



Company: Ariel Corporation
 Quote:
 Case 1:

Ariel Performance

Customer: Washington Elementary
 Inquiry:
 Project:



7.6.2.0

Compressor Data:

Elevation, ft:	1100.00	Barmtr, psia:	14.113	Ambient, °F:	120.00
Frame:	JGP/2	Stroke, in:	3.00	Rod Dia, in:	1.125
Max RL Tot, lbf:	12000	Max RL Tens, lbf:	6000	Max RL Comp, lbf:	7000
Rated RPM:	1800	Rated BHP:	170.0	Rated PS FPM:	900.0
Calc RPM:	1800.0	BHP:	98	Calc PS FPM:	900.0

Driver Data:

Type:	Nat. Gas
Mfg:	Cummins
Model:	G8.3C118
BHP:	118
Avail:	108 (10)

VALVES

Services

Service 1

Stage Data:	1	2	3
Flow Req'd, SCFM	250.000	250.000	250.000
Flow Calc, SCFM	321.861	321.863	321.859
Cyl BHP per Stage	38.5	26.6	27.0
Specific Gravity	0.60	0.60	0.60
Ratio of Sp Ht (N)	1.2807	1.2836	1.2860
Comp Suct (Zs)	0.9742	0.9440	0.8863
Comp Disch (Zd)	0.9750	0.9675	1.0352
Pres Suct Line, psig	168.00	N/A	N/A
Pres Suct Flg, psig	162.54	683.35	1727.14
Pres Disch Flg, psig	693.35	1742.94	4545.14
Pres Disch Line, psig	N/A	N/A	4500.00
Pres Ratio F/F	4.005	2.519	2.618
Temp Suct, °F	70.00	150.00	150.00
Temp Clr Disch, °F	150.00	150.00	140.00

Cylinder Data:

Throw 2

Throw 1

Throw 1

Cyl Model	3-1/2M	3SG-CE	1-3/4SG-FS-HE
Cyl Bore, in	3.250	3.000	1.250
Cyl RDP (API), psig	954.5	2727.3	5545.5
Cyl MAWP, psig	1050.0	3000.0	6100.0
Cyl Action	DBL	CE	HE
Cyl Disp, CFM	48.7	19.0	3.8
Pres Suct Intl, psig	152.65	668.08	1712.70
Temp Suct Intl, °F	76	154	153
Suct Zsph	0.9752	0.9455	0.8894
Pres Disch Intl, psig	727.15	1788.46	4589.49
Temp Disch Intl, °F	283	301	303
HE Suct Gas Vel, FPM	8309	N/A	3076
HE Disch Gas Vel, FPM	7540	N/A	3346
HE Spcrs Used/Max	1/2	N/A	0/2
HE Vol Pkt Avail, %	No Pkt	N/A	No Pkt
Vol Pkt Used, %	No Pkt	N/A	No Pkt
HE Min Clr, %	15.50	N/A	24.00
HE Total Clr, %	19.81	N/A	24.00
CE Suct Gas Vel, FPM	7314	5159	N/A
CE Disch Gas Vel, FPM	6636	5272	N/A
CE Spcrs Used/Max	0/2	2/2	N/A
CE Min Clr, %	18.73	29.67	N/A
CE Total Clr, %	18.73	54.55	N/A
Suct Vol Eff HE/CE, %	54.2/56.3	N/A/39.9	74.3/N/A
Disch Event HE/CE, ms	4.4/5.2	N/A/5.3	6.3/N/A
Suct Pseudo-Q HE/CE	6.5/5.1	N/A/2.6	1.3/N/A
Gas Rod Ld Comp, %	70.6 C	79.5 C	79.5 C
Gas Rod Ld Tens, %	67.0 T	79.5 T	79.5 T
Gas Rod Ld Total, %	74.7	86.1	86.1
Xhd Pin Deg/%RvrsI lbf	174/72.9	175/53.4	175/53.4
Flow Calc, SCFM	321.861	321.863	321.859
Cyl BHP	38.5	26.6	27.0

ARIEL Compressor MultiRun

RPM: 1800.0, Pd, psig: 4500.00

Driver: Cummins Model: G8.3C118

Frame: JGP/2SCFM at 14.70 psia, 60.0 °F

Thw2: 3-1/2M (3.250) Stage: 1, Service: Service 1, SG: #0.60, Suct Temp (°F): 70.00

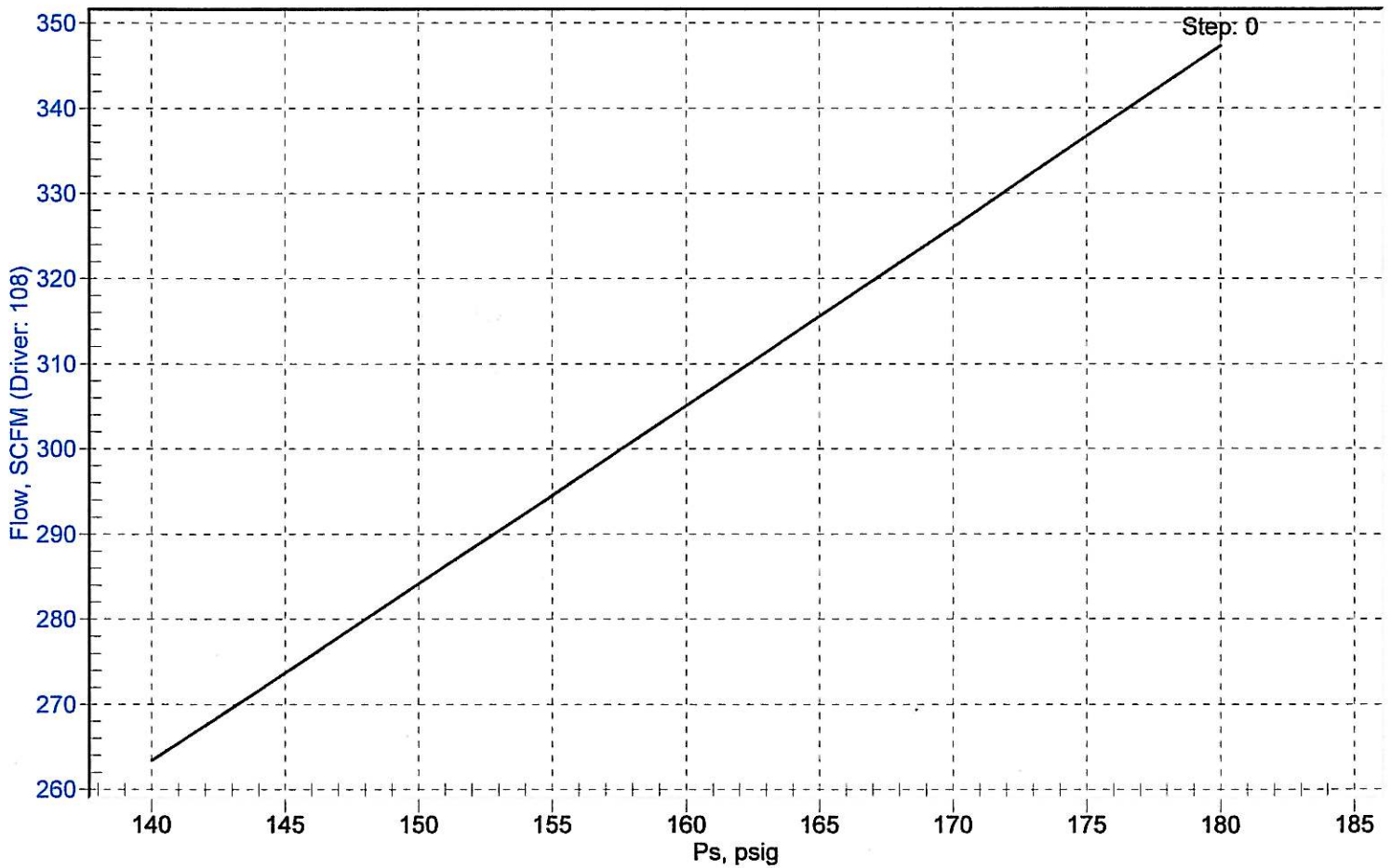
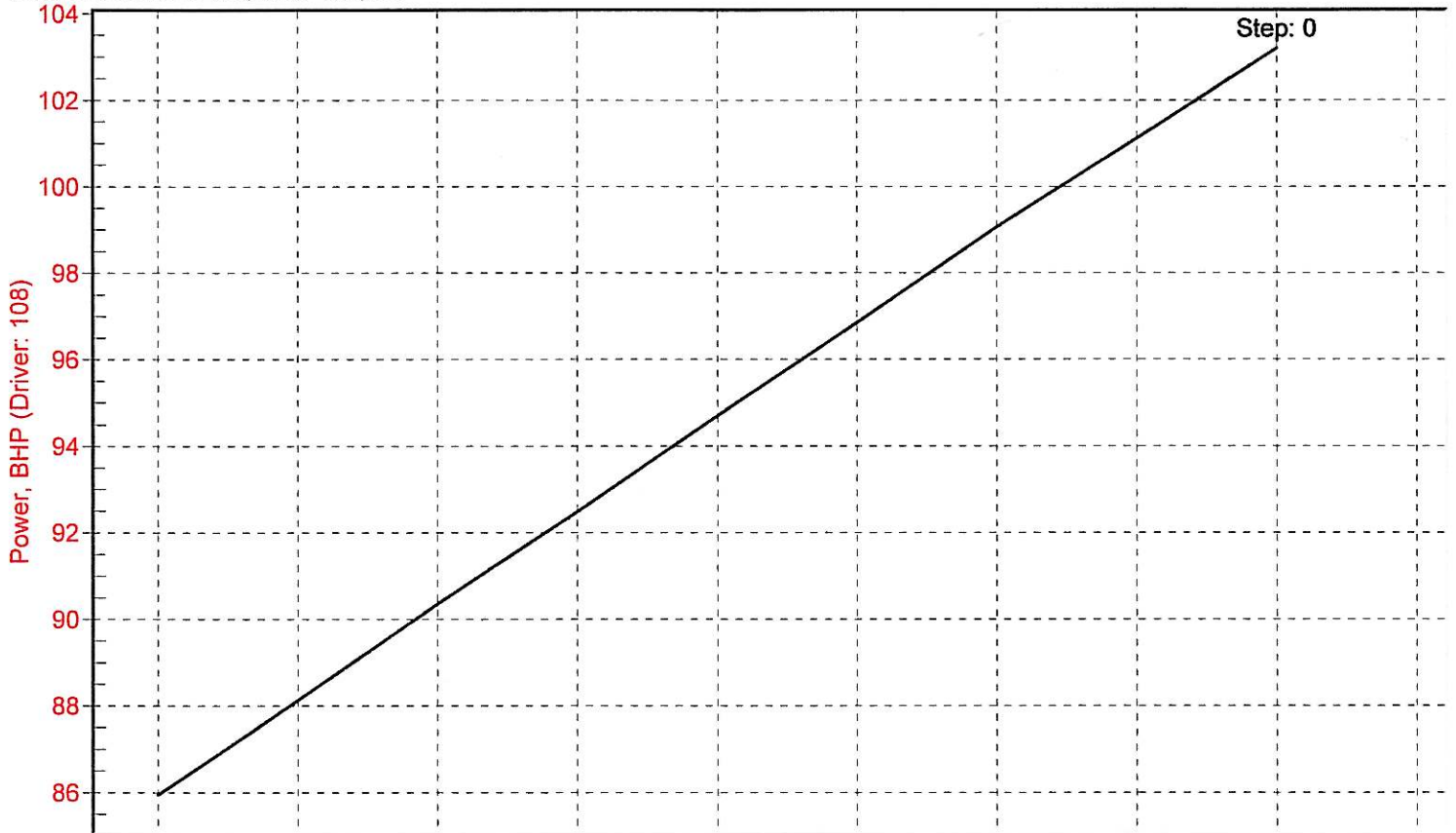
Thw1CE: 3SG-CE (3.000) Stage: 2

Thw1HE: 1-3/4SG-FS-HE (1.250) Stage: 3

Ariel 7.6.2.0 MRV 1.8

Ariel 168 Inlet 332 scfm 3 stg.RUN

Ariel1_MR.csv





Company: Ariel Corporation - MDB
Order #: 54318 (AP020306)
Case 1:

7.6.2.1

Ariel Compressor Balancing Record

Customer: Washington Elem Sch District
Inquiry: Q00282
Project: Trinium Washington Elementary School



Balance By: **STEVE BISHOP** Completed: 8/8/2010 Frame: **JGP/2** Frame S/N: **F34090** Operating RPM: **1800.0**
Stroke, in: **3.00**

Parts Group	Throw #1		Throw #2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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Ariel Lubrication Sheet

Company: Ariel Corporation - MDB
Order #: 54318 (AP020306)

Customer: Washington Elem Sch District
Inquiry: Q00282
Project: Trinium Washington Elementary School



7.6.2.1

Case 1:

Frame: JGP/2 **Stroke, in:** 3.00 **Rod Dia, in:** 1.125 **Frame S/N:** F34090
Gas Stream: Pipeline Quality Natural Gas Including CNG (Dry)

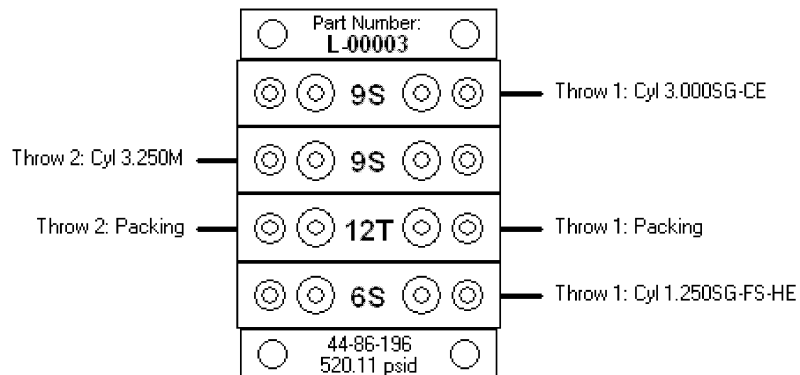
Throw	Cylinder Model	MAWP psig	Service	Stage #	Suct Press psia	Disch Press psia	Serial No.
1	3.000SG-CE	3000.0	Service 1	2	696.76	1758.02	C117527
	1.250SG-FS-HE	6100.0	Service 1	3	1742.22	4559.25	C117528
2	3.250M	1050.0	Service 1	1	176.65	706.76	C117529

Applied Speed, RPM	1800
Cycle Time at Applied Speed, sec	47.0 (see chart, lower right)
Break-In Cycle Time, sec	24.0 (For period of 200 hours)
Recommended lubricant (mineral oil) for application and pressures	<u>Cylinder Oil (ISO 320-460) w/ Compounding</u>

Rupture Disc	Blue 7300.00 psig, 0.125 in hole dia.
Lubricator Pump Diameter	3/16" (0.1875 in)
Qty of Pumps feeding this block	1
Recommended base feed rate	0.30 Pints/day/in of bore diameter

High mawp requires thick walled tubing on this pump system per Customer Tech Bulletin#137

Throw 1, 2



Lube Point Description	Base Rate Multiplier	Recommended Pints/day	Delivered Pints/day	Del/ Rec
Throw 1: Cylinder 3.000SG-CE	1.25	1.13	1.15	102%
Throw 2: Cylinder 3.250M	1.00	0.98	1.15	118%
Throw 2: Packing	1.00	0.68	0.76	113%
Throw 1: Packing	1.25	0.84	0.76	91%
Throw 1: Cylinder 1.250SG-FS-HE	2.00	0.75	0.76	102%

RPM	Cycle Time, sec		Pints/day	
	Normal	Break-In	Normal	Break-In
1800	47.0	24.0	4.6	9.0
1700	49.8	25.4	4.3	8.5
1600	52.9	27.0	4.1	8.0
1500	56.4	28.8	3.8	7.5
1400	60.4	30.9	3.6	7.0
1300	65.1	33.2	3.3	6.5
1200	70.5	36.0	3.1	6.0
1100	76.9	39.3	2.8	5.5
1000	84.6	43.2	2.6	5.0
900	94.0	48.0	2.3	4.5

****NOTE:** Ariel suggests that delivered/recommended amount for cylinders and packings be within 90 - 125%. These recommendations are general guidelines. If the lubricants or flow rates do not appear to work adequately, flow rates and/or lubricant types may need to be changed. Please contact the lubricant supplier for specific lubricant recommendations. See Section 6.0 of the Ariel Packager Standards for more information.


ARIEL CORPORATION
Recommended Spares Start-Up

Mon Aug 16 09:24:03 EDT 2010

F34090
C117527, C117528, C117529
Project:

QTY	Part Number	Description	Your Price	Net Amount
JGM-JGP FRAME CLASS				
1	B-0104	GSKT,RET,TOP CVR,M:P, 1/32	\$0.0000	\$0.00
2	A-0067	GSKT,RET,9-1/2X6-7/16X1/32	\$0.0000	\$0.00
1	A-0661	LO FILTER ELEMENT,SPIN-ON	\$0.0000	\$0.00
4	A-3540	RUPTURE DISC,7300 PSIG,BLUE	\$0.0000	\$0.00
Sub Total				\$0.00
CYL,3 SG-CE-HP,4.55"AFC 3000				
2	A-11395	STL GASKET, 3.500 X 3.105 X 60	\$0.0000	\$0.00
4	A-0027	O-RING,VT, 2.520 O.D. X .210	\$0.0000	\$0.00
1	A-3250	THUMB SCREW,NYLON,1/4-20 X1/2	\$0.0000	\$0.00
2	A-13192	STL GSKT,2.250 ID X 2.438OD 60	\$0.0000	\$0.00
1	B-3712-M	DIS VLV, 52RX ,PKX	\$0.0000	\$0.00
1	B-4087-AA	SUC VLV, 52RX ,MTX	\$0.0000	\$0.00
Sub Total				\$0.00
CYL ASSY, 1-1/4SG-HE,STD 6100				
2	A-0013	O-RING,VT, 3.520 O.D. X .210	\$0.0000	\$0.00
2	A-1812	O-RING,VT, 3.887 O.D. X .139	\$0.0000	\$0.00
1	A-12084	STL GASKET, 2.438 X 2.125 X60	\$0.0000	\$0.00
1	B-1961-E	CONC VLV,062/030 1-1/4	\$0.0000	\$0.00
Sub Total				\$0.00
CYL ASSY, 3-1/4M,STD 1050				
3	A-0400	STL GASKET, 3.875 X 3.625 X 60	\$0.0000	\$0.00
3	A-0257	STL GASKET, 2.438 X 2.250 X 30	\$0.0000	\$0.00
3	A-0027	O-RING,VT, 2.520 O.D. X .210	\$0.0000	\$0.00
1	B-3590-L	DIS VLV, 52RX, PKX	\$0.0000	\$0.00
1	B-3650-BB	SUC VLV, 52RX,MTX	\$0.0000	\$0.00
Sub Total				\$0.00
Start-Up Grand Total				\$0.00


ARIEL CORPORATION
Recommended Spares Consumables

Mon Aug 16 09:24:03 EDT 2010

F34090
C117527, C117528, C117529
Project:

QTY	Part Number	Description	Your Price	Net Amount
JGM-JGP FRAME CLASS				
1	B-0104	GSKT,RET,TOP CVR,M:P, 1/32	\$0.0000	\$0.00
4	A-0067	GSKT,RET,9-1/2X6-7/16X1/32	\$0.0000	\$0.00
4	A-3780	CHK.VLV,DOU.BALL SOFT SEAT SS	\$0.0000	\$0.00
1	A-8723-K	FILTER KIT, LUBRICATOR 150 MIC	\$0.0000	\$0.00
1	A-9476	FF LUBR PUMP 3/16 PREMIER	\$0.0000	\$0.00
2	A-0661	LO FILTER ELEMENT,SPIN-ON	\$0.0000	\$0.00
4	A-3540	RUPTURE DISC,7300 PSIG,BLUE	\$0.0000	\$0.00
1	A-3535	RUPTURE DISC ASSY,7300 PSI	\$0.0000	\$0.00
			Sub Total	\$0.00
CYL,3 SG-CE-HP,4.55"AFC 3000				
2	A-11395	STL GASKET, 3.500 X 3.105 X 60	\$0.0000	\$0.00
6	A-0027	O-RING,VT, 2.520 O.D. X .210	\$0.0000	\$0.00
2	A-3780	CHK.VLV,DOU.BALL SOFT SEAT SS	\$0.0000	\$0.00
7	A-7108	PISTON RING, 1-1/4JG:SG,PK,SJ	\$0.0000	\$0.00
3	A-7171	RIDER RING, 3" JG:A:N:Q:SG	\$0.0000	\$0.00
1	B-2647-K	RBLD KIT,PIST ROD PKG,1.125	\$0.0000	\$0.00
1	A-6029	WEAR BAND, 1-1/4JG:SG:RJ,.875W	\$0.0000	\$0.00
2	A-10357	GUIDE RING,52RX,.279 THK	\$0.0000	\$0.00
1	A-12180-A	DIS VLV SEAT ASSY, 52RX THK	\$0.0000	\$0.00
1	KB-3712-M	KIT,VLV, 52RX ,PKX	\$0.0000	\$0.00
2	A-10355	GUIDE RING,52RX,.260 THK	\$0.0000	\$0.00
2	A-1366	LOCKNUT, DRAKE,5/16-24	\$0.0000	\$0.00
1	A-12991	SUC VLV SEAT, 52RX	\$0.0000	\$0.00
1	KB-4087-AA	KIT,VLV, 52RX ,MTX	\$0.0000	\$0.00
			Sub Total	\$0.00
CYL ASSY, 1-1/4SG-HE,STD 6100				
2	A-0013	O-RING,VT, 3.520 O.D. X .210	\$0.0000	\$0.00
2	A-1812	O-RING,VT, 3.887 O.D. X .139	\$0.0000	\$0.00
2	A-8057	CHECK VLV,OMNI 1/4"FPT SS BALL	\$0.0000	\$0.00
2	A-12084	STL GASKET, 2.438 X 2.125 X60	\$0.0000	\$0.00
1	A-1236	LOCKNUT, DRAKE 1/4-28	\$0.0000	\$0.00
1	A-6085	UPPER PART,CONC VLV	\$0.0000	\$0.00
1	A-6086-A	LOWER PART ASSY,CONCENTRIC VLV	\$0.0000	\$0.00
1	KB-1961-E	KIT,VLV,CONC,062/030 1-1/4	\$0.0000	\$0.00

Ariel Recommended Spares

			Sub Total	\$0.00
CYL ASSY, 3-1/4M,STD 1050				
3	A-0400	STL GASKET, 3.875 X 3.625 X 60	\$0.0000	\$0.00
2	A-3780	CHK.VLV,DOU.BALL SOFT SEAT SS	\$0.0000	\$0.00
4	A-0291	PISTON RING, 3-1/4M:P	\$0.0000	\$0.00
1	B-2648-K	RBLD KIT,PIST ROD PKG,1.125	\$0.0000	\$0.00
4	A-1290	GUIDE RING,52RX,,213 THK	\$0.0000	\$0.00
1	A-11990-A	DIS VLV SEAT ASSY, 52RX	\$0.0000	\$0.00
2	KB-3590-L	KIT,VLV, 52RX, PKX	\$0.0000	\$0.00
4	A-1366	LOCKNUT, DRAKE,5/16-24	\$0.0000	\$0.00
4	A-7710	GUIDE RING,52RX,,232 THK	\$0.0000	\$0.00
1	A-11438	SUC VLV SEAT, 52RX	\$0.0000	\$0.00
2	KB-3650-BB	KIT,VLV, 52RX,MTX	\$0.0000	\$0.00
			Sub Total	\$0.00
			Consumables Grand Total	\$0.00


ARIEL CORPORATION
Recommended Spares Insurance

Mon Aug 16 09:24:03 EDT 2010

F34090
C117527, C117528, C117529
Project:

QTY	Part Number	Description	Your Price	Net Amount
JGM-JGP FRAME CLASS				
4	FP0500FE	DOWEL PIN, 1/4 X 3/4 +.0002	\$0.0000	\$0.00
1	A-0203	CHAIN,35-1 X 94	\$0.0000	\$0.00
1	FW0500GA	FLAT WASHER, 1/2 SAE	\$0.0000	\$0.00
2	B-0003	BUSHING,BZ,ROD,JG:A:M:P:S:I	\$0.0000	\$0.00
4	B-0023	SLEEVE BRG,H/S,ROD,JG:M:P:S	\$0.0000	\$0.00
1	B-0104	GSKT,RET,TOP CVR,M:P, 1/32	\$0.0000	\$0.00
3	B-0024	SLEEVE BRG,H/S,MAIN,JG:M:P:S	\$0.0000	\$0.00
1	B-0025	SLEEVE BRG,H/S,THRUST,JG:M:P:S	\$0.0000	\$0.00
2	B-0002	BUSHING,BZ,XHD,JG:N:A:Q	\$0.0000	\$0.00
2	FN0461EA	SELF-LOCK NUT,ESNA,3/8-24	\$0.0000	\$0.00
1	A-0060	CROSSHEAD PIN,JG:A:M:P:I:S	\$0.0000	\$0.00
2	A-0194	GSKT,RND,OIL SEAL,1/32	\$0.0000	\$0.00
2	A-0245	DUST SEAL,TFE,JG:A:M:P:N:Q	\$0.0000	\$0.00
2	A-3763	CHK VLV,1/8MX1/8F,SS,PPT/14PSI	\$0.0000	\$0.00
1	A-0077	SIGHT GLASS,1" NPT	\$0.0000	\$0.00
1	A-5641	SIGHT GLASS,3/4" NPT	\$0.0000	\$0.00
1	A-9476	FF LUBR PUMP 3/16 PREMIER	\$0.0000	\$0.00
1	A-0068	GSKT,RND,5-1/4X1/32	\$0.0000	\$0.00
1	A-0073	GSKT,NST,1/32,M:P:I:JG/2,TUT	\$0.0000	\$0.00
2	A-0261	GAUGE,100PSI,1/4NPT,BOTT MOUNT	\$0.0000	\$0.00
1	A-10753	FF S/D,DNFT,PS,TRAB,DC, 3 MIN	\$0.0000	\$0.00
1	A-9093	GAUGE, 7500 PSI, BACK MOUNT	\$0.0000	\$0.00
1	L-00003	12T-9S-9S-6S	\$0.0000	\$0.00
Sub Total				\$0.00
CYL,3 SG-CE-HP,4.55"AFC 3000				
2	A-0065	GSKT,RND,12 X 1/64	\$0.0000	\$0.00
6	A-0027	O-RING,VT, 2.520 O.D. X .210	\$0.0000	\$0.00
1	C-3649	PIST/ROD, 3.000 X 1.250SA	\$0.0000	\$0.00
1	A-3250	THUMB SCREW,NYLON,1/4-20 X1/2	\$0.0000	\$0.00
2	A-13192	STL GSKT,2.250 ID X 2.438OD 60	\$0.0000	\$0.00
1	B-3712-M	DIS VLV, 52RX ,PKX	\$0.0000	\$0.00
1	B-4087-AA	SUC VLV, 52RX ,MTX	\$0.0000	\$0.00
Sub Total				\$0.00
CYL ASSY, 1-1/4SG-HE,STD 6100				
2	A-0013	O-RING,VT, 3.520 O.D. X .210	\$0.0000	\$0.00

Ariel Recommended Spares

2	A-1812	O-RING,VT, 3.887 O.D. X .139	\$0.0000	\$0.00
2	A-12084	STL GASKET, 2.438 X 2.125 X60	\$0.0000	\$0.00
1	B-1961-E	CONC VLV,062/030 1-1/4	\$0.0000	\$0.00
			Sub Total	\$0.00
CYL ASSY, 3-1/4M,STD 1050				
2	A-0065	GSKT,RND,12 X 1/64	\$0.0000	\$0.00
1	A-0057	PISTON COLLAR, 2-1/2=8JG:MP	\$0.0000	\$0.00
1	B-0019	PISTON NUT, 2-1/4"THRU 8"JG:MP	\$0.0000	\$0.00
1	C-0138	P ROD, 3.00STK/18.557LG	\$0.0000	\$0.00
6	A-0257	STL GASKET, 2.438 X 2.250 X 30	\$0.0000	\$0.00
5	A-0027	O-RING,VT, 2.520 O.D. X .210	\$0.0000	\$0.00
2	B-3590-L	DIS VLV, 52RX, PKX	\$0.0000	\$0.00
2	B-3650-BB	SUC VLV, 52RX,MTX	\$0.0000	\$0.00
			Sub Total	\$0.00
			Insurance Grand Total	\$0.00

All amounts are in US dollars and price is subject to change at any time.

ARIEL OPERATORS MANUAL

ARIEL Heavy Duty Balanced Opposed Compressors

TECHNICAL MANUAL
For Models:

JGM, JGN, JGP and JGQ;
and JGI (Vertical Non-Balanced)



CAUTION

GAS COMPRESSOR UNITS ARE COMPLICATED AND DANGEROUS PIECES OF EQUIPMENT, IF YOU ARE NOT FULLY TRAINED AND FAMILIAR WITH THEIR OPERATION.

BEFORE STARTING THIS UNIT:

FAMILIARIZE YOURSELF WITH THE UNIT.

READ AND STUDY START-UP AND SHUT-DOWN INFORMATION FOR BOTH PACKAGE AND COMPRESSOR CAREFULLY!

A GAS/AIR MIXTURE UNDER PRESSURE CAN EXPLODE! YOU CAN BE SEVERELY INJURED OR KILLED. MAKE SURE THE COMPRESSOR IS SUFFICIENTLY PURGED OF ANY EXPLOSIVE MIXTURE BEFORE LOADING.

AFTER COMPLETING THE ABOVE, BEGIN PROPER STARTING PROCEDURE.



CAUTION

DO NOT ATTEMPT TO START-UP UNIT WITHOUT REFERRING TO THIS MANUAL SECTION 3: START-UP. IT IS ALSO ESSENTIAL TO REFER TO THE PACKAGER'S OPERATING MANUAL.

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SECTION 1 - DESIGN SPECIFICATIONS & DATA

General

Ariel compressors are designed for ease of operation and maintenance. Experience has shown that an Ariel compressor will normally provide years of satisfactory performance with minimal maintenance.

While Ariel compressors share many similarities, each model has aspects that are unique to the particular type. If you as an operator are familiar with Ariel compressors, it is still important to review this manual to determine the differences. If you are new to Ariel compressors it is critical that you become very familiar with this manual prior to operating the compressor.

This manual is designed to provide information on installation, start up, operation and maintenance of a JGI, JGM, JGN, JGP or JGQ compressor. If you have any questions please contact your packager. If they are unable to provide resolution, they will refer your concerns to Ariel Corporation. If you prefer, you may always contact Ariel directly.

This manual provides design specifications for standard current production equipment at publication date. Do not exceed information plate ratings for a particular compressor.

The location of the throws and the data shown on the Information Plates is very important when communicating questions concerning an Ariel compressor.

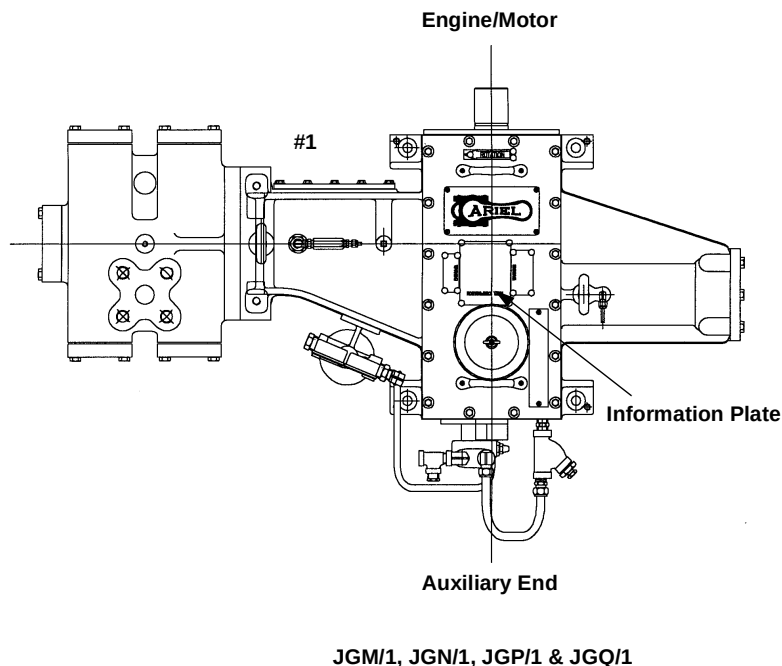


FIGURE 1-1: TYPICAL COMPRESSOR THROW NUMBERING AND INFORMATION PLATE LOCATION - 1/THROW

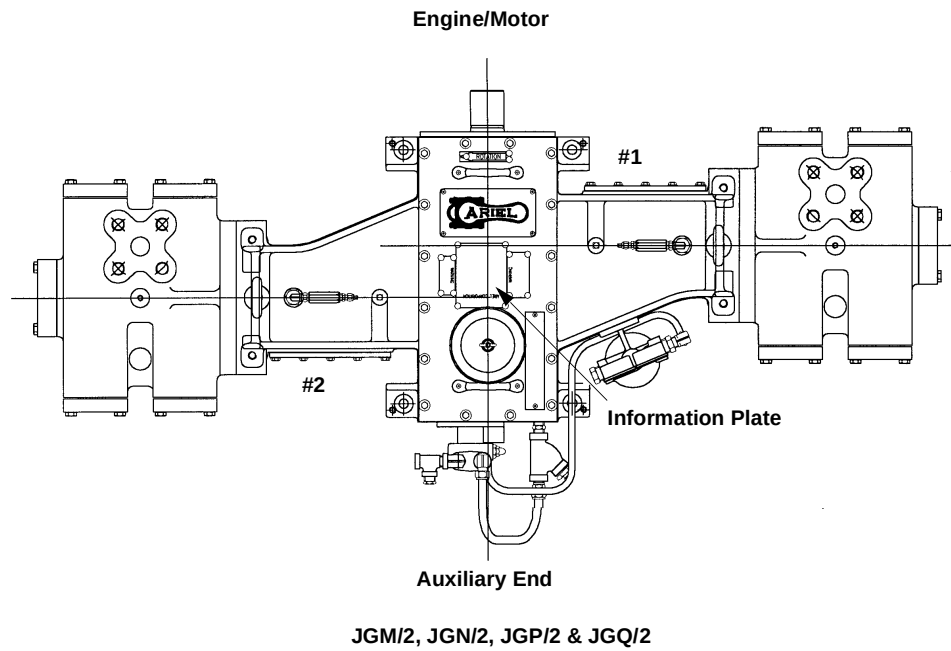


FIGURE 1-2: TYPICAL COMPRESSOR THROW NUMBERING AND INFORMATION PLATE LOCATION - 2/THROW

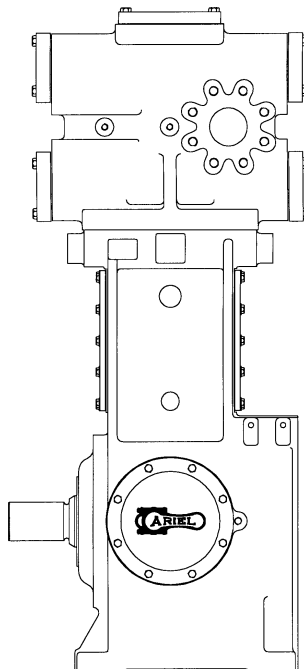


FIGURE 1-3: JGI - VERTICAL NON-BALANCED COMPRESSOR (SIDE VIEW)

Specifications

TABLE 1-1: JGI, JGM & JGP FRAME SPECIFICATIONS

MODEL	JGI/1	JGM/1	JGM/2	JGP/1	JGP/2
Stroke, inches (mm)	3-1/2 (89)	3-1/2 (89)	3-1/2 (89)	3 (76)	3 (76)
Speed, RPM	To 800	To 1500	To 1500	To 1800	To 1800
Piston Speed, FPM (m/s)	To 467 (2.37)	To 875 (4.45)	To 875 (4.45)	To 900 (4.57)	To 900 (4.57)
Number of Throws	1	1	2	1	2
Horsepower (kW)	To 55 (41)	To 84 (63)	To 167 (125)	To 85 (63)	To 170 (127)
Height - Bottom to Crankshaft Φ , in. (mm)	10.250 (260.35)	9.250 (234.95)	9.250 (234.95)	9.250 (234.95)	9.250 (234.95)
Connecting Rod Φ To Φ , in. (mm)	8.250 (209.55)	8.250 (209.55)	8.250 (209.55)	8.250 (209.55)	8.250 (209.55)
Maximum Width, in. (m)	25 (6.35)	62 (1.58)	83 (2.11)	62 (1.58)	83 (2.11)
Maximum Length, in. (m)	25 (6.35)	35 (0.89)	35 (0.89)	35 (0.89)	35 (0.89)
Approximate Weight with Cylinders, lb. (kg)	1100 (455)	1400 (640)	2000 (900)	1400 (640)	2000 (900)
Oil Pump Capacity, GPM (L/s)	3 (0.19)	4 (0.25)	4 (0.25)	4 (0.25)	4 (0.25)
Oil Heat Rejection, BTU/hr. (J/s)	3000 (879)	4000 (1172)	4000 (1172)	5000 (1465)	5000 (1465)
Sump Capacity, US gallons (L)	4 (15)	2.5 (9.5)	2.5 (9.5)	2.5 (9.5)	2.5 (9.5)
Piston Rod Diameter, in. (mm)	1.125 (28.63)	1.125 (28.63)	1.125 (28.63)	1.125 (28.63)	1.125 (28.63)
Internal Rod Load - Double Acting:					
Compression + Tension, lbf. (kN)	12,000 (53)	12,000 (53)	12,000 (53)	12,000 (53)	12,000 (53)
Tension, lbf. (kN)	6000 (26)	6000 (26)	6000 (26)	6000 (26)	6000 (26)
Compression, lbf. (kN)	7000 (31)	7000 (31)	7000 (31)	7000 (31)	7000 (31)
Internal Rod Load - Single Acting:					
Tension, lbf. (kN)	6000 (26)	6000 (26)	6000 (26)	6000 (26)	6000 (26)

TABLE 1-2: JGN & JGQ FRAME SPECIFICATIONS

MODEL	JGN/1	JGN/2	JGQ/1	JGQ/2
Stroke, inches (mm)	3-1/2 (89)	3-1/2 (89)	3 (76)	3 (76)
Speed, RPM	To 1500	To 1500	To 1800	To 1800
Piston Speed, FPM (m/s)	To 875 (4.45)	To 875 (4.45)	To 900 (4.57)	To 900 (4.57)
Number of Throws	1	2	1	2
Horsepower (kW)	To 126 (94)	To 252 (188)	To 140 (104)	To 280 (209)
Height - Bottom to Crankshaft $\varnothing$, in. (mm)	9.250 (234.95)	9.250 (234.95)	9.250 (234.95)	9.250 (234.95)
Connecting Rod $\varnothing$ To $\varnothing$, in. (mm)	8.250 (209.55)	8.250 (209.55)	8.250 (209.55)	8.250 (209.55)
Maximum Width, in. (m)	62 (1.58)	83 (2.11)	62 (1.58)	83 (2.11)
Maximum Length, in. (m)	35 (0.89)	35 (0.89)	35 (0.89)	35 (0.89)
Approximate Weight with Cylinders, lb. (kg)	1400 (640)	2000 (900)	1400 (640)	2000 (900)
Oil Pump Capacity, GPM (L/s)	4 (0.25)	4 (0.25)	4 (0.25)	4 (0.25)
Oil Heat Rejection, BTU/hr. (J/s)	4000 (1172)	4000 (1172)	5000 (1465)	5000 (1465)
Sump Capacity, US gallons (L)	2.5 (9.5)	2.5 (9.5)	2.5 (9.5)	2.5 (9.5)
Piston Rod Diameter, in. (mm)	1.125 (28.63)	1.125 (28.63)	1.125 (28.63)	1.125 (28.63)
Internal Rod Load - Double Acting:				
Compression + Tension, lbf. (kN)	18,000 (80)	18,000 (80)	20,000 (89)	20,000 (89)
Tension, lbf. (kN)	9000 (40)	9000 (40)	10,000 (44)	10,000 (44)
Compression, lbf. (kN)	10,000 (44)	10,000 (44)	11,000 (49)	11,000 (49)
Internal Rod Load - Single Acting:				
Tension, lbf. (kN)	9000 (40)	9000 (40)	10,000 (44)	10,000 (44)

Product Information and Safety Plates

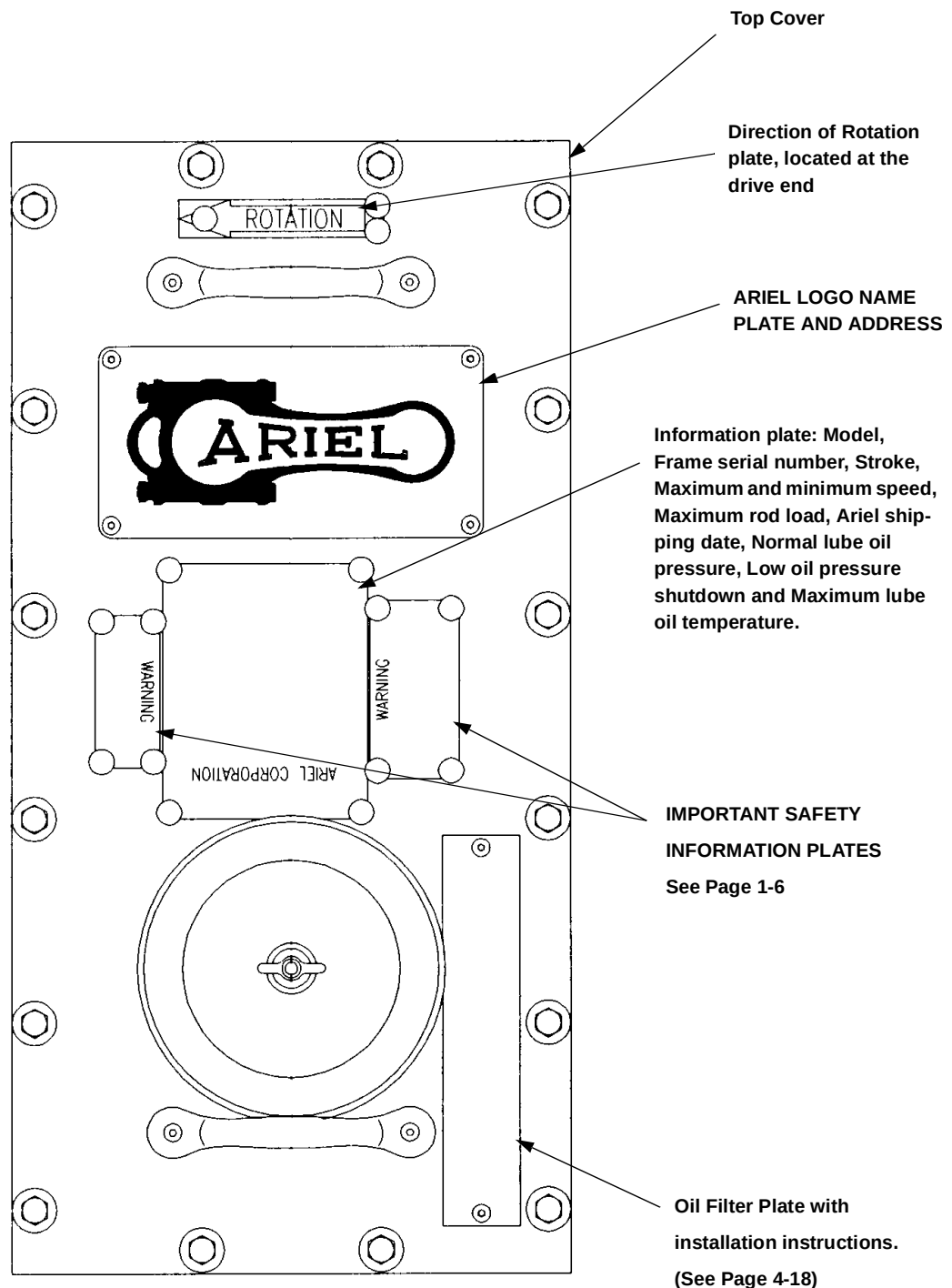


FIGURE 1-4: TOP COVER

Important Safety Information

CAUTION

SEVERE PERSONAL INJURY AND PROPERTY DAMAGE CAN RESULT IF PRESSURE SYSTEM IS NOT COMPLETELY VENTED BEFORE LOOSENING THE BOLTS ON FLANGES, HEADS, VALVE CAPS, OR PACKING. CONSULT ARIEL TECHNICAL MANUAL BEFORE PERFORMING ANY MAINTENANCE.

CAUTION

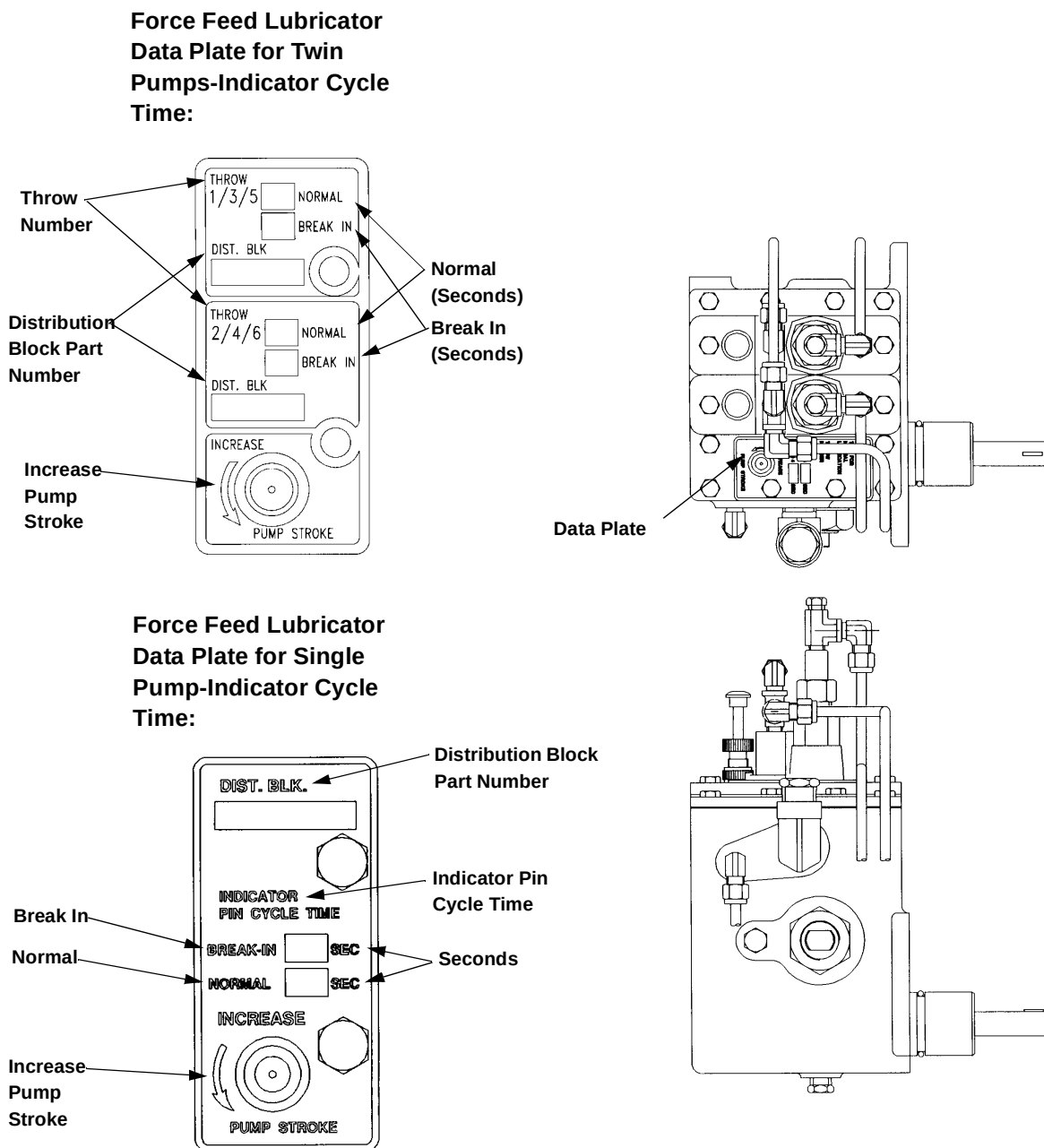
SEVERE PERSONAL INJURY AND PROPERTY DAMAGE WILL RESULT IF SUCTION AND DISCHARGE VALVES ARE NOT INSTALLED IN THEIR PROPER LOCATION.

CAUTION

NOISE GENERATED BY RECIPROCATING MACHINERY CAN BE A SOURCE FOR HEARING INJURY. SEE PACKAGER'S INFORMATION FOR ANY SPECIFIC RECOMMENDATIONS. WEAR HEARING PROTECTION WHEN UNIT IS RUNNING.

CAUTION

HOT GAS TEMPERATURES ESPECIALLY THE CYLINDER DISCHARGE AREAS, 190°F (88°C) OIL AND HIGH FRICTION AREAS CAN BE A SOURCE FOR BURNS. WEAR PROPER INSULATION WHEN WORKING AROUND THESE AREAS. SHUT DOWN UNIT AND ALLOW TO COOL BEFORE DOING MAINTENANCE IN THESE AREAS.



The Force Feed Lubricator provides oil to the piston rod packing and the compressor pistons. The Lubricator Plate gives directions for adjusting the flow of oil. If this plate is missing, please contact Ariel Corporation, Mount Vernon, Ohio for a replacement or specific directions.

NOTE: THE FORCE FEED LUBRICATOR BOX CONTAINS APPROXIMATELY 1/3 GALLON (1L) OF LUBRICANT.

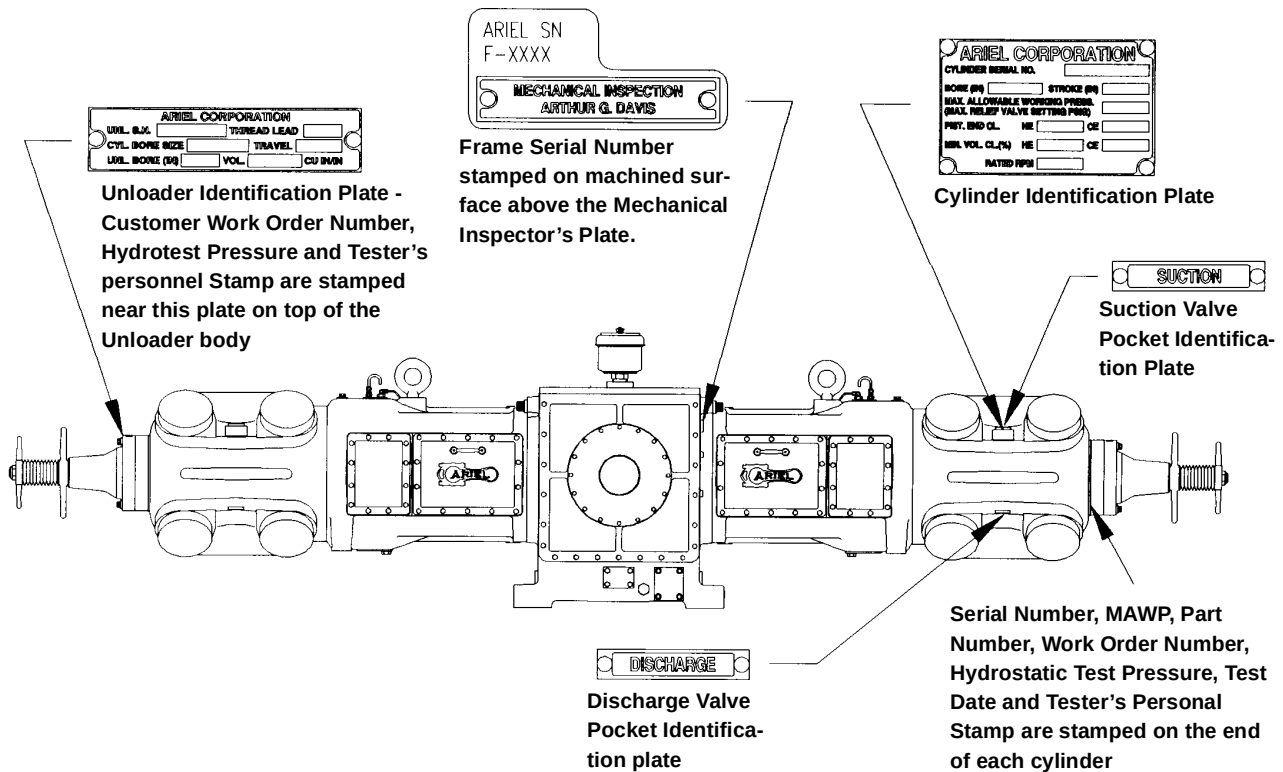


FIGURE 1-6: IDENTIFICATION PLATES - TYPICAL

Cylinder Identification Plates appear on each cylinder. The serial number is also stamped on the end of each cylinder. If any plate is missing, please contact Ariel Corporation, Mount Vernon, Ohio for a replacement or specific directions.

NOTE: USE THE CYLINDER AND FRAME SERIAL NUMBERS IN ALL CORRESPONDENCE.

**CYLINDER IDENTIFICATION
PLATE:**

The diagram shows a rectangular plate with the text "ARIEL CORPORATION" at the top. Below this are several fields with labels and arrows pointing to them:

- Nominal Bore Diameter Inches:** Points to the "BORE(IN)" field.
- Stroke Inches:** Points to the "STROKE (IN)" field.
- Maximum Allowable Working Pressure (Maximum Relief Valve Setting PSIG - Pounds per Square Inch Gauge):** Points to the "MAX.ALLOWABLE WORKING PRESS. (MAX.RELIEF VALVE SETTING PSIG)" field.
- Piston End Clearance Inches:** Points to the "PIST.END CL. HE" field.
- Minimum Volumetric Clearance Percentage:** Points to the "MIN.VOL. CL.(%) HE" field.
- Class:** Points to the "CLASS" field.
- Rated Revolutions per Minute:** Points to the "RATED RPM" field.
- Crank End:** Points to the "CE" field.
- Head End:** Points to the "HE" field.
- Cylinder Serial Number:** Points to the "CYLINDER SERIAL NO." field.

The plate contains the following text and fields:

ARIEL CORPORATION

BORE(IN) [] CLASS []

STROKE (IN) [] RATED RPM []

MAX.ALLOWABLE WORKING PRESS. (MAX.RELIEF VALVE SETTING PSIG) []

PIST.END CL. HE [] CE []

MIN.VOL. CL.(%) HE [] CE []

CYLINDER SERIAL NO. []

**UNLOADER IDENTIFICATION
PLATE:**

The diagram shows a rectangular plate with the text "ARIEL CORPORATION" at the top. Below this are several fields with labels and arrows pointing to them:

- Unloader Serial Number:** Points to the "UNL. S.N." field.
- Nominal Cylinder Bore Diameter Inches:** Points to the "CYL. BORE (IN)" field.
- Nominal Unloader Bore Diameter Inches:** Points to the "UNL.BORE (IN)" field.
- Thread Lead - Threads Per Inch:** Points to the "THD. LEAD (TPI)" field.
- Travel Inches:** Points to the "TRAV. (IN)" field.
- Volume:** Points to the "VOL." field.
- Cubic Inches Per Inch:** Points to the "CU IN/IN" field.

The plate contains the following text and fields:

ARIEL CORPORATION

UNL. S.N. [] THD. LEAD (TPI) []

CYL. BORE (IN) [] TRAV. (IN) []

UNL.BORE (IN) [] VOL. [] CU IN/IN []

FIGURE 1-7: CYLINDER AND UNLOADER IDENTIFICATION PLATES

Clearances

TABLE 1-3: CLEARANCES

DESCRIPTION	CLEARANCE, IN.	(CLEARANCE, mm)
Crankshaft Dust Seal (Feeler Gauge - Centered) N/A to JGI	0.008 to 0.010	(0.20 to 0.25)
Crankshaft Thrust (End) JGM, JGN, JGP & JGQ	0.0035 to 0.011	(0.09 to 0.26)
Crankshaft Thrust (End) JGI	0.009 to 0.025	(0.23 to 0.64)
Crankshaft Journal Bearing (Jack) N/A to JGI	0.0005 to 0.0035	(0.01 to 0.09)
Crankshaft Pin to Connecting Rod Bearing (Jack) N/A to JGI	0.0015 to 0.0040	(0.04 to 0.10)
Connecting Rod Thrust (Side) JGM, JGN, JGP & JGQ	0.007 to 0.016	(0.18 to 0.41)
Connecting Rod Thrust (Side) JGI	0.009 to 0.015	(0.23 to 0.38)
Connecting Rod Bushing to Crosshead Pin	0.0014 to 0.0031	(0.04 to 0.08)
Crosshead Bushing to Crosshead Pin - JGN/JGQ	0.0014 to 0.0036	(0.04 to 0.09)
Crosshead (Bronze) to Crosshead Pin	0.0015 to 0.0025	(0.04 to 0.07)
Crosshead (Gray Iron) to Crosshead Pin - JGI/JGM/JGP	0.0015 to 0.0025	(0.04 to 0.07)
Crosshead (Babbitted Ductile Iron) to Guide - JGN/JGQ (Feeler Gauge ^a)	0.004 to 0.008	(0.10 to 0.20)
Crosshead (Babbitted Bronze) to Guide (Feeler Gauge ^a)	0.006 to 0.010	(0.15 to 0.25)
Crosshead (Gray Iron) to Guide - JGI/JGM/JGP (Feeler Gauge ^a)	0.006 to 0.010	(0.15 to 0.25)
Total Piston End Clearance - Double Acting ^b	0.090 to 0.145	(2.29 to 3.68)
Piston End Clearance - Crank End (Double Acting) ^b	0.035	(0.89)
Piston End Clearance - Head End (Double Acting) ^b	0.055 to 0.110	(1.40 to 2.79)
Total Piston End Clearance - Tandem ^b	0.090 to 0.180	(2.29 to 4.57)
Piston End Clearance - Crank End (Tandem) ^b	0.035	(0.89)
Piston End Clearance - Head End (Tandem) ^b	0.055 to 0.145	(1.40 to 3.68)

a. Crosshead guide to crosshead clearance at the top is to be checked by inserting a standard 0.500 inch (13 mm) wide feeler stock from one side edge of the crosshead across to the opposite side. This is to be done at both ends. The bottom clearance is to be checked with 0.0015 inch (0.038 mm) feeler stock at the 4 corners. If the feeler can be inserted more than 0.500 inches (14 mm), the assembly is not acceptable.

b. If total piston end clearance is not within table tolerance, crank end + head end, contact Packager or Ariel.

NOTE: MEASURED CLEARANCES WILL NOT NECESSARILY AGREE BECAUSE OF OIL FILMS, ASSEMBLY TOLERANCES, WEAR, ETC. PLASTIGAGES, SOLDER, ETC. ARE NOT TO BE USED.

