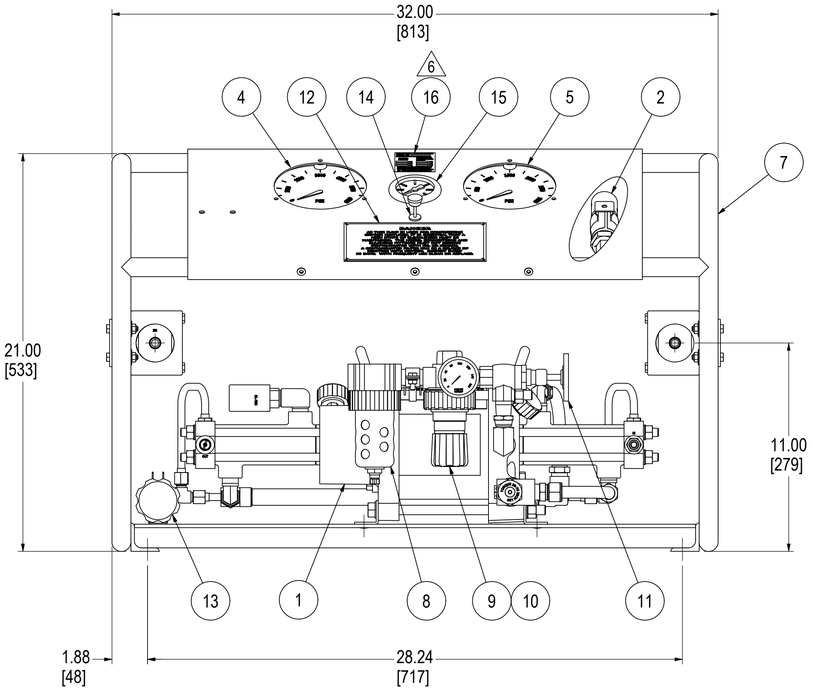
TEST PROCEDURE:

1. ATTACH OUTLET RECEIVER VOLUME 134 CU. IN. MIN.
2. CONNECT INLET SUPPLY GAS NOMINALLY 1300 PSI/90 BAR (N2) (±800 PSI/56 BAR).
3. ATTACH AIR DRIVE 150 PSI/11 BAR MAX.
4. BUBBLE CHECK SYSTEM AT NOMINAL 1000 PSI/69 BAR (N2).
5. SET ALL SYSTEM RELIEF VALVES PER SCHEMATIC OR P/L AS SHOWN (+0 PSI/BAR -50 PSI/-4 BAR).
6. SET INLET AIR PILOT SWITCH AT DECREASING SETTING, PER SCHEMATIC OR P/L AS SHOWN (+25 PSI/+2 BAR -0 PSI/BAR).
7. SET REMOTESET AIR PILOT SWITCH AND NOTE SIGNAL PRESSURE AS REFERENCED BY NOTE 6 OF THIS DRAWING (+0 PSI/BAR -50 PSI/-4 BAR).
8. RECHECK SYSTEM (BUBBLE CHECK) FOR LEAKAGE AT FULL SYSTEM PRESSURE.
9. VENT CIRCUIT AND PREPARE FOR SHIPMENT.









PARTS LIST				
ITEM	PART NUMBER	DESCRIPTION	BSC	-1
1	27187	OXYGEN BOOSTER W/ EXT PILOT MOD (AGT-15X/30X)	1	1
2	28755-13	AIR PILOT SWITCH NO SET @ 150 PSI/11 BAR DECR	1	1
3	55790-10	REMOTESET AIR PILOT SWITCH NO INCR SEE NOTE 6	1	1
4	59560-60-PSI/BAR-CAL	PRESSURE GAUGE, DUAL SCALE, 0-6000 PSI/414 BAR	1	1
5	59560-30-PSI/BAR-CAL	PRESSURE GAUGE, DUAL SCALE, 0-3000 PSI/207 BAR	1	1
6	87260-12	GAS FILTER BRASS (10 MICRON)	2	-
7	55820-30G	ROLL BAR FRAME (GREEN)	1	1
8	27990	AIR FILTER (40 MICRON)	1	1
9	27991	AIR REGULATOR	1	1
10	27997	AIR PRESSURE GAUGE 0-160 PSI/12 BAR	1	1
11	27745	SPEED CONTROL VALVE	1	1
12	54205	NAMEPLATE, OXYGEN SYSTEMS	1	1
13	27741-12	RELIEF VALVE SET @ 2650 PSI/183 BAR	1	1
14	58537	REMOTESET PILOT REGULATOR	1	1
15	85420-1.6-BAR-CAL	REMOTESET PRESSURE GAUGE, DUAL SCALE, 0-160 PSI/11 BAR	1	1
16	57876	REMOTESET NAMEPLATE	1	1

NEXT ASSY (REF ONLY)
B-8312

APPROVALS		DATE
DRAWN	RTG	7/13/1971
CHECKED		
APPROVED	FJB	
CAD FILENAME		26968

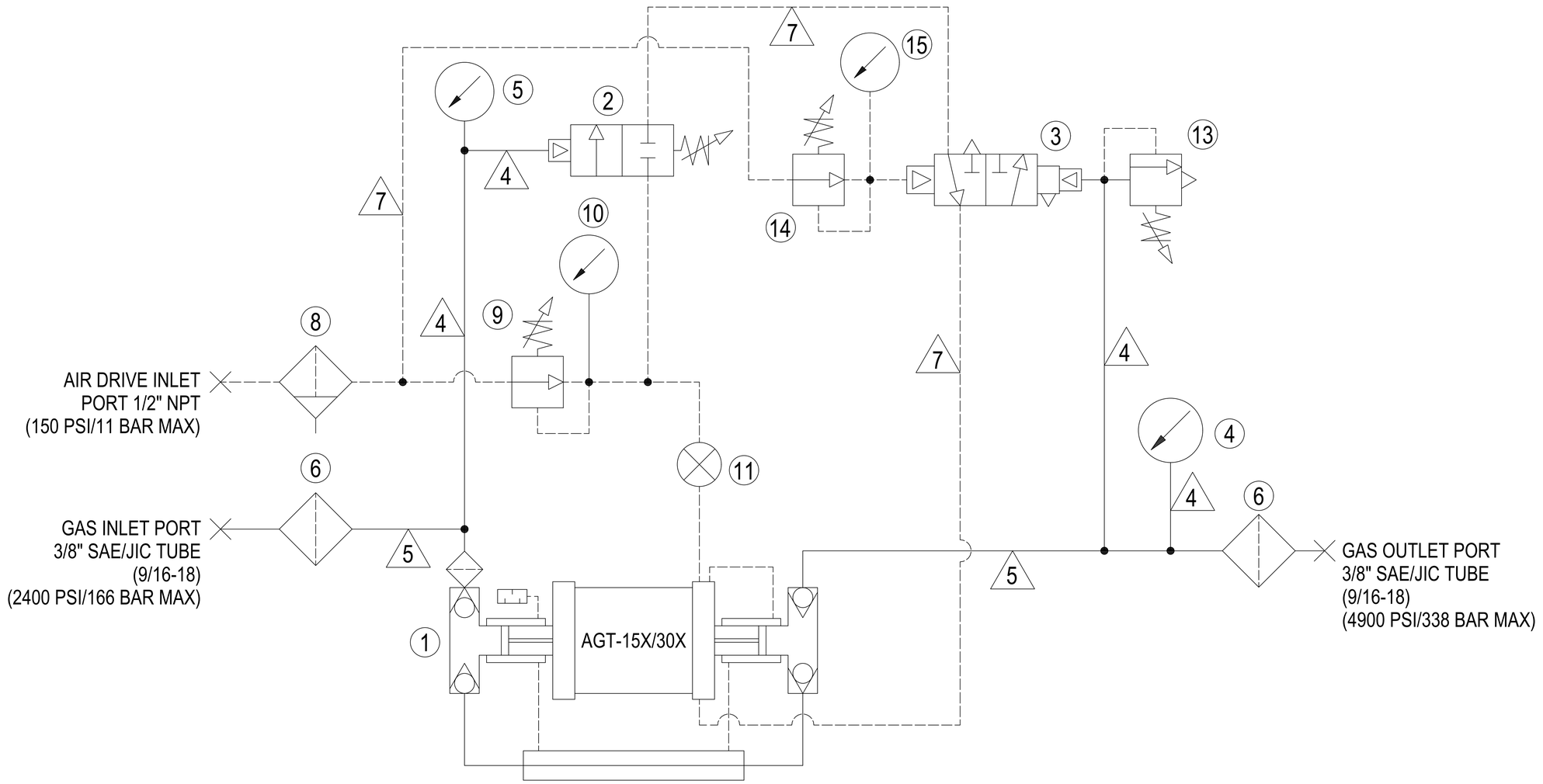
Haskel International, LLC
Burbank, California 91502

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

SIZE	CAGE CODE	DWG NO.	REV
D	81400	26968-TAB	AG

SCALE: 1/4 | INVENTOR DRAWING | SHEET 1 OF 2

REVISION			
REV	DESCRIPTION	DATE	CHECKED
	SEE SHEET 1		



SCHEMATIC

Haskel International, LLC
Burbank, California 91502

DRAWN	RTG	SIZE	CAGE CODE	DWG NO.	REV
CHECKED		D	81400	26968-TAB	AG
		SCALE: 1/4	INVENTOR DRAWING	SHEET 2 OF 2	

REV. 08/15/2013, D. MACH

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.

