ARIEL
Heavy Duty
Oil Flooded Twin Screw
Rotary Compressors

Technical Manual
For Models:

RG282M and RG357M

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REV: 6/09

CAUTION

GAS COMPRESSOR UNITS ARE COMPLICATED AND DANGEROUS PIECES OF EQUIPMENT. OPERATORS AND MECHANICS MUST BE FULLY TRAINED AND FAMILIAR WITH THEIR OPERATION.

BEFORE STARTING THIS UNIT:

FAMILIARIZE YOURSELF WITH THE UNIT.

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

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 STARTING.

AFTER COMPLETING THE ABOVE, BEGIN PROPER STARTING PROCEDURE.

ARIEL

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.

CAUTION

THIS MANUAL EDITION IS BASED ON THE CURRENT DESIGN AND BUILD PRACTICES. THIS MANUAL MAY NOT BE APPLICABLE TO EQUIPMENT BUILT PRIOR TO THE DATE ON FRONT COVER AND IS SUBJECT TO CHANGE WITHOUT NOTICE. CONTACT ARIEL WITH ANY QUESTIONS. REFER TO LAST PAGE OF THIS MANUAL FOR CONTACT INFORMATION.

WHEN THIS SYMBOL APPEARS ON THE COMPRESSOR OR CONTROL PANEL, THIS TECHNICAL MANUAL IS TO BE CONSULTED FOR SPECIFIC INFORMATION BEFORE PROCEEDING. IF MORE INFORMATION IS NEEDED CONTACT YOUR PACKAGER AND/OR ARIEL CORPORATION.

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This section is currently under review. Please contact Ariel for recommendations concerning the oil system, lubrication, or venting for your Ariel rotary screw compressor.

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 proper maintenance.

While Ariel rotary compressors share many similarities, each model has aspects that are unique to the particular model type. The RG series compressors are specifically designed for the natural gas gathering market, where the majority of Ariel compressors are applied.

If you, as an operator, are familiar with Ariel rotary compressors, it is still important to review this manual to determine the differences. If you are new to Ariel rotary compressors, it is critical that you become very familiar with this manual prior to operating the compressor. Rotary compressors are precision rotating equipment, requiring knowledgeable operation and maintenance.

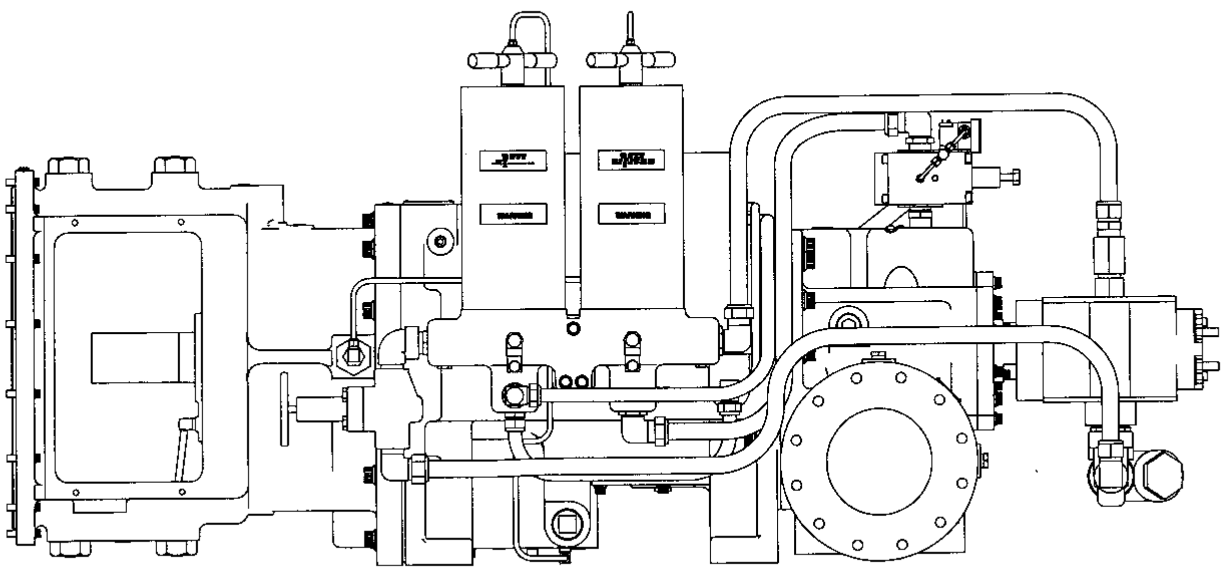


FIGURE 1-1 INTEGRAL OIL SYSTEM AND BELL HOUSING MOUNTING - DISCHARGE SIDE VIEW

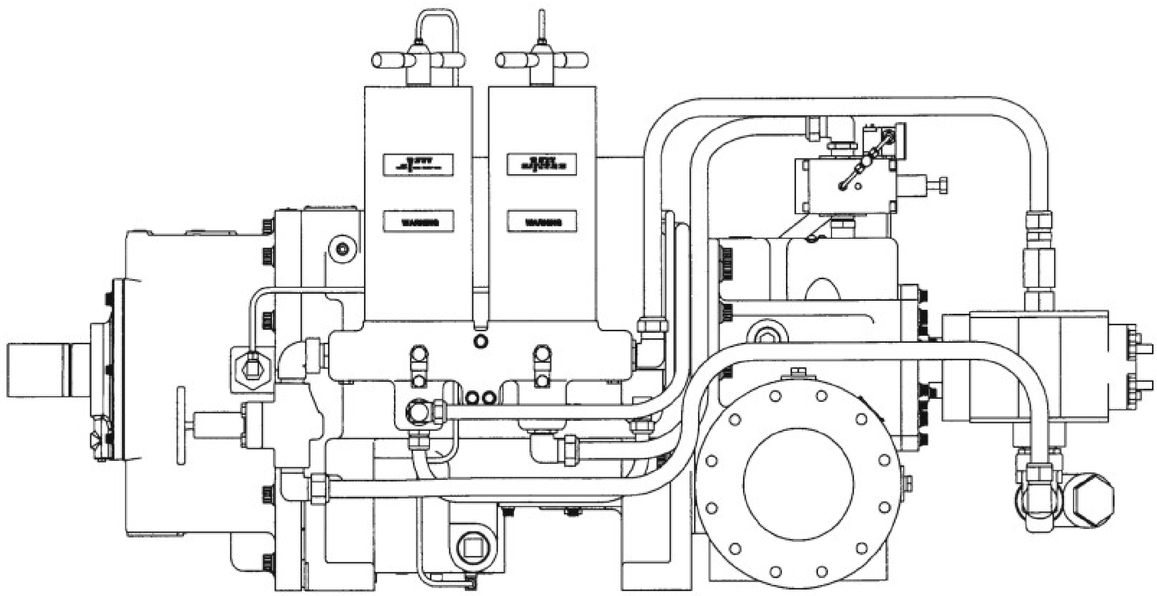


FIGURE 1-2 INTEGRAL OIL SYSTEM AND W/O BELL HOUSING - DISCHARGE SIDE VIEW

Ariel rotary compressors feature positive displacement, single stage, oil-flooded, twin screw rotors, designed primarily for natural gas gathering, but have applications for other gases. Heavy duty babbitted journal bearings, anti-friction rolling element thrust and jack shaft bearings, variable volume ratio (Vi) at full and partial load conditions, variable capacity control and changeable speed increasing gears allow RG rotary compressors to operate in a wide variety of gas applications.

NOTE: VOLUME RATIO (VI) IS THE VOLUME OF GAS, IN ACTUAL VOLUME, AT THE POINT WHERE COMPRESSION BEGINS, DIVIDED BY THE VOLUME OF GAS, AT THE END OF COMPRESSION. VI = VS/VD.

Rotary compressors have few moving parts, can run at high rotating speeds, can accommodate a wide range of compression ratios, and operate with minimum pressure pulsations. They are generally applied in low suction pressure applications, discharging into medium pressure lines. To maintain high compressor efficiency, care should be taken to operate the compressor with the volume ratio (Vi) adjusted as close as possible to the required Vi.

NOTE: REQUIRED VI = (PD/PS)1/K, WHERE
PD = DISCHARGE PRESSURE, ABSOLUTE
PS = SUCTION PRESSURE, ABSOLUTE
K = GAS ISENTROPIC EXPONENT

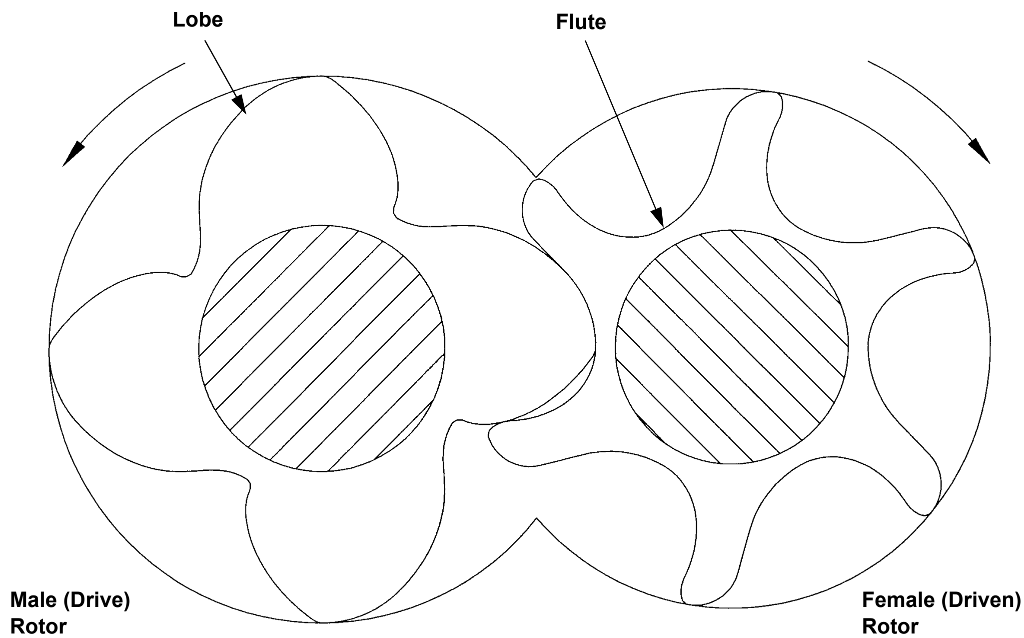


FIGURE 1-3 MALE/FEMALE ROTOR PAIR (4/6 LOBE/FLUTE RATIO) - TYPICAL

RG282M and RG357M compressors are available without bell housing and use all four compressor feet for mounting to the skid, or with bell housing SAE flanges for mounting to the engine and use two feet for mounting to the skid.

Oil is the lifeblood of oil-flooded rotary screw compressors. Catastrophic damage can occur to rotors, bearings, mechanical seal and gears without adequate oil quality, volume and viscosity. Compressor oil selection is based upon process gas composition and contaminants at operating temperatures and pressures. Therefore if gas composition or operating conditions change, the compressor rotating speed, lubrication selection, and gas/oil separator operating temperature must be re-evaluated.

During compressor operation, process gas will always dilute the lubricating oil, reducing viscosity. Liquid and solid contaminants entering with the suction gas stream must be effectively removed to minimize the detrimental affects on the compressor and its oil system. Pressurized oil viscosity should never be allowed to drop below the minimum requirement. Only the oil supplier can predict oil viscosity in its diluted operating condition. Ariel rotary screw compressors are designed for oil flooding of the process gas, with oil separation and recirculation. Packager design and customer oil selection determines the amount of oil carryover (loss) downstream of the gas/oil separator's coalescing filter.

This manual is designed to provide information on installation, start up, operation, maintenance and troubleshooting of an RG 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, refer to See “Contacting Ariel” on page 7-9..

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

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

NOTE: USE SERIAL NUMBERS IN ALL CORRESPONDENCE. REFERENCE FIGURE 1-9 ON PAGE 1-11.

NOTE: INSTALLED SPEED INCREASING GEAR RATIO CAN BE DETERMINED FROM THE GEARBOX HOUSING INFORMATION PLATE.

NOTE: THE ROTARY COMPRESSOR OFFERS TWO OPTIONS FOR CAPACITY AND VOLUME RATIO (VI) CONTROL: HYDRAULIC AND HANDWHEEL.

The various rotary compressor control configurations are shown in Figure 1-5 on Page 1-9, Figure 1-6 on Page 1-9, Figure 1-7 on Page 1-10, and Figure 1-8 on Page 1-10.

Compressor Operating Theory

Ariel developed the 282 mm (11.10 inch) and 357 mm (14.06 inch) male rotor diameter oil-flooded rotary screw compressors specifically for low pressure natural gas service. RG compressors are integrally geared, with interchangeable speed increasing gear sets, to load driver horsepower based upon application requirements.

The rotary compressor's oil-flooded, twin screw design consists of a male rotor which drives the female rotor. The male rotor lobes drive the female rotor flutes, as in a helical gear set. The female rotor speed is linked to the male rotor set through the ratio of male lobes to female flutes (4/6). An optional oil pump is directly coupled to the auxiliary end of the female rotor. Rotor tip speeds are generally between 49 to 197 ft/sec (15 to 60 m/sec).

The male rotor is driven through an integral speed increasing gear set. The compressor and the gearbox share a common oil system. To accommodate a wide application range, gear ratios range from 1:1.029 to 1:2.240 speed increasing for the RG282M compressor and 1:1.000 to 1:2.667 for the RG357M compressor. The compressor's input pinion gear is driven by a bull gear mounted on a jack shaft, that is coupled to the prime mover (engine or motor).

As the compressor's twin rotors un-mesh, at the top, the rotor flutes are exposed to the suction gas stream and filled with gas. As the rotors turn out, the flutes are closed and sealed by the rotor housing, creating spiral segmental compression chambers that move gas axially toward discharge. Oil is injected into the compression chambers, after they close off from the suction pressure, to provide sealing, cooling and lubrication. The rotor meshing, at the bottom, progressively reduces each compression chamber's volume axially, thereby increasing gas/oil mixture pressure. Rotor rotation progressively exposes the compression chambers to the discharge port, moving the compressed gas/oil mixture out of the compressor.

Discharge piping carries the compressed gas/oil mixture to a degassing vessel where the oil is separated from the process gas using gravity separation and a coalescing filter. The oil is piped to a cooler and re-circulated to the compressor.

Refer to Ariel's “Oil Flooded Rotary Compressor Theory of Operation” and “RG282 Features and Operating Theory” videos, available on CD from Ariel on request, for more details.

Compressor Capacity Control Theory

The compressor's rotor length, diameter, lobe/flute combination and rotating speed determine full load capacity. The selected capacity control position determines inlet volume (Vs), while the selected volume ratio (Vi) determines internal compression ratio. Capacity control positioning provides variable part load capacities. Seven speed increasing gear set choices are available for each compressor model. Depending upon the gear option chosen, the compressor's maximum rotating speed and corresponding full load capacity can be adjusted to load available driver horsepower when operating conditions change. The gear sets are “field” changeable by replacing the bull/pinion gears as a set with a gear ratio appropriate for the conditions. The gear set can be replaced in a properly equipped shop.

The RG series has separate inlet volume (capacity) and discharge volume (volume ratio, Vi) control devices, instead of using a traditional slide-valve. To maintain high compressor efficiency for varying application pressures, RG compressors have independent capacity and volume ratio controls which provide volume ratio control for both full and reduced capacity conditions. The capacity and Vi controls are actuated separately, but move in concert to optimize compressor efficiency with changing conditions. Hydraulically actuated capacity and Vi controls are typically adjusted within the driver's horsepower and speed range using a programmable logic controller (PLC) along with compressor package feedback. Manually actuated capacity and Vi controls are typically adjusted by an operator to meet the driver's optimal horsepower and speed range for the operating conditions encountered.

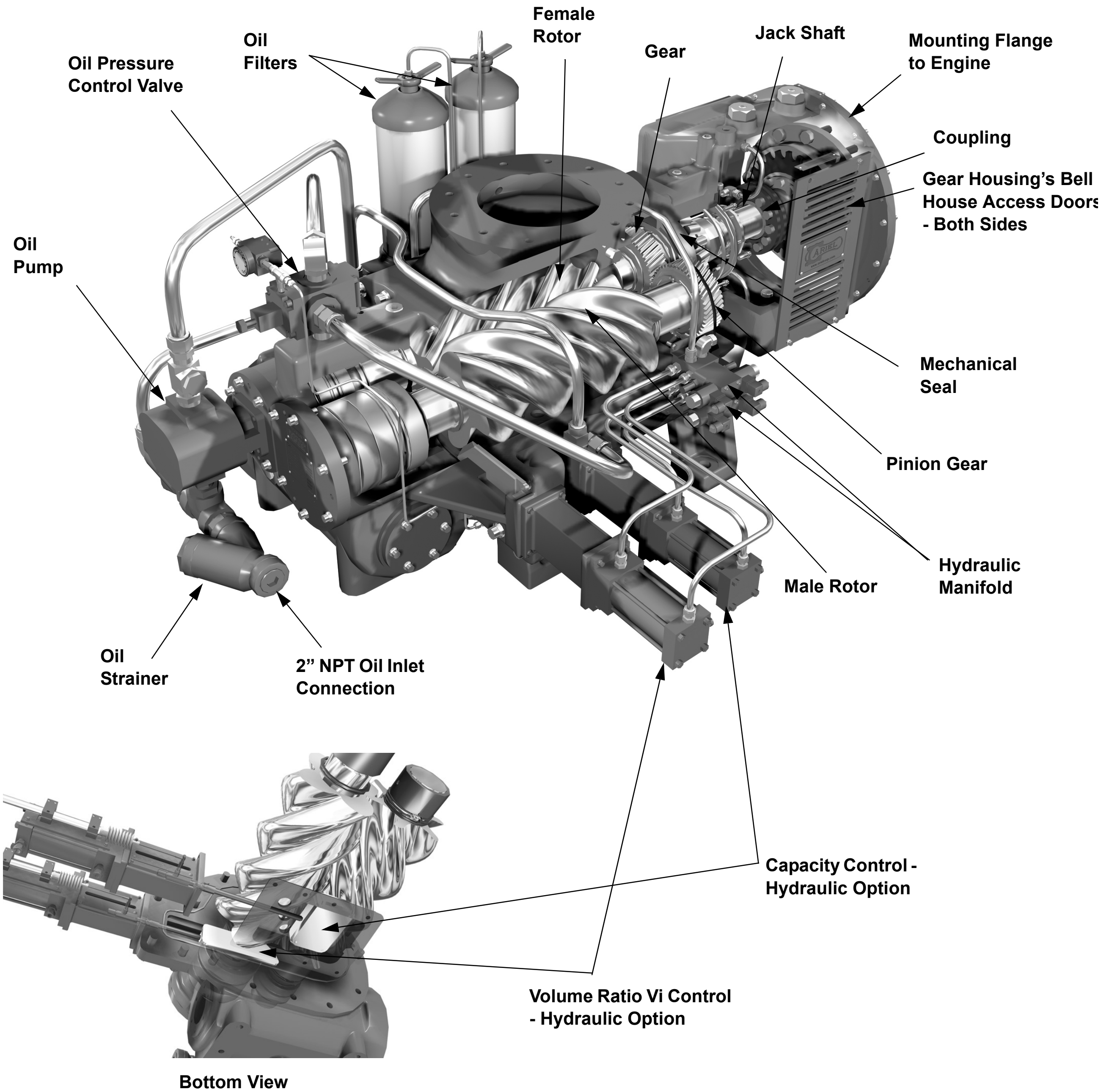


FIGURE 1-4 CROSS-SECTION - HYDRAULIC CONTROLS - TYPICAL

Specifications

TABLE 1-1 BASIC SPECIFICATIONS[A]

MODEL	RG282M	RG357M
Male Rotor Diameter, in. (mm)	11.102 (282)	14.055 (357)
Number of Male Rotor Lobes	4	4
Number of Female Rotor Flutes	6	6
L/D Ratio	2.0	2.1
Max. Input Speed, RPM	1800	1800
Gear Ratios, 7 Speed Increasing	1:1.029, 1.250, 1.433, 1.613, 1.793, 2.037, 2.240	1:1.000, 1.375, 1.567, 1.778, 2.040, 2.304, 2.667
Male Rotor Operating Speed, RPM	1040 to 4065	840 to 3230
Full-Load Inlet Volume Capacity, CFM (m^3/h)	1070 to 2930 (1818 to 4978)	1320 to 5150 (2243 to 8750)
Rated Horsepower BHP (kW)	800 (597)	1375 (1025)
Suction Pressure, psia (bar_a)	Unconditional 3 to 75 (0.21 to 5.17); Conditional[b], >75 (>5.17)	Unconditional 3 to 65 (0.21 to 4.48); Conditional[b], >65 (>4.48)
Maximum Running Pressure, psig (bar_g), Discharge	230 (15.86)	230 (15.86)
Maximum Discharge Temperature, °F (°C)	248 (120)	248 (120)
Height - Mounting Feet to Jackshaft, in. (mm)	15.75 (400.1)	18.0 (457.2)
Maximum Height, Mounting Feet to Highest Point[c], in. (m)	41.8 (1.06)	45.0 (1.14)
Maximum Width[c], in. (m)	63.2 (1.61)	72.1 (1.83)
Maximum Length[c], in. (m)	w/o Bell Housing 85.1 (2.16); SAE “0” 91.1 (2.31)	w/o Bell Housing 97.2 (2.47); SAE “00” 109.0 (2.77)
Approximate Weight with Oil Pump & Integral Oil System & Hydraulic Controls, lb. (kg)	w/o Bell Housing 4825 (2200); SAE “0” 5250 (2400)	w/o Bell Housing 9000 (4100); SAE “00” 9850 (4475)
Volume Ratio, (Vi) Adjustable Range[d]	2.5 to 5.0	2.5 to 5.0
Oil Filter - Bearing, Seal & Gears, ß6 = 200; 99.5% efficiency rating at removing particles 6 µm & larger	6 micron	6 micron
Oil Filter - Rotor Injection, ß16 = 200; 99.5% efficiency rating at removing particles 16 µm & larger	16 micron	16 micron
Recommended Oil Retention in Gas/Oil Separator[e]	2 minutes	2 minutes

a. For more details see the Electronic Databook, available in the Ariel Performance Program.
b. Higher suction pressure may be allowed under limited conditions. Contact Ariel Applications Engineering for Approval.
c. See the Ariel Outline Drawings for more dimensional details.
d. Hydraulic or handwheel actuated controls options available.
e. Per API-619, actual retention time depends on separator design.

TABLE 1-2 HANDWHEEL TURNS VS. CAPACITY CONTROL POSITION

RG282M			RG357M		
CAPACITY HANDWHEEL POSITION	TRAVEL, IN. (mm)	LOAD PERCENTAGE	CAPACITY HANDWHEEL POSITION	TRAVEL, IN. (mm)	LOAD PERCENTAGE
Clockwise to Full Stop	0	100%	Clockwise to Full Stop	0	100%
10 Turns from 100%	0.8 (19)	90%	12 Turns from 100%	0.9 (23)	90%
21 Turns from 100%	1.6 (41)	80%	24 Turns from 100%	1.8 (47)	80%
31 Turns from 100%	2.4 (61)	70%	36 Turns from 100%	2.8 (70)	70%
41 Turns from 100%	3.1 (79)	60%	48 Turns from 100%	3.7 (94)	60%
52 Turns from 100%	4.0 (102)	50%	60 Turns from 100%	4.6 (117)	50%
(62 Turns) Counter-Clockwise to Full Stop	4.7 (119)	40% (Minimum)	(72 Turns) Counter-Clockwise to Full Stop	5.5 (141)	40% (Minimum)

NOTE: TURN HANDWHEEL COUNTER-CLOCKWISE TO REDUCE CAPACITY (UNLOAD) AND CLOCKWISE TO INCREASE CAPACITY (LOAD).

TABLE 1-3 HANDWHEEL TURNS VS. VARIABLE VOLUME RATIO (VI) POSITION

RG282M			RG357M		
Vi HANDWHEEL POSITION	TRAVEL, IN. (mm)	VI	Vi HANDWHEEL POSITION	TRAVEL, IN. (mm)	Vi
Clockwise to Full Stop	0	2.5	Clockwise to Full Stop	0	2.5
12 Turns CCW	0.9 (24)	3.0	17 Turns CCW	1.3 (32)	3.0
25 Turns CCW	1.9 (45)	3.5	33 Turns CCW	2.5 (65)	3.5
37 Turns CCW	2.8 (72)	4.0	50 Turns CCW	3.8 (98(	4.0
49 Turns CCW	3.9 (96)	4.5	66 Turns CCW	5.1 (129)	4.5
(62 Turns) Counter-Clockwise to Full Stop	4.7 (119)	5.0	(83 Turns) Counter-Clockwise to Full Stop	6.3 (161)	5.0

NOTE: TURN HANDWHEEL COUNTER-CLOCKWISE TO INCREASE VI AND CLOCKWISE TO DECREASE VI.