Piston Ring and Packing Ring Side Clearance, Inches (mm)

The standard side clearance in inches (mm) for JG, M, P and SP class cylinders - piston rings and packing rings, when new, are as follows:

TABLE 1-4: NEW CONVENTIONAL PISTON RING SIDE CLEARANCE, INCHES (mm)

NOMINAL WIDTH	ACTUAL GROOVE WIDTH	TEFLON ONE-PIECE	BRONZE
3/16 (4.76)	0.187 to 0.189 (4.75 to 4.80)	0.005 to 0.009 (0.13 to 0.23)	0.004 to 0.008 (0.10 to 0.20)
1/4 (6.35)	0.250 to 0.252 (6.35 to 6.40)	0.005 to 0.009 (0.13 to 0.23)	0.004 to 0.008 (0.10 to 0.20)
3/8 (9.53)	0.375 to 0.377 (9.53 to 9.58)	0.007 to 0.011 (0.18 to 0.28)	0.004 to 0.008 (0.10 to 0.20)
3/4 (19.05)	0.750 to 0.752 (19.05 to 19.10)	0.014 to 0.019 (0.36 to 0.48)	0.006 to 0.010 (0.15 to 0.25)

TABLE 1-5: NEW RIDER RING PISTON RING SIDE CLEARANCE, INCHES (mm)

NOMINAL WIDTH	ACTUAL GROOVE WIDTH	TWO-PIECE
3/16 (4.76)	0.187 to 0.189 (4.75 to 4.80)	0.007 to 0.012 (0.18 to 0.30)
1/4 (6.35)	0.250 to 0.252 (6.35 to 6.40)	0.008 to 0.013 (0.20 to 0.33)
3/8 (9.53)	0.375 to 0.377 (9.53 to 9.58)	0.008 to 0.013 (0.20 to 0.33)
1/2 (12.70)	0.500 to 0.502 (12.70 to 12.75)	0.008 to 0.013 (0.20 to 0.33)
3/4 (19.05)	0.750 to 0.752 (19.05 to 19.10)	0.008 to 0.013 (0.20 to 0.33)

TABLE 1-6: PACKING RING SIDE CLEARANCE, INCHES (mm)

ACTUAL GROOVE WIDTH	1 · RING/GROOVE NON-METAL OR CI	2 · RINGS/GROOVE NON-METAL OR CI	3 · RINGS/GROOVE NON-METAL & CI	BRONZE
0.375 to 0.377 (9.53 to 9.58)	0.011 to 0.014 (0.28 to 0.36)	0.011 to 0.015 (0.28 to 0.38)	N/A	0.006 to 0.008 (0.15 to 0.20)
0.447 to 0.449 (11.35 to 11.41)	N/A	N/A	0.013 to 0.018 (0.33 to 0.46)	
0.562 to 0.564 (14.28 to 14.33)	N/A	N/A	0.017 to 0.022 (0.43 to 0.56)	
0.936 to 0.938 (23.77 to 23.82)	N/A	Zero (0) ^a		N/A

a. Side loaded “AL” (5) ring type

TABLE 1-7: PISTON TO BORE CLEARANCE AND CONVENTIONAL PISTON RING END GAP, IN. (mm) - M, P & SP CLASS CYLINDERS

BORE DIAMETER ^a	PISTON TO BORE CLEARANCE	PISTON RING END GAP - TFE	
		NEW	MAXIMUM
2.0625 (52)	0.007 to 0.011 (0.18 to 0.28)	0.025 to 0.030 (0.64 to 0.76)	0.120 (3.05)
2.25 (57)	0.007 to 0.011 (0.18 to 0.28)	0.027 to 0.032 (0.69 to 0.81)	0.128 (3.18)
2.5 (64)	0.007 to 0.011 (0.18 to 0.28)	0.030 to 0.036 (0.76 to 0.91)	0.144 (3.66)
2.75 (70)	0.007 to 0.011 (0.18 to 0.28)	0.033 to 0.040 (0.84 to 1.02)	0.160 (3.71)
3 (76)	0.007 to 0.011 (0.18 to 0.28)	0.036 to 0.044 (0.91 to 1.12)	0.176 (4.47)
3.25 (83))	0.009 to 0.013 (0.23 to 0.33)	0.039 to 0.047 (0.99 to 1.19)	0.188 (4.76)
3.5 (89)	0.009 to 0.013 (0.23 to 0.33)	0.042 to 0.052 (1.07 to 1.30)	0.208 (5.28)
3.75 (95)	0.010 to 0.014 (0.25 to 0.36)	0.046 to 0.056 (0.17 to 1.42)	0.224 (5.69)
3.875 (98)	0.010 to 0.014 (0.25 to 0.36)	0.047 to 0.057 (0.19 to 1.45)	0.228 (5.79)
4.125 (105)	0.010 to 0.014 (0.25 to 0.36)	0.049 to 0.060 (1.24 to 1.52)	0.240 (6.10)
4.375 (111)	0.011 to 0.015 (0.28 to 0.38)	0.052 to 0.064 (1.32 to 1.63)	0.255 (6.48)
4.75 (121)	0.012 to 0.017 (0.30 to 0.43)	0.057 to 0.077 (1.45 to 1.96)	0.308 (7.82)
5.125 (130)	0.012 to 0.017 (0.30 to 0.43)	0.061 to 0.081 (1.55 to 2.06)	0.324 (8.23)
5.5 (140)	0.013 to 0.018 (0.33 to 0.46)	0.065 to 0.085 (1.65 to 2.16)	0.340 (8.64)
5.75 (146)	0.013 to 0.018 (0.33 to 0.46)	0.068 to 0.088 (1.73 to 2.24)	0.352 (8.94)
6.125 (156)	0.014 to 0.020 (0.36 to 0.51)	0.073 to 0.093 (1.85 to 2.36)	0.372 (9.45)
6.5 (165)	0.014 to 0.020 (0.36 to 0.51)	0.077 to 0.097 (1.96 to 2.46)	0.388 (9.86)
7.5 (191)	0.016 to 0.022 (0.41 to 0.56)	0.089 to 0.109 (2.26 to 2.77)	0.430 (10.92)
8 (203)	0.016 to 0.022 (0.41 to 0.56)	0.095 to 0.115 (2.41 to 2.87)	0.460 (11.68)
8.5 (216)	0.017 to 0.023 (0.43 to 0.58)	0.102 to 0.122 (2.59 to 3.10)	0.488 (12.40)
8.875 (225)	0.018 to 0.024 (0.46 to 0.61)	0.106 to 0.126 (2.69 to 3.20)	0.504 (12.80)
10.5 (267)	0.021 to 0.027 (0.53 to 0.69)	0.125 to 0.145 (3.18 to 3.68)	0.580 (14.73)
11 (279)	0.022 to 0.028 (0.56 to 0.71)	0.131 to 0.151 (3.33 to 3.84)	0.604 (15.34)
13 (330)	0.026 to 0.032 (0.66 to 0.81)	0.155 to 0.175 (3.94 to 4.45)	0.700 (17.78)
13.5 (343)	0.027 to 0.033 (0.69 to 0.84)	0.162 to 0.182 (4.12 to 4.63)	0.728 (18.49)

- a. Conventional piston rings are standard for all M, P and SP Class Cylinders, except for 1-3/4M-FS Class Cylinder with bore diameters of 1.625" (41mm) and 1.75" (44) where piston/rider rings are standard. Piston/rider rings are optional for all other M, P and SP Class Cylinders.

TABLE 1-8: PISTON TO BORE CLEARANCE AND PISTON/RIDER RING END GAP, IN. (mm) - M, P & SP CLASS CYLINDERS

BORE DIAMETER ^a	PISTON TO BORE CLEARANCE	PISTON/RIDER RING END GAP	
		NEW	MAXIMUM
1.625 (41)	0.090 to 0.096 (2.29 to 2.44)		
1.75 (44)	0.090 to 0.096 (2.29 to 2.44)	0.016 to 0.032 (0.41 to 0.81)	0.128 (3.25)
2.0625 (52)	0.090 to 0.096 (2.29 to 2.44)	0.020 to 0.036 (0.51 to 0.91)	0.144 (3.66)
2.25 (57)	0.090 to 0.096 (2.29 to 2.44)		
2.5 (64)	0.090 to 0.096 (2.29 to 2.44)	0.044 to 0.060 (1.12 to 1.52)	0.240 (6.10)
2.75 (70)	0.090 to 0.096 (2.29 to 2.44)	0.044 to 0.060 (1.12 to 1.52)	0.240 (6.10)
3 (76)	0.090 to 0.096 (2.29 to 2.44)	0.044 to 0.060 (1.12 to 1.52)	0.240 (6.10)
3.25 (83))	0.090 to 0.096 (2.29 to 2.44)	0.044 to 0.060 (1.12 to 1.52)	0.240 (6.10)
3.5 (89)	0.090 to 0.096 (2.29 to 2.44)	0.044 to 0.060 (1.12 to 1.52)	0.240 (6.10)
3.75 (95)	0.090 to 0.096 (2.29 to 2.44)	0.044 to 0.060 (1.12 to 1.52)	0.240 (6.10)
3.875 (98)	0.090 to 0.096 (2.29 to 2.44)	0.045 to 0.061 (1.14 to 1.55)	0.244 (6.20)
4.125 (105)	0.090 to 0.096 (2.29 to 2.44)	0.049 to 0.065 (1.24 to 1.65)	0.260 (6.60)
4.375 (111)	0.090 to 0.096 (2.29 to 2.44)	0.052 to 0.068 (1.32 to 1.73)	0.272 (6.91)
4.75 (121)	0.090 to 0.096 (2.29 to 2.44)	0.057 to 0.073 (1.45 to 1.85)	0.292 (7.42)
5.125 (130)	0.090 to 0.096 (2.29 to 2.44)	0.062 to 0.078 (1.57 to 1.98)	0.312 (7.93)
5.5 (140)	0.090 to 0.096 (2.29 to 2.44)	0.068 to 0.084 (1.73 to 2.13)	0.336 (8.53)
5.75 (146)	0.090 to 0.096 (2.29 to 2.44)	0.071 to 0.087 (1.80 to 2.21)	0.348 (8.84)
6.125 (156)	0.090 to 0.096 (2.29 to 2.44)	0.069 to 0.099 (1.75 to 2.51)	0.396 (10.06)
6.5 (165)	0.090 to 0.096 (2.29 to 2.44)	0.074 to 0.104 (1.88 to 2.64)	0.416 (10.57)
7.5 (191)	0.090 to 0.096 (2.29 to 2.44)	b	b
8 (203)	0.090 to 0.096 (2.29 to 2.44)	b	b
8.5 (216)	0.090 to 0.096 (2.29 to 2.44)	0.114 to 0.144 (2.90 to 3.66)	0.576 (14.63)
8.875 (225)	0.090 to 0.096 (2.29 to 2.44)	0.120 to 0.150 (3.05 to 3.81)	0.600 (15.24)
10.5 (267)	0.090 to 0.096 (2.29 to 2.44)	0.144 to 0.174 (3.66 to 4.42)	0.696 (17.68)
11 (279)	0.090 to 0.096 (2.29 to 2.44)	0.152 to 0.182 (3.86 to 4.62)	0.728 (18.49)
13 (330)	0.090 to 0.096 (2.29 to 2.44)	0.182 to 0.212 (4.62 to 5.39)	0.848 (21.54)
13.5 (343)	0.090 to 0.096 (2.29 to 2.44)	0.190 to 0.220 (4.83 to 5.59)	0.880 (22.35)

a. Conventional piston rings are standard for all M, P and SP Class Cylinders, except for 1-3/4M-FS Class Cylinder with bore diameters of 1.625" (41mm) and 1.75" (44) where piston/rider rings are standard. Piston/rider rings are optional for all other M, P and SP Class Cylinders.

b. 8M x 3-1/2" (88.9 mm) stroke & 8SP-HE class cylinders, w/ 7.5" (191) bore: end gap, new is 0.099" to 0.129" (2.51 to 3.53), maximum is 0.516" (13.11). 8M x 3" (76.2) stroke, w/ 7.5" (191) bore: new 0.088" to 0.118" (2.24 to 3.00), maximum 0.472" (11.99). 8M x 3-1/2" (88.9) & 8SP-HE, w/ 8" (203) bore: new 0.106" to 0.136" (2.69 to 3.43), maximum 0.544" (14.07). 8M x 3" (76.2) w/ 8" (203) bore: new 0.095" to 0.125" (2.41 to 3.18), maximum 0.500" (12.70).

TABLE 1-9: PISTON TO BORE CLEARANCE AND CONVENTIONAL PISTON RING END GAP, IN. (mm) - JG CLASS CYLINDERS

BORE DIAMETER ^a	PISTON TO BORE CLEARANCE	PISTON RING END GAP - NON-METALLIC	
		NEW	MAXIMUM
1.25 (32) ^b	0.025 to 0.033 (0.64 to 0.84)	0.018 to 0.028 (0.46 to 0.71)	0.112 (2.85)
1.5 (38) ^b	0.030 to 0.038 (0.76 to 0.97)	0.021 to 0.031 (0.51 to 0.79)	0.124 (3.15)
1.625 (41) ^b	0.030 to 0.038 (0.76 to 0.97)	0.023 to 0.033 (0.58 to 0.84)	0.132 (3.35)
1.75 (44) ^b	0.030 to 0.038 (0.76 to 0.97)	0.025 to 0.035 (0.64 to 0.89)	0.140 (3.55)
2.75 (70)	0.009 to 0.014 (0.23 to 0.36)	0.027 to 0.033 (0.69 to 0.81)	0.132 (3.35)
3 (76)	0.009 to 0.014 (0.23 to 0.36)	0.030 to 0.036 (0.76 to 0.91)	0.144 (3.66)
3.375 (86)	0.010 to 0.015 (0.25 to 0.38)	0.034 to 0.041 (0.88 to 1.04)	0.164 (4.17)
3.625 (92)	0.010 to 0.015 (0.25 to 0.38)	0.036 to 0.044 (0.91 to 1.12)	0.176 (4.47)
3.875 (98)	0.011 to 0.016 (0.28 to 0.41)	0.039 to 0.047 (0.99 to 1.19)	0.188 (4.78)
4.125 (105)	0.011 to 0.016 (0.28 to 0.41)	0.041 to 0.050 (1.04 to 1.27)	0.200 (5.08)
4.75 (121)	0.012 to 0.018 (0.30 to 0.46)	0.057 to 0.077 (1.45 to 1.96)	0.308 (7.82)
5.125 (130)	0.012 to 0.018 (0.30 to 0.46)	0.061 to 0.081 (1.55 to 2.06)	0.324 (8.23)
6.125 (156)	0.013 to 0.019 (0.33 to 0.48)	0.073 to 0.093 (1.85 to 2.36)	0.372 (9.45)
6.5 (165)	0.014 to 0.020 (0.36 to 0.51)	0.077 to 0.097 (1.96 to 2.46)	0.388 (9.86)
7.125 (181)	0.015 to 0.021 (0.38 to 0.53)	0.085 to 0.105 (2.16 to 2.67)	0.409 (10.39)
7.5 (191)	0.015 to 0.021 (0.38 to 0.53)	0.089 to 0.109 (2.26 to 2.77)	0.430 (10.92)
8.5 (216)	0.017 to 0.023 (0.43 to 0.58)	0.102 to 0.122 (2.59 to 3.10)	0.488 (12.40)
8.875 (225)	0.018 to 0.024 (0.46 to 0.61)	0.106 to 0.126 (2.69 to 3.20)	0.504 (12.80)

a. Conventional piston rings are standard for JG Class Cylinders, except 2-1/2JG-FS-HE Class cylinders with bore diameters of 2.25" (57mm) & 2.5" (64); 3JG-CE, 2.75" (70) & 3" (76); and 3-5/8JG-CE, 3.375" (86) & 3.625" (92), which use piston/rider rings. Piston/rider rings are optional for other JG Cylinders, except for 1-3/4JG-FS-HE, which uses conventional rings and wear band.

b. These sizes use conventional piston rings and wear band, see Table 1-10 for wear band values.

TABLE 1-10: WEAR BAND END GAP & RADIAL PROJECTION (NEW) - 1-3/4JG-FS-HE CLASS, IN. (mm)

BORE DIAMETER ^a	END GAP MINIMUM	RADIAL PROJECTION
1.25 (32)	0.049 (1.24)	0.005 to 0.012 (0.13 to 0.30)
1.5 (38)	0.049 (1.24)	0.008 to 0.012 (0.20 to 0.30)
1.625 (41)	0.052 (1.32)	0.008 to 0.012 (0.20 to 0.30)
1.75 (44)	0.058 (1.47)	0.008 to 0.015 (0.20 to 0.38)

a. New wear band side clearance is 0.010 to 0.014" (0.25 to 0.36).

TABLE 1-11: PISTON TO BORE CLEARANCE AND PISTON/RIDER RING END GAP, IN. (mm) - JG CLASS CYLINDERS

BORE DIAMETER ^a	PISTON TO BORE CLEARANCE	PISTON/RIDER RING END GAP	
		NEW	MAXIMUM
2.25 (57)	0.090 to 0.096 (2.29 to 2.44)	0.023 to 0.039 (0.58 to 0.99)	0.156 (3.96)
2.5 (64)	0.090 to 0.096 (2.29 to 2.44)	0.030 to 0.046 (0.76 to 1.17)	0.184 (4.67)
2.75 (70)	0.090 to 0.096 (2.29 to 2.44)	0.044 to 0.060 (1.12 to 1.52)	0.240 (6.10)
3 (76)	0.090 to 0.096 (2.29 to 2.44)	0.044 to 0.060 (1.12 to 1.52)	0.240 (6.10)
3.375 (86)	0.090 to 0.096 (2.29 to 2.44)	0.044 to 0.060 (1.12 to 1.52)	0.240 (6.10)
3.625 (92)	0.090 to 0.096 (2.29 to 2.44)	0.047 to 0.063 (1.19 to 1.60)	0.252 (6.40)
3.875 (98)	0.090 to 0.096 (2.29 to 2.44)	0.051 to 0.067 (1.30 to 1.70)	0.268 (6.81)
4.125 (105)	0.090 to 0.096 (2.29 to 2.44)	0.055 to 0.071 (1.40 to 1.80)	0.284 (7.21)
4.75 (121)	0.090 to 0.096 (2.29 to 2.44)	0.057 to 0.073 (1.45 to 1.85)	0.292 (7.42)
5.125 (130)	0.090 to 0.096 (2.29 to 2.44)	0.062 to 0.078 (1.57 to 1.98)	0.312 (7.93)
6.125 (156)	0.090 to 0.096 (2.29 to 2.44)	0.069 to 0.099 (1.75 to 2.51)	0.396 (10.06)
6.5 (165)	0.090 to 0.096 (2.29 to 2.44)	0.074 to 0.104 (1.88 to 2.64)	0.416 (10.57)
7.125 (181)	0.090 to 0.096 (2.29 to 2.44)	0.083 to 0.113 (2.11 to 2.87)	0.452 (11.48)
7.5 (191)	0.090 to 0.096 (2.29 to 2.44)	0.088 to 0.118 (2.24 to 3.00)	0.472 (11.99)
8.5 (216)	0.090 to 0.096 (2.29 to 2.44)	0.114 to 0.144 (2.90 to 3.66)	0.576 (14.63)
8.875 (225)	0.090 to 0.096 (2.29 to 2.44)	0.120 to 0.150 (3.05 to 3.81)	0.600 (15.24)

- a. Conventional piston rings are standard for JG Class Cylinders, except 2-1/2JG-FS-HE Class cylinders with bore diameters of 2.25" (57mm) & 2.5" (64); 3JG-CE, 2.75" (70) & 3" (76); and 3-5/8JG-CE, 3.375" (86) & 3.625" (92), which use piston/rider rings. Piston/rider rings are optional for other JG Cylinders, except for 1-3/4JG-FS-HE, which uses conventional rings and wear band.

Fastener Tightening Torque

Listed in the following tables are fastener tightening torque values required for proper assembly of Ariel JGI, JGM, JGN, JGP and JGQ compressors. Refer to the section concerning a subject component for detailed assembly procedures.

Threads are to be clean and free of burrs.

Torque values are based on the use of petroleum type lubricants on both the threads and seating surfaces. Use lubricating oil or Lubriplate 630, except for compressor rods-piston end, which use Never-Seez (by Bostik, Boston St., Middleton, MA 01949, phone: 508-777-0100). Molybdenum disulfide lubricants and Never-Seez are not otherwise to be used for fastener lubrication, unless specified, or excessive stresses can result with the listed values.

TABLE 1-12: FASTENER TIGHTENING VALUES

FASTENER	NOMINAL SIZE, INCH · TPI	TYPE	TORQUE, LB X FT (N·m)
Main Bearing Cap - Cap Screw	1/2 - 13	12 Point - Grade 8	58 (79)
JGI Bearing Carrier to Frame - Cap Screw	1/2 - 13	12 Point - Grade 8	44 (60)
Connecting Rod Cap - Cap Screw	1/2 - 13	12 Point/Socket Head	58 (79)
Connecting Rod Cap - Cap Screw	1/2 - 20	12 Point - Grade 8	67 (91)
Crosshead Pin Thru Bolt - Lock Nut	3/8 - 24	Hex - Flexloc	25 (34)
Frame to Cylinder - Cap Screw	1/2 - 13	12 Point - Grade 8	48 (65)
Frame to Support - Cap Screw	5/8 - 11	Hex - Grade 8 or 9	88 (120)
Eccentric Vernier Cap - Cap Screw	5/16 - 18	Hex - Grade 8	144 lb x in. (16)
Idler Sprocket Thru Bolt - Lock Nut	1/2 - 20	Hex - Drill & Pin	41 (55)
Rod Packing - Cap Screw	1/2 - 13	12 Point - Grade 8	35 (48)
Piston Nut	7/8 - 12	Ariel Design	222 (300)
Crosshead Nut	1 - 12	Ariel Design	255 (345)
Rupture Disk - Blow-Out Fitting Cap	1/4 Nom. Tube	Hex - Tube Fitting	36 lb x in. (4.1)
Hold Down - Stud-Nut	5/8 - 11	Hex Stud-Nut	100 ^a (130)
Valve Cap/Cylinder Head/Gas Passage/ Unloader - Cap Screw ^b	3/8 - 16	Hex - Grade 8 or 9 or 12 Point - Grade B7M or 8	193 lb x in. (22)
	7/16 - 14		26 (35)
	1/2 - 13		40 (54)
	5/8 - 11		79 (105)
	3/4 - 10		140 (190)
	7/8 - 9		230 (310)
	7/8 - 14		260 (350)
	1 - 8		345 (465)

TABLE 1-12: FASTENER TIGHTENING VALUES

FASTENER	NOMINAL SIZE, INCH - TPI	TYPE	TORQUE, LB X FT (N·m)
Tandem Cylinder to Cylinder - Cap Screw ^b	1/2 - 13	Hex - Grade 8 or 9 or 12 Point - Grade 8	44 (60)
	5/8 - 11		88 (120)
	3/4 - 10		160 (215)
Seating Studs in Cylinder	3/8 - 16	Dog Point	107 lb x in. (12)
	7/16 - 14		172 lb x in. (19)
	1/2 - 13		22 (30)
	9/16 - 12		32 (43)
	5/8 - 11		44 (60)
	3/4 - 10		79 (105)
	7/8 - 9		130 (170)
	1 - 8		190 (260)
Distribution Block Tie Rod - Nut	1/4 - 28	Hex	68 lb x in. (7.7)
Distribution Block Divider Valve - Screw	1/4 - 28	Socket Head	109 lb x in. (12)
Grade 5 - Hex Cap Screw	1/4 - 20	Hex - Grade 5	46 lb x in. (5.4)
	1/4 - 28		54 lb x in. (6.1)
	5/16 - 18		96 lb x in. (11)
	3/8 - 16		171 lb x in. (19)
	3/8 - 24		17 (23)
	7/16 - 14		23 (31)
	1/2 - 20		41 (55)

- a. Minimum torque for recommended 5/8" - 11TPI hold down stud size to provide stress in stud of 55,000 psi (380 MPa). Stud must have an ultimate strength of 100,000 psi (690 MPa) or greater. If greater, increase torque to stress stud to about 55% of ultimate strength of stud material, as specified by packager.
- b. When studs are specified for cylinder applications, tighten stud-nuts to the same values as cap screws in similar applications. Reference Figure 1-8:

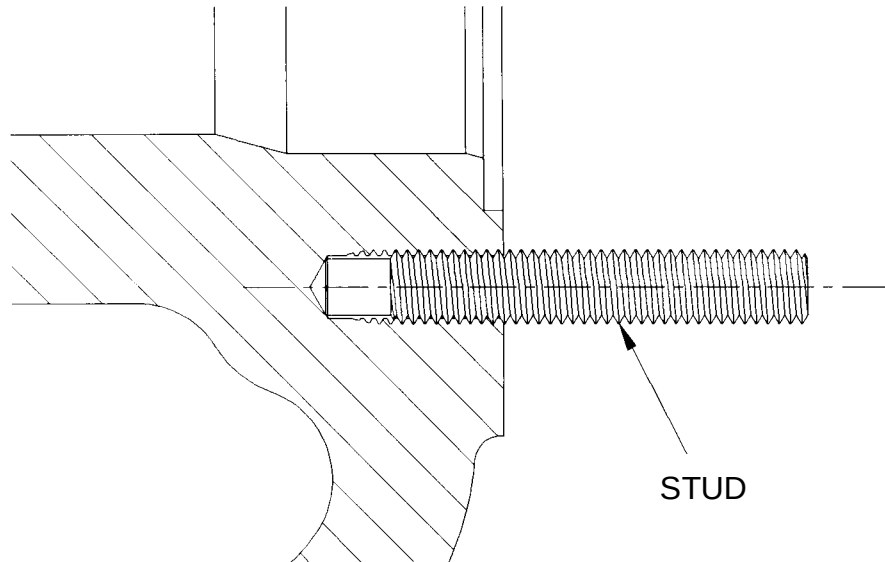


FIGURE 1-8: DOG POINT STUDS

TABLE 1-13: VALVE ASSEMBLY FASTENERS - TIGHTENING VALUES

FASTENER	NOMINAL SIZE INCH - TPI	TYPE	TORQUE, LB X FT (N·m)
Center Cap Screw ^{a b}	5/16 - 24	12 Point - Steel Grade 8	26 (35)
	3/8 - 24		45 (61)
	7/16 - 20		62 (83)
	5/16 - 24	12 Point- Steel Grade 5	18 (24)
	3/8 - 24		32 (43)
	7/16 - 20		50 (68)
	5/16 - 24	12 Point - Grade B8M - Stainless Steel	120 lb x in. (13.6)
	3/8 - 24		192 lb x in. (21.7)
	7/16 - 20		24 (33)
Center Stud - Drake Lock Nut	1/4 - 28	Bottom Half	103 lb x in. (11.6)
		Top Half	66 lb x in. (7.5)
	5/16 - 24	Bottom Half	168 lb x in. (18.9)
		Top Half	96 lb x in. (10.8)
	3/8 - 24	Bottom Half	192 lb x in. (21.7)
		Top Half	96 lb x in. (10.8)
	1/2 - 20	Bottom Half	36 (49) ^c
		Top Half	20 (27)
	5/8 - 18	Bottom Half	73 (99)
		Top Half	40 (54)
	3/4 - 16	Bottom Half	130 (176)
		Top Half	70 (95)
Peripheral Cap Screws	10 - 32	Hex Socket Head	25 lb x in. (2.8)
	12 - 28		43 lb x in. (4.9)
	1/4 - 20		110 lb x in. (12.4)
	5/16 - 18		176 lb x in. (19.9)
	3/8 - 16		21 (28)

- a. 12 Point Cap Screw Center Fasteners in Valve Assemblies not marked SPL (Spirallock Threads), must be cleaned with Loctite Safety solvent and locked with one to two drops of Loctite #272. Do not use petroleum thread lubricants.
- b. 12 Point Cap Screws in Valve Assemblies with Spirallock Threads and marked SPL (see Figure 1-9:) are lubricated, both threads and seating surfaces, with a petroleum type lubricant only.
- c. 29 lb x ft (39 N·m) for 1/2 - 20 Bottom Half - Drake Lock Nut with non-metallic Plates in Lift-washer Type Valves.

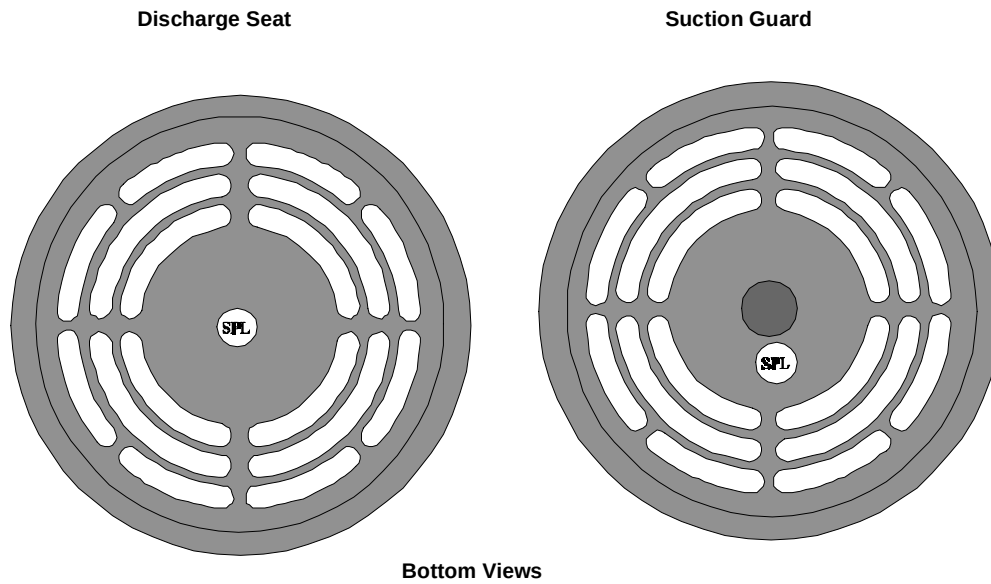


FIGURE 1-9: SPIRALOCK THREADED VALVE ASSEMBLY - MARKED SPL

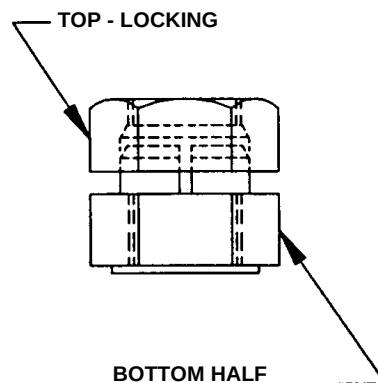


FIGURE 1-10: DRAKE LOCK NUT

Tightening Torque Procedures

Listed below are some procedures which make fastener tightening more accurate and will help ensure that the proper torque is being applied.

1. Ensure that the torque wrench is properly calibrated and used by qualified personnel to achieve the required fastener tightening torque for all critical parts, except for the crosshead balance/lock nut which may be tightened using the “tried and true” slugging procedure.
2. Always check to determine over what range the torque wrench is accurate since most torque wrenches are not accurate over their entire range.

3. Always apply a steady slow force to a torque wrench, do not jerk it. When a torque wrench is jerked the amount of torque applied can be as much as one and a half times the amount set on the wrench. For example, if a wrench is set at 80 lb x ft but is jerked, 120 lb x ft torque can be applied.
4. Always do the final tightening with a torque wrench. Do not tighten the fastener with a ratchet or impact wrench and then "check" the torque with a torque wrench.
5. Do not double tap a torque wrench. Rapidly double tapping a torque wrench will make the torque on the bolt more than what is set by a significant amount. If it is desired to check the setting release all pressure on the wrench and then slowly apply a steady force until the click is felt.
6. Always reset the torque wrench to its lowest setting when the job is complete. If the torque wrench is left in a high setting the spring in it is stressed and will become inaccurate with time. If the torque wrench is put back to its lowest setting the spring will relax and retain its accuracy.
7. Do not use a torque wrench to break fasteners loose as it may overload the torque wrench and/or cause loss of calibration.
8. For applications requiring the use of a boxed end or crowsfoot adapter with a torque wrench to reach not readily accessible fasteners, the torque wrench setting will not be the actual torque applied to the fastener.¹
9. The ratio of actual torque at the fastener with that on the wrench scale is a function of the adapter's length and its position in relation to the torque wrench beam and the location on that at which the force is applied (see Figure 1-11:).

$$T_w = T_a \left(\frac{L}{L + A} \right)$$

T_w = Torque wrench setting, lb x ft

T_a = Torque required at fastener, lb x ft

L = Length of wrench, ft (from square drive end to center point of force on handle)

A = Length of adapter, ft (measured through end of adapter on a line parallel to the center line of the wrench)

These are general guidelines to assist in the proper use of torque wrenches. Consult with your torque wrench dealer for more detailed information.

1. The exception is when the adapter is 90° to the torque wrench. The torque will be the same as on the wrench scale (see Figure 1-12:).

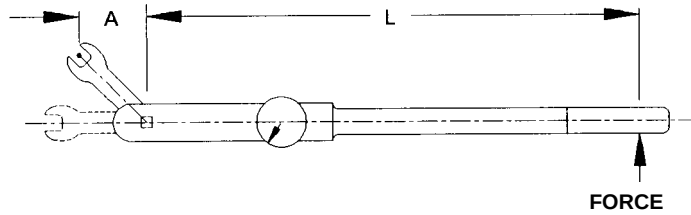


FIGURE 1-11: TORQUE WRENCH WITH ADAPTOR AT ANY ANGLE

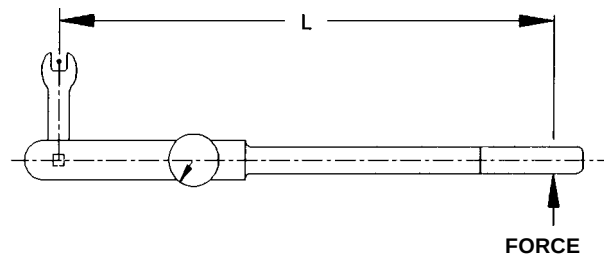
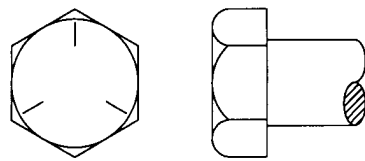


FIGURE 1-12: TORQUE WRENCH WITH ADAPTOR AT RIGHT ANGLE

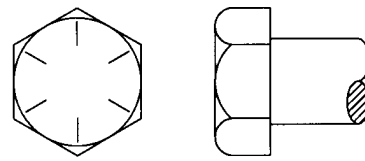
Ariel Bolting

Bolts have been selected that meet Ariel's strength, elongation, sealing and locking requirements. Proper bolting must be used and tightened to the values listed in Table 1-12 on page 1-16. Figure 1-13: is provided to assist in the identification of bolts used in an Ariel compressor.

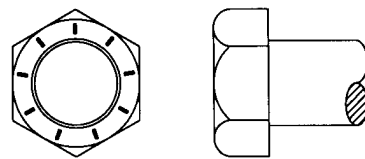
Connecting rod, valve cap and suction/discharge nozzle-Ariel supplied specialized companion flange-bolting is modified to prevent fatigue and cannot be replaced with standard bolts. If attempting to replace other bolting with standard bolts and there is any question, contact your packager or Ariel. Ariel supplied replacement bolting is recommended.



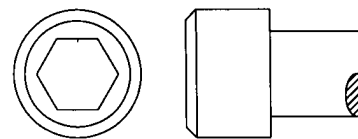
Hex head Grade 5



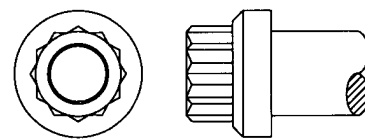
Hex head Grade 8



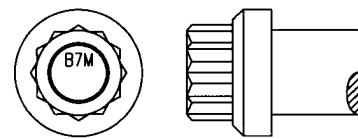
Hex head Grade 9



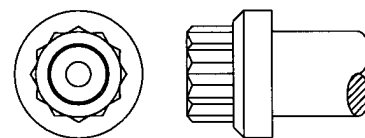
Hex Socket Head Grade 8



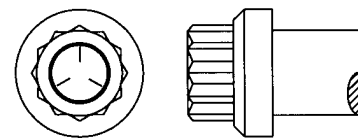
12 Point Grade 8



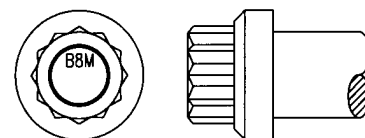
12 Point Grade B7M (NACE)



12 Point Interim Grade 5



12 Point Grade 5



12 Point Stainless
Steel Grade B8M

FIGURE 1-13: BOLT IDENTIFICATION

Optional Main Bearing Temperature Instrumentation - Alarm & Shutdown

Amot 4103 Temperature Valve

This eutectic alloy device is selected to melt at 228°F (109°C) to vent control pressure and to provide a shutdown signal. Upon melting, the fuse rod must be replaced. To ensure proper operation of the detector, replace the fuse rod every five years.

Electrical Instrumentation Setting

Set within 10% of normal operating temperature, to a maximum of 220°F (104°C) alarm and 230°F (110°C) shutdown.

SECTION 2 - INSTALLATION

General

The installation of the compressor with the associated driver and piping must be done with care and precision. This section does not attempt to address all of the concerns that can arise during installation. This section addresses some of the more critical installation considerations and requirements.

Procedure For Setting and Aligning

The following points deserve special attention during the setting and alignment of the compressor:

1. The skid design should:
 - Transmit compressor and driver reaction forces to the foundation.
 - Ensure that there is a proper mismatch between the shaking forces and the natural frequency of the skid.
 - Have sufficient stiffness and strength so that the compressor can be mounted flat with no bending or twisting of the compressor frame, crosshead guides or cylinder. This can be accomplished by shims or careful grouting.
 - Have enough stiffness and mass to resist vibration induced by the unbalanced couples as specified in the **Ariel Application Data Book**.
2. The feet on the crosshead guides must be supported in a fashion that not only provides vertical support but also prevents horizontal movement perpendicular to the piston rod.
3. Each crosshead guide will deflect an amount relative to the weight of the cylinder mounted on that throw. This amount of deflection is shown on the Cylinder Outline Drawing in the **Ariel Application Data Book**. Shims equaling the deflection value as listed on the cylinder outline drawing are to be added to the shim pack under the crosshead guide, elevating the crosshead guide to a level position. The crosshead guide supports must be capable of carrying the combined weight of the cylinders, bottles and piping.

Setting

The following procedure is to be used for setting the compressor on the skid:

After finding the approximate position of the compressor frame, the mounting bolts are to be tightened in place and then loosened. Shims are then to be adjusted so there is no movement more than a variation of 0.002 inches (0.05 mm) between the bottom of the frame and the skid supports. With the frame again bolted into place and the crosshead guide supports free, the distance from the crosshead guide supports to their respective skid supports is to be measured. To these measurements add the amount of deflection due to the cylinder weight as listed on the appropriate compressor cylinder outline drawing. Raise the cylinder and shim between the guide and guide support before tightening the crosshead guide mounting bolts. Consult Packager's information for mounting bolt tightening torque values. This work must be performed prior to the addition of bottles and piping.

Alignment

Proper alignment is necessary for satisfactory performance. A flexible coupling will not make up for poor alignment. Misalignment can result in:

- High bending moment on the crankshaft
- Large axial forces
- Excessive wear to the bearings
- And if severe, probable damage to various components

An Ariel compressor may be aligned by any of a number of acceptable methods such as:

- Face/peripheral
- Reverse indicator
- Across the disc pack
- Optical
- Laser
- Mechanical direct to computer

When aligning a unit some procedural concerns are:

- Soft foot (compressor and driver are not laying flat)
- Repeatable readings
- Which way indicator moves (plus or minus)
- Thermal growth
- Indicator sag

When properly aligned, the forces on the connected equipment will be at a minimum. This will result in long bearing life and a smooth running unit. Consult Packager's information for alignment requirements.

Vents and Drains¹

It is critical, for the safe operation of the compressor, to ensure that all vents and drains are open, functional and, if necessary, tubed off of the skid or out of the building. Depending upon your climate and insect population it can be necessary to install screens over the vents and drains to ensure that they do not become blocked. This can be essential if the compressor is shutdown for a long period of time.

Some other points are:

1. A vent should be provided to safely relieve pressure from the system.
2. Adequate vents and drains are to be provided for the distance pieces, primary packing vents and crankcase. Primary vents and drains must be independently vented from the secondary vents and drains. All vents and drains must be installed in such a manner as to prevent the collection of liquids that could cause the build up of either gas or liquid. When a heavier than air gas is involved, vent and drain design must be accommodating.

1. Also see Section 4.

NOTES

SECTION 3 - START UP

General

To ensure proper start up, it is important to carefully follow the Start Up Check List provided in this section. It is also important that the operator be thoroughly familiar with this manual and with the Packager's Operating Manual.



CAUTION

BEFORE STARTING A NEW COMPRESSOR, OR AFTER RE-LOCATING OR RE-APPLYING A COMPRESSOR, OR AFTER MAJOR OVERHAUL, BE SURE TO COMPLETE AND CHECK OFF ALL THE ITEMS ON THE START UP CHECK LIST ON PAGES 3-2 THROUGH 3-4. THIS LIST IS DESIGNED TO ENSURE MAXIMUM SAFETY IN STARTING AND OPERATING THE COMPRESSOR



CAUTION

FOR SAFE OPERATION, DO NOT ATTEMPT TO START-UP THE UNIT WITHOUT BEING COMPLETELY KNOWLEGABLE ON THE INFORMATION CONTAINED IN THIS SECTION. IT IS ALSO ESSENTIAL TO REFER TO THE PACKAGER'S OPERATING MANUAL.

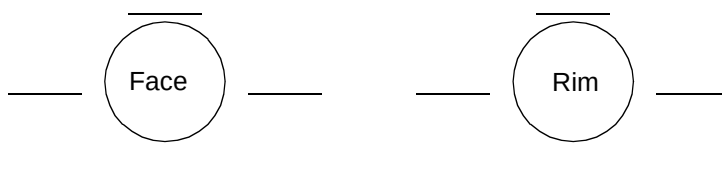
Start-Up Check List

Compressor Model _____ Serial No. F- _____
 Cylinder S/N C- _____ C- _____ C- _____ C- _____ C- _____ C- _____
 Driver _____ Rated Speed _____
 Packager _____ Packager Unit No. _____
 Date Packager Shipped _____ Start Up Date _____
 Serviceman _____ Customer _____
 Location _____ Field Contact _____
 Field Telephone No. _____ Unit Location _____
 Frame Oil - Make/Grade _____
 Cylinder Oil - Make/Grade _____

Check List - Prior To Starting

YES **NO**

1. Are the correct Ariel parts book, technical manual, special tools, and spares available? _____
2. Have the design limitations for the compressor model such as rod load, maximum and minimum speed, discharge temperature been checked? _____
3. Have the design operating conditions been determined?
 Pressure, PSIG (kPa): Suction _____ Discharge _____
 Temperature, °F (°C): Suction _____ Discharge _____
 Maximum RPM _____ Minimum RPM _____
4. Soft Foot Check: Have the compressor feet and crosshead guide supports been shimmed so the machine is not twisted or bent? _____
5. Have bottom crosshead clearances on all corners been checked? _____
 Maximum 0.0015" (0.038 mm) feeler inserted to 1/2" (12.7 mm) maximum depth
6. Record top crosshead minimum feeler clearance below. Throw #
 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____
7. Have the piping and supports been checked to be sure they do not bend or stress compressor? _____
8. Have coupling bolt torque values been rechecked? _____
9. Has the compressor to driver alignment been checked?
 Maximum allowable 0.005 inches (0.13 mm) TIR _____
10. Record coupling dial indicator readings in inches at the 3, 6, 9 & 12 o'clock positions on lines provided:



11. Has the crankshaft thrust clearance been checked?
 Record crankcase thrust clearance here: _____ inches (mm)

Compressor Model _____ Serial No. F-_____

	YES	NO
12. Have piston end clearances been checked with feeler gauges? Record below:	_____	_____
Throw #1 #2 #3 #4 #5 #6		
HE _____		
CE _____		
13. Has the crankcase been filled with oil to the proper level?	_____	_____
14. Has proper oil been installed if extreme ambient conditions exist or special gases are compressed?	_____	_____
15. Is the compressor crankcase oil level control working and set at the proper level?	_____	_____
16. Is the crankcase oil supply isolation valve open?	_____	_____
17. Does the crankcase low level shutdown work?	_____	_____
18. Has the recommended oil filter element been installed?	_____	_____
19. Are the oil filter element and all lube oil piping primed with oil?	_____	_____
20. Is the low oil pressure shutdown installed and tubed correctly to the downstream side of the oil filter?	_____	_____
21. Does the low oil pressure shutdown work?	_____	_____
22. Oil cooler? Compressor inlet oil temperature is 190°F (88°C) max.	_____	_____
23. Is the crankcase oil temperature shutdown installed, set and working?	_____	_____
24. If oil is cooled, is there a temperature control valve?	_____	_____
25. Is the crankcase breather element clean?	_____	_____
26. Is the force feed lubricator box filled with oil?	_____	_____
27. Is the force feed lubrication system primed?	_____	_____
28. Is the force feed lubrication system no flow shutdown installed and working?	_____	_____
29. Is the force feed blow out assembly installed? Check rupture disc for color? Purple is standard = 3250 PSIG (22 400 kPa).	_____	_____
30. Has the lubricator instruction plate or Technical Manual Cylinder Lubrication Sheet been checked for proper lube feed rate?	_____	_____
31. Is there a working vibration shutdown mounted on compressor?	_____	_____
32. Are the primary and secondary packing vents and the distance piece vents open, and when necessary, tubed off of the skid or out of the building?	_____	_____
33. Is there some method of suction pressure control?	_____	_____
34. Are the suction pressure, interstage pressure and discharge pressure shutdowns set and working?	_____	_____
35. Are the safety relief valves installed and working to protect cylinders and piping for each stage of compression?	_____	_____

Compressor Model _____ Serial No. F-_____

	YES	NO
36. Are the gas discharge temperature shutdowns installed, set and working?	_____	_____
37. Have the gas suction lines been blown out to remove water, slag, dirt, etc.?	_____	_____
38. Have temporary screens been installed at cylinder suction?	_____	_____
39. Was compressor prelubed prior to starting? For electric motor driven units, compressor must have prelube pump.	_____	_____
40. For engine driven units, has the machine been rolled with the starter to make sure it is free? The oil pressure should come up noticeably while rolling on the starter.	_____	_____
41. For other drivers, has the machine been barred over by hand to ensure it is rolling free?	_____	_____
42. Does the driver rotation match the compressor rotation arrow?	_____	_____
43. For machines compressing a combustible gas, have the piping and compressor been purged to remove all air?	_____	_____
44. Have start-up instructions for other package equipment been followed?	_____	_____
45. Has the Packager's representative done the required review of the Packager's Start-Up and Operating Instructions for the unit with the unit operator?	_____	_____

Check List - After Starting

	YES	NO
1. Did the oil pressure come up immediately?	_____	_____
2. Are the oil filter pressure gauges working?	_____	_____
3. Oil filter diff. pressure <10 psi (69 kPa), unless otherwise specified?	_____	_____
4. Any strange noises or shaking in the compressor or piping?	_____	_____
5. Is low oil pressure shutdown set at 35 PSIG (240 kPa)?	_____	_____
6. Are the high discharge gas temperature shutdowns set at approx 10% above normal discharge temperature? 375°F (190°C) max.	_____	_____
7. Is the distribution block indicator pin moving, and have you set lubricator for proper break-in flow rate?	_____	_____
8. Are there any oil leaks? If so, where?	_____	_____
9. Are the scrubber dumps and high level shutdowns working?	_____	_____
10. Are the scrubbers removing all liquids from the gas? How often do they dump? (____minutes)	_____	_____
11. Are there sands or oxides in the gas?	_____	_____
12. Is the overspeed shutdown set?	_____	_____
13. Are rod packings sealing properly?	_____	_____
14. Have all safety functions been tested to ensure shutdown of unit upon malfunction?	_____	_____

Maximum Allowable Working Pressure

All Ariel Compressor Cylinders have a "Maximum Allowable Working Pressure (MAWP)." The MAWP, the hydrostatic test pressure, and the test date are stamped on the end of every Ariel Cylinder (see Figure 1-6: on page 1-8).



API Specification 11P, Second Edition, November 1989, Paragraph 1.10.4 defines "Maximum Allowable Working Pressure" as follows:

"Maximum allowable working pressure (MAWP) is the maximum continuous pressure for which the manufacturer has designed the equipment (or any part to which the term is referred), when handling the specified fluid at the maximum specified temperature."

API SPEC 11P, paragraph 2.5.1.1 defines "Maximum Allowable Working Pressure" for Compressor Cylinders as follows:

"The maximum allowable working pressure of the cylinder shall exceed the rated discharge pressure by at least 10 percent or 25 psig¹, whichever is greater."

API SPEC 11P, paragraph 1.10.5 defines the rated discharge pressure as follows:

"Rated discharge pressure is the highest pressure required to meet the conditions specified by the purchaser for the intended service."

1. (172 kPa)

Relief Valve Settings

It is the responsibility of the packager to provide relief valves for every stage of compression in compliance with API SPEC 11P, paragraph 7.20.3, as follows:

"Relief valve setting shall take into consideration all possible types of equipment failure and the protection of the lowest pressure rated component in any continuous system. Relief valves shall be set to operate at not more than the maximum allowable working pressures but not less than the values following:

System Discharge Pressure psig (kPa)	Relief Valve Margin Above System Discharge Pressure
-14.7 to 150 (-101 to 1034)	15 PSI (100 kPa)
151 to 2500 (1035 to 17 237)	10%
2501 to 3500 (17 238 to 24 132)	8%
3501 to 5000 (24 133 to 34 474)	6%

NOTE: For rated discharge pressures above 5000 psig (34 474 kPa), the relief valve setting shall be agreed upon between the purchaser and the vendor."



CAUTION

WHEN A BYPASS IS FURNISHED, A RELIEF VALVE MUST BE INSTALLED IMMEDIATELY DOWNSTREAM OF THE BYPASS VALVE OR ON THE INLET SCRUBBER OF THE DOWNSTREAM CYLINDER. THIS RELIEF VALVE MUST BE SET FOR THE MAXIMUM ALLOWABLE WORKING PRESSURE OF THE CYLINDER WHICH HAS THE LOWEST MAWP OF THOSE IN THE BYPASS CIRCUIT. THIS IS TO PROTECT AGAINST DISCHARGE-CHECK VALVE FAILURE WHEN OPERATING ON BYPASS. (SEE ARIEL PACKAGER'S STANDARDS, SECTION 4.4 "RELIEF VALVES").

Filling Sump & Priming a Main Oil Lube Oil System - Before Starting

Filling The Sump

1. Remove breather and fill compressor sump through top cover.
2. Check sight glass on auxiliary end. Oil level at start-up should be near the top of the glass. DO NOT OVERFILL SUMP. The crankshaft will dip into the oil, churn it, and make it difficult to pump and to control the proper level. (After the machine is running, it may be necessary to add oil to bring up oil level to one-half the height of the sight glass; but it must never exceed two-thirds height, while running.)
3. When the sump is filled to the proper level, replace and snug up the breather cap by hand, to facilitate later removal.

Priming - Main Lube Oil System

NOTE: BE SURE THE OIL SYSTEM FROM THE LUBE OIL PUMP THRU THE COOLER AND OIL FILTER IS FILLED WITH OIL.

JGI, JGM, JGN, JGP and JGQ frames should be equipped with a manual lube oil priming pump. It is important to prime the unit until the bearings receive oil. Five strokes of the pump, after the pressure gauge at the oil filter outlet indicates pressure, is sufficient. If the unit is equipped with a motor-driven pre-lube pump, the pump should run at pressure for a minimum of fifteen seconds before starting the unit.

Force Feed Lubricator Adjustment

Ensure that the force feed lubricator is set at the break-in rate shown on the force feed lubricator plate (see Figure 1-5: on page 1-7). An indicator pin on the distributor block shows the rate at which the block is cycling. To adjust, screw down the feed regulator until the indicator strokes at the proper rate. Run at this setting for 200 hours of operation. The lubricator adjustment may then be reduced to the normal operating rate (see Figure 1-5:).

NOTES

SECTION 4 - LUBRICATION AND VENTING

General

Lubrication is vital for successful operation of a compressor and deserves special attention in the package design.

All compressors must have an oil cooler. Maximum allowable oil temperature into the compressor frame is 190°F (88°C). The packager is responsible for sizing a proper oil cooler. Operating conditions which must be taken into account are; the cooling medium, cooling medium temperature, cooling medium flow rate, lube oil temperature, and lube oil flow rate. Oil heat rejection data for each frame are shown in the Application Data Book in the specification section (contact your Packager or Ariel when you need this information). The cooler should be mounted as close to the compressor as possible, with piping of adequate size to minimize pressure drop of both the lubricating oil and the cooling medium.

1. For proper operation of the Amot thermostatic valve provided as an option by Ariel, the maximum differential pressure between the hot oil supply line (point B) and the cooled oil return line (point C) is 10 psi (0.7 bar). Refer to Figure 4-8: Lube Oil System Schematic - Typical.
2. Ariel recommends installation of the Amot thermostatic valve in the mixing mode.

If a compressor is exposed to cold ambient temperatures, the oil system must be designed so the unit may be safely started with adequate oil flow to the main bearings. Temperature controlled cooler by-pass valves, oil heaters, cooler louvers and even buildings may be needed to ensure successful operation. Cold weather installations may use multi-viscosity oils in the compressor frame if the oil supplier can certify that the oil is shear stable. The viscosity of shear stable oil does not degrade through use. Multi-viscosity oils are subject to a shorter oil life than single grade oils by 30% to 50%.

Electric motor driven compressors must have a prelube pump to ensure oil flow prior to start-up. A start permissive should disable the start-up sequence if oil pressure is below 10 psig (0.7 bar_g). An automatic prelube cycle is strongly recommended for all electric drive systems, and required on those with unattended start sequences or frequent starts.

Lubrication performs at least six functions in a compressor:

1. Reduce friction - decreasing friction decreases energy requirement and heat buildup.
2. Reduce wear - decreasing wear increases equipment life expectancy and decreases maintenance costs.
3. Cool rubbing surfaces - cooling of rubbing parts maintains working tolerances, extends oil life, and removes heat from the system.
4. Prevent corrosion - minimization of surface corrosion decreases friction, heat,

and component wear. Generally provided by additives rather than the base lubricant.

5. Seal and reduce contaminant buildup - improves gas seal on piston rings and packing rings, and flushes away contaminants from moving parts.
6. Dampen shock - shock loads are cushioned, thereby reducing vibration and noise, and increasing component life.

Liquid lubricants commonly used in compressors include petroleum based oils and synthetic fluids. Lubricant additives are used to improve the viscosity index, inhibit oxidation, depress the lubricant pour point, inhibit rust formation, improve detergency, provide anti-wear protection, provide extreme pressure protection, improve “lubricity”, decrease effects of gas dilution, increase “wetability”, and resist “washing” of the lubricant due to water, wet or saturated gas, or diluent properties of the gas stream.

- *Viscosity index* is a measure of the ability of an oil to resist the thinning effect caused by increasing the oil temperature.
- *Lubricity* is the “slipperiness” or ability of a lubricant to decrease friction.
- *Wetability* is a measure of the ability of the lubricant to adhere to metal surfaces. An increase in wetability increases the lubricants’ resistance to “washing” effects.

Petroleum Based Oils - also referred to as mineral oils:

Paraffinic - higher wax content, better resistance to thinning at higher operating temperatures than napthenic.

Napthenic - (as compared to paraffinic) lower wax content, better flowability at low temperatures for cold start-ups, lower resistance to thinning at higher operating temperatures, better solvency, lower life/oxidation stability. Napthenic oils leave softer carbon deposits/residues on discharge valves, etc.

Animal Fats

Generally acidless tallow used as a compounding additive to petroleum lubricants to improve “slipperiness” at higher pressures and resist dilution in wet or saturated gases. They can solidify at low or high temperatures. Oils with these additives should not be used in the compressor frame.

Vegetable Oils

Rapeseed oil is an example. Used as a compounding additive in petroleum lubricants to improve “slipperiness” at higher pressures and resist dilution in wet or saturated gases. These additives are not high temperature oxidation stable and therefore additive life decreases rapidly above 170°F (77°C). Oils with these additives should not be used in the compressor frame.

Synthetic Lubricants

Man-made materials with more consistent, controlled chemical structures than petroleum lubricants. This improves predictability of viscosity and thermal stability. Synthetic lubricants can be designed with better oxidation resistance, better lubricity, better film strength, natural detergency, lower volatility, and results in decreased operating temperatures. These attributes can help to decrease cylinder feed rate requirements. Justification for the use of synthetic lubricants is based on energy savings, reduced lubricant usage, increased component life, decreased equipment downtime, and reduced maintenance/labor. Some synthetic lubricants can be used in the compressor frame. Consult with the lubricant supplier before using these lubricants in the compressor frame.

- Synthesized Hydrocarbons - polyalphaolefins (PAO) can be used as compressor lubricants:
 1. Compatible with mineral oils.
 2. Requires additives to improve detergent action and improve seal compatibility.
 3. Soluble in some gases. Verify application with lubricant supplier.
- Organic Esters - diesters and polyolesters:
 1. Compatible with mineral oils
 2. Incompatible with some rubbers (O-rings), plastics, and paints. Compatible with Viton.
 3. Primarily used in air compressors.
- Polyglycols - polyalkylene glycols (PAG), polyethers, polyglycolethers, and polyalkylene glycol ethers:
 1. Poor inherent oxidation stability and corrosion protection - requires additives.
 2. Can be water soluble - must verify application with lubricant supplier.
 3. Not recommended for air compressors.
 4. Not compatible with mineral oils, some plastics and paints. Requires complete system flush when changing to or from polyglycols.
 5. Compatible with Viton and HNBR - Buna N (high end acrylonitrile-butadiene).
 6. Resistant to hydrocarbon gas dilution. Excellent wetability.

Cylinder oils are specially compounded lubricants designed for use in steam cylinders and/or compressor cylinders. Compounded lubricants can be petroleum or synthetic base. Additives can be animal, vegetable, or synthetic base. These lubricants are formulated to enhance oil film strength to counter the affects of water, wet gases, solvents, etc. present in the gas.

Compressor Frame Lubricants

Ariel recommends, for use in the compressor frame, a good quality mineral oil which provides proper lubrication and heat removal, as well as oxidation inhibition, rust and corrosion inhibition, and anti-wear properties.

For clean, dry, pipeline quality gas, the oil used in the natural gas fueled engine should be satisfactory. SAE 40 weight (ISO 150 grade) oil is recommended for normal operation.

The maximum viscosity of the lube oil for cold ambient temperature starting is 15,000 SUS (3300 cSt), typically 40°F (4°C) for SAE 30 weight (ISO 100 grade) oil, or 55°F (13°C) for SAE 40 weight (ISO 150 grade) oil.

The minimum viscosity at operating temperature is 60 SUS (10 cSt).

Low ash or no ash oils are recommended as high ash oils can increase maintenance requirements.

Additives must not be corrosive to lead or copper based bearing materials.

The compressor frame driven lube oil pumps maintain oil pressure with a spring loaded regulating valve within the pump head. Lube system pressure can be raised or lowered by adjusting this valve. Normal pressure on the discharge side of the lube oil filter is factory set for 60 psig (4.1 bar_g). If the lube oil pressure drops below 50 psig (3.4 bar_g), the cause should be found. A low lube oil pressure shutdown, set at 35 psig (2.4 bar_g), is required for protection of the compressor.

The minimum lube oil operating temperature is 150°F (66°C). This is the minimum temperature required to drive off water vapor.

When frame lube oil immersion heaters are used, the watt density of the heater element should not exceed 5 watts per square inch (0.8 W/cm²) for systems without circulating pumps. Oil coking will occur at the element with higher wattage heaters if a circulating pump is not used. When high wattage heaters are required, the heaters must be interlocked with an oil circulation pump to ensure that coking of the oil will not occur. Coked oil will form deposits which can “insulate” the system and decrease heat removal. The deposits can also break loose and act as abrasives in the lubricating system.

JGI, JGM, JGN, JGP & JGQ compressors are equipped with simplex, spin-on, resin-impregnated cellulose type filters as standard. Pressure gauges are provided for monitoring pressure drop across the filter.

Compressor frame lubricating oil should be changed at regular maintenance intervals (6 months or 4,000 hours), when oil filter differential pressure exceeds 10 psi (0.7 bar) or when oil sample results indicate the need. A more frequent oil change interval may be required if operating in an extremely dirty environment or if the oil supplier recommends it. Oil sampling should be performed on a regular basis to verify suitability of oil for continued service. Degradation to the next lower viscosity grade below the original viscosity or an increase in viscosity to the next higher grade requires a complete oil change. Viscosity testing should be performed at 212°F (100°C).

Cylinder And Packing Lubrication Requirements

Cylinder lubrication requirements will vary with the operating conditions and the composition of the gas to be compressed. Please refer to the following table for lubrication recommendations for various gas compositions and various operating conditions. Note that lubrication

rates can change with operating conditions. Lubricating oil type will also vary with the composition of the gas which is to be compressed.

Separate force feed lube systems require oil with a viscosity below 5000 SUS (1100 cSt) at the lubricator pump inlet. Measures which may be necessary to make sure that the force feed pump is filled with oil during the suction stroke include; appropriate pipe and fitting size from the tank to the force feed pump, heating the oil, and pressurizing the supply tank. An in-line oil filter or fine screen is required between the supply tank and the force feed lubricator pumps. Recommended filtration is 20 micron nominal.

Under lubrication results in a “mini-lube” condition. This condition results in extremely rapid breakdown of Teflon and PEEK piston and packing ring materials. Black, gummy deposits which can be found in the distance piece, packing case, cylinder and valves are indicators of under lubrication.

Over lubrication can result in excessive oil carryover into the gas stream, and increased quantities of deposits in the valves and gas passages. Valve plate breakage and packing failure are also symptoms of over lubrication. The packing case will “hydraulic”, which forces the packing rings to lift off of the rod enough to form a leak path. Increased gas leakage then results in packing and rod overheating. A rod and packing case can turn blue even though the lubrication appears sufficient.

Even when the proper rate and lubricating medium are in use, dirt and foreign matter in the gas will prevent the lubricant from performing properly. Inlet gas debris screens with a maximum 50 micron opening are recommended. Proper maintenance of the inlet screens is required.

The proper lubrication rate may be determined several ways. The cigarette paper method utilizes two layers of un-waxed cigarette papers or equivalent. Place the layers together and lightly rub the cylinder bore. The first layer of paper should show oil and the second layer should be dry.

When observed symptoms indicate lack of lubrication; first verify that the force feed lubricator pumps are operating properly, confirm that the distribution block cycle time matches the lube sheet provided by Ariel, double check that all tubing and fittings are tight and no leaks are present. Do not overlook the fittings inside the cylinder gas passages. The lubricant flow rates are so low that all of the required flow to a lube point may be observed as a drip at a fitting.

To set the proper force feed lubrication pump flow rate, the cycle time indicator on the distribution block is to be observed. Time the cycle from flash to flash for a digital no-flow timer switch (DNFT), or from initial movement of the indicator pin at the fully retracted position, to the time when the pin returns to the fully retracted position and begins to move back out again for a magnetic cycle indicator assembly.

NOTE: WHEN ADJUSTING THE FORCE FEED LUBRICATION PUMP SETTING FOR THE APPROPRIATE CYCLE TIME, DO NOT SET THE PUMPS AT TOO LOW A FLOW RATE. THE PUMPS CAN BECOME INCONSISTENT WHEN SET TOO LOW.

The force feed lubrication pumps should be capable of delivering twice the “normal” required lube rate for the break in period. Please contact Ariel for assistance if the existing pump is not capable of the flow rate required.

Used engine oil may be used as long as the new oil specifications meet the listed requirements, and the oil is appropriately filtered, i.e. 20 micron nominal. Oil viscosity must be monitored and tested, as noted above, for serviceability.

The use of higher viscosity lubricants or specially compounded lubricants can compensate somewhat for the presence of liquids in the gas stream.

NOTE: WHEN THERE ARE LIQUIDS PRESENT IN THE GAS, THE MOST EFFECTIVE LUBRICATION OF CYLINDERS AND PACKING REQUIRES REMOVAL OF THE LIQUIDS BEFORE THE GAS ENTERS THE COMPRESSOR.

THESE LUBRICATION RECOMMENDATIONS ARE GENERAL GUIDELINES. IF THE RECOMMENDED LUBRICANTS OR FLOW RATES DO NOT APPEAR TO WORK ADEQUATELY, FLOW RATES AND/OR LUBRICANT TYPES MAY NEED TO BE CHANGED. PLEASE CONTACT THE LUBRICANT SUPPLIER FOR SPECIFIC LUBRICANT RECOMMENDATIONS.

WARRANTY OF COMPONENT FAILURES WHICH OCCUR WHILE USING LUBRICANTS WHICH DO NOT MEET THESE SPECIFICATIONS WILL BE SUBJECT TO REVIEW ON A CASE BY CASE BASIS.