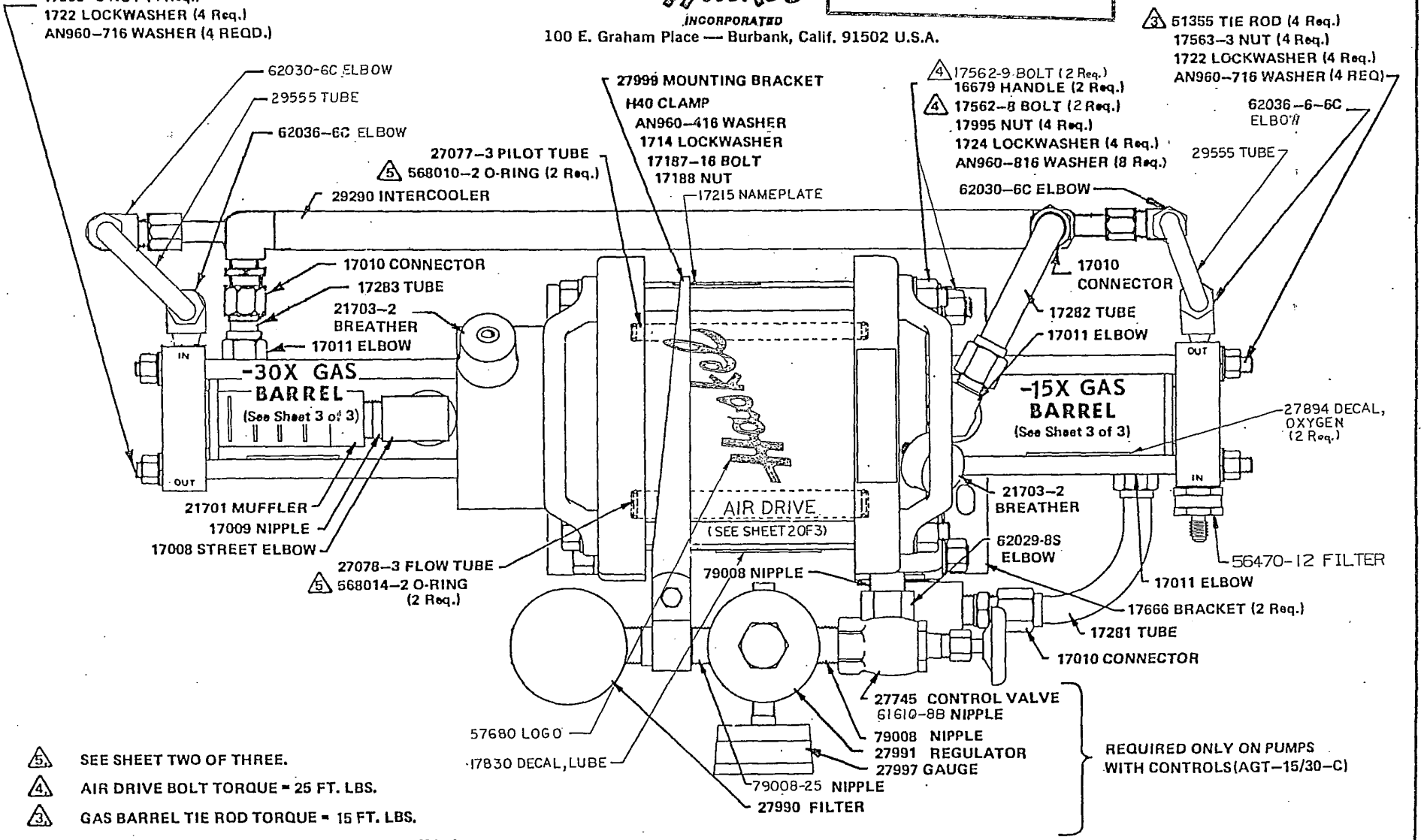
CONTROL COPY

LOCATION # 1

MACH. TOLERANCES UNLESS OTHERWISE SPECIFIED DECIMAL DIM. .XX± .030 .XXX± 010 ANGULAR DIM .X°± .1° .X°XX' ±0°10'. BREAK SHARP EDGES .006 .030 INTERNAL RADII .030 MACHINE FINISH 250			Haskel	HASKEL, INT'L 100 E. GRAHAM PLACE 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

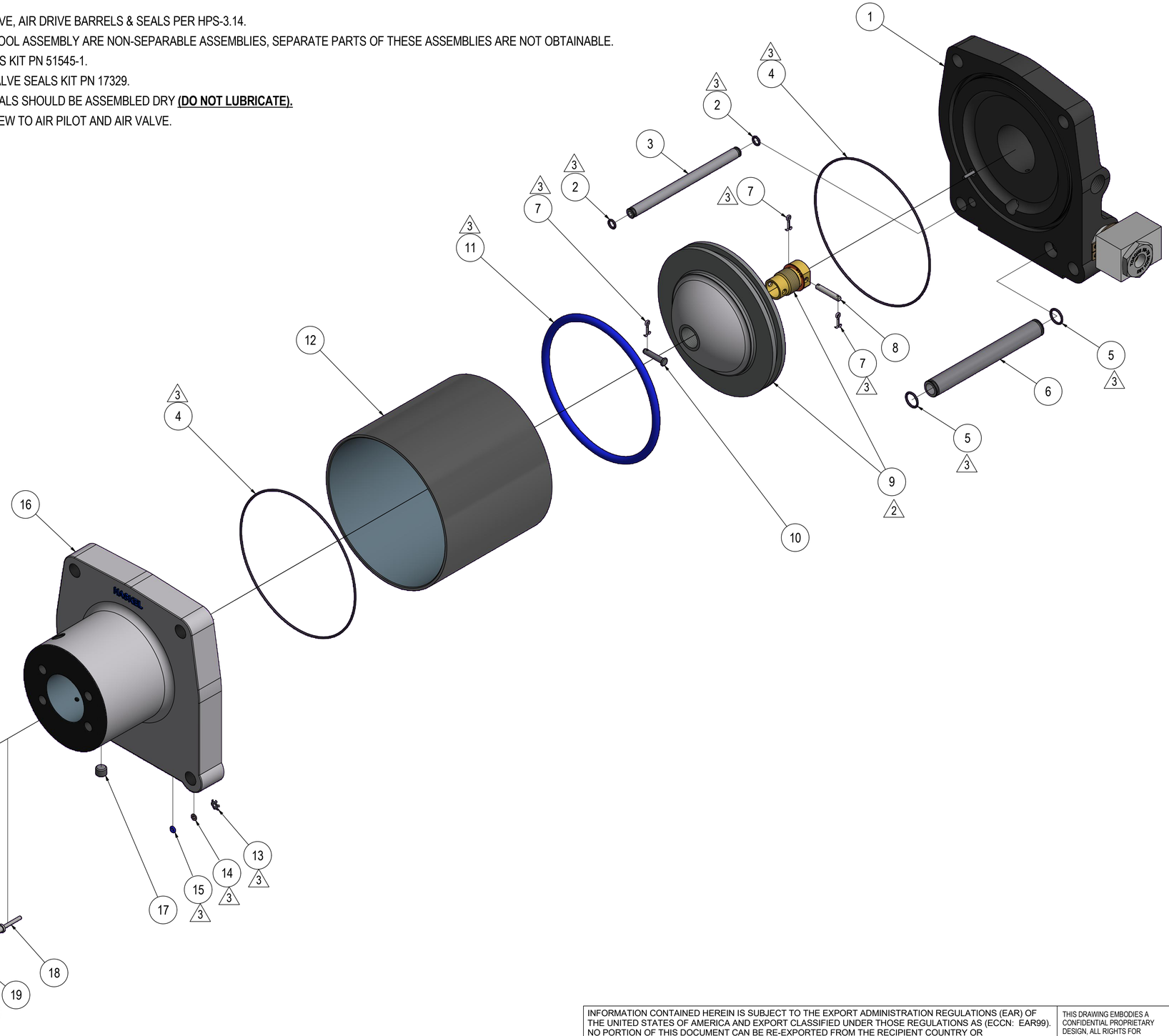
REV	DESCRIPTION	DATE	DISP	BY	APPR.
F	SEE ECO 2197	5-15-95		JP	DH

AD-7

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. INCLUDED IN AIR DRIVE SEALS KIT PN 51545-1.
4. INCLUDED IN AIR CYCLING VALVE SEALS KIT PN 17329.
5. ALL CARBON FILLED PTFE SEALS SHOULD BE ASSEMBLED DRY **(DO NOT LUBRICATE).**
6. REFER PAGE 2 FOR DETAIL VIEW TO AIR PILOT AND AIR VALVE.

REVISION			
REV	DESCRIPTION	DATE	CHECKED
R	REVISED PER ECO33754	9/5/2023	ES



QTY	PART NUMBER	DESCRIPTION	MATERIAL	ITEM
1	16788	RETAINER	2024-T4 ALUM	34
2	568021-2	O-RING	BUNA-N	33
1	16789	FITTING	ALUM 6061-T6 / QQ-A-225	32
1	568015-38	O-RING	CARBOXYLATED NITRITE	31
1	5100-112H	RETAINER RING	18-8 STEEL	30
8	568017-38	O-RING	CARBOXYLATED NITRITE	29
1	568013-2	O-RING	BUNA-N	28
1	28088	SPOOL ASSEMBLY	----------	27
5	568020-2	O-RING	BUNA-N	26
1	16648	SLEEVE	AL 7075-T6	25
1	17524	SPACER (NEOPRENE)	300 SERIES SS/NEOPRENE	24
1	17568-5	PIPE PLUG	STEEL	23
1	27375-7V	STEM	304 SS	22
2	16510	PLUG	AL 2024-T351 OR T4	21
2	568906-9	O-RING	BUNA-N	20
2	16513	SPRING	ASTM-A-228	19
1	27375-6V	STEM	303 SS	18
2	17568-2	PLUG, 1/8 NPT	STEEL	17
1	51357	CAP-UPPER	AISI 12L14	16
2	568006-2	O-RING	BUNA-N	15
2	16517	SPACER	BRASS	14
2	5005-31H	RETAINER RING	15-7 PH	13
1	17339-2	BARREL	AMALGA BA-0575-NS-C	12
1	27272	O-RING	BUNA-N	11
1	MS20392-2C25	PIN	18-8 SS	10
1	17580	PISTON ASSEMBLY	----------	9
1	17554	PIN	4130/8630 STEEL	8
3	MS24665-151	COTTER PIN	C.R. STEEL	7
1	27078-3	FLOW TUBE	304 SS / ASTM A 240	6
2	568014-2	O-RING	BUNA-N	5
2	568050-2	O-RING	BUNA-N	4
1	27077-3	TUBE, PILOT	300 SERIES SS	3
2	568010-2	O-RING	BUNA-N	2
1	51356	LOWER CAP	ALUMINUM-6061-AHC	1

PARTS LIST

NEXT ASSY (REF ONLY)