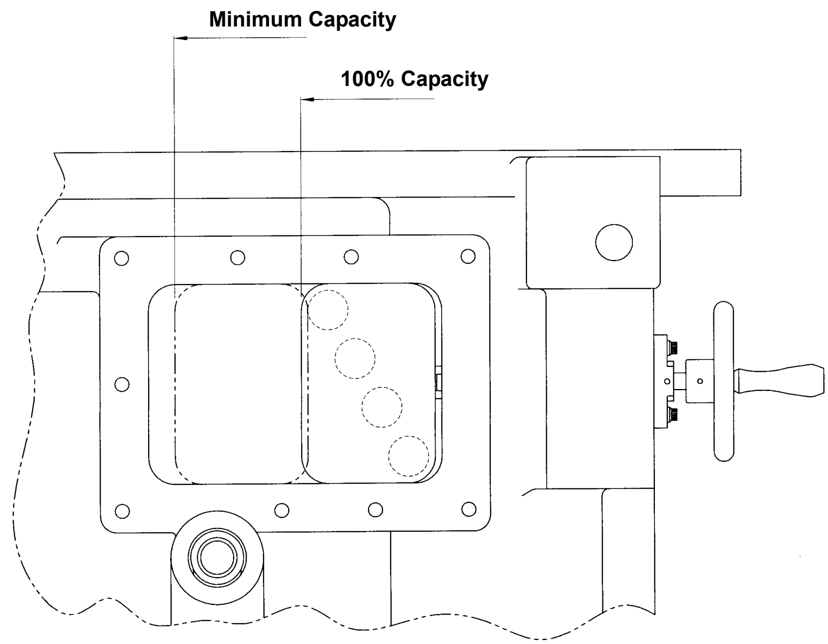


FIGURE 1-5 HANDWHEEL ACTUATED CAPACITY CONTROL - BOTTOM VIEW - TYPICAL

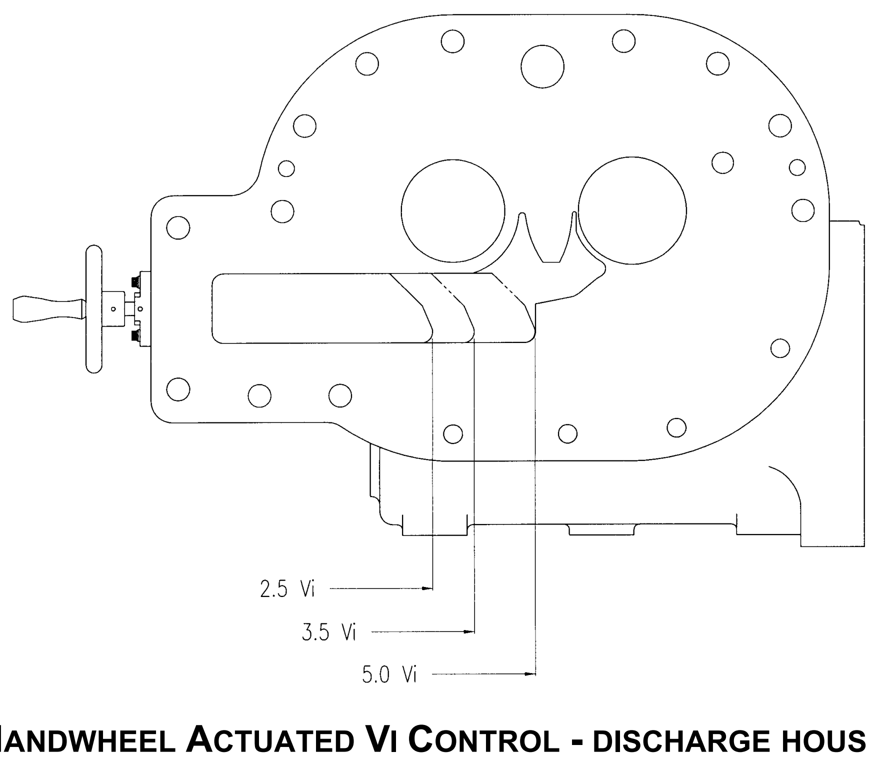


FIGURE 1-6 HANDWHEEL ACTUATED VI CONTROL - DISCHARGE HOUSING - TYPICAL

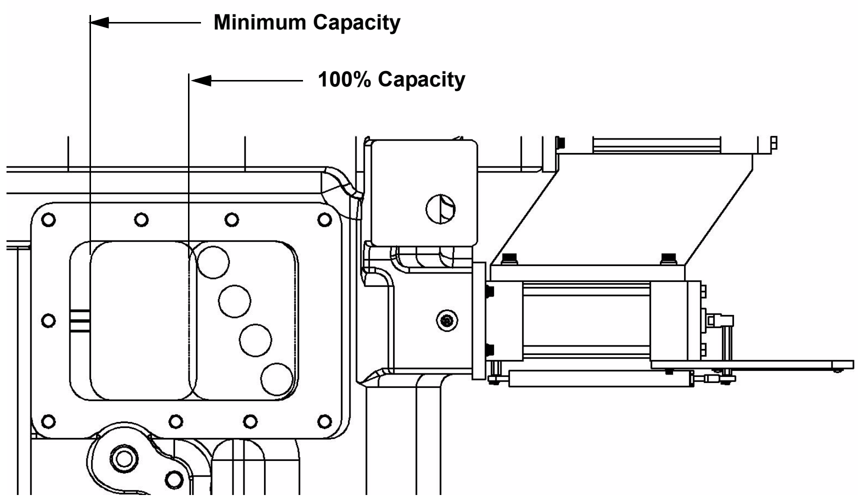


FIGURE 1-7 HYDRAULIC ACTUATED CAPACITY CONTROL - BOTTOM VIEW - TYPICAL

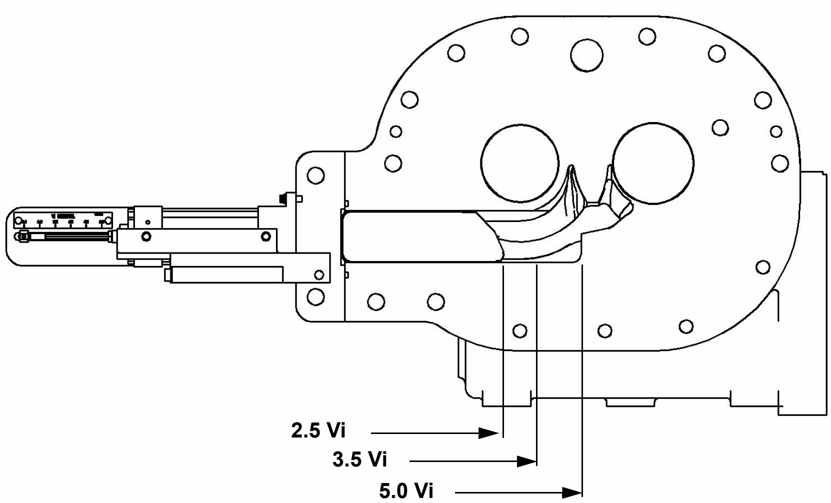


FIGURE 1-8 HYDRAULIC ACTUATED VI CONTROL - DISCHARGE HOUSING - TYPICAL

Product Information and Safety Plates

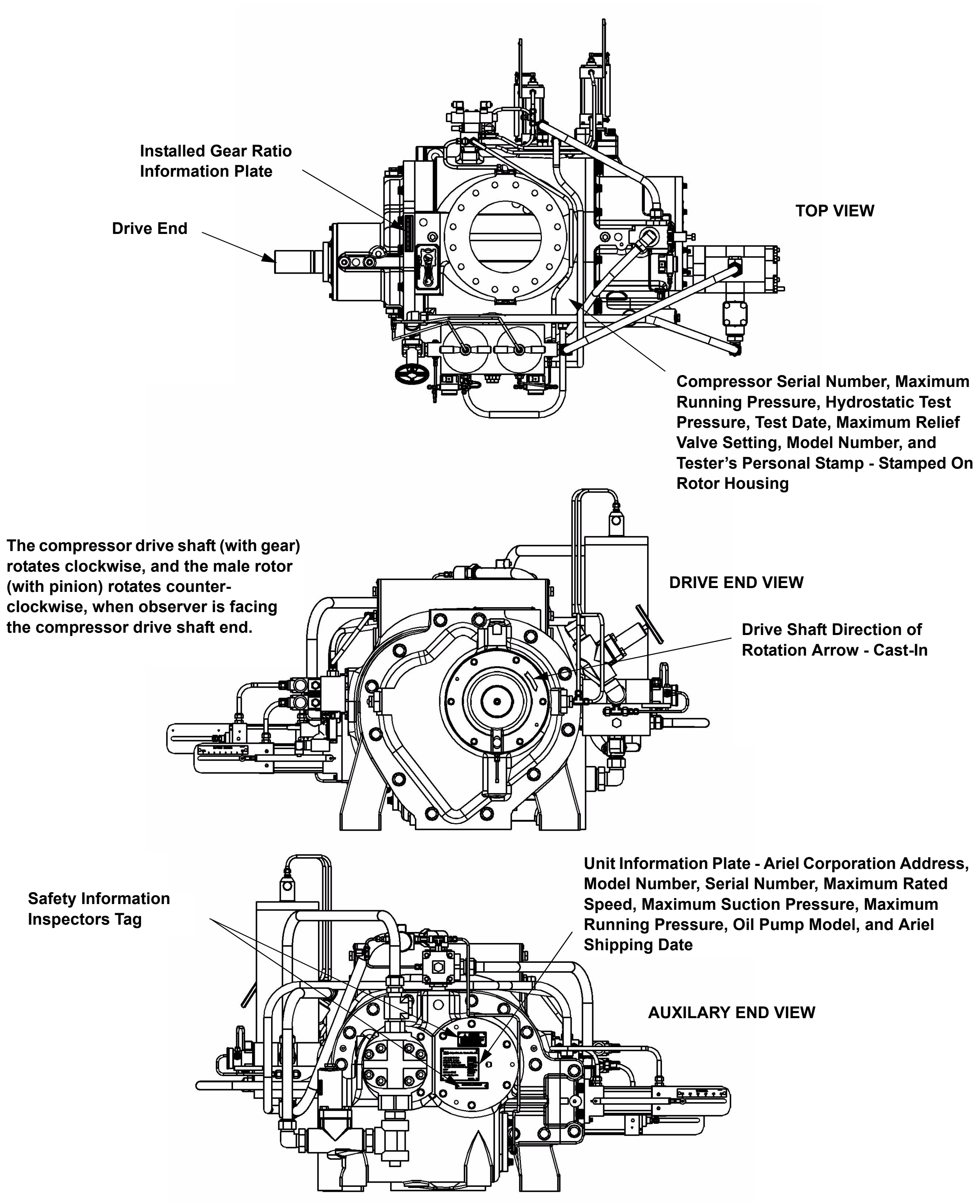


FIGURE 1-9 PRODUCT INFORMATION AND SAFETY - TYPICAL

Important Safety Information

⚠ CAUTION

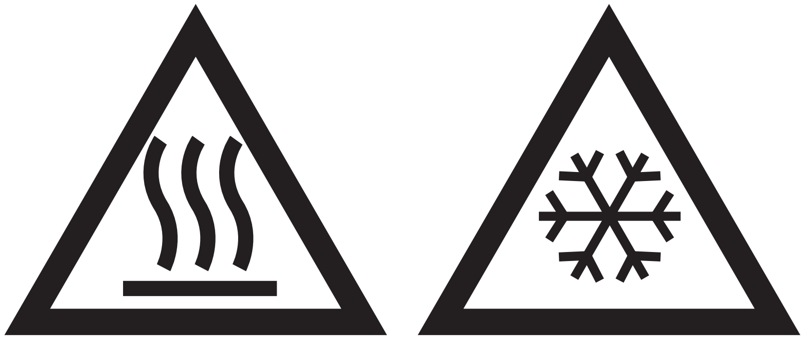
SEVERE PERSONAL INJURY AND PROPERTY DAMAGE CAN RESULT IF PRESSURE SYSTEM IS NOT COMPLETELY VENTED BEFORE LOOSENING THE BOLTS ON FLANGES, HEADS, VALVE CAPS, OR PACKING. CONSULT ARIEL TECHNICAL MANUAL BEFORE PERFORMING ANY MAINTENANCE.

⚠ CAUTION

NOISE GENERATED BY COMPRESSION 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 GAS DISCHARGE AREAS, HOT 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.



CAUTION Hot Surfaces CAUTION Cold Surfaces

Where these CAUTION symbols appear on the compressor, the surfaces are hot or cold when compressor is operating and can cause injury if touched without proper insulated protective clothing. If servicing the compressor, allow these surfaces to cool or warm to safe temperatures or wear protective clothing before proceeding. When applied to compressor cylinders, the temperature CAUTION applies to all connected piping and equipment.

FIGURE 1-10 HOT & COLD SURFACES - CAUTION SYMBOLS

Fastener Tightening Torque

Listed in Ariel Engineering Reference ER-63.1 are fastener tightening torque values, required for proper assembly of an Ariel RG compressor. ER-63.1 is provided in the toolbox as a laminated chart. ER-63.1 is also available as an electronic document on the Ariel web site.

Threads are to be clean and free of burrs. Check that the threads on the bolts are in good condition to prevent damage to the threaded holes.

Torque values are based on the use of petroleum type lubricants on both the threads and seating surfaces. Use lubricating oil or Lubriplate 630 on threads and seating surfaces, except where Loctite is specified. Molybdenum disulfide lubricants and antiseize compounds are not to be used for fastener lubrication, unless specified, or excessive stresses can result with the listed values.

Tightening Torque Procedures

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

1. Be sure that the torque wrench is properly calibrated and used by qualified personnel to achieve the required fastener tightening torque for all critical parts.
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. Tighten critical multi-bolt assemblies in steps. Tighten each bolt until snug using a alternating (criss-cross) pattern. Next, tighten each bolt to 25 percent of full torque, moving across from bolt to bolt, in a criss-cross pattern. Repeat this step for 50, 75, and 100 percent of full torque.

4. Always apply a slow steady increasing force to a torque wrench handle, 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_f-ft (108 N·m) but is jerked, 120 lb_f-ft (163 N·m) torque can be applied.
5. 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.
6. 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.
7. When checking tightened fastener torque, set torque wrench to proper required torque value, slowly apply a steady increasing force to the torque wrench handle until the click is felt.
8. 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.
9. Do not use a torque wrench to break fasteners loose as it may overload the torque wrench and/or cause loss of calibration.
10. For applications requiring the use of a boxed end or crowsfoot type 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]
11. 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.

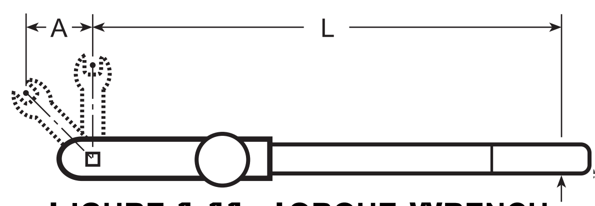


FIGURE 1-11 TORQUE WRENCH WITH ANGLED ADAPTER

$$Tw = Ta\left(\frac{L}{L + A}\right)$$

Tw = Torque wrench setting, lb x ft or N·m

Ta = Torque required at fastener, lb x ft or N·m

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

A = Length of adapter, ft or m (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

1. The exception is when the adapter is 90 degrees to the torque wrench. The torque will be the same as on the wrench scale, see Figure 1-11.

your torque wrench dealer for more detailed information.

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 ER-63.1.

The fasteners used within an RG compressor are twelve point flanged capscrews.

NOTE: WHEN RE-ASSEMBLING OR REPLACING BOLTING, SEE THE PARTS LIST TO DETERMINE THE PROPER FASTENER GRADE, TYPE, AND PART NUMBER.

Alarm & Shutdown (Also Refer To Section 4)

Gas Discharge High Temperature Settings

A gas discharge high temperature shutdown is required. Set within 10 percent of normal operating temperature, to a maximum of 238°F (114°C) alarm and 248°F (120°C) shutdown. High temperature limits are based on rotating clearance requirements.

NOTE: EXCEEDING THE HIGH TEMPERATURE SHUTDOWN LIMITATION WILL RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

Storage and Transportation of Compressor

Protect compressor to prevent corrosion and seal to prevent exchange of atmosphere, when inactive, in storage or when transporting. Consult Ariel for instructions to protect and seal compressor to ER-25-1.

Zone 1 Environment

A Zone 1 environment requires the installation of proper intrinsically safe or equivalent protection to fulfill the electrical requirements, where applicable.

SECTION 2 - INSTALLATION

General

Compressor installation with the associated driver and piping, is to be done with care and precision. This section does not attempt to address all of the concerns that can arise during installation, but addresses those areas that the user must be aware.

Electrical Grounding

CAUTION: THE COMPRESSOR SKID MUST BE GROUNDED TO A SUITABLE EARTH GROUND.

Procedure For Setting and Aligning

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

1. Be sure that driver will rotate compressor rotor drive shaft in proper direction, prior to start-up. See Figure 1-9 on Page 1-11 drive end view for rotation arrow.

NOTE: THE COMPRESSOR JACK SHAFT (WITH GEAR) ROTATES CLOCKWISE, AND THE MALE ROTOR (WITH PINION) ROTATES COUNTER-CLOCKWISE, WHEN OBSERVER IS STANDING AT THE DRIVER LOOKING TOWARD THE COMPRESSOR. REVERSE ROTATION CAN RESULT IN SERIOUS DAMAGE TO THE COMPRESSOR.

2. The skid design should:
   a. Transmit compressor and driver reaction forces to the foundation.
   b. Be sure that there is a sufficient mismatch between the shaking forces and the natural frequency of the skid.
   c. Have sufficient stiffness and strength so that the compressor can be mounted flat with no bending or twisting of the compressor casing, and so that proper compressor coupling alignment can be attained and maintained. This can be accomplished by shims or careful grouting.

Setting

Ariel RG rotary screw compressors, when supplied with an SAE mounting-flange are designed to be mounted directly to the driver. The three point mounting method uses the two (2) rear compressor feet and the SAE mounting-flange to attach the compressor to its pedestal and the driver flange, see Figure 2-1 on Page 2-2. When supplied without a bell housing SAE mounting flange, the compressor is mounted using all four feet.

Follow the coupling manufacturer's instructions for installing the coupling. Reference any packager's instructions, and Ariel's ER-41.1 on coupling installation.

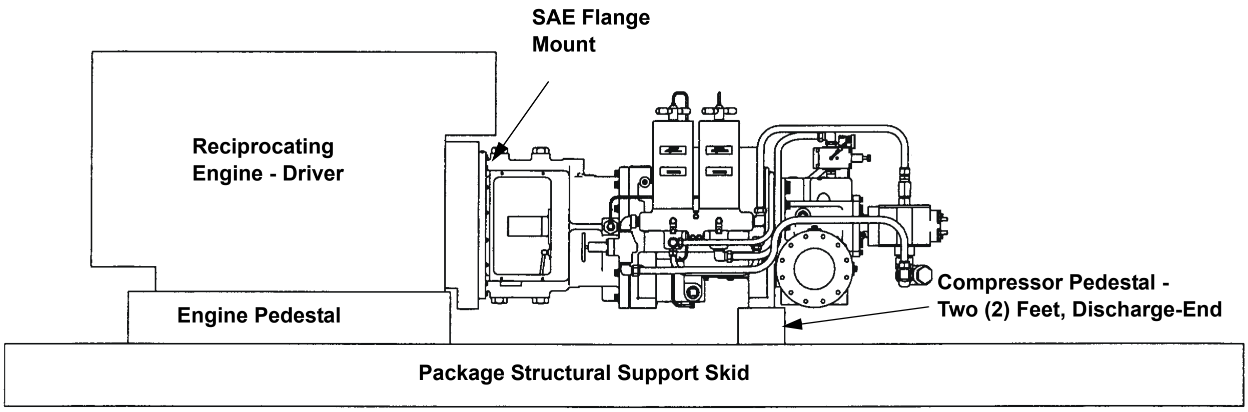


FIGURE 2-1 ENGINE/RGM COMPRESSOR ARRANGEMENT - TYPICAL FLANGE MOUNTED

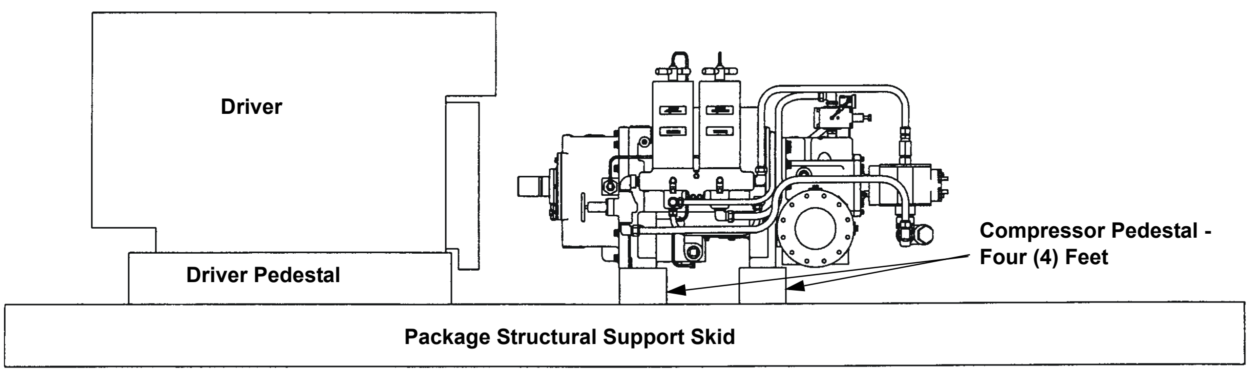


FIGURE 2-2 DRIVER/RGM COMPRESSOR ARRANGEMENT - TYPICAL W/O BELL HOUSING

The RG compressor's integral gears (speed increasing) require a torsionally soft (elastomeric) coupling that incorporates a flywheel adapter. The compressor's SAE flange and input-shaft are designed to accept several manufacturers' existing coupling designs. The straight, keyless input-shaft end location is positioned to use a flywheel adapter type coupling that incorporates a hub with a compression-type shaft attachment method. The hub's reusable compression design provides hub to shaft interference without heat, and allows for multiple reuses.

NOTE: FAILURE TO INSTALL A PROPER COUPLING CAN RESULT IN COUPLING AND/OR COMPRESSOR BEARING DAMAGE. VERIFY THE COUPLING'S FLYWHEEL ADAPTER BOLT CIRCLE WILL FIT WITHIN THE COMPRESSOR'S SAE BELL HOUSING. THE COUPLING MUST BE BALANCED TO ISO 1940 G2.5 AND MATCH MARKED.

A wide variety of preferences and techniques exist on the subject of skid mounting rotary compressors. The objective is to have a smooth running compressor that is not twisted or distorted.

Setting Compressor with an SAE Mounting-Flange

The following general procedure is to be used for setting the compressor onto the package skid;

1. Install driver to skid per packager's recommendations.
2. Lift the compressor with an overhead crane using the forged eyebolts supplied in the Ariel toolbox. Maintaining compressor balance, near to level, will facilitate setting the compressor. Refer to Figure 2-3 for the compressor's required lifting points. See the compressor outline drawing for the compressor's center of gravity.

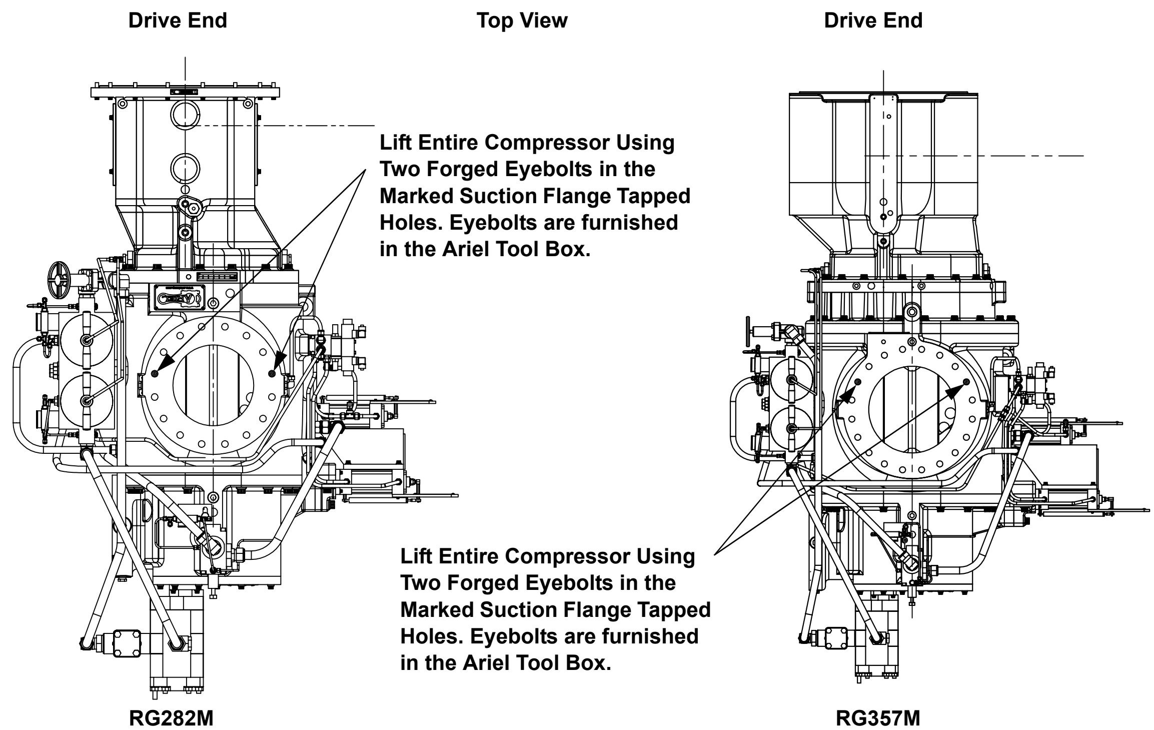


FIGURE 2-3 LIFTING POINTS FOR COMPRESSORS WITH BELL HOUSING

3. Align the SAE mounting-flange square to the driver housing.
4. Fit the compressor's SAE flange pilot to the mating driver groove.
5. While continuing to support the weight of the compressor on the crane, use four bolts at the top and four bolts at the bottom of the SAE flange to draw the flange pilot diameter completely into the driver flywheel housing.