TABLE 4-1: CYLINDER/PACKING LUBE OIL RECOMMENDATIONS FOR VARIOUS GAS STREAM COMPONENTS

GAS STREAM	< 1000 PSIG (< 70 BAR_g)	1000 TO 2000 PSIG (70 TO 140 BAR_g)	2000 TO 3500^a PSIG (140 TO 240 BAR_g)	3500 TO 5000^a PSIG (240 TO 345 BAR_g)	≥ 5000^a PSIG (≥ 345 BAR_g)
Pipeline Quality Natural Gas	SAE 40 weight ISO 150	SAE 40-50 weight ISO 150-220 1.25 x base rate	SAE 50 weight w/ compounding ISO 220-320 1.5 x base rate	Cylinder Oil ISO 320-460 2.0 x base rate or Synthetic - Diester/Polyglycol	Cylinder Oil w/ compounding ISO 460-680 3.0 x base rate or Synthetic - Polyglycol
Natural Gas w/ Water &/or heavy hydrocarbons ^b Methane < 90% SG > 0.7 Propane > 8%	SAE 40-50 weight ISO 150-220 1.25 x base rate	SAE 50-60 weight or SAE 40 weight w/ compounding ISO 220-320 1.5 x base rate	Cylinder Oil w/ compounding ISO 460-680 2.0 x base rate	Cylinder Oil w/ compounding ISO 680 3.0 x base rate or Synthetic - Diester/Polyglycol	Contact Lubricant Supplier
CNG	SAE 40 weight ISO 150	SAE 40-50 weight ISO 150-220	See Pipeline Quality Natural Gas or Synthetic - Polyglycol/Diester	See Pipeline Quality Natural Gas or Synthetic - Polyglycol/Diester	See Pipeline Quality Natural Gas or Synthetic - Polyglycol
Air	SAE 40 weight Air Compressor Oil ISO 150	SAE 50 weight Air Compressor Oil w/ compounding ISO 220 1.5 x base rate	Synthetic - Diester 1.5 x base rate	Contact Lubricant Supplier	Contact Lubricant Supplier
Wet Air	SAE 40-50 weight Air Compressor Oil w/compounding ISO 150-220	Synthetic - Diester 1.5 x base rate	Synthetic - Diester 2.0 x base rate	Contact Lubricant Supplier	Contact Lubricant Supplier

TABLE 4-1: CYLINDER/PACKING LUBE OIL RECOMMENDATIONS FOR VARIOUS GAS STREAM COMPONENTS

GAS STREAM	< 1000 PSIG (< 70 BAR_g)	1000 TO 2000 PSIG (70 TO 140 BAR_g)	2000 TO 3500^a PSIG (140 TO 240 BAR_g)	3500 TO 5000^a PSIG (240 TO 345 BAR_g)	≥ 5000^a PSIG (≥ 345 BAR_g)
Natural Gas w/ Carbon Dioxide >2% to 10%	SAE 40-50 weight ISO 150-220 1.25 x base rate	SAE 50-60 weight or SAE 40 weight w/compounding ISO 220-320 1.5 x base rate	Cylinder Oil w/ compounding ISO 460-680 2.0 x base rate or Synthetic PAG	Cylinder Oil w/ compounding ISO 680 3.0 x base rate or Synthetic PAG	Contact Lubricant Supplier
Natural Gas w/ Carbon Dioxide ≥ 10%	SAE 40-50 weight ISO 150-220 1.5 x base rate	SAE 50-60 weight or SAE 40 weight w/compounding ISO 220-320 2.0 x base rate	Cylinder Oil w/ compounding ISO 460-680 3.0 x base rate or Synthetic PAG	Cylinder Oil w/ compounding ISO 680 4.0 x base rate or Synthetic PAG	Contact Lubricant Supplier
Nitrogen	SAE 40 weight ISO 150	SAE 40-50 weight ISO 150-220	SAE 50 weight ISO 220	SAE 60 weight ISO 320	Cylinder Oil ISO 460-680
Natural Gas w/ H ₂ S >2% to 30%	SAE 40 weight w/ compounding 1.25 x base rate ISO 150	SAE 40-50 weight w/compounding 1.5 x base rate ISO 150-220	SAE 50 weight w/ compounding 2.0 x base rate ISO 220	SAE 60 weight w/ compounding 3.0 x base rate ISO 320	Cylinder Oil w/ compounding 4.0 x base rate ISO 460-680
Natural Gas w/ H ₂ S ≥ 30%	SAE 40 weight w/ compounding 1.5 x base rate ISO 150	SAE 40-50 weight w/ compounding 2.0 x base rate ISO 150-220	SAE 50 weight w/ compounding 2.5 x base rate ISO 220	SAE 60 weight w/ compounding 4.0 x base rate ISO 320	Cylinder Oil w/ compounding 6.0 x base rate ISO 460-680
Propane ^c (refrigerant)	SAE 40 weight or Refrigerant Oil 0.5 x base rate	SAE 40 weight or Refrigerant Oil 1.0 x base rate	Refrigerant Oil Contact Lubricant Supplier	Refrigerant Oil Contact Lubricant Supplier	Refrigerant Oil Contact Lubricant Supplier

a. Also requires water cooled packing.

b. Lean Burn Engine Oils contain detergents, dispersants, and ash additives which hold water in suspension. This suspension does not provide adequate lubrication in the cylinder and packings.

c. Verify oil pour point temperature is below inlet gas temperature.

NOTE: BASE RATE REFERRED TO ABOVE IS AS FOLLOWS:

0.3 PINTS/DAY/INCH BORE (0.0056 L/DAY/mm BORE) FOR JGI, JGM, JGN, JGP AND JGQ FRAMES - 1 (STD) OR 2 (OPT) LUBE POINTS PER CYLINDER.

ROD SIZE IS DOUBLED AND TREATED LIKE A CYLINDER.

BREAK IN RATE IS TWICE THE RECOMMENDED RATE. BREAK IN RATE SHOULD BE MAINTAINED FOR 200 HOURS OF OPERATION.

SPECIAL LUBRICANT FORMULATIONS ARE AVAILABLE FROM LUBRICANT SUPPLIERS FOR SPECIFIC APPLICATIONS. APPROPRIATE DOCUMENTATION SHOULD BE PROVIDED BY THE SUPPLIER WHICH CERTIFIES SUITABILITY OF THE FORMULATION FOR SITE CONDITIONS. CONTACT ARIEL FOR VERIFICATION OF WARRANTY COVERAGE.

Force Feed Lubrication System - Description

The force feed lubrication system provides oil to the compressor cylinders and the piston rod packings.

All cylinders have both top and bottom lubrication injection points available as an order option.

Oil is supplied to the suction side of the force feed lubricator pump directly from the pressure side of the frame lube oil system, or from an overhead tank.

The lubricator has its own oil reservoir to lubricate the worm gear and cam. The reservoir is self-contained and is not fed by the lube oil system. A sight glass on the lubricator will show the oil level in the lubricator reservoir.

There is a 1/8 inch NPT plug in the discharge line near the force feed lubricator pump through which the system may be primed.

Next in the discharge line is a blow-out disc. If there is a blockage in the system, the pressure build-up will fracture the disc. Venting the system through the blow-out disc causes the no-flow shutdown switch to close.

The oil then travels to the distribution block. It is here that the lubricating oil is apportioned to provide the exact amounts to the cylinders and packings. The pistons in the intermediate sections of the distribution block move back and forth in a continuous cycle, forcing lubricant successively through the several outlets as long as lubricant is supplied under pressure at the inlet. Each outlet has a check valve to prevent oil from backing up in the block. An indicator on the block shows the rate at which the block is cycling.

From the distribution block, oil travels to the cylinders and packings.

Some of the oil to the packing travels through to the cylinders, but the bulk of it is drained out through the pressure vent/drain fitting on the bottom of the crosshead guide and through the atmospheric drain also in the bottom of the guide.

An oil level control valve, supplied by the packager and mounted on the skid, maintains proper level in the crankcase sump to replace oil used in cylinder lubrication.

Force Feed Lubricator Adjustment

See instructions under "Force Feed Lubricator Adjustment" on page 3-7 and refer to Figure 5-10:.

NOTE: THE FORCE FEED SYSTEM MUST HAVE A BLOW-OUT DISC BETWEEN THE FORCE FEED LUBRICATOR PUMP AND THE NO-FLOW SHUTDOWN.

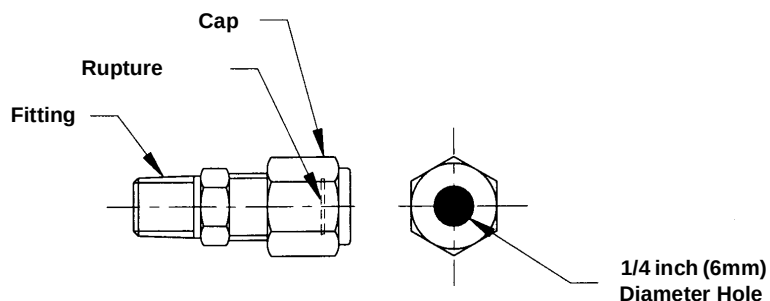
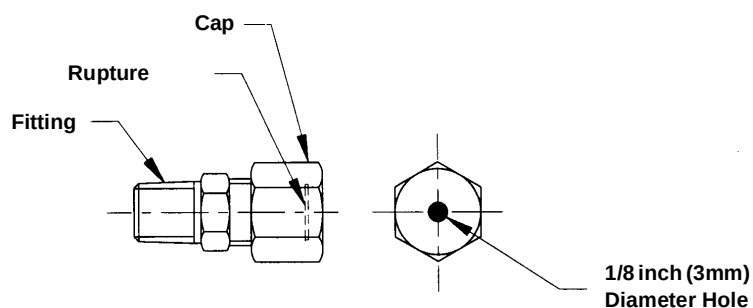
THE FORCE FEED SYSTEM MUST HAVE A WORKING NO-FLOW SHUTDOWN. THIS SHUTDOWN MUST BE SET TO ACTUATE WITHIN THREE TO FIVE MINUTES AFTER INTERRUPTION OF THE LUBRICATOR OIL FLOW.

Blow-Out Fittings and Rupture Disks

TABLE 4-2: BLOW-OUT FITTING ASSEMBLIES AND REPLACEMENT RUPTURE DISKS

SUPPLIER	BLOW-OUT FITTING ASSEMBLY			REPLACEMENT RUPTURE DISK ^A			
				ARIEL P/N	COLOR	THICKNESS	
	ARIEL P/N	RATED PSI	RATED MPa			INCHES	MM
Lincoln	A-0080	3250	22.4	A-0124	Purple	0.0225	0.57
Lubriquip	A-3531	3700	26	A-3536	Yellow	0.010	0.28
Lubriquip	A-3532	4600	32	A-3537	Red	0.012	0.30
Lubriquip	A-3533	5500	38	A-3538	Orange	0.014	0.36
Lubriquip	A-3534	6400	44	A-3539	Aluminum	0.016	0.41
Lubriquip	A-3535	7300	50	A-3540	Blue	0.020	0.51

- a. Do not use a Lincoln replacement rupture disk in a Lubriquip blow-out fitting assembly, nor a Lubriquip disk in a Lincoln fitting. See Table 1-12 on page 1-16 for blow-out fitting cap tightening torque. Do not over tighten cap or blow-out pressure can be reduced.


FIGURE 4-1: LINCOLN ST. LOUIS BLOW-OUT FITTING ASSEMBLY

FIGURE 4-2: LUBRIQUIP BLOW-OUT FITTING ASSEMBLY

Divider Valves

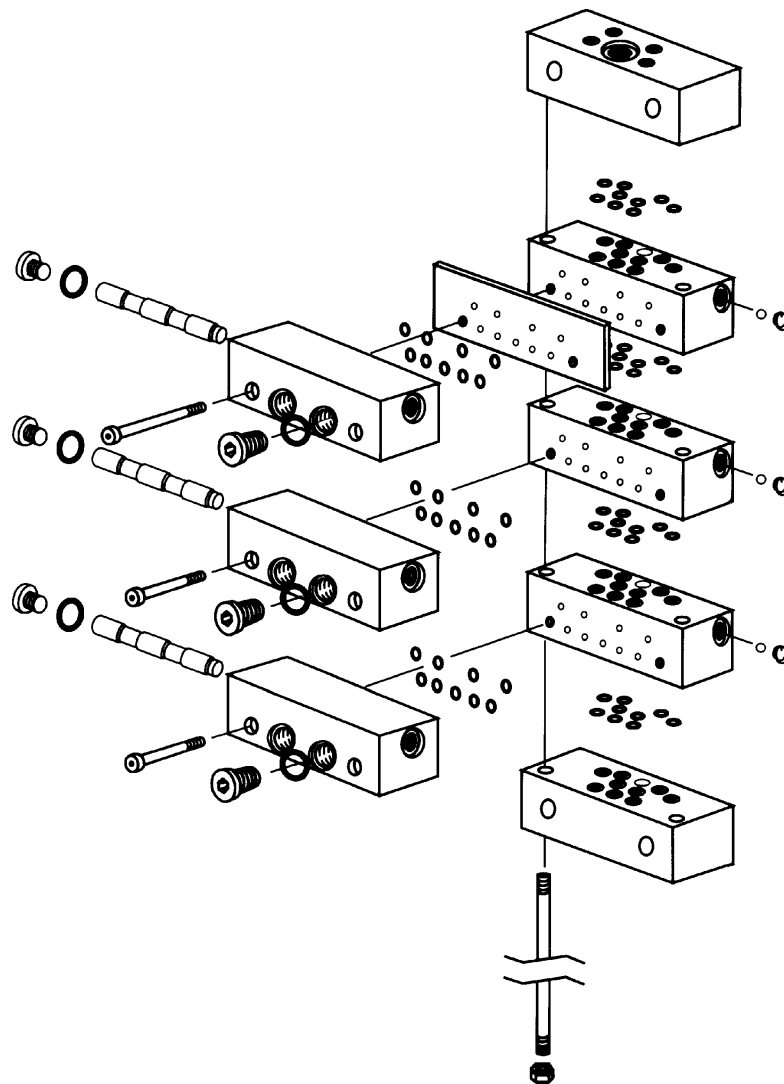


FIGURE 4-3: DIVIDER VALVE; DISTRIBUTION BLOCK - TYPICAL

NOTE: REFER TO PARTS BOOK FOR THE FRAME BEING SERVICED FOR ASSEMBLY DRAWINGS, PARTS LIST AND REPAIR KITS THAT ARE AVAILABLE FOR DIVIDER VALVES.

Description

Divider valves are comprised of three to eight valve blocks fastened to a segmented baseplate. O-rings are used to seal between the valve blocks and the baseplate and between the baseplate segments. These divider valves are used in a single line, progressive lubrication system and can be used for dispensing oil or grease. Valves and baseplate segments are normally supplied with Buna-N O-rings.

Check valves are installed at the inlets of all lube points.

Valve blocks containing metering pistons discharge a predetermined amount of lubricant with each cycle. Valve blocks can be single or twin and can be externally singled or cross-ported. Outlets not to be used when singling or crossporting must be plugged.

A by-pass block can be used in any position on the baseplate. The use of a by-pass block allows the addition or deletion of lubrication points without disturbing existing tubing. Both outlets under a by-pass block must be plugged.

The valve blocks and by-pass blocks are fastened to a baseplate mounted on the machine to be lubricated. The baseplate contains the divider valve's inlet and outlet connections, interrelated passageways and built-in check valves. All piping of lubricant to and from the divider valve is connected to the baseplate.

The baseplate consists of one inlet block, three to eight intermediate blocks, one end block and three tie rods. Gasket plate seals are included with the baseplate segments. The valve block capacity of each baseplate is dependent upon the number of intermediate blocks in the baseplate. There must be a minimum of three working valves on each valve and baseplate assembly.

Standard Electronic-Lubricator Digital No-Flow Timer Switch - DNFT

The DNFT is a microprocessor-based switch used to sense no-flow or slow-flow conditions in the compressor cylinder lubrication system to facilitate alarm and/or shutdown. The DNFT also contains an amber light-emitting diode (LED) cycle indicator to provide a positive visual indication of system operation. The Ariel DNFT includes a proximity switch. The standard DNFT is factory set for (3) three minutes from no-flow to alarm/shutdown signal and is not adjustable. Optional programmable models are available. Introduced in September of 1996, the DNFT replaced the traditional mechanical no-flow switch and is standard on all new units. Since its introduction, the DNFT has undergone a series of design enhancements and several versions are in service. The current DNFT is shown in Figure 4-4:

The DNFT works thru a magnetic pin which cycles back and forth as the divider valve piston moves, flashing the amber LED and indicating a complete cycle of the divider valve. The DNFT operates on a non-replaceable sealed internal lithium battery, with an expected battery life of 6 to 10 years depending on cycle time. Optional models are available with a factory replaceable battery. Battery failure results in a fail safe DNFT no-flow output signal for shutdown. Battery failure requires replacement of the DNFT. Expired DNFT's may be returned for partial credit.

While earlier versions of the DNFT required position adjustment on the magnet housing assembly, DNFT's supplied after August 1997 no longer require such adjustment. To replace the DNFT, remove conduit and mark wiring connections. Remove wiring and the old

DNFT. Retain for partial credit return. Disassemble the magnetic housing from the switch body by loosening the (2) 1/4"-20 set screws on a new DNFT. Be sure magnet pin and spring are intact and working in the magnetic housing assembly. You should feel spring force when pushing on the magnet pin by hand. Screw the magnetic housing assembly into the end of the divider valve housing. Be sure set screws are loosened and slide the switch body all the way onto the nut of the magnetic assembly. Tighten set screws and re-attach wiring and conduit.

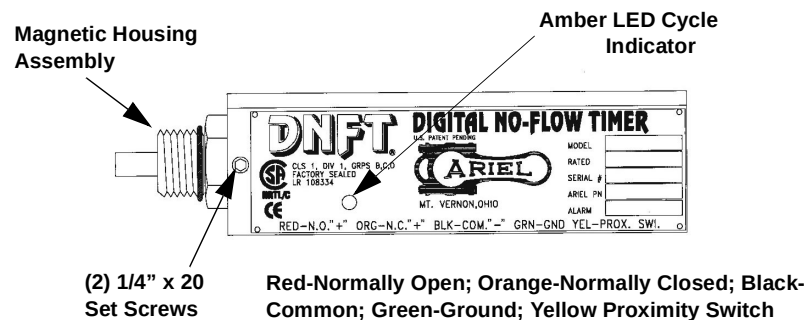


FIGURE 4-4: DIGITAL NO-FLOW TIMER SWITCH - (DNFT)

Assembly Instructions For Divider Valves

NOTE: THE CENTER TIE ROD IN THE BASEPLATE IS OFFSET SO THAT THE INTERMEDIATE BLOCKS CANNOT BE ASSEMBLED BACKWARDS. IF EXCESSIVE FORCE IS ENCOUNTERED DURING ASSEMBLY, MAKE SURE BLOCK IS NOT BACKWARDS.

1. Screw three tie rods into inlet block until ends are flush with surface of block.
2. Slide inlet gasket onto tie rods.
3. Alternately slide an intermediate block and an intermediate gasket plate onto the tie rods until the last intermediate block is in place.
4. Discard remaining intermediate gasket plate.
5. Slide end gasket plate and end block onto tie rods.
6. Lay baseplate assembly on flat surface and tightening nuts to 72 lb-in. (8.1 N·m), torque.
7. Mount divider valves with gasket plates onto baseplate and tightening mounting screws to 108 lb-in. (12.2 N·m), torque.

Operation

The inlet passageway is connected to all piston chambers at all times with only one piston free to move at any one time. With all pistons at the far right, lubricant from the inlet flows against the right end of piston 1. (See Figure 4-5: illustration 1)

Lubricant flow shifts piston 1 from right to left dispensing piston lube through connecting passages to outlet 1. Piston 1 shift directs flow against right side of piston 2. (See Figure 4-5: illustration 2)

Lubricant flow shifts piston 2 from right to left dispensing lube through valve ports of piston 1 and through outlet 2. Piston 2 shift directs lubricant flow against right side of piston 3. (See Figure 4-5: illustration 3)

Lubricant flow shifts piston 3 from right to left dispensing lube through valve ports of piston 2 and through outlet 3. Piston 3 shift directs lubricant through connecting passage to the left side of piston 1. (See Figure 4-5: illustration 4)

Lubricant flow against left side of piston 1 begins the second half-cycle which shifts pistons from left to right dispensing lubricant through outlets 4, 5 and 6 of the divider valve.

If pistons refuse to move, check for air lock in one or more valve ports by manually shifting a piston from right to left.

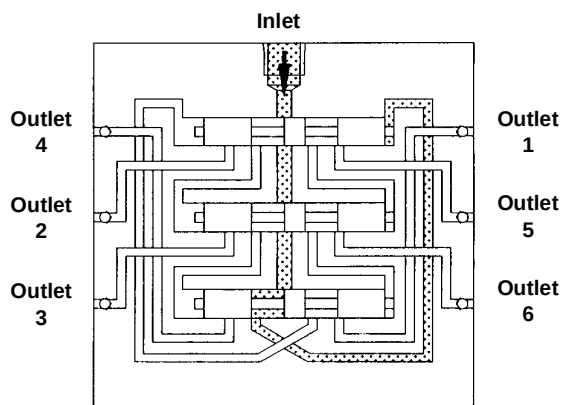


Illustration 1

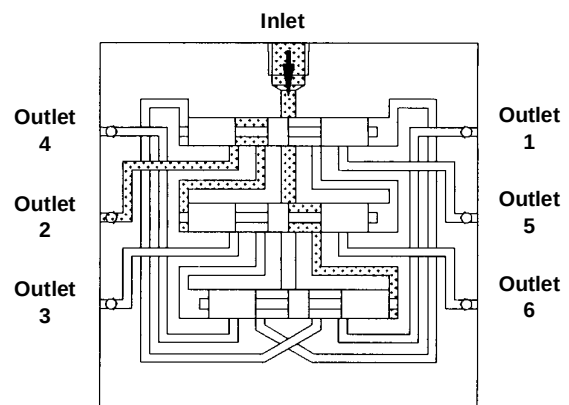


Illustration 3

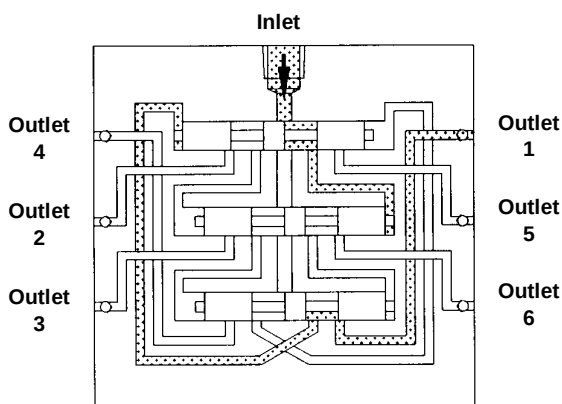


Illustration 2

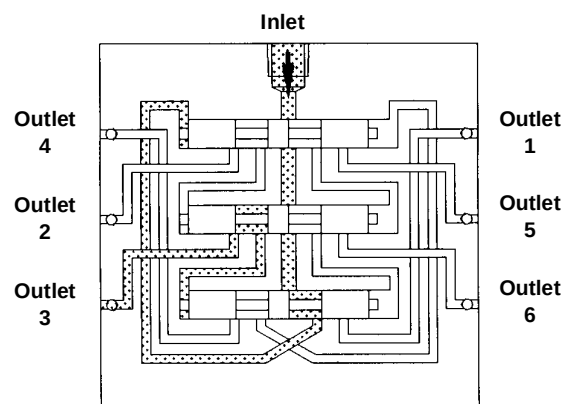


Illustration 4

FIGURE 4-5: DIVIDER VALVE OPERATION SCHEMATIC

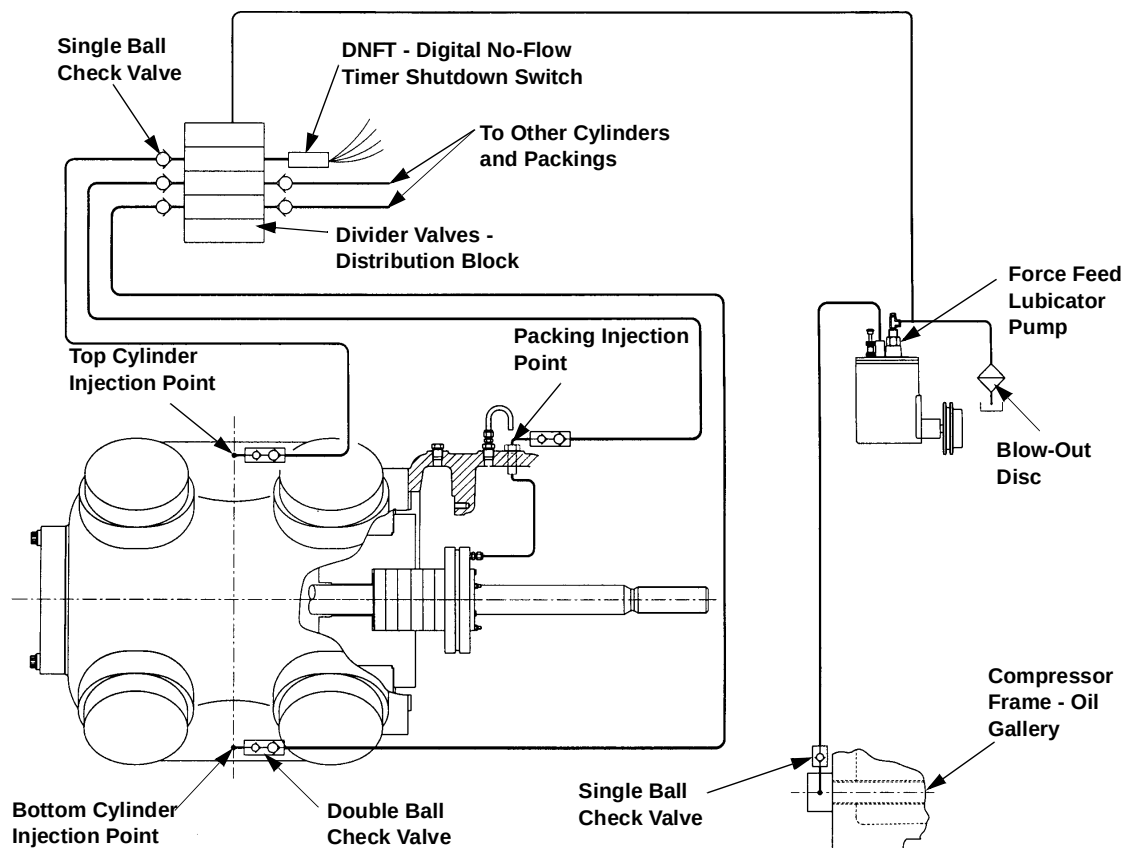


FIGURE 4-6: FORCE FEED LUBRICATION SYSTEM SCHEMATIC - TYPICAL

NOTE: PRESSURE IN FORCE FEED LUBE LINES IS, AS A MINIMUM, 110% OF THE CYLINDER SUCTION GAS PRESSURE.

Force Feed Lubrication System and Running Conditions

Force Feed Lubrication System

1. Check sight glass on lubricator reservoir to make sure it is properly filled with oil. The oil in the reservoir is used only to lubricate the worm gear and cam; it does not flow through the system. Oil is added only if it becomes necessary to raise the reservoir oil level.
2. The system has been filled with oil at the factory, and unless the piping has been disturbed, is ready for operation. If piping has been removed, or if the system has been drained, it can be filled and primed through a 1/8 inch plug on the discharge end of the lubricator pump. Priming the force feed lubrication system requires the use of a priming pump.

3. If the unit has been overhauled, adjust the lubricator for maximum delivery. Refer to Figure 5-10:. Loosen the adjusting screw locknut. Turn the plunger stroke adjustment screw to the full up position. Tighten the adjusting screw locknut. Proper feed rate may be set after the machine is started.

Running Conditions

When the machine is running, make sure that the oil level in the lubricator reservoir is at least one-half way up the sight level, but does not exceed two-thirds.

See your packager's specific data to determine the normal operating conditions, the cylinder working pressures, and the rated speed.

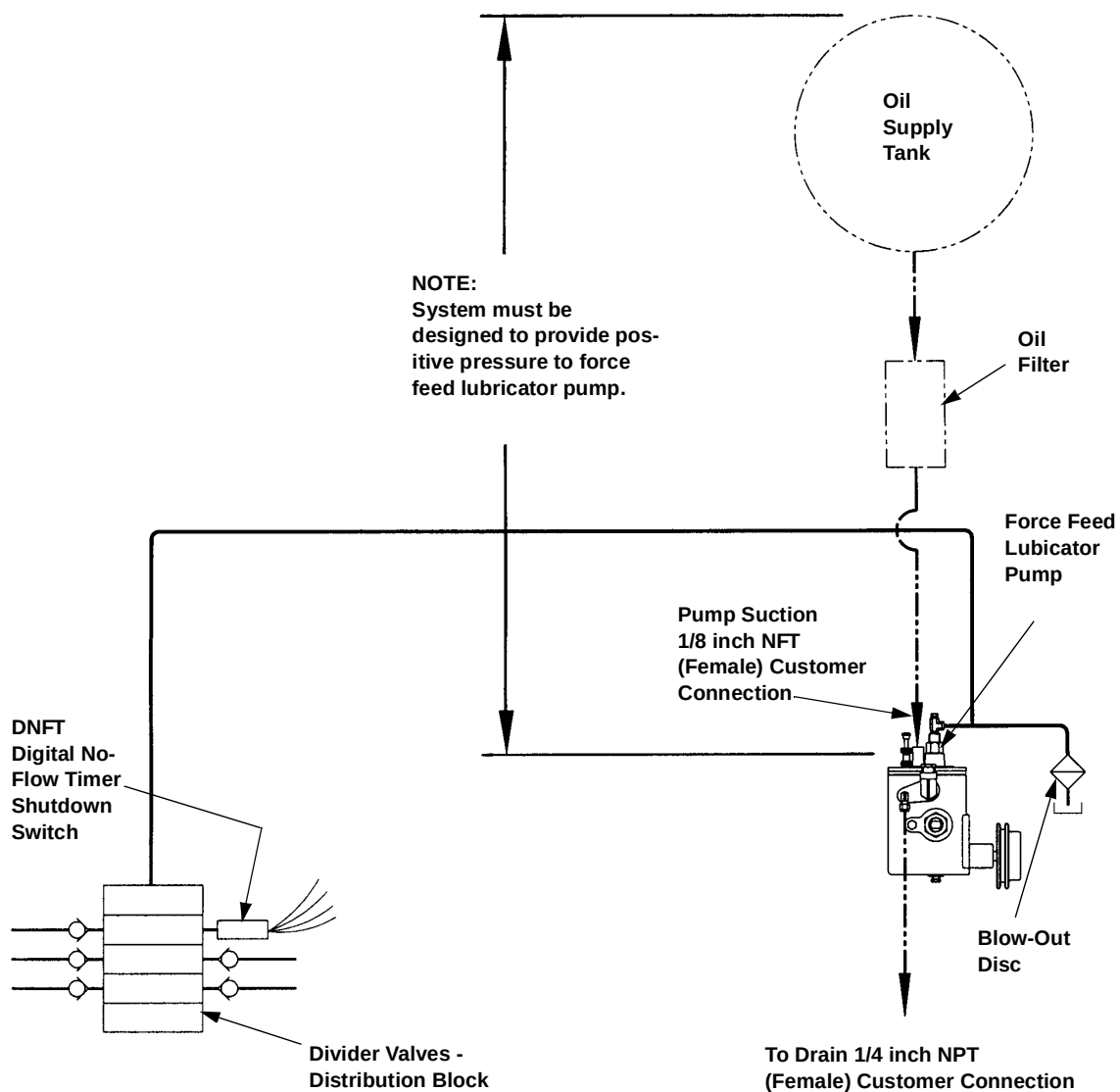


FIGURE 4-7: FORCE FEED LUBRICATION SYSTEM - INDEPENDENT OIL SUPPLY

Frame Lubricating System - Description

The frame lubricating system supplies oil to the internal frame running gear. The cylinders are supplied with lubrication by the force feed system (see "Force Feed Lubrication System - Description" on page 4-8). An oil level regulator outside the crankcase should be used maintain the proper oil level in the sump.

Frame lubrication is drawn from the sump through the suction strainer into the oil pump that is mounted on the crankcase auxiliary end cover. The pump's discharge is piped to an oil cooler mounted on the compressor skid and is temperature controlled with a thermostatic control valve. Oil returns from the cooler to the oil filter mounted on the auxiliary end of the crankcase. Pressure gauges are provided on the filter inlet and outlet. Normal pressure drop thru a clean filter is 2 to 6 PSI (15 to 40 kPa), at normal operating temperature.

From the filter, oil travels to an oil gallery cast in the crankcase and running the length of the crankcase.

Drilled holes from the gallery thru the bearing saddles deliver oil to the crankshaft bearings.

Passages drilled diagonally thru the crankshaft from the crank journals to the crank pins deliver oil to the connecting rod bearings.

Holes drilled through the length of the connecting rods deliver oil to the connecting rod bushing.

Oil travels from the bushings thru holes drilled in the middle of the crosshead pin to the hollow crosshead pins, and from there to the crosshead bushing.

Drilled passages from the oil gallery deliver oil at full system pressure thru the tubing to lubricate the top and bottom of each crosshead. Run-off from the shoes, crosshead, and connecting rod bushings collects in the crosshead guide and drains back to the sump (see Figure 4-8: Lube Oil System Schematic - Typical).

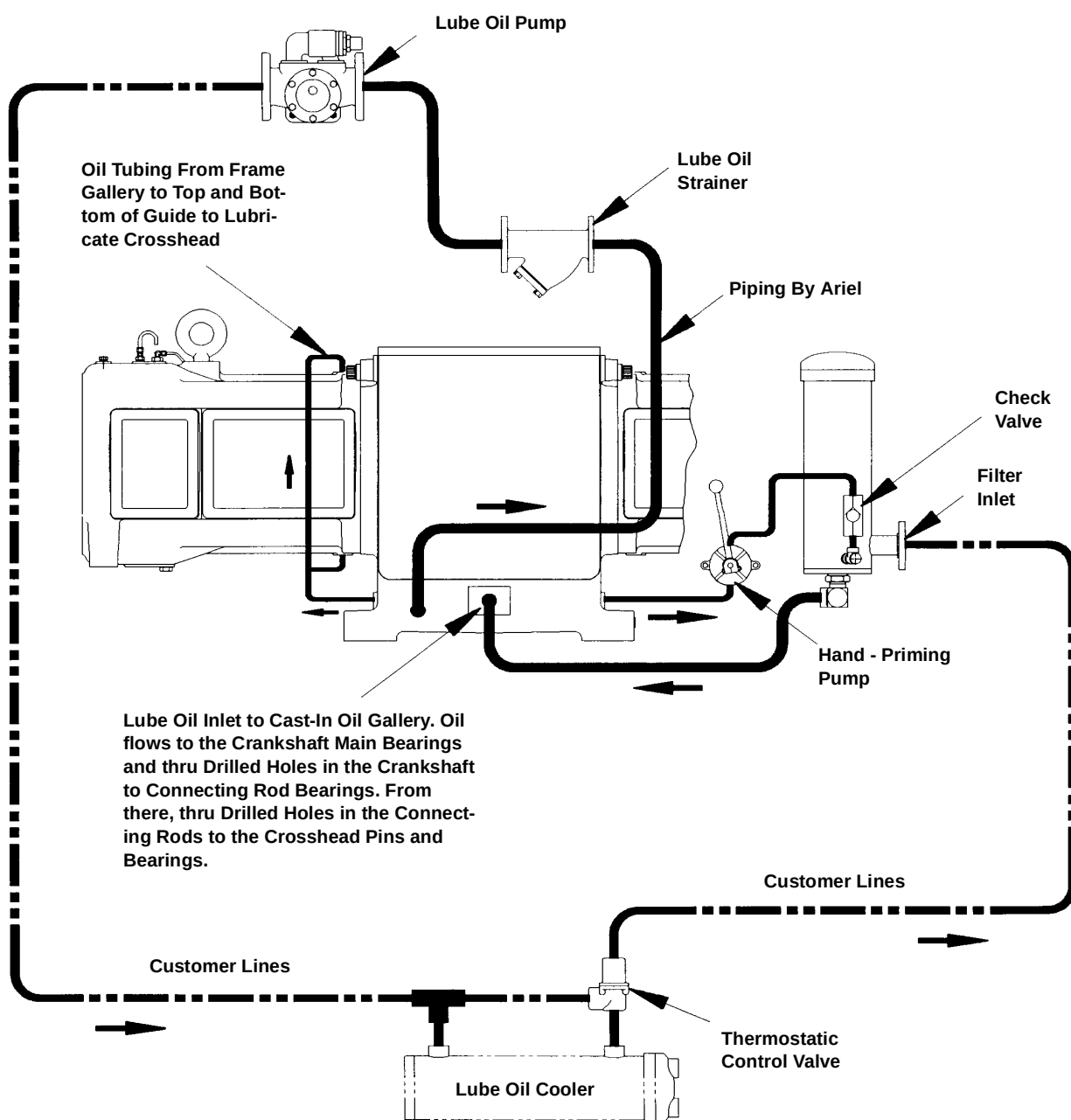


FIGURE 4-8: LUBE OIL SYSTEM SCHEMATIC - TYPICAL

Lube Oil Strainer, Filter & Filter Installation Instructions

Lube Oil Strainer

The strainer is located on the auxiliary end of the crankcase below the oil level. The strainer basket should be taken out and washed in an appropriate solvent whenever the lubricating oil is changed.

Lube Oil Filter

Ariel recommends replacing filter element when differential pressure reaches approximately 10 PSI (70 kPa) across the filter at normal operating temperatures or at six month intervals.

Filter Element Installation Instructions

1. Clean filter base surface, and be certain old gasket is removed.
2. Fill filter with clean oil using the same grade oil as in the crankcase.
3. Apply clean lube oil to the filter gasket.
4. After the filter gasket contacts the base, tighten one turn.
5. After starting the unit, check for leaks, and retighten if necessary.
6. Do not run unit with a damaged filter can. It can fracture or leak. Replace only with an Ariel approved filter.

NOTE: FAILURE TO FILL FILTER VESSEL WITH OIL, PRIOR TO STARTING, CAN CAUSE SEVERE DAMAGE TO THE COMPRESSOR.

Lube Oil Pump & Lube Oil Pressure

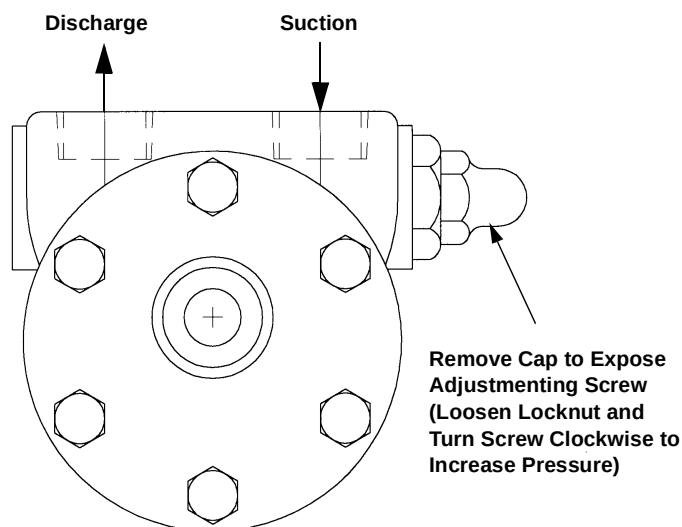


FIGURE 4-9: LUBE OIL PUMP

Description & Adjustment

Oil pump discharge pressure is held nearly constant by a spring loaded regulating valve within the pump head. Lube system pressure can be raised or lowered by adjusting this valve (see Figure 4-9:).

Lube Oil Pressure

NOTE: NORMAL PRESSURE ON THE DISCHARGE SIDE OF THE LUBE OIL FILTER IS SET AT THE FACTORY AT 60 PSI (414 kPa) WHEN CRANKSHAFT SPEED EQUALS OR EXCEEDS 400 RPM FOR THE JGI; 750 RPM FOR THE JGM AND JGN, AND 900 RPM FOR THE JGP AND JGQ. IF OIL PRESSURE DROPS BELOW 50 PSI (350 kPa), THE CAUSE MUST BE FOUND AND CORRECTED.

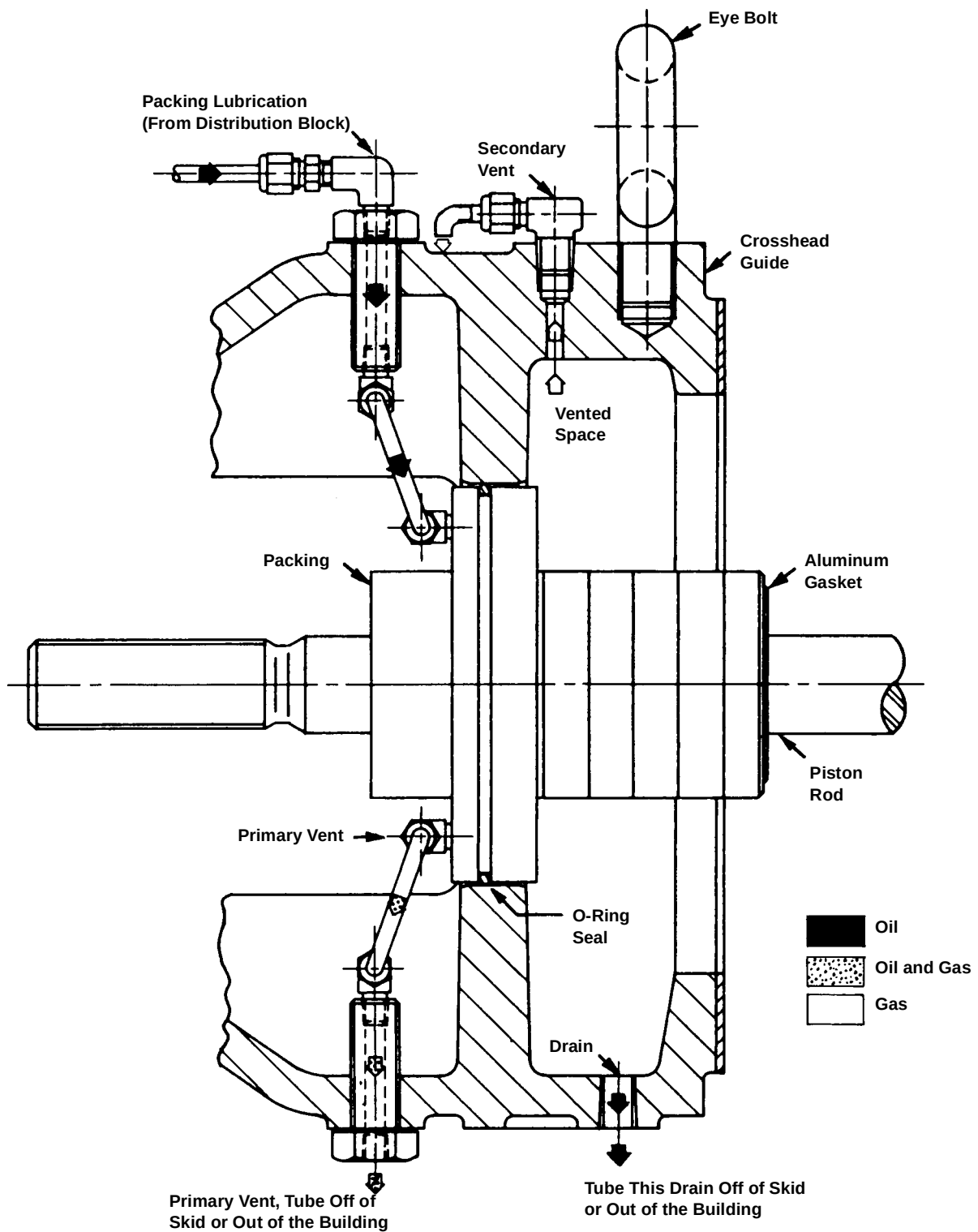
Low Oil Pressure Shutdown

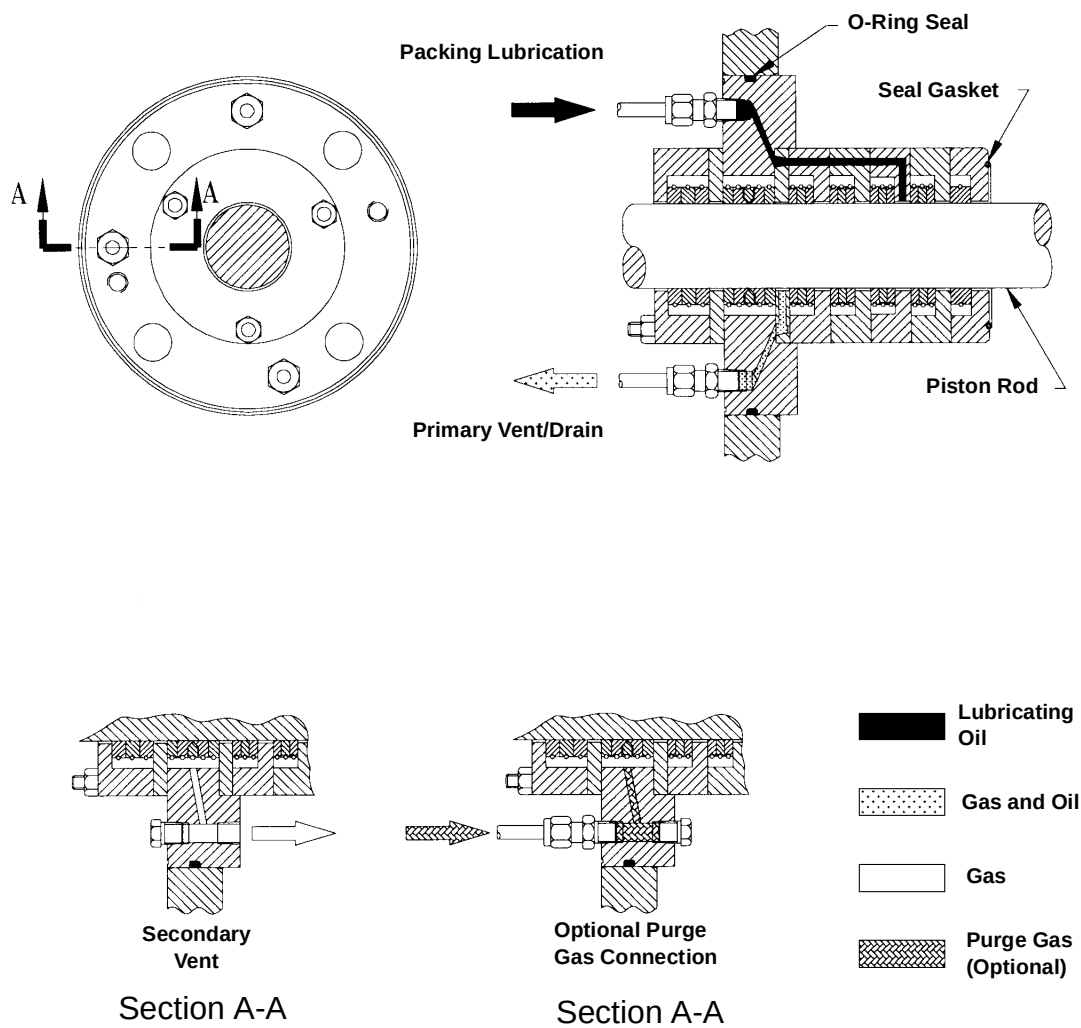
The low oil pressure shutdown is normally mounted by the packager and is supplied to customer specifications. Ariel provides an oil pressure pickup fitting on the oil gallery located after the cooler and filter. The electric or pneumatic oil pressure switch is to be set to actuate when oil pressure falls below 35 PSIG (240 kPa).

NOTE:

- 1. THE COMPRESSOR MUST HAVE A WORKING LOW OIL PRESSURE SHUT-DOWN.**

2. DO NOT ATTEMPT TO ADD OIL TO THE CRANKCASE THROUGH THE BREATHER HOLE WHILE THE UNIT IS RUNNING. THIS WILL CAUSE OIL FOAMING AND UNNECESSARY NO FLOW SHUTDOWNS IN THE FORCE FEED LUBRICATION SYSTEM.
3. SINCE THE FORCE FEED LUBRICATION SYSTEM IS CONSTANTLY USING OIL FROM THE CRANKCASE, A WORKING CRANKCASE OIL LEVEL CONTROLLER IS NECESSARY. THIS MUST BE DESIGNED TO ALLOW OIL TO FLOW INTO THE CRANKCASE FROM AN OVERHEAD TANK AT ALL AMBIENT TEMPERATURE CONDITIONS.

**FIGURE 4-10: PACKING, TUBING AND DISTANCE PIECE VENTING**

**FIGURE 4-11: PACKING LUBRICATION AND VENTING**

SECTION 5 - MAINTENANCE

General Introduction

The major components of the frame assembly are the crankcase or frame with integral crosshead guides, crankshaft and bearings, connecting rods, chain drive system and cross-heads.

A cast-in oil gallery runs the length of the crankcase. Drilled oil passages feed lubricating oil to the running gear.

A top cover on horizontally opposed models, and connecting rod and chain access covers on the JGI, and crosshead guide side covers provide generous access for inspecting and removing internal components. The top cover is made of aluminum for easy handling.

Absolute cleanliness, including the use of lint-free wiping cloths, is a necessity during any maintenance on the compressor. When access covers have been removed, keep the frame covered to protect the interior from dust except when actually working on the unit. Any components that have been removed should be protected from falling objects that might mar or chip running surfaces.

Whenever the machine is dismantled, gaskets at non-pressure positions are to be carefully inspected before reuse. Damaged gaskets must be replaced. Gaskets at pressure locations should be replaced. Always apply an anti-seize lubricant to both sides of the gaskets for easy removal at a later date. During major overhauls, drain and flush the crankcase.



CAUTION

TO PREVENT PERSONAL INJURY, ENSURE THAT COMPRESSOR CRANKSHAFT CANNOT BE TURNED BY THE DRIVER OR COMPRESSOR CYLINDER GAS PRESSURE DURING MAINTENANCE: -- ON ENGINE-DRIVEN COMPRESSORS, REMOVE THE CENTER COUPLING OR LOCK THE FLYWHEEL. -- ON ELECTRIC MOTOR-DRIVEN COMPRESSORS, IF IT IS INCONVENIENT TO DETACH THE DRIVER FROM THE COMPRESSOR, THE DRIVER SWITCH GEAR MUST BE LOCKED OUT DURING MAINTENANCE.

BEFORE STARTING ANY MAINTENANCE OR REMOVING ANY COMPONENTS, RELIEVE ALL PRESSURE FROM THE COMPRESSOR CYLINDERS. SEE PACKAGER'S INSTRUCTIONS FOR COMPLETELY VENTING THE SYSTEM.

 CAUTION

AFTER PERFORMING ANY MAINTENANCE, THE ENTIRE SYSTEM MUST BE PURGED WITH GAS PRIOR TO OPERATION, TO AVOID A POTENTIALLY EXPLOSIVE AIR/GAS MIXTURE.

Connecting Rod - Removal

1. Remove the top cover from the crankcase (connecting rod and chain access covers on the JGI) and the side covers from the crosshead guides.
2. Move the throw to the outer dead center position.
3. Remove the crosshead as described in "Crosshead - Removal" on page 5-5. Turn the crankshaft until the throw is at its highest point. Remove the top two connecting rod bolts and the rod bearing cap. The bottom two bolts remain in the cap while the cap is being removed.
4. Half of the bearing shell will come out with the cap. The other half can be removed by sliding it out.
5. Turn the crankshaft until the rod can be taken out through the top opening of the crankcase (or connecting rod access hole on the JGI).
6. After the removal of the connecting rods, be sure to protect the crank pins from being nicked or scratched.

NOTE: IF ALL CONNECTING RODS ARE TO BE REMOVED, IT MAY BE MORE EXPEDIENT TO REMOVE THE CRANKSHAFT PRIOR TO REMOVING THE RODS.

Crank Pin Bearing & Connecting Rod Bushing Removal & Installation

Crank Pin Bearing

This is a tri-metal (steel, bronze, and babbitt with a tin flash) precision split bearing. A visual inspection should be sufficient to determine if the bearing is serviceable. Any appreciable wear of the babbitt would expose the bronze underneath. Such exposure indicates the need for bearing replacement.

There are notches in the rod and rod cap for the bearing tabs in order to position and maintain the position of the bearing halves.

Connecting Rod Bushing

Check crosshead pin to bushing clearance (see Table 1-3 on page 1-10 for recommended clearance.) Wear on the pin can be determined by a visual inspection. Replace the pin if necessary.

If a replacement bushing is needed, the existing bushing should be filed or hack-sawed to within 1/32 inches (1 mm) of its thickness. It can then be easily drifted out.

A press would be helpful to install the new bushing. Do not use a hammer to force the bushing into place as this will distort the bushing's bore. Lay the connecting rod on the press surface so that the chamfered edge of the rod bushing hole is on top. Be sure to locate the bushing oil hole at the connecting rod oil passage before pressing it in. The bushing has an annular groove around its outer surface in line with the oil hole; therefore, if the bushing should shift circumferentially during operation, oil can still travel to its inner surface and to the crosshead pin. However, during installation of a new bushing, no more than 1/3 of the oil passage hole in the rod should be covered by the bushing.

The bushing must be installed into the connecting rod by cooling the bushing in a dry ice and alcohol solution. The bushing needs to be left in the solution long enough to reach the same temperature as the solution, about -120°F (-85°C). **DO NOT TOUCH COLD SURFACES WITHOUT PROPER INSULATION TO PREVENT INJURY.**

NOTE: ABSOLUTE CLEANLINESS IS REQUIRED OF BOTH THE BUSHING AND THE CONNECTING ROD TO PREVENT DIRT FROM ACCUMULATING BETWEEN THE BUSHING AND CONNECTING ROD.

Connecting Rod - Installation

1. Snap the half bearing shell into the rod with the bearing tab properly located in the notch on the rod. With the crankcase top cover off, turn the throw to the inner dead center position and slide the rod into the crosshead guide space.

NOTE: THE CAPS AND RODS ARE NUMBERED BY THROW BEGINNING WITH NUMBER ONE AT THE DRIVE END. ALWAYS INSTALL RODS WITH THE NUMBERS UP (OR TOWARD ACCESS HOLE IN THE JGI). BE SURE TO PROTECT CRANK PIN AT ALL TIMES.

2. Fit the connecting rod to the crank pin and turn to the highest position. Replace the cap, the half bearing shell properly located in the notch, and the bolts. Snug up all bolts. Do not tighten bolts to full torque at this point.
3. Reconnect the rod and the crosshead with the pin. Install the end plates, the thru bolt and lock nut. Tighten the lock nut to the value listed in Table 1-12 on page 1-16.
4. Tighten the connecting rod bolts in 25% increments to full torque to the values listed in Table 1-12 using a crisscross pattern.
5. Measure each crankshaft to connecting rod bearing jack clearance, with a dial indicator and magnetic stand, to the values listed in Table 1-3 on page 1-10. Turn the crankshaft pin up and mount the indicator stand on an adjacent web with the stem of the indicator on the rod above the centerline of the pin. Push down on the rod, set indicator to zero, then pry up on the head of the connecting rod bolt with a bar, observe and record reading

Note: Install Throw Marking and Joint Match Marks Up (or Toward Access opening for JGI)

Correct Orientation of the Rod is with Bearing Notches on Top Joint.

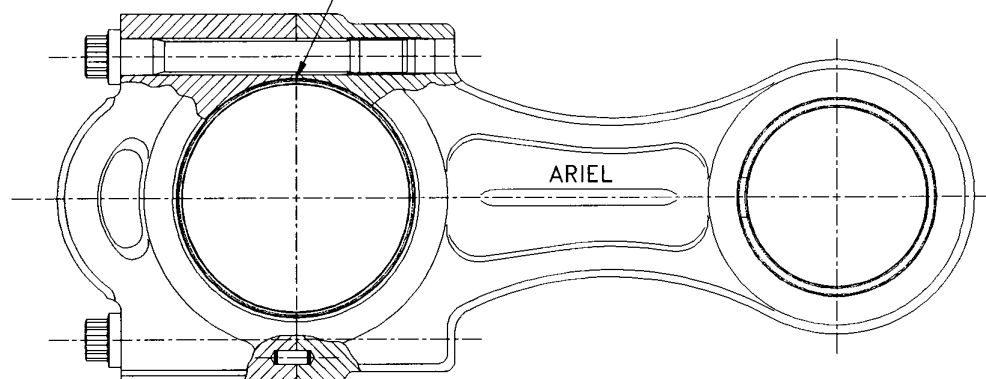


FIGURE 5-1: CONNECTING ROD - TYPICAL

6. Examine the removed top cover or access cover gaskets. If there is any doubt about their condition, install new gaskets. Before installing old or new gaskets, apply an anti-seize lubricant to both sides to aid in their easy removal at a later date. Replace the top cover and crosshead guide cover. Tighten all capscrews.

Crosshead - Removal

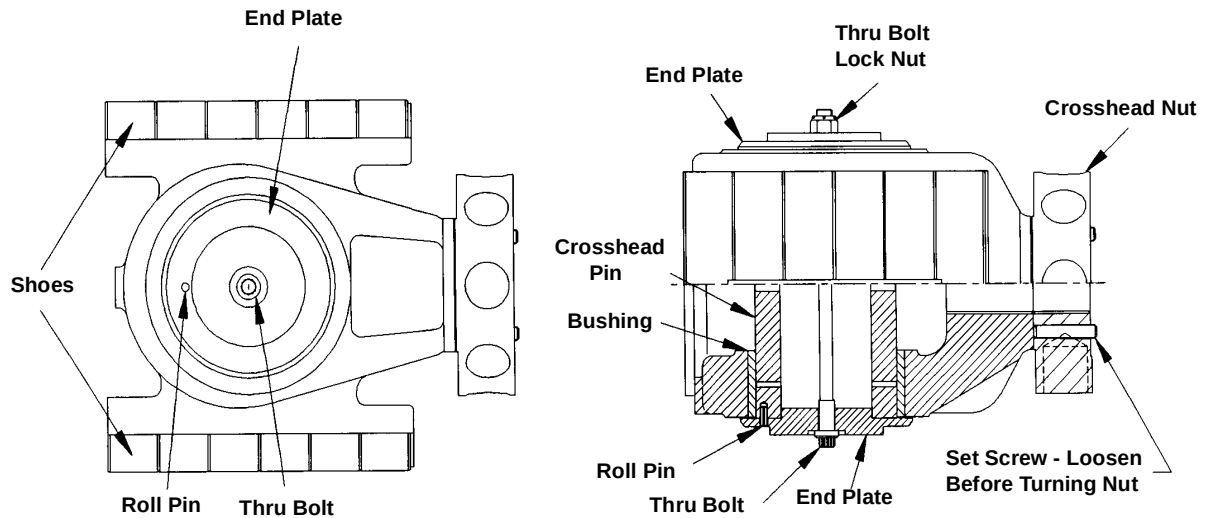


FIGURE 5-2: CROSSHEAD - TYPICAL

CAUTION

BEFORE REMOVING THE CYLINDER HEAD, BACK OFF ALL CAPSCREWS TO 1/8 INCHES (3 mm). MAKE SURE THAT THE HEAD IS LOOSE AND THE CYLINDER IS VENTED. SEE IMPORTANT SAFETY INFORMATION PLATES ON UNIT TOP COVER, (REFERENCE FIGURE 1-4: ON PAGE 1-5 FOR LOCATION.)

1. Remove crosshead guide side covers and cylinder head.
2. Move the crosshead to its inner dead center position and back off, but do not remove, the crosshead nut set screws. Loosen the crosshead nut with the special slugging Peg or Open End Wrench shown in Figure 7-1: on page 7-3, depending on nut style.
3. Use the Piston Nut Spanner (Torquing Adaptor) shown in Figure 7-1: to screw the piston rod out of the crosshead. The two dowels on the Adapter fit holes in the piston nut. Turn the crosshead nut off the piston rod. Push the rod end forward to the edge of the packing to provide a clearance for crosshead removal.
4. With the crosshead in its outer dead center position, remove the crosshead pin

thru bolt, lock nut, end-plates and pin. Crib JGI models so that crosshead does not fall down.

5. Turn the crankshaft to its inner dead center position. Move the crosshead to its outer dead center position to be free of the connecting rod. Make sure the connecting rod does not drop and damage the crosshead guide surface.
6. Roll the crosshead 90 degrees and remove it through the guide opening.
7. Check the crosshead pin to crosshead/bushing clearance. (See Table 1-3 on page 1-10.) Wear on the pin can be determined by a visual inspection. Replace the pin if necessary. If the bushings need to be replaced, hacksaw or file to within 1/32 inches (1 mm) of their thickness. They can be easily drifted out. A press will be needed to install new bushings. The bushing can be installed in the crosshead by cooling the bushing in a dry ice and alcohol solution. The bushing needs to be left in the solution long enough to reach the same temperature as the solution, about -120° F (-85°C). **DO NOT TOUCH COLD SURFACES WITHOUT PROPER INSULATION TO PREVENT INJURY.** Gray iron crossheads (JGI, JGM & JGP) and bronze crossheads do not have bushings; if the crosshead pin bearing area is worn, these crossheads should be replaced.

NOTE: THE SIDE OF THE CROSSHEAD RECEIVING THE NEW BUSHING SHOULD BE SUPPORTED DIRECTLY TO PREVENT POSSIBLE CRUSHING OF THE CROSSHEAD BY THE PRESS. (SEE FIGURE 5-3:)

ABSOLUTE CLEANLINESS IS REQUIRED OF BOTH BUSHING AND CROSSHEAD TO PREVENT DIRT FROM ACCUMULATING BETWEEN THE BUSHING AND CROSSHEAD BORE.

8. Visually inspect the shoe surfaces for scoring. Since they are constantly lubricated under pressure during operation, there should be virtually no wear.

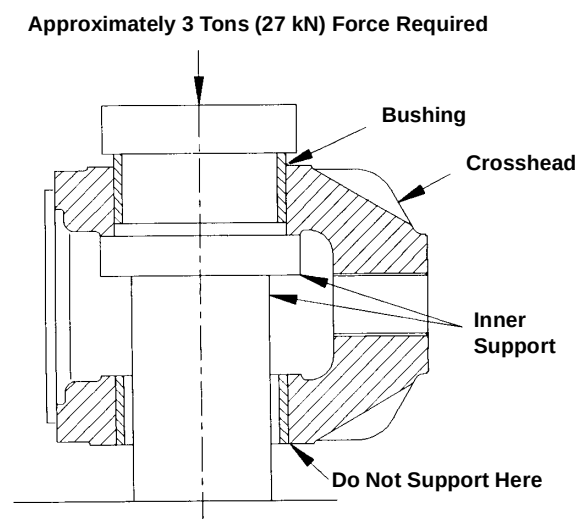


FIGURE 5-3: CROSSHEAD BUSHING REPLACEMENT

Crosshead - Installation

NOTE: BE SURE CROSSHEADS ARE RETURNED TO THEIR ORIGINAL THROW LOCATION.