Haskel International, LLC
Burbank, California 91502

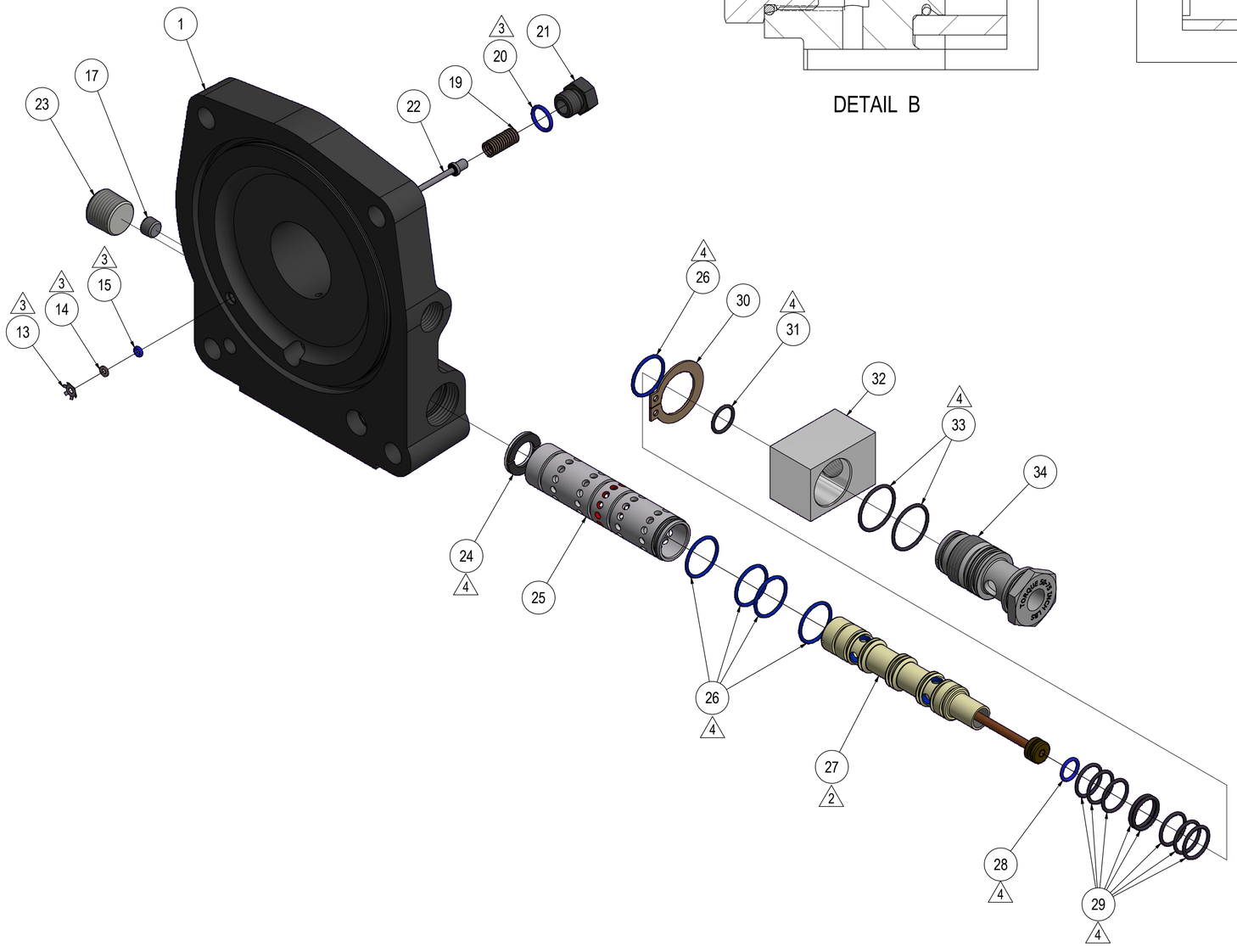
APPROVALS		DATE
DRAWN	JAN	10/3/2007
CHECKED	DL	4/20/2008
APPROVED	SDQ	4/21/2008
CAD FILENAME		AD-7

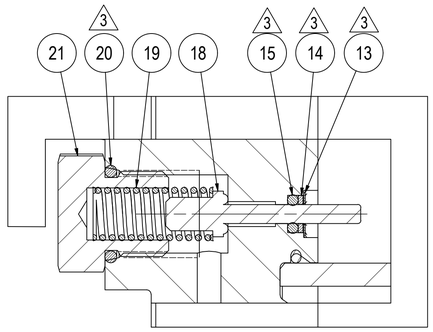
TITLE: AIR DRIVE

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

SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 2

REVISION			
REV	DESCRIPTION	DATE	CHECKED
	SEE SHEET 1		





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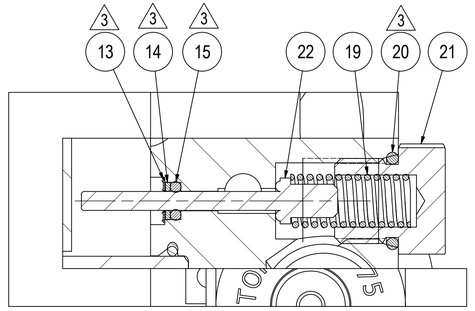

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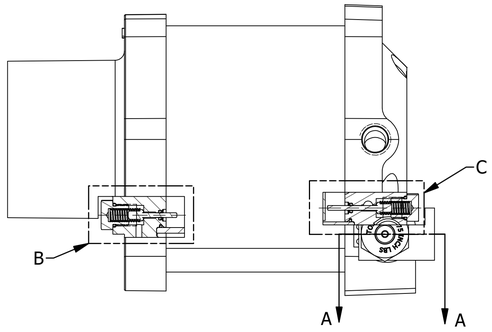
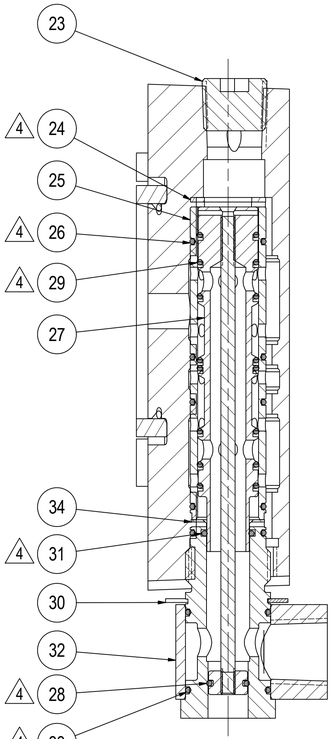




SECTION A-A

Haskel International, LLC
Burbank, California 91502

DRAWN	JAN
CHECKED	DL

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

SCALE: NONE | INVENTOR DRAWING | SHEET 2 OF 2

REV. 08/15/2013, D. MACH

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.

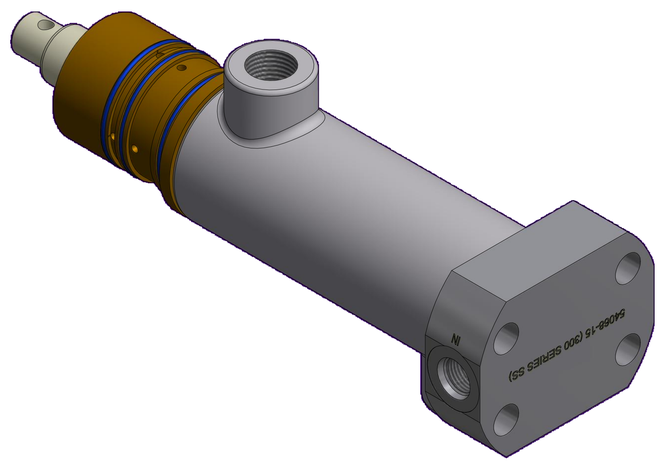
   SCREW THE SEAT IN UNTIL IT IS SNUG (APPROXIMATELY 5/8" BELOW END CAP FACE). CHECK THAT THE BALL IS FREE TO MOVE BY DEPRESSING IT WITH A THIN ROD FROM THE INLET END.

△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	

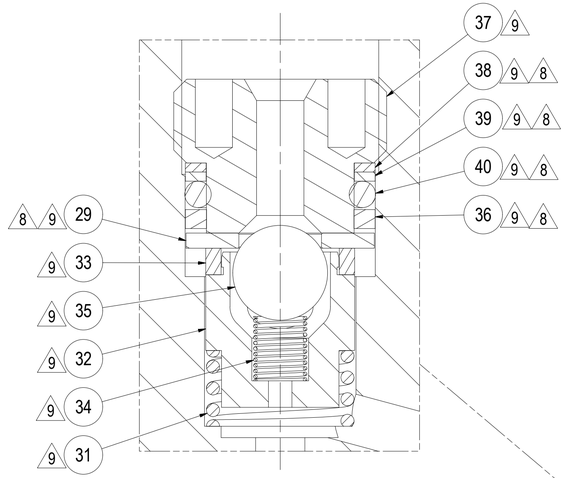
TITLE: GS-15X GAS SECTION (FOR OXYGEN SERVICE)

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

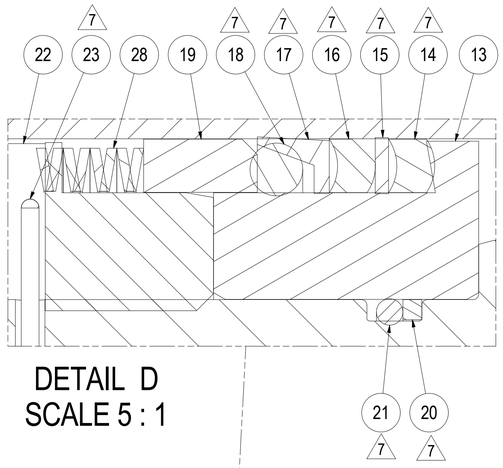
SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 2

GS-15X

REVISION			
REV	DESCRIPTION	DATE	CHECKED
	SEE SHEET 1		



DETAIL B
SCALE 5 : 1
INLET



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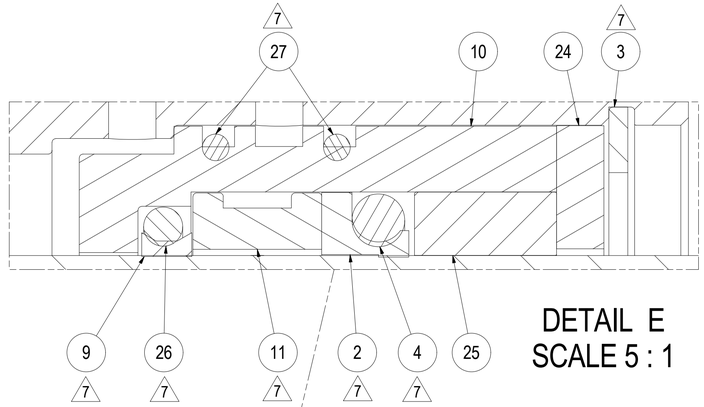