NOTE: DO NOT USE THE BOLT HOLES BESIDE THE ACCESS DOORS TO DRAW THE COMPRESSOR FLANGE TO THE ENGINE. EXCESSIVE SIDE FORCES EXERTED ON THE COMPRESSOR'S SAE FLANGE MAY CAUSE FLANGE DAMAGE.

6. Shim to completely fill the gap between the compressor rear feet and the pedestal.
7. Loosen the eight bolts used to draw in the flange pilot diameter, leaving no more than 1/8 in. (3 mm) under the bolt heads. Relax the crane and use feeler stock to measure the gap at the top and bottom of the compressor bell housing to engine flywheel housing flange faces. Adjust the shims at the rear feet to provide an equal gap at the top and bottom flange faces. Utilize the crane to support the compressor when adjusting shims.

⚠ CAUTION

DO NOT SUSPEND THE COMPRESSOR FROM ITS SAE MOUNTING FLANGE. THE COMPRESSOR IS TO BE SEPARATED FROM THE DRIVER, WHEN LIFTING. ATTEMPTING TO LIFT THE DRIVER/COMPRESSOR FLANGE COMBINATION CAN RESULT IN SERIOUS COMPRESSOR FLANGE DAMAGE AND POSSIBLE PERSONAL INJURY.

8. With the crane relaxed, tighten the rear feet bolting to full torque and re-measure the top and bottom flange gap. Adjust the shims at the rear feet, to provide an equal gap at the top and bottom flange faces with rear feet bolting tight and crane relaxed. Utilize the crane to support the compressor when adjusting shims.
9. Loosen the rear feet bolting. Install the remaining SAE flange bolting and tighten all flange bolts to ER-63.1 using an alternating star (criss-cross) pattern (25, 50, 75, and 100 percent of final torque). Then re-tighten rear feet bolting to full torque.
10. With the compressor SAE mounting-flange bolting complete and the compressor supported on its pedestal, remove crane support.
11. After finding the approximate position of the compressor, a soft foot check is to be performed. The compressor's two rear feet pedestal mounting bolts are to be tight and then loosened. Shims are then adjusted so there is no vertical movement more than 0.002 inch (0.05 mm) between the bottom of the compressor feet and the skid's pedestal.
12. Consult Packager's information for rear feet mounting bolt tightening torque values.
13. This work must be performed prior to the addition of piping.

Setting Compressor w/o a Bell Housing

The following general procedure is to be used for setting the compressor onto the package skid;

1. Install driver to skid per packager's recommendations.
2. Lift the compressor with an overhead crane using the forged eyebolts supplied in the Ariel toolbox. Maintaining compressor balance, near to level, will facilitate setting the compressor. Refer to Figure 2-4 for the compressor's required lifting points. See the compressor outline drawing for the compressor’s center of gravity

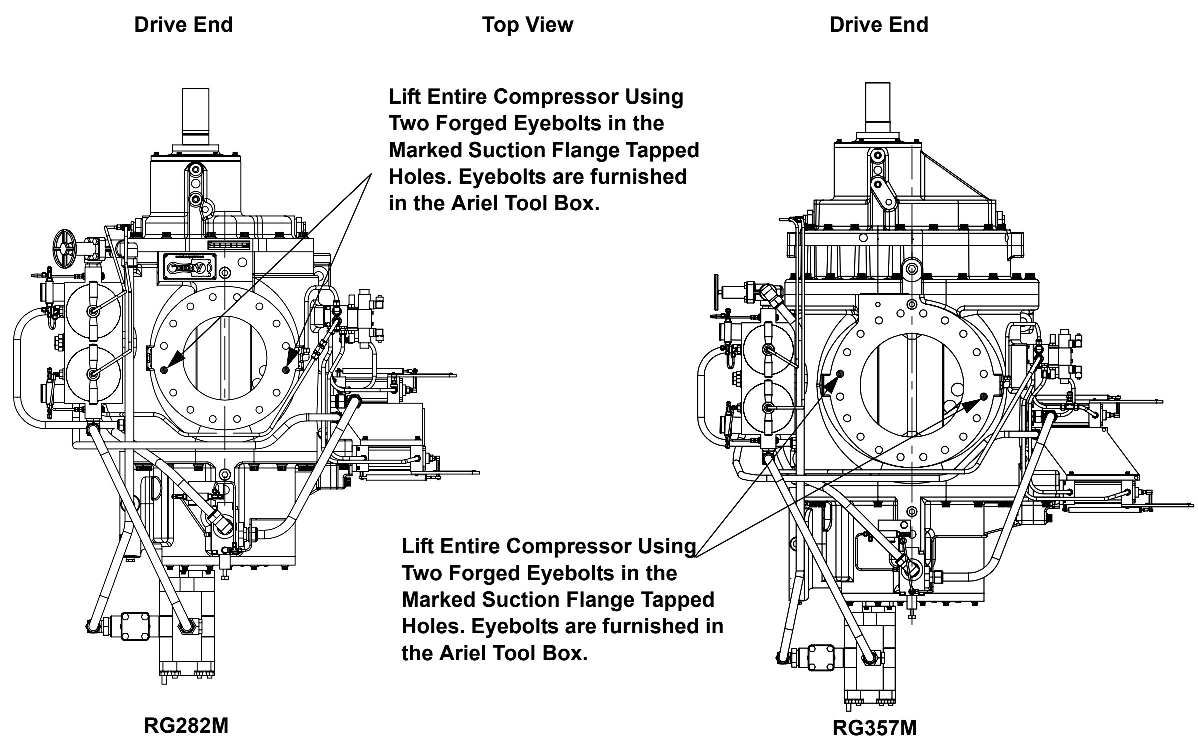


FIGURE 2-4 LIFTING POINTS FOR COMPRESSORS WITHOUT BELL HOUSING

3. Shim the gap under the compressor's four feet to positively support the compressor.
4. After finding the approximate position of the compressor, a soft foot check is to be performed. The compressor's four pedestal mounting bolts are to be tightened in place and then loosened. Shims are then adjusted so there is no vertical movement more than 0.002 inch (0.05 mm) between the bottom of the compressor feet and the skid's pedestal.
5. Consult Packager’s information for mounting bolt tightening torque values.
6. This work must be performed prior to the addition of piping.

Alignment

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

- High bending moment on the compressor drive shaft
- Large axial forces which reduce thrust bearing life
- Excessive wear to the bearings
- And if severe, probable damage to various components

SAE bell housing mounting was developed for the RG series to minimize misalignment. Actual alignment may be verified by any of a number of acceptable methods such as:

- Face/peripheral
- Reverse indicator
- Across the coupling
- Optical
- Laser
- Mechanical direct to alignment calculating computer

When aligning a unit some procedural concerns are:

- Soft foot (compressor and driver are not laying flat)
- Mounting bolts are bound in skid holes, i.e. “Bolt Bound”
- Repeatable readings
- Which way indicator moves (plus or minus)
- Thermal growth
- Piping stresses
- 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 procedure.

Compressor Thermal-Growth

The compressor will grow in height at operating temperatures. This growth is to be taken into consideration when setting the compressor. See the following Figures and Table for thermal growth values. The values are calculated for a growth between room temperature 68°F (20°C) and normal operating temperatures.

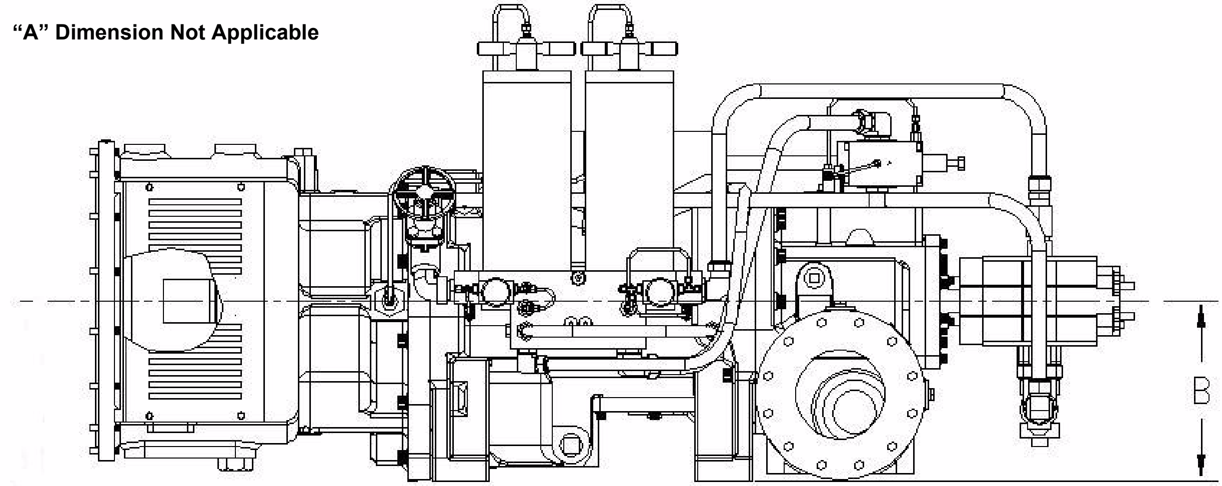


FIGURE 2-5 COMPRESSOR WITH BELL HOUSING - THERMAL GROWTH

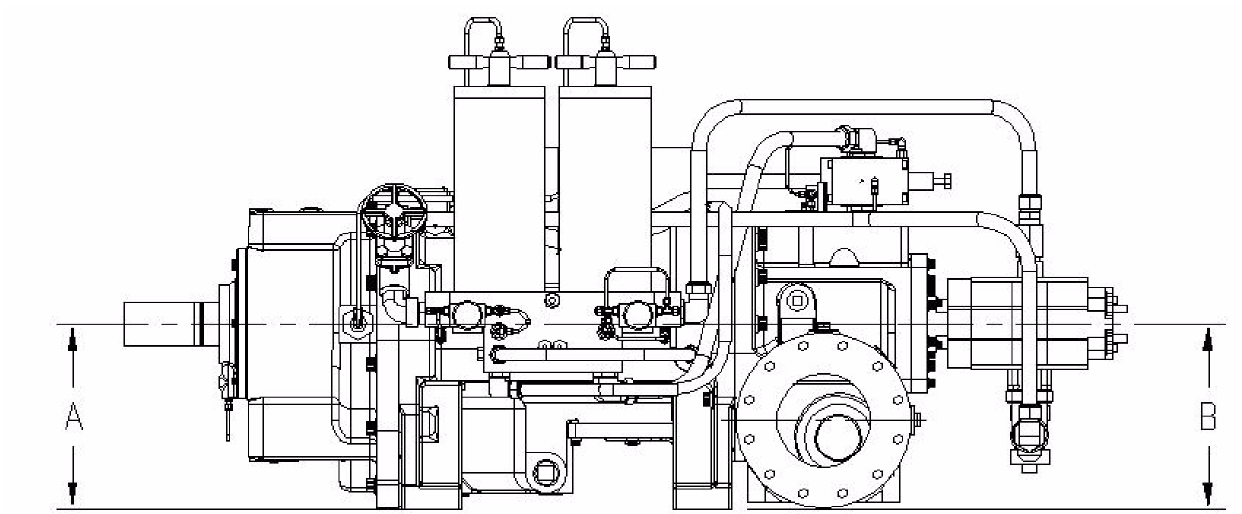


FIGURE 2-6 COMPRESSOR WITHOUT BELL HOUSING - THERMAL GROWTH

TABLE 2-1:COMPRESSOR THERMAL-GROWTH VALUES

MODEL	THERMAL GROWTH	
	"A" in. (mm)	"B" in. (mm)
RG282M	0.005 (0.12)	0.007 (0.18)
RG357M	0.006 (0.15)	0.009 (0.22)

Hydraulic Cylinder Brace

The RGM compressors come equipped with a brace between hydraulic cylinders that actuate the Vi and Capacity valves. This brace must be tied to the package structural support skid for additional support, which will reduce vibration in the hydraulic cylinder assembly. Refer to Figure 2-7.

NOTE: FAILURE TO SUPPORT THE BRACE TO THE PACKAGE STRUCTURAL SUPPORT SKID CAN RESULT IN EXCESSIVE VIBRATION, DAMAGE TO THE TUBING, FITTINGS, AND WEAR ON PISTON SEALS.

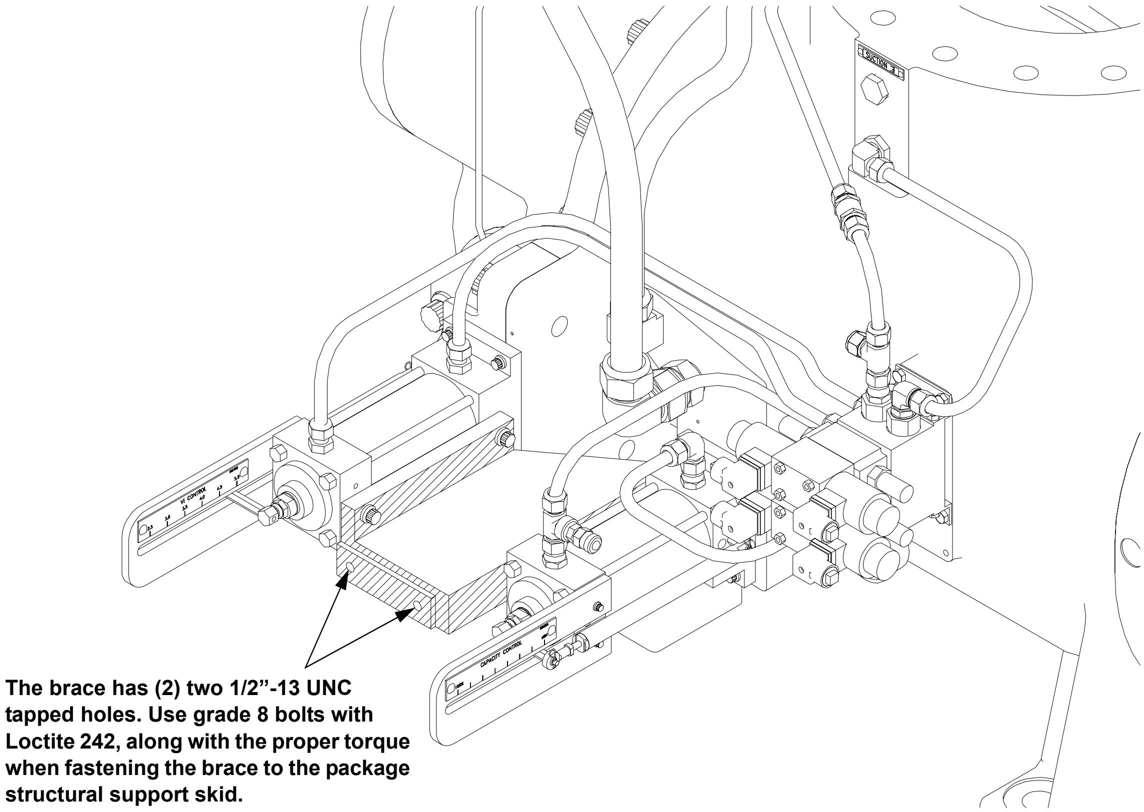


FIGURE 2-7 HYDRAULIC CYLINDER BRACE

Vents and Drains[1]

It is critical, for the safe operation of the compressor, to be sure 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.

1. Also refer to Section 4.

2. Adequate vents and drains are to be provided for mechanical seal weepage and rotor housing oil drainage. 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.
3. Do not block view of mechanical seal weepage tube, as oil leakage rate is a visual indication of seal condition.

Inlet Gas Debris Strainers

Foreign matter in the gas stream can effect compressor wear and lubrication. Inlet gas debris screens with a maximum 420 micron openings (0.0165 in. aperture, 40 mesh) are required to be installed upstream of the compressor suction flange. These screens should be monitored by differential pressure and cleaned or replaced before differential pressure approaches the collapse pressure of the screen.

Inlet Gas Liquids and Solids

Liquid water, gas condensates and solid particulate in the process gas stream have detrimental affects on oil system gas/oil separator operating temperature and oil viscosity. Liquid slugging that can adversely affect the compressors's mechanical operation and oil system must be effectively removed or compressor damage will occur.

NOTE: SOLID AND LIQUID CONTAMINANTS IN THE PROCESS GAS SYSTEM MUST BE EFFECTIVELY REMOVED UPSTREAM OF THE COMPRESSOR.

NOTE: FREE LIQUIDS THAT ARE NOT REMOVED CAN BE PARTICULARLY TROUBLESOME IN LOW PRESSURE NATURAL GAS SERVICE APPLICATIONS. MINERAL DEPOSITS (SALT AND CALCIUM) CAN BUILD UP ON THE SUCTION STRAINER SCREEN AND IN THE COMPRESSOR DUE TO DISSOLVED MINERALS IN WATER SATURATED PROCESS GAS. THESE MINERALS PLATE OUT WHEN WATER FLASHES OFF DUE TO PRESSURE DROP OR HEAT.

Inlet Gas Scrubbers

Each rotary compressor must have a scrubber or some other liquid and particulate removal device immediately ahead of the compressor and a suction strainer ahead of the compressor suction nozzle.

<u>When the process gas stream does not contain continuous particulate carryover</u>, the suction scrubber is to be designed for the removal of both free and entrained liquids, and occasional solids that can loosen from the pipe wall. Solid particulate greater than 75 micron (0.003 in. aperture, 200 mesh screen) should be removed from the gas stream within the scrubber ahead of the compressor, unless a specific contaminant (iron sulfide, pipeline dust, coal fines,

etc.), requires a lower limit.

When the process gas stream does contain continuous particulate carryover of known contaminant, the suction scrubber is to use elements that remove both free and entrained liquids and filter the particulate damaging to the compressor. Ariel recommends particulate filtering of the incoming gas to no larger than 5 micron. Otherwise, continuous particulate carryover will lead to excessive wear of rotors and housing and could eventually cause reliability problems.

SECTION 3 - START UP

General

To be sure of a smooth start up, it is important that the items in the Start Up Check List, provided in this section, be positively satisfied. It is also important that the operator understand how to operate the compressor in a safe and efficient manner, prior to start up.

⚠ CAUTION

BEFORE STARTING A NEW COMPRESSOR, OR AFTER RELOCATING OR REAPPLYING A COMPRESSOR, OR AFTER MAJOR OVERHAUL, BE SURE TO COMPLETE AND CHECK OF ALL THE ITEMS ON THE START UP CHECK LIST SHOWN IN THIS SECTION. THIS LIST IS DESIGNED TO HELP ENSURE SAFETY IN STARTING AND OPERATING THE COMPRESSOR.

⚠ CAUTION

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

Start Up Check List

For latest available Start Up Check List, see ER-10.4.3 at www.arielcorp.com.

Compressor Model RG______M Serial/No. R-_________ Gear Ratio_____

Control Actuation - Hydraulic______ Handwheel______

Driver Manufacturer_________________ Model___________ Rated Speed________RPM

Packager ________________________________ Packager Unit No._____________

Date Packager Shipped _____________________ Serviceman ___________________

Customer ________________________________ Start Up Date __________________

Location _________________________________ Field Contact _________________

Field Telephone No. _______________________ Unit Location __________________

Gas Service _______________________________

Compressor Oil - Make/Grade ____

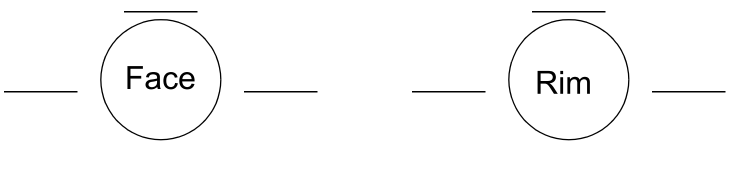
Check List - Prior To Starting:

	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 maximum suction & discharge pressures, maximum and minimum speed, discharge temperature been checked?	________	________
3. Have the Packager’s design operating conditions been reviewed? Pressure, psig (bar_g): Suction ________ Discharge________ Temperature, °F (°C): Suction ________ Discharge________ Maximum RPM __________ Minimum RPM __________ Type of Gas__________________________ SG___________ If start-up conditions are different check with Packager or Ariel.	________	________
4. Soft Foot Check [max. allowable 0.002” (0.05 mm)]: Have the compressor feet supports been shimmed so the machine is not twisted or bent? (Rear compressor feet only with the optional bell-house mount)	________	________
5. Have the compressor anchor and/or bell-housing flange bolts been re-torqued?	________	________
6. Have the piping and supports been checked to be sure they do not bend or stress the compressor?	________	________
7. Is the coupling properly installed to ER-41.1, see Ariel Packager’s Standards?	________	________

COMPRESSOR MODEL RG_______M SERIAL/NO. R-______________

	YES	NO
8. Have coupling bolt torque values been rechecked?	________	________
9. Has the compressor to driver alignment been field checked? See Ariel ER-58.05 for compressor thermal growth values.	________	________

10. Record coupling dial indicator field verification readings in inches (mm) at the 3, 6, 9 and 12 o'clock positions on lines provided: (not applicable to bell-house mountings)



Maximum allowable face misalignment 0.005 in. (0.13 mm) TIR
Maximum allowable radial misalignment 0.003 in. (0.08 mm) TIR

	YES	NO
11. Does the driver rotation match the compressor rotation arrow?	________	________
12a. For engine driven units, has the machine been rolled to be sure it is free?	________	________
12b. For other drivers, has the machine been barred over by hand to be sure it is rolling free?	________	________
13. Has any preservation oil been drained from the compressor?	________	________
14. Have the oil & gas systems been pressurized & leak tested?	________	________
15. Has the compressor oil system been filled with oil to the proper level without over filling?	________	________
16. Is the compressor oil supply isolation valve open?	________	________

NOTE: NOTE: CLEARLY LABEL UNIT WITH THE COMPRESSOR OIL MAKE/GRADE CURRENTLY IN USE.