1. With the crosshead on its side, slip it in the crosshead guide. Once inside, it can be rolled upright. Make sure it does not become cocked. Should the crosshead become wedged, do not force it. ease it off and start again. Be careful not to damage the crosshead shoe surface during installation.
2. Turn the crankshaft to its outer dead center position to locate the connecting rod in position and insert the crosshead pin. Install the end plates, thru bolt and locknut. Tighten the locknut to the torque value listed in Table 1-12.
3. Reinstall the crosshead nut on the piston rod. Be sure to have setscrew cup points on the crosshead side of the nut. Screw the piston/rod assembly into the crosshead using the Piston Nut Torquing Adaptor. Make sure all threads are well lubricated with clean fresh oil to ensure smooth installation.

NOTE PISTON END CLEARANCE MUST NOW BE SET OR SERIOUS DAMAGE COULD OCCUR. REFER TO TABLE 1-3 ON PAGE 1-10 FOR PISTON END CLEARANCE SETTINGS.

4. Tighten the crosshead nut using the special slugging Peg Wrench or Open End Wrench shown in Figure 7-1: on page 7-3 and a slugging hammer.
5. Before installing the side covers, apply an anti-seize lubricant to the gaskets. This will aid to ease removal at a later date.
6. Replace the crosshead guide side covers; tighten all capscrews.

Crankshaft - Removal

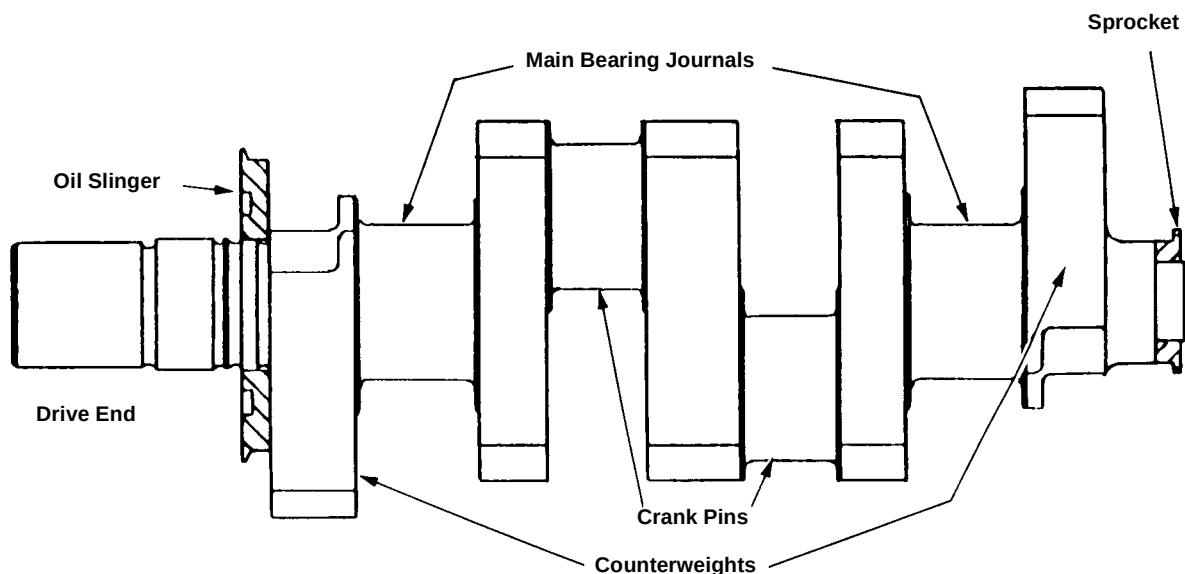


FIGURE 5-4: CRANKSHAFT WITH SLINGER AND SPROCKET - TYPICAL

1. Remove the coupling shim pack. Remove the coupling hub. (In order to remove the coupling hub it may be necessary to heat it. Use insulated gloves to protect hands.)
2. Remove the top cover and crankshaft seal housing (or connecting rod, chain drive and crosshead access covers for a JGI).
3. Detach the connecting rods. (See "Connecting Rod - Removal" on page 5-2.) Move the rods to their full outer position. For the JGI, cribbing at the crosshead guide access hole is required to keep connecting rod up at the full outer position.
4. Remove the capscrews on the chain adjustment cap. Turn the cap to loosen the chain. Slip the chain off the crankshaft sprocket.
5. Remove the capscrews from the main bearing caps. Pull the caps straight up to prevent damage to the dowel fit. If the cap is tight, use a Bearing Cap Puller as illustrated in Figure 5-5: For the JGI remove the capscrews in the bearing carrier, remove carrier and slide crankshaft out thru carrier hole to remove it.

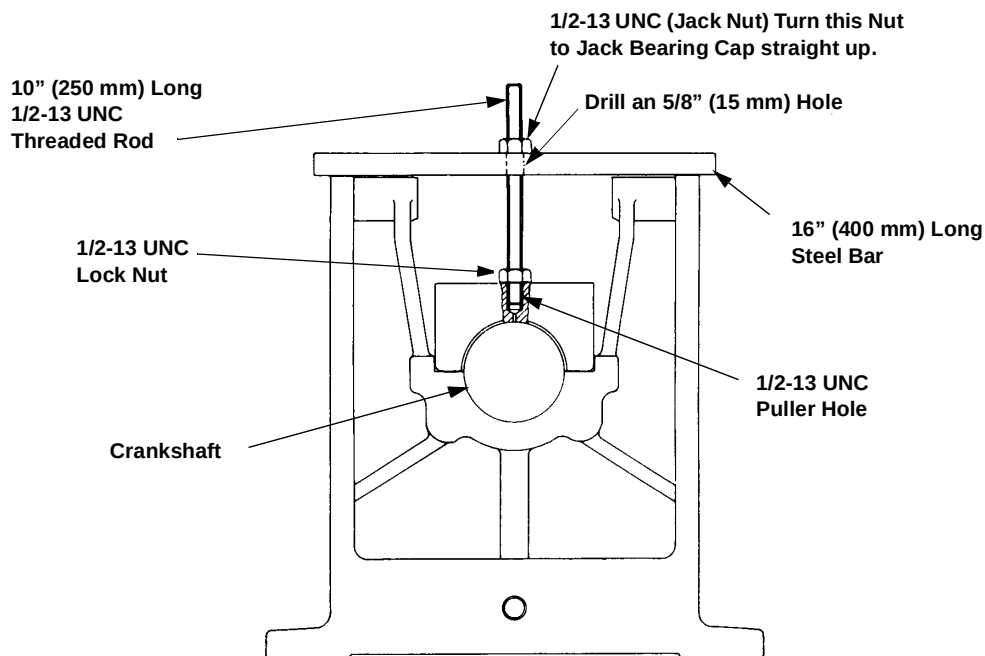


FIGURE 5-5: BEARING CAP PULLER

6. Before removing the crankshaft from the crankcase, wooden saddles or a notched wooden crate with sides high enough to prevent the webs or oil slinger from touching bottom should be prepared in order to store the crankshaft during maintenance - even though it may be out for only a short time. In addition, the crankshaft should be adequately protected from above so that dropped tools or equipment cannot mar the surface of pins and journals.
7. For horizontally opposed models, turn the crankshaft so that the drive end counterweight is straight up. The two throw crankshaft weighs about 100 lb (45 kg)

and can be lifted out by two persons or by using a crane and a clean nylon lifting sling at the second throw crank pin. The sling lifting point is to be above the center of gravity of the shaft, so that it does not want to rotate when lifted. Lift the crankshaft to tip up the chain drive end so that the crankshaft drive end will clear the frame seal housing opening and allow removal. Great care must be taken during this operation since the shaft could bind and become damaged. Wear gloves to avoid being cut by the slinger and to achieve a good grip. (As with each operation, the gloves should be clean to avoid marring of the running surface.)

NOTE: THE LOWER HALF BEARING SHELLS SOMETIMES HAVE A TENDENCY TO STICK TO THE SHAFT JOURNALS BECAUSE OF THE CLOSE FITTING OILY SURFACES OF THE TWO PARTS. THEREFORE, WHEN THE SHAFT HAS BEEN LIFTED CLEAR OF THE SADDLES, APPROXIMATELY 1/4 inches OR 6 mm, CHECK TO MAKE SURE THAT THE LOWER HALF BEARING SHELLS HAVE NOT COME OUT WITH THE SHAFT. IF SO, THE BEARING SHELLS SHOULD BE TAPPED BACK ONTO THE SADDLES BEFORE LIFTING THE SHAFT ANY FURTHER.

Crankshaft - Oil Slinger

Removal

Although the slinger should last indefinitely with proper care, it can become nicked. Should it need replacement, suspend the crankshaft on a sling with the drive end tipped down, and heat the slinger to 400° F (240°C). It will attain a yellow glow at this temperature. When it has expanded it should fall off by itself. **DO NOT TOUCH HOT SURFACES WITHOUT PROPER INSULATION TO PREVENT INJURY.**

Installation

Put a rod at least 1/2 inches (13 mm) in diameter through the slinger. (Special care should be exercised when handling the slinger, not only to keep its surfaces unmarred, but to avoid being cut by the outer sharp edge.) After the slinger is suspended heat it with a small torch. When it has attained a yellow glow, approximately 400° F (240°C), it can be slipped over the drive end of the crankshaft. Hold the slinger in position with high temperature gloves or two pieces of clean wood, rotating it slightly to make sure it is square, until it has cooled enough to shrink onto the crankshaft. **DO NOT TOUCH HOT SURFACES WITHOUT PROPER INSULATION TO PREVENT INJURY.**

Crankshaft - Chain Sprocket

Removal

Examine the sprocket carefully for signs of wear. If it has been in operation for five years or more, it may be convenient to replace it if the crankshaft is removed from the frame.

Drill a hole in the sprocket hub. This hole should be parallel to the shaft centerline and big enough that it removes most of the hub cross section. (See Figure 5-6:) Be careful not to touch the shaft with the drill. Mark the drill with tape so you do not drill through the sprocket and into the crankshaft face.

The drilled hole will relieve most of the shrink, and a couple of good radial hits with a hammer and chisel will open the sprocket enough so it can be easily removed.

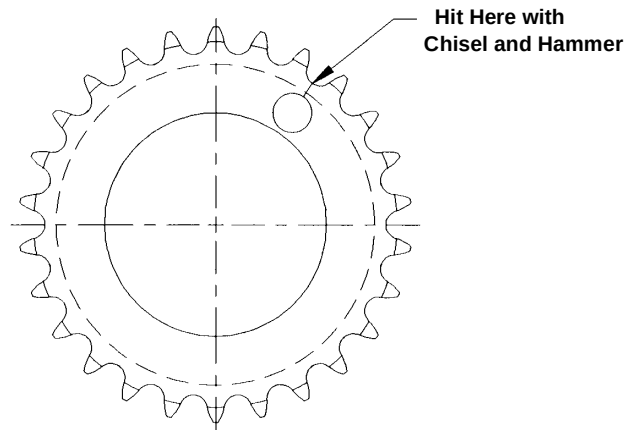


FIGURE 5-6: CRANKSHAFT - CHAIN SPROCKET

Installation

Encircle the sprocket with wire. Suspend the sprocket from the wire and heat it with a small propane torch. When it has attained a yellow glow, approximately 400°F (240°C), it can be slipped over the auxiliary end of the crankshaft. Hold the sprocket in position with high temperature gloves or two pieces of clean wood, rotating it slightly to make sure it is square, until it has cooled enough to shrink on the crankshaft. **DO NOT TOUCH HOT SURFACES WITHOUT PROPER INSULATION TO PREVENT INJURY.**

Main Bearings - Removal and Installation

Bearings must be replaced if they show signs of wear or scoring. Wear will be indicated by the bronze showing through the babbitted surface.

If replacement bearings are needed, the old bearing halves can easily be slid out, new bearings slid in (untabbed end first), and snapped into place. Locate tabs in the notches in the bearing saddles and bearing caps.

On JGI models, remove the carrier bearing using a hydraulic press or jack. Remove the frame bearing using a hydraulic jack. A pushing tool with a shoulder is needed. Install new sleeve bearings by cooling bearings and using the hydraulic tools. Oil holes on bearing must

be aligned with holes in frame and carrier. The bearings must be pressed 3/16 in. (4.8 mm) below flush of the thrust faces, no more than 1/3 of the oil passage hole in the rod can be covered by the bushing. DO NOT TOUCH COLD SURFACES WITHOUT PROPER INSULATION TO PREVENT INJURY.

Crankshaft - Installation

1. Move the connecting rods to their full outer position. While the crankshaft is being lowered very slowly into the crankcase (if suspended by a crane with a nylon sling, use second throw crank pin), maneuver the drive end into the crankcase to clear the seal housing opening. Use clean gloves as during removal. Lower crankshaft into place so that both drive end and auxiliary end journals touch the bearing saddles at the same time. (For JGI models, slide crankshaft into position thru the bearing carrier opening and then replace bearing carrier).
2. When the crankshaft is resting on the bearing saddles, attach the bearing caps with the capscrews lightly snugged. Then, starting at the thrust end, tighten the bolts in a crisscross pattern in 25% increments to the recommended torque value in Table 1-12 on page 1-16. Bearing caps are match-marked to correspond with the throw position on the frame.
3. Be sure the dowels in the bearing caps are aligned with the holes in the crankcase base. A set screw on top of each dowel prevents it from backing out.
4. Measure each crankshaft journal bearing jack clearance, with a dial indicator and magnetic stand to Table 1-3 on page 1-10. To measure main bearing clearance, turn the adjacent crankshaft pin up and mount the indicator stand on the main bearing cap, with the indicator stem touching the web of the crank adjacent to the bearing cap. Push down on the crank, set indicator to zero, pry up, observe and record reading. This is best done before the connecting rods are installed by pulling a clean lifting strap around the adjacent pin and pulling up on the crankshaft with a crane or bar on the strap.
5. Reattach the connecting rods (See "Connecting Rod - Installation" on page 5-4), packing diaphragms, and unloaders/head end heads.
6. Reinstall the chain drive. (See "Chain Drive System" on page 5-11).
7. Install new cover gaskets. Examine the top cover gasket. If there is any doubt that it is not in good usable condition, install a new gasket. Before installing gaskets, apply an antiseize lubricant to all gaskets or to the metal surfaces on which they will seat. This will aid in their easy removal at a later date.
8. Reinstall covers, crankshaft seal housing and the top cover. Align crankshaft dust seal to clearance requirements in Table 1-3 on page 1-10

Chain Drive System

Description

The chain drive system is crankshaft-driven at the auxiliary end of the frame. The chain runs the lube oil pump and force feed lubricator. Chain tightness is controlled by an idler sprocket attached to the eccentric adjustment cap. The chain dips into the crankcase oil and, as a

result, is constantly lubricated. See Figure 5-7:, for the auxiliary end components and chain drive system.

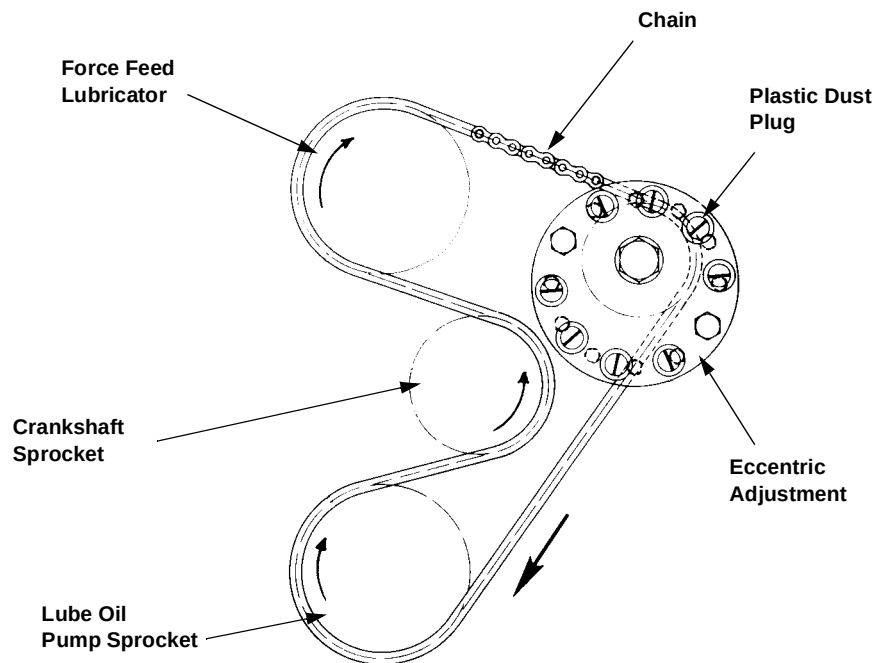


FIGURE 5-7: CHAIN DRIVE SYSTEM - TYPICAL

Chain Adjustment

1. Roll machine to the tightest position of the chain. This prevents snugging up on the chain at a slack position and breaking rollers or ruining the pump and lubricator bearings when the chain goes through its tightest position.
2. Remove the two capscrews and eight plugs from the eccentric adjustment cap. Rotate the cap 6 degrees clockwise facing cap from outside to line up two new capscrew holes. If this makes the chain too tight, try turning the cap around in a counterclockwise direction for a different hole lineup.
3. Tighten the two capscrews to the recommended torque shown in Table 1-12 on page 1-16, and roll the machine to check the tightness in a number of positions. At its tightest position, the chain should be adjusted so that the deflection of the most accessible span [4-3/4 inches (12cm)] is within 0.036 to 0.060 inches (0.91 to 1.51mm). This deflection is measured from a straight edge held on the chain wrapped over the two sprockets. The allowable deflection is measured at the center of the span, while a force of 2 to 10 lb (9 to 45 N) finger pressure is applied to chain.
4. Replace the dust plugs in the eccentric adjustment cap to keep dirt out of the unused holes in the end cover.

Chain and Sprocket Replacement

The chain should be replaced if the elongation exceeds 0.084 inches (2.13 mm) over a 10 pitch length. The section of chain to be measured should be stretched tight, in place, in the compressor and measured with vernier calipers. A reading made outside of the rollers at 10 pitches should be added to a reading between the inside of the same rollers and then be divided by two. If this calculation exceeds 3.834 inches (97.38 mm) for 3/8 pitch, the chain should be replaced. Any sprocket showing any undercutting should be replaced.

Chain Idler Sprocket Replacement - (Eccentric Adjustment Caps)

1. Remove the frame top cover (or chain access cover for JGI). Remove the dust plugs and the two capscrews that hold the eccentric adjustment cap to the end cover. Rotate the eccentric cap to loosen the chain for removal. After dropping the chain off the idler sprocket, the entire assembly can be removed from the end cover.
2. With a good machinist rule, measure the exact distance from the outer face of the chain sprocket to the closest face of the eccentric cap. Note the measurement for the proper positioning of the new sprocket.
3. Drift the roll pin from the idler nut. Remove the nut, capscrew, sprocket and Stat-O-Seal washer. Discard all four items since they must be replaced with new parts. Remove and discard the cap O-ring.
4. Reassemble all parts using a new capscrew, Stat-O-Seal washer, sprocket, and nut. Compare the sprocket to cap measurement to the measurement previously taken. If necessary, shim between the cap and the idler spacer to make the measurements equal.
5. Install the assembly on the frame. Do not install the chain. First check the alignment to the crankshaft drive sprocket, with crankshaft centered in end play, using a straight edge.
6. If not in alignment within 1/32 inch (1 mm), shim as necessary, see Figure 5-8:. If the alignment is within 1/32 inch (1 mm), remove the entire assembly again. Tighten the idler nut to the recommended torque in Table 1-12 on page 1-16 and drill a 1/8 in. (3.175 mm) hole through the nut. Tap in a new roll pin.
7. Apply oil and install a new O-ring. Install the assembly and adjust the chain according to the instructions given in "Chain Adjustment" on page 5-12.

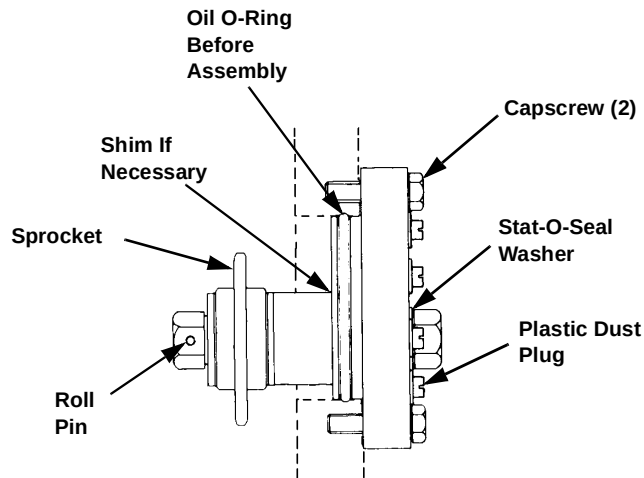
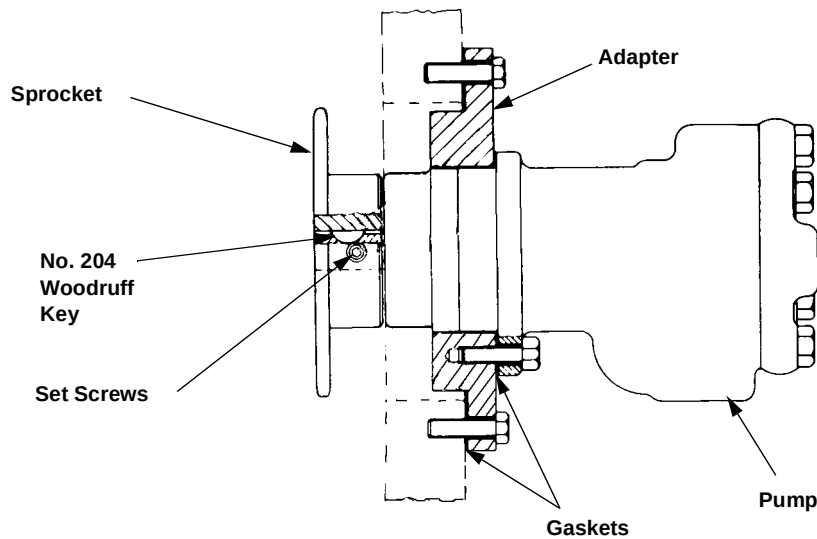


FIGURE 5-8: CHAIN IDLER SPROCKET (ECCENTRIC)

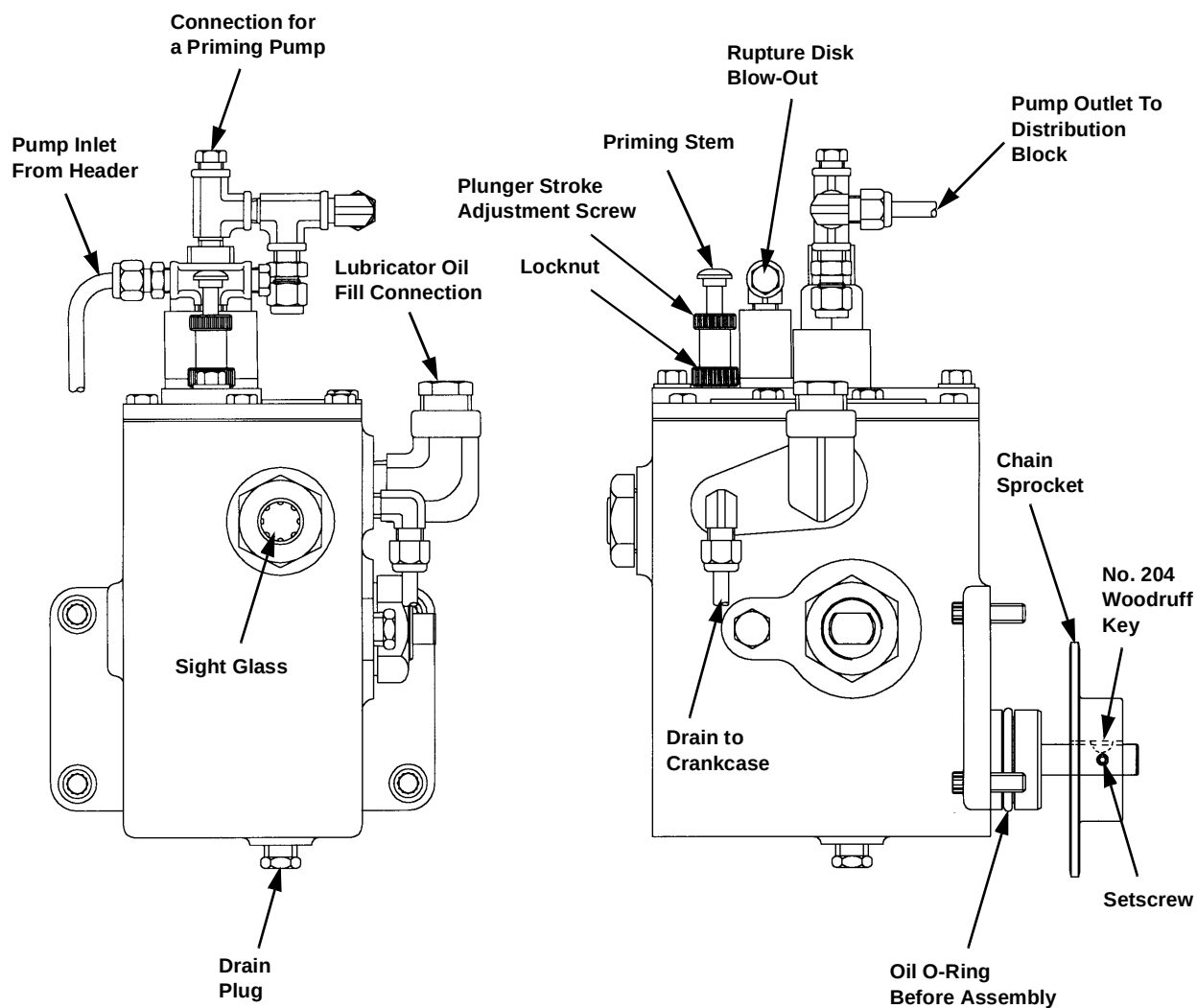
Lube Oil Pump Chain Sprocket Replacement

1. Refer to Figure 5-9:.
2. Remove all piping from the pump. Remove fasteners from pump mounting adaptor and the pump with sprocket will come free through the hole in the end cover after the removal of the chain.
3. With a good machinist rule, measure the exact distance from the sprocket drive face to the pump mounting adaptor face, in order to position the new sprocket. Note this measurement for future reference.
4. With the oil pump on a bench, use an Allen Wrench to remove the sprocket set screw; then, pull the sprocket from its shaft.
5. Remove the No. 204 Woodruff key.
6. Install a new No. 204 Woodruff, after first checking to make sure the key will fit into the new sprocket. If the key is too thick, it can be polished with an emery cloth on a flat surface until it can easily slide into the notch. It may also be a little high and require filing of the top edge.
7. Install a new sprocket to the original measurement between the sprocket drive face and the pump mounting flange face. When it is in position, tighten the set screw.
8. Install new gaskets. Before reinstalling the pump, apply an anti-seize lubricant to the gasket surfaces. This will aid in easy removal at a later date.
9. Reinstall the pump onto the frame. Check the alignment to crankshaft drive sprocket, with crankshaft centered in end play, using a straight edge to within 1/32 inch (1 mm). If not in alignment, adjust sprocket position as necessary.
10. Re-install and adjust the chain according to the instructions in "Chain Adjustment" on page 5-12.
11. Reinstall all tubing to the pump.

**FIGURE 5-9: LUBE OIL PUMP AND SPROCKET**

Force Feed Lubricator Chain Sprocket Replacement

1. Refer to Figure 5-10: on page 5-16.
2. Remove the sprocket set screw and sprocket. Detach all tubing to the lubricator.
3. Remove the four mounting bracket capscrews and remove the lubricator.
4. With the lubricator on the bench, remove the Woodruff Key from the shaft and file the shaft to remove any burrs raised by the cup point of the set screw. Install a new O-ring.
5. Install a new No. 204 Woodruff Key after first checking to make sure the key will fit into the new sprocket. If it is too thick, it can be polished with an emery cloth on a flat surface until it can easily slide into the notch. It may also be a little high and require filing of the top edge.
6. After the new key has been installed and it has been determined that the new sprocket will fit, oil the new O-ring and remount the lubricator on the frame.
7. Put the new sprocket onto the shaft.
8. Check alignment to the crankshaft drive sprocket with crankshaft centered in end play, using a straight edge, to within 1/32 inch (1mm). Tighten the set screw.
9. Install chain and adjust using the instructions given in "Chain Adjustment" on page 5-12.
10. Re-attach all tubing to the lubricator.

**FIGURE 5-10: LUBRICATOR AND SPROCKET**

Piston and Rod - Removal

CAUTION

TO PREVENT PERSONAL INJURY, ENSURE THAT COMPRESSOR CRANKSHAFT CANNOT BE TURNED BY THE DRIVER OR COMPRESSOR CYLINDER GAS PRESSURE DURING MAINTENANCE: -- ON ENGINE-DRIVEN COMPRESSORS, REMOVE THE CENTER COUPLING OR LOCK THE FLYWHEEL. -- ON ELECTRIC MOTOR-DRIVEN COMPRESSORS, IF IT IS INCONVENIENT TO DETACH THE DRIVER FROM THE COMPRESSOR, THE DRIVER SWITCH GEAR MUST BE LOCKED OUT DURING MAINTENANCE.

BEFORE PERFORMING ANY MAINTENANCE, COMPLETELY VENT SYSTEM. BEFORE REMOVING A CYLINDER HEAD, BACK OFF ALL CAPSCREWS 1/8" (3 mm). MAKE SURE THE HEAD IS LOOSE AND THE CYLINDER IS COMPLETELY VENTED.

1. Remove the crosshead guide side covers and the cylinder head. The cylinder head is to be loosened first to the Caution! instructions above.
2. Move the crosshead to its inner dead center position. Back off, but do not remove, the crosshead nut set screws. Loosen the crosshead nut with the special slugging wrench and slugging hammer, (see Figure 7-1: on page 7-3). Use the open-end wrench for hex nuts and the peg wrench for round nuts.
3. Remove the cylinder head. In the case of tandem cylinders where the outboard cylinder bore is smaller than the inboard bore, it is necessary to remove the outboard cylinder. Support such cylinders during removal and installation, as to not put excessive weight on the piston and rod assembly which might cause bending.
4. Use the Piston Nut Spanner and a speed wrench to screw the piston and rod assembly out of the crosshead. The two dowels on the Piston Nut Spanner fit the holes in the piston nut. Turn the crosshead nut off the piston rod.
5. As the piston leaves the cylinder, be careful in handling the piston rings. Despite their toughness in service, rings are fragile with regard to removal. Always handle them with clean tools and hands protecting the rings from nicks, marring, and bending. Move the piston out of the cylinder until a fraction of the first ring clears the cylinder. Encircle the ring by hand (use a band for larger sizes) until it is clear and remove it. Use this same procedure to remove the succeeding rings and wear band.
6. Slide the piston rod out of the head end. The threaded crosshead end of the rod is 1/8 inches (3 mm) smaller in diameter than the inside diameter of the packing. Using extreme care, slowly slide the piston rod through the packing to avoid damaging the rod threads or the packing rings.

Piston and Rod - Disassembly and Reassembly

Disassembly

The Piston and Rod Clamping Fixture shown in Figure 5-11: will be useful for the piston and rod disassembly and reassembly operations. This fixture may be purchased from Ariel.

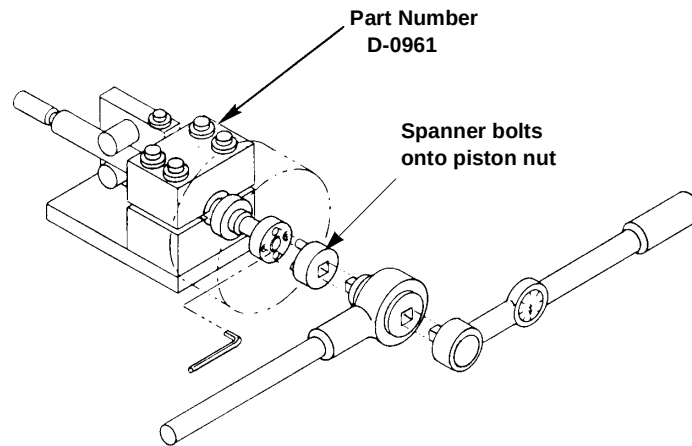


FIGURE 5-11: PISTON AND ROD CLAMPING FIXTURE

1. Clamp the piston and rod assembly in the special Clamping Fixture (D-0961), using the bushing for a 1-1/8" rod size (see Figure 5-11:). Tighten the four 12-point cap screws to prevent the rod from turning. The fixture will properly hold the piston rod to prevent damage to the parts and promote safety during disassembly and reassembly. The Clamping Fixture must be securely bolted down to prevent it from turning with the piston rod. It should be at a convenient height of approximately three feet or 0.9 meters. Remove the setscrews from the piston nut. Although the piston nut has been staked to lock the setscrews, they can be forced out, by turning with an Allen wrench, past the small lip that has been formed.
2. Remove piston nut using piston nut spanner (see Figure 7-1: on page 7-3).

NOTE: A SMALL AMOUNT OF GAS PRESSURE CAN BUILD UP WITHIN THE PISTON DURING OPERATION. THIS WILL VENT WHEN THE PISTON NUT IS LOOSENED.

3. After the piston nut has been removed, the piston and collar will slip off the end of the rod.

Reassembly

1. Clean all piston and rod assembly parts thoroughly. Be sure piston is internally

clean and dry.

2. Inspect each part for nicks, burrs or scratches and dress surfaces with a fine grit stone as required.
3. Inspect the piston rod threads and collar shoulder. Threads should be clean and free of burrs. Fit collar and nut into piston to verify the outside diameter fits, and turn freely by hand in the piston. Install the collar and nut onto the piston rod to verify that the inside diameter fits and rotates freely. Run the piston nut down by hand until the rod threads protrude to verify freedom of thread engagement. Remove nut and collar.
4. Check piston rings to determine wear (see "Determining Ring Wear:" on page 5-22). Replace piston rings as required.
5. Secure the piston rod in Torque Fixture D-0961.
6. Apply a thin coat of Never-Seez to piston rod shoulder and rod collar locating band, and collar face in contact with the piston, then slide collar onto rod.
7. Apply a thin coat of Never-Seez to the piston rod threads at the piston end, then slide piston onto rod and collar.

NOTE: ONE END OF SINGLE PIECE PISTONS ARE MACHINED 0.001" (0.03 MM) UNDERSIZE ACROSS A 3/4 INCH (20 MM) WIDE BAND FOR MANUFACTURING PURPOSES. THIS IS THE HEAD END OF THE PISTON.

8. Apply a thin coat of Never-Seez to the piston nut threads and piston mating face. Install nut and hand tighten to make up the piston and rod assembly.
9. Tighten the piston nut to the recommended torque in Table 1-12 on page 1-16.
10. After tightening nut, the piston rod should not protrude more than 0.010 in. (0.25mm) past the piston face.
11. Apply a thin coat of Never-Seez to two new Allen set screws. Two new Allen wrenches are also required per nut at each tightening and are discarded after their one time destructive use. Install the set screws and tighten so that the Allen wrench is permanently deformed by tightening past its yield point (twisted thru a 15° arc).
12. Prick-punch the piston nut, within 1/16 in. (1.5mm) of the set screw threads, to lock the set screws in place. Prick-punch marks should deform nut screw threads to lock the set screws in place.
13. Weigh the piston rod assembly with piston rings included. Stamp the weight on the piston' head end. Flatten and raise lips to avoid clearance measurement errors. Record this weight for future reference.

Piston and Rod - Installation

1. Install the piston/rod assembly with piston rings into the cylinder. The threaded crosshead end of the rod is 1/8 inches (3 mm) smaller than the inside diameter of the packing. It is not necessary to use an entering sleeve if reasonable care is taken, but a sleeve may be helpful. Using a non-metallic sleeve will help ensure that packing rings are not damaged.
2. Screw the crosshead nut onto the piston rod. Make sure all threads and nut seating surfaces are well lubricated with clean, fresh oil to ensure proper assembly. Position the crankshaft in the inner dead center position. Remove a crank

end discharge valve. Determine the required piston crank end clearance as shown on the cylinder identification plate. Refer to Table 1-3 on page 1-10. Insert a feeler gage, equal to the required crank end clearance, thru the discharge valve pocket. Use the Piston Nut Spanner and a speed wrench to screw the piston rod into the crosshead until piston is snug against the feeler gage. Snug the crosshead nut, but do not tighten. Remove the feeler gage.

3. Ensure that the Piston Turning Tool has been removed. Replace the cylinder head and gasket. Tighten all cylinder head bolts evenly to the proper torque value listed in Table 1-12 on page 1-16.
4. Remove a head end suction valve. Determine the required piston head end clearance as shown on the cylinder identification plate. Refer to Table 1-3 on page 1-10. Rotate the crankshaft 180° to the outer dead center position, and using the feeler gages thru the valve pocket, check the head end clearance. Determine that measured clearance is within the required clearance limits.
5. Tighten the crosshead nut to the proper torque value listed in Table 1-12 on page 1-16.
6. Tighten set screws in the crosshead nut.
7. Before installing the side covers, apply an anti-seize lubricant to the gaskets. This will aid removal at a later date.
8. Replace the crosshead guide side covers; tighten all capscrews.
9. Replace the valve assemblies, tighten all valve cap bolts evenly to the proper torque value listed in Table 1-12 on page 1-16.

Piston Rod Run Out

Check piston rod run out after installing a new unit, after relocating a unit or after any maintenance that could affect rod run out.

Verify that the crosshead guides are properly shimmed to level. Refer to "Procedure For Setting and Aligning" on page 2-1. Verify that the crossheads are in direct contact with the bottom guide. A 0.0015 inches (0.04 mm) feeler stock should not be able to be inserted more than 1/2 inches (13 mm) at all four corners of the crosshead.

Position the dial indicator¹ stem against the piston rod, close to the packing case. Set the indicator to zero with the piston toward the crank end. Readings are to be taken in both the vertical and horizontal directions. When measuring vertical rod movement, upward movement will be recorded as positive, downward movement will be recorded as negative. When measuring horizontal rod movement, rod movement toward the auxiliary end of the frame, will be recorded as a positive reading, movement toward the drive end of the frame will be recorded as a negative reading. Copy Table 5-1 to record readings. Bar over crankshaft by hand and record readings at mid-stroke and with piston at the head end.

1. Use a 0.0001 inches (0.001 mm) increment dial indicator.

TABLE 5-1: PISTON ROD RUN OUT

THROW NUMBER:		1	2
VERTICAL	Piston @ CE	0	0
	Mid-Stroke		
	Piston @ HE		
HORIZONTAL	Piston @ CE	0	0
	Mid-Stroke		
	Piston @ HE		

Compare readings to Table 5-2.

TABLE 5-2: MAXIMUM ACCEPTABLE PISTON ROD RUN OUT READINGS

DIRECTION	JGM, JGN, JGP & JGQ		JGI
	INCHES	(mm)	
Vertical	0.0010	(0.025)	N/A
Horizontal	0.0005	(0.013)	

If a vertical reading is greater than the maximum acceptable reading, the following procedure is used to determine acceptability: With the piston at the head end, use feeler gages to determine clearance at the top of the piston. On rider ring pistons this clearance is over the band. Feeler top clearance is divided by ($\div$) 2 and then the following amount is subtracted: (-)0.003 inches (0.08 mm). Place a feeler of this calculated thickness under the bottom of the piston. Place the feeler under the wear band on wear band pistons. This feeler should be long enough to stay under the piston as the piston is moved throughout its stroke. Re-measure vertical run out and compare to acceptable limits in the table above. The horizontal readings, taken without the use of feelers are to be used for acceptance. Copy Table 5-3 and record calculations and readings.

TABLE 5-3: FEELER THICKNESS TO CORRECT FOR PISTON WEIGHT

LINE	THROW NUMBER:	1	2
1	Top Feeler Clearance		
2	Line 1 ($\div$ 2)		
3	Line 2 - 0.003" (-0.08 mm)	- 0.003" (-0.08 mm)	- 0.003" (-0.08 mm)
4	Bottom Feeler Thickness		
5	Vertical - Piston @ CE	0	0
6	Vertical - Piston @ HE		

If readings are not within acceptable limits after replacing worn parts and correcting any piping misalignment, the piston rod assembly should be replaced.

Piston Rings

All JGM, JGP, JGN and JGQ cylinders use one-piece angle cut filled Teflon piston rings.

Determining Ring Wear:

Ariel recommends replacing rings when the end gap has increased three times the new dimension. To measure the end gaps, insert the rings in the cylinders without pistons. (See Table 1-7 or Table 1-9 for new end gap dimensions.)

Removal:

See paragraph 4 at “Piston and Rod - Removal” on page 5-17 for piston ring removal.

Wear Bands

1-3/4JG-FS-HE cylinder class pistons use a one-piece angle cut Teflon wear band.

Determining Wear Band Wear:

Since the wear band does not work as a sealing ring, end gap is not critical. The amount of wear band projection beyond the outer diameter of the piston is important. Wear band projection can be checked by measuring piston to cylinder bore clearance at the bottom of the bore. This can be done without removing the piston from the cylinder. Replace the wear band before it has worn enough to allow the piston to touch the cylinder bore.

Piston Rings - Installation

1. Place the rings over the grooves in the piston. Compress the Teflon one-piece rings by hand.
2. With the rings fully compressed in the grooves, insert the rod and piston into the cylinder. Make sure the rings stay in place while inserting the piston and rod.

NOTE: RING GAPS ARE TO BE STAGGERED AROUND THE PISTON, RATHER THAN IN LINE.

3. Follow the steps under “Piston and Rod - Installation” on page 5-19.

Wear Band - Installation

Install the wear band as if it was another piston ring as above. Wear bands are only used on 1-3/4JG-FS-HE cylinder class pistons.

Piston Rod Pressure Packing - Removal

1. Remove the piston and piston rod. See "Piston and Rod - Removal" on page 5-17.
2. Remove packing diaphragm and oil wiper packing.
3. Disconnect the lube oil tube and/or coolant connections from the top of the packing gland and the primary vent tube from the bottom of the gland. Remove the twelve point capscrews that hold the pressure packing gland to the cylinder.
4. At this point do not remove the small nuts from the studs. These studs hold the entire packing case together so it can be removed as an assembly.
5. Screw two short 3/8-16 UNC capscrews into the two tapped holes provided in the crankend face of the packing gland. A screwdriver or pry bar under the heads of the capscrews can be used to pull the entire pressure packing out into the crosshead guide. It will then come out through the side opening of the guide. The pressure packing may now be taken to a clean place for disassembly.
6. Set the pressure packing on a clean surface on its nose cup or cylinder end. Three long tie studs hold the pressure packing together. The stud holes are not equally spaced. This prevents the stack of parts from being aligned incorrectly. Remove the stud nuts and the pressure packing can be unstacked. Replace these nuts each time the pressure packing is serviced.
7. Ring wear can be determined by placing the assembled rings, (note match-marks), on the piston rod. Check end gap clearance. If the ends butt, or nearly butt, they should be replaced by new rings.
8. Fins or wire edges on the rings due to wear should be carefully filed off so that all matching edges will be square.
9. The metal gasket on the end cup can be pried loose with a sharp awl. Be careful not to scratch the sides of the gasket groove.
10. Before reassembly be certain all parts are perfectly clean.

Piston Rod Packing - Reassembly

1. Be sure to refer to the pressure packing assembly in your parts book. Ariel supplies four parts books with each unit. Please contact your distributor if you do not have a parts book. A pressure packing assembly drawing also is packaged with each pressure packing re-build kit.
2. If installing a new set of rod rings in an existing packing case, the case parts need to be inspected for wear. Cups should be smooth and flat on the back side where the rod rings must seal. If the cups or grooves have worn concave or tapered, they should be reground or relapped. It is rarely necessary to alter the crosshead side of the cups, however, if this is found necessary, care must be taken so that the correct side clearance for the renewal rings is not destroyed.

NOTE: IF PREMATURE WEAR IS SUSPECTED, REFER TO THE ARIEL "Cylinder And Packing Lubrication Requirements" on PAGE 4-4.

3. Before a packing case is installed, it should always be disassembled and thoroughly cleaned in an appropriate solvent for the intended service.
4. Make sure that each rod ring and cup is properly positioned and that rings are liberally coated with a clean lubricant before reassembly. Examine all parts for unusual nicks or burrs which might interfere with the free floating of the rod ring in the cups. Particular care should be taken with rod rings made of soft materials, such as bronze or TFE, and it is extremely important that wiper rings be handled and installed so as to prevent damage to the scraping edges.
5. Parts should be laid out on a work bench so that they can be installed progressively with each in its correct position and the rod rings with their proper faces toward the pressure. Note that all rod ring segments are carefully lettered and must be assembled accordingly. This is most important in order to ensure proper sealing. After the tie stud nuts are tightened, all rings should be free to "float" radially in each cup.
6. For new installations, care must be given to the cleaning of all accumulated dirt in the lines and compressor because foreign material will lodge in the packing to become destructively abrasive.
7. Prior to installing the packing case into the cylinder, the end cup gasket must be inspected for nicks and damage that would cause it to leak in service. When in doubt, replace the gasket with a new one.
8. Before installing the packing case into the cylinder, be sure the gasket surface in the packing counter bore on the crank end of the cylinder is clean and not scratched.
9. Reinstall the complete packing case assembly with the oil supply point on top. Using the rod packing bolts, pull the packing into place.
10. Reinstall the packing diaphragm and wiper packing.
11. Reinstall the piston and rod. Follow the steps under "Piston and Rod - Installation" on page 5-19.
12. After the crosshead nut has been tightened, tighten the rod packing bolts evenly to the recommended torque in Table 1-12 on page 1-16. This procedure will ensure that the pressure packing comes up square on its nose gasket. Alignment is readily accomplished by the use of feelers to maintain a uniform clearance all around between the case bore and the rod.
13. Retighten the small tie stud nuts. Reinstall the tubing connections for the oil supply, primary vent and/or coolant. Take care not to cross-thread the tubing nuts. Tubing nuts must be tight.

NOTE: AFTER INSTALLING THE NEW PRESSURE PACKING RINGS, REFER TO "Force Feed Lubrication System" on PAGE 4-14 FOR INSTRUCTIONS FOR PRIMING THE FORCE FEED LUBE SYSTEM. PRIMING SHOULD BE REPEATED EACH TIME A COMPRESSOR IS STARTED BECAUSE OIL LINES MAY HAVE BEEN BLED DURING DOWN TIME. FOLLOW INSTRUCTIONS IN "Force Feed Lubricator Adjustment" on PAGE 4-8 FOR LUBRICATION RATES THAT ARE RECOMMENDED FOR BREAK-IN OF A NEW MACHINE. BREAK-IN LUBE RATES ARE TWICE THE NORMAL RATES - OR ONE-HALF THE NORMAL INDICATOR PIN CYCLE TIME.

Types of Piston Rod Packing Rings

Type "P" Pressure Breaker

This is a single ring. It is cut radially into three equal segments. Total end clearance for the ring is 0.022 to 0.028 inches (0.56 to 0.71 mm) for PEEK rings and 0.011 to 0.017 inches (0.28 to 0.43 mm) for bronze and cast iron rings. This ring breaks down or slows the gas flow without sealing it completely. This end gap should be maintained by adjusting the ring gap or replacing the ring. See Figure 5-12:.

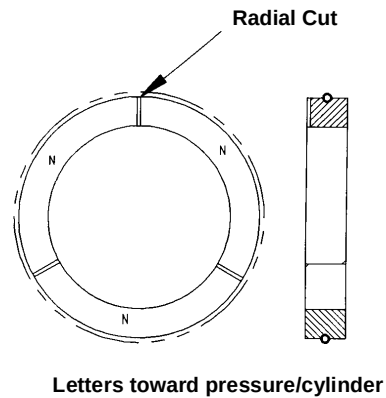


FIGURE 5-12: TYPE "P" PRESSURE BREAKER

Type "BTR" Single Acting Seal Set

This set is made up of three rings. It seals in one direction only. The first ring (pressure side) is radially cut. The installed total end gap is 0.046 to 0.078 inches (1.17 to 1.98 mm) for Teflon and 0.093 to 0.125 inches (2.36 to 3.18 mm) for bronze and Polyimide. The second ring is a tangentially step cut ring. The first two rings are doweled so the cuts are staggered from one ring to the other. The third ring is called a back-up ring and is radially cut. The bore in this ring is larger than the rod diameter. This allows the radial joints to be tight together forming a gas seal. No dowel is necessary for this ring. See Figure 5-13:

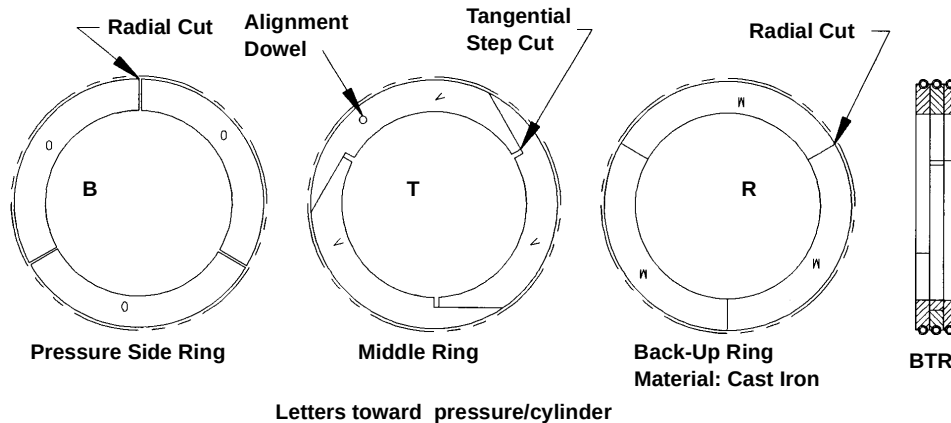


FIGURE 5-13: TYPE "BTR" SINGLE ACTING SEAL SET

Type "AL" Double Acting Seal Set

This set is made up of five rings. The center three are radial cut and the two outboard rings are step-tangent cut. The last two rings on each end are doweled together to stagger the cuts. The center ring, along with the two adjacent rings, form a wedge that overcomes rod friction and forces the set to have constant contact against both groove faces during either direction of rod travel. The installed total end gap is 0.062 to 0.093 (1.57 to 2.34 mm). This ring set is designed for gas purge applications. See Figure 5-14:

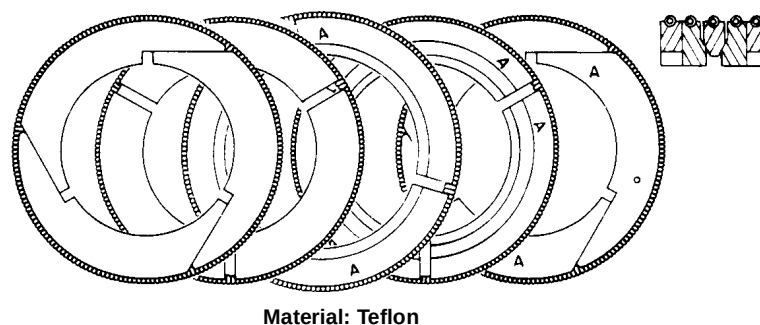


FIGURE 5-14: TYPE "AL" DOUBLE ACTING

Type "BD" Double Acting Seal Set

This set consists of two tangentially step cut rings. The rings are doweled so the tangential cuts are staggered from one ring to the other. The installed total end gap is 0.046 to 0.078 inches (1.17 to 1.98 mm) for Teflon and 0.093 to 0.125 inches (2.36 to 3.18 mm) for bronze and Polyimide. The set is double acting in that it will seal in either direction. It is used in cylinders operating near atmospheric pressure to prevent air from entering the cylinder. Install with the match mark letters facing the pressure. See Figure 5-15:

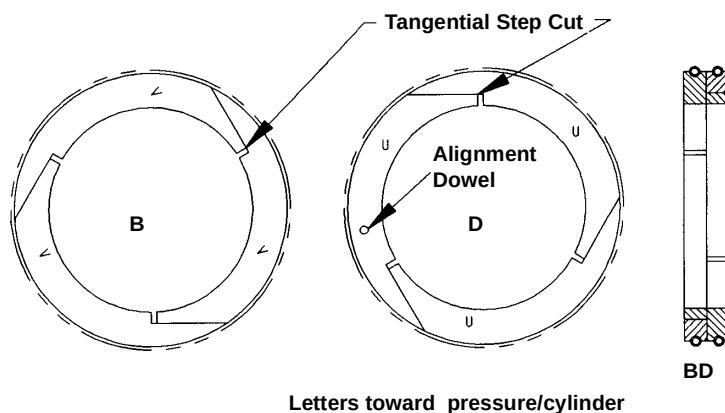


FIGURE 5-15: TYPE "BD" DOUBLE ACTING

Type "3RWS" Oil Wiper Set

This set uses three radial cut rings. They are doweled to provide a staggered arrangement. Their purpose is to keep crankcase oil out of the packing and cylinder. Assemble with the blank face towards the oil (crankcase) and the slotted side towards the pressure packing. See Figure 5-16:

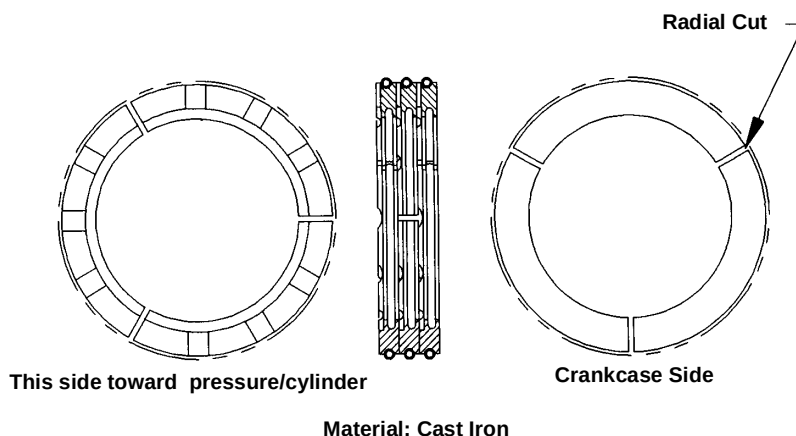
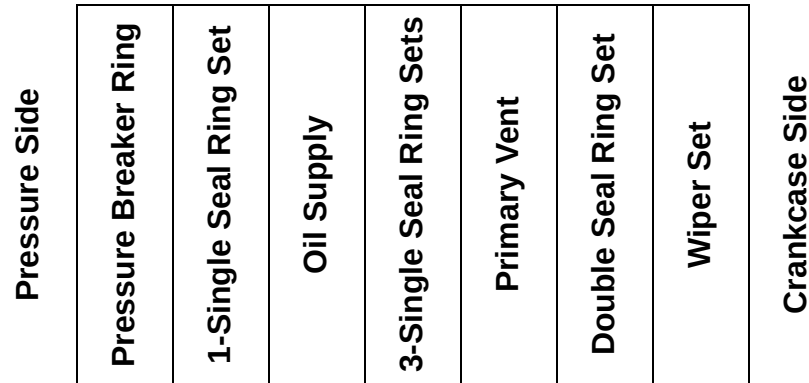


FIGURE 5-16: TYPE "3RWS" WIPER SET

Typical Arrangement of Piston Rod Packing Rings

The general arrangement of the oil supply, seal ring and vent locations is shown below:



The oil wiper rings and a seal ring set are carried on a separate diaphragm in the crosshead guide when a “two compartment distance piece” is supplied.

NOTE: REFER TO THE PACKING ASSEMBLY IN YOUR PARTS BOOK. SEE PAGE 4-21 FOR PACKING TUBING AND DISTANCE PIECE VENTING AND PAGE 4-22 FOR PACKING LUBRICATION AND VENTING.

Piston Rod Packing Ring Material

In the past, bronze was the standard material for Ariel packing rings. Bronze, however, is unsatisfactory for sour gas service, (hydrogen sulfide in the gas). PEEK, cast iron and Teflon provide outstanding service with sour gas, and since they perform equally well with sweet gas, they are now the standard materials.

A typical packing will have a PEEK pressure breaker, Teflon/cast iron single acting rings, all Teflon double acting rings, and a cast iron wiper set. The Teflon is glass reinforced and impregnated with molybdenum disulfide. This provides a strong, slick material to reduce friction and wear.

Valves

CAUTION

BEFORE ATTEMPTING TO REMOVE ANY VALVE CAP, BE CERTAIN THAT ALL PRESSURE HAS BEEN VENTED FROM THE COMPRESSOR CYLINDER. THE PRESSURE MUST BE COMPLETELY VENTED FROM BOTH THE SUCTION AND DISCHARGE PASSAGES OF THE CYLINDER. SEE FIGURE 1-4: ON PAGE 1-5 FOR LOCATION OF IMPORTANT SAFETY INFORMATION PLATES.

Valves - Removal

1. Slightly loosen all of the bolts on each valve cap. With all the bolts loose, the cap should stay in its original position. If it pushes out on its own accord-stop! Take steps to completely vent the cylinder. See Caution above. A typical valve assembly is shown in Figure 5-17: on Page 5-31.
2. After all the above safety checks, remove the valve cap bolts. A pair of prybars (or screwdrivers), one on each side of the cap, will help pry it loose. With the retainer still in place, screw a valve tool over the valve center bolt. See Figure 7-1: on page 7-3. Now the valve and retainer can be pulled out together. For cylinder class 1-3/4JG-FS-HE and 2-1/2JG-FS-HE tandem cylinders, the suction and discharge piping and cylinder head must be removed to gain access to the concentric valve. A concentric valve combines the suction and discharge valves in one assembly. See Caution at "Piston and Rod - Removal" on page 5-17.
3. In most cases the flat metal gasket will remain in the pocket. It is difficult to see. A flashlight and a small mirror on an adjustable rod are the best tools to see the gasket clearly. On cylinders with horizontal valves, the gasket may fall into the gas passage. A small magnet on a flexible extension rod will help fish it out. This gasket should be replaced after several uses.

Valves - Maintenance

Ariel uses valves manufactured by Hoerbiger Corporation. Before servicing any valve refer to the correct valve assembly drawing and parts list and Hoerbiger's literature in the Parts Book. On the valve assembly drawing you will notice that valves have different springing for different pressure levels. The cylinder cover sheet in the Parts Book lists the valve originally supplied with each cylinder. If different operating pressures are encountered, then different springs may be required.

The suction valve must be selected on the basis of operating suction pressure and the discharge valve for operating discharge pressure. Proper valve spring selection is also based upon the operating speed (RPM), gas specific gravity and the suction temperature of the gas.

Contact Ariel in Mount Vernon, for assistance in valve selection.

Valves - Reassembly

1. The 1/32 inches (0.8 mm) thick soft metallic flat gasket should be coated with an anti-seize lubricant. It can then be either inserted into the valve pocket or stuck onto the valve. In either case, care must be taken to keep this gasket from falling into the gas passage.
2. The retainer keeper is a plastic thumb screw in a threaded hole in the bottom valve retainers. This should be screwed through just far enough to provide friction so that bottom retainers will not fall out while the cap is being installed.
3. Using the Valve Tool illustrated in Figure 7-1: on page 7-3, the valve and the retainer may be inserted into the pocket together. When installed correctly, the distance from the outer retainer face to the surface of the valve boss on the cylinder will be 1/8 inches (3 mm) shorter than the length of the nose on the valve cap.
4. Inspect the valve cap o-ring for cuts or gashes and replace it if necessary. Lubricate the o-ring and the nose of the valve cap. Some high pressure cylinders use a soft metallic wire gasket in lieu of the o-ring design. Insert the cap and tighten the bolts evenly to the recommended torque in Table 1-12 on page 1-16. See "Bolt Tightening for Valve Caps" on page 5-31. If the assembly is correct, the distance from the underside of the cap to the valve boss surface on the cylinder will be 1/8 inches (3 mm).

NOTE: BE CERTAIN ALL PARTS, GASKET FACES, AND MATING SURFACES ARE ABSOLUTELY CLEAN AND ALWAYS USE CLEAN, FRESH OIL ON THE THREADS BEFORE REINSTALLING BOLTS.

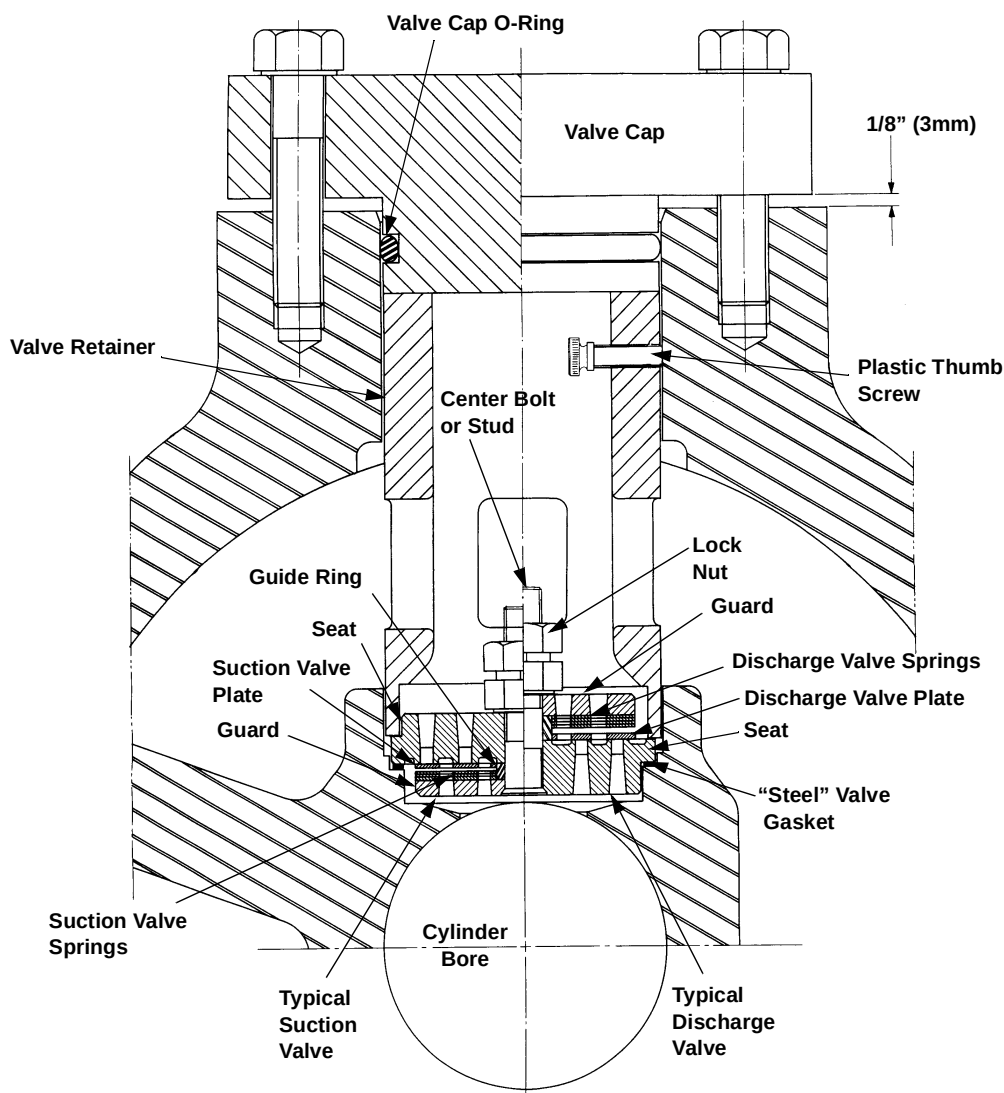


FIGURE 5-17: TYPICAL VALVE ASSEMBLIES

Bolt Tightening for Valve Caps

Proper fastener tightening technique is essential for sealing of valve caps with soft metallic wire gaskets used in some high pressure cylinders. It is important to draw up bolting to full torque in even and gradual steps. Do not allow the valve cap to be tightened with bias on one bolt or to become cocked in the bore. Such bias or cocking can cause uneven crush of the gasket, which could cause a leak and could also cause bolt failure. This step tightening procedure is also recommended for all valve caps.