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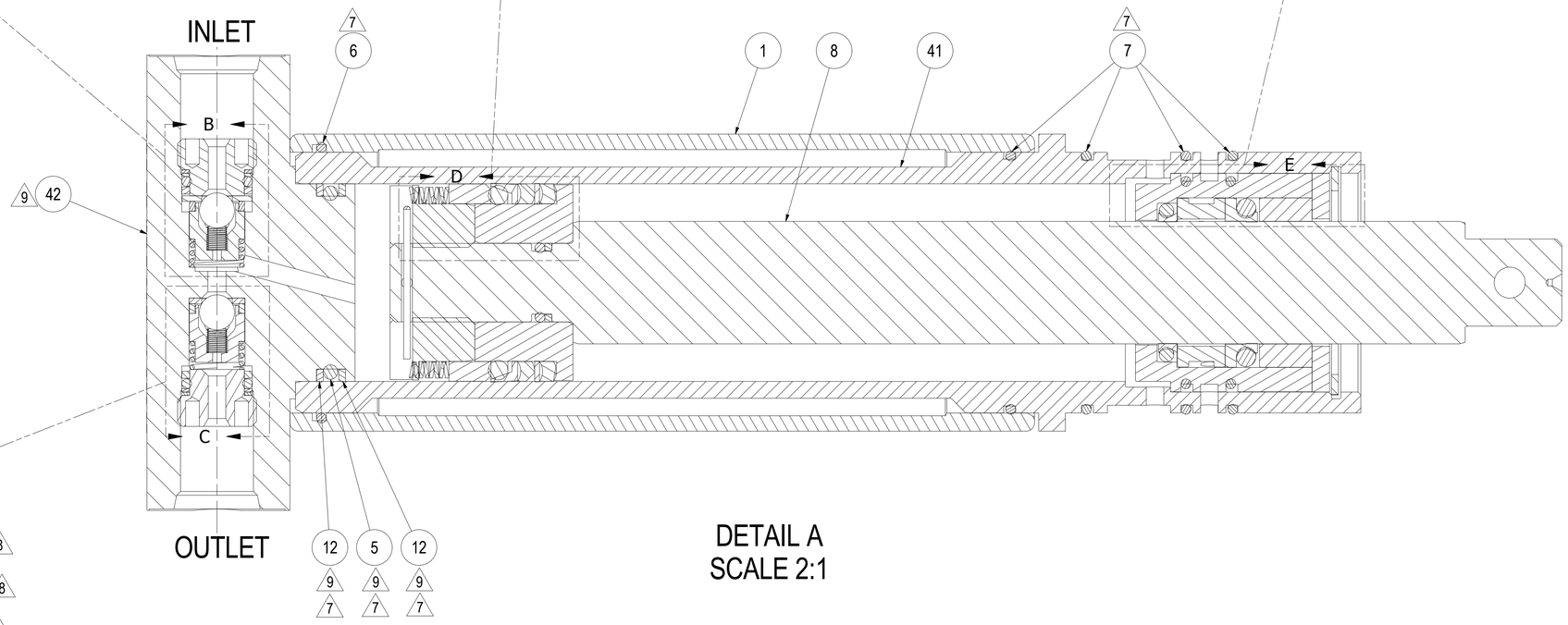

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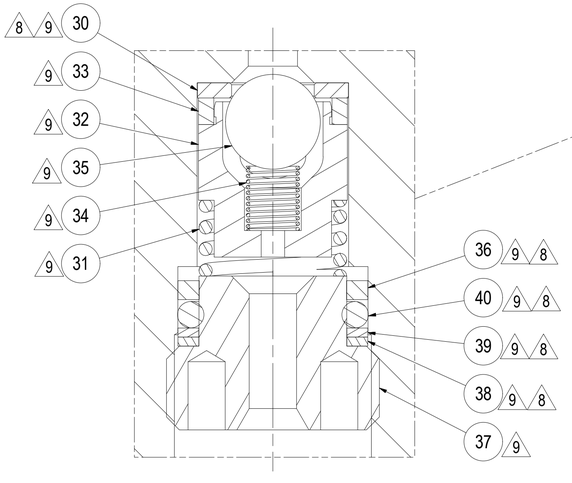
SCALE 2:1



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.

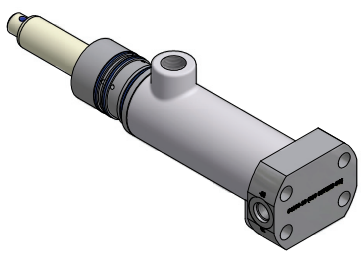
NOTE: WHEN PROPERLY TIGHTENED THE 51364 NUT SHOULD SOLIDLY CONTACT THE 17937-1
ROD AND BE APPROXIMATELY FLUSH WITH THE ROD END.
(IF NECESSARY, USE FEWER 16719-5 SPRINGS TO ACHIEVE THIS).

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.

⚠1 INDICATES PARTS IN SEAL KIT 51548-30
⚠2 INDICATES PARTS IN SEAL KIT 17677
⚠3 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

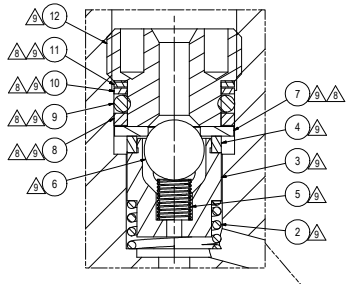
TITLE: GS-30X GAS SECTION (O2 SERVICE)

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

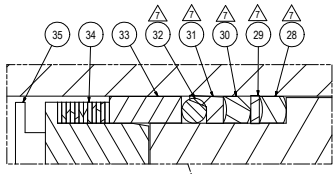
SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 2

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

REVISION			
REV	DESCRIPTION	DATE	CHECKED
	SEE SHEET 1		



DETAIL B
SCALE 5 : 1
INLET



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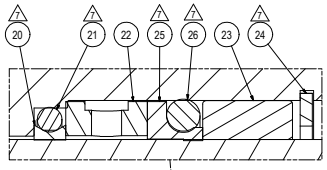

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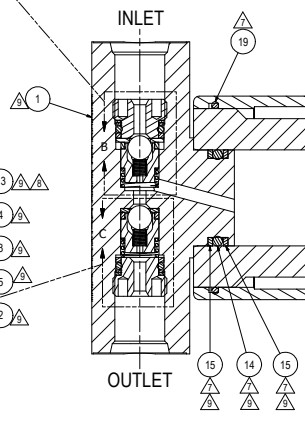

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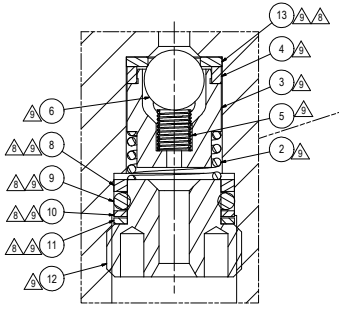
SCALE 2:1



DETAIL C
SCALE 5 : 1
OUTLET

-30X GAS SECTION
(FOR OXYGEN SERVICE)

Hamilton Sundstrand — Hamilton International, Inc., Burbank, California 91502

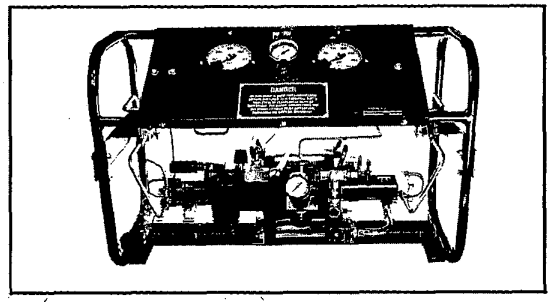
DRAWN	CGW
CHECKED	PD

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

Haskel

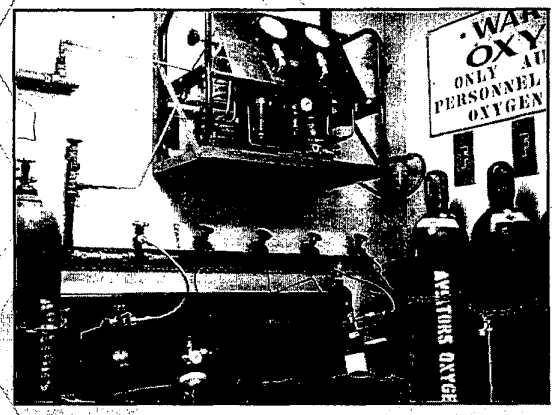
Air Driven OXYGEN BOOSTER Unit Model 26968

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.

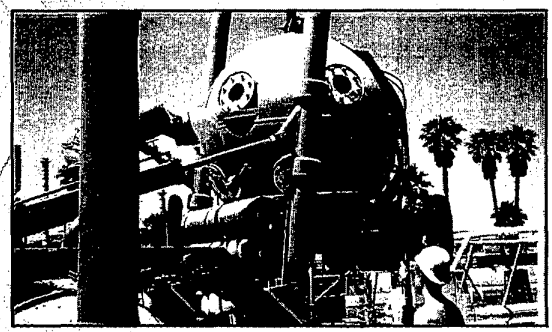


Model 26968 in oxygen bay of major U.S. airline.

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.

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.

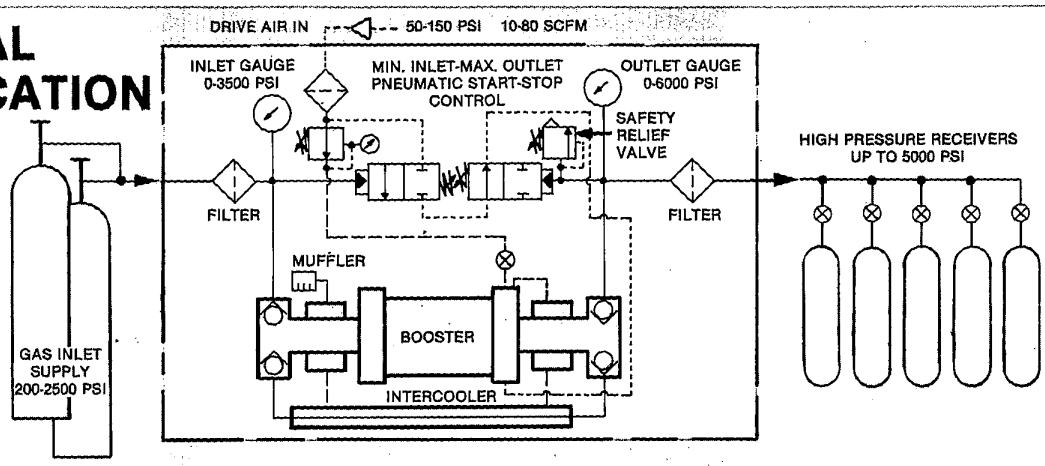


Deep submersible vehicle with breathing gas cylinders. This large diving contractor is a major user of Haskel 26968 units.