	YES	NO
17. Does the compressor oil system low level shutdown work?	________	________
18. Have the properly rated elements been installed in the compressor oil filter canisters (bearing/seal & rotor injection)?	________	________
19. Have the properly rated elements been installed in the gas inlet separator, strainers, and gas/oil separator?	________	________
20. Are the oil filter elements and all oil piping primed with oil?	________	________
21. Has the compress been prelubed?	________	________
22. Is the low lube oil supply differential pressure shutdown installed & tubed correctly to the bearing oil supply and scavenged oil gallery?	________	________
23. Is the low oil differential pressure shutdown set per Ariel's recommendations & does it work on falling pressure?	________	________

COMPRESSOR MODEL RG_______M SERIAL/NO. R-_____________

	YES	NO
24. Is there an oil cooler? Note: Recommended minimum compressor inlet oil temperature is 140°F (60°C); maximum 160°F (71°C).	______	______
25. Is the rotor injection's oil temperature control (trim) valve setting appropriate for cold start-up applications?	______	______
26. Is the oil temperature control valve piped for a "mixing" condition?	______	______
27. Is there a working vibration shutdown mounted on the compressor or drive train?	______	______
28. Is there suction pressure control upstream of the compressor? Refer to Ariel's performance prediction program to verify acceptable P_1, P_2 combination.	______	______
29. Are the suction and discharge pressure shutdowns set & working?	______	______
30. Are the safety relief valves installed & working to protect compressor gas and oil piping?	______	______
31. Is the gas high discharge temperature shutdown installed, set at 10% above anticipated temperature & working? 248°F, max. (120°C)	______	______
32. Is the mechanical seal leakage tubing installed, unplugged and visible to determine if leakage occurs?	______	______
33. Have the gas suction lines been thoroughly cleaned to be sure that no dirt, slag or other debris enters the compressor?	______	______
34. Has strainer screen been installed upstream of compressor suction?	______	______
35. For combustible gas applications, has the piping and compressor been purged to remove all air?	______	______
36. Have start-up instructions for other package equipment been followed?	______	______
37. Has compressor variable Vi been moved to the maximum Vi position, 5.0? (Vi range 2.5 to 5.0)	______	______
38. Has compressor capacity control plate been moved to minimum load position, to reduce compressor start-up torque?	______	______
39. Has the Packager's representative reviewed the Packager's Start-Up & Operating Instructions for the unit with the unit operator?	______	______
40. Has the separator scavenge line been connected to the gearbox and is the scavenge control valve fully open?	______	______
41. Is there a back-pressure control valve set to maintain 50 psi (3.4 bar) above suction pressure?	______	______

COMPRESSOR MODEL RG_______M SERIAL/NO. R-______________

Check List - After Starting:	YES	NO
1. When idle speed is achieved, did the compressor bearing oil pressure come up immediately?	________	________
2. Did the discharge pressure raise within 1 to 3 minutes to facilitate oil scavenging and lube flow?	________	________
3. Was the required differential pressure in the separator, above suction, achieved immediately & maintainable until normal operating pressures are reached?	________	________
4. Are the oil filters, bearing & oil system, & hydraulic-valve-stack pressure gauges working?	________	________
5. Are the bearing/seal lube oil filter differential pressures less than 35 psid (2.4 bar_d) at operating temperature, unless otherwise specified?	________	________
6. Is the rotor injection lube oil filter differential pressure less than 11 psid (0.75 bar_d) at operating temperature, unless otherwise specified?	________	________
7. Any strange noises or shaking in the compressor or piping?	________	________
8. Is the compressor system oil level within acceptable limits?	________	________
9. Is bearing oil differential pressure above minimum specified?	________	________
10. Is the mechanical seal weep hole leaking? Drops/minute______ (typically 3 to 5)	________	________
11. Are there any other oil leaks? If so, where?	________	________
12. Are the scrubber dumps and high level shutdowns working?	________	________
13. Are the scrubber dumps removing all liquids from the gas without obvious carryover?	________	________
14. Do you hear solid contaminants in the suction piping?	________	________
15. Is overspeed shutdown set?	________	________
16. Is the mechanical seal properly sealing gas and oil at the shaft?	________	________
17. Have all Package safety functions been tested to be sure of unit shutdown upon malfunction?	________	________
18. After compressor and driver are warmed up, was Vi and capacity control set to load available driver horsepower?	________	________
19. After the compressor reaches normal operating conditions, has the separator scavenge control been set to show mostly gas flow at the sight glass?	________	________

COMPRESSOR MODEL RG_______M **SERIAL/NO. R-______________**

	YES	NO
20. After running compressor for 24 hours, are oil filter and separator differential pressures less than maximum allowable?	________	________
21. Upon shutdown verify that compressor reverse rotation is less than 2 seconds to be sure of check valve operation.	________	________
22. Has initial compressor operating data been recorded?	________	________

23. Complete Ariel's "Compressor Warranty Notification and Installation List Data", copy this completed "Start-up Checklist" and mail both to Ariel Corporation, 35 Blackjack Road, Mount Vernon, OH 43050, USA, Attention: Administrative Assistant - Sales or fax to Ariel at 740-397-3856, Attention: Administrative Assistant - Sales.

DAILY LOG SHEET

COMPANY/LOCATION_______________________________ UNIT_______________

COMPRESSOR MODEL RG______M SERIAL NO. R-_______ GEAR RATIO_______

Date/Time							
Operator							
Driver Load, HP (kW)							
Driver Speed, RPM							
Compressor Speed, RPM							
Gas flow Rate MMSCFD (m^3/s_n)							
Variable Vi Position (Vi or # of turns)							
Capacity Control Position (% or # of turns)							
Suction Pressure, psig (bar_g)							
Suction Temperature, °F (°C)							
Discharge Pressure, psig (bar_g)							
Discharge Temperature, °F (°C)							
Compr. Bearing Oil Supply Temp., °F (°C)							
Bearing Oil Differential Pressure, psid (bar_d)							
Bearing Oil Filter Differential, psid (bar_d)							
Rotor Injection Oil Filter Differential, psid (bar_d)							
Hydraulic Oil Supply Pressure, psig (bar_g)							
Separator Coalescing Filter Differential, psid (bar_d)							
Compressor Oil Supply Pressure, psig (bar_g)							
Coalescing Scavenged Oil Line Valve Adjusted & Flow Observed							
Mechanical Seal Weep Rate, drops/min.							
System Oil Level							
Compressor Oil added, gal (L)							
Remarks:							

CAUTION

OPERATING CONDITIONS MUST NOT EXCEED COMPRESSOR DESIGN LIMITATIONS.

Maximum Running Pressure (MRP)

The maximum discharge pressure for these compressors is 230 psig (15.9 bar_g) when running (with rotors turning) and compressing the specified fluid at maximum specified temperature.

All compressors must be equipped with a fail-safe device to shutdown the driver (stop the rotors) if the discharge pressure at the compressor flange exceeds the maximum allowable running pressure.

Maximum Relief Valve Setting (MRVS)

These compressors are designed to withstand a pressure of 300 psig (20.7 bar_g) when the compressor is not running.

It is the responsibility of the packager to provide relief valves to protect the equipment, piping and oil separator. All compressors must have a relief valve in the discharge piping, set not to exceed the maximum relief valve setting for the compressor of 300 psig maximum (20.7 bar_g) or the maximum allowable working pressure of piping components whichever is less.

The pressure within the compressor MUST be lowered to the maximum running pressure or less prior to starting.

Filling & Priming a Oil Lube Oil System - Before Starting

Filling The System

1. The normal operating oil level may be higher or lower than the level at shutdown (at rest). The gas/oil separator, piping and oil cooler capacity and elevation affect operating oil levels. Consult the package build book or contact Packager for the approximate design oil fill capacity.
2. Fill the oil filters, piping, cooler and gas/oil separator to an intermediate level on the gas/oil separator's sight glass.

3. Run the prelube pump or circulating pump to ensure system is filled, and bearings and seals are pre-lubricated. Bleed piping and cooler high points vents to remove trapped air pockets.
4. Check sight glass on separator. Oil level at start-up could be high or low on the site glass depending upon component elevations. DO NOT OVERFILL.
5. Proper oil system level is to be checked after compressor is operating when temperatures and pressures have stabilized and should be mid-point of the site glass, during normal operation.

Compressor Control Devices

Ariel developed the RG oil-flooded rotary screw compressors specifically for low pressure natural gas service. Instead of using a traditional slide-valve, the RG series has separate inlet volume (capacity) and discharge volume (volume ratio, Vi) control devices. Compressor Vi and capacity control positions can be adjusted independently, either hydraulically or manually (hand wheel) depending on the purchase option.

To maintain high compressor efficiency, an RG compressor uses the two independent control devices, which allows for Vi optimization during full and reduced capacity conditions. The compressors capacity and Vi controls are actuated separately, but move in concert to optimize compressor efficiency with changing conditions.

NOTE: FAILURE TO MATCH THE COMPRESSOR'S INTERNAL ROTOR COMPRESSION RATIO ($CR_{INT} = VI^K$) WITH THE COMPRESSOR'S EXTERNAL COMPRESSION RATIO (CR_{EXT} = PD/PS, IN PSIA FROM SUCTION FLANGE TO DISCHARGE FLANGE) RESULTS IN EITHER OVER OR UNDER COMPRESSION. OVER COMPRESSION WASTES MORE HORSEPOWER THAN UNDER COMPRESSION, AND SIGNIFICANTLY INCREASES BEARING LOADS. THE COMPRESSOR'S ANTI-FRICTION BEARING LIFE CAN BE MAXIMIZED BY MINIMIZING EXCESSIVE BEARING LOADS DUE TO OVER/UNDER COMPRESSION FROM IMPROPERLY ADJUSTED VI.

Capacity Control (internal recycle)

Capacity control is achieved with an internal recycle method using an adjustable horizontal slide plate that uncovers progressive, overlapping holes connected to a bypass passage, see Figure 1-5 on Page 1-9 and Figure 1-7 on Page 1-10. The bypass passages are designed to recycle gas at the suction end of the compression chamber before compression begins.

NOTE: THE HORIZONTAL SLIDE PLATE ADJUSTS INLET VOLUME ONLY, WHILE THE VI SLIDE PLATE ADJUSTS DISCHARGE VOLUME ONLY. THIS CONTROL METHOD IS DIFFERENT THAN A TRADITIONAL SLIDE VALVE THAT AFFECTS BOTH INLET AND DISCHARGE VOLUMES WITH A SINGLE MOVEMENT.

Internal bypassing works together with variable Vi to maintain high part load efficiency with step-less capacity control. Internal bypassing allows the compressor load to be adjusted from

100 percent down to about 40 percent of full load capacity.

Since the compressor's operating conditions often change in gas gathering applications, the capacity control position can be selected with external adjustments. Capacity control adjustments can be made using either hydraulic or hand wheel actuation. With hydraulic actuation, capacity is infinitely adjustable from about 40 to 100 percent of full load capacity, and held in place hydraulically. With hand wheel actuation, capacity is manually adjustable from about 40 to 100 percent of full load capacity, and held in place with a stem locking pin.

Capacity Control Positioning - Hydraulic

On compressors furnished with hydraulically actuated capacity control, the slide plate position is infinitely adjustable from a 100 to 0 percent of travel, with the compressor running or stopped. The sliding plate is pressure balanced to minimize the hydraulic force required to move it in either direction.

Compressor bearing oil pressure provides the hydraulic force used to move the sliding plate, in both load and unload directions, from 100 percent to about 40 percent of full load capacity at full load capacity rotating speed. Oil contained within the hydraulic cylinder is used to hold the horizontal plate in a given position. The horizontal plate's travel position is determined visually and electrically by a feedback signal from a precision electronic linear displacement position indicator, see Figure 5-12 on Page 5-10.

This capacity control actuation design allows for the conversion from hydraulic to handwheel operation, with a minimum of conversion components. Contact Ariel for conversion instructions.

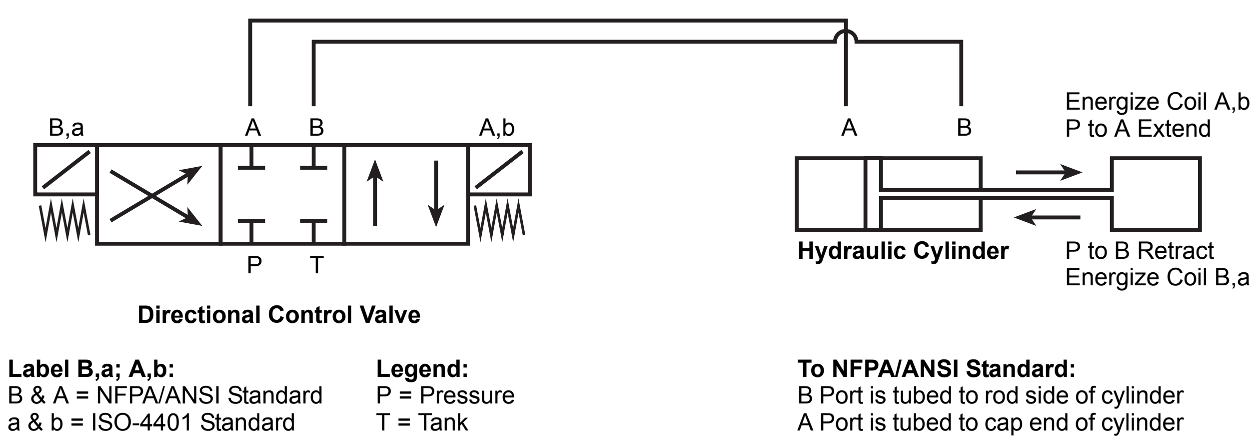


FIGURE 3-1 CAPACITY CONTROL AND VARIABLE VI POSITIONING CONTROL SCHEMATIC

Capacity Control Theory of Operation - Hydraulic

The capacity control's hydraulic cylinder is located on the male rotor side, drive end. It is dual acting. A directional control valve is used to simultaneously direct oil to and from each side of the hydraulic cylinder piston.

To Increase Compressor Capacity

Energize coil B (a) to change the directional valve position so that P pressurized oil goes to B port and A port goes to T tank, see Figure 3-1 on Page 3-10. This causes the hydraulic cylinder to retract, as pressurized compressor oil flows into the rod side of the cylinder, the oil on the cap end of the cylinder drains into the compressor inlet nozzle port. The retracting hydraulic cylinder moves the slide plate away from the male rotor, covering bypass holes and increasing capacity, see Figure 1-7 on Page 1-10.

To Hold Capacity Control Position

Allow the directional valve's position to remain neutral. Oil is prevented from entering or leaving the hydraulic cylinder, which maintains the capacity control plate in a given position.

To Decrease Compressor Capacity

Energize coil A (b) to change the directional valve's position so that P pressurized oil goes to A port and B port goes to T tank. Pressurized compressor oil enters the cap end of the hydraulic cylinder causing it to extend and moving the slide plate toward the male rotor, which uncovers bypass holes and decreases capacity.

NOTE: COLD OIL EXITING A HYDRAULICALLY ACTUATED CYLINDER(S) CAN SIGNIFICANTLY INCREASE SLIDE PLATE POSITIONING TIME COMPARED TO HOT OIL. IT MAY BE NECESSARY TO HEAT TRACE AND INSULATE THE HYDRAULIC CYLINDER(S), OIL TUBING LINES AND DIRECTIONAL CONTROL VALVE FOR COLD WEATHER APPLICATIONS.

NOTE: ANY OIL LEAKAGE IN OR OUT OF THE DIRECTIONAL CONTROL VALVE WILL ALLOW THE SLIDE PLATE TO MOVE.

NOTE: FOR SMOOTH EXTENSION AND RETRACTION OF THE HYDRAULIC CYLINDER, A MINIMUM OF 50 PSID (65 BAR_D) DIFFERENTIAL OIL PRESSURE BETWEEN P-PORT TO T-PORT IS RECOMMENDED.

Procedure for Adjusting Capacity Loading & Unloading Speed

Adjust upper screw (#1), on the directional flow control valve closest to the drive end, to control the compressor unloading speed, see figure. Remove dust cover, loosen locknut and turn in allen screw clockwise all the way. Then turn out (counter-clockwise) a total of nine (9) full turns. Tighten locknut and replace dust cover. Adjustment can be made with hot or cold oil.

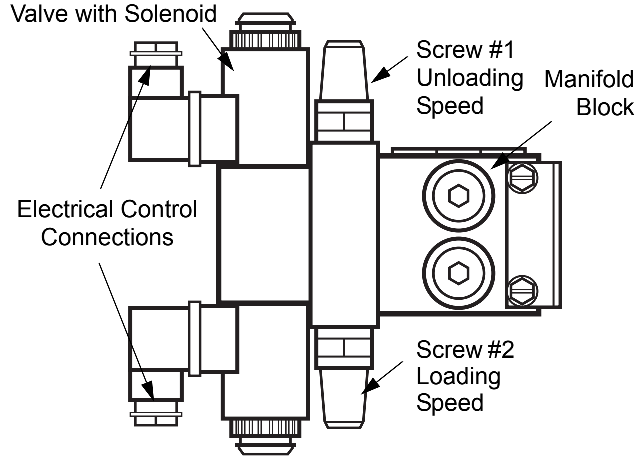


FIGURE 3-2 HYDRAULIC CAPACITY CONTROL VALVE - TYPICAL

Adjust lower screw (#2) to control loading speed. Remove dust cover, loosen locknut and turn in allen screw clockwise all the way. When adjusting with cold oil, turn allen screw out (counter-clockwise) 3 to 4 full turns, to provide a good starting point. Or with hot oil turn out 2 to 3 full turns. Final adjustment is made with compressor running at desired loading speed. After loading is set to the desired speed, tighten locknut and replace dust cover.

Capacity Control Positioning - Hand Wheel

On compressors furnished with hand wheel actuated capacity control, the slide plate position is infinitely adjustable and may be adjusted, from 100 to 0 percent of travel, with the compressor running or stopped. The sliding plate itself is pressure balanced to minimize the manual force required move it in either direction.

A manual hand wheel is used to move the slide plate in both load and unload directions, from 100 percent to about 40 percent of full load capacity, using a non-rising stem design. A stem locking device is used to hold the radial plate in a given position, see figure. The slide plate's travel position is determined by counting the number of hand wheel turns, as shown in Table 1-2 on Page 1-8 and Figure 1-5 on Page 1-9.

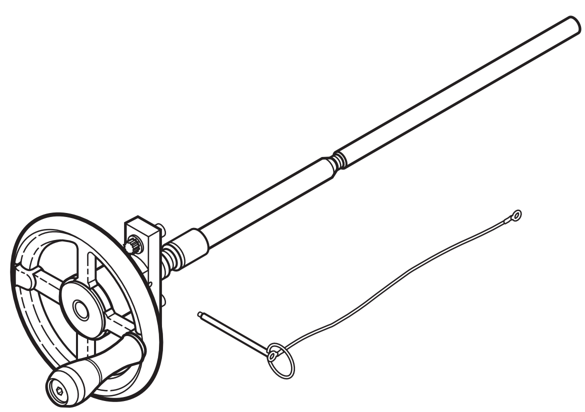


FIGURE 3-3 CAPACITY CONTROL AND VARIABLE VI POSITIONING CONTROL

This capacity control actuation design allows for the conversion from handwheel to hydraulic operation, with a minimum of conversion components. Contact Ariel for conversion instructions.

Capacity Control Theory of Operation - Hand Wheel

The capacity control's hand wheel actuator is located on the male rotor side, drive end. Since manual capacity control is adjusted by means of a hand wheel connected to a threaded rod, no external oil is required.

The slide plate's position can be moved when the compressor is pressurized and operating. To adjust compressor capacity, remove the stem locking device, so the stem is free to turn, see Figure 3-3 on page 3-12. Turn the stem by using the hand wheel on the male rotor side, drive end.

To Increase Compressor Capacity

To adjust capacity, remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn the wheel clockwise to cover internal bypass holes and increase capacity.

To Hold Capacity Control Position

To hold the desired capacity control position, align hole and re-install the stem locking pin.

To Decrease Compressor Capacity

To adjust capacity, remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn hand wheel counter-clockwise to uncover internal bypass holes and decrease capacity.

Variable Vi Control

Variable volume ratio (Vi) is achieved using an adjustable slide plate on the discharge end that changes the compressor's axial port (butterfly) size, see Figure 1-6 on Page 1-9 and Figure 1-8 on Page 1-10. The compressor's anti-friction bearing life can be maximized, by minimizing excessive bearing loads due to over/under compression from improperly adjusted Vi. Ariel's method of varying Vi is different than the traditional slide valve, which does not provide independent inlet volume and discharge volume control capability.

Since the compressor's operating conditions often change in gas gathering applications, an appropriate Vi can be selected with external adjustments. Vi adjustments can be made using either hydraulic or hand wheel actuation. With hydraulic actuation, Vi is infinitely adjustable from 2.5 to 5.0, and held in place hydraulically. With hand wheel actuation, Vi is manually adjustable from 2.5 to 5.0, and held in place with a stem locking pin.

Variable Vi Positioning - Hydraulic

On compressors furnished with hydraulically actuated Vi control, the slide plate position is infinitely adjustable from 100 to 0 percent of travel, with the compressor running or stopped. The sliding plate is pressure balanced to minimize the hydraulic force required to move it in either direction.

Pressurized compressor bearing oil provides the hydraulic force used to move the sliding plate in either direction between a 2.5 Vi (minimum) and a 5.0 Vi (maximum). Oil contained within the hydraulic cylinder is used to hold the slide plate in a given position. The slide plate's travel position is determined visually and electrically by a feedback signal from a precision electronic linear displacement position indicator, see Figure 5-12 on Page 5-10.

This Vi control actuation design allows for the conversion from hydraulic to handwheel operation, with a minimum of conversion components. Contact Ariel for conversion instructions.

Variable Vi Positioning Theory of Operation - Hydraulic

The variable Vi's hydraulic cylinder is located on the male rotor side, non-drive end. It is dual acting. A directional valve is used to simultaneously add and remove oil from the hydraulic cylinder.

To Increase Vi

Energize coil A (b) to change the directional valve position so that P pressurized oil goes to A port and B port goes to T tank, see Figure 3-1 on Page 3-10. This causes the hydraulic cylinder to extend, as pressurized compressor oil flows into the cap end side of the cylinder, the oil on the rod end of the cylinder drains into the compressor inlet nozzle port. The extending hydraulic cylinder moves the slide plate toward from the male rotor, decreasing the butterfly profile and increasing Vi, see Figure 1-8 on Page 1-10.

To Hold Vi Position

Allow the directional valve's position to remain neutral. Oil is prevented from entering or leaving the hydraulic cylinder, which maintains the Vi plate in a given position.

To Decrease Compressor Vi

Energize coil B (a) to change the directional valve’s position so that P pressurized oil goes to B port and A port goes to T tank. Pressurized compressor oil enters the rod side of the hydraulic cylinder causing it to retract and moving the slide plate away from the male rotor, which increases the butterfly profile and decreases Vi.

NOTE: COLD OIL EXITING A HYDRAULICALLY ACTUATED CYLINDER(S) CAN INCREASE SLIDE PLATE POSITIONING TIME COMPARED TO HOT OIL. IT MAY BE NECESSARY TO HEAT TRACE AND INSULATE THE HYDRAULIC CYLINDER(S), OIL TUBING LINES AND PROPORTIONAL VALVE FOR COLD WEATHER APPLICATIONS.

NOTE: CONTACT ARIEL REGARDING VI POSITION DEAD BAND WITH PLC CONTROLLER. EXCESSIVE VI POSITIONING IS DETRIMENTAL TO SOME ELECTRONIC COMPONENTS.

NOTE: ANY OIL LEAKAGE IN OR OUT OF THE DIRECTIONAL CONTROL VALVE WILL ALLOW THE SLIDE PLATE TO MOVE.

NOTE: FOR SMOOTH EXTENSION AND RETRACTION OF THE HYDRAULIC CYLINDER, A MINIMUM OF 50 PSID (65 BAR_D) DIFFERENTIAL OIL PRESSURE BETWEEN P-PORT TO T-PORT IS RECOMMENDED.

Variable Vi Positioning - Hand Wheel

On compressors furnished with hand wheel actuated capacity control, the slide plate position is infinitely adjustable and may be adjusted, from 100% to 0% of travel, with the compressor running or stopped. The sliding plate itself is pressure balanced to minimize the manual force required move it in either direction.

A manual hand wheel is used to move the sliding plate in either direction, between a 2.5 Vi (minimum) and a 5.0 Vi (maximum), using a non-rising stem design. A stem locking device is used to hold the radial plate in a given position, see Figure 3-3 on page 3-12. The slide plate's travel position is determined by counting the number of hand wheel turns, as shown in Table 1-3 on Page 1-8 and Figure 1-6 on Page 1-9.

This Vi control actuation design allows for the conversion from handwheel to hydraulic operation, with a minimum of conversion components. Contact Ariel for conversion instructions.

Variable Vi Theory of Operation - Hand Wheel

The variable Vi's hand wheel actuator is located on the male rotor side, non-drive end. Since manual Vi is adjusted by means of a hand wheel connected to a threaded rod, no external oil is required.

The slide plate's position can be moved when the compressor is pressurized and operating. Turn the stem by using the hand wheel on the male rotor side, non-drive end.

To Increase Vi

To adjust Vi, remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn the wheel counter-clockwise to move the plate toward the male rotor, which decreases the butterfly profile and increases Vi.

To Hold Vi Control Position

To hold the desired capacity control position, align hole and re-install the stem locking pin.

To Decrease Vi

To adjust Vi, remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn the wheel clockwise to move the plate away from the male rotor, which increases the butterfly profile and decreases Vi.

Visual Position Indicator - Capacity Control & Vi

Hydraulically actuated capacity control and variable Vi have both visual position indication and electronic position feedback capabilities. Hand wheel actuated capacity control and variable Vi positions are indicated by counting number of hand wheel turns with a non-rising stem.

Position Indicator - Hydraulic Visual

The position travel scale nameplates on the spacer/adaptors provide visual indication of the slide plates travel positions.

Position Indication - Hand Wheel

The hand wheel actuators have no visual indication of the slide plates travel positions. The manual hand wheels are used to move the sliding plates in either direction using a non-rising stem design. The slide plates travel positions are most accurately determined by counting the number of hand wheel turns on a threaded shaft, refer to Table 1-2 on Page 1-8 and Table 1-3 on Page 1-8.

Slide Plates Positioning at Start-up

Prior to starting, position the slide plates, hydraulic or hand wheel actuated, to the minimum capacity and maximum Vi positions. The recommended position of the Vi plate is the 5.0 position.

Minimizing compressor capacity will reduce driver starting torque and maximizing the Vi will provide pressure to circulate the oil properly.

Bearing oil pressure and discharge pressure should increase immediately after starting the compressor. Position other oil system valves, as required, for normal operations.

After compressor and driver are warmed up, compressor speed, Vi and capacity control are used to load the available driver horsepower.