Install the valve assembly (and high clearance spacer, when applicable), with the flat gas-kets(s) and valve retainer, in the valve pocket. See "Valves - Reassembly" on page 5-30.

For high pressure applications, place a new, proper, soft metallic wire gasket on the retainer and install the valve cap. Be careful not to gouge the bore, distort or damage the wire gasket. Always use a new metallic wire gasket; wire gaskets are not reusable.

Lubricate threads and bolt seating surfaces with petroleum type lubricant, and install bolts. Do not use anti-seize compounds on valve cap bolting. Tighten each bolt until snug using a criss-cross pattern. Next, tighten each bolt to 25% of full torque, moving across from bolt to bolt, in a criss-cross pattern. See Figure 5-18: 1-2-3-4-5. Repeat this step for 50%, 75% and 100% of full torque.

Proper tightening and torquing is important for all valve caps, but is especially important for high pressure valve cap assemblies. High pressure applications have caution plates on the cylinder which are stamped with proper torque values:

 CAUTION

**SEVERE PERSONAL INJURY AND PROPERTY DAMAGE
CAN RESULT IF VALVE CAP BOLTING IS NOT INSTALLED
TO PROPER TORQUE OF _____ FT. LBS. _____ N·m.**

**REFER TO TECHNICAL MANUAL FOR PROPER TORQUING
PROCEDURE.**

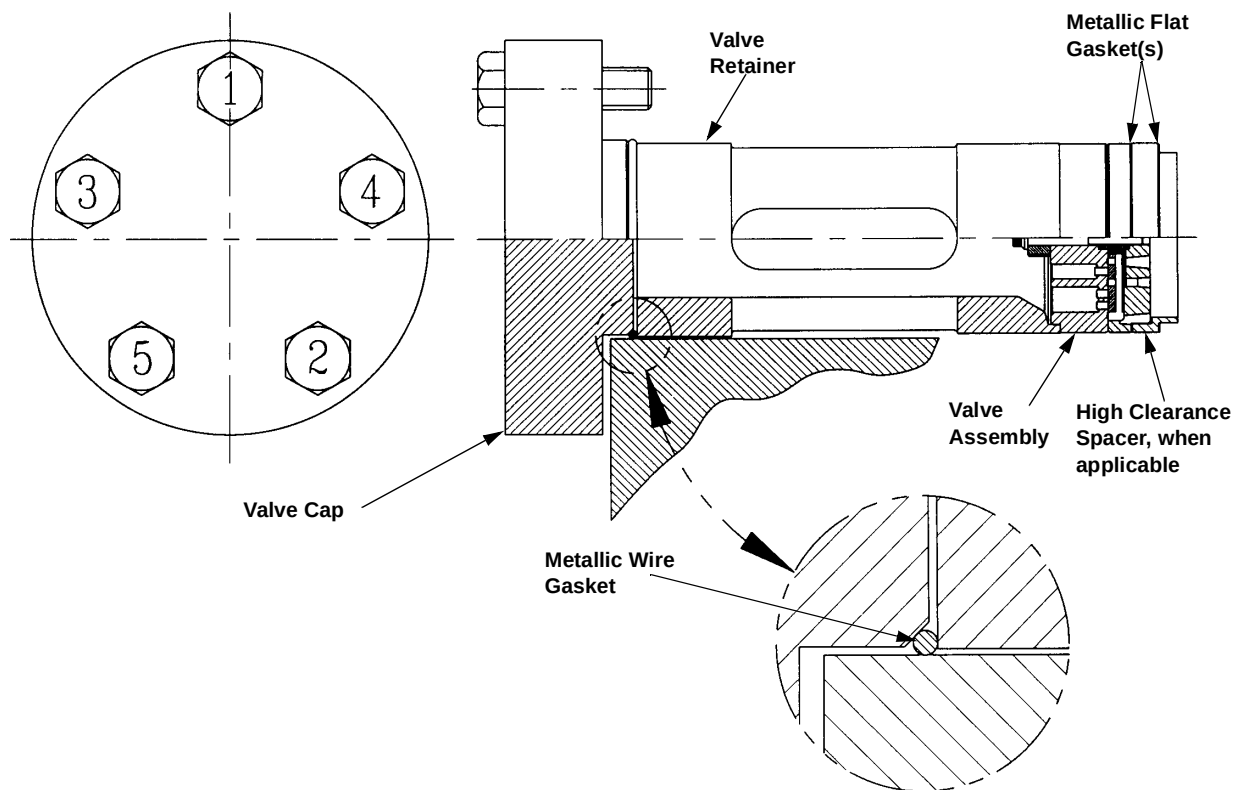


FIGURE 5-18: HIGH PRESSURE VALVE CAP ASSEMBLY

VVCP - Variable Volume Clearance Pocket Head End Unloader

Removal

Disconnect the VVCP packing vent. Remove the VVCP from the cylinder using similar procedures as when removing a cylinder head. The approximate weights of VVCP's for handling purposes can be found in the Ariel Data Book.

Disassembly

Unsnap the thread protector bellows from the slot in the hand wheel. With the locking handle locked, remove locknut and hand wheel. A hammer or puller may be required to break hand wheel to stem tapered fit. Loosen locking handle and unscrew to remove handle. Remove socket head screws at inside of bolt flange and separate the halves of the VVCP. Unscrew the VVCP stem and piston assembly to remove.

 CAUTION

TRAPPED GAS PRESSURE CAN PRESENT A PERSONAL SAFETY HAZARD WHEN SERVICING THE VVCP. WORK IN A WELL VENTILATED, NON SPARKING AREA. DO NOT BREATHE GAS OMMITTED FROM VVCP WHEN VENTING TRAPPED GAS.

Maintenance

To replace or clean the VVCP packing, remove the bolts and flange that hold the packing in place and remove the packing. Replace the VVCP packing when excessive leakage is noted at the vent. Remove the VVCP piston ring; replace as necessary.

Clean all parts to remove all debris, rust, etc. The stem and piston are permanently pinned, do not attempt to disassemble.

Reassemble the VVCP in reverse order, using a new o-ring at the bolt flange. While the torque used for the socket head bolting is not critical, these bolts must be sufficiently tight to prevent loosening during service. Be sure that thread protector bellows are properly aligned when installing hand wheel. Lubricate stem with 3-4 pumps of all-purpose petroleum grease with a hand pump grease gun at the grease fitting.

To re-install the VVCP on the cylinder, use a new head gasket. Lubricate threads and bolting seating surfaces with petroleum type lubricant and install bolting. Tighten each cap screw until snug using a criss-cross pattern. Next tighten each cap screw to 25% of full torque, moving from cap screw to cap screw in a criss-cross pattern. Repeat this step for 50%, 75% and 100% of full torque. See Table 1-12 on page 1-16 for tightening torque value. Reconnect VVCP packing vent. When installing a new VVCP, check total piston end clearance and re-set crank end/head end feeler clearances with VVCP completely closed. See Table 1-3 on page 1-10 for clearances.

Adjustment

VVCP clearance volume may be changed with the compressor running or stopped. Consult the Packager's instructions regarding where to set the VVCP. Also reference the VVCP data sheet in the Ariel Technical Manual Parts Book.

The VVCP piston ring is designed not to be gas tight, to allow a nearly balanced gas pressure for ease of VVCP adjustment with the cylinder pressurized. Gas pressure behind the VVCP piston normally vents when cylinder is vented. Process debris or rust around the piston ring can make a seal that takes some time to vent. If gas is trapped behind the piston,

the VVCP can be adjusted when the cylinder is pressurized, but difficult to turn when the cylinder is vented. This problem is corrected by disassembling the VVCP and cleaning.

To adjust the volume, loosen the stem locking handle, so that stem is free to turn. Turn the stem by use of the hand wheel on the outboard end of the shaft. Turn hand wheel clockwise to load; counterclockwise to unload. Re-tighten the stem locking handle to 150 lbs-ft (203 Nm) torque.

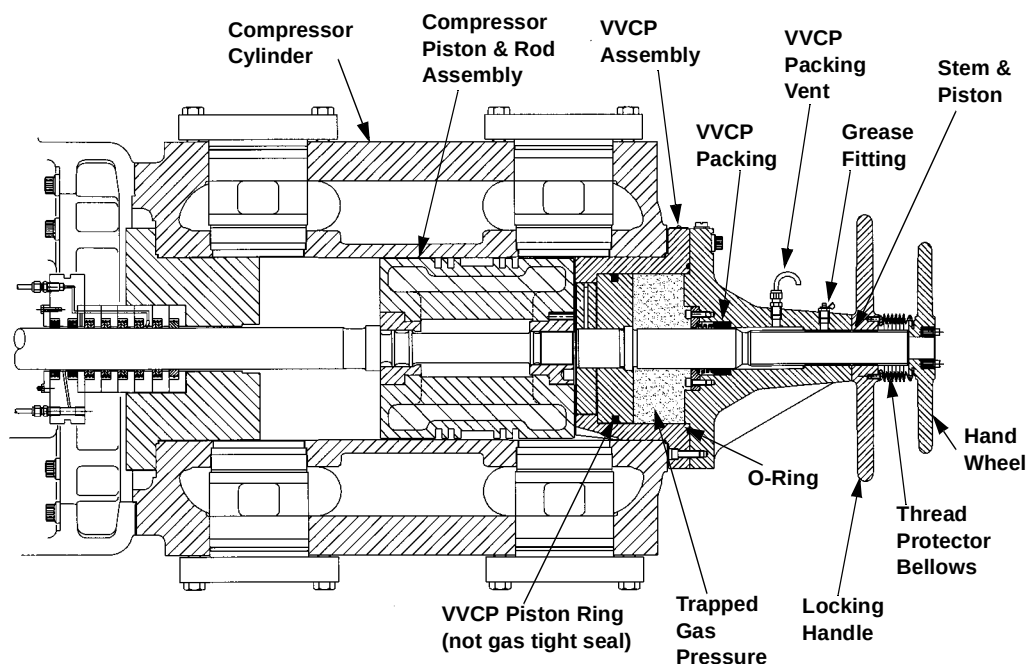


FIGURE 5-19: CYLINDER WITH VVCP

NOTES

SECTION 6 - TECHNICAL ASSISTANCE

Recommended Maintenance Intervals

Like all equipment, Ariel compressors do require maintenance. The frequency of maintenance is dictated by the environment in which the compressor is placed, the loads the user imposes on the compressor and the cleanliness of the gas.

First and foremost on the preventative maintenance list is the completion and compliance with the Ariel Corporation Packagers Standard and Compressor Start Up Check List. All items must be adhered to, both before and after start up.

The following is a guide only and, as stated above, may vary due to operating conditions. The time intervals start from the start up date of the unit. If your oil supplier's recommended oil service changes are more frequent than the Ariel recommendation, the supplier's intervals should be followed. Regular oil analysis is recommended. If problems develop, the oil should be changed immediately and the cause of the problem determined and corrected.

A log book should be kept with each unit. Every maintenance item can be recorded with exacting detail in order that records will be available for tracking maintenance cost per unit and for trouble-shooting.

Operator logs should be reviewed by qualified personnel to determine trends in compressor performance and/or maintenance.

Daily

1. Check frame oil pressure. It should be 50-60 PSIG (350-420 kPa) when at operating temperature. Compressor inlet oil temperature is 190°F (88°C) maximum.
2. Check frame oil level. It should be in the sight glass and, if not, determine and correct cause. Do not overfill. Check oil makeup tank for sufficient oil supply.
3. Check lubricator block cycle movement indicator. Refer to information plate on top of lubricator box for correct cycle time. Very dirty or wet gas may require a more frequent cycle time than normal.
4. Check primary and secondary packing vents for blowing. If blowing, determine cause and, if necessary, replace packing internal parts.
5. Check and correct any gas leaks.
6. Check and correct any oil leaks.
7. Check operating pressure and temperatures. If not normal, determine cause of abnormality. It is recommended that a daily log of operating temperatures and pressure be kept for reference.
8. Check shutdown set points.
9. Low oil pressure shutdown is 35 psi (240 kPa) minimum.

10. High temperature shutdown to be set within 25°F (14C) of actual operating temperature.
11. High-low pressure shutdowns set as close as practical. Consideration should be given to rod load capacity of machine.
12. Check lubricator box oil level.
13. Check for unusual noises or vibrations.

Monthly (in addition to Daily Requirements)

1. Check and confirm safety shutdown functions.
2. For cylinders rated greater than 3500 psi (24 000 kPa), remove cylinder heads and check cylinder for oil presence to verify lubrication is adequate.

Every 6 Months or 4,000 Hours (plus Daily/Monthly)

1. Drain and replace lubricator box oil.
2. Change oil filter or when differential pressure exceeds 10 psi (70 kPa).
3. Change oil. A more frequent oil change interval may be required if operating in an extremely dirty environment or if the oil supplier recommends it or if an oil analysis dictates it. A less frequent oil change interval may be allowed if the oil is replenished on a regular basis due to force feed lubricator usage.
4. Clean strainer when oil is changed.
5. Open frame when oil is changed and visually inspect for foreign material. Disassembly is not recommended unless a reason for it is identified.
6. Check fluid level in damper (if applicable).
7. Re-tighten hold down stud-nuts to proper torque values and perform a soft foot check. More than 0.002 inches (0.05 mm) pull down requires re-shimming. If re-shimming is required, realign if necessary to hold coupling alignment within 0.005 inches (0.13 mm) TIR.
8. For cylinders rated greater than 3500 psi (24 000 kPa), inspect piston ring end gap. Replace rings that are outside the maximum limits listed in Table 1-7 and Table 1-9.

Yearly or 8,000 Hours (plus Daily/Monthly/6 Months)

1. Check main bearing clearance, connecting rod bearing clearance, and crank thrust clearance with a bar and indicator. If outside the limits listed in Table 1-3 on page 1-10, replace the affected bearings.
2. Check crosshead guide clearance with feelers, and if outside the limits listed in Table 1-3 on page 1-10, replace the affected parts.
3. Inspect valves for broken plates and loose center bolts, replace broken parts and tighten center bolts to torque values listed in Table 1-13 on page 1-19.
4. Inspect cylinder bores for damage or wear. If gouged, so that the total cross sectional area of the gouges is greater than 0.001 square inches per inch of cylinder circumference (0.025 mm²/mm of cylinder circumference), cylinder should be

replaced or re-bored to a maximum of 0.020 inches (0.50 mm) oversize. The cylinder should also be replaced or re-bored if the bore is more than 0.001 inches per inch of cylinder diameter (0.001m/m of cylinder diameter) out of round or tapered.

NOTE: REBORING REMOVES NITRIDED SURFACE OF CYLINDER BORE. CONTACT ARIEL FOR RE-NITRIDING.

5. Inspect piston ring end gap. Replace rings that are outside the maximum limit listed in Table 1-7 and Table 1-9.
6. Inspect piston rods for damage and excessive wear. If gouged or scratched, replace the rod. If the rod is more than 0.005 inches (0.13 mm) under size, out of round more than 0.001 inches (0.03 mm), or tapered more than 0.002 inches (0.05 mm), replace the rod.
7. Rebuild cylinder packing cases.
8. Inspect for frame twist or bending by checking shimming of compressor feet.
9. Realign if necessary to hold coupling alignment within 0.005 inches (0.13 mm) TIR.
10. Check and re-calibrate all temperature and pressure gauges.
11. Check and record compressor rod run out.
12. Grease VVCP stem threads at grease fitting, with 2 to 3 pumps of multi-purpose grease using a standard hand pump grease gun.
13. Clean crankcase breather filter.
14. Adjust drive chains.
15. Pressure test distribution blocks.

Every 2 Years or 16,000 Hours (plus Daily/Monthly/6 months/yearly)

1. Check auxiliary and chain drive for sprocket teeth undercutting and chain for excessive stretching.
2. Rebuild oil wiper cases.

Every 4 Years or 32,000 Hours (plus Daily/Monthly/6 Months/1/2 Years)

1. Check main and connecting rod bearing clearances by using an indicator and a pry bar. Disassembly to check clearances is not recommended. Disassembly should be performed if the pry bar check indicates excessive clearance.
2. Check crosshead guide clearances with feeler gauges.
3. Check crosshead pin to crosshead pin bore and connecting rod bushing bore by removing crosshead pins.
4. Check for excessive wear in the auxiliary end drive chain tightener.
5. Check for excessive ring groove wear in pistons.

Every 6 Years or 48,000 Hours (plus Daily/Monthly/6 Months/1/2/4 Years)

1. Replace main and connecting rod bearing shells and bushings.
2. Replace lubricator distribution blocks.
3. Replace crosshead bushings.
4. Replace DNFT.

Trouble Shooting

Minor problems can be expected during the routine operation of an Ariel compressor. These troubles are most often traced to liquid, dirt, improper adjustment or to operating personnel being unfamiliar with Ariel compressors. Difficulties of this type can usually be corrected by cleaning, proper adjustment, elimination of an adverse condition, replacement of a relatively minor part or proper training of the operating personnel.

Major problems can usually be traced to long periods of operation with unsuitable lubrication, careless operation, lack of routine maintenance or the use of the compressor for purposes for which it was not intended.

Recording of the interstage pressures and temperatures on multistage units is valuable because any variation, when operating at a given load point, indicates trouble in one of the stages. Normally, if the interstage pressure drops the trouble is in the lower pressure cylinder. If it rises, the problem is normally in the higher pressure cylinder.

While it would be impossible to compile a complete list of every possible problem, listed below are some of the more common ones with their possible causes.

Problem	Possible Causes
Low Oil Pressure	Oil pump failure. Oil foaming from counterweights striking oil surface (oil level too high). Cold oil. Dirty oil filter. Interior frame oil leaks. Excessive leakage at bearings. Improper low oil pressure switch setting. Oil pump relief valve set too low. Defective pressure gauge. Plugged oil sump strainer. Improper end clearance in oil pump.
Noise in Cylinder	Loose piston. Piston hitting cylinder head end head or crank end head. Loose crosshead balance nut. Broken or leaking valve(s). Worn or broken piston rings or wear bands. Valve improperly seated or damaged seat gasket. Liquids in cylinder.

Problem	Possible Causes
Excessive Packing Leakage	Worn packing rings. Improper lube oil and or insufficient lube rate. Dirt in packing. Packing rings assembled incorrectly. Improper ring side or end gap clearance. Plugged packing vent system. Scored, tapered or out of round piston rod. Excessive piston rod run-out. Packing not seated or properly run in.
Packing Over Heating	Lubrication failure. Improper lube oil and/or insufficient lube rate. Worn packing rings. Dirt in packing. Improper ring side or end gap clearance. Scored, tapered or out of round piston rod. Excessive piston rod runout.
Excessive Carbon on Valves	Excessive lube oil. Improper lube oil. Oil carry-over from inlet system or previous stage. Broken or leaking valves causing high temperature. Excessive temperature due to high pressure ratio across cylinders.
Relief Valve Popping	Faulty relief valve. Leaking suction valves or rings on next higher stage. Obstruction, bind or valve closed in discharge line.
High Discharge Temperature	Excessive ratio across cylinder due to leaking inlet valves or rings on next higher stage. Fouled intercooler piping. Leaking discharge valves or piston rings. High inlet temperature. Improper lube oil and or lube rate.
Frame Knocks	Loose crosshead pin or pin caps. Loose or worn main, crankpin or crosshead bearings. Low oil pressure. Cold oil. Incorrect oil. Knock is actually from cylinder end. Low fluid level in damper.
Drive End of Crankshaft Oil Leak	Clogged vent or vent piping. Excessive cylinder packing leakage.
Piston Rod Oil Wiper Leaks	Worn wiper rings. Wipers incorrectly assembled. Worn/scored rod. Improper fit of rings to rod/side clearance.

NOTES

SECTION 7 - APPENDICES

Ariel Tools

Ariel Furnished Tools

Ariel provides one tool box with each unit with tools included in the box as listed below (see Figure 7-1:).

- Peg Wrench for Round Crosshead Nuts 3/4" Diameter (P/N A-0076)
- Open End Wrench for Hex Crosshead Nuts 2" (P/N B-0016)
- 1/4" x 3/8" UNF Valve Tool for Installing or Removing Valves (P/N A-0409)
- 5/16" x 1/2" UNF Valve Tool for Installing or Removing Valves (P/N A-0135)
- Piston Nut Spanner for 3/4" Square Drive Ratchet (P/N A-0279)
- Piston Turning Tool for 9/16" socket (P/N A-1678) provided with small tandem cylinders only
- Crank End Clearance Setting Tool 0.035" (0.89 mm), special tool provided for 2-3/4M, 3M, 2-14P-CE, 2-3/4P-CE and 3-1/4P-CE class cylinders only
- Torque Chart (D-2159)

Ariel provides these tools with every compressor. Please contact your Distributor if you do not have these tools.

These tools are specifically designed for use on Ariel units. Clean all tools before use. Ensure that the tool and the part being removed or installed are fully engaged during the process. If a tool is missing, worn or broken, please call your distributor for a replacement. Do not use substitute, worn or broken tools.

Also included in the tool box are standard commercial tools as follows:

- Allen Wrenches: 3/32", 1/8", 9/64", 5/32", 3/16", 1/4", 5/16" & 3/8"

Ariel Optional Tools

- Piston and Rod Clamping Fixture (P/N D-0961) (see Figure 5-11: on page 5-18)
- Force Feed Lubricator Bearing Housing Spanner Wrench (P/N A-8158)

Standard Tools

The following standard tools are normally all that is required to work on Ariel JGI, JGM, JGN, JGP and JGQ compressors. These are in addition to the Ariel tools listed above. Please contact Ariel if you have any questions about tools for Ariel units.

- 3/8" Square Drive Ratchet Wrench
- 2" and 6" Extensions for above Ratchet
- 3/8" Square Drive Breaker Bar
- 1/2" Drive Speed Wrench
- 1/2" Female x 3/4" Male Adaptor
- 3/8" Square Drive Universal Joint
- 3/8" Square Drive Torque Wrenches (10 LB-IN to 250 LB-IN)
- 1/2" Square Drive Torque Wrench (15 LB-FT to 250 LB-FT)
- Set of 12 Point Sockets for a 3/8" Square Drive
- Set of 12 Point Sockets for a 1/2" Square Drive
- 3/8" Hex Key and 1/4" Hex Key (Allen) Sockets for a Square Drive Ratchet Wrench
- 5/16" - 12 Point Box Wrench
- 1/2" x 9/16" Open End Wrench
- 3/8" x 7/16" Open End Wrench
- 12" Adjustable Wrench
- 2 - Medium Size Screw Drivers
- Babbitt or Plastic Faced Slugging Hammer
- Feeler Gage Pack
- Awl

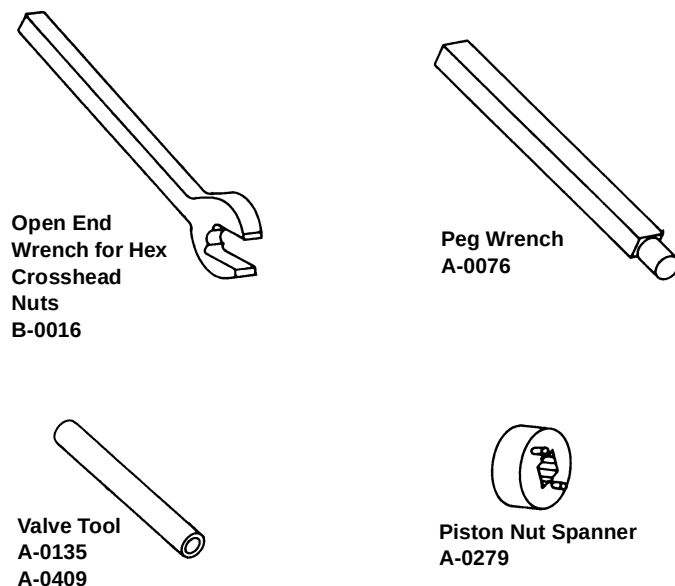


FIGURE 7-1: ARIEL TOOLS

Terms, Abbreviations¹ and Conversion to SI Metric²

Area

in² or square inch x 0.00064516 = meter², or m²

in² or square inch x 6.4516 = centimeter², or cm²

Flow - Gas

MMSCFD or million standard cubic feet per day (at 14.696 psia & 60°F) x 0.310 = normal meter³/second (at 1.01325 bar & 0°C), or m³/s_n

SCFM or standard cubic feet per minute (at 14.696 psia & 60°F) x 1.607 = normal meter³/hour (at 1.01325 bar & 0°C), or m³/h_n

1. US units of measure can appear abbreviated in upper or lower case.
2. Maintain upper and lower case letters in SI Metric as shown.

Flow - Liquid

GPM or US gallons per minute $\times 0.0630902$ = liter/second, or L/s = dm^3/s

GPM or US gallons per minute $\times 0.227125$ = $\text{meter}^3/\text{hour}$, or m^3/h

Force

lbf or pound (force) $\times 4.44822$ = Newton, or N

Heat

BTU or British Thermal Units $\times 1.05506$ = kilojoule, or kJ

Length

in. or " or inches $\times 25.4000$ = millimeters, or mm

ft or feet $\times 0.304800$ = meter, or m

Mass

lb or pound (mass) $\times 0.453592$ = kilogram, or kg

Moment or Torque

LB $\times$ FT or pound-foot (force) $\times 1.35583$ = Newton-meter, or N $\cdot$ m

LB $\times$ IN or pound-inch (force) $\times 0.112985$ = Newton-meter, or N $\cdot$ m

Power¹

HP or Horsepower $\times 0.745700$ = kilowatt, or kW

Pressure² or Stress

psi $\times 6894.757$ = Pascal, or Pa

Pa $\times 0.000145$ = psi

psi $\times 6.894757$ = kiloPascal, or kPa

kPa $\times 0.145$ = psi

1. Horsepower based on 550 ft-lb/sec

2. G suffix (PSIG) indicates gauge pressure, A indicates absolute

bar x 100 000 = Pascal, or Pa

Pa x 0.00001 = bar

bar x 100 = kPa

kPa x 0.01 = bar

psi x 68.94757 = mbar or millibar

mbar x 0.0145 = psi

psi x 0.06894757 = bar

bar x 14.5 = psi

Speed

FPM or feet per minute x 0.005080 = meter per second, or m/s

RPM or r/min or revolutions per minute x 60 = revolutions per second, or rev/s

Temperature

°F or degrees Fahrenheit. $(^{\circ}\text{F} - 32)/1.8$ = degrees Celsius, or °C

Time

sec = second, or s

min or minute x 60 = second, or s

hr or h or hour x 3600 = second, or s

Viscosity

SSU, SUS or Saybolt Universal seconds x 0.22 - (180/SSU) = mm²/s = centistoke, or cSt
(for a range of 33 thru 200,00 SUS)

Volume

gal or gallons (US liquid) x 3.78541 = liter, or L

Other Abbreviations

CE = Crank End

CI = Cast Iron

CL. = Clearance

CU = Cubic

CYL = Cylinder

⌀ = Centerline

DNFT = Digital No-Flow Timer Switch

ESNA = Registered Trade Mark of Elastic Stop Nut Division, Harvard Industries

HE = Head End

HEX = Hexagon

MAWP = Maximum Allowable Working Pressure

MAX. = Maximum

MIN. = Minimum

N/A = Not Applicable

NO. = Number

NPT = National Pipe Thread

PEEK = Poly-Ether-Ether-Ketone plastic material

% = Percent

PIST = Piston

SAE = Society of Automotive Engineers

SG = Specific Gravity

SI = International System, as applied to the modern metric system

S. N. or S/N = Serial Number

TFE = Teflon

THD = Thread

TIR = Total Indicator Reading

TPI = Threads Per Inch

TRAV = Travel

UNC = Unified (Inch) National Coarse Screw Threads

UNF = Unified (Inch) National Fine Screw Threads

UNL = Unloader

VOL = Volume

W/ = With

TABLE 7-1: USEFUL SI METRIC MULTIPLE AND SUBMULTIPLE FACTORS

MULTIPLICATION FACTOR	PREFIX	SI SYMBOL ^A
1 000 000 = 10^6	mega	M
1 000 = 10^3	kilo	k
100 = 10^2	hecto ^b	h
10 = 10^1	deka ^b	da
.1 = 10^{-1}	deci ^b	d
.01 = 10^{-2}	centi ^b	c
.001 = 10^{-3}	milli	m
.000 001 = 10^{-6}	micro	μ

a. Maintain upper and lower case letters as shown.

b. Not Recommended, but occasionally used.

Technical and Service Schools on Ariel Compressors

Ariel schedules several in plant schools each year, which include classroom and hands on training. Ariel can also arrange to send a representative to provide a customized training school at your location. Contact Ariel for details.

Ariel Customer Technical Bulletins (Formerly Ariel Newsletters)

Ariel Customer Technical Bulletins provide important technical information including changes, corrections and/or additions to the Technical Manual for Packagers and End Users. Be sure to refer to this material before operating or servicing the equipment.

A complete listing of these Bulletins is available at the Ariel Website, and copies may be obtained from the Packager or from Ariel.

FRAME

7/27/10

ARIEL CORPORATION
SALES ORDER COVER SHEET

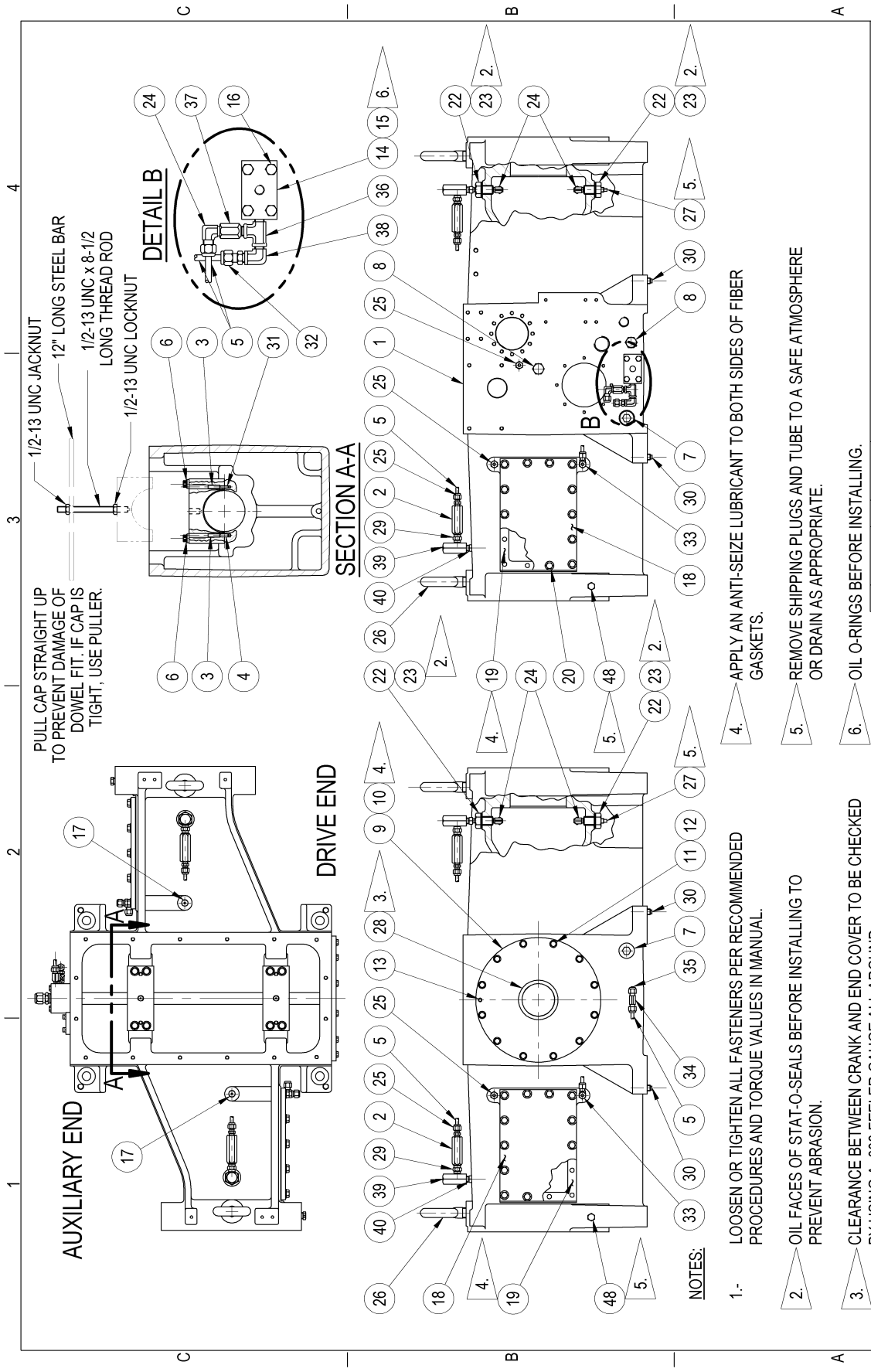
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RHCOVP02

SERIAL #: F-34090

PART: JGM:P CLASS DESCRIPTION: JGM-JGP FRAME CLASS

PART NUMBER	QUANTITY	DESCRIPTION	DRAWING NO.
G-16784	1	FRAME ASSY, JGM:N:P:Q/2	A-16459
G-11596	1	CRANKSHAFT ASSY, JGP/2	A-6501
G-0174	2	CONN ROD ASY, DI, M:P:I:212:162S	A-3985
G-0175	2	X-HEAD ASSY, JGM:P:I:162JGS	A-6873
B-0015	1	XHD NUT, .7#, HEX, G:A:M:P	B-0015
D-0149	2	XHD, LGT, CI, 11.4#, JGM:P:I	D-0149
L-00003	1	12T-9S-9S-6S	N.A.
G-3220	1	1"SIGHT GLASS, JGAMP:RWJ/2&ACF	N.A.
G-17066	1	LO PUMP ASSY, JGM:P:N:Q/2	A-16730
G-2844	1	FF LUBR, 3/16, JG:A/2M:P:I	D-1106
G-5095	1	DIST.BLK.MTG.SPACER, M:N:P:Q	N.A.
G-2706	1	RUPTURE DISC ASSY, 7300 PSI	N.A.
G-1080	1	FF TUB.TANDEM, JG:A:M:P EA CYL	N.A.
G-1079	1	FF TUBING, JG:A:M:P/2 D.A.CYLS	N.A.
G-9055	1	FF TUBING, M=R2, W/CYL>3600	N.A.
G-0176	1	CHAIN ASSY, M:P:N:Q, STD OR R/R	A-7765
G-0173	1	TOP CVR ASSY, JGM:P:N:Q, STD&R/R	A-7931
G-7676	1	FF GAGE, 7500PSI/BLK, MNPQ	A-9021
G-4669	1	FF S/D, DIGITAL NO FLOW, DC	A-6423
G-16340	1	TOOL KIT ASSY, JG:M:N:P:Q:I:S	N.A.



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7/27/10

PARTS LIST

FRAME AND OIL/DUST SEAL ASSEMBLY
JGM:P:N:Q/2

PART NO. G-16784
REF DRAWING A-16459

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	D-3218	1	FRAME, JGM:P:N:Q/2
2	A-3780	2	CHK.VLV,DOU.BALL SOFT SEAT SS
3	FS0400DG	0	CUP PT.SET-SCREW,5/16-18 X 1
4	FP0500FE	0	DOWEL PIN, 1/4 X 3/4 +.0002
5	PT0200CB	147. "	SS TUBING, 1/4 OD X .035 WALL
6	FC0120GT	8	12 PT,1/2-13 X 4-1/2 G8
7	PP0850KB	2	PIPE PLUG,1"NPTF,HEX SOC,STL
8	PP0810GB	2	PIPE PLUG,1/2NPT,HEX HD,STL
9	C-0080	1	SHAFT SEAL HOUSING, JGM:P:N:Q
10	A-0194	1	GSKT,RND,OIL SEAL,1/32
11	FC0102CF	12	HEX HD CAP, 1/4-20 X 7/8 G5
12	FW0501BA	12	FLAT WASHER, 1/4 I.D. PLAIN
13	FP0505FG	1	ROLL PIN, 1/4 X 1"
14	A-0147	1	END PLT,OIL GALLERY, JG:A/2/4
15	A-0009	1	O-RING,VT, 1.387 O.D. X .139
16	FC0102CK	4	HEX HD CAP, 1/4-20 X 2 G5
17	PP0850CB	4	PIPE PLUG,1/4NPTF,HEX SOC,STL
18	A-0066	2	GUIDE COVER,M:P:JG:A:JGS
19	A-0067	2	GSKT,RET,9-1/2X6-7/16X1/32
20	A-10185	28	SEMS BOLT, 5/16-18 X 1
22	A-0101	4	LUBE FITTING, 3/4-10 X 1
23	FW0550IA	4	STAT-O-SEAL, 3/4 DIA., NITRILE
24	A-0815	5	MALE ELBOW,STL, 1/4T X 1/8P

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

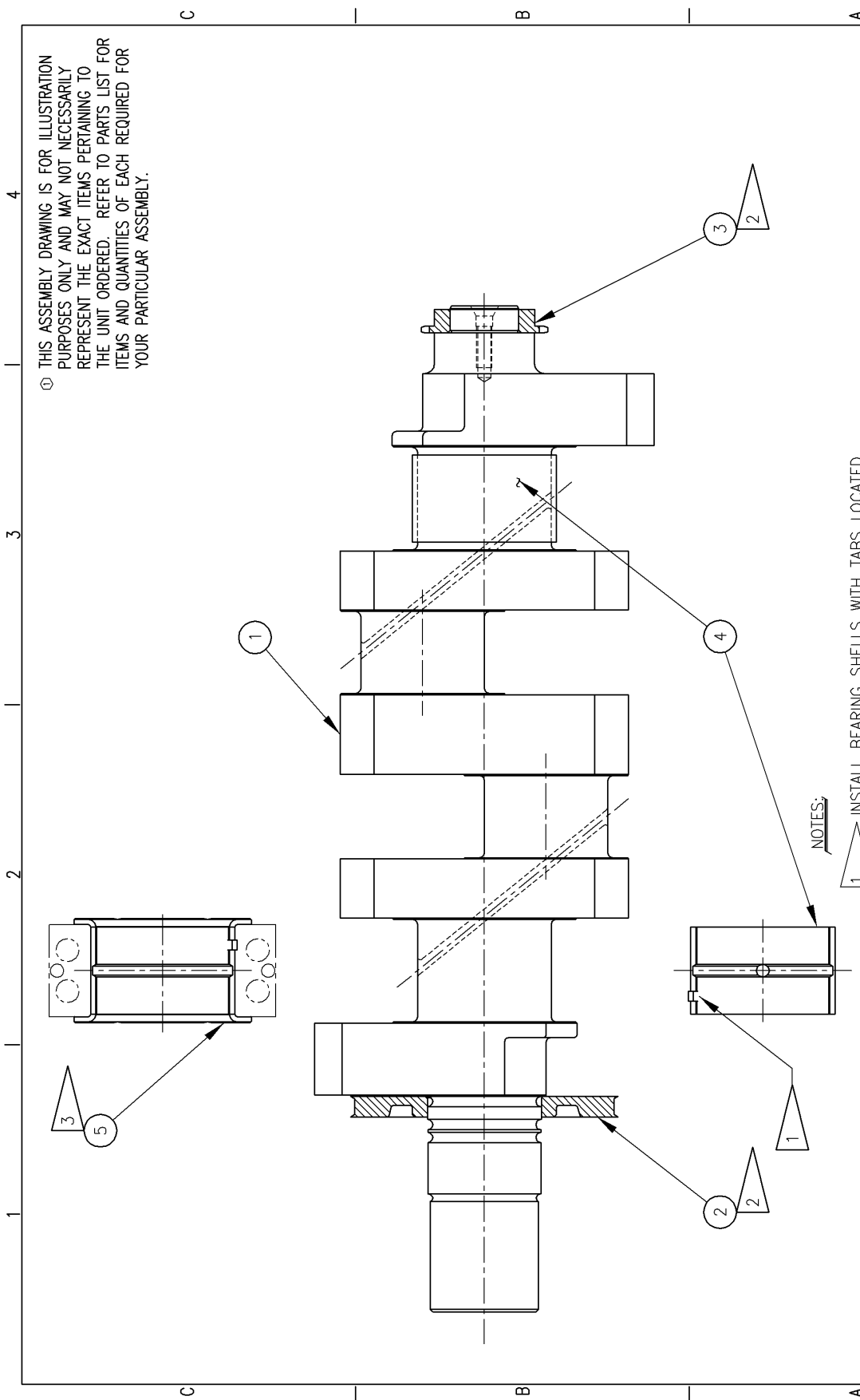
7/27/10

PARTS LIST

25	A-0827	5	MALE CONN, STL, 1/4T X 1/4P
26	A-3881	2	EYEBOLT, 7/8-9 UNC
27	A-15842	2	PIPE PLUG, 1/8NPT, DRILLED
28	A-0245	1	DUST SEAL, TFE, JG:A:M:P:N:Q
29	A-3529	2	HEX PIPE NIPPLE, STL, 1/4 X 1/4
30	FS0401GH	4	1/2 DOG SETSCREW, 1/2-13 X1-1/4
31	FP0500EE	0	DOWEL PIN, 3/16 X 3/4 +.0002
32	A-0830	1	MALE CONN, STL, 1/4T X 1/8P
33	A-0856	2	MALE RUN T, STL, 1/4T X 1/4P
34	A-0808	1	MALE BRANCH T, STL, 1/4T X 1/4P
35	A-0918	1	PLUG, TUBE FIT, FEMALE, STL, 1/4T
36	A-15556	1	STREET TEE, STL, 1/8P
37	A-3763	1	CHK VLV, 1/8MX1/8F, SS, PPT/14PSI
38	A-0804	1	STREET ELBOW, STL, 1/8P, 90
39	A-8724	2	OMNI OIL TRAP, BODY, SS, 1/4NPTF
40	A-8725	2	OMNI OIL TRAP, STEM, SS, 1/8NPT
48	A-12569	2	PIPE PLUG, 1/4NPT, DRILLED

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



THIS ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT ITEMS PERTAINING TO THE UNIT ORDERED. REFER TO PARTS LIST FOR ITEMS AND QUANTITIES OF EACH REQUIRED FOR YOUR PARTICULAR ASSEMBLY.

NOTES:

1. INSTALL BEARING SHELLS WITH TABS LOCATED IN NOTCHES IN CAPS AND CRANKCASE.
2. HEAT TO 400° F TO SHRINK ON.
3. INSTALL IN CAP

REV	DESCRIPTION	INIT/DATE	NET
1	ADDED NOTE "THIS ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY." - 004.	01/14/2003	

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1	11125
0	6441

REV	ECN
0	6441

DRAWN	CHECKED	APPROVED	SCALE
JJZ	9/10/96		NONE



ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

ASSEMBLY
DWG. NO. **A-6501**

7/27/10

PARTS LIST

CRANKSHAFT AND MAIN BEARINGS, NO KEY WAY PART NO. G-11596
JGP/2, 3" STROKE REF DRAWING A-6501

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	AD-1972	1	CRANK ASSY, FS, N/KEY, A:Q:P/2
2	B-0004	0	OIL SLINGER, JG:A:M:P:Q:N
3	A-0003	0	SPKT, 35-1 X 24T
4	B-0024	3	SLEEVE BRG, H/S, MAIN, JG:M:P:S
5	B-0025	1	SLEEVE BRG, H/S, THRUST, JG:M:P:S

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

NOTES

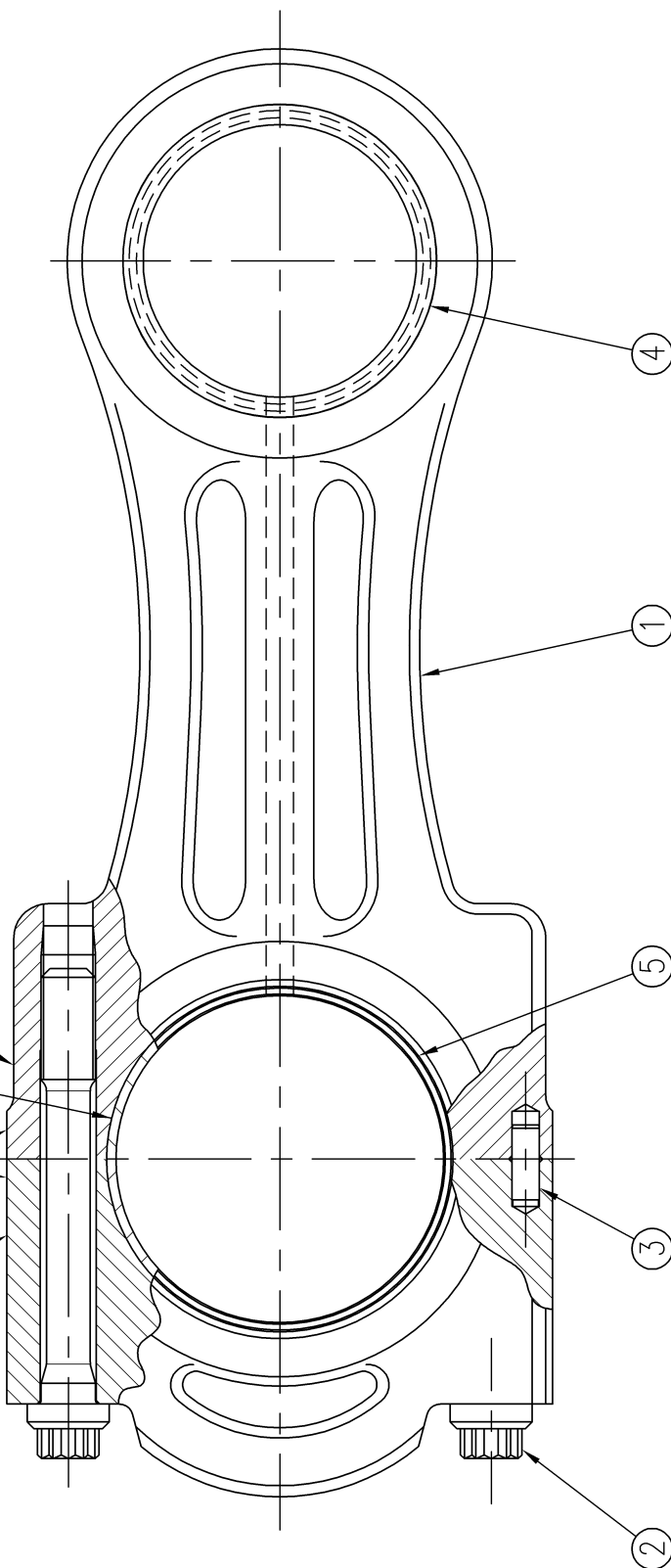
1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.
2. PRESS BRONZE BUSHING IN WHILE MAINTAINING ALIGNMENT OF OIL HOLE TO OIL PASSAGE IN ROD.
3. INSTALL BEARING SHELLS WITH TABS LOCATED IN NOTCHES IN ROD AND ROD CAP.

JOINT MATCH MARKING INSTALLED UP.
①

CORRECT ORIENTATION OF THE ROD IS WITH BEARING NOTCHES ON TOP JOINT.
①

STAMP THROW NUMBER ON TOP.
①

STAMP PART NUMBER ON TOP.
①



116756
04734

ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

ASSEMBLY
DWG. No. **A-3985**

ADDED NOTES: "JOINT MATCH MARKING INSTALLED UP", "STAMP THROW NUMBER ON TOP", "STAMP PART NUMBER ON TOP", AND "CORRECT ORIENTATION OF THE ROD IS WITH BEARING NOTCHES ON TOP JOINT".

REV DESCRIPTION

7/27/10

PARTS LIST

CONNECTING ROD, DUCTILE IRON
JGM, JGP, JGI, 212:162JGS

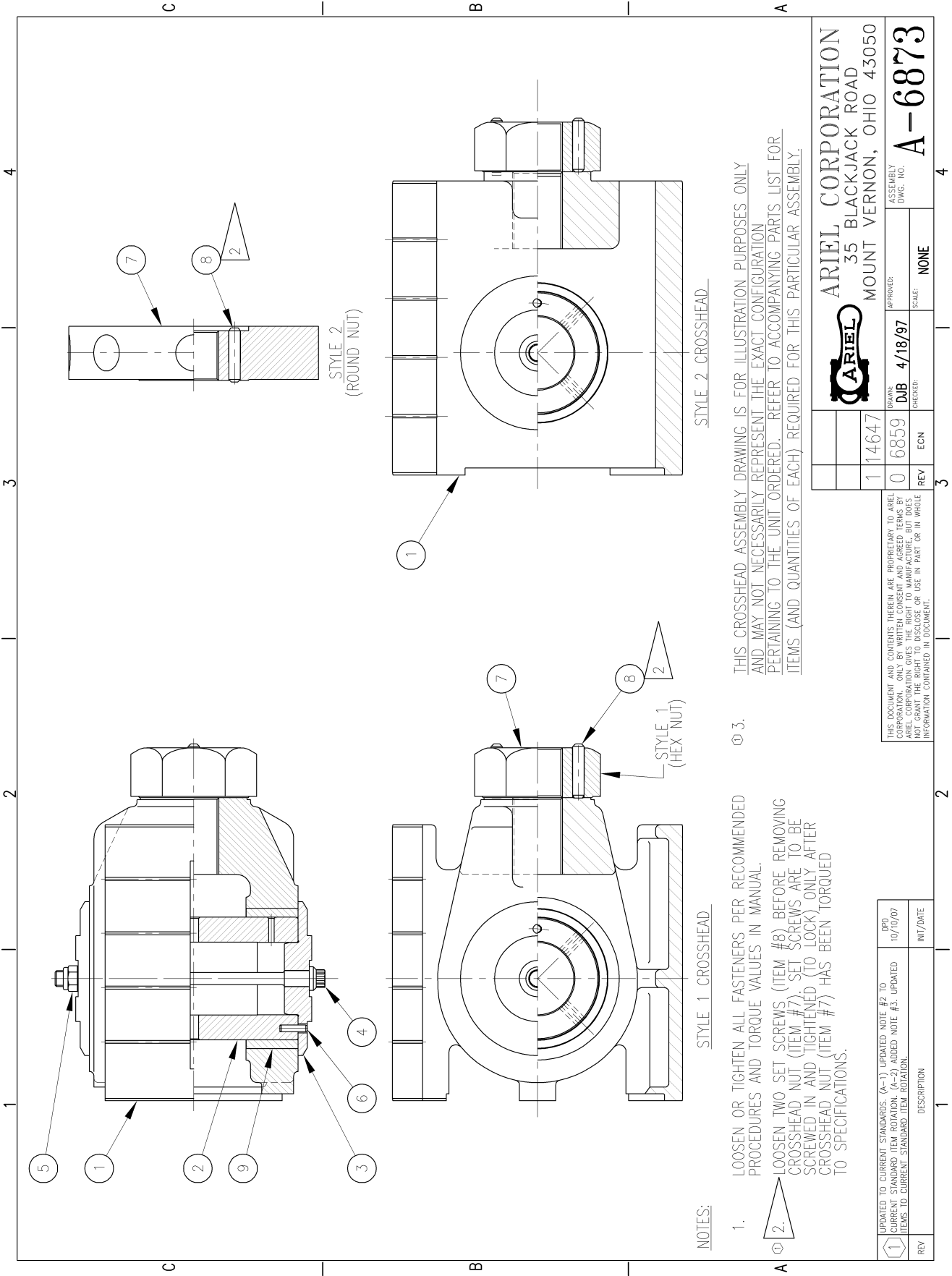
PART NO. G-0174
REF DRAWING A-3985

ITEM

NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	AD-0124	1	CONN ROD ASY,DI,M:P:I:212:162S
2	A-0209	0	12 PT, 1/2 -13 X 4 G
3	FP0500FE	0	DOWEL PIN, 1/4 X 3/4 +.0002
4	B-0003	0	BUSHING, BZ, ROD, JG:A:M:P:S:I
5	B-0023	2	SLEEVE BRG, H/S, ROD, JG:M:P:S

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

- 1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.
- 2. LOOSEN TWO SET SCREWS (ITEM #8) BEFORE REMOVING CROSSHEAD NUT (ITEM #7). SET SCREWS ARE TO BE SCREWED IN AND TIGHTENED (TO LOCK) ONLY AFTER CROSSHEAD NUT (ITEM #7) HAS BEEN TORQUED TO SPECIFICATIONS.
- 3. THIS CROSSHEAD ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS PARTICULAR ASSEMBLY.

STYLE 1 CROSSHEAD

STYLE 2 CROSSHEAD

REV	DESCRIPTION	INT/DATE
1	UPDATED TO CURRENT STANDARDS (A-1) UPDATED NOTE #2 TO CURRENT STANDARD ITEM ROTATION (A-2) ADDED NOTE #3, UPDATED ITEMS TO CURRENT STANDARD ITEM ROTATION.	DDP 10/10/07

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1	14647	0
0	6859	4/18/97
REV	ECN	CHECKED:

APPROVED:	SCALE:	NONE
DJB		



ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

A-6873
ASSEMBLY
DMG. NO.

7/27/10

PARTS LIST

CROSSHEAD, PIN AND BALANCE NUT
JGM, JGP, JGI AND 162JGS

PART NO. G-0175
REF DRAWING A-6873

ITEM		QUANTITY	DESCRIPTION
NUMBER	PART NUMBER		
1	CROSSHEAD	0	FOR PART NO. SEE COVER SHEET
1	D-0089	0	XHD, HVY, BZ, 24.2#, JGAMPNQ
1	D-0149	0	XHD, LGT, CI, 11.4#, JGM:P:I
1	D-0150	0	XHD, MED, CI, 19.1#, JGM:P
1	D-2979	0	XHD, HVY, BZ, 26.7#, JGAMPNQ
1	D-3284	0	XHD, XLT, DI, 8.0#, JGAMPNQ
2	A-0060	1	CROSSHEAD PIN, JG:A:M:P:I:S
3	A-0061	2	END PLATE, CROSSHEAD PIN, JG:M:P
4	A-0059	1	12 PT, 3/8 -24 X 5, SPCL
5	FN0461EA	1	SELF-LOCK NUT, ESNA, 3/8-24
6	FP0505CE	2	ROLL PIN, 1/8 X 3/4
7	A-0051	0	XHD NUT, 2.7#, RND, G:A:M:P
7	A-0052	0	XHD NUT, 4.7#, RND, G:A:M:P
7	A-0053	0	XHD NUT, 6.7#, RND, G:A:M:P
7	A-0377	0	XHD NUT, 8.7#, RND, G:A:M:P
7	A-3886	0	XHD NUT, 10.0#, RND, G:A:MP
7	B-0015	0	XHD NUT, .7#, HEX, G:A:M:P
7	CROSSHEAD NUT	0	FOR PART NO. SEE COVER SHEET
8	FS0455CG	2	CUP PT.S-SCRW, NY, 1/4-28 X 1
9	B-0002	0	BUSHING, BZ, XHD, JG:N:A:Q

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

CRANKCASE LUBE OIL LEVEL SIGHT GLASS PART NO. G-3220
JG:A, JGM:P, JGR:W & JGJ/2 REF DRAWING N.A.

ITEM			
NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-0077	1	SIGHT GLASS,1" NPT

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.
*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

LUBE OIL PUMP, STRAINER, FILTER
JGM/2, JGP/2, JGN/2, JGQ/2

PART NO. G-17066
REF DRAWING A-16730

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	C-0084	1	L O PUMP,M:P:I:JG:A/2,TUTHILL
2	A-0002	1	SPKT,35-1 X 30T
3	FK0360AA	1	WOODRUFF KEY,#204,1/2D X 1/16
4	FS0455CE	1	CUP PT.S-SCRW,NY, 1/4-28 X 3/4
5	A-0073	1	GSKT,NST,1/32,M:P:I:JG/2,TUT
7	B-0029	1	L O PUMP ADPTR,TUT,JG:A/2
8	A-8247	1	LO STRAINER, 3/4"NPT
10	C-0394	1	LO FILTER HEAD,SINGLE L/R
12	A-0661	1	LO FILTER ELEMENT,SPIN-ON
13	A-0660	0	STUD,SPIN-ON L O FILTER
20	FC0102EG	2	HEX HD CAP,3/8-16 X 1 G5
23	FC0102CF	8	HEX HD CAP, 1/4-20 X 7/8 G5
25	A-15683	2	PIPE PLUG,1/2NPT,DRILLED
36	A-0261	2	GAUGE,100PSI,1/4NPT,BOTT MOUNT
60	PP0810GB	2	PIPE PLUG,1/2NPT,HEX HD,STL
67	PT0200GC	24.	" SS,TUBING, 5/8 OD X .049 WALL
69	PT0200FB	54.00	" SS,TUBING, 1/2 OD X .035 WALL
71	A-0857	1	MALE CONN,STL, 1/2T X 1/2P
72	A-0068	1	GSKT,RND,5-1/4X1/32
74	A-0860	1	MALE ELBOW,STL, 5/8T X 1/2P
75	A-0901	1	MALE ELBOW,STL, 1/2T X 1/2P
76	A-0844	3	HEX RED BUSH,STL,3/4M X 1/2F
77	A-0843	1	STREET ELBOW,STL,1/2P,90

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

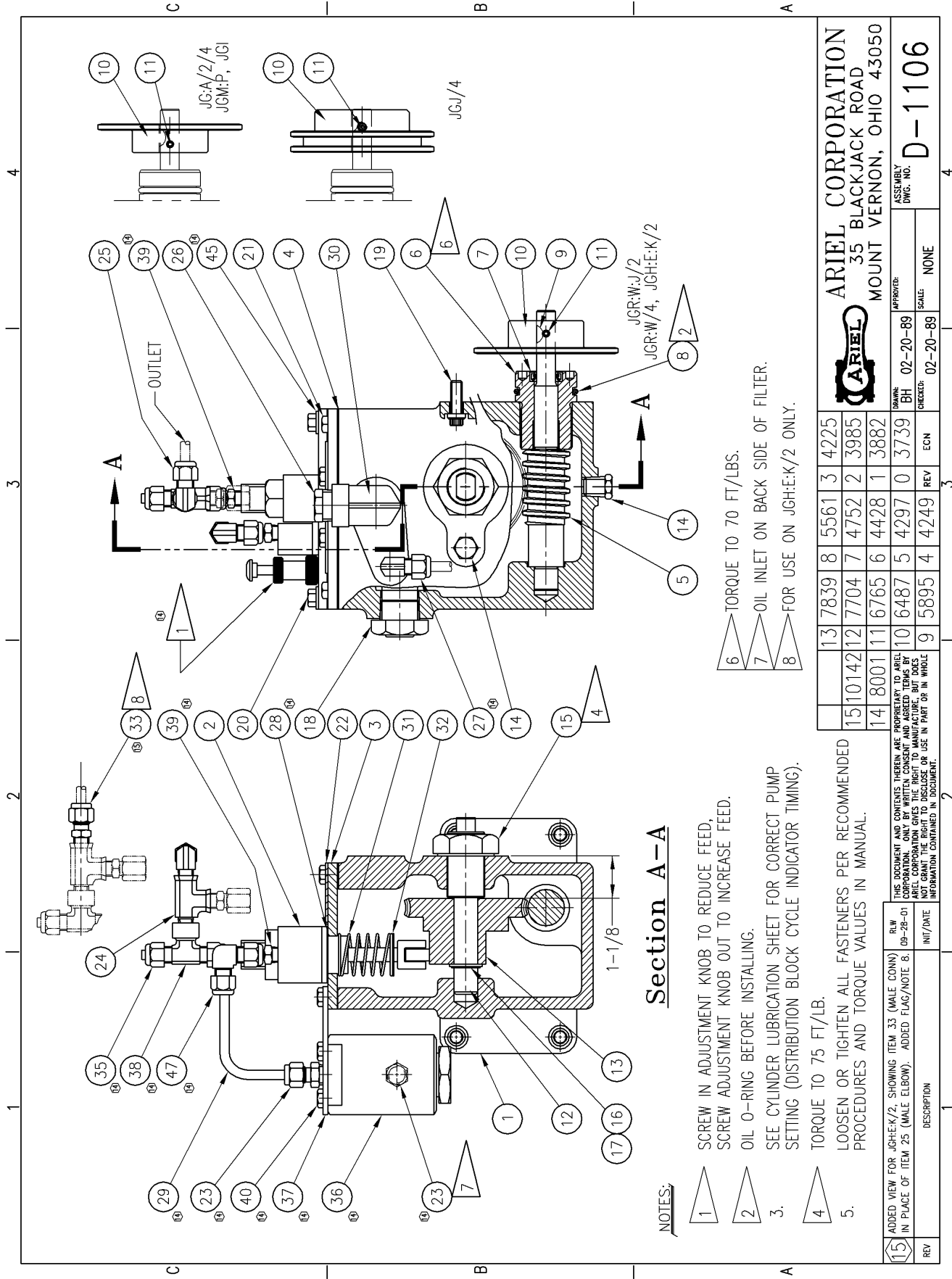
7/27/10

PARTS LIST

86	A-0864	1	MALE BRANCH TEE, STL, 1/2P
87	A-15558	1	STREET TEE, STL, 1/2P
90	A-0828	1	HEX RED NIPPLE, STL, 3/4M X 1/2M
91	FC0105CE	3	HEX HD CAP, 1/4-28 X 3/4 G9
92	A-0859	1	MALE CONN, STL, 5/8T X 1/2P

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



Section A-A

NOTES:

- 1 SCREW IN ADJUSTMENT KNOB TO REDUCE FEED,
SCREW ADJUSTMENT KNOB OUT TO INCREASE FEED.
- 2 OIL O-RING BEFORE INSTALLING.
- 3 SEE CYLINDER LUBRICATION SHEET FOR CORRECT PUMP
SETTING (DISTRIBUTION BLOCK CYCLE INDICATOR TIMING).
- 4 TORQUE TO 75 FT/LB.
- 5 LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED
PROCEDURES AND TORQUE VALUES IN MANUAL.