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

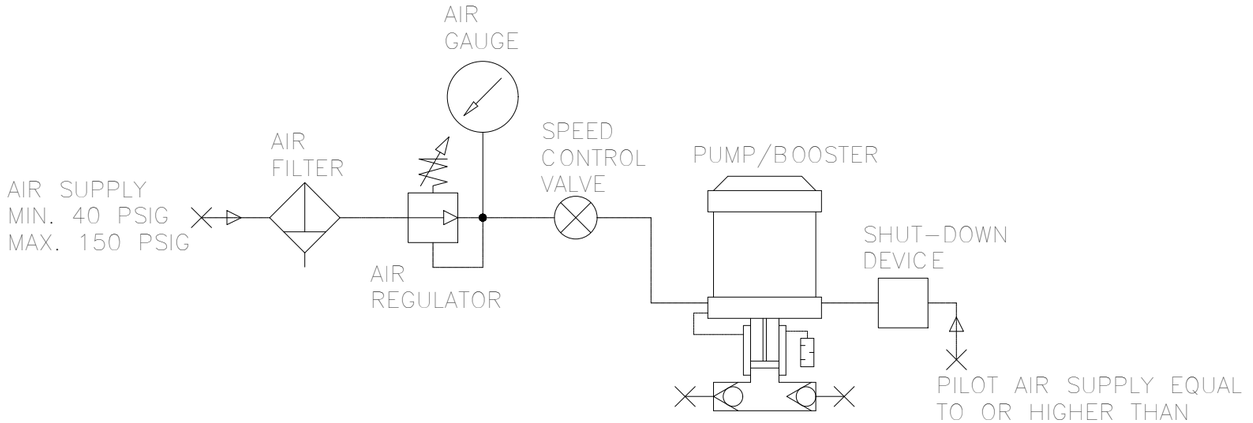
General Pneumatic S.A. ■ Groupe Haskel ■ Lille 59650, France
(20) 04.66.00 ■ FAX : (20) 33.31.95

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

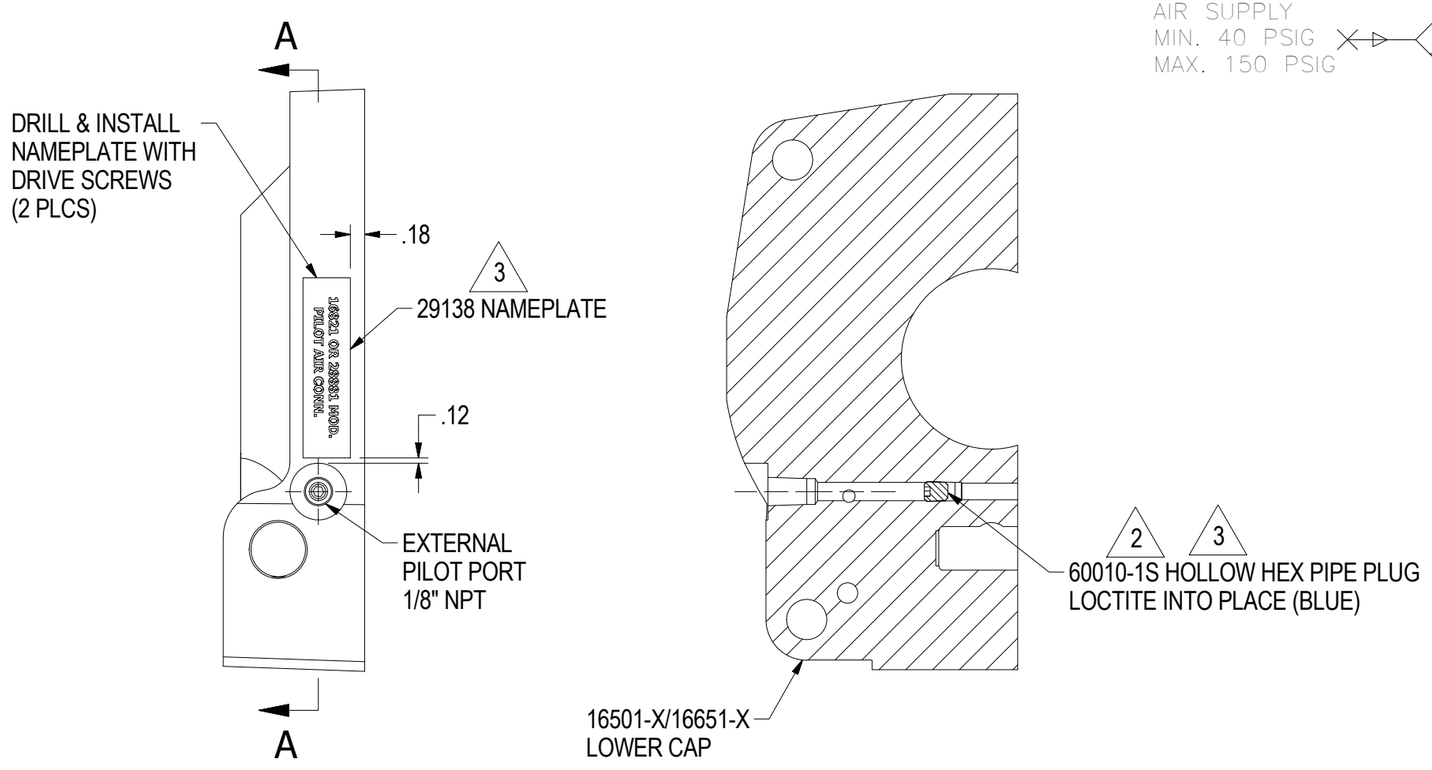
NOTES:

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.

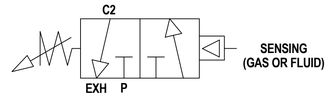
28755-TAB

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.

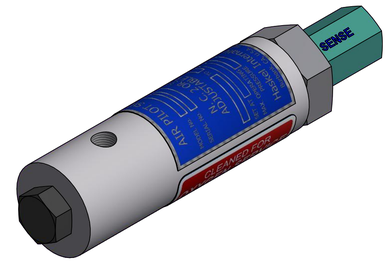
DASH NO	SENSING RANGE (PSIG)	SERVICE
-1	1,500 - 10,000	GENERAL
-2	300 - 3,500	GENERAL
-3	150 - 700	GENERAL
-8	800 - 9,500	GENERAL
5 -11	1,500 - 5,000	OXYGEN
5 -12	300 - 3,500	OXYGEN
5 -13	150 - 700	OXYGEN
5 -18	800 - 5,000	OXYGEN

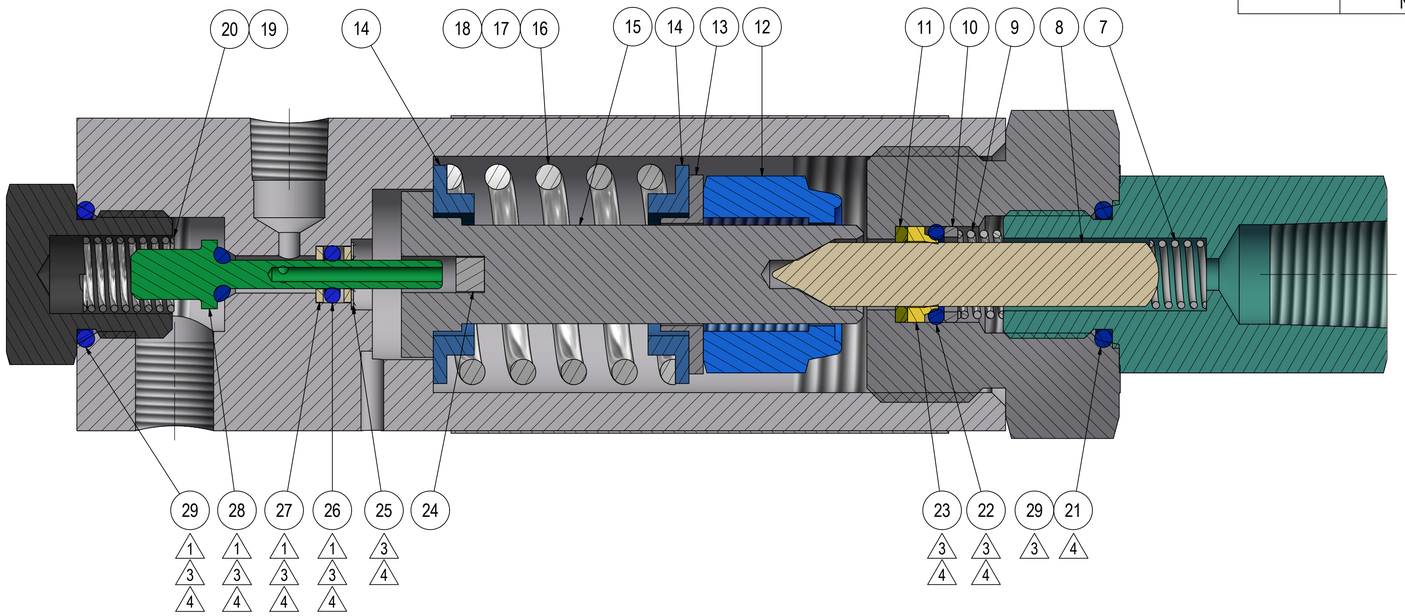
ABOVE SET POINT	P TO C2 EXH BLOCKED
TRANSITION	P, C2 & EXH BLOCKED
BELOW SET POINT (NORMAL)	P BLOCKED C2 TO EXH.
SENSING PRESSURE	AIR VALVE FLOW PATHS OFFSET POSITIONS 3 WAY N.C.