Thrust Balance System

The thrust balance system is integral to the compressor and not adjustable. Discharge gas thrust loads are internally opposed by the gear set thrust load.

Gas/Oil Separator Coalescing Filter

Gas/Oil Separator Minimal Differential Pressure Requirement

A minimal differential pressure of 50 psi (3.4 bar) above the compressor suction pressure must be maintained in the gas/oil separator, from compressor start-up until the system reaches normal operating pressures. This minimal differential pressure is to be sure that an adequate flow of scavenge line gas and oil will prevent the collapse of the coalescing filter elements, that a gearbox differential pressure will allow the gearbox oil to drain at low operating differentials, and that adequate pressure to flow oil, especially when cold, to the inlet of the lube oil pump will prevent cavitation or inadequate oil flow to the journal bearings and mechanical seal.

Scavenged Gas/Oil Line Flow Adjustment

The gas/oil separator coalescing filter removes residual oil from the discharge gas stream. The oil scavenge line is necessary to minimize oil accumulation on the downstream side of the filter. A metering valve, check valve, flow indicator and a 75 micron (0.003 inches, 200 mesh) strainer or filter are to be located in the scavenged oil line to return the downstream coalescing filter oil to the compressor. With the compressor at normal operating conditions, adjust the valve to show primarily gas flow movement into the compressor with minimal oil inclusion. Excessive gas flow will reduce compressor performance, due to the recycled gas. Insufficient oil flow will reduce coalescing filter performance resulting in oil carryover with discharge gas stream.

NOTES:

SECTION 4 - OIL SYSTEM, LUBRICATION & VENTING

This section is currently under review. Please contact Ariel for recommendations concerning the oil system, lubrication, or venting for your Ariel rotary screw compressor.

Ariel Contact Information

Contact	Telephone	Fax	E-Mail
Ariel Response Center	888-397-7766 (toll free USA & Canada) or 740-397-3602 (International)	740-397-1060	arc@arielcorp.com
Spare Parts		740-393-5054	spareparts@arielcorp.com
Order Entry		740-397-3856	---
Ariel World Headquarters	740-397-0311	740-397-3856	info@arielcorp.com
Technical Services			fieldservice@arielcorp.com
Web Site: www.arielcorp.com			

Ariel Response Center Technicians or Switchboard Operators answer telephones during Ariel business hours, Eastern Time - USA or after hours by voice mail. Contact an authorized distributor to purchase Ariel parts. Always provide Ariel equipment serial number(s) to order spare parts.

The after-hours Telephone Emergency System works as follows:

1. Follow automated instructions to Technical Services Emergency Assistance or Spare Parts Emergency Service. Calls are answered by voice mail.
2. Leave a message: caller name and telephone number, serial number of equipment in question (frame, cylinder, unloader), and a brief description of the emergency.
3. Your voice mail routes to an on-call representative who responds as soon as possible.

SECTION 5 - MAINTENANCE

General Introduction

The major components of the compressor are the rotor-housing, discharge-housing and gearbox-housing, speed increasing gears, rotors, bearings, mechanical seal, seal housing, oil pump, compressor control devices and oil filters. The mechanical seal, oil pump with coupling, control actuating devices and oil filters may be maintained or replaced in the field.

NOTE: IF OTHER INTERNAL COMPONENTS REQUIRE REPAIR, CONTACT ARIEL FOR ASSISTANCE.

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 compressor covered to protect the internal surfaces from wind blown debris, except when actually working within it. Any components that have been removed should be protected from falling objects that might mar or chip machined surfaces.

Whenever the compressor is dismantled, O-rings at non-pressure containing positions are to be carefully inspected before reuse, if damaged they should be replaced. O-rings at pressure containing locations should be replaced. O-ring lubricants must be compatible with O-ring materials, lube oil and process gas. Ariel's standard O-ring material is viton.

CAUTION

TO PREVENT PERSONAL INJURY, ENSURE THAT COMPRESSOR ROTOR CANNOT BE TURNED BY THE DRIVER 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 COMPONENT, RELIEVE ALL PRESSURE FROM THE COMPRESSOR GAS AND OIL SYSTEMS, 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.

Mechanical Seal

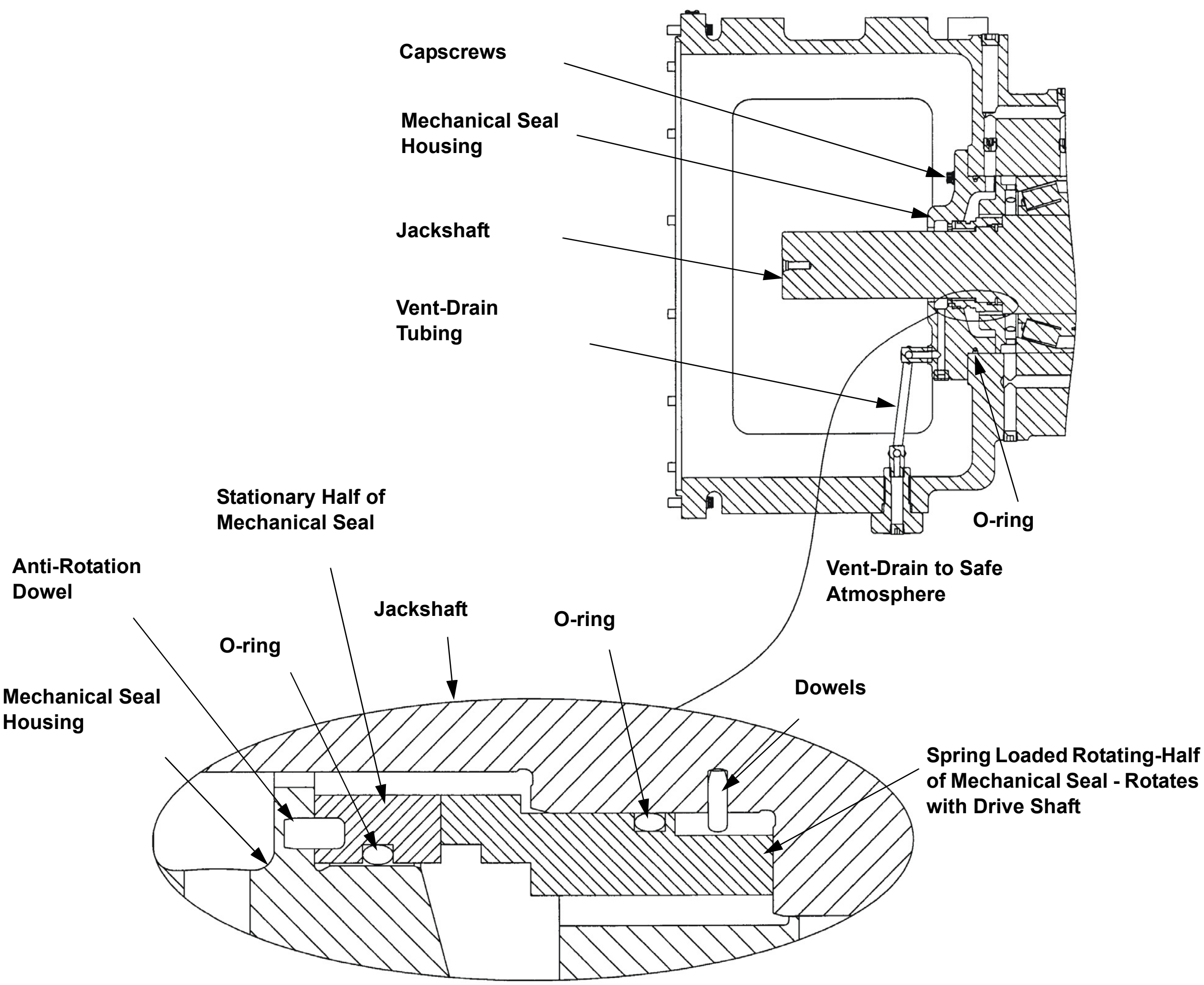


FIGURE 5-1 MECHANICAL SEAL SIDE VIEW - TYPICAL

The mechanical seal prevents loss of internal process gas pressure, at the power input jackshaft, around the shaft to the atmosphere. The seal consists of a spring loaded, pressure balanced carbon seal assembly that turns with the input jackshaft and an outer ring which is held stationary in the seal housing.

NOTE: MECHANICAL SEAL CRITICAL SURFACES SUCH AS SEAL FACES, O-RING SEATS AND FITS MUST BE HANDLED WITH EXTREME CARE, REPLACEMENT SEAL COMPONENTS MUST BE TRANSPORTED AND STORED IN ORIGINAL UNOPENED PACKAGING. REPLACEMENT SEALS THAT HAVE BEEN SUBJECTED TO SUDDEN IMPACT FORCES, SUCH AS BEING DROPPED, ARE NOT TO BE USED. STORAGE CONDITIONS MUST BE DRY, DUST FREE AND MAINTAINED AT A REASONABLY CONSTANT TEMPERATURE. SEALS STORED IN EXCESS OF THREE (3) YEARS SHOULD BE RE-INSPECTED BEFORE BEING CONSIDERED FOR USE. DO NOT DISASSEMBLE THE SEAL'S SPRING LOADED ASSEMBLY.

TABLE 5-1 APPROXIMATE COMPONENT WEIGHTS - WHEN REPLACING MECHANICAL SEAL

COMPONENT	WEIGHT			
	RG282M		RG357M	
	LB	(kg)	LB	(kg)
Bell Housing Access Cover	10	4.5	20	9
Coupling Components	See Packager Information			
Mechanical Seal Housing	39	17.7	42	19.1
Mechanical Seal	5	2.3	5	2.3

Replacing the Mechanical Seal

Be sure that all pressure is vented from the compressor and piping. Be sure that all the proper tools are available, in good condition and clean. Remove the coupling guard enclosure or the access doors on bell housing mounted models. Disassemble the coupling and remove to allow for mechanical seal replacement. Temporarily reassemble the coupling components and store coupling protected from dust and corrosion.

Install (slip fit) Ariel seal housing removal/installation tool provided in the Ariel tool box as part number 002169. Push tool (over the jackshaft) into place, engaging the spring-loaded grips onto the seal housing. The flange of the tool should be flush with the seal housing. Reference Figure 5-2 on Page 5-4 and Figure 7-1 on Page 7-1.

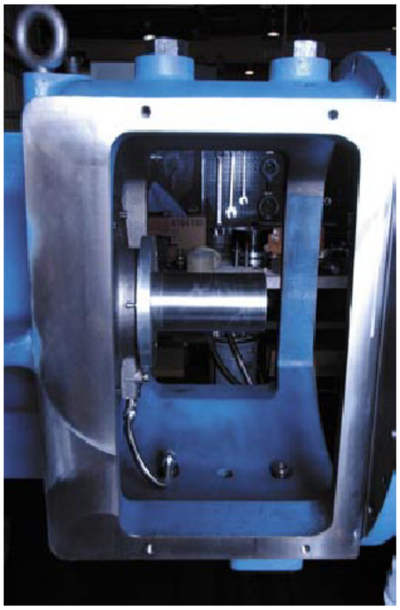


FIGURE 5-2 INSTALLING SEAL HOUSING REMOVAL/INSTALLATION TOOL

Remove the seal housing vent-drain line tubing.

Remove the 12-point capscrews that secure the mechanical seal housing to the gear housing. Using two of the capscrews as jack bolts in the two tapped holes, loosen the seal housing from the gear housing. See Figure 5-3. Withdraw the seal housing with the installation tool attached, off of the jackshaft to remove. Remove O-ring from seal housing, and stationary ring half of the mechanical seal with its O-ring and discard. Be sure that the anti-rotation dowel pin that holds the stationary ring from turning in the seal housing is retained.

FIGURE 5-3 LOOSENING & REMOVING SEAL HOUSING & TOOL

Remove the spring loaded rotating half of the mechanical seal with its O-ring from the jackshaft and discard. Two large screwdrivers can be used to free the mechanical seal from the jackshaft (engage the large holes on either side of the seal). Be sure that the drive dowels in the jackshaft are retained. Dowels normally stay in place and need not be removed.

FIGURE 5-4 ROTATING HALF OF SEAL REMOVED

Clean parts carefully to remove dirt or residue. Check seal housing for nicks or burrs and remove if necessary. Reassemble using a new mechanical seal with its new O-rings, and a new seal housing O-ring. Inspect new seal to be sure it is clean and the seal faces are free of cracks, scratches, chips and nicks. Lubricate O-rings with a high viscosity silicone fluid such as Parker Super-O-Lube or equal.

Put the new spring-loaded rotating half of seal into place on jackshaft. Be sure that the drive dowels are properly in place and the seal element slots are aligned on the dowels. Fully seat seal into place using the proper assembly tool provided as part number 001788, see Figure 7-1 on Page 7-1. Seal will “snap” into place.

FIGURE 5-5 REAR VIEW ROTATING HALF OF SEAL

Remove the seal housing removal/installation tool (002169) from seal housing before installing the new stationary seal ring. Push the new stationary seal ring into seal housing using the proper assembly tool provided as part number 001742 to seat the seal, see Figure 7-1 on Page 7-1. Before installing stationary half of seal, be sure that the anti-rotation dowel is properly in place in the seal housing and the slot in the ring is aligned with the dowel. Do not push or tap against seal ring face without the proper tool or ring can crack or break. Replace the O-ring on the seal housing.

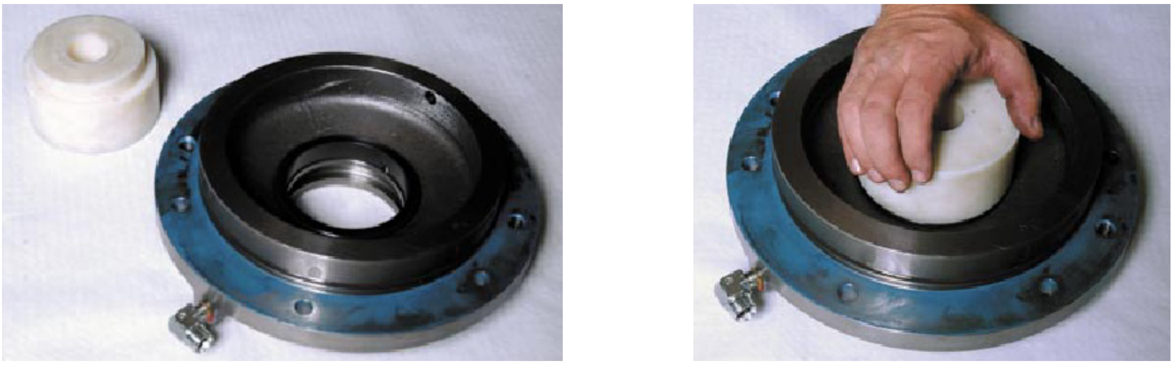


FIGURE 5-6 INSTALLING STATIONARY HALF OF SEAL

Prior to installing the seal housing, check seal faces again. Faces are to be free from cracks, scratches, dirt, chips and nicks. Use a clean, soft, lint free cloth or paper towel to lightly oil the seal faces with new clean lube oil.

Reinstall seal housing with seal housing removal/installation tool (002169) in place, into gear housing over the jackshaft, being careful to properly position the vent-drain connection vertically downward while aligning bolting holes. Lubricate cap screws, reinstall and tighten to torque values in ER-63.1 using an alternating-star (criss-cross) pattern in 25 percent increments to be sure that seal elements come together squarely. Remove tools, re-install vent-drain line tubing, coupling, and coupling guard or access doors on gear housing, as applicable. Clean tools and return to toolbox.

FIGURE 5-7 INSTALLING SEAL HOUSING & TUBING

NOTE: THE COUPLING BOLT TORQUES ARE BASED UPON COUPLING DESIGN AND THE POWER TO BE TRANSMITTED, CONSULT PACKAGER'S INFORMATION FOR PROPER TORQUE VALUES.

Capacity Control Devices

Capacity control inlet volume (capacity) and discharge volume (volume ratio, Vi) devices can be handwheel or electro-hydraulic actuated. Capacity and Vi devices are identical except for the handwheels or hydraulic actuators. Handwheel actuated devices are positioned by numbers of turns. The hydraulic position actuators have visual indicator plates and electronic position indicators.

Hand Wheel Control Removal

Remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn the wheel clockwise to move the sliding valve plate toward the handwheel - this will make it easier to re-engage the valve stem when reinstalling. Orient the hand wheel so a standard socket wrench can access the capscrews. Remove the two capscrews. Turn the hand wheel stem counter-clockwise to disengage it from the valve plate. When the threads have disengaged, pull the stem out. Remove the two Polypac seals and the seal spacer from the valve stem cavity. Discard and replace the Polypac seals. The seal spacer can be reused.

Hydraulic Control Removal

Retract the stem of the hydraulic cylinder to move the sliding plate toward the cylinder - this will make it easier to re-engage the valve stem when reinstalling. Remove tubing from the hydraulic cylinder. Disengage the two "clevis" pins and remove the linear displacement sensor. Protect the sensor from damage. Remove the four capscrews which hold the hydraulic cylinder to the housing. Turn the stem of the hydraulic cylinder counter-clockwise to disengage it from the valve plate. When the threads have disengaged, pull the stem out. Remove the two Polypac seals and seal spacer from the valve stem cavity. Discard and replace the Polypac seals. The seal spacer can be re-used.

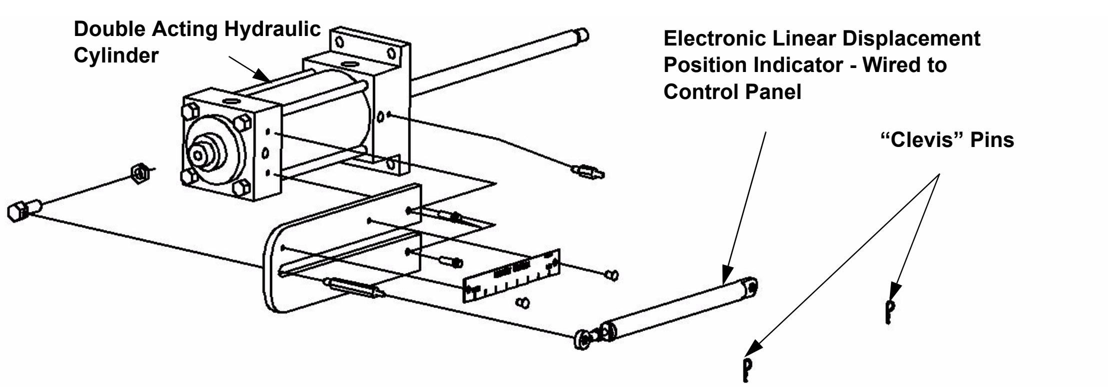


FIGURE 5-8 HYDRAULIC ACTUATED CYLINDER & HARDWARE

TABLE 5-2 CAPACITY CONTROL DEVICES - APPROXIMATE COMPONENT WEIGHTS

COMPONENT	WEIGHT			
	RG282M		RG357M	
	LB	(kg)	LB	(kg)
Hydraulic Cylinder	21	(9.5)	36	(16)
Capacity Valve Cover	55	(25)	97	(44)
Capacity Valve Plate	23	(10)	49	(22)
Vi Valve Cover	24	(11)	44	(20)
Vi Valve Plate	4	(2)	7	(3)

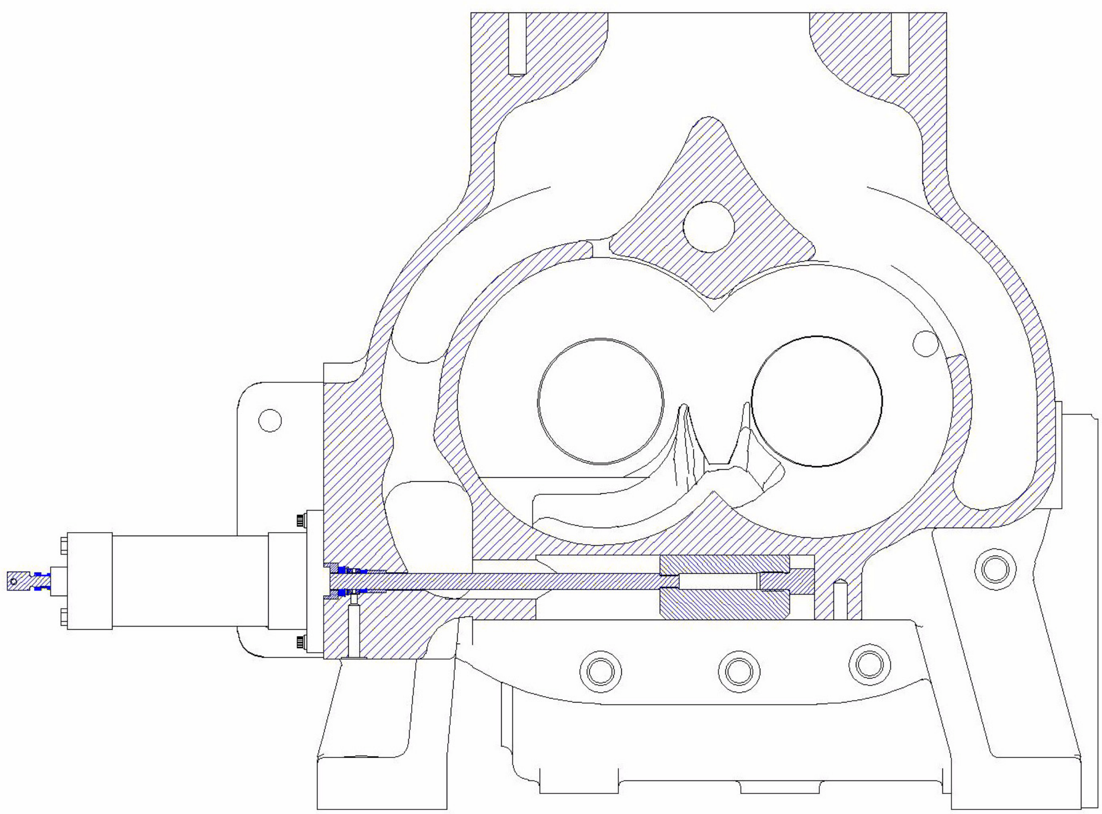


FIGURE 5-9 CAPACITY CONTROL CYLINDER CONNECTED TO ROTOR HOUSING

Capacity Control Cavity Cleanout

First remove the hand wheel or hydraulic control as described in the “Hand Wheel Control Removal” or “Hydraulic Control Removal” sections above, otherwise the valve stem will be bent when removing the capacity control access cover. Remove the drain plug. While supporting the capacity control valve cover, remove the capscrews which hold the cover to the rotor housing. Carefully lower the access cover and valve plate. Note, the valve plate will be setting loose on the access cover. Remove and replace the O-ring on the access cover. Reference Figure 5-10 on Page 5-9.

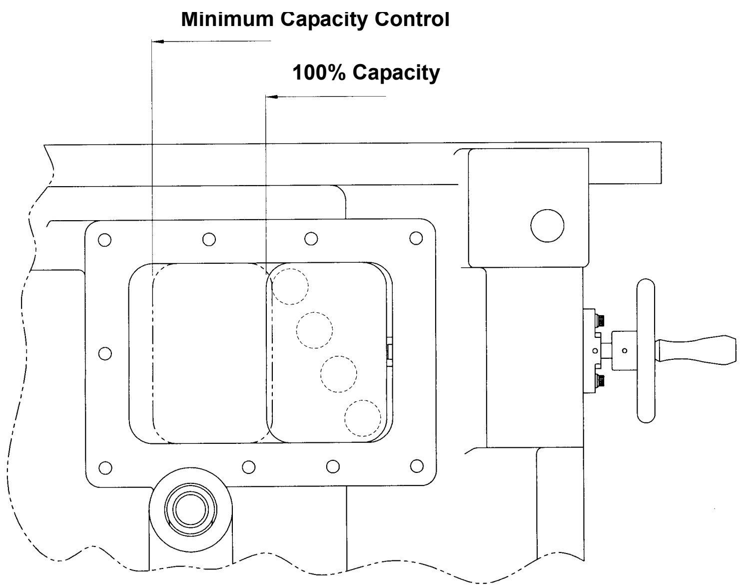


FIGURE 5-10 CAPACITY CONTROL SLIDING VALVE PLATE OVER BYPASS HOLES - TYPICAL BOTTOM VIEW

Vi Control Sliding Valve Plate Removal

First remove the hand wheel or hydraulic control. As described in the “Hand Wheel Control Removal” or “Hydraulic Control Removal” sections above, make certain that the valve plate has been moved toward the Vi valve cover. Remove the four capscrews which hold the Vi valve cover to the rotor housing and discharge housing. Remove the Vi valve cover taking care not to damage the O-ring. Pull the O-ring out of the face of the rotor housing and slide the Vi valve plate under the O-ring.

When reinstalling the Vi valve cover housing, hand tighten the four capscrews in sequence 1-2-3-4 in 1/4 turn increments until cover is firmly seated against the discharge and rotor housings. See Figure 5-11 on Page 5-10. Torque the capscrews 1 & 4 to the full torque value given in ER-63.1 in 25 percent increments, prior to tightening capscrews 2 & 3.