- 6 TORQUE TO 70 FT/LBS.
- 7 OIL INLET ON BACK SIDE OF FILTER.
- 8 FOR USE ON JGH:E:K/2 ONLY.

ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050		APPROVER: BH DATE: 02-20-89 CHECKED: 02-20-89 SCALE: NONE		ASSEMBLY DWG. NO. D-1106	
REV	DESCRIPTION	INIT/DATE	R/W	ECN	REV
15	ADDED VIEW FOR JGH:E:K/2, SHOWING ITEM 33 (MALE CONN) IN PLACE OF ITEM 25 (MALE ELBOW). ADDED FLAG/NOTE 8.	09-28-01	15	10142	12
			13	7839	8
			8	5561	3
			3	4225	
			7	4752	2
			2	3985	
			14	8001	11
			6	4428	1
			1	3882	
			5	4297	0
			10	6487	5
			4	4249	4
			9	5895	4

7/27/10

PARTS LIST

FORCE FEED LUBRICATOR
3/16"DIA.PUMP JGP, JGM, JG/2, JGA/2, JGI

PART NO. G-2844
REF DRAWING D-1106

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	D-2000	1	FF LUBR,1, LH,PUMP TANK ASSY
2	A-9476	1	FF LUBR PUMP 3/16 PREMIER
3	A-2346	0	TOP CVR SINGLE FF LUBE BOX
4	A-2348	0	GSKT,ARL SNGL LUB BOX CVR,1/32
5	A-2360	0	WORM SHAFT,FF LUBR 1/2D E
6	A-5638	0	HSG BRG FF LUBE BOX LH
7	A-3911	0	SHAFT OIL SEAL
8	A-0030	0	O-RING,VT, 1.637 O.D. X .139
9	FK0360AA	1	WOODRUFF KEY,#204,1/2D X 1/16
10	A-0072	1	SPKT,35-1 X 30T
11	FS0455CE	1	CUP PT.S-SCRW,NY, 1/4-28 X 3/4
12	A-2352	0	ADJ SHAFT-SINGLE LUBE BOX
13	B-1176	0	CAM/WORM GEAR,1-PUMP FF LUBR
14	PP0810CB	2	PIPE PLUG,1/4NPT,HEX HD,STL
15	FN0457KA	0	HEX NUT,JAM,STL,1"-14
16	A-2359	0	SNAP RING,STL,RADIAL ASSY0.625
17	A-2358	0	FLAT WASHER,SUPPORT,5/8,HARD
18	A-5641	0	SIGHT GLASS,3/4" NPT
19	FC0120DF	4	12 PT CAP,5/16-18 X 7/8 G8
20	FC0102CG	0	HEX HD CAP, 1/4-20 X 1 G5
21	FC0102CE	0	HEX HD CAP, 1/4-20 X 3/4 G5
22	A-16622	1	DATA PLATE,1 & 2 PUMP FF LUBR
23	A-0827	2	MALE CONN,STL, 1/4T X 1/4P

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

24	A-15556	1	STREET TEE, STL, 1/8P
25	A-0815	1	MALE ELBOW, STL, 1/4T X 1/8P
26	PP0810GB	1	PIPE PLUG, 1/2NPT, HEX HD, STL
27	A-0800	1	MALE ELBOW, STL, 1/4T X 1/4P
28	A-16762	0	FF LUB PUMP GSKT, 1/16 X DC100
29	PT0200CB	20.	" SS TUBING, 1/4 OD X .035 WALL
30	A-0843	1	STREET ELBOW, STL, 1/2P, 90
31	A-9619	0	SPRING, FF PUMP, PREMIER
32	A-9618	0	SPRING RETAINER, FF PUMP, PREM
35	A-0918	1	PLUG, TUBE FIT, FEMALE, STL, 1/4T
36	A-8723	1	FF LUBR FILTER, 150 MIC
37	A-8729	1	BRKT, FF INLET FILTER
38	A-8824	1	FEMALE BRANCH TEE STL1/4TX1/8P
39	A-8828	2	MALE ADAPTR, STL, 1/4T X 1/8P
40	FC0102CC	2	HEX HD CAP, 1/4-20 X 1/2 G5
45	FW0500CA	0	WASHER, 1/4" I.D., SAE
47	A-0805	1	UNION ELBOW-TUBE, STL 1/4T
99	A-8723-K	0	FILTER KIT, LUBRICATOR 150 MIC
99	AD-2870	0	FF LUBR, 3/16 1/2S

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

DISTRIBUTION BLOCK, MOUNTING BOLTS AND
SPACER FOR SINGLE BLOCK. JGM:P

PART NO. G-5095
REF DRAWING N.A.

ITEM

NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-5617	2	DIST BLOCK SPACER TRAB
2	FC0102CL	4	HEX HD CAP, 1/4-20 X 2-1/4 G5

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

RUPTURE DISC ASSEMBLY
7300 PSI

PART NO. G-2706
REF DRAWING N.A.

ITEM		QUANTITY	DESCRIPTION
NUMBER	PART NUMBER		
1	A-3535	1	RUPTURE DISC ASSY, 7300 PSI
2	A-3540	0	RUPTURE DISC, 7300 PSIG, BLUE
3	A-2570	1	PLUG PLASTIC, 7 X RED

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

FORCE FEED LUBRICATION TUBING FOR JGM/2, PART NO. G-1080
JGA/2, JG/2, JGP/2 WITH DOUBLE ACTING REF DRAWING N.A.
CYLINDER AND TANDEM

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	PT0200CB	100.	" SS TUBING, 1/4 OD X .035 WALL
2	A-0886	1	BULK.UNION,STL, 1/4T X 1/4T
3	A-0401	1	BRACKET,BULKHEAD UNION
4	FC0134CC	1	BUT HD CAP,1/4-20 X 1/2 316SS

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

FORCE FEED LUBRICATION TUBING
JGM/2, JGP/2, JGA/2, JG/2
WITH TWO DOUBLE ACTING CYLINDERS

PART NO. G-1079
REF DRAWING N.A.

ITEM

NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	PT0200CB	250.	" SS TUBING, 1/4 OD X .035 WALL
2	A-0886	2	BULK.UNION,STL, 1/4T X 1/4T
3	A-0401	2	BRACKET,BULKHEAD UNION
4	FC0134CC	2	BUT HD CAP,1/4-20 X 1/2 316SS

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

FORCE FEED LUBRICATION TUBING FOR UNITS PART NO. G-9055
WITH CYLINDERS OVER 3700 MAWP. REF DRAWING N.A.
JGM THROUGH JGR/2

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	PT0201CD	255.	" TUBING, 316 SS 1/4 OD X .065

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.
*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

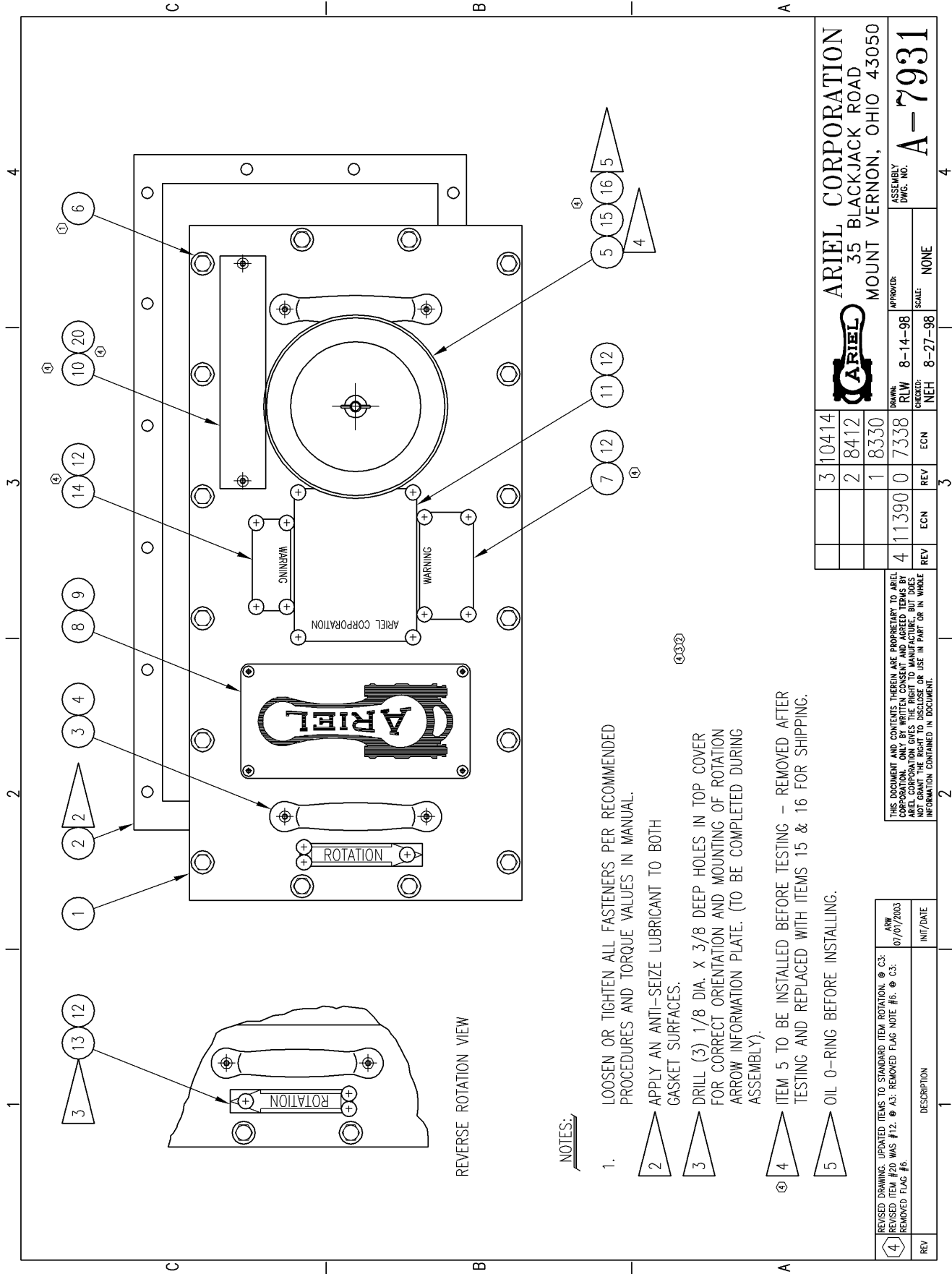
CHAIN DRIVE, STANDARD OR REVERSE ROTATION
JGM, JGP, JGN, JGQ

PART NO. G-0176
REF DRAWING A-7765

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	B-0030	1	ECC VERNIER CAP
2	A-0071	1	IDLER SPACER, JG:A/2:4, I
3	A-0085	1	SPKT, 35-1 X 20T
4	A-0109	8	MACHINE SCREW PLUG, PL, 7/16-14
5	FC0107GS	1	HEX HD CAP, 1/2-20 X 4 G5
6	FW0550GA	1	STAT-O-SEAL, 1/2 DIA., BLACK
7	FN0468GA	1	HEX NUT, STOVER TYPE C, 1/2-20
8	FW0500GA	1	FLAT WASHER, 1/2 SAE
9	A-0010	1	O-RING, VT, 2.637 O.D. X .139
10	FC0100DH	2	HEX HD CAP, 5/16-18 X 1-1/4 G9
11	A-0203	1	CHAIN, 35-1 X 94
12	FW0501CA	2	FLAT WASHER, 5/16 I.D. PLAIN

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



REVERSE ROTATION VIEW

NOTES:

1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.
2. APPLY AN ANTI-SEIZE LUBRICANT TO BOTH GASKET SURFACES.
3. DRILL (3) 1/8 DIA. X 3/8 DEEP HOLES IN TOP COVER FOR CORRECT ORIENTATION AND MOUNTING OF ROTATION ARROW INFORMATION PLATE. (TO BE COMPLETED DURING ASSEMBLY).
4. ITEM 5 TO BE INSTALLED BEFORE TESTING - REMOVED AFTER TESTING AND REPLACED WITH ITEMS 15 & 16 FOR SHIPPING.
5. OIL O-RING BEFORE INSTALLING.

REVISED DRAWING. UPDATED ITEMS TO STANDARD ITEM ROTATION. @ C3: REVISED ITEM #20 WAS #12. @ A3: REMOVED FLAG NOTE #6. @ C3: REMOVED FLAG #6.		INIT/DATE ANW 07/01/2003	
DESCRIPTION		INT/DATE	
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3 10414		4 11390 0 7338	
2 8412		REV ECN	
1 8330		REV ECN	
ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050		ASSEMBLY DWG. NO. A-7931	

7/27/10

PARTS LIST

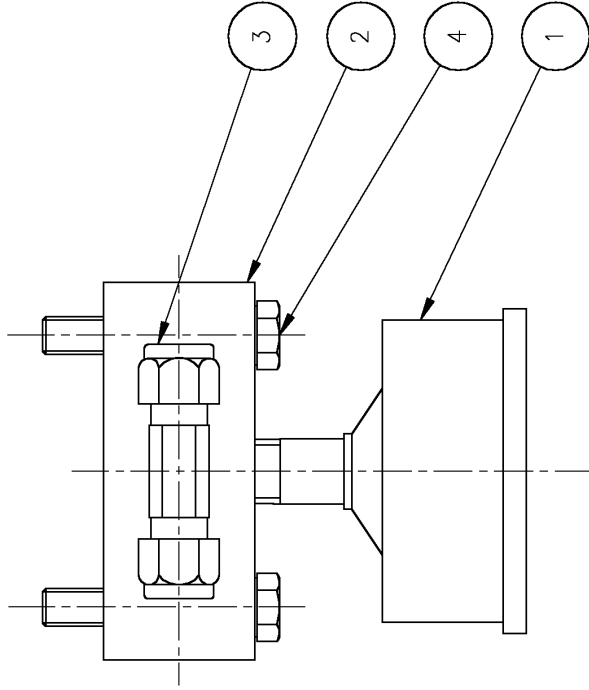
TOP COVER AND BREATHER
JGM, JGP, JGN, JGQ FOR STANDARD AND
REVERSE ROTATION.

PART NO. G-0173
REF DRAWING A-7931

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	B-0103	1	TOP COVER, JGM:P
2	B-0104	1	GSKT,RET,TOP CVR,M:P, 1/32
3	A-2958	2	HANDLE, TOP / SIDE COVER
4	FC0134CD	4	BUT HD CAP,1/4-20 X 5/8 316SS
5	B-4798	1	BREATHER,1"NPT,FRAME
6	A-10186	16	SEMS BOLT, 5/16-18 X 1-1/4
7	A-0463	1	CAUTION PLATE,CYLINDER VENTING
8	A-0138	1	NAME PLATE,ARIEL LOGO
9	FC0134BC	4	BUT HD CAP,10-24 X 1/2 316SS
10	A-0713	1	INFO PLATE,L O FILTER,SPIN-ON
11	A-14766	1	DATA PLATE,FRAME SPECIFICATION
12	FR0570CC	15	DRIVE SCREW, #6 X 1/4 U-TYPE
13	A-0719	1	INFO PLATE,ROTATION ARROW
14	A-0464	1	CAUTION PLT,COMPRESSOR VLV
15	A-7655	1	PIPE PLUG,1"NPT,SLOTTED HEAD
16	A-0009	1	O-RING,VT, 1.387 O.D. X .139
20	FC0134BB	2	BUT HD CAP,10-24 X 3/8 316SS

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.

						 ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050		ASSEMBLY DWG. NO. A-9021	
						DRAWN: WSH 7/28/99 CHECKED: NEH 07/31/99		APPROVED: _____ SCALE: NONE	
		0		7704		ECN		REV	

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REV	DESCRIPTION

7/27/10

PARTS LIST

FORCE FEED PRESSURE GAUGE
7500 PSI, PER BLK. MNPQ

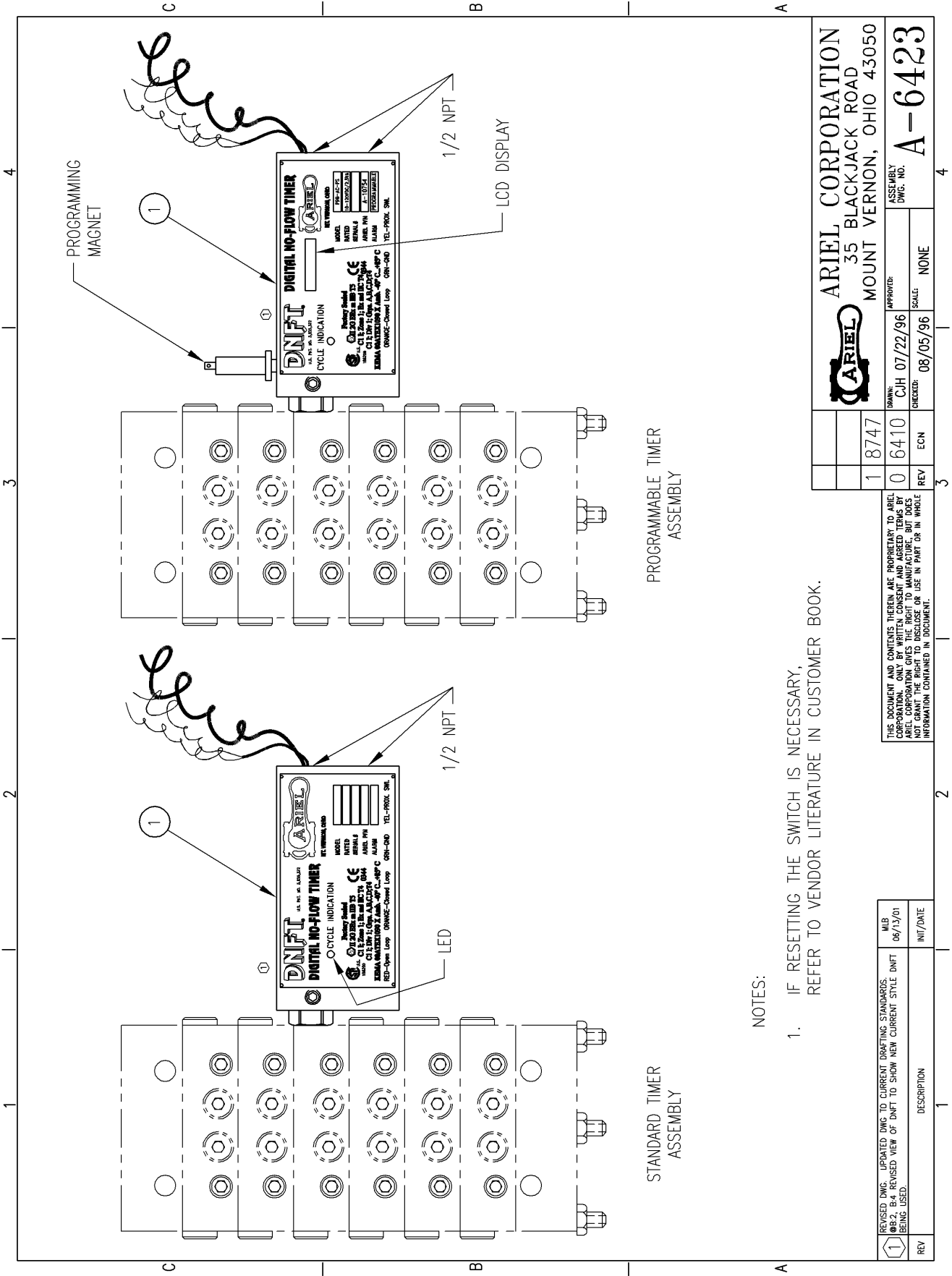
PART NO. G-7676
REF DRAWING A-9021

ITEM

NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-9093	1	GAUGE, 7500 PSI, BACK MOUNT
2	A-9019	1	BRACKET, FF GAGE MOUNTING
3	A-2288	1	MALE BRANCH T, 1/4T X 1/8P
4	FC0102DJ	2	HEX HD CAP, 5/16-18 X 1-3/4G5

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

1. IF RESETTING THE SWITCH IS NECESSARY, REFER TO VENDOR LITERATURE IN CUSTOMER BOOK.

ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050		ASSEMBLY DWG. NO. A-6423	
1 8747	0 6410	APPROVED: C/JH 07/22/96	NONE
REV	ECN	CHECKED: 08/05/96	SCALE:

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REV	DESCRIPTION	INIT/DATE	WJB
1	REVISED DWG. UPDATED DWG TO CURRENT DRAFTING STANDARDS. 08/2, B4: REVISED VIEW OF DNFT TO SHOW NEW CURRENT STYLE DNFT BEING USED.	06/13/01	

7/27/10

PARTS LIST

FORCE FEED LUBRICATOR DIGITAL NO FLOW
TIMER WITH PROXIMITY SWITCH FOR TRABON
DISTRIBUTION BLOCKS

PART NO. G-4669
REF DRAWING A-6423

ITEM

NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-10753	1	FF.S/D,DNFT,PS,TRAB,DC, 3 MIN
99	A-6506	0	DNFT MAGNET ASSY,TRAB, 7/16-20

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

7/27/10

PARTS LIST

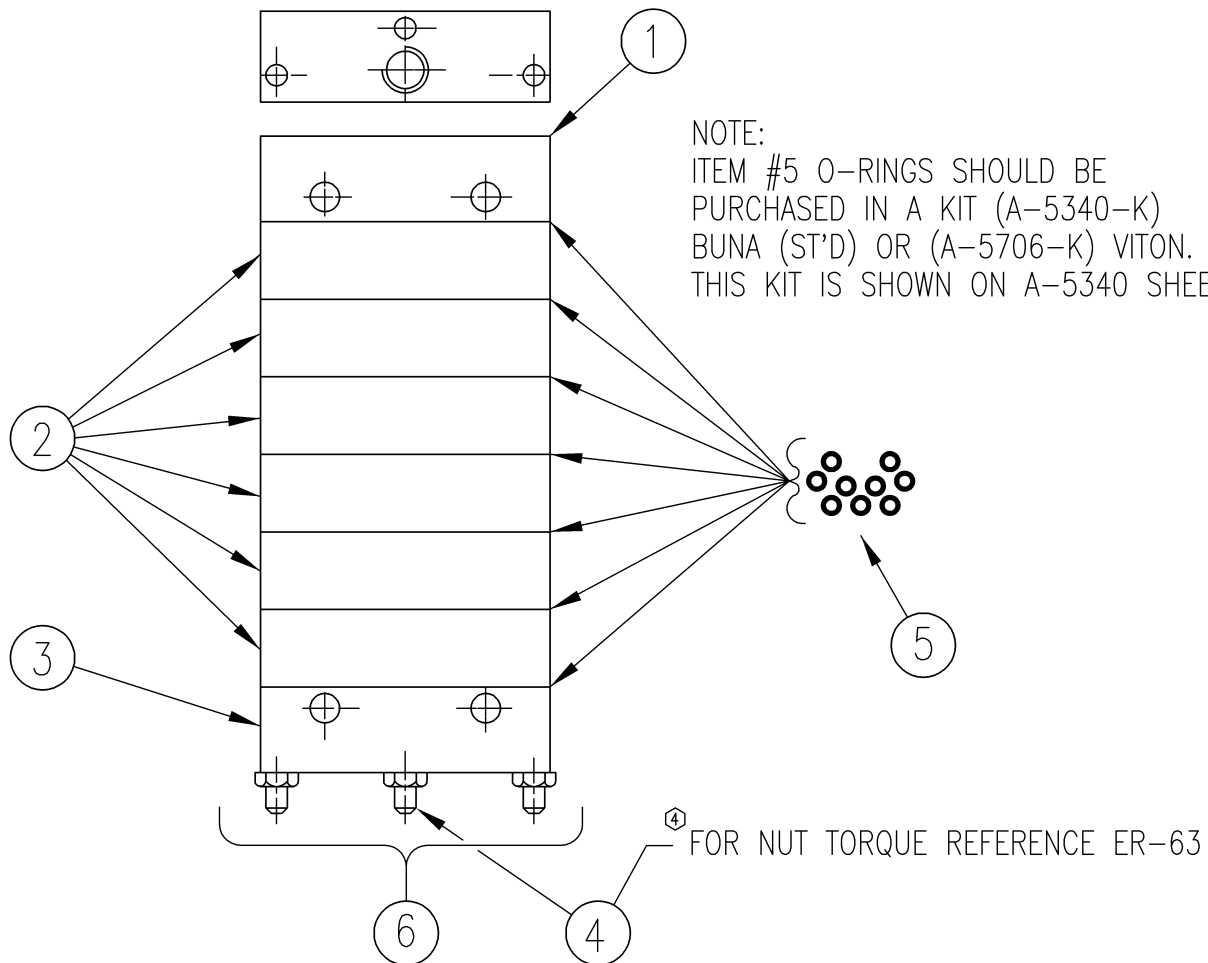
SPECIAL TOOLS
JG:A/2:4, JGP:Q/1:2, JGM:N/1:2, JGS, JGI
PART NO. G-16340
REF DRAWING N.A.

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-0076	1	PEG WRENCH, 3/4"
2	A-0135	1	VALVE PULLER, 5/16 X 1/2 UNF
3	A-0279	1	PISTON NUT SPANNER, JG:M:P
4	A-0409	1	VALVE PULLER, 1/4 X 3/8 UNF
5	A-0798	1	TOOL BOX
6	B-0016	1	CROSSHEAD NUT WRENCH, 2 INCH
7	TA0100CA	10	ALLEN WRENCH, 3/32 SHORT ARM
8	TA0100EA	10	ALLEN WRENCH, 1/8 SHORT ARM
9	TA0100FA	1	ALLEN WRENCH, 9/64 SHORT ARM
10	TA0100GA	5	ALLEN WRENCH, 5/32 SHORT ARM
11	TA0100HA	5	ALLEN WRENCH, 3/16 SHORT ARM
12	TA0100JA	3	ALLEN WRENCH, 1/4 SHORT ARM
13	TA0100KA	3	ALLEN WRENCH, 5/16 SHORT ARM
14	TA0100LB	2	ALLEN WRENCH, 3/8 LONG ARM
15	ER-63	1	TORQUE CHART, ALL UNITS
16	A-8158	0	BRG HSG SPANNER WRENCH
17	A-14781	1	PIST RD ENTER SLEEVE, 2PC JG=Q
18	A-15236	1	THREAD GAUGE

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

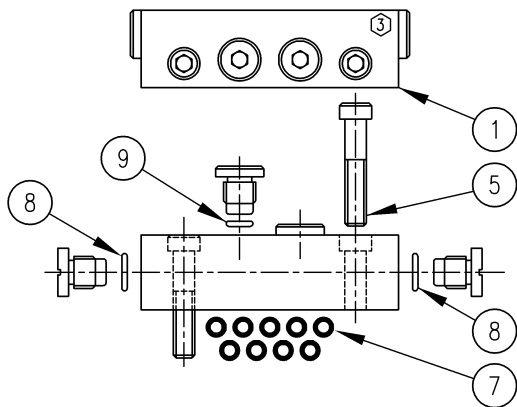
*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

NUMBER OF BASE PLATES SECTIONS				DESCRIPTION	ARIEL PART No.	ITEM
3	4	5	6			
1	1	1	1	INLET SECTION	A-5537	1
3	4	5	6	INTERMEDIATE SECTION	A-5531	2
1	1	1	1	END SECTION	A-5538	3
3				TIE ROD W/NUT	A-5539	4
	3			TIE ROD W/NUT	A-5540	
		3		TIE ROD W/NUT	A-5541	
			3	TIE ROD W/NUT	A-5542	
36	45	54	63	O-RING, BUNA STANDARD	A-5570	5
36	45	54	63	O-RING, VITON	A-5703	
A-5533	A-5534	A-5535	A-5536	COMPLETE BASE PLATE ASSEMBLY		6

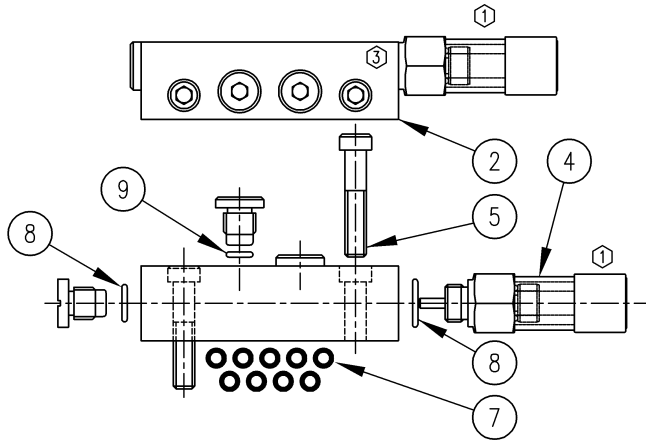


		5 14799		3 10737		 ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050		
		4 12506		2 8200				
	ON SHEET #1: IN TITLE BLOCK, REMOVED VENDOR NAME.		REVISED	DUJ 02/07/2008	1 8175		TITLE: DISTRIBUTION BLOCK VALVE 	DRAWING No. A-5340 SHT 1 OF 2
	ON SHEET #2: IN TITLE BLOCK, REMOVED VENDOR NAME. ITEM #4, PART NUMBER A-14282 WAS A-9787.				0 5695			
REV	DESCRIPTION			INT/DATE	REV	ECN		

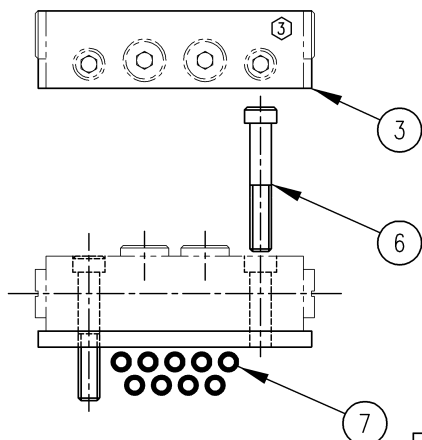
WITHOUT CYCLE PIN



WITH CYCLE PIN



CROSSPORT



ITEM	ARIEL PART	QUAN	DESCRIPTION
1	A-5543	1	DIVIDER VALVE, 6T
	A-5545	1	DIVIDER VALVE, 6S
	A-5547	1	DIVIDER VALVE, 9T
	A-5549	1	DIVIDER VALVE, 9S
	A-5551	1	DIVIDER VALVE, 12T
	A-5553	1	DIVIDER VALVE, 12S
	A-5555	1	DIVIDER VALVE, 18T
	A-5557	1	DIVIDER VALVE, 18S
	A-5559	1	DIVIDER VALVE, 24T
	A-5561	1	DIVIDER VALVE, 24S
	A-5563	1	DIVIDER VALVE, 30T
	A-5565	1	DIVIDER VALVE, 30S
2	A-5544	1	DIVIDER VALVE, 6T W/CIP
	A-5546	1	DIVIDER VALVE, 6S W/CIP
	A-5548	1	DIVIDER VALVE, 9T W/CIP
	A-5550	1	DIVIDER VALVE, 9S W/CIP
	A-5552	1	DIVIDER VALVE, 12T W/CIP
	A-5554	1	DIVIDER VALVE, 12S W/CIP
	A-5556	1	DIVIDER VALVE, 18T W/CIP
	A-5558	1	DIVIDER VALVE, 18S W/CIP
	A-5560	1	DIVIDER VALVE, 24T W/CIP
	A-5562	1	DIVIDER VALVE, 24S W/CIP
	A-5564	1	DIVIDER VALVE, 30T W/CIP
	A-5566	1	DIVIDER VALVE, 30S W/CIP
3	A-5567	1	CROSSPORT BAR, RIGHT
	A-5568	1	CROSSPORT BAR, LEFT
	A-5569	1	CROSSPORT BAR, BOTH
4	A-14282	1	CYCLE INDICATOR
5	FC0115CH	2	SOC. CAP. 1/4-28 X 1-1/4
6	FC0115CI	2	SOC. CAP. 1/4-28 X 1-1/2

NOTE:

O-RINGS SHOULD BE PURCHASED IN A KIT (A-5340-K) BUNA (ST'D) OR (A-5706-K) VITON. THE KITS CONTAIN THE FOLLOWING O-RINGS:

7	A-5570	20	O-RING, INTERFACE, BUNA
	A-5703	20	O-RING, INTERFACE, VITON
8	A-5696	4	O-RING, ENCLOSURE, BUNA
	A-5704	4	O-RING, ENCLOSURE, VITON
9	A-5695	4	O-RING, OUTLET, BUNA
	A-5705	4	O-RING, OUTLET, VITON

5	SEE SHEET #1 FOR REVISIONS.	DLI 02/07/2008	5 14799
4	SEE SHEET #1.	RWR 01/17/03	4 12506
REV	DESCRIPTION	INT/DATE	3 10737
		REV	2 8200
		ECN	1 8175
			0 5695



ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

TITLE: DISTRIBUTION BLOCK VALVE ⑤

DRAWING No. **A-5340** SHT 2 OF 2

1ST STAGE CYLINDER

7/27/10

ARIEL CORPORATION
SALES ORDER COVER SHEET

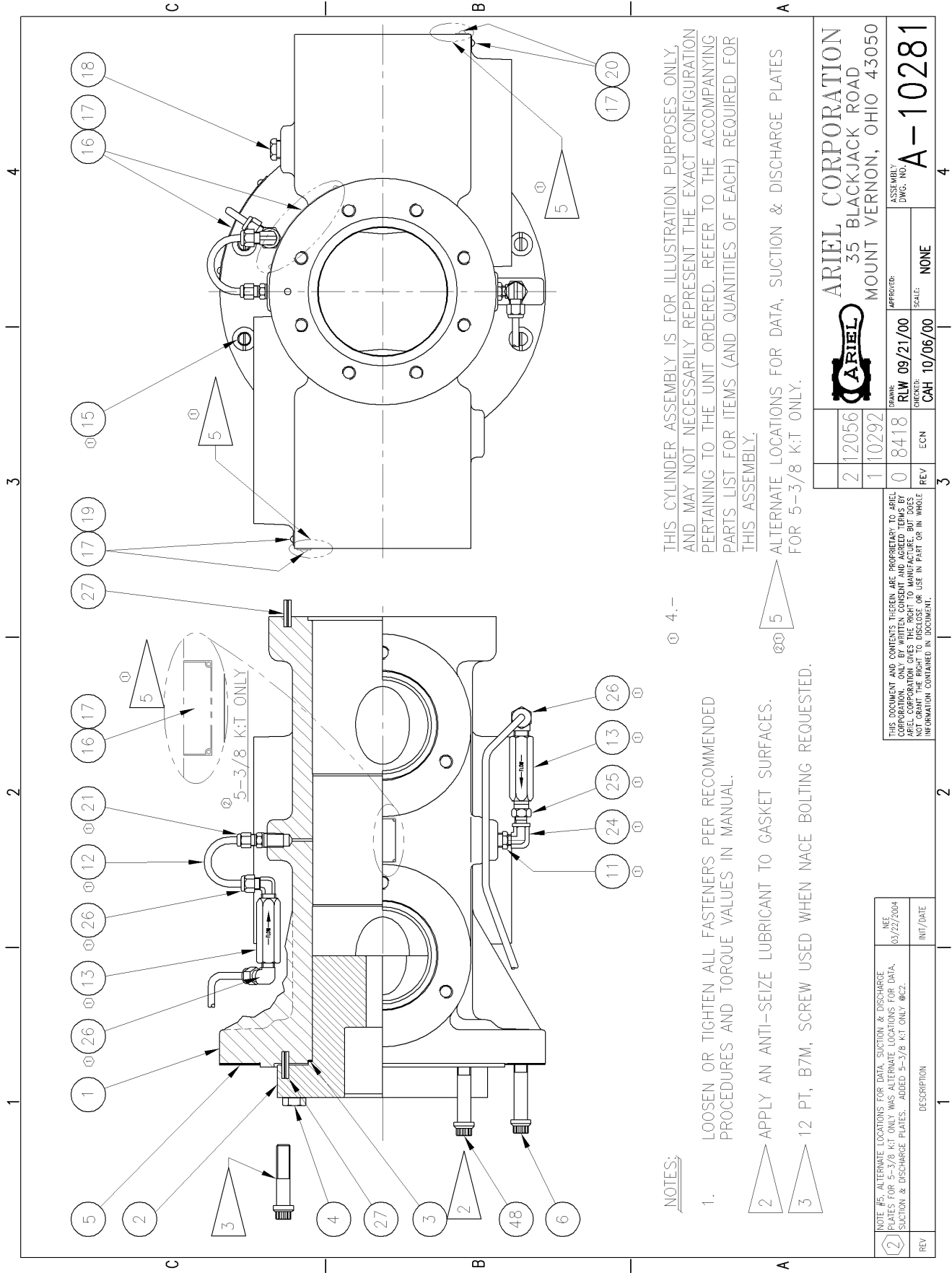
C/N: 001

RHCOVP02

SERIAL #: C-117529

PART: 3-1/2M CLASS DESCRIPTION: 3-1/2"JGM CYLINDER CLASS

PART NUMBER	QUANTITY	DESCRIPTION	DRAWING NO.
G-0422	1	CYL ASSY, 3-1/4M,STD 1050	A-10281
G-10044	2	SUC VLV ASSY, 3-1/2M	A-6362
G-10045	2	DIS VLV ASSY, 3-1/2M	A-6363
G-6714	1	PIST. 3-1/4M0,STD	A-4582
B-3650-BB	2	SUC VLV, 52RX,MTX	A-9202
B-3590-L	2	DIS VLV, 52RX, PKX	A-9208
G-10046	1	HCL VLV ASSY,SUC, 3-1/2M	A-12945
G-1712	1	HE HEAD ASSY, 3-1/4M	A-8170



NOTES:

1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.

2. APPLY AN ANTI-SEIZE LUBRICANT TO GASKET SURFACES.

3. 12 PT, B7M, SCREW USED WHEN NACE BOLTING REQUESTED.

④ 4. —

⑤ 5

THIS CYLINDER ASSEMBLY IS FOR ILLUSTRATION PURPOSES ONLY, AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO THE ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS ASSEMBLY.

⑤ 5 ALTERNATE LOCATIONS FOR DATA, SUCTION & DISCHARGE PLATES FOR 5-3/8 K:T ONLY.

2 12056		1 10292	
0	8418	0	8418
REV	ECN	REV	ECN
CAH 10/06/00		CAH 10/06/00	
NONE		NONE	
DRAWN: RLM 09/21/00		APPROVED: CAH 10/06/00	
CHECKED: CAH 10/06/00		ASSEMBLY DWG. NO. A-10281	

ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

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REV	DESCRIPTION	INIT/DATE	NEE
2	NOTE #5, ALTERNATE LOCATIONS FOR DATA, SUCTION & DISCHARGE PLATES FOR 5-3/8 K:T ONLY WAS ALTERNATE LOCATIONS FOR DATA, SUCTION & DISCHARGE PLATES. ADDED 5-3/8 K:T ONLY @C2.	03/22/2004	

7/27/10

PARTS LIST

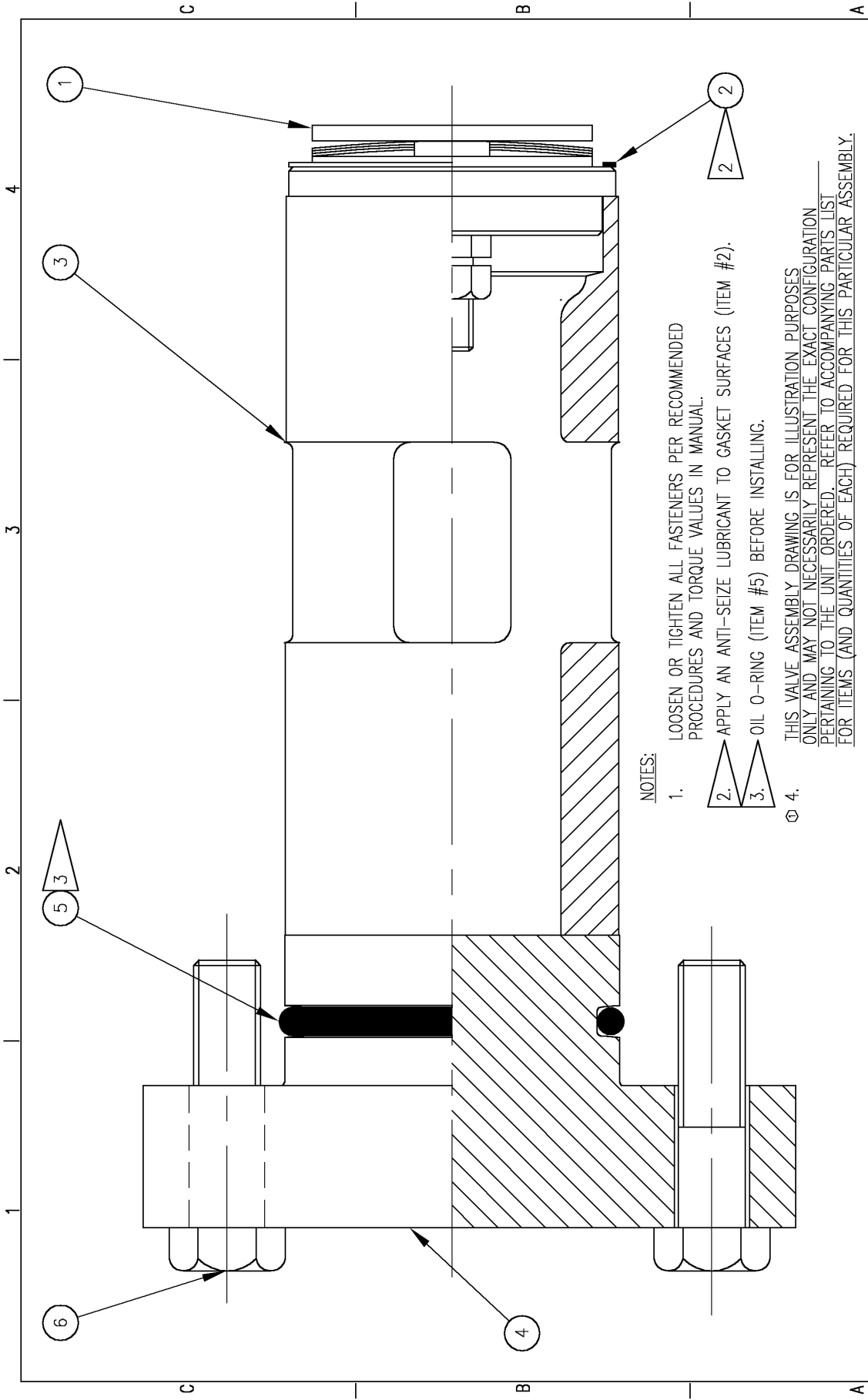
3-1/4"JGM CYLINDER BODY
RDP 955#, MAWP 1050#

PART NO. G-0422
REF DRAWING A-10281

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION	
1	D-0228	0	CYL, 3-1/4M	1050
2	C-0146	0	CE HEAD, 3-1/2M CL	
3	A-0400	1	STL GASKET, 3.875 X 3.625 X 60	
4	FC0100GL	8	HEX HD CAP, 1/2-13 X 2-1/4 G9	
5	A-0065	1	GSKT,RND,12 X 1/64	
6	FC0120GP	4	12 PT,1/2-13 X 3-1/4	G8
12	PT0201CD	39.	" TUBING,316 SS 1/4 OD X .065	
13	A-3780	1	CHK.VLV,DOU.BALL SOFT SEAT SS	
15	A-0256	4	MACHINE SCREW PLUG,PL, 1/2-13	
16	A-0576	1	DATA PLATE,CYLINDER SPEC,SMALL	
17	FR0570CC	8	DRIVE SCREW, #6 X 1/4 U-TYPE	
18	PP0810GB	1	PIPE PLUG,1/2NPT,HEX HD,STL	
19	A-0640-A	1	INFO PLATE,SUCTION	
20	A-0640-B	1	INFO PLATE,DISCHARGE	
21	A-0827	1	MALE CONN,STL, 1/4T X 1/4P	
26	A-0800	2	MALE ELBOW,STL, 1/4T X 1/4P	
48	FC0120G0	4	12 PT,1/2-13 X 3	G8
100	HD-0228	1	CYL ASSY, 3-1/4M	

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.
2. APPLY AN ANTI-SEIZE LUBRICANT TO GASKET SURFACES (ITEM #2).
3. OIL O-RING (ITEM #5) BEFORE INSTALLING.
4. THIS VALVE ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS PARTICULAR ASSEMBLY.

1	ADDED NOTE #4, UPDATED BOARDER	JLS 02/22/01
REV	DESCRIPTION	INIT/DATE

		ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050	
1	8412	ASSEMBLY DWG. NO.	A-6362
0	0598	APPROVED:	
REV	ECN	SCALE:	NONE
		CHECKED:	06/04/96

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7/27/10

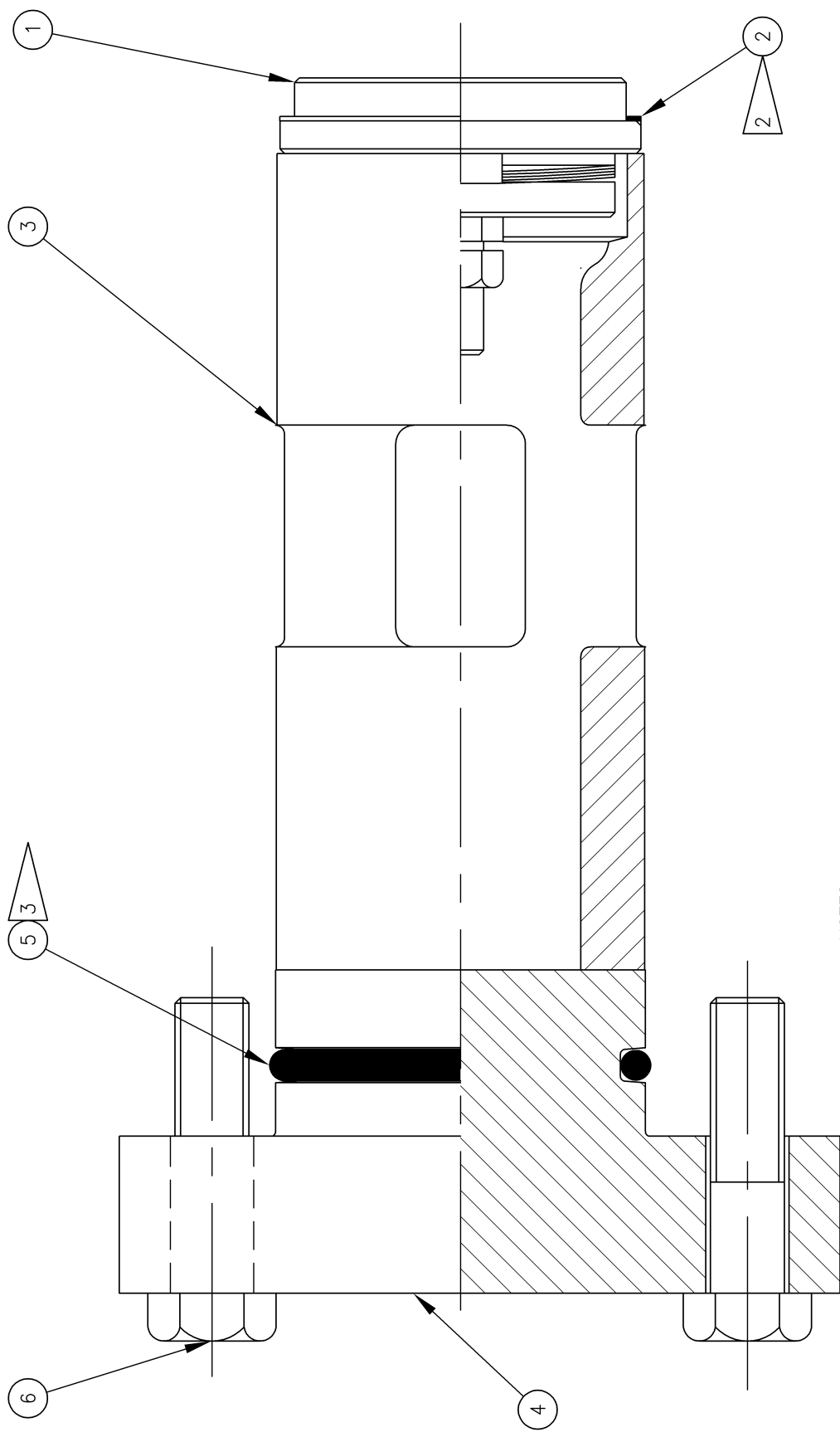
PARTS LIST

SUCTION VALVE, RETAINER AND CAP PART NO. G-10044
3-1/2" JGM CLASS CYLINDER REF DRAWING A-6362
(3-1/2" AND 3" STROKE)

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	SUCTION VALVE	0	FOR PART NO. SEE COVER SHEET
2	A-0257	1	STL GASKET, 2.438 X 2.250 X 30
3	B-3361	1	VLV RET,S&D, 3-1/2M
4	B-0281	0	VLV CAP, 3-1/2M, 3-3/4SP
5	A-0027	1	O-RING,VT, 2.520 O.D. X .210
6	FC0171CED	3	12 PT,1/2 -13 X 2 X 9/16 G8

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.
2. APPLY AN ANTI-SEIZE LUBRICANT TO GASKET SURFACES (ITEM#2).
3. OIL O-RING (ITEM#5) BEFORE INSTALLING.

105956
ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050

ASSEMBLY
 DWG. No. **A-6363**

DESCRIPTION	
REV	

7/27/10

PARTS LIST

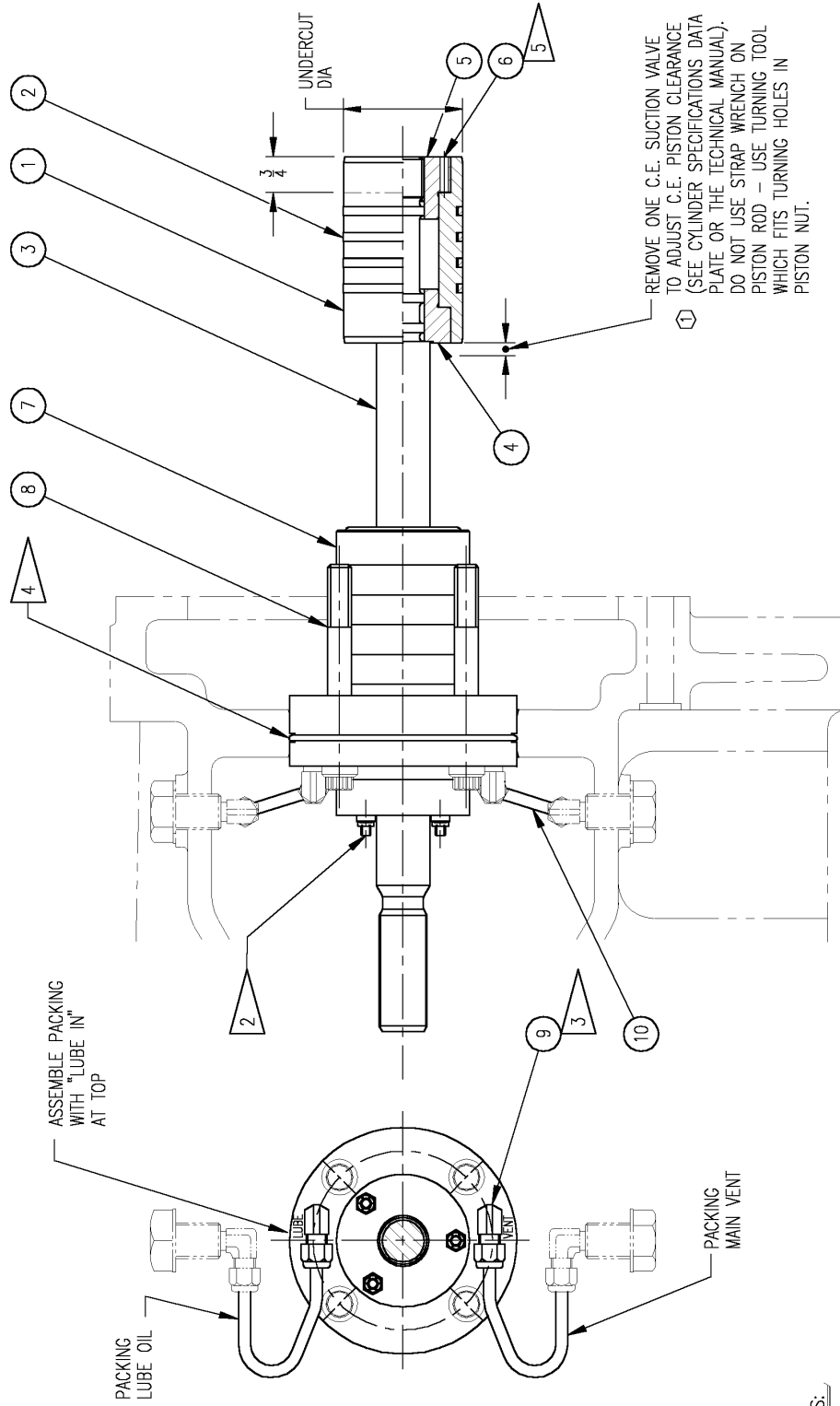
DISCHARGE VALVE, RETAINER AND CAP
3-1/2" CLASS JGM CYLINDER
(3-1/2" AND 3" STROKE)

PART NO. G-10045
REF DRAWING A-6363

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	DISCHARGE VALV	0	FOR PART NO. SEE COVER SHEET
2	A-0257	1	STL GASKET, 2.438 X 2.250 X 30
3	B-3361	1	VLV RET,S&D, 3-1/2M
4	B-0281	0	VLV CAP, 3-1/2M, 3-3/4SP
5	A-0027	1	O-RING,VT, 2.520 O.D. X .210
6	FC0171CED	3	12 PT,1/2 -13 X 2 X 9/16 G8

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.
2. RETIGHTEN TIE STUD NUTS AFTER CASE (ITEM 7) IS BOLTED INTO CYLINDER.
3. ASSEMBLY FITTINGS (ITEM 9) BEFORE INSTALLING PACKING.
4. OIL O-RING BEFORE INSTALLING.
5. PRICK PUNCH TO RETAIN SET SCREWS (ITEM 6).

ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050		THIS DOCUMENT AND CONTENTS THEREIN ARE PROPRIETARY TO ARIEL CORPORATION. ONLY BY WRITTEN CONSENT AND AGREED TERMS BY ARIEL CORPORATION CAN ANY PART OF THIS DOCUMENT BE REPRODUCED OR NOT GRANT THE RIGHT TO DISCLOSE OR USE IN PART OR IN WHOLE INFORMATION CONTAINED IN DOCUMENT.	
		REV 1	DESCRIPTION
1	6900	REV 0	DESCRIPTION
ARIEL CORPORATION		APPROVED: 11-23-94	ASSEMBLY DWG. NO. A-4582
35 BLACKJACK ROAD		CHECKED: 11-15-94	SCALE: NONE
MOUNT VERNON, OHIO 43050		DRAWN: WRB 06-01-94	ECN

7/27/10

PARTS LIST

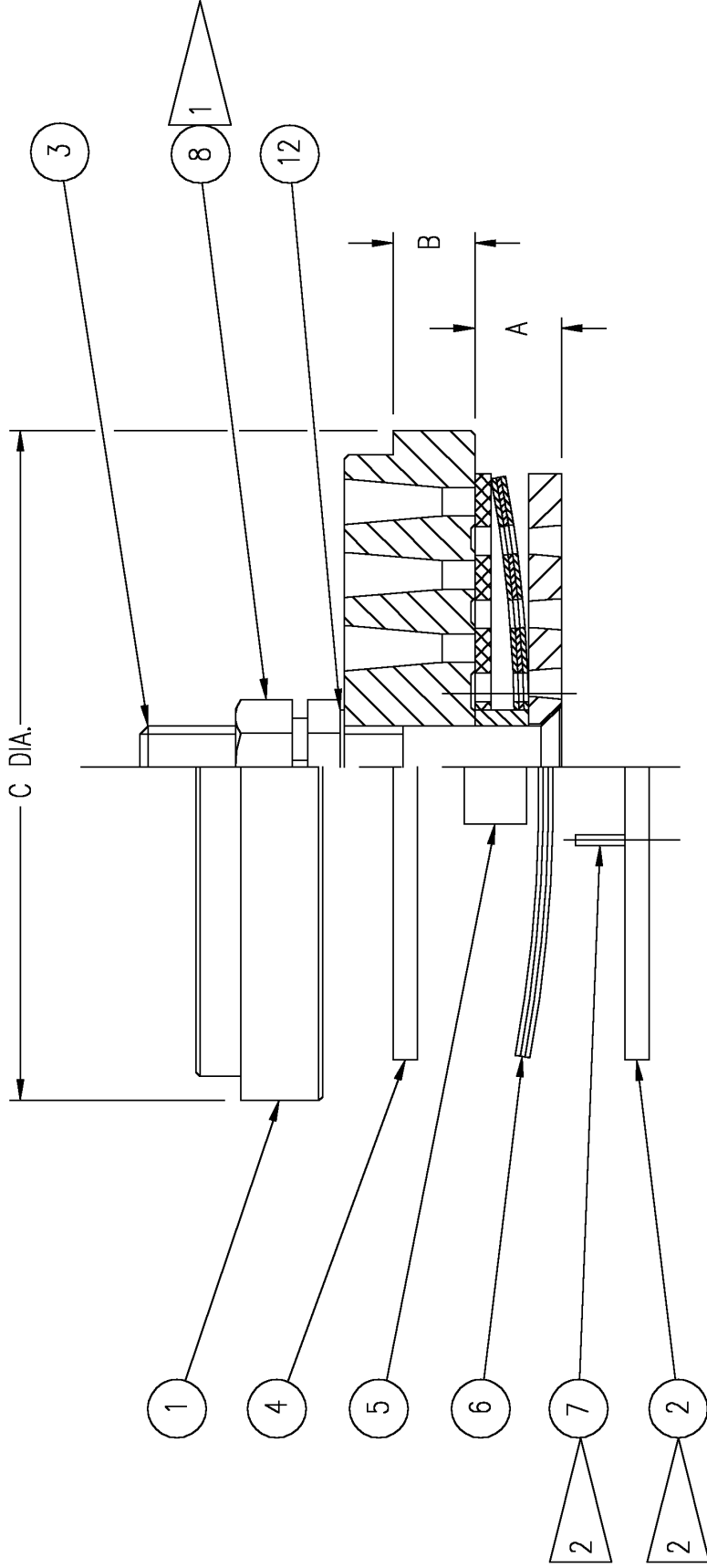
3-1/4" JGM PISTON, TFE RINGS, TFE/CI
PACKING. 3" STROKE

PART NO. G-6714
REF DRAWING A-4582

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	B-0285	1	PIST, , 3-1/4M0
2	A-0291	4	PISTON RING, 3-1/4M:P
3	C-0138	1	P ROD, 3.00STK/18.557LG
4	A-0057	1	PISTON COLLAR, 2-1/2=8JG:MP
5	B-0019	1	PISTON NUT, 2-1/4"THRU 8"JG:MP
6	FS0405BE	2	CUP PT.SET-SCREW, #10-32 X 3/4
7	B-2648	1	PKG,1.125,2550,STD
8	FC0120GN	4	12 PT,1/2-13 X 2-3/4 G8
9	A-0815	0	MALE ELBOW,STL, 1/4T X 1/8P
10	PT0200CB	12.	" SS TUBING, 1/4 OD X .035 WALL
99	B-2648-K	0	RBLD KIT,PIST ROD PKG,1.125

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

1. SEE MANUAL FOR TORQUE VALUES (ITEM #8).
2. VALVE GUARD ASSEMBLY (ITEM #2) CONSISTS OF VALVE GUARD AND SPIROL PIN (ITEM #7).

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050

TITLE: SUCTION VALVE, RX		MATERIAL: PROCURED	
DRAWN: IG 9/21/99		R.S. No.	
CHECKED: ED 10/1/99		PART NO.	
SCALE: NONE		DWG. No: A-9202	
REV	DESCRIPTION	REV	ECN
0	7799	0	7799

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DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
 ---- DO NOT SCALE DRAWING ----
 DIMENSIONING AND TOLERANCING PER ARIEL SPECIFICATION ER-17.0.1 UNLESS OTHERWISE SPECIFIED.