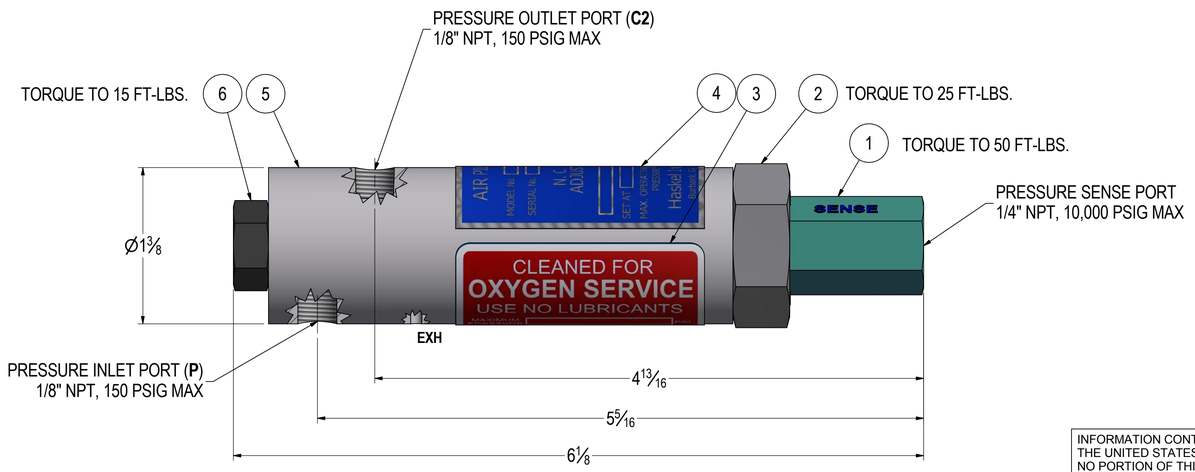


SCHEMATIC

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

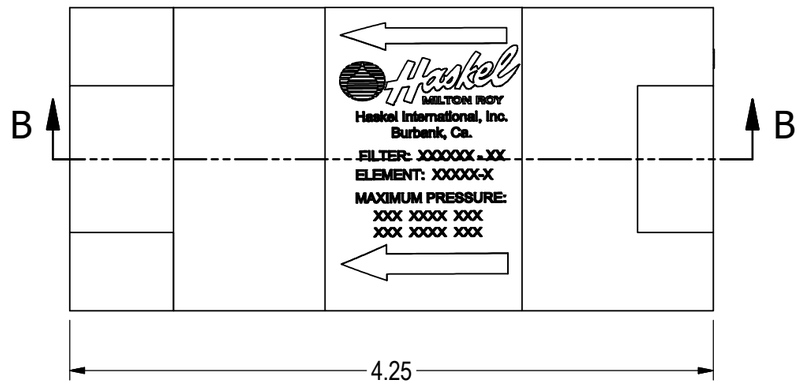
TITLE: AIR PILOT SWITCH - THREE-WAY, NORMALLY CLOSED

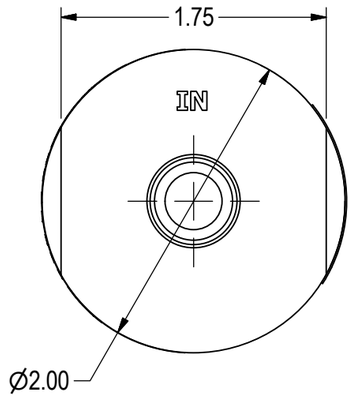
SIZE	CAGE CODE	DWG NO.	REV
D	81400	28755-TAB	Y

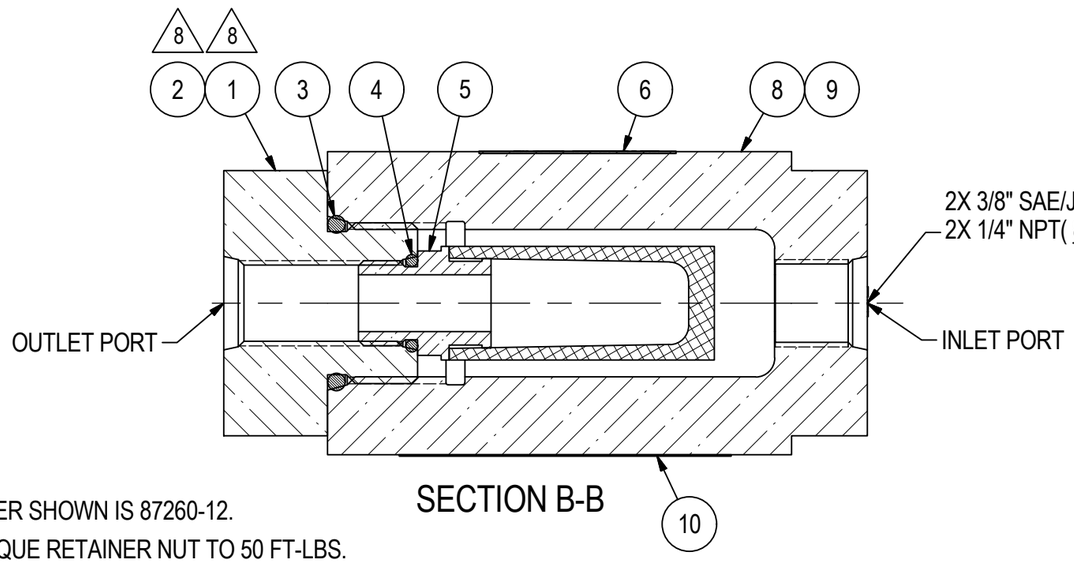
SCALE: NONE | INVENTOR DRAWING | SHEET 1 OF 1

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

REVISIONS			
REV	DESCRIPTION	DATE	CHECKED
C	REVISED PER ECO 33188	3/4/2020	J LANG







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.

NOTES:

-12	-10	PART NUMBER	DESCRIPTION	MATERIAL	ITEM
1	1	27894	DECAL, OXYGEN SERVICE	ALUMINUM	10
1	0	87259-2	BODY, FILTER, 3/8 TUBE	C36000, BRASS	9
0	1	87259-1	BODY, FILTER, 1/4 NPT	C36000, BRASS	8
1	0	28784-6	STENCIL, OXYGEN FILTER		7
0	1	28784-5	STENCIL, OXYGEN FILTER		6
1	1	87256	FILTER ASSEMBLY		5
1	1	568906-7	O-RING (INCLUDED WITH 87256)	VITON	4
1	1	568912-7	O-RING	VITON	3
1	0	87258-2	END FITTING, FILTER, 3/8 TUBE	C36000, BRASS	2
0	1	87258-1	END FITTING, FILTER, 1/4 NPT	C36000, BRASS	1

PARTS LIST

NEXT ASSY (REF ONLY)
FILTER, OXYGEN

Haskel International, LLC
Burbank, California 91502

APPROVALS		DATE
DRAWN	JAN	12/12/2008
CHECKED	MK	3/27/2009
APPROVED	SDQ	3/27/2009
CAD FILE NAME	87260-TAB	

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

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

SCALE: FULL | INVENTOR DRAWING | SHEET 1 OF 1

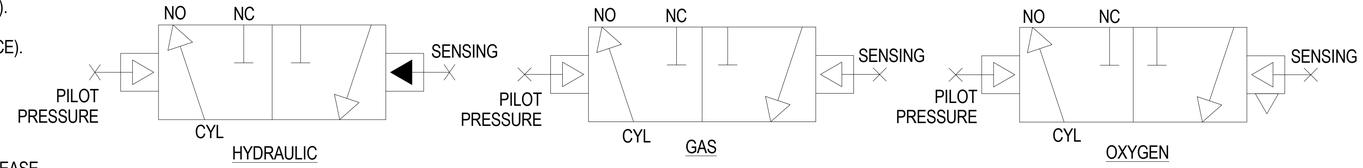
55790-TAB

NOTES:

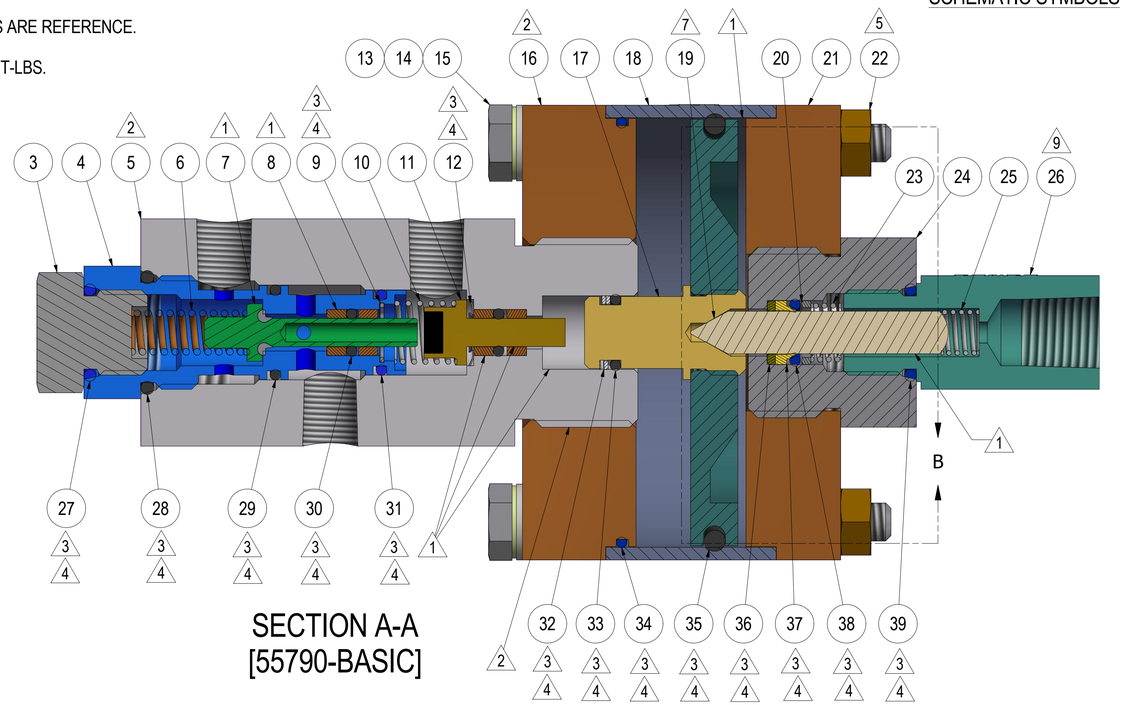
1. LUBRICATE THIS SEALING SURFACE LIGHTLY PER HSP 3.14.
2. ASSEMBLE WITH BLUE LOCTITE - 1/8" NPT PILOT PORT ORIENTED AS SHOWN.
3. INDICATES PARTS IN SEAL KIT PN 55793 (GENERAL SERVICE).
4. INDICATES PARTS IN SEAL KIT PN 55793-10 (OXYGEN SERVICE).
5. TORQUE TO 50 IN-LBS.
6. OXYGEN CLEAN PN 55793-10 PER 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