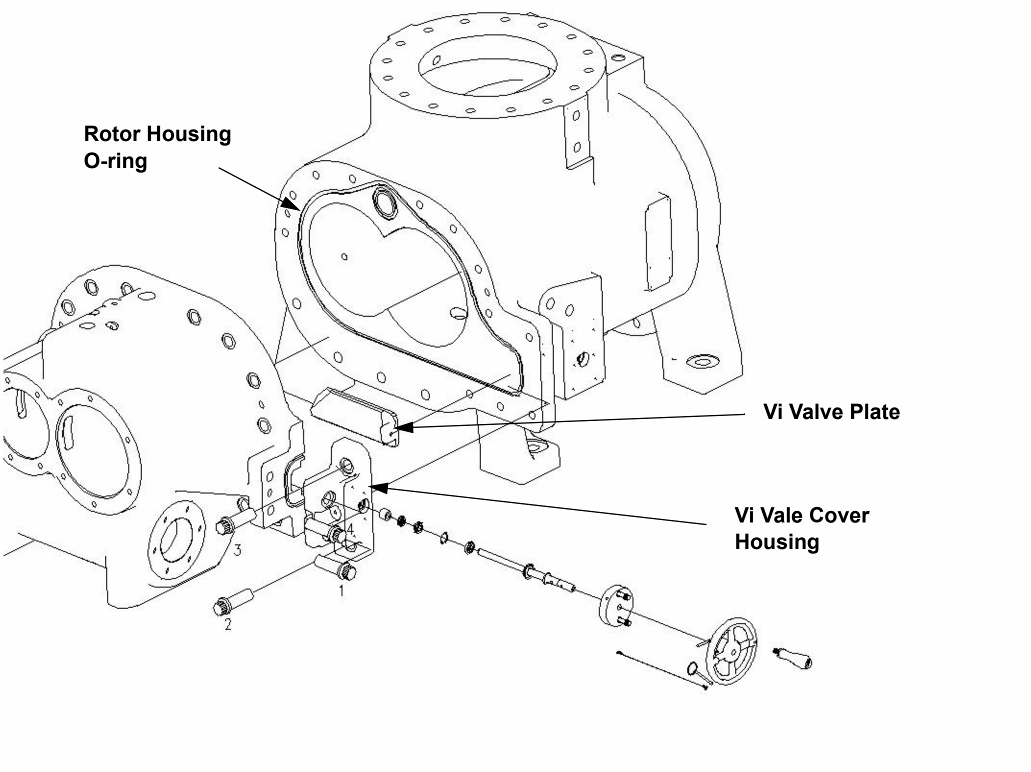


FIGURE 5-11 HANDWHEEL ACTUATED VI CONTROL - TYPICAL

Hydraulic Actuated Control

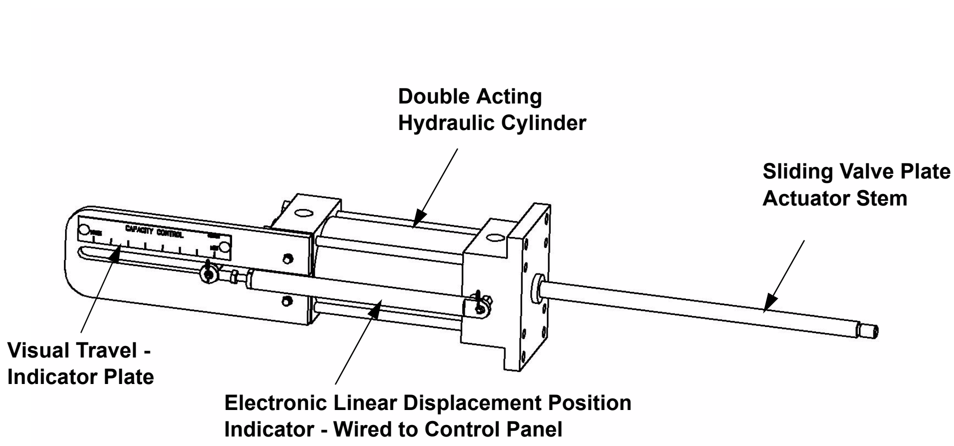


FIGURE 5-12 HYDRAULIC ACTUATED - CYLINDER & ASSOCIATED HARDWARE - TYPICAL

See Ariel Web page at www.arielcorp.com for vendor literature on electronic indicators.

Hand Wheel Actuated Control Position Indication

See Table 1-2 on Page 1-8 and Table 1-3 on Page 1-8 for numbers of turns vs. positions.

Oil Pump and Geared Tooth Coupling

Oil Pump Replacement

Refer to Figure 5-13 on Page 5-12. To replace the oil pump, first mark the pump suction and discharge end connections, then remove oil piping from the pump as required. To remove pump from compressor, remove capscrews (or stud-nuts) and slide pump out, separating the coupling halves at the sleeve. The coupling driven-half will come out attached to the pump shaft, while the coupling sleeve is retained by the drive half of the coupling which is bolted and dowelled to the female rotor. Remove O-ring and discard.

Loosen the key set screw and remove gear coupling-half from the pump shaft with a two or three jaw gear puller. Inspect the coupling's geared teeth, if there is excessive wear, replace the entire coupling with a new assembly.

Replace the pump with a new part, correct for the compressor application. Install the coupling driven-half to the new pump shaft with key installed and firmly seated. There should be a slight clearance of 0.005 in. (0.13 mm) between the top of the key and the mating coupling. Position the coupling-half on the pump shaft end so the axial spacing between the coupling halves is 3/32 in. (2.5 mm), then tighten set screw.

NOTE: THE COUPLING DRIVEN-HALF SHOULD BE APPROXIMATELY FLUSH WITH THE PUMP SHAFT END.

Replace O-ring(s) with new parts. Lubricate coupling sleeve teeth with clean oil. Slide the pump into place, with shaft position rotated to properly engage gear teeth. Be sure pump flow is in the correct direction. Be sure that the flange cover oil passage holes are aligned to scavenged oil port for proper bearing oil flow. Replace fasteners and tighten to the proper torque shown in ER-63.1. Pour a small quantity of oil into pump intake to lubricate new pump, and re-attach oil piping as required.

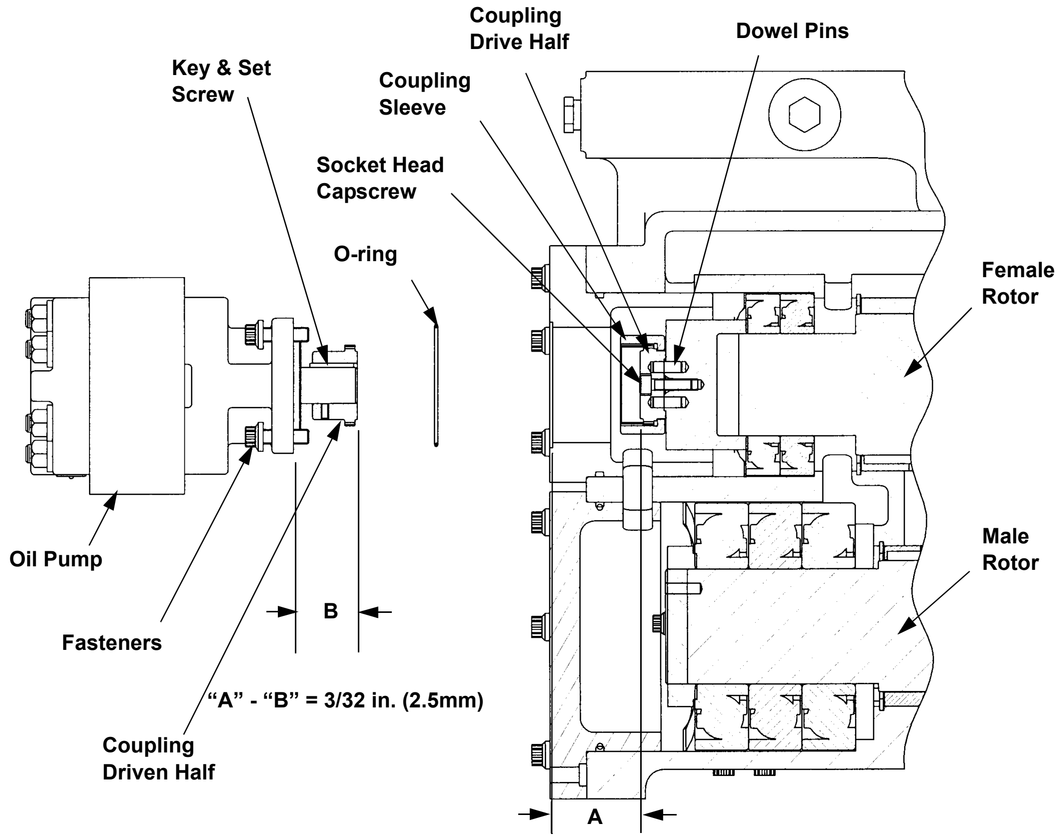


FIGURE 5-13 OIL PUMP AND COUPLING REPLACEMENT - TYPICAL

Oil Pump Coupling Replacement

NOTE: IF THE PUMP COUPLING IS REPLACED, CHECK THE SLEEVE AND HUBS FOR ANY MACHINING CHIPS OR BURRS AND REMOVE BEFORE INSTALLING.

To replace the entire pump coupling, begin as described in first paragraph under Oil Pump Replacement above. Remove the fasteners as required and O-ring. Discard the O-ring. Remove the drive coupling-half socket head cap screw. Remove the drive coupling-half and sleeve assembly, being careful not to cock the coupling half and break the hardened dowel pins.

Replace coupling drive half and sleeve with new parts. Position coupling drive-half, with sleeve installed, over dowel pins and draw up by tightening the cap screw to the proper torque shown in ER-63.1. Verify the sleeve is free to pivot on the drive coupling-half gear teeth. Position new coupling driven-half on the end of the pump shaft and proceed with oil pump re-installation in "Oil Pump Replacement" above.

Drive Gear Set Replacement

TABLE 5-3 APPROXIMATE GEARBOX-ASSEMBLY WEIGHTS

COMPONENT	WEIGHT			
	RG282M		RG357M	
	LB	(kg)	LB	(kg)
w/o Bell Housing	715	(325)	980	(445)
w/Bell Housing	1145	(520)	1805	(820)

Gearbox Removal with Bell Housing Flange Mounting

Be sure all pressure is vented from the compressor and piping. Remove access doors, gas and oil connected piping, vent and drain lines and electrical connections.

Remove coupling. Temporarily reassemble the coupling components and store coupling protected from dust and corrosion.

Supporting the compressor weight from an overhead crane while separating the compressor from driver. Remove the mounting bolts at the two compressor feet. Ariel has identified specific compressor lifting points, and provides lifting eyebolts in the toolbox to support compressor weight while separating and to move the compressor. Refer to Figure 1-9 on Page 1-11 for the compressor's center of gravity and recommended lifting points.

While supporting the compressor weight from the crane, remove the mounting flange bolting. Use four (4) mounting bolts in the four (4) threaded jack bolt holes. Tighten jack bolts in an alternating-star (criss-cross) pattern, one turn at a time, to separate the compressor from the engine. Utilizing a crane, eases the compressor to engine separation and keeps the compressor from exhibiting a sudden downward movement once the SAE pilot diameter disengages the driver housing bore.

Set compressor on its feet on a flat solid surface capable of supporting the weight, to allow for changing the gear set.

Do not suspend compressor from its SAE mounting-flange, when lifting. The compressor is to be separated from the driver when lifting. Attempting to lift the driver/compressor combination can result in serious compressor flange damage and possible personal injury.

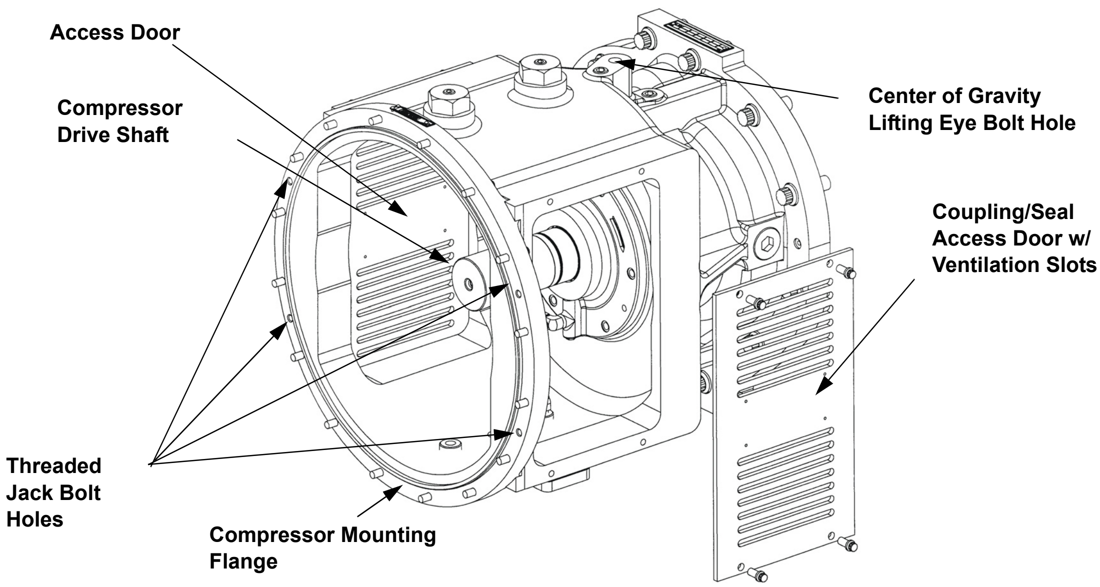


FIGURE 5-14 COMPRESSOR GEARBOX WITH FLANGE MOUNTING - DISCHARGE-SIDE VIEW - TYPICAL

Gearbox Removal without Bell Housing Flange Mounting

It is not necessary to remove the compressor from the package. Be sure all pressure is vented from the compressor and piping. Remove the coupling guard and coupling. Temporarily reassemble the coupling components and store coupling protected from dust and corrosion. Remove vent and drain lines from compressor gearbox.

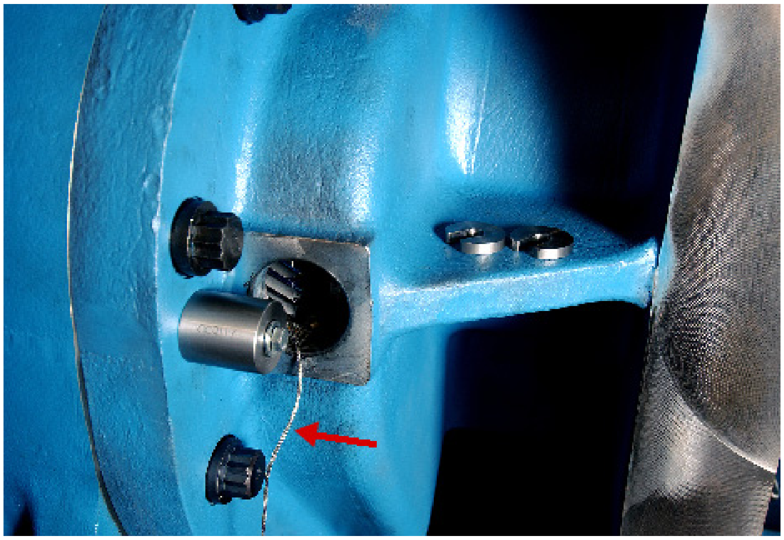
Gearbox Removal (continued) - with or without Bell Housing

Ariel recommends that the gearbox not be removed from the compressor under outdoor or other conditions which could result in contamination of the gears or bearings.

If changing the gear ratio to accommodate a change of conditions, contact your packager or Ariel for proper application information. See Table 1-1 on Page 1-7 for gear ratios available. A new drive gear and new pinion must be matching ratio, but **new** gears are not matched sets. That is, any new gear can be assembled with any new pinon with matching ratio. If a used gear and the mating pinion are available to the desired gear ratio, the used parts may be installed after cleaning and inspecting to be sure that parts are in good condition, free of corrosion or pitting and do not have an uneven or excessive wear pattern. **Used** drive gear and pinion become matched sets as a result of wear-in and can only be used together.

With the compressor in the horizontal position, place a lifting lug eye bolt in the center-of-gravity position for the gearbox shown in Figure 5-14 on Page 5-14.

Using the dowel puller provided in the Ariel toolbox as part number 002119, pull alignment dowels to completely loosen, leaving the dowels in the gearbox housing.



NOTE: Thermocouple wire at arrow is not present on a typical compressor in the field.

FIGURE 5-15 PULLING ALIGNMENT DOWELS

Remove two capscrews, 180° apart just above the horizontal centerline from the gearbox flange and install the two guide pins provided as part number 002151.

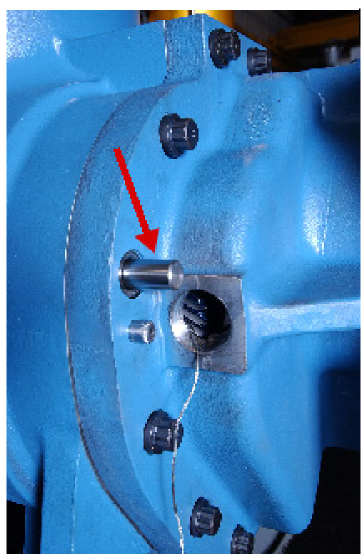


FIGURE 5-16 GUIDE PINS INSTALLED

Set a crane in a lifting position, and adjust so that lifting chain or strap is tight, but without lifting the assembly. With a correct crane setting the gear box should remain horizontal when all the capscrews are removed.

Remove remaining capscrews. A special bolting torque adapter provided as part number 002278 is required to remove one of the capscrews. With a correct setting of the crane the gear box can be moved by hand away from the inlet housing. If the crane is not set correctly the gear and pinion teeth can lock up, resisting removal. This can usually be detected by an uneven gap from top to bottom of the flange face. A small adjustment of the crane up or down should rectify any gear lockup. Remove the housing flange O-ring and discard.

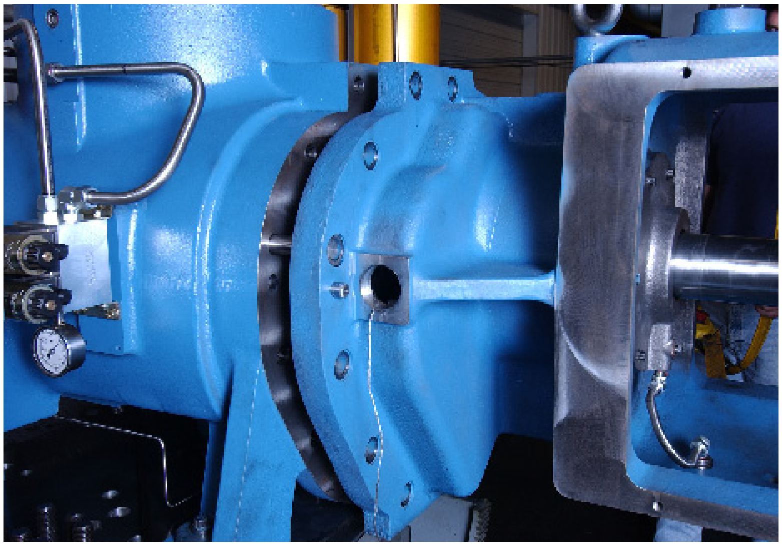


FIGURE 5-17 SEPARATING GEAR HOUSING FROM COMPRESSOR

Gear Set Removal

With the gear box housing secure on a flat surface, install (slip fit) the plastic protective sleeve tool over the end of the jackshaft. The sleeve is provided as a part the gear stop/retaining tool part number 002119, to protect the inner bearing race shaft-surface from damage.

FIGURE 5-18 INSTALLING PLASTIC PROTECTIVE SLEEVE TOOL

Route the hydraulic hose provided with the hydraulic gear removal connection hardware part number 002191 through the clearance hole in the gear stop tool. Tighten hose connection into the jackshaft threaded port. Install the gear stop with the capscrew provided, allowing 1/8 in. (3 mm) clearance between the gear and the gear stop to limit gear travel during removal.

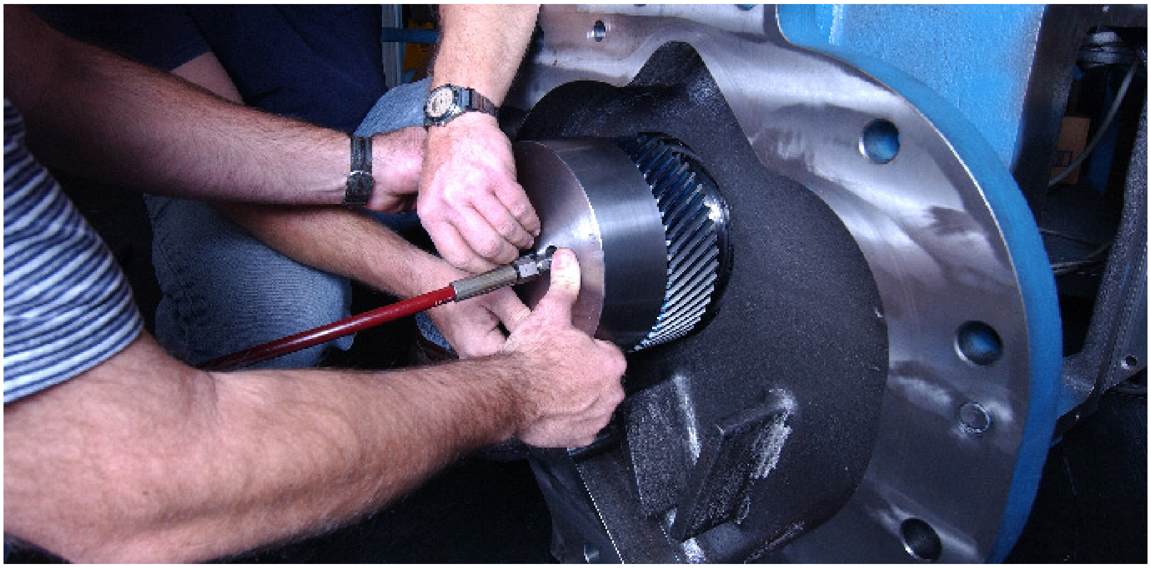


FIGURE 5-19 INSTALLING GEAR STOP/RETAINER

CAUTION: BE SURE THE GAP BETWEEN THE GEAR STOP/RETAINER TOOL AND THE GEAR IS NO MORE THAN 1/8 IN (3 mm). FAILURE TO USE THIS TOOL OR ALLOWING A GREATER GAP CAN RESULT IN PERSONAL INJURY AND DAMAGE TO THE HARDWARE.

Apply hydraulic pressure, approximately 15,000 to 22,000 psi (1000 to 1500 bar) using a hand pump such as is available from Ariel, purchased separately, as part number 002191, until the taper fit gear pops to loosen it from the jackshaft. Move out gear stop by loosening center capscrew slightly and re-pressurize until gear is free from the jackshaft.

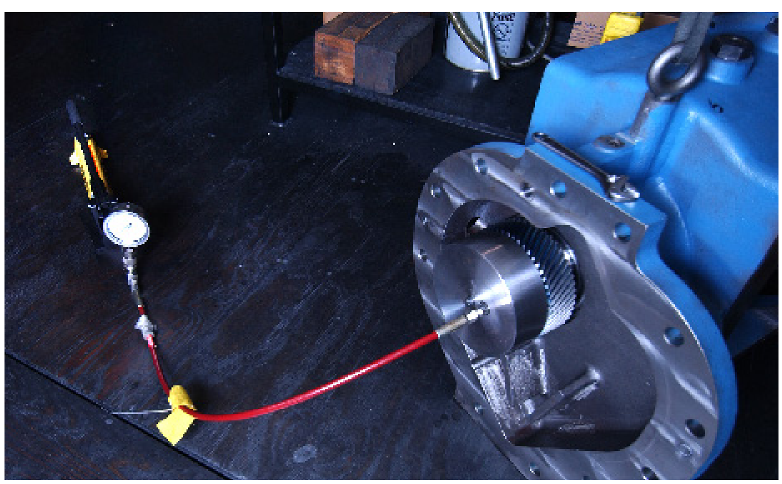


FIGURE 5-20 PRESSURIZING TO REMOVE GEAR

Repeat the gear removal procedure for the pinion gear on the male rotor, using the pinion stop/retaining tool furnished as part number 002158, secured with a capscrew to retain the pinion as it comes free.