7/27/10

PARTS LIST

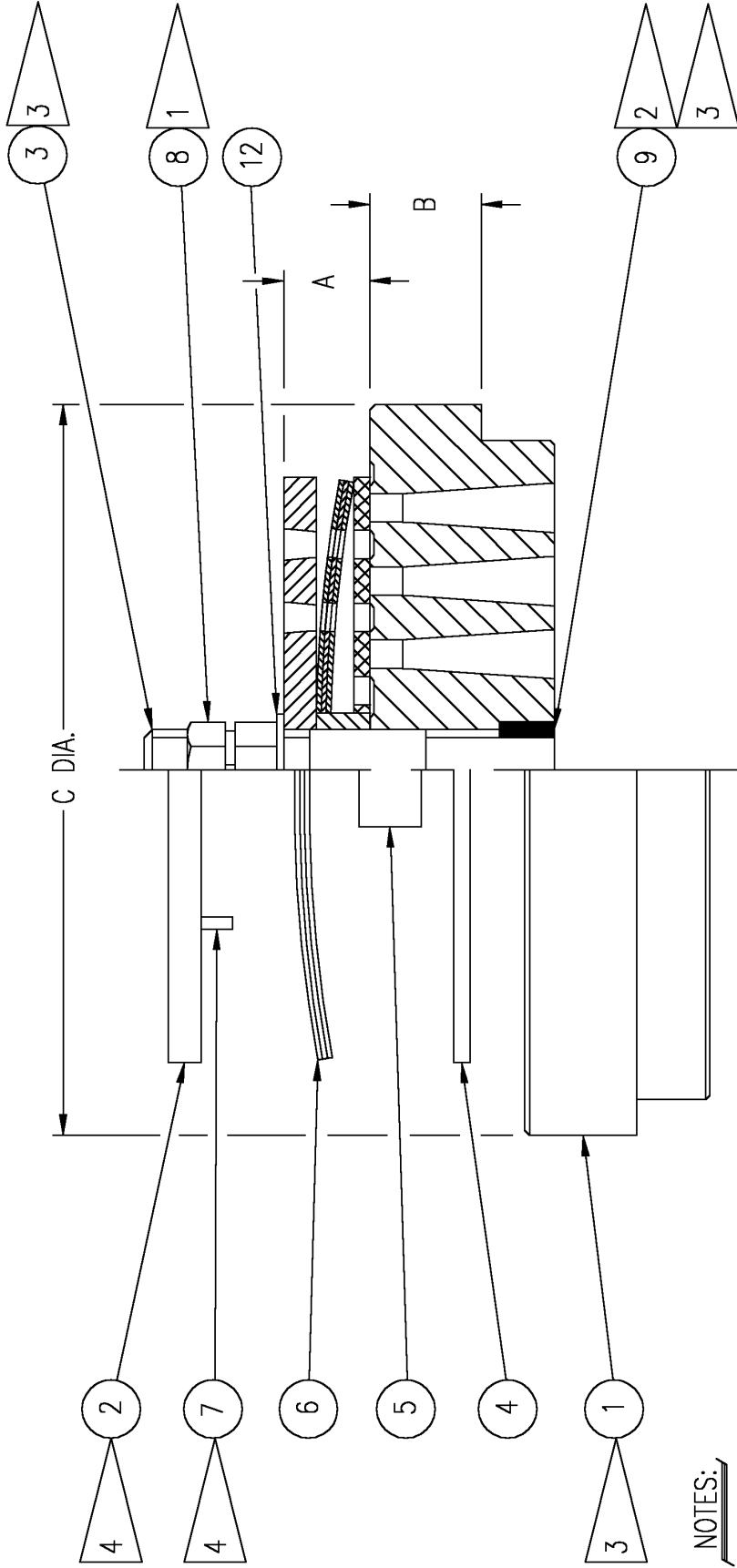
0.2640=A
0.4170=B
2.4410=C
0.0470=LFT

PART NO. B-3650-BB
REF DRAWING A-9202

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-11438	1	SUC VLV SEAT, 52RX
2	A-1173-C	1	SUC VLV GUARD ASSY, 52RX
3	A-10368	1	CNTR STUD, 5/16-24X2.047
4	A-9147	1	VLV PLT, 52RX.118THK, MTX
5	A-7710	1	GUIDE RING, 52RX, .232 THK
6	A-1002	3	SPRING PLATE, 52RX, .020 THK
7	A-1162	1	SPIROL PIN, .078D X .438L
8	A-1366	1	LOCKNUT, DRAKE, 5/16-24
12	A-11437	1	VLV WASHER, 5/16, .118 THK
99	KB-3650-BB	0	KIT, VLV, 52RX, MTX

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

1. SEE MANUAL FOR TORQUE VALUES (ITEM #8).
2. INSTALL PER ER-52.
3. VALVE SEAT ASSEMBLY (ITEM #1) CONSISTS OF VALVE SEAT, CENTER STUD (ITEM #3) AND DOWEL PIN (ITEM #9).
4. VALVE GUARD ASSEMBLY (ITEM #2) CONSISTS OF VALVE GUARD AND SPIROL PIN (ITEM #7).

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050

TITLE: DISCHARGE VALVE, RX		MATERIAL: PROCURED	
DRAWN: IC 9/21/99		R.S. No.	
CHECKED: ED 10/1/99		PART NO.	
SCALE: NONE		DWG. No: A-9208	
REV	DESCRIPTION	REV	ECN
0	7799	0	7799

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 ---- DO NOT SCALE DRAWING ----

DIMENSIONING AND TOLERANCING PER ARIEL SPECIFICATION ER-17.0.1 UNLESS OTHERWISE SPECIFIED.

7/27/10

PARTS LIST

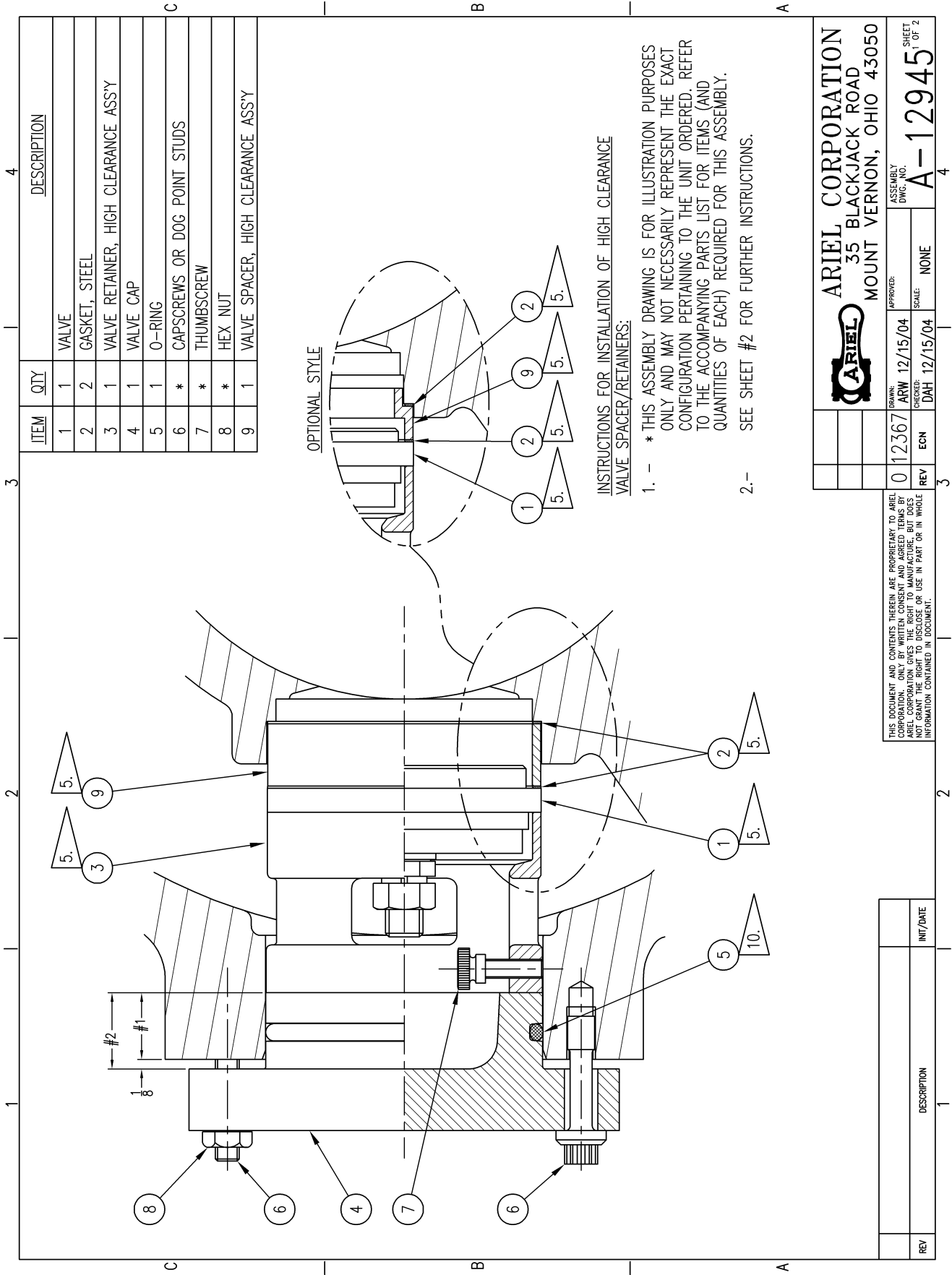
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0.4170=B
2.4400=C
0.0470=LFT

PART NO. B-3590-L
REF DRAWING A-9208

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-11990-A	1	DIS VLV SEAT ASSY, 52RX
2	A-10349-A	1	DIS VLV GUARD ASSY, 52RX
3	A-1325	1	CNTR STUD, 5/16-24X2.323 STL
4	A-10350	1	VLV PLT, 52RX.118THK, PKX
5	A-1290	1	GUIDE RING, 52RX, .213 THK
6	A-1002	2	SPRING PLATE, 52RX, .020 THK
7	A-1314	1	SPIROL PIN, .078D X .563L
8	A-1366	1	LOCKNUT, DRAKE, 5/16-24
9	A-16466	1	LOCK, STUD .098D
12	A-11437	1	VLV WASHER, 5/16, .118 THK
99	KB-3590-L	0	KIT, VLV, 52RX, PKX

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



		APPROVED:	
ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050		DRAWN: ARW 12/15/04	
REV	ECN	CHECKED: DAH 12/15/04	SCALE: NONE
0 12367		ASSEMBLY Dwg. No. A-12945	

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REV	DESCRIPTION	INIT/DATE

7/27/10

PARTS LIST

HIGH CLEARANCE SUCTION VALVE, SPACER AND
RETAINER
3-1/2" JGM CLASS CYLINDER

PART NO. G-10046
REF DRAWING A-12945 2 SHT

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	SUCTION VALVE	0	FOR PART NO. SEE COVER SHEET
2	A-0257	2	STL GASKET, 2.438 X 2.250 X 30
3	B-3362	1	HCL VLV RET,S&D, 3-1/2M CL
4	B-0281	0	VLV CAP, 3-1/2M, 3-3/4SP
5	A-0027	1	O-RING,VT, 2.520 O.D. X .210
6	FC0171CED	0	12 PT,1/2 -13 X 2 X 9/16 G8
9	A-0268	1	HCL VSPCR,3M,3-1/4P,3-5/8JG:HE

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

INSTRUCTIONS FOR INSTALLING HIGH CLEARANCE VALVE SPACER/RETAINERS: Cont.

WARNING:

BEFORE ATTEMPTING TO REMOVE ANY VALVE CAP, BE VERY CERTAIN THAT ALL GAS PRESSURE HAS BEEN VENTED FROM THE CYLINDER. PRESSURE MUST BE COMPLETELY VENTED FROM BOTH THE SUCTION AND DISCHARGE PASSAGES OF THE CYLINDER.

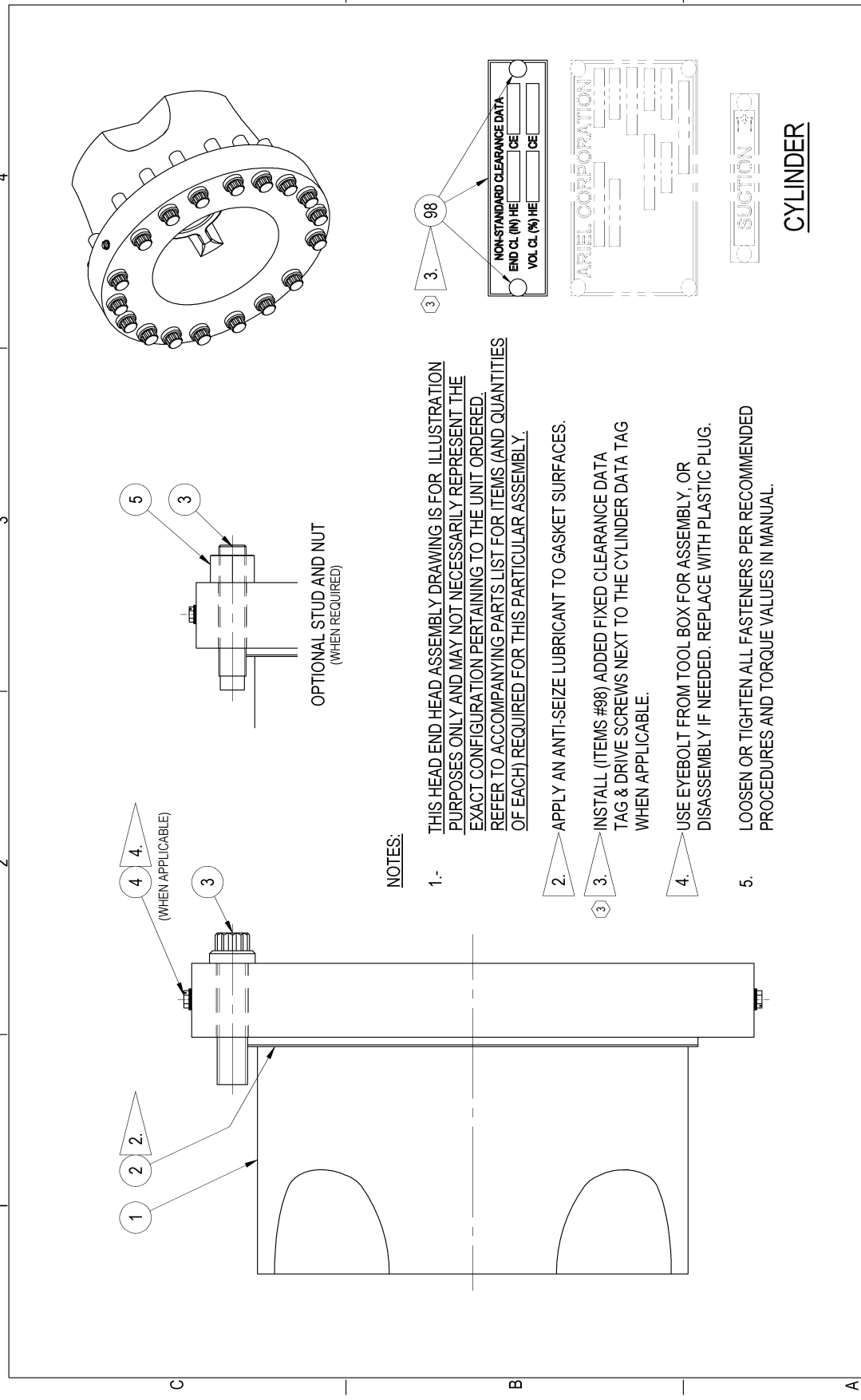
- 3.- REMOVE VALVE CAP AND EXTRACT EXISTING VALVE RETAINER, VALVE AND GASKET.
- 4.- AFTER CLEANING AND INSPECTING THE VALVE POCKET BORE, INSTALL A NEW METALLIC GASKET COATED WITH AN ANTI-SEIZE LUBRICANT TO RETAIN IT IN POSITION WHILE THE REMAINDER OF THE ASSEMBLY IS INSERTED.
5.  ASSEMBLE VERTICALLY; THE SPACER, METALLIC GASKET (COATED WITH AN ANTI-SEIZE LUBRICANT), VALVE AND NEW VALVE RETAINER. IF ADDITIONAL CLEARANCE IS NOT REQUIRED REMOVE THE SPACER AND USE THE STANDARD RETAINER. THE SPACER IS NOT DESIGNED TO BE PLACED BETWEEN THE VALVE AND RETAINER
- 6.- THREAD THE VALVE PULLER ONTO VALVE CENTER BOLT AND PICK UP THE ASSEMBLY HOLDING THE SPACER AND NEW VALVE RETAINER IN POSITION.
- 7.- INSERT THE ASSEMBLY INTO THE APPROPRIATE VALVE POCKET. TO CHECK IF THE VALVE ASSEMBLY IS SEATED PROPERLY TWIST THE VALVE PULLER HANDLE CLOCKWISE. IF SEATED PROPERLY THE ASSEMBLY SHOULD SPIN. TO ENSURE THE VALVE ASSEMBLY IS FULLY "HOME", MEASURE DISTANCE #1 FROM THE TOP OF THE VALVE RETAINER TO THE EDGE OF THE VALVE POCKET BORE. MEASURE THE NOSE LENGTH ON THE VALVE CAP, DISTANCE #2 AND SUBTRACT DIMENSION #1 FROM IT. 1/8" WILL BE THE RESULT. IF YOU HAVE A VALUE GREATER THAN 1/8" CALL THE ARIEL RESPONSE CENTER AT 1-888-397-7766 (NORTH AMERICA) OR 1-740-397-3602 (INTERNATIONAL) FOR ASSISTANCE.
- 8.- HOLD THE VALVE ASSEMBLY IN VALVE POCKET USING HAND AND UNTHREAD THE VALVE PULLER.
- 9.- WHILE STILL HOLDING THE VALVE ASSEMBLY IN VALVE POCKET, TIGHTENING THE THUMBSCREWS (PROVIDED ON DISCHARGE RETAINER ONLY).
10.  INSTALL OILED, NEW O-RING ON THE VALVE CAP AND INSERT IN THE VALVE POCKET.
- 11.- INSTALL CAP SCREWS AND TIGHTEN EVENLY, IN SMALL STEPS, TO PROPER TORQUE PER ER-63.

NOTE:

IF ASSEMBLED CORRECTLY, THERE SHOULD BE AN 1/8" GAP BETWEEN THE VALVE CAP AND THE CYLINDER VALVE PAD.

[illegible]

1 2 3 4



NOTES:

- 1.- THIS HEAD END HEAD ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS PARTICULAR ASSEMBLY.
2. APPLY AN ANTI-SEIZE LUBRICANT TO GASKET SURFACES.
3. INSTALL (ITEMS #98) ADDED FIXED CLEARANCE DATA TAG & DRIVE SCREWS NEXT TO THE CYLINDER DATA TAG WHEN APPLICABLE.
4. USE EYEBOLT FROM TOOL BOX FOR ASSEMBLY, OR DISASSEMBLY IF NEEDED. REPLACE WITH PLASTIC PLUG.
5. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.

3 REDRAWN IN SOLID EDGE. @B2: REVISED NOTE #3 WAS REFER TO ACCOMPANYING PARTS LIST FOR CORRECT FASTENERS...@A4 & B4: ADDED ITEMS #98 & VIEWS.		CPM 04/2010	THIS DOCUMENT AND CONTENTS THEREIN ARE PROPRIETARY TO ARIEL CORPORATION. ONLY BY WRITTEN CONSENT AND AGREED TERMS BY ARIEL CORPORATION GIVES THE RIGHT TO DISCLOSE OR USE IN PART OR IN WHOLE INFORMATION CONTAINED IN DOCUMENT.													
			REV	DESCRIPTION	INITIATE	REV	ECON	REV	ECON	REV	ECON	REV	ECON			
												</				



ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

ASSEMBLY
DWG. NO.

SCALE

7/27/10

PARTS LIST

HEAD END HEAD
3-1/4" JGM CYLINDER

PART NO. G-1712
REF DRAWING A-8170

ITEM		QUANTITY	DESCRIPTION
NUMBER	PART NUMBER		
1	C-0715	1	HE HEAD, 3-1/4M
2	A-0400	1	STL GASKET, 3.875 X 3.625 X 60
3	FC0100GL	8	HEX HD CAP, 1/2-13 X 2-1/4 G9

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

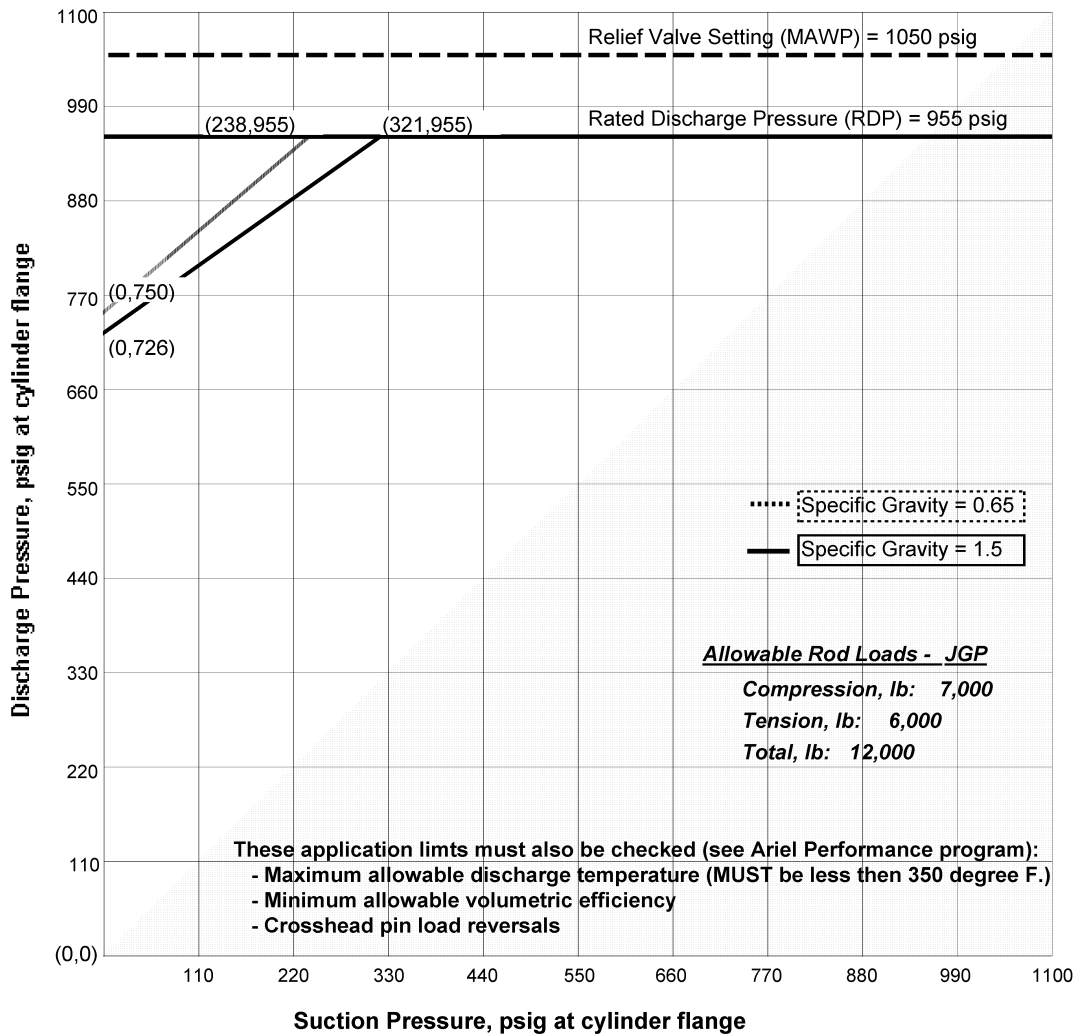
*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

Estimated Gas Rod Load and Pressure Limits for 3 inch stroke at 1800 RPM

Cylinder Class: 3-1/2M

Bore, inches: 3.250

Cylinder Serial Number: C-117529



This chart defines allowable operating limits for gas rod loads and standard working pressures. Pressure combinations falling above the line for the applicable Specific Gravity of the gas being compressed will exceed the Rod Load limitations of the equipment.

Calculations are based on 80 degrees Fahrenheit hydrocarbon gas at 1500 ft. elevation.

2ND STAGE CYLINDER

7/27/10

ARIEL CORPORATION
SALES ORDER COVER SHEET

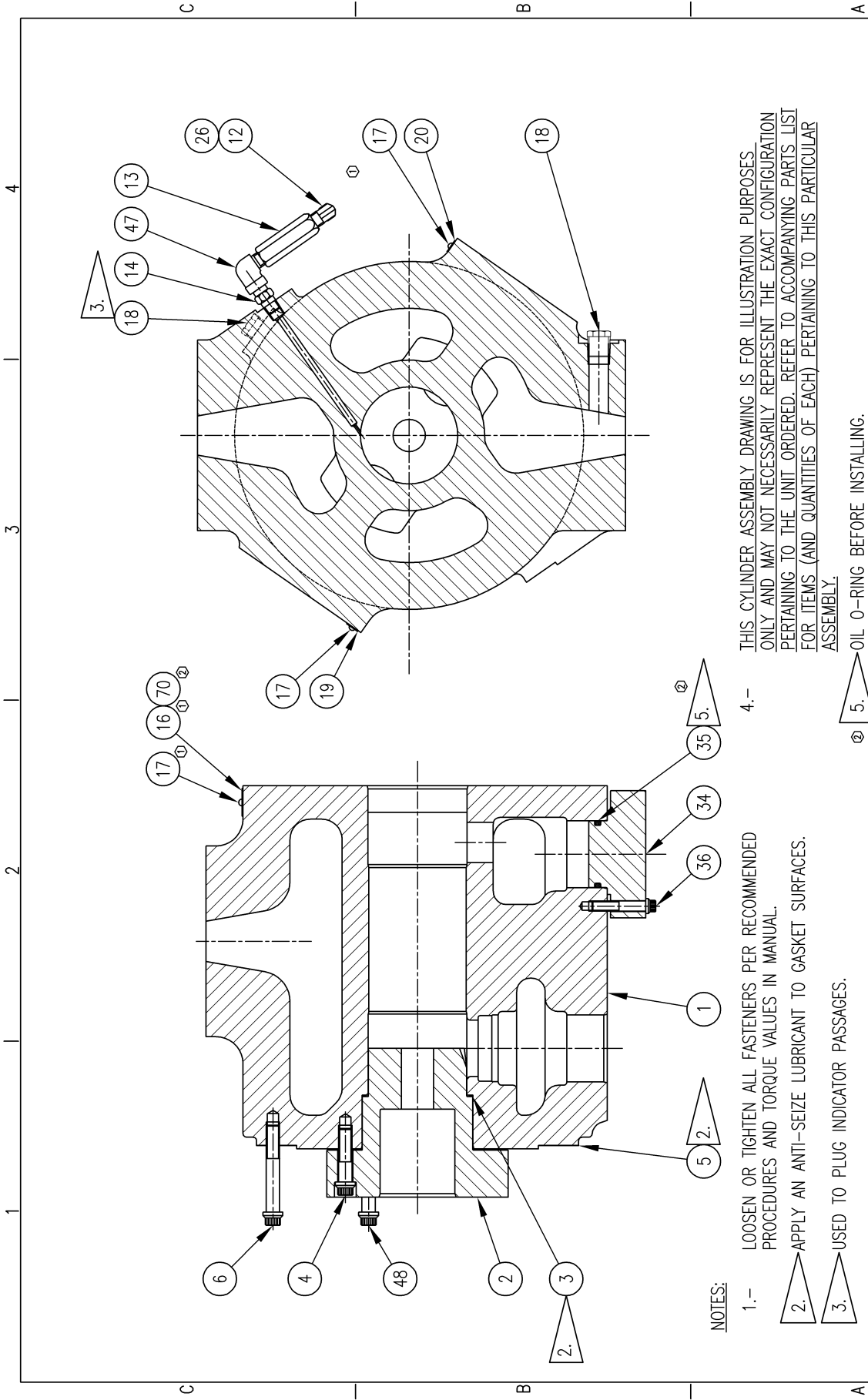
C/N: 001

RHCOVP02

SERIAL #: C-117527

PART: 3SG CE HP DESCRIPTION: 3SG-CE-HP CYLINDER CLASS

PART NUMBER	QUANTITY	DESCRIPTION	DRAWING NO.
G-14815	1	CYL, 3 SG-CE-HP, 4.55"AFC 3000	A-13895
G-11157	1	SUC VLV ASSY, 3SG-CE & HP	A-6267
G-11158	1	DIS VLV ASSY, 3SG-CE & HP	A-6267
G-16040	1	PIST. 3.000 X 1.250SA-HP	A-10982
B-4087-AA	1	SUC VLV, 52RX ,MTX	A-9251
B-3712-M	1	DIS VLV, 52RX ,PKX	A-9208



NOTES:

- 1.- LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.
2. APPLY AN ANTI-SEIZE LUBRICANT TO GASKET SURFACES.
3. USED TO PLUG INDICATOR PASSAGES.

- 4.- THIS CYLINDER ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) PERTAINING TO THIS PARTICULAR ASSEMBLY.
5. OIL O-RING BEFORE INSTALLING.

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050



ASSEMBLY
 DWG. NO. **A-13895**

REV	ECN	REV	ECN	REV	ECN
2	15391	1	13904	0	13629

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REV	DESCRIPTION	INIT/DATE
②	④A3: ADDED NOTE #5. ADDED FLAG #5. ④C3: ADDED ITEM #70. UPDATED TO CURRENT STANDARDS. UPDATED BORDER.	CPW 08/18/08
①	RELOCATED ITEM #16 (CYL. DATA TAG) FROM C4 TO C2.	JRY 09/08/2006

7/27/10

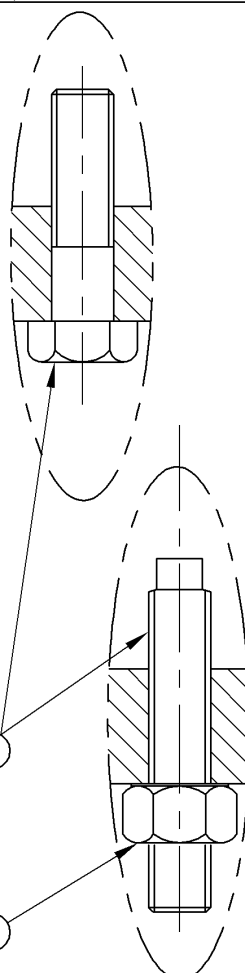
PARTS LIST

3" SG-CE-HP TANDEM CYLINDER BODY & CRANK PART NO. G-14815
 END HEAD. VENT CAP.4.55IN3 ADDED FIXED REF DRAWING A-13895
 CLEARANCE. RDP 2727#, MAWP 3000#

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	D-4523	0	CYL, 3 SG-CE-HP 3000
2	C-5121	0	CE HEAD, 3 SG-CE-HP,4.55"AFC
3	A-11395	1	STL GASKET, 3.500 X 3.105 X 60
4	FC0120GK	12	12 PT,1/2-13 X 2 G8
5	A-0065	1	GSKT,RND,12 X 1/64
6	FC0120GP	8	12 PT,1/2-13 X 3-1/4 G8
12	PT0201CD	24.	" TUBING,316 SS 1/4 OD X .065
13	A-3780	1	CHK.VLV,DOU.BALL SOFT SEAT SS
14	A-3529	1	HEX PIPE NIPPLE,STL,1/4 X 1/4
16	A-0576	1	DATA PLATE,CYLINDER SPEC,SMALL
17	FR0570CC	10	DRIVE SCREW, #6 X 1/4 U-TYPE
18	PP0810GB	2	PIPE PLUG,1/2NPT,HEX HD,STL
19	A-0640-A	1	INFO PLATE,SUCTION
20	A-0640-B	1	INFO PLATE,DISCHARGE
26	A-0800	1	MALE ELBOW,STL, 1/4T X 1/4P
34	B-4305	0	VENT CAP,3&3-5/8SG-CE CL
35	A-0027	2	O-RING,VT, 2.520 O.D. X .210
36	FC0120EK	16	12 PT CAP, 3/8-16 X 2 G8
47	A-2113	1	STREET ELBOW,STL,1/4P
48	FC0120G0	4	12 PT,1/2-13 X 3 G8
70	A-15202	1	DATA TAG, ADDED FIXED CLRC SM
100	HD-5014	1	CYL ASSY, 3 SG-CE-HP,4.55"AFC

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
 DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



- THIS ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO THE ACCOMPANYING PARTS LIST ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS ASSEMBLY.

2
REVISED DRAWING. UPDATED ITEM #'S TO CURRENT ITEM # ROTATION.
ADDED VIEWS OF CAPSCREW AND STUD AND NUT.
REVISED NOTE #5. WAS "MAY NOT APPLY TO ALL ASSEMBLIES."
ADDED ITEM #8 (NUT)

REV	2	DESCRIPTION	INIT/DATE
		REVISED DRAWING UPDATED ITEM #15 TO CURRENT ITEM # ROTATION. ADDED VIEWS OF CARSCREW AND STUD AND NUT. REVISED NOTE #15, WAS "WAS NOT APPLY TO ALL ASSEMBLIES." ADDED ITEM #6 (NUT)	JCS 9/30/02

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[illegible]

44

7/27/10

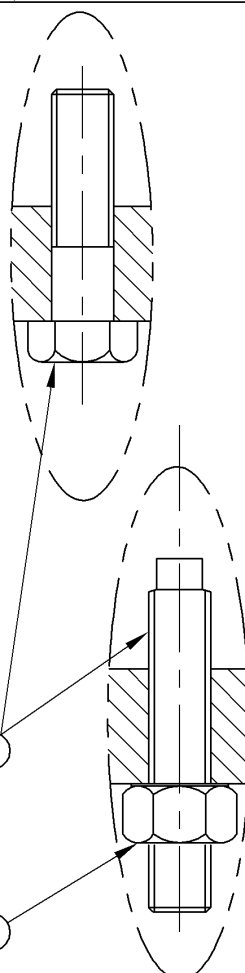
PARTS LIST

SUCTION VALVE, RETAINER AND CAP PART NO. G-11157
3" SG:A-CE & HIGH PRESS.CYLINDER CLASS. REF DRAWING A-6267

ITEM			
NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	SUCTION VALVE	0	FOR PART NO. SEE COVER SHEET
2	A-13192	1	STL GSKT, 2.250 ID X 2.4380D 60
3	B-3711	1	VLV RET, S&D, 3SG-CE CL
4	B-3411	0	VLV CAP, 3&3-5/8SG-CE CL
5	A-0027	1	O-RING, VT, 2.520 O.D. X .210
6	FC0171CFD	6	12 PT, 1/2-13 X 2-1/4 X 9/16 G8

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



- THIS ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO THE ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS ASSEMBLY.

THIS ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO THE ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS ASSEMBLY.

44		
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7/27/10

PARTS LIST

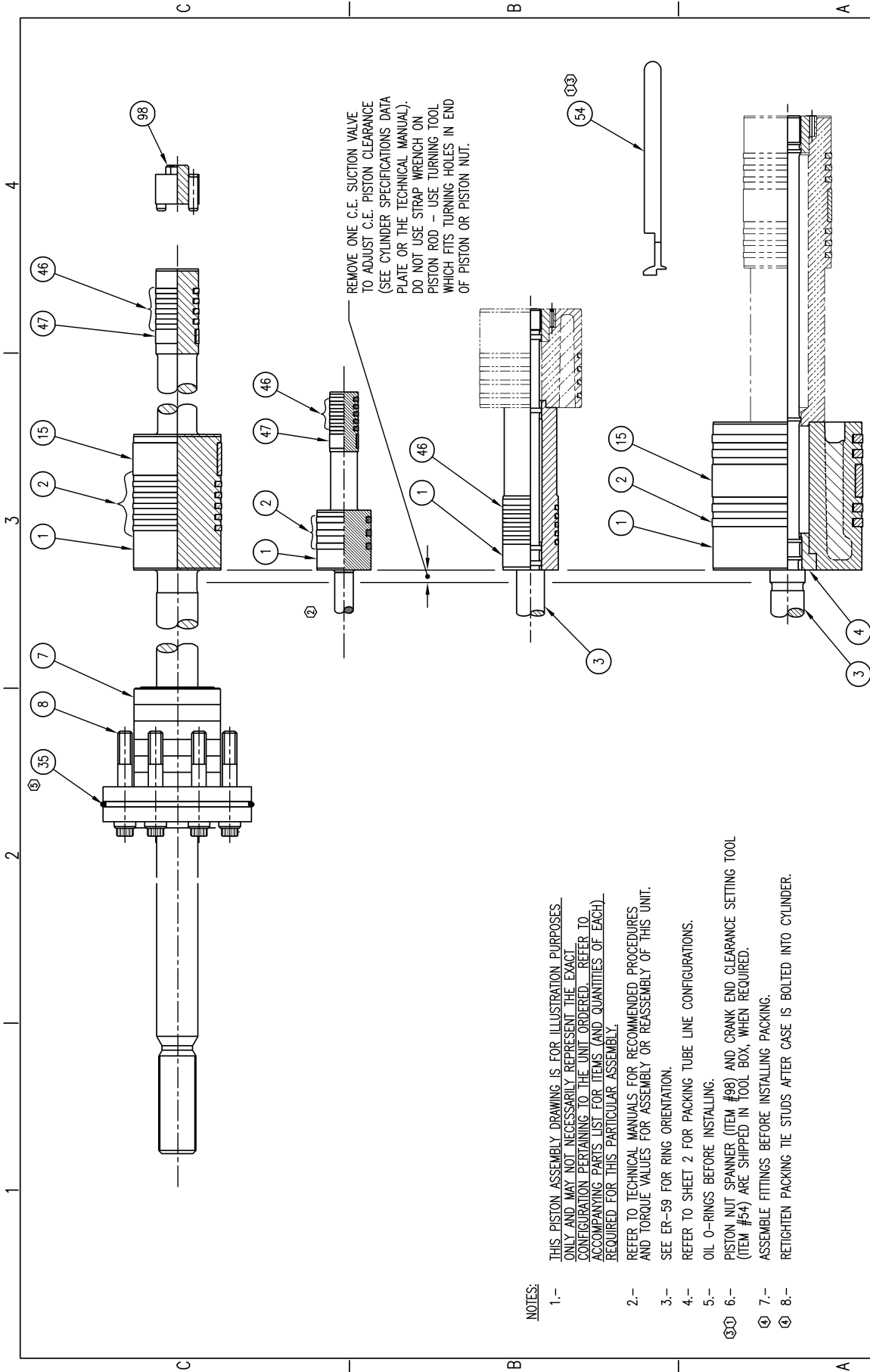
DISCHARGE VALVE, RETAINER AND CAP PART NO. G-11158
3" SG:A-CE & HIGH PRESS.CLASS CYLINDER. REF DRAWING A-6267

ITEM

NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	DISCHARGE VALV	0	FOR PART NO. SEE COVER SHEET
2	A-13192	1	STL GSKT, 2.250 ID X 2.4380D 60
3	B-3711	1	VLV RET, S&D, 3SG-CE CL
4	B-3411	0	VLV CAP, 3&3-5/8SG-CE CL
5	A-0027	1	O-RING, VT, 2.520 O.D. X .210
6	FC0171CFD	6	12 PT, 1/2-13 X 2-1/4 X 9/16 G8
7	A-3250	1	THUMB SCREW, NYLON, 1/4-20 X 1/2

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

- 1.- THIS PISTON ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS PARTICULAR ASSEMBLY.
- 2.- REFER TO TECHNICAL MANUALS FOR RECOMMENDED PROCEDURES AND TORQUE VALUES FOR ASSEMBLY OR REASSEMBLY OF THIS UNIT. SEE ER-59 FOR RING ORIENTATION.
- 3.- REFER TO SHEET 2 FOR PACKING TUBE CONFIGURATIONS.
- 4.- OIL O-RINGS BEFORE INSTALLING.
- 5.- PISTON NUT SPANNER (ITEM #98) AND CRANK END CLEARANCE SETTING TOOL (ITEM #54) ARE SHIPPED IN TOOL BOX, WHEN REQUIRED.
- 6.- ASSEMBLE FITTINGS BEFORE INSTALLING PACKING.
- 7.- RETIGHTEN PACKING TIE STUDS AFTER CASE IS BOLTED INTO CYLINDER.

5	ON SHEET #1: 002: ADDED ITEM #35.	CPM	08/11/09
4	REVISED DRAWING UPDATED TO CURRENT STANDARDS.	AW	08/22/2006
4	ON SHEET #1: 001: ADDED NOTES #7 & #8.		
4	ON SHEET #2: 001: REMOVED NOTES #1 THRU #4. ADDED JCA VIEW.		
REV	DESCRIPTION	INT/DATE	

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3	13310	3	ECN	REV	ECN	REV
2	10801	2	ECN	REV	ECN	REV
5	16183	1	10442	0	13844	0
4	13844	0	10074	0	10074	0



ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

APPROVED:
SCALE: NONE

CHECKED:
CAH 08-28-01

ASSEMBLY
DWG. NO. A-10982
SHEET 1 OF 2

7/27/10

PARTS LIST

3" X 1.250" JGA TANDEM PISTON/ROD,
3" STROKE.

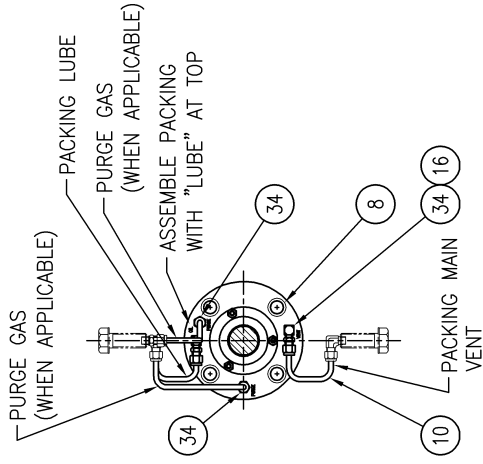
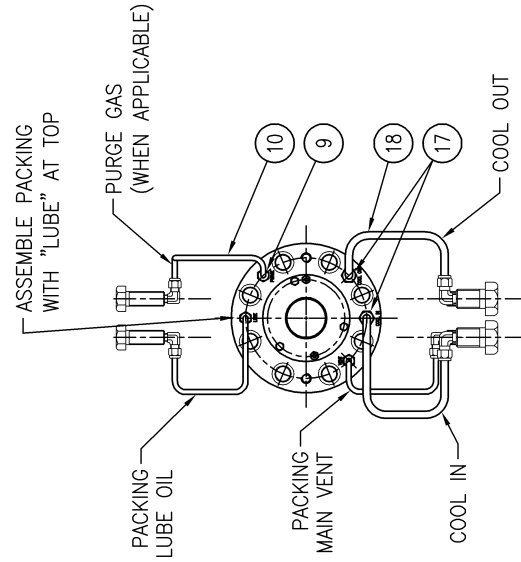
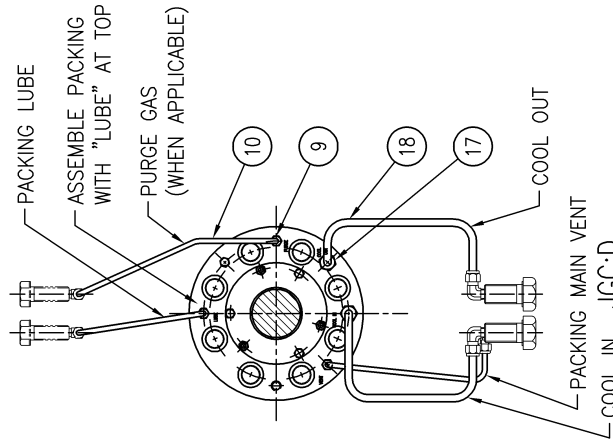
PART NO. G-16040
REF DRAWING A-10982 2 SHT

ITEM

NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	C-3649	1	PIST/ROD, 3.000 X 1.250SA
2	A-7171	3	RIDER RING, 3" JG:A:N:Q:SG
7	B-2649	1	PKG,1.125,3500,STD
8	FC0120GK	6	12 PT,1/2-13 X 2 G8
10	PT0201CD	12.	" TUBING,316 SS 1/4 OD X .065
33	A-0815	0	MALE ELBOW,STL, 1/4T X 1/8P
46	A-7108	7	PISTON RING, 1-1/4JG:SG,PK,SJ
47	A-6029	1	WEAR BAND, 1-1/4JG:SG:RJ, .875W
98	A-1678	1	PISTON NUT SPANNER,SPECIAL
99	B-2647-K	0	RBLD KIT,PIST ROD PKG,1.125

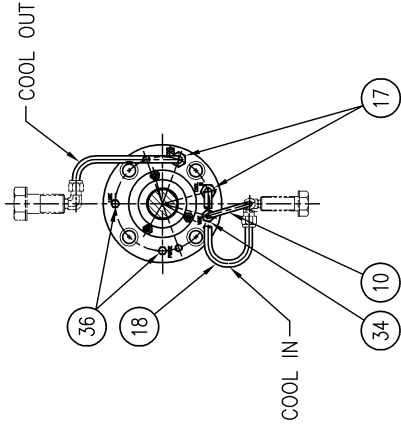
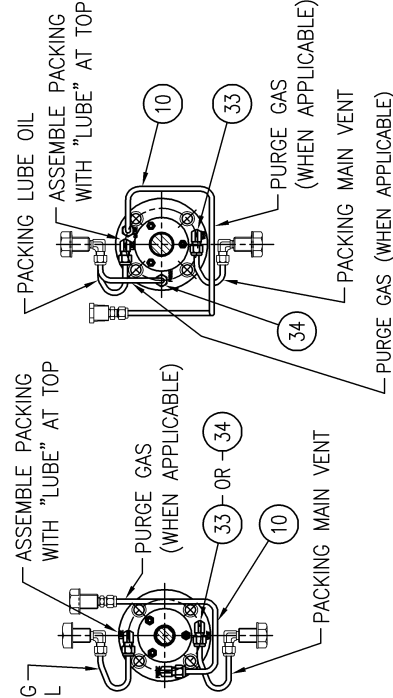
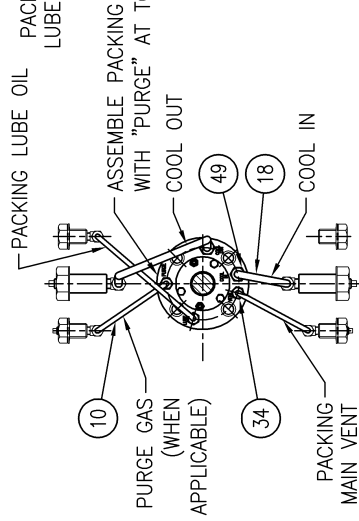
WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



JGH:K:E:T

JGRJ



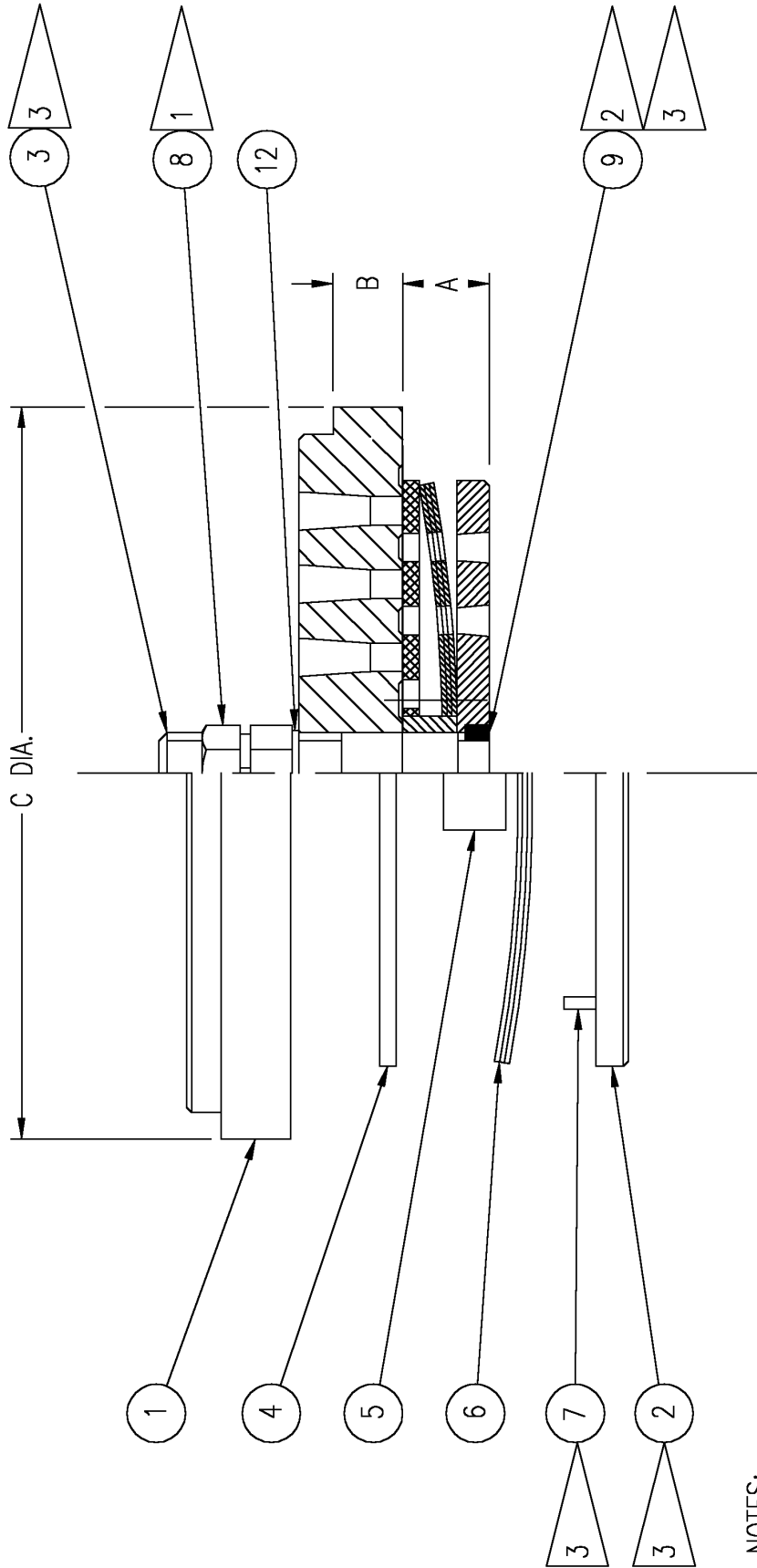
JG:A ④

JGM:P:N:Q, JG:A

5	SEE SHEET #1 FOR REVISION.	CPM 08/11/09
4	SEE SHEET #1 FOR REVISION.	ARW 08/22/06
REV	DESCRIPTION	INT/DATE

ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050			
3	13310	2	10801
5	16183	1	10442
4	13844	0	10074
REV	ECN	REV	ECN
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APPROVED: SCALE: NONE SHEET 2 OF 2			

ASSEMBLY
DWG. NO. **A-10982**
SHEET 2 OF 2



NOTES:

1. SEE MANUAL FOR TORQUE VALUES (ITEM #8).
2. INSTALL PER ER-52.
3. VALVE GUARD ASSEMBLY (ITEM #2) CONSISTS OF VALVE GUARD, CENTER STUD (ITEM #3), SPIROL PIN (ITEM #7) AND DOWEL PIN (ITEM #9).

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050

TITLE:	SUCTION VALVE, RX
MATERIAL:	PROCURED
DRAWN:	IG 9/24/99
CHECKED:	ED 10/1/99
SCALE:	NONE
DWG. No:	A-9251

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DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
 ---- DO NOT SCALE DRAWING ----

DIMENSIONING AND TOLERANCING PER ARIEL SPECIFICATION ER-17.0.1 UNLESS OTHERWISE SPECIFIED.

REV	DESCRIPTION
0	7799
0	7799

7/27/10

PARTS LIST

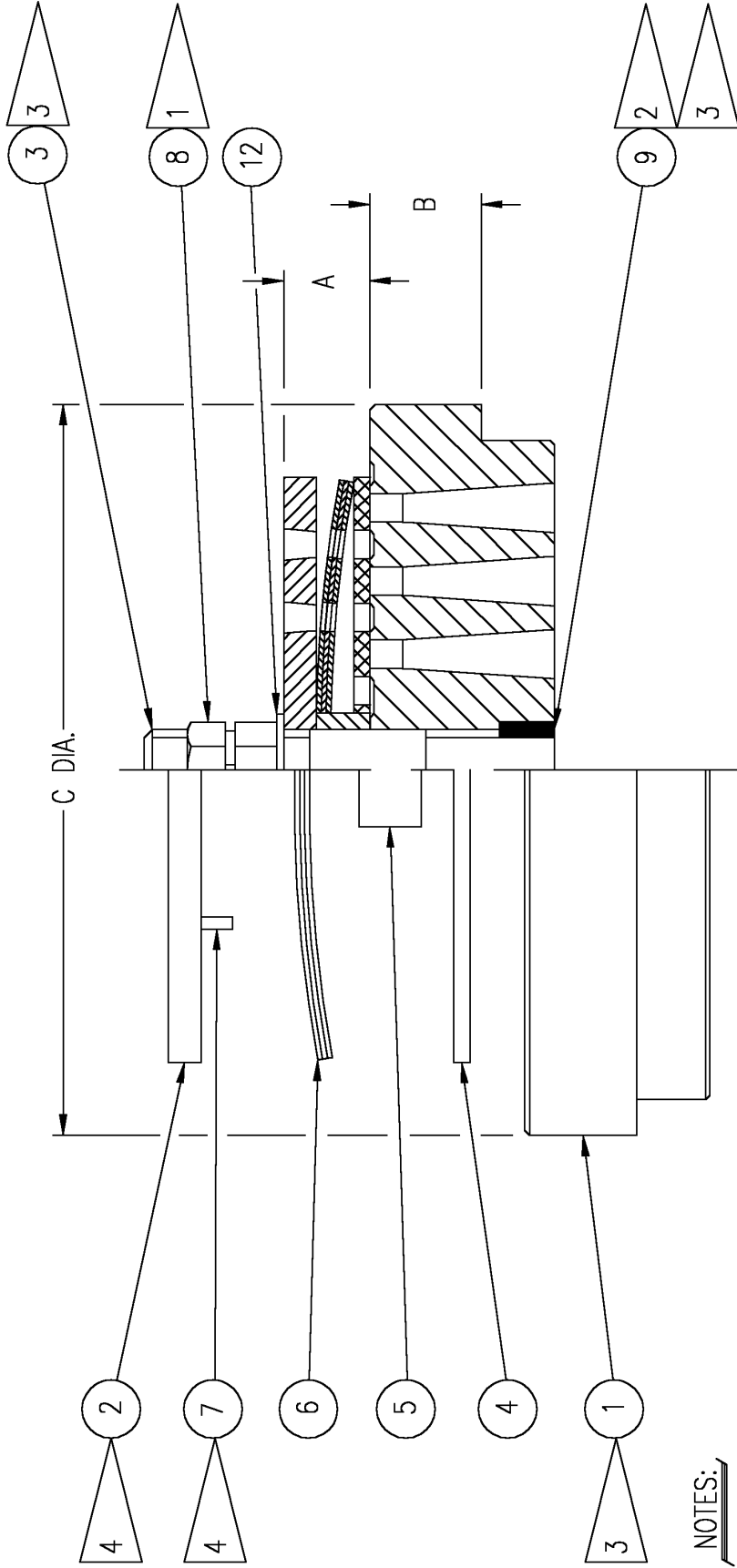
0.3780=A
0.6930=B
2.4720=C
0.0550=LFT

PART NO. B-4087-AA
REF DRAWING A-9251

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-12991	1	SUC VLV SEAT, 52RX
2	A-12992-A	1	SUC VLV GUARD ASSY, 52RX
3	A-12990	1	CNTR STUD, 5/16-24, 2.36 THK
4	A-11606	1	VLV PLT, 52RX.157THK, MTX
5	A-10355	1	GUIDE RING, 52RX, .260 THK
6	A-1002	2	SPRING PLATE, 52RX, .020 THK
7	A-1314	1	SPIROL PIN, .078D X .563L
8	A-1366	1	LOCKNUT, DRAKE, 5/16-24
9	A-16466	1	LOCK, STUD .098D
12	A-11437	1	VLV WASHER, 5/16, .118 THK
99	KB-4087-AA	0	KIT, VLV, 52RX , MTX

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***



NOTES:

1. SEE MANUAL FOR TORQUE VALUES (ITEM #8).
2. INSTALL PER ER-52.
3. VALVE SEAT ASSEMBLY (ITEM #1) CONSISTS OF VALVE SEAT, CENTER STUD (ITEM #3) AND DOWEL PIN (ITEM #9).
4. VALVE GUARD ASSEMBLY (ITEM #2) CONSISTS OF VALVE GUARD AND SPIROL PIN (ITEM #7).

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050

TITLE: DISCHARGE VALVE, RX		MATERIAL: PROCURED	
REV	DESCRIPTION	DRAWN: IC 9/21/99	R.S. No.
		CHECKED: ED 10/1/99	PART NO.
0	7799	SCALE: NONE	DWG. No: A-9208

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DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
 ---- DO NOT SCALE DRAWING ----

DIMENSIONING AND TOLERANCING PER ARIEL SPECIFICATION ER-17.0.1 UNLESS OTHERWISE SPECIFIED.

7/27/10

PARTS LIST

0.5070=A
0.9090=B
2.4490=C
0.0550=LFT

PART NO. B-3712-M
REF DRAWING A-9208

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-12180-A	1	DIS VLV SEAT ASSY, 52RX THK
2	A-1177-C	1	DIS VLV GUARD ASSY, 52RX
3	A-11611	1	CNTR STUD, 5/16-24 X 2.60 STL
4	A-11952	1	VLV PLT, 52RX.157THK, PKX
5	A-10357	1	GUIDE RING, 52RX, .279 THK
6	A-1002	3	SPRING PLATE, 52RX, .020 THK
7	A-2042	1	SPIROL PIN, .078D X .625L
8	A-1366	1	LOCKNUT, DRAKE, 5/16-24
9	A-16466	1	LOCK, STUD .098D
12	A-1025	1	VLV WASHER, 5/16, .063 THK
99	KB-3712-M	0	KIT, VLV, 52RX , PKX

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

3RD STAGE CYLINDER

7/27/10

ARIEL CORPORATION
SALES ORDER COVER SHEET

C/N: 001

RHCOVP02

SERIAL #: C-117528

PART: 1-3/4SG FS HE DESCRIPTION: 1-3/4SG-FS-HE CYLINDER CLASS

PART NUMBER	QUANTITY	DESCRIPTION	DRAWING NO.
G-13230	1	CYL ASSY, 1-1/4SG-HE, STD 6100	A-11783
G-1471	1	CONC VLV.ASSY(1.75JG:2R:RJ)-HE	A-6094
B-1961-E	1	CONC VLV, 062/030 1-1/4	A-9236
G-4571	1	VLV.REMVL.TOOL, 1.25 & 1.5JG-HE	B-0992

NOTES:

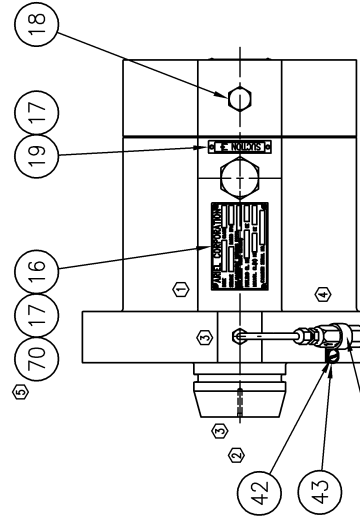
② 1.-

THIS CYLINDER ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS PARTICULAR CYLINDER ORDERED.

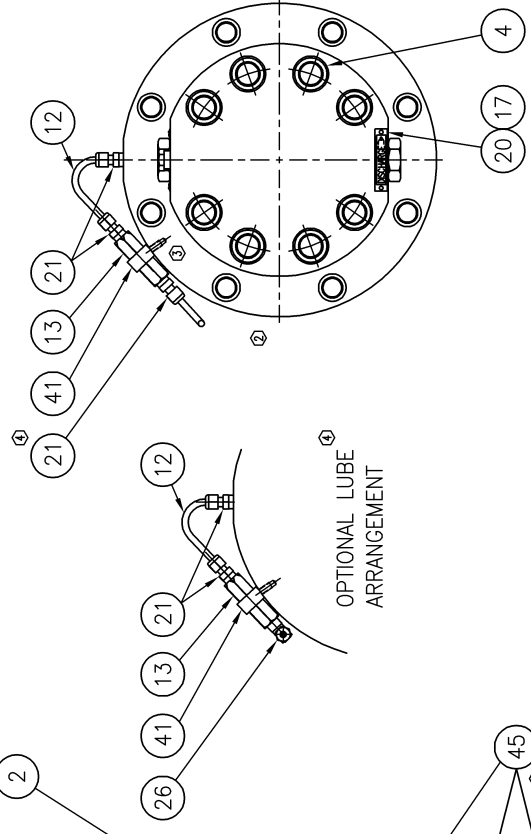
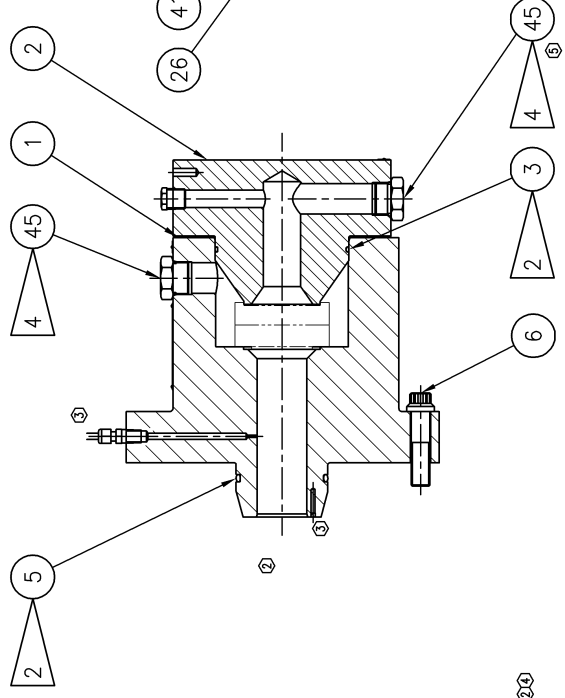
② OIL O-RINGS BEFORE INSTALLING.

③.- LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.

④ 1" SAE PLUG FOR SHIPPING ONLY.



OPTIONAL LUBE ④ ARRANGEMENT



OPTIONAL LUBE ④ ARRANGEMENT

REV	DESCRIPTION	INIT/DATE
5	②C2: ADDED ITEM #70. ②A3: ADDED ITEM #45 & FLAG #4. UPDATED TO CURRENT STANDARD ITEM ROTATION. UPDATED TO CURRENT STANDARDS.	CPM 08/14/08
4	②B3: ADDED OPTIONAL VIEW FOR ITEM #26 CONNECTOR. ②B4: STANDARD VIEW WAS CHANGED TO INCLUDE ITEM #21 CONNECTOR. ②C1: ADDED OPTIONAL VIEW FOR ITEM #26 CONNECTOR. ②C2: STANDARD VIEW WAS CHANGED TO INCLUDE ITEM #21. ②A1, REMOVED VIEW FOR BOTTOM SUCTION.	JRY 9/11/2008

3	11702	3	11702	3	11702
2	11493	2	11493	2	11493
5	15391	1	11159	5	15391
4	13904	0	10801	4	13904
REV	ECN	REV	ECN	REV	ECN
3		3		3	



ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

ASSEMBLY
DWG. NO. **A-11783**

APPROVED: JCS 11/20/02
CHECKED: DAH 11/25/02
SCALE: NONE

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8/10/10

PARTS LIST

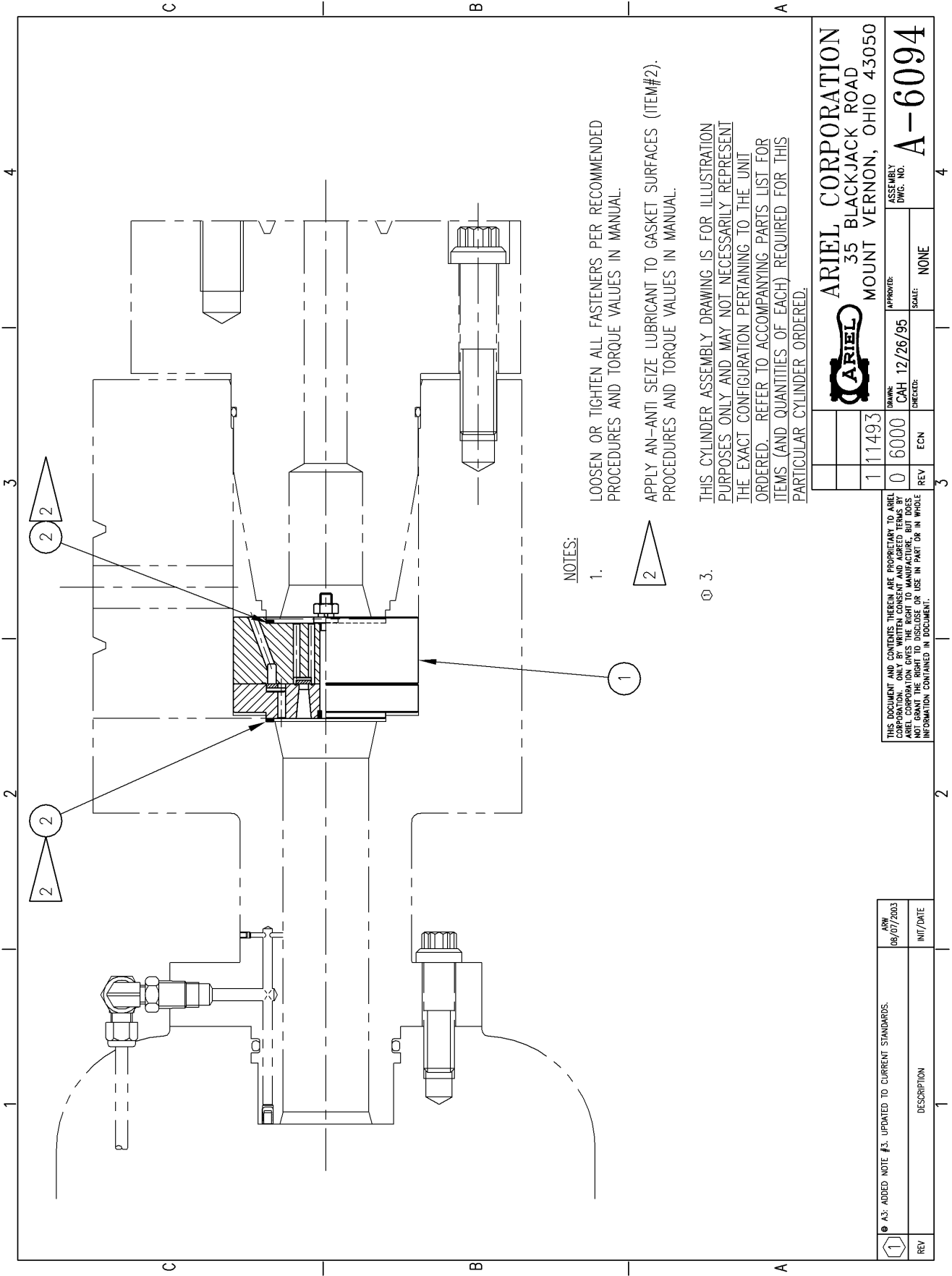
1-1/4"SG:A-HE TANDEM CYLINDER BODY AND
HEAD END HEAD.
RDP 5545#, MAWP 6100#

PART NO. G-13230
REF DRAWING A-11783

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
001	D-3689	0	CYL, 1-1/4SG-HE,16N 6100
002	C-4488	0	HE HEAD, 1-3/4SG-HE CL
003	A-1812	1	O-RING,VT, 3.887 O.D. X .139
004	FC0120I0	8	12 PT,3/4-10 X 3 G8
005	A-0013	1	O-RING,VT, 3.520 O.D. X .210
006	FC0120H0	8	12 PT,5/8-11 X 3 G8
012	PT0201CD	80 "	TUBING,316 SS 1/4 OD X .065
013	A-8057	1	CHECK VLV,OMNI 1/4"FPT SS BALL
016	A-0465	1	DATA PLATE,CYLINDER SPEC STD
017	FR0570CC	8	DRIVE SCREW, #6 X 1/4 U-TYPE
018	PP0810GB	1	PIPE PLUG,1/2NPT,HEX HD,STL
019	A-0640-A	1	INFO PLATE,SUCTION
020	A-0640-B	1	INFO PLATE,DISCHARGE
021	A-0827	3	MALE CONN,STL, 1/4T X 1/4P
041	A-15555	1	TUBING CLAMP, 7/8 TUBE
042	FC0134CC	2	BUT HD CAP,1/4-20 X 1/2 316SS
043	A-8958	1	WASHER,EXT.TOOTH LOCK,1/4" STL
045	PP0860JB	2	PLUG,STL, SAE-16
100	HD-4478	1	CYL ASSY, 1-1/4SG-HE

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

**** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ****



NOTES:

1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.
2. APPLY AN-ANTI SEIZE LUBRICANT TO GASKET SURFACES (ITEM#2). PROCEDURES AND TORQUE VALUES IN MANUAL.
3. THIS CYLINDER ASSEMBLY DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT NECESSARILY REPRESENT THE EXACT CONFIGURATION PERTAINING TO THE UNIT ORDERED. REFER TO ACCOMPANYING PARTS LIST FOR ITEMS (AND QUANTITIES OF EACH) REQUIRED FOR THIS PARTICULAR CYLINDER ORDERED.

1	DESCRIPTION	REV
A3: ADDED NOTE #3. UPDATED TO CURRENT STANDARDS.		
ASIN		06/07/2003

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1 11493		DRAWN: CAH 12/26/95		APPROVED: NONE	
0 6000		CHECKED: NONE		SCALE: NONE	
REV		ECN		ASSEMBLY	
3		4		DWG. NO.	
2		1		A-6094	
1		4		A-6094	

ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

7/27/10

PARTS LIST

CONCENTRIC VALVE, RETAINER, CAP
1-3/4JG-HE:2R-HE:2RJ-HE CLASS
STEEPLE CYLINDER

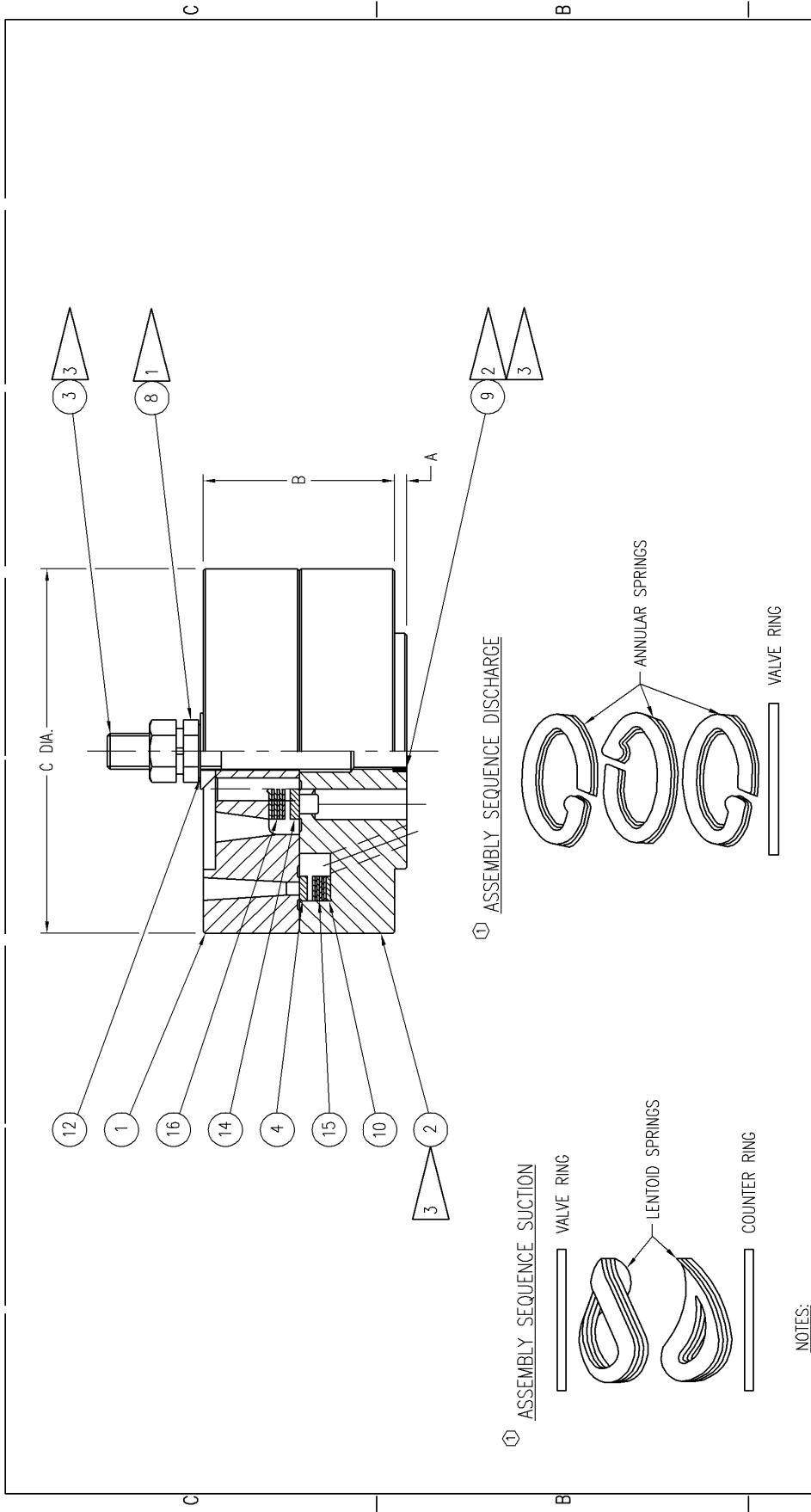
PART NO. G-1471
REF DRAWING A-6094

ITEM

NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	CONCENTRIC VLV	0	FOR PART NO. SEE COVER SHEET
2	A-12084	2	STL GASKET, 2.438 X 2.125 X60

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***





ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

TITLE:
CONCENTRIC VALVE

MATERIAL:
PROCURED

DRAWN:
IG 09/23/99

CHECKED:
ED 10/04/99

SCALE:
NONE

DWG. No:
A-9236

REV	DESCRIPTION	INIT/DATE	MLB
1	UPDATED DRAWING TO CURRENT STANDARDS. ADDED VIEWS SHOWING ASSEMBLY SEQUENCE FOR BOTH SUCTION/DISCHARGE SHOWING ORIENTATION OF LENTOID AND ANNUAL SPRINGS	09/29/06	

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DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.

----- DO NOT SCALE DRAWING -----

1

2

3

4

- NOTES:
1. SEE MANUAL FOR TORQUE VALUES (ITEM #8).
 2. INSTALL PER ER-52.
 3. LOWER PART ASSEMBLY (ITEM #2) CONSISTS OF LOWER PART, CENTER STUD (ITEM #3) AND SPIROL PIN (ITEM #7).

7/27/10

PARTS LIST

0.1260=A
1.9760=B
3.7760=C
0.0390=LFT

PART NO. B-1961-E
REF DRAWING A-9236

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
1	A-6085	1	UPPER PART, CONC VLV
2	A-6086-A	1	LOWER PART ASSY, CONCENTRIC VLV
3	A-6087	1	CNTR STUD, 1/4-28X2.835 LG.
4	A-6089	1	VLV RING, 62C, .079 THK
8	A-1236	1	LOCKNUT, DRAKE 1/4-28
9	A-16466	1	LOCK, STUD .098D
14	A-6088	1	VLV RING, 30R, .079 THK
15	A-6091	2	LENTOID SPRING, 62C, .128 THK
16	A-6090	2	LENTOID SPRING, 30R, .079 THK
99	KB-1961-E	0	KIT, VLV, CONC, 062/030 1-1/4

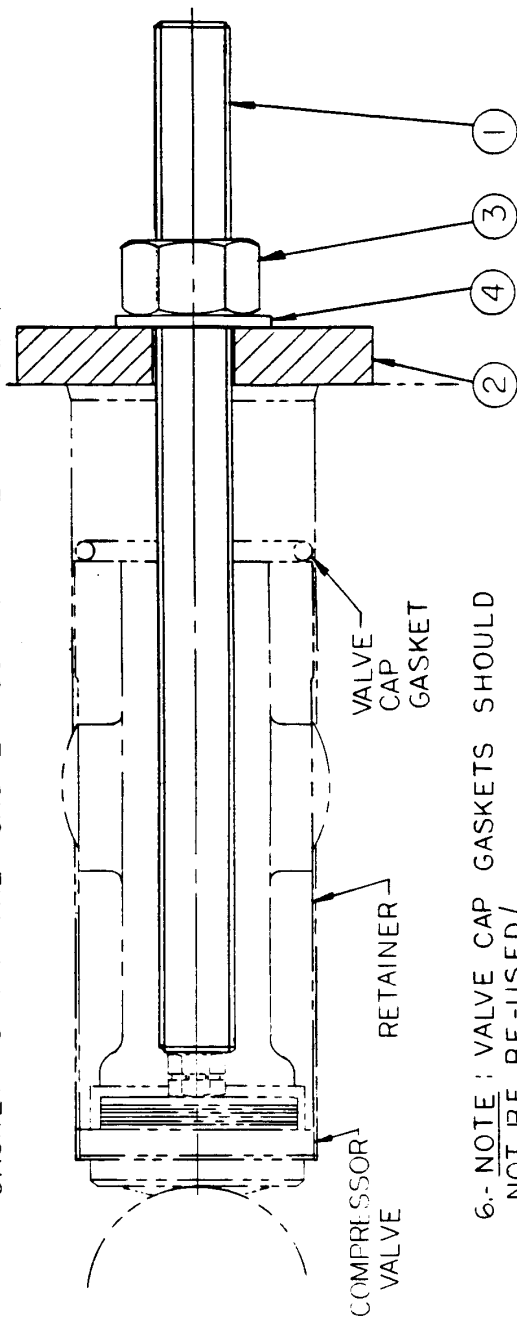
WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

*** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ***

G-1446
G-1809

TO REMOVE A COMPRESSOR VALVE :

- 1.-AFTER DEPRESSURIZING THE CYLINDER AND REMOVING THE VALVE CAP; ATTACH THE VALVE PULLER STUD, ITEM#1 TO THE VALVE STUD.
- 2.-SLIDE THE VALVE PULLER PLATE, ITEM#2 OVER THE END OF THE PULLER STUD SO THAT IT RESTS ON THE CYLINDER BODY.
- 3.-SLIDE THE WASHER, ITEM#4 OVER THE STUD AND THREAD THE NUT, ITEM#3 ONTO THE STUD.
- 4.-TIGHTEN THE NUT, THIS WILL PULL THE VALVE, RETAINER AND VALVE CAP GASKET OUT OF THE POCKET.
- 5.-THE ASSEMBLY ONLY NEEDS TO BE PULLED FAR ENOUGH OUT OF THE POCKET SO THERE IS ROOM BETWEEN THE TOP OF THE RETAINER AND THE VALVE CAP GASKET TO PRY THE GASKET OUT OF THE CYLINDER.



6.- NOTE : VALVE CAP GASKETS SHOULD NOT BE RE-USED!

6/2/00
02/00

ARTEL CORPORATION
MT. VERNON, OHIO
ASST.
DRWG. NO.: B-992

8/10/10

PARTS LIST

VALVE REMOVAL TOOL
1-3/4"JG-HE CLASS CYLINDER

PART NO. G-4571
REF DRAWING B-0992

ITEM NUMBER	PART NUMBER	QUANTITY	DESCRIPTION
001	A-6284	1	A/T STUD,VLV PULLER,1-3/4JGT
002	A-1760	1	PLT,VLV PULLER,1-3/4M
003	FN0451HD	1	HEX NUT,H/W,2H,5/8-11
004	FW0500HA	1	WASHER, 5/8 SAE

WHEN A ZERO APPEARS IN THE QUANTITY COLUMN IT
DOES NOT REPRESENT THE QUANTITY REQUIRED.

**** ALWAYS PROVIDE SERIAL NUMBER WHEN ORDERING SPARE PARTS. ****

VENDOR'S LITERATURE

HOERBIGER VALVES

DIGITAL NO-FLOW TIMER

GORMAN-RUFF PUMP

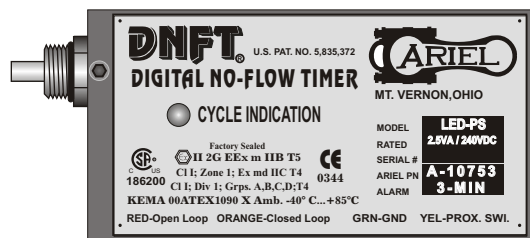
COOK ROD & RINGS



ARIEL # A-10753

SPECIFICATIONS

Material.....Stainless Steel, Aluminum
Temperature Range..... -40° F to +185° F
Switch Rating.....2.5VA/240 VDC
Epoxy Encapsulated.....UL LISTED EL-CAST VFR 641
Alarm/Shutdown..... Factory default for 3 minute alarm
Power.....Field Replaceable - Lithium Battery
Battery.....Ariel P/N A-10807
Divider Block Application.....SBCO/Trabon O-Ring
Warranty.....2.5 Years



DNFT-LED-PS

- MONITORS MOVEMENT OF DIVIDER VALVE PISTON FOR DEPENDABLE "TIMED" SHUTDOWN PROTECTION
- CLOSED LOOP OR OPEN LOOP OPERATION
- INSTALLS DIRECTLY TO DIVIDER VALVE
- NOT AFFECTED BY TEMPERATURE OR OIL VISCOSITY
- REQUIRES NO EXTERNAL POWER
- LED INDICATOR - CYCLE INDICATION
- DEDICATED SWITCH CLOSURE TO MONITOR EACH DIVIDER VALVE CYCLE (PS OPTION)
- FIELD REPLACEABLE BATTERY

RATINGS



II 2G EEx m IIB T5

CI I; Zone 1; Ex md IIC T4

CI I; Div 1; Grps. A,B,C,D;T4



0344

KEMA 00ATEX1090 X Amb. -40° C...+85°C

DESCRIPTION

The DNFT-LED is a totally enclosed electronic device, combining the latest technology in microprocessor and transistor components for detecting Slow-Flow and No-Flow of divider block lubrication systems. The DNFT incorporates an oscillating crystal to accurately monitor the cycle time of the lubrication system to enable precision timed shutdown capability. The magnet assembly and control housing mount directly to the divider valve becoming an integral part of the lubrication system. The DNFT operates on a field replaceable lithium battery. If battery voltage drops below normal operating levels the DNFT goes into alarm mode and the unit cannot be restarted. LED models utilize an LED to indicate each cycle of the divider valve. This enables the operator to easily set and monitor lubrication rates.

OPERATION

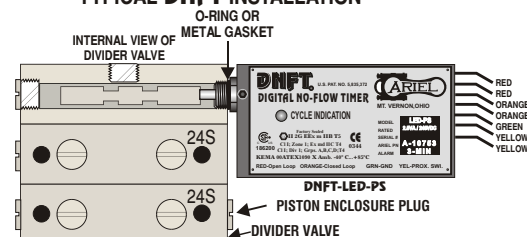
Lubricant flow through the divider valve assembly forces the pistons to cycle back and forth causing a lateral movement of a magnet linked to the piston. Movement is monitored by the microprocessor which resets the timer, lights the LED, and allows the unit to continue operation, this indicates one complete cycle of the lubrication system. The microprocessor must receive this cycle in a predetermined time or a shutdown will occur. The DNFT will automatically reset alarm circuit when normal.

TROUBLESHOOTING DNFT-LED

NOTICE: WHEN MORE THAN ONE DNFT IS INSTALLED ON THE COMPRESSOR OR ENGINE, EACH DNFT MUST BE WIRED TO A SEPARATE ALARM CIRCUIT ON THE CONTROL PANEL, ANNUNCIATOR OR PLC TO SIMPLIFY TROUBLESHOOTING THE LUBRICATION SYSTEM AND DNFT.

PROBLEM	POSSIBLE CAUSE	SERVICE PROCEDURE AND / OR CORRECTION
1. LED does Not Blink, Control Panel Indicates Lube No-Flow (See also, 3. Erratic shutdown)	A. Improperly Adjusted DNFT	Loosen set screws, slide DNFT all the way onto hex of magnet housing and torque to 25 inch pounds max. (Do not over tighten) Cycle divider valve by pumping clean oil through system with lubrication system purge gun or running compressor. If necessary, adjust DNFT 1/16" back until LED blinks with each cycle of divider valve.
	B. Spring or Magnet is Broken in Magnet Assembly	Loosen set screws, remove DNFT from magnet housing. Remove magnet assembly from divider valve. Remove magnet, spacer and spring. Check components for damage. Replace damaged spring and/or magnet and install on divider valve. If necessary, adjust DNFT, check for LED blink. Purge air from system with lubrication system purge gun.
	C. Low Battery voltage	Remove the battery from the DNFT per the attached instructions. Replace the battery if the voltage is below 2.5 volts using a factory recommended replacement battery.
	D. Bent Magnet Housing	Loosen set screws, remove DNFT from magnet housing. Check for damaged or bent magnet housing. Remove magnet assembly from divider valve. Replace magnet housing, magnet, spring and spacer. Re-install DNFT on magnet housing. If necessary, adjust DNFT, check for LED blink. Purge air from system with lubrication system purge gun.
2. After installation of DNFT, Rupture Disc is Blown and Divider Valve is Locked up.	A. Wrong Magnet Housing. Installed on Divider Valve (See magnet assy. Below)	Loosen set screws and remove DNFT from magnet housing. Check for correct magnet housing for divider valve manufacturer. Remove and replace with correct magnet housing. Replace DNFT on magnet housing. If necessary adjust DNFT, check for LED blink. Purge air from system with lubrication system purge gun.
	B. Air or Debris in Divider Valve System.	Check system pressure insure oil is flowing to divider valves. If necessary install pressure gauge to monitor operation of lubrication system. 1. <u>Loosen</u> outlet plugs in front of valve blocks. Fast purge the system with lubrication system purge gun until clean, clear, air free oil appears from plugs. 2. <u>Loosen</u> each piston enclosure plug individually to purge air from behind piston. Do not remove piston enclosure plugs. Tighten all divider valve plugs. Adjust DNFT. <u>To insure proper operation of the divider block lubrication system, it is absolutely necessary that all tubing and components be filled with oil and free of air before start-up.</u>
ELETRICAL TESTING OF DNFT ALARM CIRCUIT		1. NORMALLY OPEN - Attach ohmmeter to red wires. Meter should read 10 megaohms in operation and less than 10 ohms in alarm state. 2. NORMALLY CLOSED - Attach ohmmeter to orange wires. Meter should read less than 10 ohms in operation and infinity in alarm state.
Faulty Lube Pump		Check system pressure to insure oil is flowing to divider valves. If necessary, install pressure gauge to monitor operation of lubrication system. Check gauge to insure pump will build sufficient pressure to inject oil into cylinder. You cannot check for oil flow into cylinder by removing tubing from check valve and pumping oil to atmosphere. Replace pump.

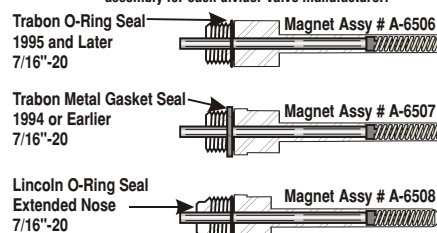
TYPICAL DNFT INSTALLATION



CAUTION: DISCONNECT ALL WIRING PRIOR TO WELDING ON COMPRESSOR OR SKID.

Magnet Assemblies and Applications

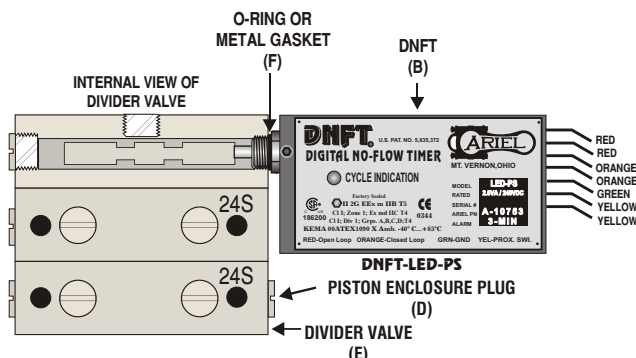
DNFT must be installed with correct magnet assembly for each divider valve manufacturer.



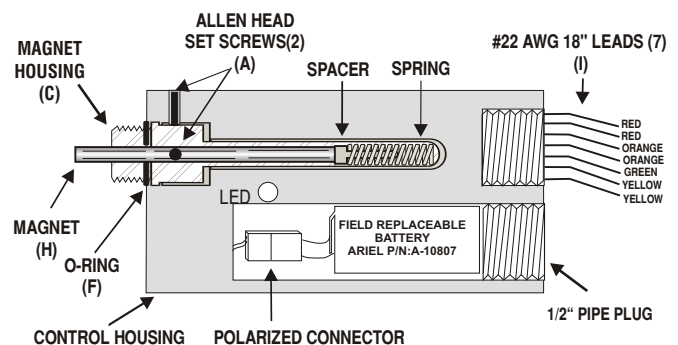
ARIEL #A-10753 DNFT-TO-LED-PS DIGITAL NO-FLOW TIMER WITH DEDICATED PROXIMITY SWITCH. INSTALL ON TRABON* DIVIDER VALVE WITH O-RING SEALS. SWITCH RATING 2.5VA 240VDC

1. Loosen all Allen head set screws (A) on DNFT (B) and remove magnet housing (C). Do not remove magnet, spring or spacer from magnet housing.
2. Remove piston enclosure plug (D) from end of divider valve where DNFT will be installed. The DNFT does not have to be installed on the top divider valve. It may be installed on any convenient divider valve, top to bottom. (**Notice:** Do not install DNFT on Lincoln divider valves with cycle indicator pins or any Dropsa divider valve less than SMX 16.)
3. Be sure O-ring or metal gasket (F) is in place on magnet housing (C). Screw magnet housing (C) into end of divider valve (E). Torque to 15 foot pounds max.
4. Slide DNFT (B) all the way onto hex of magnet housing (C). Tighten set screws on hex of magnet housing. Torque 25 inch pounds max.
5. The LED on the DNFT indicates each divider valve cycle. This enables operator to adjust the lubricator pump for correct cycle time and oil consumption recommended by compressor manufacturer. If LED does not blink with compressor running or by manually pumping oil into divider valve, the DNFT must be adjusted. Normal cycle indication is a bright strobe type blink.
6. Before adjusting DNFT, divider valve must be cycling. This can be achieved with the compressor running or by manually pumping oil through the divider valve assembly with a hand priming pump.
7. Adjustment is made by sliding the DNFT (B) all the way on the hex of the magnet housing (C). Tighten set screws on hex of the magnet housing to 25 inch pounds max. Check for LED blink to confirm correct adjustment. If LED does not blink with divider valve cycling, adjust the DNFT back in 1/16" increments. Correct adjustment of the DNFT is confirmed by blinking LED.
8. All conduit and connections should be appropriate for area classification. **Notice:** Conduit and fittings must be supported to avoid bending magnet housing.
9. **After installing magnet assembly and pre-compressor start-up, it is absolutely necessary to purge all air from divider block lubrication system. This can easily be accomplished with a lubrication system purge gun.**
10. DNFT must be installed with correct magnet assembly for each divider valve manufacturer.
 - Lincoln-7/16"-20 extended nose with O- ring
 - Trabon-1994 or earlier 7/16"-20 with metal crush gasket
 - Trabon-1995 and later 7/16"-20 with O-ring

Notice: When installing more than one DNFT, each DNFT must be wired to a separate alarm circuit of the control panel, annunciator or PLC to simplify troubleshooting the lubrication system and DNFT.



CAUTION: DISCONNECT ALL WIRING PRIOR TO WELDING ON COMPRESSOR OR SKID.

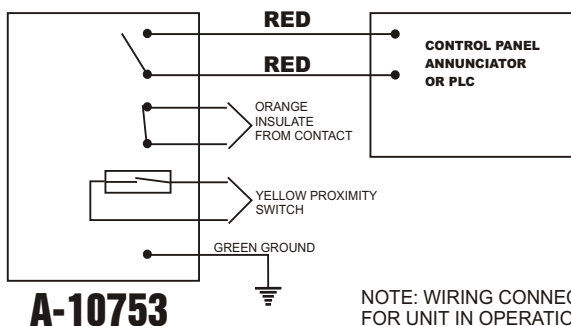


WIRING LEGEND

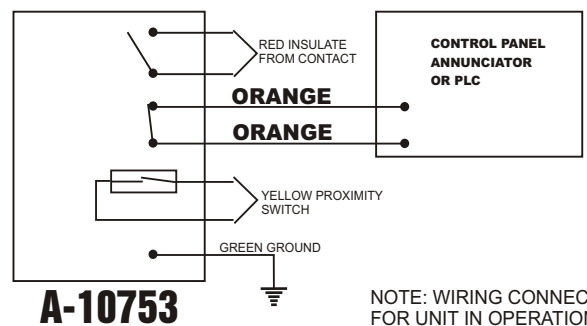
RED.....NORMALLY OPEN OPERATION
ORANGE.....NORMALLY CLOSED OPERATION
GREEN.....CASE GROUND
YELLOW.....DEDICATED PROX. SWITCH
UNIT MUST BE SECURELY GROUNDED. DISCONNECT ALL WIRING PRIOR TO WELDING ON SKID.

ARIEL # A-10753

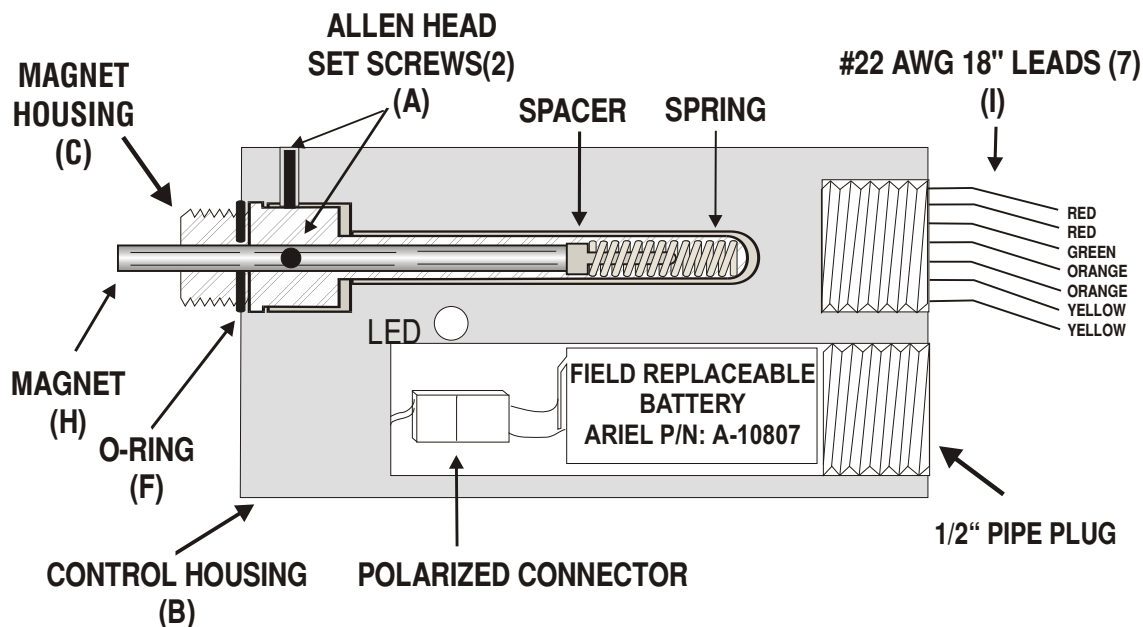
OPEN LOOP MODE



CLOSED LOOP MODE



DNFT BATTERY REPLACEMENT INSTRUCTIONS



Directions for replacing the battery in the Digital No Flow Timer.

1. Shut down the engine or set the bypass timer.
2. Use a 3/8" ratchet to remove the 1/2" NPT Pipe plug.
3. Remove the battery from the DNFT and disconnect from the polarized connector.
4. Connect the new battery to the attached polarized plug.
5. Reinsert the battery and reinstall 1/2" NPT Pipe plug.
6. Verify the DNFT is working by pre-lubing the system and check for LED blink.

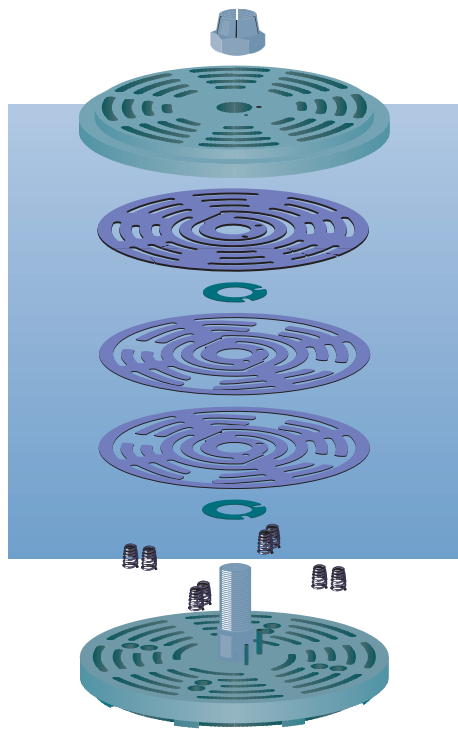
ITEMS REQUIRED FOR REPLACING THE DNFT BATTERY:

- (1) ARIEL P/N: A-10807 BATTERY or RADIO SHACK P/N: 960-0418 (alternate replacement)
- (1) 3/8" RATCHET WRENCH (for removal of battery plug)

**COMPRESSION
TECHNOLOGY
GROUP**

Service Guide

SERVICE GUIDE FOR MAINTENANCE OF HOERBIGER VALVES



HOERBIGER

SERVICE GUIDE FOR MAINTENANCE OF HOERBIGER-VALVES

Modern compressors equipped with HOERBIGER-Valves require a minimum of maintenance. The performance and the reliability of such compressors depend, however, to a large degree on the care applied to these few maintenance operations.

AT WHAT INTERVALS HAS MAINTENANCE OF VALVES TO BE CARRIED OUT?

We cannot give any general guide lines as valve life is influenced by many parameters. Maintenance frequency will depend for example on the type of compressor (e.g. Process machine or garage compressor), whether the compressor is running on continuous duty or intermittent duty, on the compressor speed and pressures, the compression ratio, also the type of gas (corrosive or non-corrosive gas, clean gas with or without carry-over of foreign material, moisture content). The compressor manufacturer will have established guide lines both for the running in period and subsequent operation, which will have to be followed. Experience proves that after the initial running - in period the maintenance intervals can be extended considerably.

THEY COVER THE FOLLOWING PROCEDURES

- 1 Remove valve from compressor**
- 2 Dismantle the valve**
- 3 Clean all parts**
- 4 Check the condition of all components**
especially for wear, damage to the seat face, the plates, and for setting of the springs.
- 5 Repair or replace worn parts**
Repair all parts which can be remachined without impairing the strength. Replace all parts which are worn or show any cracks.
- 6 Reassemble the valve**
following the instructions on our drawing or assembly sheet.

RECOMMENDATIONS AND WARNINGS

1 Recommendations and warnings are to be followed according to the compressor manufacturer.

In case our recommendations and warnings deviate from those of the compressor manufacturer, the ones of the compressor manufacturer take precedence.

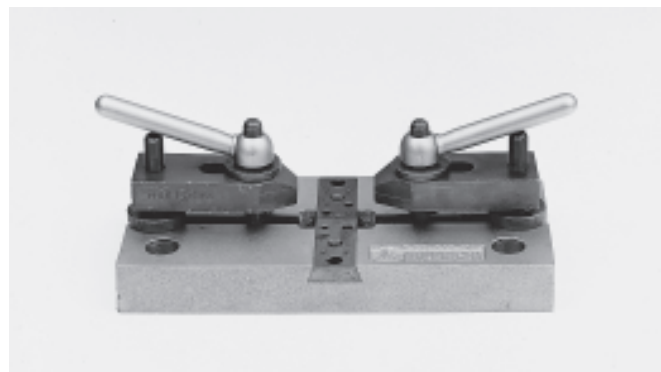
ASSEMBLY DEVICE

The HOERBIGER Assembly Device allows the valve to be held correctly without danger of damage. Adjustable location pins secure the valve against rotation. These pins locate in the slots of the seat or guard respectively without causing damage. The best way to tighten the nut is with a torque wrench. HOERBIGER Assembly Devices can be used for all valve types. The standard clamps will hold heights "H" (fig. 12) up to 78 mm. The base plate can be screwed on to any work bench or held in a suitable holding device.

3 sizes are available:

Size	max. O. D. of valve mm	L mm	B mm
1	20-100	260	120
2	20-250	420	200
3	20-430	590	350

fig. 1



1 Remove valve from compressor

2 Before valves are removed from the compressor, all pressure has to be released from the cylinders and piping. If combustible or poisonous gases are present, cylinder and piping have to be vented. Take necessary measures to prevent start up of the compressor. If the compressor valve is stuck in the cylinder, try to use valve puller device. If valve is to be jarred free by striking, use a wood block or soft metal bar to avoid damage. Never use a steel hammer to strike the valve directly.

2 Dismantle the valve

After sufficient cleaning of the center bolt and loosening of the locking device of the unit (either by removing of the cotter pin in case of a castle nut, or by pressing down the ends of the locking washer, if equipped with same), the valve should be held by means of a simple holding device shown in fig. 3 and 4. The holding pins keep the valve from rotating. It is better to use our Standard Assembly fixture shown in fig. 1 and 2 where the valve parts are clamped down effectively.



fig. 2



fig. 3



fig. 4

3 In order to prevent the locating pins in the valve from shearing off, it is advisable to hold the suction seat and delivery guard respectively, while loosening or tightening the nut especially in the case of valves with open guard (fig. 5).



fig. 5

4 How it should not be done!

Never should a valve be directly tightened in a vice, neither as shown in fig. 6 on the shoulder, nor as shown in fig. 7. Do not hammer on the wrench when loosening or tightening the nut (fig. 8 and 9).

fig. 6



fig. 7



fig. 8



fig. 9



3 Clean all parts

with a cleansing fluid using a soft brush, taking particular care to free the ports of the seat and the guard from all foreign matter to ensure full seat area in operation. Never use wire brushes or tools with sharp edges to clean the seats and plates.

5 All precautionary measures stipulated by the Occupational Safety and Health Act of 1970 (OSHA) or local safety instructions must be adhered to when handling solvents.

Caution: all excess solvent solutions used in the cleaning of compressor valves and/or pockets should be removed prior to start-up since their presence may cause an explosion hazard.

4 Check the condition of all components

6 Use only genuine HOERBIGER replacement parts.

5 Repair or replace worn parts

Valve plates

When a valve plate, or damper plate shows signs of wear, it is imperative to replace these parts, even if no breakage has occurred.

7 Valve plates and rings when worn should be replaced, not reground or inverted.

8 When a spring in a valve shows signs of deterioration, not only that particular spring but all springs must be replaced in this valve. In the case of conical springs care should be taken that they are inserted into the spring well with the large diameter resting at the bottom of the spring well (fig. 10).

Seats

For highest efficiency of the valve it is important that the seat face is flat and free of any traces of wear, thus preventing valve leakage. If any damage of the seat face appears, it is necessary to remachine and lap the seating areas. Locating pins, if fitted, have to be removed first of all. Generally remachining is done by concentric grinding and lapping. If the seat face shows only slight defects, lapping alone may prove satisfactory. Also remachining on a center lathe with very low feed may be considered, particular attention being paid to the seat face being machined. Burrs are best removed with emery paper (fig. 11.1 and 11.2)

9 When a valve seat surface is remachined, new valve plates or rings must be used to assure proper seal.

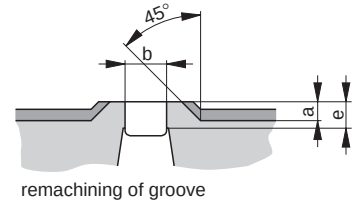


fig. 11.1

How often may a valve seat be remachined?

Under no circumstances must the bottom of the turned slots be machined to increase the depth, as this would impair the strength of the seat. The following may serve as a rough guide for remachining of seats. The material thickness „e“ (fig. 11.1) under the seating ledge should not be reduced to less than 60% of the slot width „b“ an

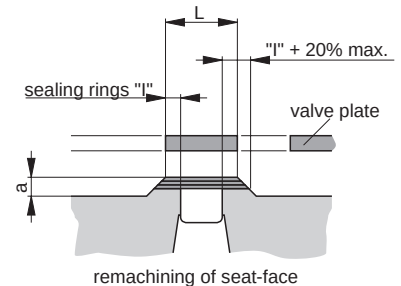


fig. 11.2

exception to the above are the steel seats of valve Types 52 R and 42 R, for which dimension „e“ should be limited to 1.2 mm minimum. Every grinding or lapping of the seat face increases the width of the ring surface marked „I“ in fig. 11.2. In order to keep the dimension constant the grooves have to be remachined. The maximum increase on width which can be tolerated is 20%.

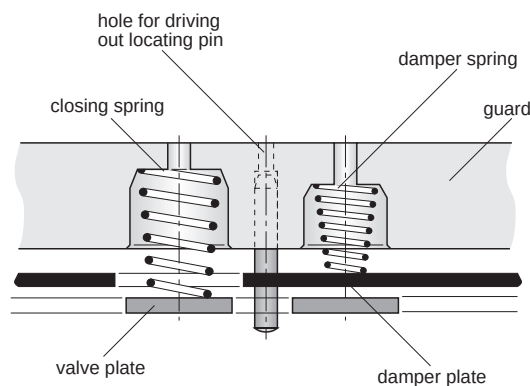
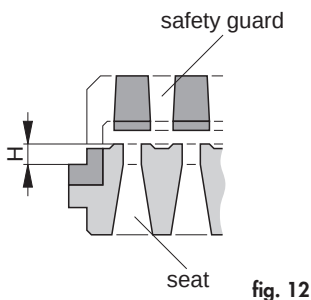


fig. 10

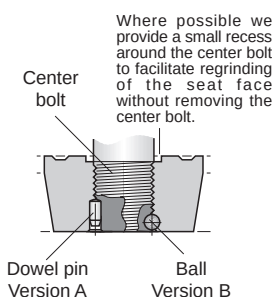
10 Do not remachine valve seats below the specified minimum dimension, otherwise there is danger of breakage.

11 Remachining has to be extended over the entire seat-face, including the center where lift washers or guide rings are located, in order to avoid any change of the valve lift.

Center bolts are secured into seats (or guards) with a dowel pin (Version A) or a bolt lock using a small ball (Version B). To remove the centre bolt, drill out the (soft) dowel pin or ball and unscrew the bolt. Upon re-assembly drill a new hole in the thread area of the



bolt and the seat or guard, respectively, and insert a new pin or ball to secure the bolt from coming loose.

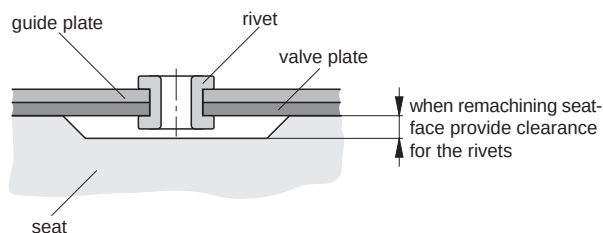


The dowel pin or ball, after it is inserted, has to be peened (slightly hammered in) to prevent it from falling out (fig. 13).

If so-called safety guards (Standard design fig.16) are centered on the seat, care must be taken to maintain dimension „H“ (fig. 16). This means any centering step on the seat, must be remachined to the same extent as the seat face.

After remachining of the seat the locating pins have to be refitted (fig. 15).

12 If the valve plate and guide plate are riveted together, the groove in the valve seat under the rivets has to be remachined after every grinding to prevent the rivet heads from hitting the seat. Remachine until the rivet has ample clearance (fig. 14).



Locating Pins

Locating pins, which have been removed from the seat before the remachining, have to be refitted, taking care that the free length is the same as before (fig. 15). If necessary, the pin holes have to be drilled deeper in order to ensure that the maximum free length is not exceeded. If the pin in the seat or the hole is damaged redrill the locating pin holes displaced by 180°.

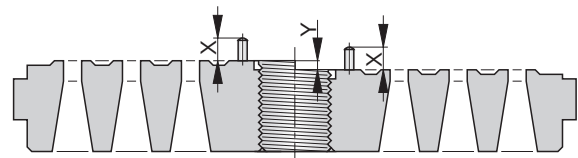


fig. 15
X... free length before and after remachining
Y... height reduction by remachining

The diameter of the new hole has to provide a press fit (dia. of drill. 0.1 mm less than dia. of locating pin). Make sure that the locating pins are at right angles to the seat face. When re-assembling the valve align the seat with the guard. In this position the nut can be tightened. Never tighten the nut without positioning the seat and guard properly. Any damage of the locating pins can impair the proper functioning of the valve.

Certain valves have no hole in their seat to accept the free end of the locating pin. Such valves are provided with marking holes on the periphery of seat and guard or visually by aligning the webs of the seat and guard, which must be lined up before the valve nut is tightened down (see fig. 16).

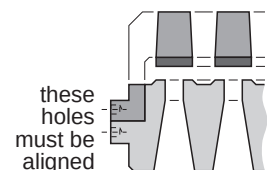


fig. 16

fig. 13

fig. 14

6 Reassemble the valve

Take special care in assembling the valve and follow procedures shown on our drawings. We are glad to give any further advice should problems arise. If valves are equipped with lock washers or locking plates, they have to be replaced after every dismantling. For more convenient assembly of the valve it is a good practice to grease the spring pockets, in order to hold the springs in place. **This does not apply for valves of oxygen compressors.** You will do a better job if you use a torque wrench for tightening the selflocking nut. (Follow the torque table given in this leaflet). When tightening the nut hold the suction seat, or the discharge guard, especially in case of valves with open guards (fig. 5) both parts should not move relative to each other. This could damage the locating pins in the valve and result in valve failure. Certain valves are provided with marking holes on the periphery of seat and guard which must be lined up before the valve nut is tightened down (fig. 16).

13 Never use oil or grease for valves used on oxygen-compressors!

14 Tightening torque of center bolt nut has to be maintained as specified. Bolt and nut threads must be clean, free of burrs and well lubricated. **CAUTION:** With Oxygen Compressors. Valves have to be completely free of oil and grease. Inspect valve again before installation. Failure to do so may result in an **EXPLOSION!** Never use self locking nuts on austenitic stainless steel material.

The torques listed in the table are for greased nuts and bolts. The data is only valid with a Genuine Centre Bolt. Self locking nuts should always be lubricated before tightening.

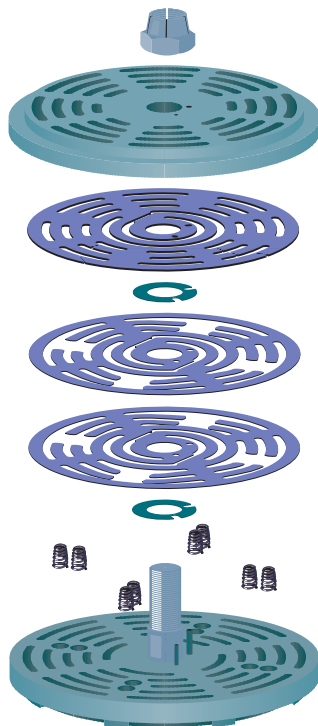


fig. 17

15 If suction valves are equipped with unloaders, the clearance between the valve plate and unloader finger as well as the clearance between unloader and actuator push rod has to be checked.

16 Valve plates have to be checked for free movement.

17 Before assembling the valve into the cylinder also clean the valve pocket and the cages.

18 When re-installing valves, do not interchange suction and discharge valves - **DANGER OF EXPLOSION!**

19 Do not install discharge valves upside down - **DANGER OF EXPLOSION!**

20 Valves must always be placed in the cylinder with the center bolt and nut **AWAY** from the cylinder bore.

21 Set screws or cover stud nuts holding the valve in place have to be tightened to the specified torque values, otherwise there is danger of valve seat breakage.

22 After all of the valves are installed, bar over the compressor at least one complete revolution to be certain there is no interference with moving parts.



fig. 18

Table of torque.
(valid for castle nuts, slotted nuts
and self locking nuts).

PRACTICAL LEAKAGE TESTING OF COMPRESSOR VALVES

Compressor valves should be flowefficient and durable in service. Leakage is one criteria that impacts on both of the above. Excessive leakage causes back-flow of gas when the valve is closed, raises the temperature of the gas and reduces efficiency. Elevated temperatures also adversely affect valve life.

For this reason, HOERBIGER's quality assurance program dictates that all valves are subjected to a leakage test. This policy covers newly made valves in our production plants and repaired valves in all our service centers. Different geometry valves and sealing elements made from steel or non-metallic material all undergo such rigorous testing.

Test methods may vary but preference is given to those procedures that simulate the conditions as they exist in a cylinder.

VALVE TESTING METHODS

There are 3 customary leakage test procedures, and HOERBIGER recommends 2 of the testing methods.

Flow Meter Testing

The leakage is determined by subjecting the closed valve to a "set" air pressure of e.g. 5 bar (70 PSI) and measuring the leakage through the valve by means of a flow meter (fig. 19).

Since small contaminants at times can be caught between the valve plate and seat lands,

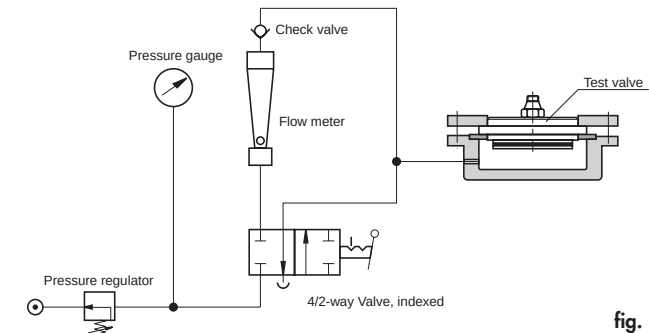


fig. 19

it is common practice to "tap" the valve plate in several areas repeatedly. This will briefly lift the plate off the seat lands and the escaping air will blow out any small particles that might be trapped between the sealing surfaces and cause excessive leakage. This should be done with an appropriate tool (flat or soft-tipped) so no damage is done to the valve plate or sealing element. Particular care is called for when non-metallic plates are used so no damage is done to these components.

The time for the pressure drop to occur and parameter for acceptable leakage are dependent on the valve size, volume of the vessel and the selected pressures of p1 and p2.

The prior "tapping" of the valve to blow out any impurities should be standard practice in this test procedure as well.

Liquid Testing

Test procedures as discussed under 2.1 and 2.2 are compatible and represent conditions as they prevail in the compressor cylinder. The sealing element is "pressure loaded" much like it is in its operating environment when installed in a cylinder (the suction valve is kept closed by the cylinder pressure while the discharge valve is under the influence of the line pressure).

Measuring Pressure Drop

In this test method, leakage is measured in pressure drop over time, using a fixed volume "V" (air supply is shut off) and measuring the time it takes for the pressure to drop from p1 to p2 (fig. 20).

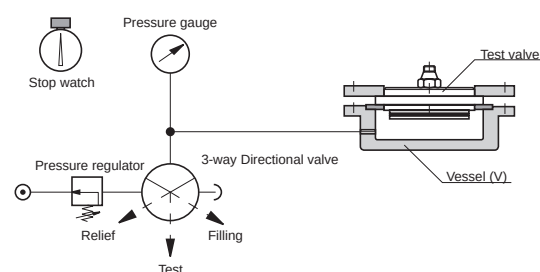


fig. 20

Thread size METRIC mm	Carbon Steel Min. tensile strength 800 N/mm²		Austenitic Stainless***) (En 58) Min. tensile strength 550 N/mm²	
	Martensitic Stainless Steel*) (En56) Min. tensile strength 750 N/mm²			
	Torque in Nm		Torque in Nm	
	Minimal	Maximal	Minimal	Maximal
4	1,2	1,5	1,0	1,2
5	2,4	2,9	1,8	1,2
6	4,1	5,0	3,2	3,8
8	10,0	12,0	7,5	9,0
10	20,0	24,5	15,5	18,5
12	36,0	44,0	28,0	33,0
14	57,0	69,0	43,0	52,0
16	90,0	110,0	70,0	85,0
20	178,0	215,0	135,0	160,0
22	245,0	295,0	185,0	220,0
24	305,0	370,0	230,0	280,0
27	330,0	400,0	330,0	400,0
30	450,0	540,0	450,0	540,0

*) Martensitic stainless steel (magnetic) is used with slightly corrosive gases

**) Austenitic stainless steel (non magnetic) is used with highly corrosive gases

Frequently, field people do not have access to leakage testers and resort to a simple "liquid testing" of the valve.

Filling the seat ports of a valve with a fluid and observing the leakage rate of the fluid through the valve is a common practice. Kerosene, Varsol and other light viscosity fluids (even water) are employed in such crude leakage tests.

Although the procedure is widely used, it is not without controversy as to the viability of its results. Contrary to the previously described methods of air pressure testing, the liquid test does not simulate conditions as found in the cylinder. The fluid pre-loads the sealing element towards its opening lift, and test results can be distorted, especially if valves use non-metallic sealing elements and if the pre-load of the springs used in the valve is very light.

Certain valves, due to their design, cannot be tested at all with the fluid method, and others will create the appearance of "leakers" when their sealing characteristic under air pressure is perfectly acceptable. This test method, therefore, is controversial and should be avoided whenever possible. The cleaning process described in air testing cannot be applied in liquid tests, and any impurities in the sealing area will show as excessive leakage.

Frequently, such liquid tests lead to unnecessary labor and repair of the valve which would possibly be termed fine under air tests.

It is recognized that proper testing of valves with air pressure is not always possible, but it remains the superior procedure and should be adopted wherever possible.



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at any time -
worldwide**



HOERBIGER

Operating Instructions for Premier Pressurized Suction Pump - Force Feed Lubrication

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Installing and Maintaining Cook Rod Rings and Packing Cases

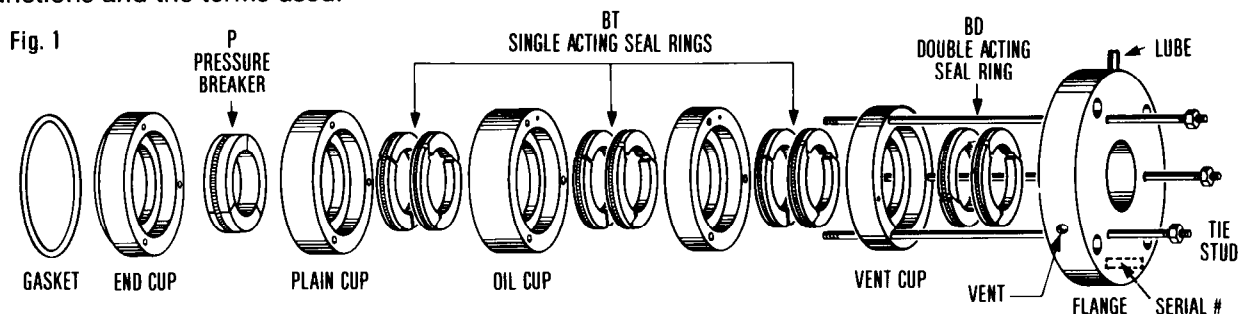
CATALOG NO. 785D

Cook's full floating rod rings are furnished in a variety of designs and materials to suit all operating conditions of reciprocating compressors and engines. It is not the purpose of this pamphlet to cover a particular design, but rather to explain the general characteristics common to most assemblies.

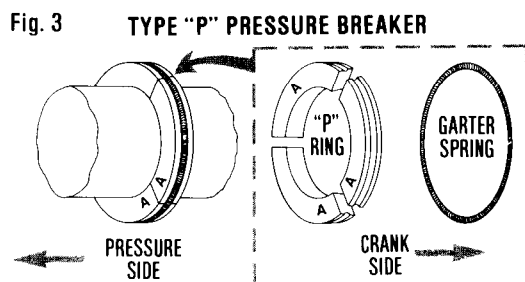
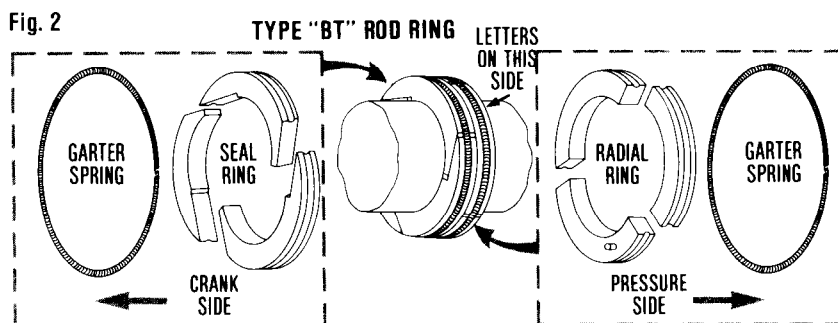
Figure 1 is an exploded view of a typical cup packing case with the various parts in proper order and each part named to familiarize an operator with the functions and the terms used.

Additional rod ring types can be found illustrated in Cook Catalog 785 where proper assembly and position with respect to pressure side is described. Also, refer to Cook Technical Bulletin TPB-76 for more information. It is likely that the exact rod ring, or one very similar to that in which you are interested, will be found among these illustrations.

The packing case comes assembled as it should appear on the rod and carries a six-digit serial number stamped on the face of the flange. When ordering replacement parts, this serial number should be given wherever possible.



Figures 2 and 3 are common type rod rings as they appear on the rod and in their disassembled state.



If installing a new set of rod rings in an existing packing case, the case parts need to be inspected for wear. Cups should be smooth and flat on the back side where the rod rings must seal. If the cups or grooves have worn concave or tapered, they should be reground or relapped. It is rarely necessary to alter the crosshead side of the cups, however, if this is found necessary, care must be taken so that the correct side clearance for the renewal rings is not destroyed. A general guide to the appropriate clearance for rod rings is shown in Table I.

TABLE I

ROD RING SIDE CLEARANCES	
ROD RING MATERIAL	MINIMUM SIDE CLEARANCE PER INCH OF GROOVE WIDTH
Metallic and Carbon	.015"/In
Nonmetallic Except Nylon	.030"/In
Nylon	.045"/In

NOTE: Typical Minimum Side Clearance For Metallic Wiper Rings Is .002"/Ring.

C. Lee Cook

A DOVER RESOURCES COMPANY

INSTALLATION

In most compressors, it is possible to bolt the packing case into the stuffing box after which the rod can be inserted with the aid of a bullet-nosed sleeve over its threaded end. Before a case is installed, it should always be disassembled and thoroughly cleaned in an appropriate solvent for the intended service.

Make sure that each rod ring and cup is properly positioned and that rings are liberally coated with a clean lubricant before reassembly. Examine all parts for unusual nicks or burrs which might interfere with the free floating of the rod ring in the cups. Particular care should be taken with rod rings made of soft materials such as bronzes or Tfe, and it is extremely important that wiper rings be handled and installed so as to prevent damage to the scraping edges.

Where it is necessary to install the packing case on a piece basis over the rod end, the case parts should be laid out on a work bench so that they can be installed progressively with each in its correct position and the rod rings with their proper faces toward the pressure (Fig. 2 & 3). Note that all rod ring segments are carefully lettered and must be assembled accordingly. This is most important in order to insure proper sealing. After the packing case has been assembled in the stuffing box and its tie studs tightened, the rod should be connected at the cross-head after which the packing case must be carefully aligned with the rod before bolting tightly into position. Alignment is readily accomplished by the use of feelers to maintain a uniform clearance all around between the case bore and the rod.

Connect oil and vent lines as indicated. If a packing case has two or more oil inlets, each

should be connected separately to individual lubricating pump plungers because pressure differentials within the packing body would result in all lubrication going into an outer point. After all connections are made, the packing case should be flooded by hand operation of the lubricating plungers to make sure lines are not air bound.

This same operation should be repeated each time a compressor is started because oil lines may have been bled during down time.

For new installations, care must be given to the cleaning of all accumulated dirt in the lines and compressors because foreign material will lodge in the packing to become destructively abrasive.

Prior to installing the packing case into the stuffing box, the end cup gasket must be inspected for nicks and damage that would cause it to leak in service. When in doubt, replace the gasket with a new one.

LUBRICATION

All lube oil lines should be fitted with a check valve at the case inlet. The selection of a proper lubricant will depend on the service involved and a Cook field service engineer should be contacted before proceeding, especially on high-pressure work or whenever there are elements in the gas which might be destructive to ordinary lubrication.

Oil ratings will range from SAE 30 for low pressure work to SAE 60 and higher for extremely high pressure. Special inhibitors or compounded oils should be used only where necessary because of unusual conditions or as recommended by a service engineer.

During initial operation, a packing case may leak or tend to overheat. This is temporary while the rings are properly mating to the rod and case. It is advisable to break in the rings on a gradually increasing pressure scale. The amount of time required will depend on the condition involved. Additional information on break-in procedures is available in Cook Bulletin TBP-76.

VENT CONNECTIONS

Most packing cases are equipped with a vent for safety reasons. This is usually connected by a separate line to atmosphere or to some point in the system where the back pressure does not exceed 15 psi.

In all back pressure vents, a check valve should be provided so that there is no flow from the vent line to the packing case. If the vent back pressure will exceed 35 pounds, a Cook service engineer should be contacted for ring and case design recommendations.

STATIC-PAC™

When a packing case is being assembled which incorporates a Static-Pac™, the lip seal and all associated springs and O-rings must be inspected for possible damage. Cases utilizing a Static-Pac™ normally require that all cup faces be coated with a light film of sealant, such as Never-Seez, to prevent case leakage. Additional information on the operation of the Static-Pac™ is available in Catalog 785 and Bulletin 784.