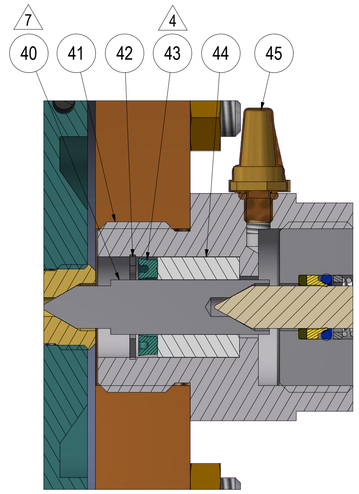
REVISION			
REV	DESCRIPTION	DATE	CHECKED
F	REVISED PER ECO 32328	9/14/2017	BB



SCHEMATIC SYMBOLS

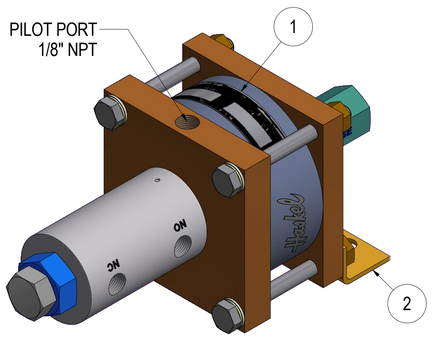


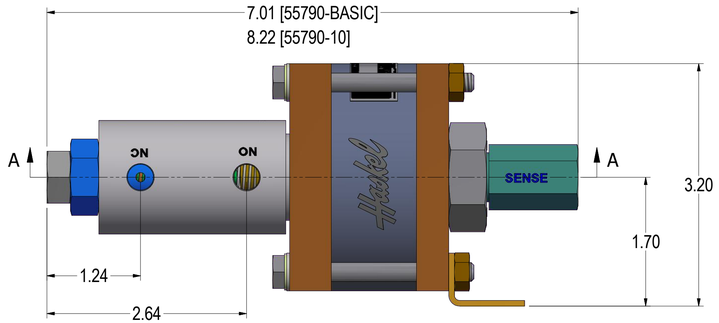
SECTION A-A
[55790-BASIC]

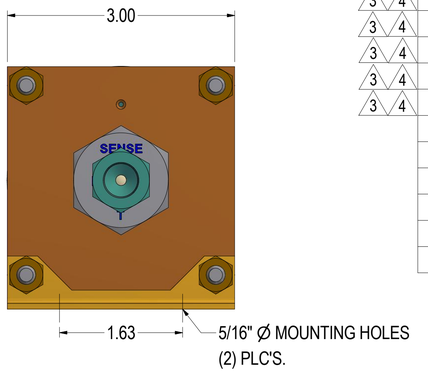


DETAIL B
[55790-10]

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

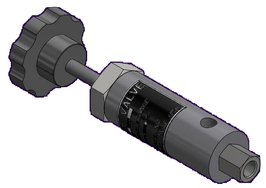
27741-TAB

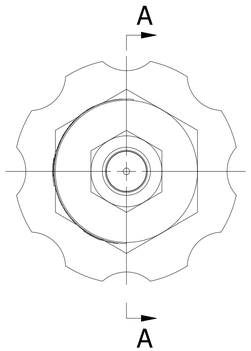
REVISION			
REV	DESCRIPTION	DATE	CHECKED
W	REVISED PER ECO 32933	4/24/2019	SQ

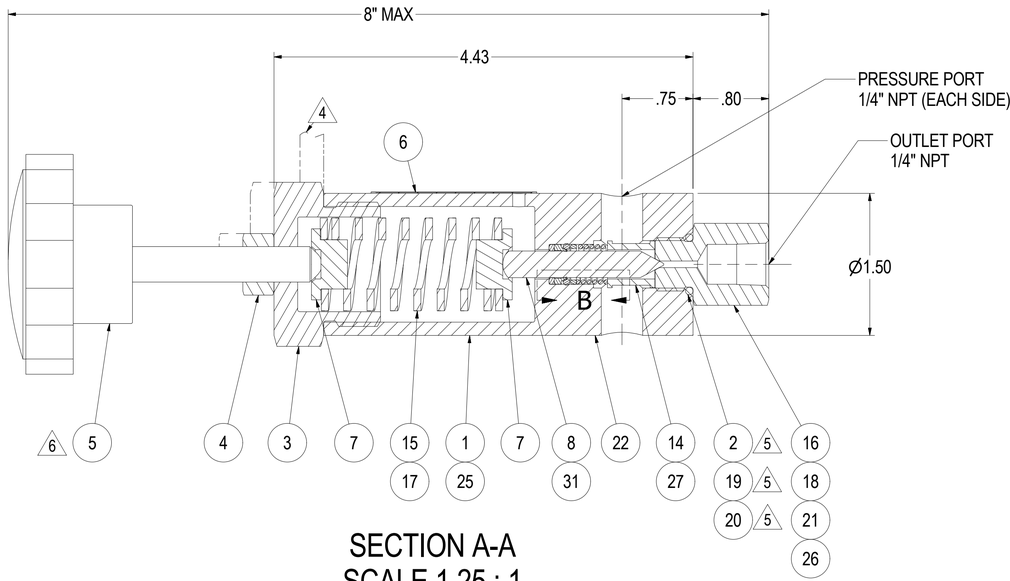
NOTES:

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 AND/OR MONEL.
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)
8. -5, -7 & -8 VARIATION DISCONTINUED.

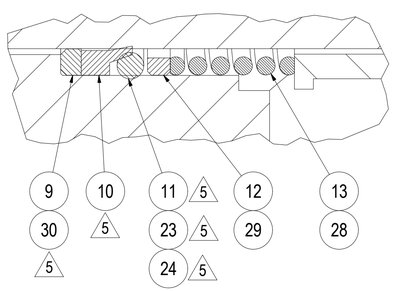
TAB. BLOCK				
PART NO.	RANGE PSIG	STATIC SEAL	SEAT	SEAL KIT P/N
27741-1	300-3,000	VITON	HARD SEAT	52051-1
27741-2	1,000-10,000	VITON	HARD SEAT	52051-2
27741-3	300-3,000	EPR	NYLON	52051-3
27741-4	1,000-10,000	EPR	NYLON	52051-4
27741-6	1,000-10,000	BUNA-N	NYLON	52051-6
27741-11	300-3,000	VITON	KEL-F	52051-11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







SECTION A-A
SCALE 1.25 : 1



DETAIL B
SCALE 5 : 1

OXYGEN LABEL
-11, -11M, -12, -12M *ONLY*

-12M	-11M	-12	-11	-6	-4	-3	-2	-1	PART NUMBER	DESCRIPTION	ITEM
1	1								15574-M	POPPET	31
1	1								26461B	BACK UP	30
1	1								27747-M	SPRING FOLLOWER	29
1	1								17950-M	SPRING	28
1	1								26463-M	TUBE	27
1	1								27746-3M	FITTING	26
1	1								15716-2M	BODY	25
					1	1			568011-13	O-RING	24
				1					568011-9	O-RING	23
1	1	1	1						27894	NAMEPLATE OXYGEN	22
		1	1						27746-3	FITTING	21
1	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		1	15579	SPRING	15
		1	1	1	1	1	1	1	26463	TUBE	14
		1	1	1	1	1	1	1	17950	SPRING	13
		1	1	1	1	1	1	1	27747	SPRING FOLLOWER	12
1	1	1	1				1	1	568011-7	O-RING	11
1	1	1	1	1	1	1	1	1	26462	SEAL	10
		1	1	1	1	1	1	1	26461-2	BACK UP	9
		1	1	1	1	1	1	1	15574	POPPET	8
2	2	2	2	2	2	2	2	2	15577	GUIDE	7
1	1	1	1	1	1	1	1	1	25308	NAME PLATE-IDENT	6
1	1	1	1	1	1	1	1	1	21896	HANDLE	5
1	1	1	1	1	1	1	1	1	17834	NUT, 3/8-24	4
1	1	1	1	1	1	1	1	1	15905	PLUG	3
				1					568906-9	O-RING	2
		1	1	1	1	1	1	1	15716-2	BODY	1

PARTS LIST

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	W

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

MODEL SELECTION CHART

Model No.	Curve On Page	Maximum Rated Gas Supply (Psig)	Maximum Rated Gas Outlet (Psig)	Static Outlet (Stall) Pressure Formula	Piston Displ. Cu. In. Per Cycle	Min. Inlet Gas Pressure; Max. Outlet Gas Pressure; Max Compression Ratio;
AGT-30/75	12	(1) 20 Pa to 9000	20000	75 Pa + 2. 5 Ps	3.1	7 bar (100 psi) 1103 bar(16,000 psi) 60:1
AGT-32/152H	12	(1) 7 Pa to 5000	25000	150 Pa + 5 Ps	6.2	7 bar (100 psi) 1724 bar(25,000 psi) 100:1
AGT/62-152H	13	(1) 40Pa to 3600 (3) 9000	25000	150 Pa + 2.5 Ps	3.1	7 bar (100 psi) 1724 bar(25,000 psi) 60:1
8AGD-1	13	300	300	1 Pa + Ps	400	3.5 bar (50 psi) 20.7 bar(300 psi) 25:1
8AGD-2	13	300	300	2 Pa + Ps	200	3.5 bar (50 psi) 20.7 bar(300 psi) 25:1
8AGD-2.8	13	800	800	2.8 Pa + Ps	125	7 bar (100 psi) 20.7 bar(300 psi) 25:1
8AGD-5	13	2500	2500	5 Pa + Ps	71.4	3.5 bar (50 psi) 172 bar(2500 psi) 20:1
8AGD-14	13	5000	5000	14 Pa + Ps	26.7	7 bar (100 psi) 172 bar(2500 psi) 20:1
8AGD-30	14	5000	5000	30 Pa + Ps	12.4	17 bar (250 psi) 345 bar(5,000 psi) 23:1
8AGD-60	14	9000	9000	60 Pa + Ps	6.2	21 bar (300 psi) 620 bar(9,000 psi) 28:1
8AGD-150	14	20000	20000	150 Pa + Ps	2.4	17 bar (250 psi) 1380 bar(20,000 psi) 25:1
8AGD-5/14	14	(1) 2.8 Pa to 2500	2500	14 Pa + 2.8 Ps	35.7	2.7 bar (25 psi) 172 bar(2500 psi) 50:1
8AGD-5/30	14	(1) 1 Pa to 2500	5000	30 Pa + 6 Ps	35.7	2.7 bar (25 psi) 345 bar(5000 psi) 50:1
8AGT-14/30	14	(1) 12Pa to 1190 (3) 2500	5000	30 Pa + 2.1 Ps	13.2	7 bar (100 psi) 345 bar(5000 psi) 50:1
8AGT-14/60	15	(1) 4.3Pa to 2500	9000	60 Pa + 4.3 Ps	13.2	7 bar (100 psi) 620 bar(9,000 psi) 50:1
8AGT-30/60	15	(1) 30 Pa to 2500 (3) 5000	9000	60 Pa + 2 Ps	6.2	17 bar (250 psi) 620 bar(9,000 psi) 100:1
8AGT-30/150	15	(1) 7Pa to 5000	20000	150 Pa + 5 Ps	6.2	17 bar (250 psi) 1380 bar(20,000 psi) 50:1
8AGT-60/150	15	(1) 40Pa to 3600 (3) 9000	20000	150 Pa + 2.5 Ps	3.1	34 bar (500 psi) 1380 bar(20,000 psi) 100:1
14AGD-125	15	15000	15000	125 Pa + Ps	8.87	69 bar (1000 psi) 1035 bar(15,000 psi) 10:1
14AGD-315	15	35000	35000	315 Pa + Ps	3.53	69 bar (1000 psi) 2415 bar(35,000 psi) 10:1
14AGT-125/315	16	(1) 82 Pa to 6000 (3) 15000	35000	315 Pa + 2.5 Ps	4.44	6.9 bar (100 psi) 2415 bar(35,000 psi) 40:1

1) Two-stage model: Supply pressure also limited by factor *x* air drive (Pa) to avoid interstage stall
2) *Maximum 1st stage pressure. If outlet pressure will exceed this, install interstage relief valve set at this pressure if at the same time, supply pressure will exceed pressure limit above the line*
3) Maximum air drive is 150 psig all models except AG-233, AG-303, AGD-1.5(130 psig)
4) *130 psig maximum drive pressure for all 8" + 14" models*

MODEL SELECTION CHART

Model No.	Curve: On Page	Maximum Rated Gas Supply (Psig)	Maximum Rated Gas Outlet (Psig)	Static Outlet (Stall) Pressure Formula	Piston Displ. Cu. In. Per Cycle	Min. Inlet Gas Pressure: Max. Outlet Gas Pressure: Max Compression Ratio:
AG-15	9	2250	2250	15 Pa	6.2	3.5 bar (50 psi) 155 bar(2250 psi) 20:1
AG-30	9	4500	4500	30 Pa	3.1	7 bar (100 psi) 310 bar(4000 psi) 25:1
AG-62	9	9000	9000	60 Pa	3.1	14 bar (200 psi) 620 bar(9000 psi) 25:1
AG-75	9	11250	11250	75 Pa	1.2	17 bar (250 psi) 775 bar(11,250 psi) 25:1
AG-152	9	20000	20000	150 Pa	1.2	17 bar (250 psi) 1380 bar(20,000 psi) 25:1
AG-233	9	22500	22500	225 Pa	1.2	17 bar (250 psi) 1380 bar(22,500 psi) 25:1
AG-303	10	39000	39000	300 Pa	0.89	34 bar (500 psi) 2690 bar(39,000 psi) 20:1
AGD-1.5	10	300	300	1.5 Pa + Ps	60	ATM 20.7 bar(300 psi) 10:1
AGD-4	10	1250	1250	4 Pa + Ps	19.3	ATM (1/4 ATM AGT-4) 86.2 bar(1250 psi) 10:1 (100:1 AGT-4)
AGD-7	10	2500	2500	7 Pa + Ps	26.4	1.7 bar (25 psi) 172 bar(2500 psi) 20:1
AGD-15	10	5000	5000	15 Pa + Ps	12.4	3.5 bar (50 psi) 345 bar(5000 psi) 20:1
AGD-30	10	9000	9000	30 Pa + Ps	6.2	7 bar (100 psi) 620 bar(9000 psi) 25:1
AGD-32	11	5000	5000	30 Pa + Ps	12.4	3.5 bar (50 psi) 310 bar(4500 psi) 20:1
AGD-62	11	9000	9000	60 Pa + Ps	6.2	14 bar (200 psi) 620 bar(9000 psi) 25:1
AGD-75	11	20000	20000	75 Pa + Ps	2.4	17 bar (250 psi) 1380 bar(20,000 psi) 25:1
AGD-152H	11	25000	25000	150 Pa + Ps	2.4	17 bar (250 psi) 1724 bar(25,000 psi) 25:1
AGT-4	11	1250	1250	4 Pa + Ps	10	1/4 ATM 86.2 bar(1250 psi) 100:1
AGT-7/15	11	(1) 6 Pa to 2500 (3) 5000	5000	15 Pa + 2 Ps	13.2	1.7 bar (25 psi) 276 bar(4000 psi) 50:1
AGT-7/30	12	(1) 2 Pa to 2500 (3) 5000	9000	30 Pa + 4 Ps	13.2	1.7 bar (25 psi) 379 bar(5500 psi) 100:1
AGT-15/30	12	(1) 15 Pa to 2500	9000	30 Pa + 2 Ps	6.2	3.5 bar (50 psi) 586 bar(8500 psi) 50:1
AGT-32/62	12	(1) 30 Pa to 2500	9000	60 Pa + 2 Ps	6.2	7 bar (100 psi) 621 bar(9,000 psi) 50:1
AGT-15/75	12	(1) 3.5 Pa to 5000	20000	75 Pa + 5 Ps	6.2	3.5 bar (50 psi) 897 bar(13,000 psi) 100:1

LEGEND: Ps = Gas Supply Pressure Pa = Drive Pressure Po + Gas Outlet Pressure

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.

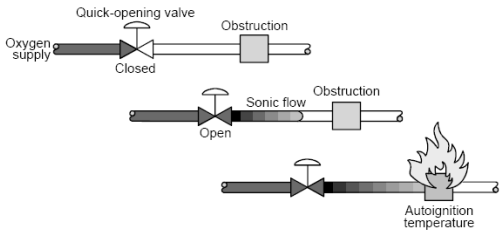


Figure 1

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

3. Special Precautions and Operating Parameters

3.1. Do not exceed 5000 psig pressure output. Consult factory for pressure use greater than 5000 psig (345 barg).

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. Do not start booster until gas has equalized from inlet to outlet pressures. Use 250 psig/min as nominal equalization rate to keep a controlled pressure rise. Design booster circuit cycling rate to no greater than 50 Cycle/Minute (CPM).

3.6. Use valves that can be opened gradually to reduce potential of particle impact and adiabatic compression. Valves such as needle valves, are recommended, **DO NOT use ¼ or 180° ball valves, or butterfly valves**, which may produce high gas velocities.

3.7. Hoses used on inlet/outlet circuit should be designed for oxygen service. **DO NOT connect a hose directly to a booster or booster system**. Use a Stainless Steel tube (12-16 in min. lenght) between hose and booster.

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

3.9. 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)

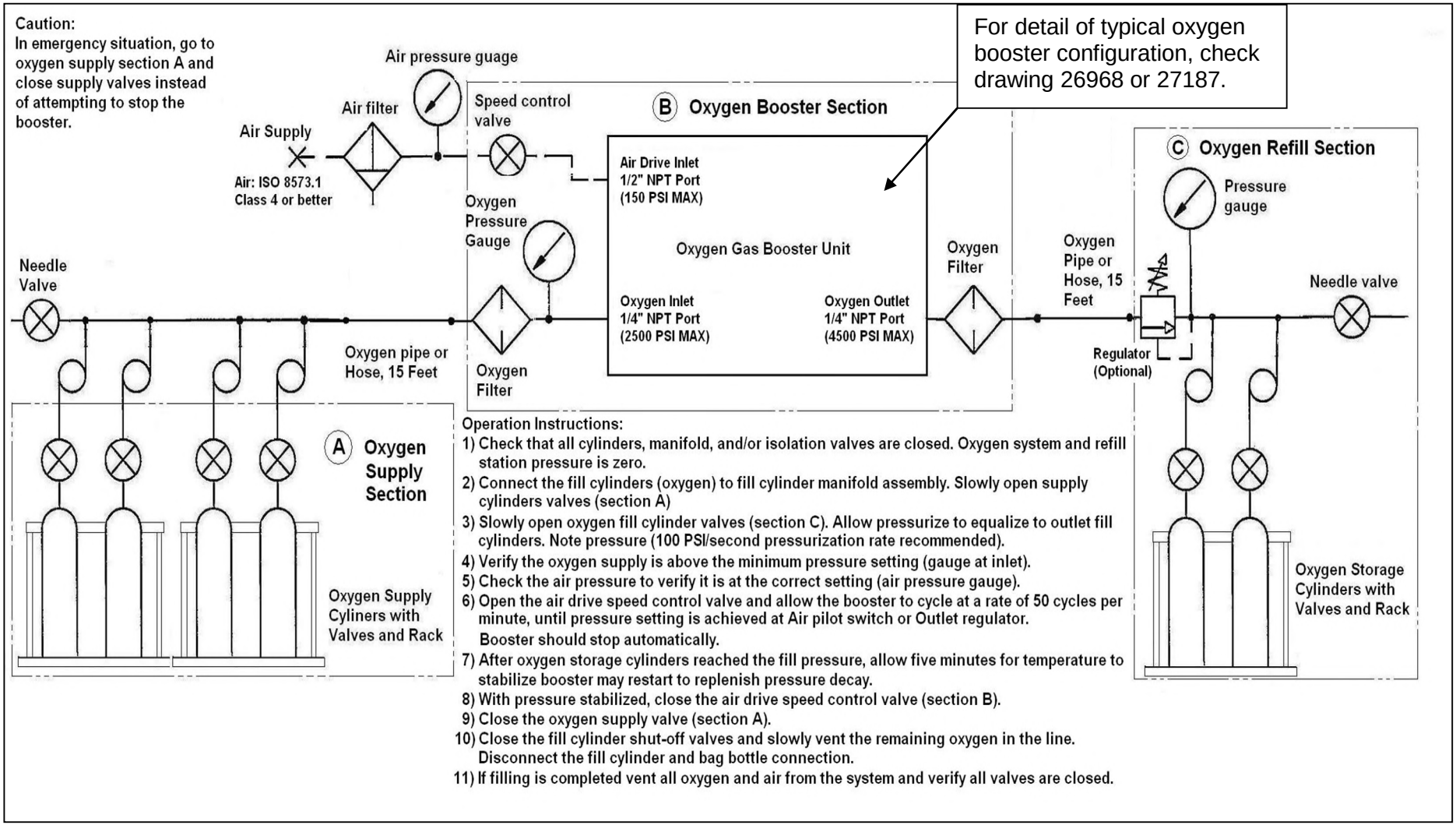


Fig. 2
Typical Configuration of
Haskel Oxygen System and Operation Instructions

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.

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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.