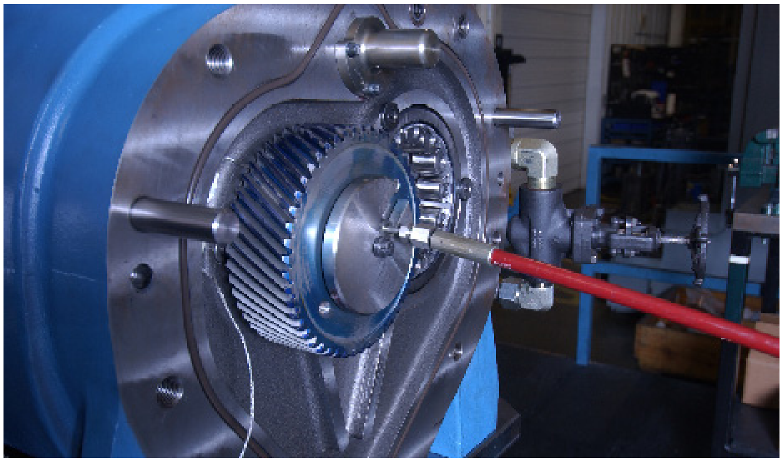


FIGURE 5-21 PRESSURIZING TO REMOVE PINION

CAUTION: FAILURE TO USE THE GEAR STOP/RETAINERS WHEN REMOVING THE GEAR AND PINION CAN RESULT IN SERIOUS PERSONAL INJURY.

Set the removed gear and pinion aside for storage preparation and appropriate marking as a matched set, or scrap depending on the condition.

Relatively new bearings should not need be replaced, but consideration should be given to bearing replacement in each individual case when changing gears.

Determination of Gear Interference Extent

In order to establish if the mounted gear set will have an acceptable interference fit the following procedure is to be followed:

Be sure that the rotor and pinion (or gear and jackshaft) temperatures are within 5°F (3°C) of each other. Be sure that shaft journals and pinion (or gear) bores are free from dirt, oil, rust, dings, burrs and high spots prior to fitting for determining intereference extent. Place the pinion (or gear) on its journal until hand tight, but do not force it further.

Measure the interference extent as shown in Figure 1 and compare with the permitted range given in Table 1. For components with a gaps outside of these ranges, contact Ariel for disposition.

To remove the pinion (or gear) off the journal following a measurement, a light knock on the gear face with a mallet is permitted. Be careful not to damage the face surface.

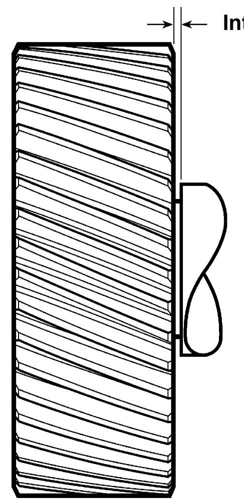


FIGURE 5-22 MEASUREMENT OF INTERFERENCE EXTENT

TABLE 5-4 PERMITTED INTERFERENCE EXTENT GAP

COMPONENT COMBINATION	PERMITTED INTERFERENCE EXTENT GAP	
	INCHES	(MM)
RG282M Gear & Jackshaft	0.234 to 0.285	(5.94 to 7.24)
RG282M Pinion & Rotor	0.081 to 0.132	(2.06 to 3.35)
RG357M Gear & Jackshaft	0.291 to 0.342	(7.39 to 8.69)
RG357M Pinion & Rotor	0.102 to 0.153	(2.59 to 3.89)

Gear Set Installation

Be sure that shaft journals and gear bores are free from dirt, oil, rust, dings, burrs and high spots prior to installation. Heat the replacement gear to 325°F maximum (163°C) using an induction heater with a calibrated temperature control. Refer to the manufacturer's instructions for the proper use of the induction heater. Care is to be taken not to over-heat the gears, as too much heat will result in a loss of material hardness causing premature wear. Insufficient heating will result in difficulties at installation due to a lack of assembly clearance. See Figure 5-23 on Page 5-20.

CAUTION: WEAR PROTECTIVE CLOTHING SUCH AS THERMAL GLOVES WHEN HANDLING HEATED PARTS OR SERIOUS BURNS CAN RESULT.

FIGURE 5-23 HEATING NEW GEAR

With the plastic protective sleeve in place on the jackshaft, quickly put the hot gear on the shaft taper and push the gear back until contacting the shaft shoulder. Rotate the gear slowly until it locks onto the jackshaft. Remove protective sleeve. To save time the gear may be cooled with compressed air.

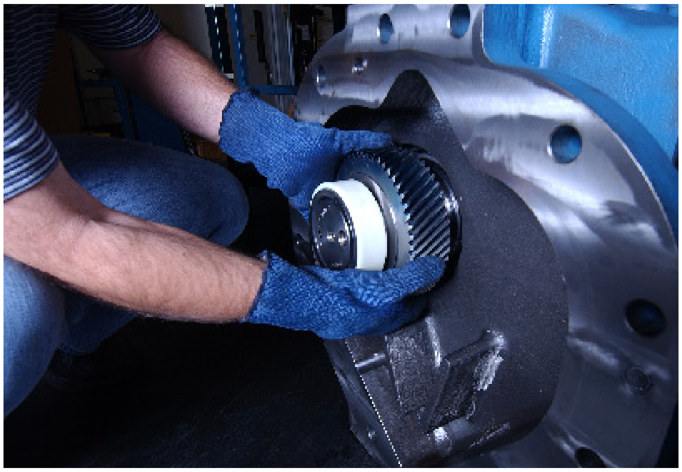


FIGURE 5-24 INSTALLING NEW GEAR

Repeat the installation process for the pinion onto the male rotor.

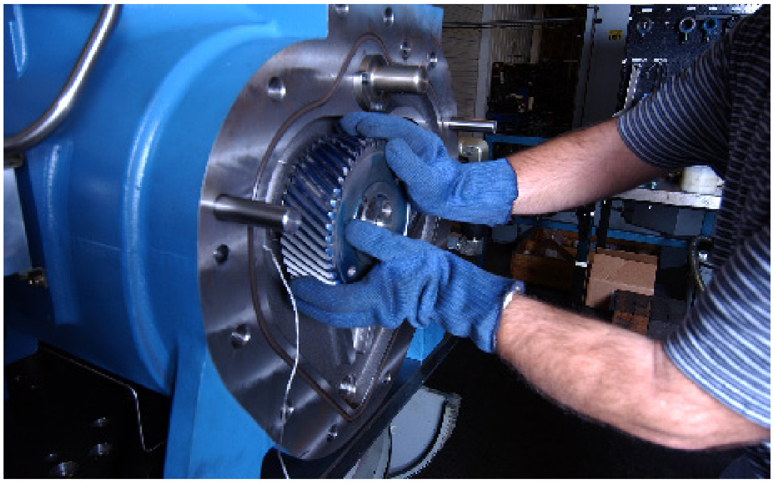


FIGURE 5-25 INSTALLING NEW PINION

Re-Installing the Gearbox

Install the two guide pins furnished as part number 002151, 180° apart just above the horizontal centerline in the rotor housing. Install a new O-ring in the compressor to gear box housing flange.

Lift gearbox toward the compressor using a crane. Be sure the housings are aligned to each other. Start gearbox housing over the guide pins. Turn jackshaft as required to align gear teeth and check alignment of jackshaft into the bearing race. When bringing housings together, start alignment dowels into the mating housing's dowel holes.

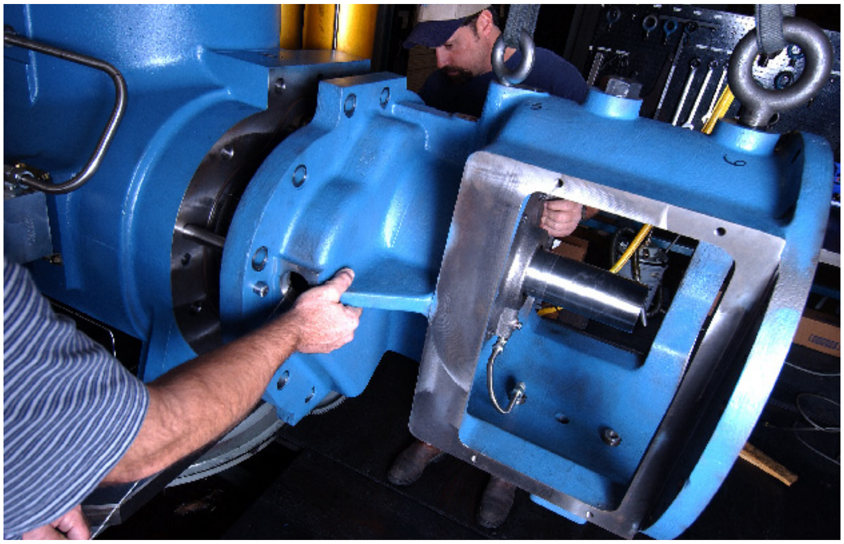


FIGURE 5-26 RE-INSTALLING GEARBOX ON COMPRESSOR

Lubricate and install the capscrews by hand except for the two holes occupied by the guide pins. Use hand wrench and the bolting to pull flanges to together, without loading the joint. Finish tapping in alignment dowels using a hammer and a brass punch. Remove the guide pins. Lubricate and install the remaining two capscrews, hand tight. Remove crane.

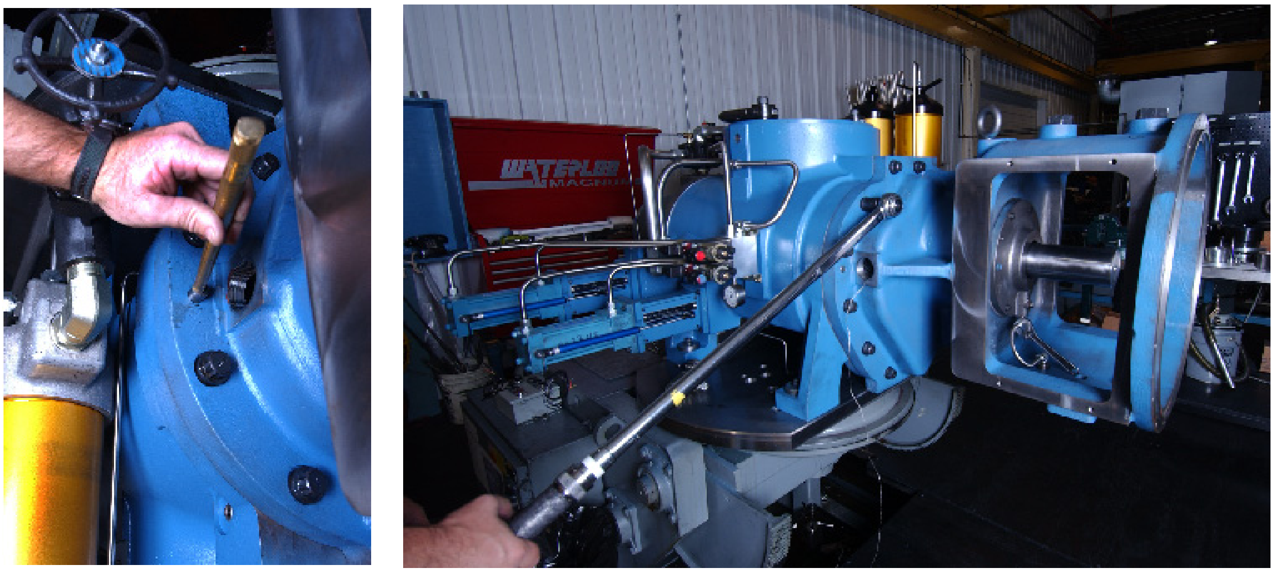


FIGURE 5-27 SETTING ALIGNMENT DOWELS & TIGHTENING BOLTING

Tighten the capscrews to the torque value in ER-63.1 in an alternating-star (criss-cross) pattern in 25% increments. A special bolting torque adapter provided in the toolbox as part number 002278 is required to tighten one of the capscrews. Clean all tools and return to toolbox.

Stamp or vibra-etch the current gear ratio and date on the installed gear ratio/date information plate, refer to Figure 5-28. See Figure 1-9 on Page 1-11, top view for plate location. Mark plate even if gear ratio did not change.

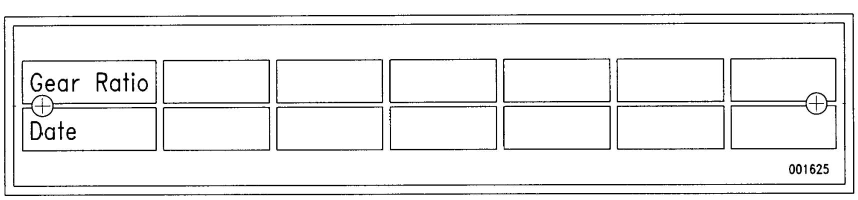


FIGURE 5-28 INSTALLED GEAR RATIO/DATE INFORMATION PLATE

Re-Couple Compressor to Driver

See Section 2 to re-install a flange mounted compressor on the skid. Re-install piping and electrical connections as required.

Reinstall coupling. Reinstall coupling guard or access doors on gear housing, as applicable. Before start-up, refer to Section 3. Repeat check list as part of start-up.

NOTE: THE COUPLING BOLT TORQUES ARE BASED UPON COUPLING DESIGN AND THE POWER TO BE TRANSMITTED, CONSULT PACKAGER'S INFORMATION FOR PROPER TORQUE VALUES.

Check Oil Pump Change Requirements

When changing gear ratio, the oil pump will normally also require changing to match the new operating conditions to the Ariel Rotary Compressor Performance Program (contact your Packager or Ariel when you need this information). See "Oil Pump and Geared Tooth Coupling" on Page 5-11 for pump installation instructions.

Old Gear Set and Oil Pump - Handling and Storage

Clean gear, pinion and oil pump to remove soil and grit. Treat surfaces of parts with a good rust inhibitor, plug openings into oil pump, and package using acid free materials.

Tag/mark gears with parts identification, gear ratio, compressor model, date and the words "Gear set - matched pair". A gear and pinion that have run together become a matched set due to wear-in and may be only reinstalled together as a set, when their gear ratio is required. Mark pump packaging with part number, and description including make and model. If in long term storage, check parts periodically and re-protect as required to prevent rusting.

Oil Filters

Contact Ariel for the compressor's oil filter specifications. Refer to the Parts List for Ariel part numbers for the proper filter elements.

When changing the canister oil filters, remove the flowing vent line and blow clean with compressed air through the bleed fitting in the T-handle. Drain oil from filter. Failure to drain filter will result in dirty oil being introduced to the compressor internal parts and reduce parts life. Clean the orifice with 1/32 in. (1 mm) diameter wire or standard paper clip (20/21 gage). Close canister drain and fill the canisters with clean filtered oil using the same type and grade as in the compressor. Trapped air will be released through the vent. Reassemble vent line after filter has been changed and canister closed. Check for and fix any leaks.

NOTE: FAILURE TO FILL FILTER VESSELS WITH OIL PRIOR TO STARTING, AND AFTER CHANGING FILTER ELEMENTS CAN CAUSE SEVERE DAMAGE TO THE COMPRESSOR.

See Packager's information for maintaining the coalescing filter in the gas/oil separator.

Oil Pressure Regulating Control Valve

Contact Ariel for further questions about the oil pressure regulating control valve.

Installation

1. Use Loctite 545 thread sealing compound with Loctite Activator “N” to seal threaded connections.
2. Install valve, as shown on appropriate Ariel assembly drawing, with outlet connection pointing toward compressor oil gallery inlet, valve inlet connection pointing up, and bypass outlet connection pointing toward drive end.
3. Tighten valve until adjusting handle points toward oil pump end of compressor.
4. Turn valve handle from stop to stop (approximately 16 revolutions) to be sure of proper mechanical operation.

Adjusting Oil Pressure Regulating Control Valve

1. This control valve functions as a pressuring sensing logic valve, where it permits secondary oil flow only after a pilot pressure signal is sensed and maintained.
2. The set pressure must be reached and maintained in the primary oil flow leg (compressor oil supply) before excess oil flow is directed to the secondary flow leg (compressor scavenged oil gallery).
3. This valve is preset to 55 psid (3.8 bar_d) at Ariel during performance testing, prior to compressor shipment.
4. If it is necessary to adjust a replacement control valve, first turn valve handle clockwise to compress spring, (16 turns from minimum to maximum spring tension), then loosen about 3 turns.
5. Start compressor, observing compressor's oil supply pressure on the valve's differential pressure gauge.
6. If it is necessary to adjust the control valve's pressure setting, either turn valve handle clockwise to compress spring and increase oil supply pressure, (16 turns from minimum to maximum spring tension), or turn valve handle counter-clockwise to loosen spring and decrease oil supply pressure.
7. Adjust valve's differential pressure to 55 psid (3.8 bar_d) at driver's rated speed (i.e. 1800, 1500, 1400 RPM), then lock handle in position by tightening stem locknut.

Ethylene Glycol Contamination

Ethylene glycol anti-freeze coolant mixture leaking into the oil from a water-cooled oil cooler leak can cause bearing damage and rotor seizure due to lack of adequate lubrication. The oil should be changed as recommended in the Section 6, while being routinely sampled and analyzed by a qualified laboratory to verify suitability for continued use, including checking for ethylene glycol contamination.

If contamination is found, find and fix coolant leak. Even small quantities of ethylene glycol in the oil can be detrimental. If contamination is less than 5 percent, drain oil, replace filters and flush oil system, including all piping, with a 50-50 mixture of butoxyethanol (Dow Chemical Co. Dowanol EB or equal) and 10W oil using a motor driven pump. Flushing should be done on a warm compressor. Bearings should be continuously flushed for 1/2 hour while barring over compressor. All surfaces that come in contact with the oil are to be flushed which includes spraying all interior surfaces in the compressor and gas/oil separator. Completely drain cleaning mixture, being sure to drain all components of the oil system. Repeat flushing operating using a 60-40 mixture of 10W oil and kerosene or fuel oil. Completely drain oil system, install new filters and fill with proper oil.

If sampling indicates that glycol contamination is greater than 5 percent or compressor has seized due to contamination, the unit is to be returned to Ariel, torn down, cleaned with 100 percent butoxyethanol, flushed with kerosene or fuel oil and repaired as required. All surfaces that come in contact with oil must be cleaned with butoxyethanol, including all passages and piping, and then flushed with kerosene or fuel oil. Oil and filters must be changed. Coolant leak is to be found and repaired.

Butoxyethanol presents health and safety hazards. Use proper eye and skin protection and adequate ventilation. Do not use near open flame or sparks. See manufacturer's Material Safety Data Sheet for complete details.

Ethylene glycol, butoxyethanol, contaminated oils and solvents must be properly disposed. A chemical disposal service should be used.

Mineral Deposit Build-up in Low Pressure Natural Gas Applications

Mineral deposit build-up can occur when liquids have not been completely removed from the gas stream, particularly in low pressure natural gas applications. These minerals (such as salt and calcium dissolved in water saturated process gas) plate out when water flashes off due to pressure drop or heating. The minerals can build up on the suction strainer screen and in the compressor. If mineral build-up is observed during maintenance, additional steps should be taken for liquid removal from the gas stream prior to entering the compressor.

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 process gas being compressed.

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, see Section 3. 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 with the start up date of the unit. If your oil supplier's recommend oil service changes are more frequent than the Ariel recommendations, the supplier's intervals should be followed. Regular oil analysis is recommended. If problems develop, an oil sample should be taken for analysis by a reputable lab. As part of correcting the problem, it may be necessary to change the oil in the entire system.

A log book should be kept with each unit. Every maintenance item can be entered with exacting detail in order that records will be available for tracking maintenance costs 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]

1. Check oil pressures and temperature. Recommended compressor inlet oil temperature is 150°F (65°C).
2. Check gas/oil separator oil level when compressor is in operation. It should be in mid-sight glass and, if not, determine and correct the cause. Do not overfill.
3. Check mechanical seal vent for blowing gas, or excessive oil leakage. If blowing, or leaking excessively, determine cause and, if necessary, replace mechanical seal parts.
4. Check and correct any gas leaks.
5. Check and correct any oil leaks.
6. Check operating pressure and temperatures. If not normal, determine cause of

1. After running a new compressor (or after re-location or major overhaul) for one week or 150 hours, shutdown and check fastener torque on gas nozzle flanges and scavenge oil connections. Refer to Paragraph 7. on Page 1-14 for information on how to properly check fastener torque and ER-63.1 for torque values.

abnormality. It is recommended that a daily log of operating temperatures and pressure be kept for reference. See Daily Log Sheet in Section 3.

7. Check shutdown set points. High-low pressure and temperature shutdowns set as close as practical to current operating conditions.
8. Check for unusual noises or vibrations.
9. Check gas/oil separator scavenged oil flow indicator for oil and entrained gas flow. Adjust as required.
10. Check oil filters differential pressures.
11. Check slide plate position. Adjust as required.
12. Check gas suction strainer differential pressure. See packager's information for details on mesh size and differential pressure limits.

Monthly (in addition to Daily Requirements)

1. Check and confirm safety shutdown functions.
2. Review oil analysis to determine if good for continued use.
3. Inspect, flange mounting bolts to driver, anchor bolts and shims for looseness. Tighten as required.
4. Check oil viscosity requirements for current gas analysis and operating conditions.

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

1. Change oil filter elements[1] or as specified by the manufacturer or oil consultant.
2. Verify that oil is suitable for continued use. 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 required If the oil is replenished on a regular basis due to usage.
3. Clean the three (3) oil strainers, or whenever lubricating oil is changed or if lube oil supply strainer differential pressure exceeds 4 psid (0.3 bar_d).
4. Re-tighten hold down stud-nuts to proper torque values and perform a soft foot check. More than 0.002 in. (0.05 mm) pull down requires re-shimming.
5. Inspect coupling element for cracking and/or axial distortion. Realign if necessary to hold coupling alignment within 0.002 inch (0.05 mm) TIR.

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

1. Inspect compressor mounting for twist or bending by checking shimming of

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1. Change rotor injection filter element more often whenever differential pressure exceeds 11 psid (0.75 bar_d).

compressor feet.

2. Check and re-calibrate all temperature and pressure gauges.
3. Change gas/oil separator coalescing filter element, or before differential pressure exceeds collapse pressure, or as specified by the manufacturer or oil consultant.
4. Clean gas strainer.
5. Inspect gear tooth mesh wear pattern for abnormal or excessive wear. Reference ANSI/AGMA 1010, "Appearance of Gear Teeth - Terminology of Wear and Failure".
6. Check gas nozzle and scavenge oil connection fastener torque.

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 alignment adjustment or to operating personnel being unfamiliar with Ariel compressors. Difficulties of this type can usually be corrected by cleaning, proper alignment 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, improper counter-thrust gas balance pressure, careless operation, lack of routine maintenance or the use of the compressor for purposes for which it was not intended.

Recording of the pressures and temperatures is valuable because any variation, when operating at a given load point, indicates trouble.

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	Defective pressure gauge. Oil regulating valves improperly adjusted for conditions. Oil regulating valve bypass is stuck in the open position. Oil pressure at pump inlet below 2 psig (0.14 bar_g. Dirty or plugged oil strainer. Dirty oil filter. Improper low oil pressure switch setting. Low oil viscosity (oil supply temperature too high). Excessive leakage at seals or bearings. Leaking oil pump check valve. Oil pump wear. Oil pump coupling disengaged. Improper end clearance in oil pump.
High Oil Pressure	Cold oil. Oil regulating valves improperly adjusted for conditions. High oil viscosity. Oil regulating valve unable to bypass excess oil.

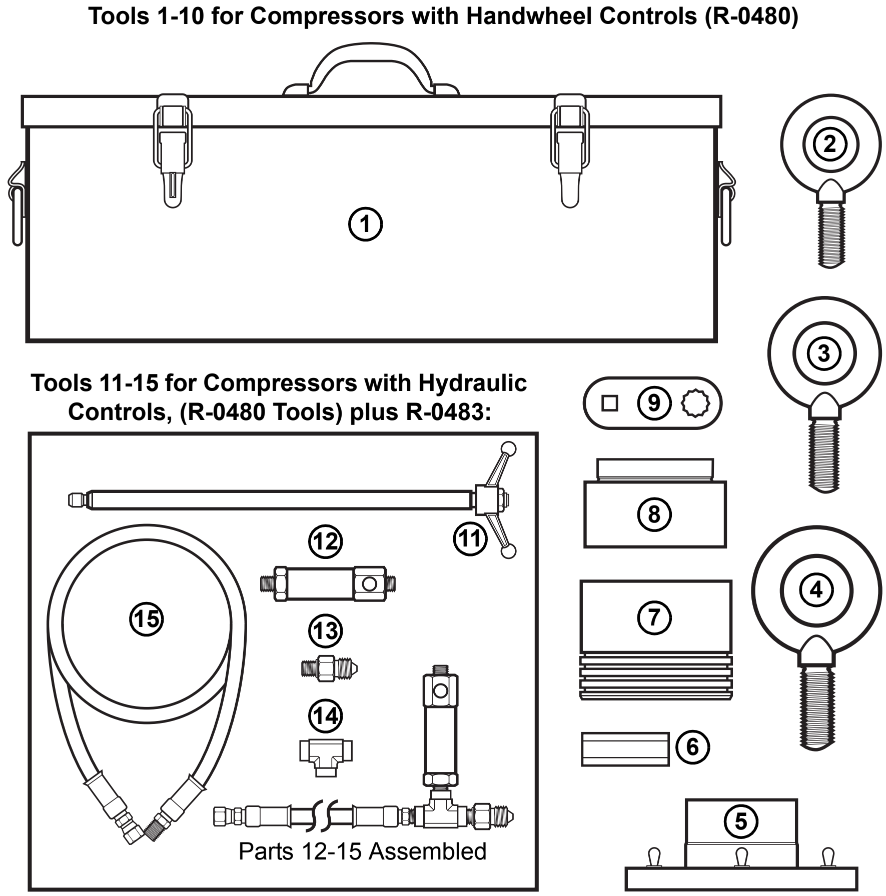
PROBLEM	POSSIBLE CAUSES
Low Oil Temperature	Thermostatic valve element defective. Oil heater or thermostat defective.
High Oil Temperature	Thermostatic valve element defective. Cooler fan not working. Oil cooler dirty. Low oil viscosity.
High Gas Discharge Temperature	Inadequate rotor injection oil rate. Plugged oil strainer. High oil supply temperature High suction temperature. High suction or discharge pressure.
Excessive Vibration and/or Noise in Compressor	Loose compressor hold down bolting. Coupling not properly aligned. Coupling out of balance. Improper lube oil and/or insufficient lube rate. Lubrication failure. Liquids in gas. Excessive rotor end play. Loose or worn bearings. Oil pump damaged.
High Oil Consumption	Oil system over filled. Separator-scavenged oil line plugged or throttling valve closed. Excessive oil dilution from process gas. Collapsed coalescing filter element. Oil/ gas separator coalescing filter gaskets not sealed or defective. Improper coalescing filter element installed. Oil pump damaged.
Excessive Leakage at Mechanical Seal Weep Tube	Mechanical seal is not effective and should be replaced.
Hydraulic Cylinder Motion Erratic	Entrapped air/gas in hydraulic system. Cycle cylinder for full stroke at least twice to remove air/gas. Differential pressure from P-port to T-port is below 35 psid (2.4 bar_d). Oil is cold and very viscous. Flow control valves need to be adjusted.
Capacity or Vi Valve Will Not Move	3-way hydraulic control valve jammed with debris. Insufficient oil pressure or flow control valves closed. Debris has jammed the valve plate. Debris in the actuator cylinder jammed the piston. Solenoid coil on directional control valves burned out.

SECTION 7 - APPENDICES

Ariel Furnished Tools

With every rotary compressor, Ariel provides a Tool Kit that contains the tools below. These tools are specifically designed for use on Ariel RG282M and RG357M compressors. Clean all tools before use and verify full tool engagement with the part to remove or install. If the Tool Kit is missing or if a tool is missing, worn, or broken, call your Ariel distributor for a replacement. Do not use worn or broken tools, or substitutes for Ariel furnished tools.

1. Tool Box, A-0798.
2. 1” - 8 UNC Forged Steel Eyebolt, FE0300KA.
3. 1 1/8” - 7 UNC Forged Steel Eyebolt, FE0300LA (RG282M only, 2 provided).
4. 1 1/4” - 7 UNC Forged Steel Eyebolt, FE0300MA (RG357M only, 2 provided).
5. Mechanical Seal Housing Installation Tool, 002169.
6. 1” Allen Wrench, 002249 for removing pipe plugs with a socket wrench.
7. Mechanical Seal Installation Tool, 001788 for spring-loaded rotating half.
8. Mechanical Seal Installation Seating Tool, 001742 for stationary half.
9. Coupling Hub bolting Torque Adapter, 002507, typical
10. Laminated **ER-63.1 Bolting Required Tightening Torque Chart**, also available at **www.arielcorp.com** (not shown).
11. Capacity Valve Removal Tool, 002592.
12. 1/4” Relief Valve, 002325.
13. 1/4” x 3/8” NPT Adapter, 002326.
14. 1/4” Pipe Tee, A-0958.
15. 4’ x 1/4” Hose, 002327.



NOTE: Tools 12-15 require a customer-supplied hydraulic hand pump rated at 300 psi (20.5 bar) minimum after a hard shutdown for capacity unloading, with hydraulic controls to allow restarting. The purchased separately high pressure hydraulic hand pump for gear removal, item 8 in Figure 7-2 may be used.

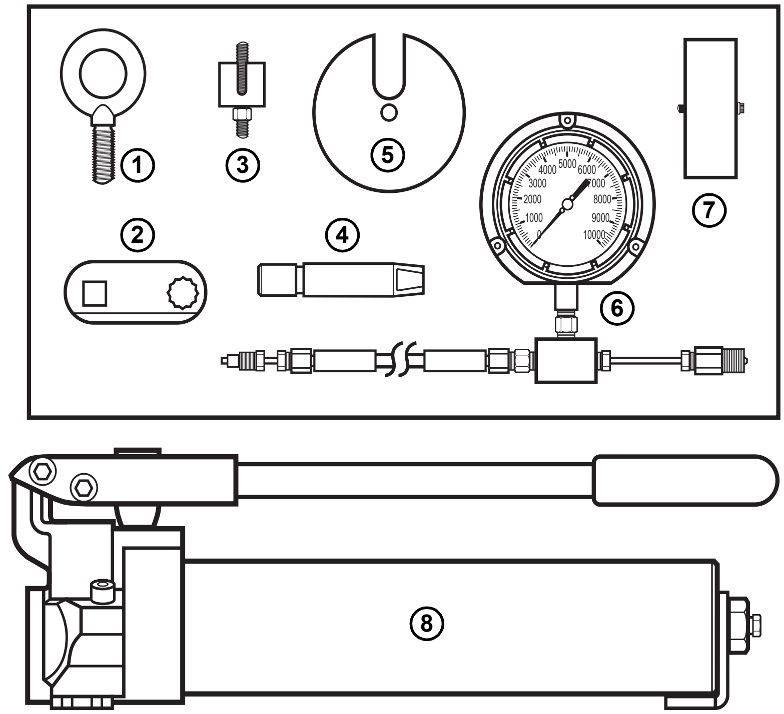
FIGURE 7-1 ARIEL FURNISHED TOOLS

Ariel Tools Purchased Separately from Authorized Dealers

1. 3/4” - 10 UNC Forged Steel Eyebolt FE0300IA, 3 provided.
2. 3/4” Square Drive x 1” 12-Point Socket Torque Adapter, 002278, for removing a gearbox to rotor housing cap screw.
3. Dowel Pin Puller Tool, 002119.
4. Gearbox Guide Pin Tool, 002151, 2 provided.
5. Pinion Gear Stop/Retaining Tool, 002158.
6. Hydraulic Gear Removal Connection Hardware, 002191. Assembly Drawing 002422 also included (not shown).
7. Gear Stop/Retaining Tool with Protective Plastic Bearing Sleeve and Capscrew, 12-Point 1/2”-13 x 2”, 002095.
8. High-Pressure Hydraulic Hand Pump R-0491, (002192).
9. Discharge Housing Lifting Tool R-0481, (002184) with 1” - 8 UNC Forged Steel Eyebolt, FE0300KA, RG282M only. For lifting disc housing with or without rotors with compressor in vertical position.
10. Discharge Housing Lifting Tool R-0484, (002185) with (two) 5/8” - 11 UNC Forged Steel Eyebolts, FE0300HA, RG357M only.

NOTE: Gear and pinion removal requires kit R-0489 and the high-pressure hydraulic hand pump R-0491, rated at 40,000 psi (2750 bar).

Gear and Pinion Hydraulic Removal Tools (R-0489)



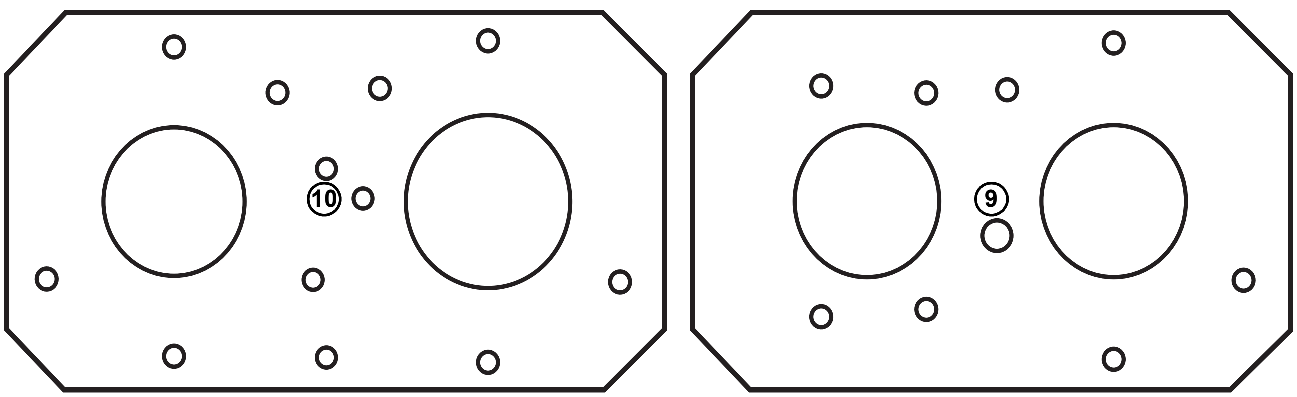


FIGURE 7-2 ARIEL TOOLS PURCHASED SEPARATELY

Hand Tools Required

To work on RG Ariel Rotary compressors usually requires no more than Ariel furnished tools the standard hand tools below, which are readily available from tool suppliers. Contact Ariel for questions about tools for Ariel units.

- 1/2" Square Drive Ratchet Wrench
- 2" and 6" Extensions for above Ratchet
- 1/2" Square Drive Breaker Bar
- 1/2" Drive Speed Wrench
- 1/2" Female x 3/4" Male Adaptors
- 1/2" Square Drive Universal Joint
- 3/8" Square Drive Torque Wrench (10 LB-IN to 250 LB-IN)
- 1/2" Square Drive Torque Wrench (15 LB-FT to 250 LB-FT)
- 3/4" Square Drive Torque Wrench (to 600 LB-FT)
- Torque Multiplier (to 1400 LB-FT)
- 1/2" 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
- 7/8" x 15/16" Open End Wrench
- 2 - Medium Size Screw Drivers
- 2 - Large Size Screw Drivers
- Slugging Hammer
- Brass Punch
- Set of Inch - 3/8" Drive, 12 Point Sockets
- Set of Inch - 1/2" Drive, 12 Point Sockets
- Set of Inch - 1/2” Drive Crowsfoot Adapters
- 3/8" Square Drive Ratchet Wrench
- Set of Inch - 3/4" Drive, 12 Point Sockets
- 3/4" Square Drive Ratchet Wrench
- 3/4" Female to 1" Male Adaptor
- Strap Wrench
- Set of Adjustable Wrenches
- 3/8” Square Speed Wrench
- Induction Heater, capable of heating gears to 325°F (163°C)
- Set of 1/8 in. min. (3 mm) Number Stamps, or Vibrating Etch Tool
- 12 in. (30 mm) Machinist’s scale

TABLE 7-1 SI METRIC CONVERSION

MEASUREMENT	CONVERSION
Area	• square inch (in^2) x 0.00064516 = meter^2 (m^2) • square inch (in^2) x 6.4516 = centimeter^2 (cm^2)
Flow - Gas	• MMSCFD or million standard cubic feet per day (at 14.696 psia & 60°F) x 0.310 = normal meter^3/second (at 1.01325 bar & 0°C), or m^3/s_n • SCFM or standard cubic feet per minute (at 14.696 psia & 60°F) x 1.607 = normal meter^3/hour (at 1.01325 bar & 0°C), or m^3/h_n
Flow - Liquid	• US gallons per minute (GPM) x 0.0630902 = liter/second (L/s = dm^3/s) • US gallons per minute (GPM) x 0.227125 = meter^3/hour (m^3/h)
Force	• lbf or pound (force) x 4.44822 = Newton (N)
Heat	• British Thermal Units (BTU) x 1.05506 = kilojoule (kJ)
Length	• inches (in or “) x 25.4000 = millimeters (mm) • “ = inches • feet (ft or ‘) x 0.304800 = meter (m) • ‘ = feet
Mass	• lb_m or pound (mass) x 0.453592 = kilogram (kg)
Moment or Torque	• LB x FT or pound-foot (force) x 1.35583 = Newton-meter (N· m) • LB x IN or pound-inch (force) x 0.112985 = Newton-meter (N· m)
Power (Horsepower based on 550 ft-lb/sec.)	• Horsepower (HP) x 0.745700 = kilowatt (kW)
Pressure or Stress (“G” or “g” suffix indicates gauge pressure; “A”, “a” indicates absolute; “D”, “d” indicates differential)	• psi x 6894.757 = Pascal (Pa) • bar x 100 = kPa • Pa x 0.000145 = psi • kPa x 0.01 = bar • psi x 6.894757 = kiloPascal (kPa) • psi x 68.94757 = millibar (mbar) • kPa x 0.1450377 = psi • mbar x 0.01450377 = psi • bar x 100000 = Pa • psi x 0.0689476 = bar • Pa x 0.00001 = bar • bar x 14.50377 = psi
Speed	• feet per minute (FPM) x 0.005080 = meter per second (m/s) • revolutions per minute (RPM or r/min) x 60 = revolutions per second (rev/s)
Temperature	• (degrees Fahrenheit (°F) - 32)/1.8 = degrees Celsius (°C)
Time	• sec or s = second • hour (hr or h) x 60 = min • minute (min) x 60 = s • h x 3600 = s
Viscosity (Dynamic)	• Saybolt Universal seconds (SSU, SUS) x 0.22 - (180/SSU) = mm^2/s = centistoke (cSt) (for a range of 33 through 200,000 SUS)
Volume	• US gallons (gal) x 3.78541 = liter (L)

TABLE 7-2 USEFUL SI METRIC MULTIPLE AND SUBMULTIPLE FACTORS

MULTIPLICATION FACTOR	PREFIX	SI SYMBOL
1 000 000= 10^6	mega	M
1 000 = 10^3	kilo	k
100 = 10^2	hecto	h
10 = 10^1	deka	da
0.1 = 10^{-1}	deci	d
0.01 = 10^{-2}	centi	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	µ

TABLE 7-3 GAS ANALYSIS COMMON ABBREVIATIONS

COMMON ABBREVIATION	COMPONENT NAME (SYNONYM)	CHEMICAL FORMULA
C1	Methane	CH4
C2	Ethane	C2H6
C3	Propane	C3H8
IC4	Iso-Butane (2-Methyl Propane)	C4H10
NC4	N-Butane	C4H10
IC5	Iso-Pentane (2-Methyl Butane)	C5H12
NC5	N-Pentane	C5H12
NEOC5	Neopentane	C5H12
NC6	Hexane	C6H14
NC7	Heptane	C7H16
NC8	Octane	C8H18
NC9	Nonane	C9H20
NC10	N-Decane	C10H22
NC11	N-Undecane (Hendecane)	C11H24
NC12	N-Dodecane	C12H26
C2-	Ethylene (Ethene)	C2H4
C3-	Propene (Propylene)	C3H6
BENZ	Benzene	C6H6
TOL	Toluene	C7H8
EBNZ	Ethylbenzene	C8H10
CO	Carbon Monoxide	CO
CO2	Carbon Dioxide	CO2
H2S	Hydrogen Sulfide	H2S
H2	Hydrogen	H2
O2	Oxygen	O2
N2	Nitrogen	N2
H20	Water	H20
He	Helium	He
Ar	Argon	Ar
---	Air	---

Abbreviations

AC = Alternating Current (Electrical)

ACT = Actuator

ADI = Austempered Ductile Iron

ADPTR = Adapter

AFC = Added Fixed Clearance

AISI = American Iron and Steel Institute

AL = Aluminum

ANSI = American National Standards Institution

API = American Petroleum Institute

ASME = American Society of Mechanical Engineers

ASSY = Assembly

ASTM = American Society of Testing and Materials

ATEX = ATmosphère EXplosible

AUX = Auxiliary

AVG = Average

AWS = American Welding Society

BAL = Balance

BHN = Brinell Hardness Number

BLK = Block

BPS = Bypass

BR = Brass

BRKT = Bracket

BRST = Burst Test

BS = Bottom Suction

BW = Butt-Welded

BZ = Bronze

C/CERT = Chemical Certification

CCT = CC Technology

CE = European Conformance Marking to European Union Directives

CE = Crank End

CERT = Certification

CGA = Compressed Gas Association

CHR = Chrome

CI = Cast Iron

CIP = Cycle Indicator Pin

CIU = Compressor Interface Unit

℄ = Centerline

CL = Clearance or Class

CL PKT = Clearance Pocket

CNTR = Center

COMP or COMPR = Compressor

CONC = Concentric

CONN or CON = Connecting or Connection

CRK or C'SHAFT = Crankshaft

CSA = Canadian Standards Association

CSTG = Casting

CT = Calcium Treated

CTB = Ariel Customer Technical Bulletin

CU = Cubic

CVR = Cover

CYL = Cylinder

DAQ = Data Accusation System

DC = Direct Current (Electrical)

D/D = Double Deck

D/S = Drilled-Seat Valves

DI = Ductile Iron

DIA or D = Diameter

DIS = Discharge

DNFT = Digital No-Flow Timer Switch

DPI = Dye Penetrant Inspection

DUPLX = Duplex

DS = Dry Sump

EEPROM = Electrical Erasable Programmable Read Only Memory

ELEC or ELECT = Electric

ELEM = Element

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

EN = European Norme

EU = European Union

EX = Explosion Protection

EXT = External

EXTB = External Thrust Bearing

EXTN = Extension or Extended

FAB = Fabricated

FEM = Female

FFT = Fluid Flow Trending (software)

FIN = Finished

FLG = Flange

FPT = Female Pipe Tap

FS = Forged Steel

FTG = Fitting(s)

FVCP = Fixed Volume Clearance Pocket

FW = Fillet-Welded

GI = Gray Iron

GPSA = Gas Producers Suppliers Association

GRHT = Gerhardt

GR = Grooved Nozzle or Grade

H/S = Half Shell

H-COM = Hydro-Com

HCL = High Clearance

HE = Head End

HES = Head End Support(s)

HEX = Hexagonal

HL = High Lift or High Level

HP = High Pressure or Horsepower, see Power above

HRC = Hardness Measurement on Rockwell C Scale

HTP = Hydrostatic Test Pressure

IEC = International Electric Congress

ID = Inside Diameter

IDP = Integral Distance Piece

IFI = International Fasteners Institute

IH = Integral Head

IN = Ion-Nitrided or Inches, see Length.

ISO = International Standards Organization

IT = Indicator Tap(s)

J BOX = Junction Box

JIC = Joint Industry Conference

KEMA = NV tot Keuring van Elektrotechnische Materialen (Electrical Engineering Equipment Testing Company)

LCD = Liquid Crystal Display

LED = Light Emitting Diode

LG = Long

LHP = Low Horsepower

LL = Low Lift or Low Level

LO = Lubricating Oil

LOSD = Lube Oil Shutdown

LXD = Higher Temperature Liquid Crystal Display

LS = Long Single Compartment Distance Piece

LUBE = Lubricating or Lubricated

L2 = Long Two Compartment Distance Piece

M/CERT = Mechanical Material Certification

M/S = Milled-Seat Valve(s)

MAWP = Maximum Allowable Working Pressure

MAX = Maximum

MC = Medium Temperature Carbon Filled Nylon

MIL = Military

MIN = Minimum

MPI = Magnetic Particle Inspection

MPPT = Mini-Poppet Valve

MPT = Male Pipe Thread

MT = Medium Temperature Glass Filled Nylon

MTD = Mounted

MTG = Mounting

N/A = Not Applicable

N/H = Not Hydrostatically Tested

NAC or NACE = (National Association of Corrosion Engineers), now NACE International Corrosion Society

NAS = National Aerospace Standard

NC or N/C = Normally Closed

NEC = National Electric Code

NFPA = National Fire Protection Association

NL = Non-Lubricated

NMC = Nimonic (Valve Spring)

NO. or # = Number

NO or N/O = Normally Open

NOZ = Nozzle

NP = No Pumps (Force Feed Lubrication)

NPT = National Pipe Thread

OD = Outside Diameter

OVRFLO = Overflow

P/N = Part Number

PC = Piece or Personal Computer

PCT or PCNT or % = Percent

PEEK or PK = Poly-Ether-Ether-Ketone (plastic material)

PIST = Piston

PL = Plastic

PLC = Programmable Logic Controller

PLT = Plate

PPA = Proprietary Polymer Alloy

PPT = Poppet

PR/PKG = Propane Package

PRC = Process

PRS = Pressure

PT = Point

PU = Purge

R/R = Reverse Rotation

RD NOZZ = Round Nozzle

RED = Reducing

RET = Retainer

RFO = Radial Force Only

RNG = Ring

RTD = Resistance Temperature Detector

RTRN = Return

S&D = Suction and Discharge

S/F = Semi-Finished

S/R = Seal Ring

SAE = Society of Automotive Engineers

SBB = Steel Backed Bronze

SD or S/D = Shutdown

SF = Stainless Steel Tubing and Fittings

SG = Specific Gravity

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

SJ = Seal Joint Piston Rings

SM = Small

S. N. or S/N = Serial Number

SOC = Socket (Head)

SPCL = Special

SPCR = Spacer

SPEC = Specifications

SPR = Spring

SS = Stainless Steel

STD = Standard

STL = Steel

STR = Straight

SUC = Suction

SVU = Suction Valve Unloader

SW = Switch

T&B = Top and Bottom (Cylinder Lubrication)

T'CPL = Thermocouple

TFE = Teflon

THD or THRD = Thread

THK = Thick

THRM = Thermostatic Valve

TIR = Total Indicator Reading

TMC = Thomas Coupling

TPI = Threads Per Inch

TR = Tail Rod

TRAV = Travel

TS = Tapered Seat

TVA = Torsional Vibration Analysis

TW = Thermowell Connection

UL = Underwriters Laboratory

UNC = Unified (Inch) National Coarse Screw Threads

UNF = Unified (Inch) National Fine Screw Threads

UNL = Unloader

UNMTD = Unmounted

UNT = Unit

UPS = United Parcel Service

UT = Ultrasonic Inspection

VIB = Vibration

VLV = Valve

VOL = Volume

VRN = Vernier

VS2 = VS2 Type Shutdown

VS = Vertical forged Steel (Cylinder)

VSPCR = Valve Spacer

VTR = Vertical Tail Rod (Cylinder)

W/ = With

W/P = With Clearance Plug

WB = Wear Band

WD = Wideland Valve Seat

WELDMENT = Welded Assembly

WN = Welded Nozzle

WR2 or WR^2 = Weight times Radius Squared (Inertia)

WTRPMP = Water Pump

WT(S) = Weight(s)

XHD = Crosshead

Z/PL = Zinc Plated

2/L = Two Lube Points

2ND = Second (Two)

2SHT = Two Sheet Drawing

Technical and Service Schools on Ariel Compressors

Ariel schedules several in-plant schools each year, which include classroom and hands-on training. See the Ariel web site **www.arielcorp.com**, go to “Support” and follow links at “Product Training” for more information and/or to register. Ariel can also send a representative to provide customized training on location. Contact Ariel for details.

Ariel Customer Technical Bulletins

Ariel Customer Technical Bulletins provide important changes, corrections, and/or additions to the Technical Manual for Packagers and End Users. Read these bulletins before operating or servicing the equipment.

For the latest editions of Ariel Customer Technical Bulletins, visit **www.arielcorp.com**, or obtain copies direct from your Packager or Ariel.

To view Ariel Customer Technical Bulletins from the Ariel Web site requires Acrobat Reader software to be installed on your computer. To install a free current version of Acrobat Reader, click **Downloads/Computer Tools** on the Ariel Home Page, then click the Acrobat Reader link. To view and print Ariel CTB’s (with Acrobat Reader installed), click **Support/Customer Technical Bulletins** on the Ariel Home Page, then click on the type of equipment. To download a CTB electronic file, right click the desired CTB number, then click **Save Target As...** in the pop up window. After using printed or downloaded CTB’s, destroy all prints and files. Seek the latest CTB information from the Ariel Web site.

Vendor Literature

When available, customers may obtain vendor literature on purchased parts used in Ariel Compressors at **www.arielcorp.com**, or direct from the Packager or Ariel.

Contacting Ariel

CONTACT	TELEPHONE	FAX	EMAIL
Ariel Response Center	**888-397-7766 (toll free USA & Canada) or 740-397-3602 (International)**	**740-397-1060**	**arc@arielcorp.com**
Spare Parts		**740-393-5054**	**spareparts@arielcorp.com**
Order Entry		**740-397-6450**	**---**
Ariel World Headquarters	**740-397-0311**	**740-397-3856**	**info@arielcorp.com**
Technical Services			**fieldservice@arielcorp.com**
Web Site: www.arielcorp.com			

Ariel Response Center Technicians or Switchboard Operators answer telephones during Ariel business hours, Eastern Time - USA or after hours by voice mail. The after Hours Telephone Emergency System works as follows:

1. Follow automated instructions to Technical Services Emergency Assistance or Spare Parts Emergency Service.
2. Leave Message: caller name, telephone number, serial number of equipment in question (frame, cylinder, unloader), and brief description of emergency.
3. The message routes to an on-call representative, who responds as soon as possible.

User’s are to contact an Authorized Distributor to purchase Ariel parts.

NOTES: