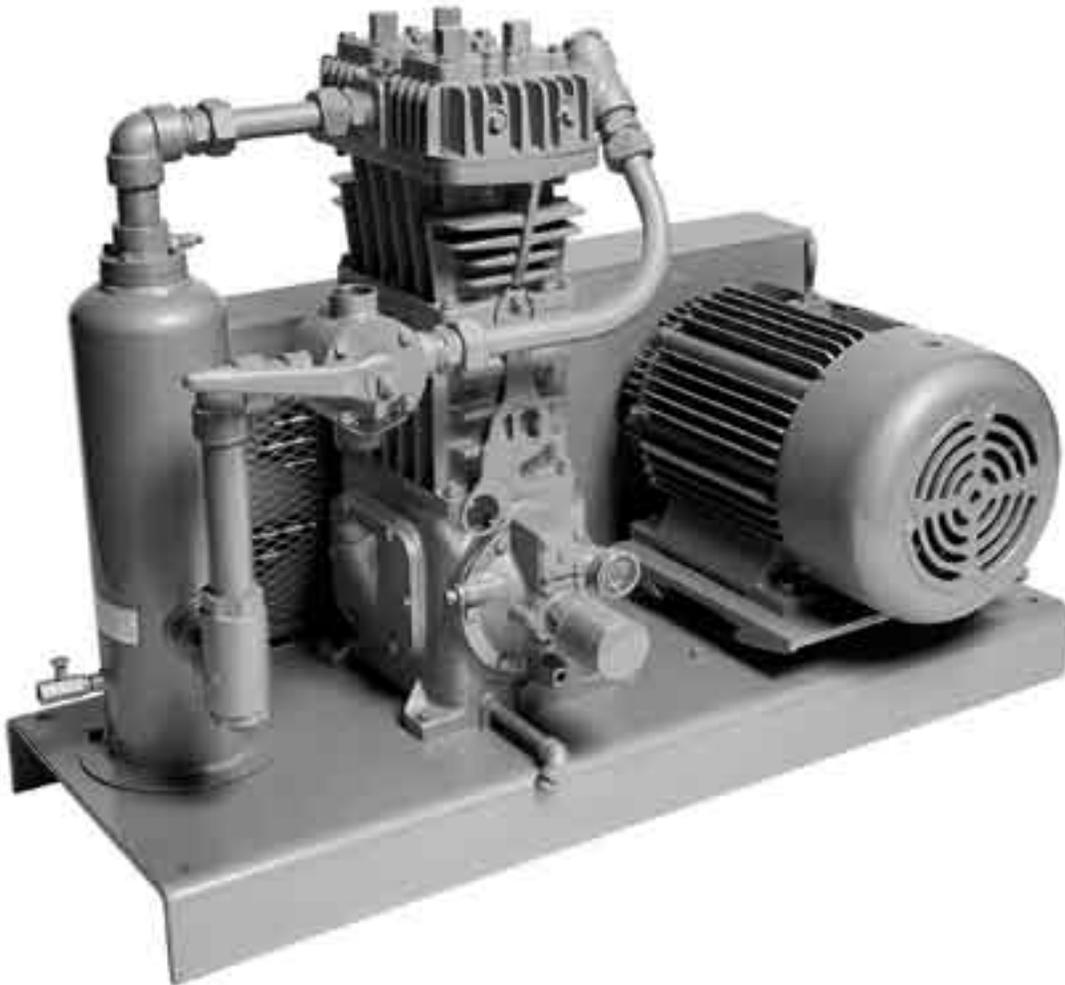


# Installation, Operation & Maintenance Manual

## Liquid Transfer-Vapor Recovery Compressors



Warning: (1) Periodic inspection and maintenance of Corken products is essential. (2) Inspection, maintenance and installation of Corken products must be made only by experienced, trained and qualified personnel. (3) Maintenance, use and installation of Corken products must comply with Corken instructions, applicable laws and safety standards (such as NFPA Pamphlet 58 for LP-Gas and ANSI K61.1-1972 for Anhydrous Ammonia). (4) Transfer of toxic, dangerous, flammable or explosive substances using Corken products is at user's risk and equipment should be operated only by qualified personnel according to applicable laws and safety standards.

*Solutions beyond products...*

 **CORKEN**<sup>®</sup>  
**IBEX**

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## Warning

Install, use and maintain this equipment according to Corken, Inc. instructions and all applicable federal, state, local laws and codes, and NFPA Pamphlet 58 for LP-Gas or ANSI K61.1-1989 for Anhydrous Ammonia. Periodic inspection and maintenance is essential.

## Corken One Year Limited Warranty

Corken, Inc. warrants that its products will be free from defects in material and workmanship for a period of 12 months following date of purchase from Corken. Corken products which fail within the warranty period due to defects in material or workmanship will be repaired or replaced at Corken's option, when returned freight prepaid to Corken, Inc., 3805 N.W. 36th Street, Oklahoma City, Oklahoma 73112.

Parts subject to wear or abuse, such as mechanical seals, blades, piston rings, valves, and packing, and other parts showing signs of abuse are not covered by this limited warranty. Also, equipment, parts and accessories not manufactured by Corken but furnished with Corken products are not covered by this limited warranty and purchaser must look to the original manufacturer's warranty, if any. This limited warranty is void if the Corken product has been altered or repaired without the consent of Corken.

**ALL IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY NEGATED TO THE EXTENT PERMITTED BY LAW AND SHALL IN NO EVENT EXTEND BEYOND THE EXPRESSED WARRANTY PERIOD.**

Corken disclaims any liability for consequential damages due to breach of any written or implied warranty on Corken products. Transfer of toxic, dangerous, flammable or explosive substances using Corken products is at the user's risk. Such substances should be handled by experienced, trained personnel in compliance with governmental and industrial safety standards.

## Contacting The Factory

For your convenience, the model number and serial number are given on the compressor nameplate. Space is provided below for you to keep a written record of this information.

ALWAYS INCLUDE THE MODEL NUMBER AND SERIAL NUMBER WHEN ORDERING PARTS.

Model No. \_\_\_\_\_

Serial No. \_\_\_\_\_

Date Purchased \_\_\_\_\_

Date Installed \_\_\_\_\_

Purchased From \_\_\_\_\_

Installed By \_\_\_\_\_

### IMPORTANT NOTE TO CUSTOMERS!

**CORKEN, INC. does not recommend ordering parts from general descriptions in this manual. To minimize the possibility of receiving incorrect parts for your machine, Corken strongly recommends you order parts according to part numbers in the Corken Service Manual and/or Installation, Operation, & Maintenance (IOM) Manual. If you do not have the appropriate service manual pages, call or write Corken with model number and serial number from the nameplate on your compressor.**

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# Chapter 1—Introduction

## **Threaded and ANSI flanges:**

Compressors are available in either threaded NPT, ANSI, or DIN flanged connections.

## **High-efficiency valves:**

Corken valves offer quiet operation and high durability in oil-free gas applications. Specially designed suction valves which tolerate small amounts of condensate are used in liquid transfer-vapor recovery compressors.

## **O-ring head gaskets:**

Easy to install O-ring head gaskets providing highly reliable seals.

## **Ductile iron construction:**

All cylinders and heads are ductile iron for maximum thermal shock endurance.

## **Self-lubricating PTFE piston rings:**

Corken provides a variety of state-of-the-art piston ring designs to provide the most cost-effective operation of compressors for non-lube service. The step-cut design provides higher efficiencies during the entire life of the piston ring.

## **Positively locked pistons:**

Simple piston design allows end clearance to be precisely set to provide maximum efficiency and long life.

## **Self-lubricating piston rod seals:**

Seals constructed of PTFE incorporating special fillers to ensure no oil carry over and maximize leakage control. Spring loaded seal design self adjusts to compensate for normal wear.

## **Nitride-coated piston rods:**

Impregnated nitride coating provides superior corrosion and wear resistance.

## **Nameplate:**

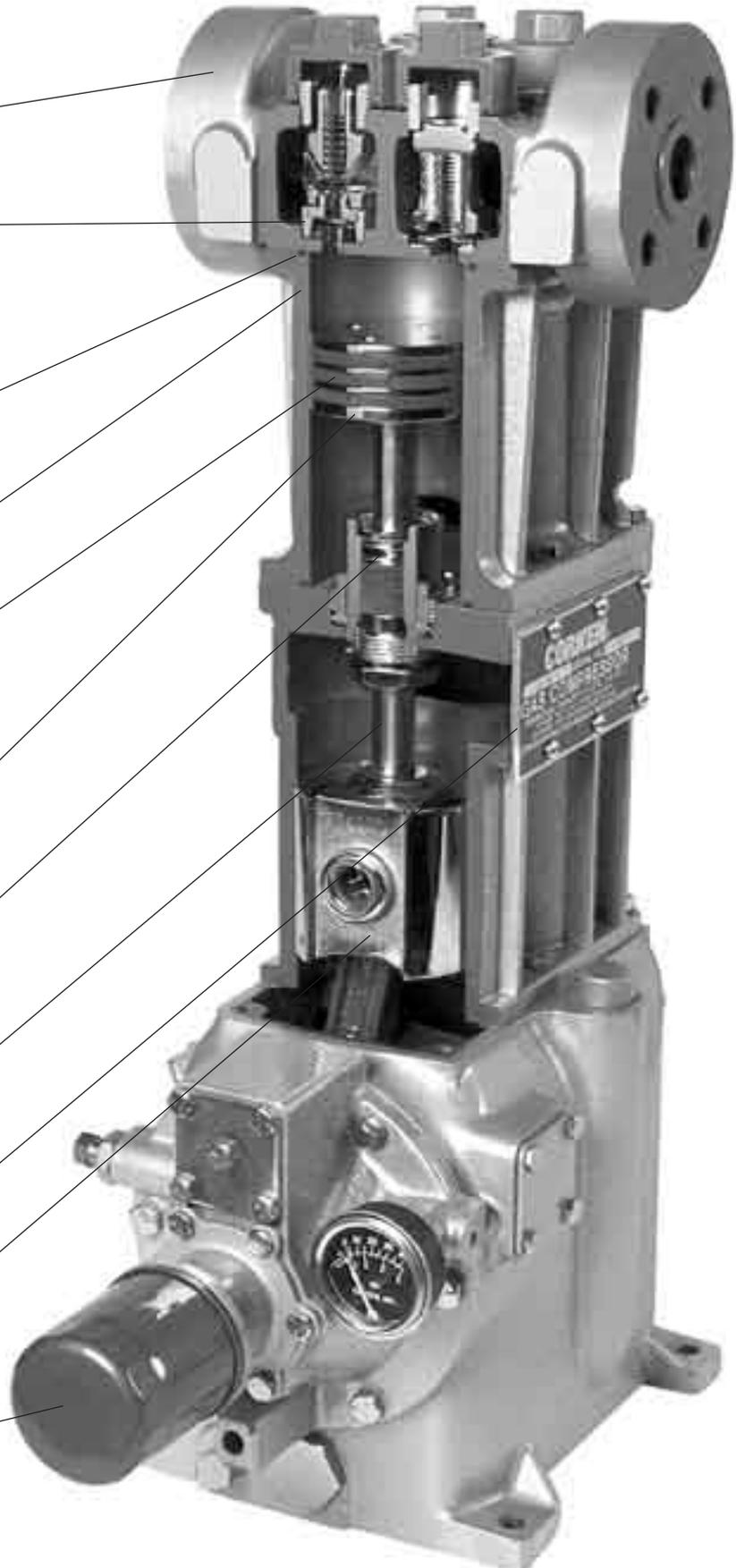
Serves as packing adjusting screw cover (see figure 1.1A).

## **Cast iron crossheads:**

Durable cast iron crossheads provide superior resistance to corrosion and galling.

## **Pressure-lubricated crankcase with filter:**

Self-reversing oil pump ensures proper lubrication regardless of directional rotation to main and connecting rod bearings. Standard 10-micron filter ensures long-lasting bearing life (not available on Model 91).



*Construction Details—Model F291 Compressor*



Figure 1.1A: Typical Nameplate  
(Also Serves as the Packing Adjusting Screw Cover)

## 1.1 Liquid Transfer By Vapor Differential Pressure

Corken LPG/NH<sub>3</sub> compressors are designed to transfer liquefied gases such as butane/propane mixtures (liquefied petroleum gas or LPG) and Anhydrous Ammonia (NH<sub>3</sub>) from one tank to another. Liquefied gases such as LPG & NH<sub>3</sub> are stored in closed containers where both the liquid and vapor phases are present.

There is a piping connection between the vapor sections of the storage tank and the tank being unloaded, and there is a similar connection between the liquid sections of the two tanks. If the connections are opened, the liquid will seek its own level and then flow will stop; however, by creating a pressure in the tank being unloaded which is high enough to overcome pipe friction and any static elevation difference between the tanks, all the liquid will be forced into the storage tank (see figure 1.1B). The gas compressor accomplishes

this by withdrawing vapors from the storage tank, compressing them and then discharging into the tank to be unloaded. This procedure slightly decreases the storage tank pressure and increases the pressure in the other tank, thereby causing the liquid to flow.

The process of compressing the gas also increases the temperature, which aids in increasing the pressure in the tank being unloaded.

## 1.2 Residual Vapor Recovery

The principle of residual vapor recovery is just the opposite of liquid transfer. After the liquid has been transferred, the four-way control valve (or alternate valve manifolding) is reversed so that the vapors are drawn from the tank just unloaded and discharged into the receiving tank. **Always discharge the recovered vapors into the liquid section of the receiving tank.** This will allow the hot, compressed vapors to condense, preventing an undesirable increase in tank pressure (see figure 1.2A).

Residual vapor recovery is an essential part of the value of a compressor. There is an economical limit to the amount of vapors that should be recovered, however.

When the cost of operation equals the price of the product being recovered, the operation should be stopped. For most cases in LP Gas and Anhydrous Ammonia services, this point is reached in the summer when the compressor inlet pressure is 40 to 50 psig (3.8 to 4.5 bars). A good rule of thumb is not to operate beyond

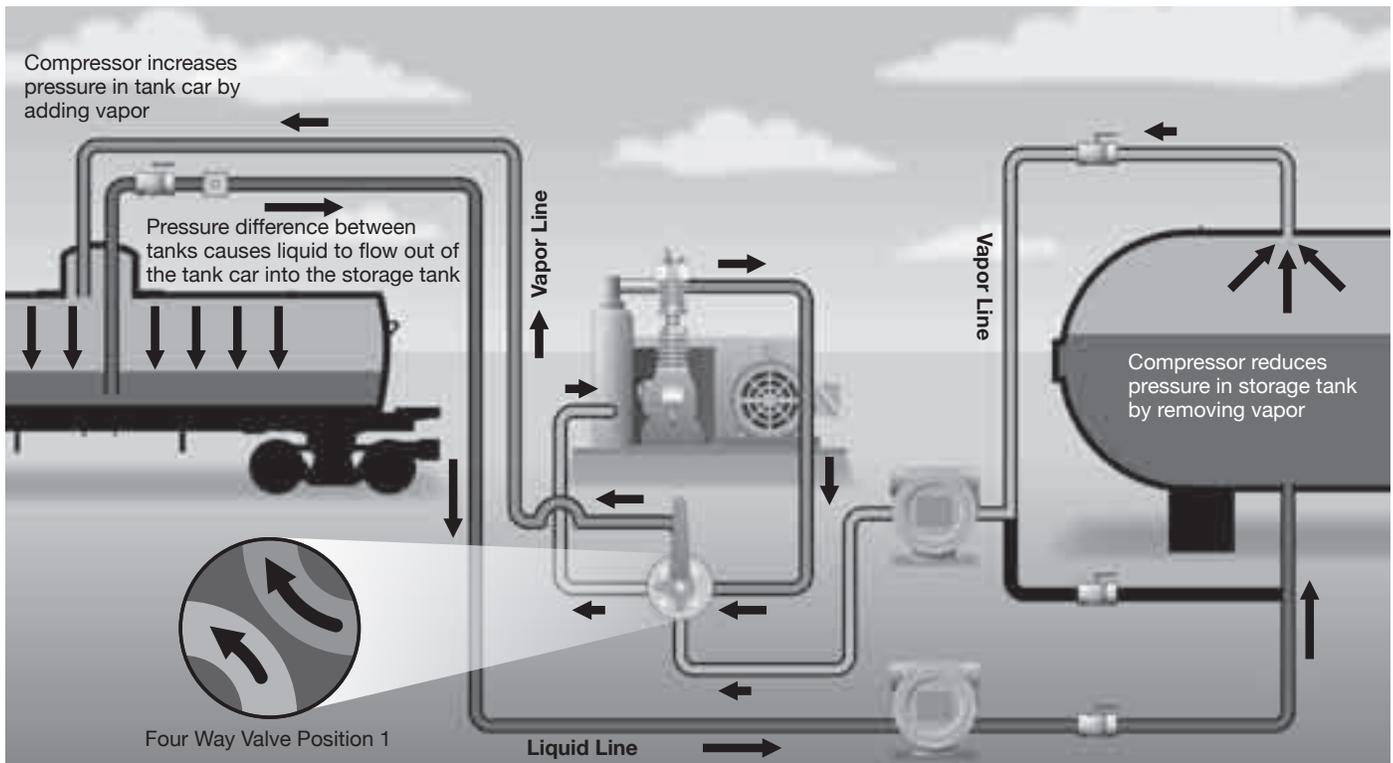


Figure 1.1B: Liquid transfer by vapor differential pressure

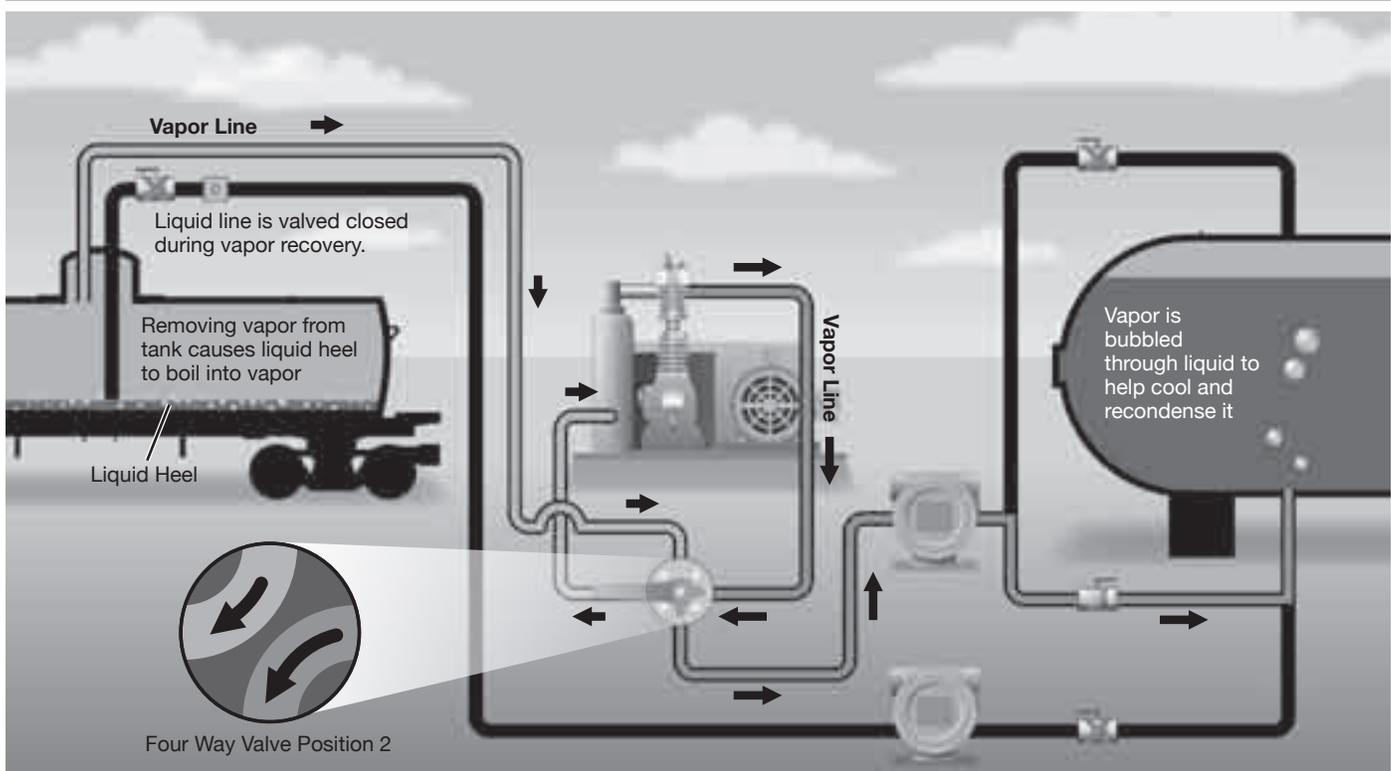


Figure 1.2A: Residual Vapor Recovery

the point at which the inlet pressure is one-fourth the discharge pressure. Some liquids are so expensive that further recovery may be profitable, but care should be taken that the ratio of absolute discharge pressure to absolute inlet pressure never exceeds 7 to 1. Further excavation of very high value products would require a Corken two-stage gas compressor.

Invariably, there is some liquid remaining in the tank after the liquid transfer operation. This liquid "heel" must be vaporized before it can be recovered, so do not expect the pressure to drop immediately. Actually, more vapor will be recovered during the first few minutes while this liquid is being vaporized than that during the same period of time later in the operation. Remember that more than half of the economically recoverable product is usually recovered during the first hour of operation on properly sized equipment.

### 1.3 Compressor Construction Features

The Corken liquid transfer-vapor recovery compressor is a vertical single-stage, single-acting reciprocating compressor designed to handle flammable gases like LPG and toxic gases such as ammonia. Corken compressors can handle these potentially dangerous gases because the LPG/NH<sub>3</sub> is confined in the compression chamber and isolated from the crankcase and the atmosphere. A typical liquid transfer-vapor recovery compressor package is shown in figure 1.3A.

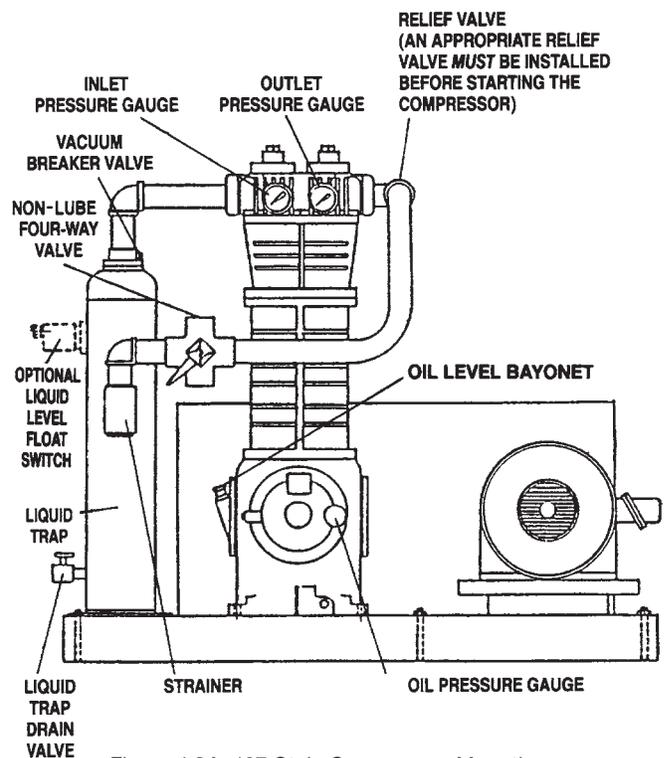


Figure 1.3A: 107-Style Compressor Mounting

Corken gas compressors are mounted on oil lubricated crankcases that remain at atmospheric pressure. Crankshafts are supported by heavy-duty roller bearings and the connecting rods ride the crankshaft on journal bearings. With the exception of the small size model 91 compressor, all compressor crankcases are lubricated by an automotive type oil pressure system. An automatically reversible gear type oil pump circulates oil through

passages in the crankshaft and connection rod to lubricate the journal bearings and wrist pins (see figure 1.3B). Sturdy iron crossheads transmit reciprocating motion to the piston.

Corken's **automatically** reversible oil pump design allows the machine to function smoothly in either direction of rotation.

Corken compressors use iron pistons that are locked to the piston rod. The standard piston ring material is a glass-filled PTFE polymer specially formulated for non-lubricated services. Piston ring expanders are placed behind the rings to ensure that the piston rings seal tightly against the cylinder wall.

Piston rod packing is used to seal the gas in the compression chamber and prevent crankcase oil from entering the compressor cylinder. The packing consists of several PTFE V-rings sandwiched between a male and female packing ring and held in place by a spring (see figure 1.3C).

The typical Corken compressor valve consists of a seat, bumper, one or more spring/s and one or more valve/s discs or plates as shown in figure 1.3D. Special heat-treated alloys are utilized to prolong life of the valve in punishing non-lubricated services. The valve opens whenever the pressure on the seat side exceeds the pressure on the spring side.

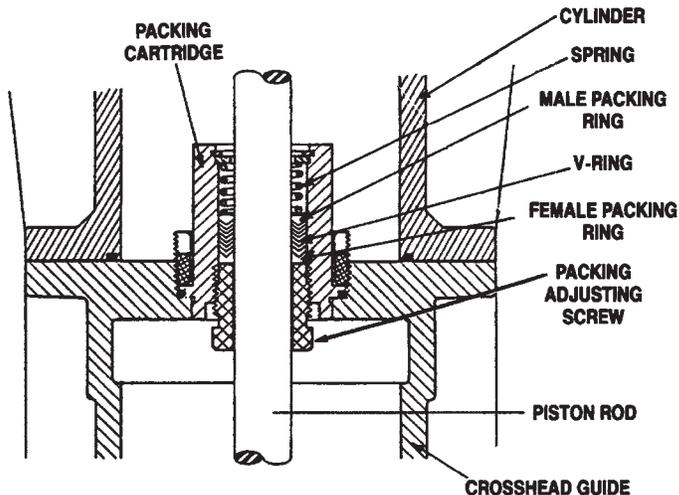


Figure 1.3C: Compressor Sealing System

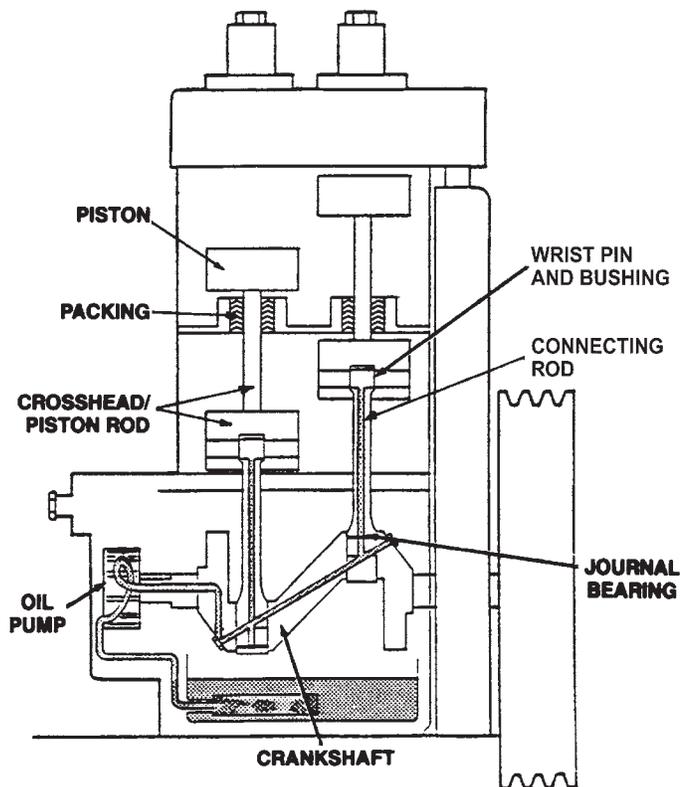


Figure 1.3B: Pressure Lubrication System  
(Not Available on Model 91)

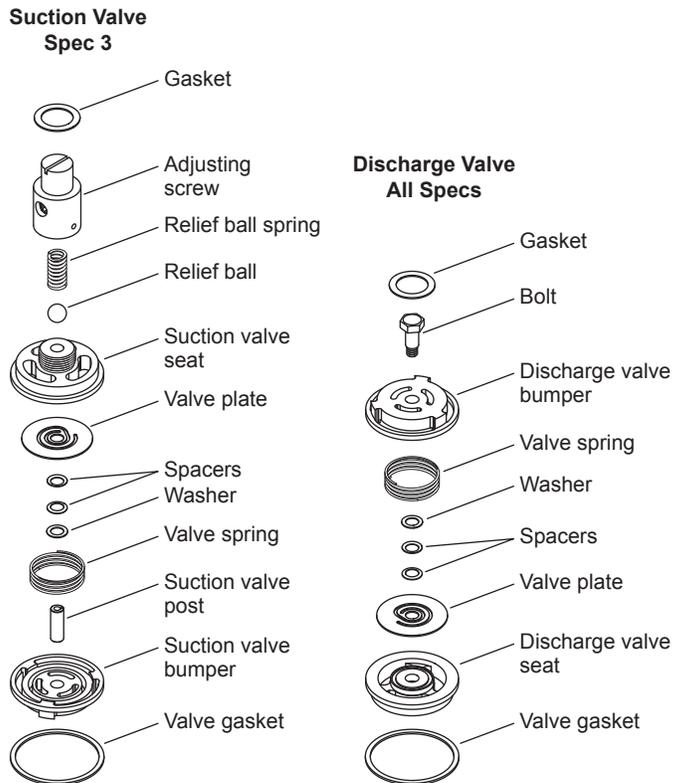


Figure 1.3D: Suction and Discharge Valves

# Chapter 2—Installing Your Corken Compressor

## 2.1 Location

**NOTE:** Compressor must be installed in a well ventilated area.

Corken compressors are designed and manufactured for outdoor duty. For applications where the compressor will be subjected to extreme conditions for extended periods such as corrosive environments, arctic conditions, etc., consult Corken. Check local safety regulations and building codes to assure installation will meet local safety standards.

Corken compressors handling toxic or flammable gases such as LPG/NH<sub>3</sub> should be located outdoors. A minimum of 18 inches (45 cm) clearance between the compressor and the nearest wall is advised to make it accessible from all sides and to provide unrestricted air flow for adequate cooling.

**NOISE.** Corken vertical compressors sizes model 91 through 891 should not exceed an 85 DBA noise level when properly installed.

## 2.2 Foundation

Proper foundations are essential for a smooth running compression system. Corken recommends the compressor be attached to a concrete slab at least 8 in. thick with a 2 in. skirt around the circumference of the baseplate. The baseplate should be securely anchored into the foundation by 1/2 in. diameter “J” bolts 12 in. long. **Four bolts should be used for models 91, 291, and 491. Six bolts should be used for model 691.** The total mass of the foundation should be approximately twice the weight of the compressor system (compressor, baseplate, motor, etc.).

After leveling and bolting down baseplate, the volume beneath the channel iron baseplate **must be grouted** to prevent flexing of the top portion of the baseplate and the “J” bolt that extends beyond the foundation. The grout also improves the dampening capabilities of the foundation by creating a solid interface between the compressor and foundation.

On some of the longer baseplates, such as with the 691–107, a 3 in. hole can be cut in the baseplate for filling the middle section of the baseplate with grout.

See ED410 (Compressor Foundation Design).

## 2.3 Piping

Proper piping design and installation is as important as the foundation is to

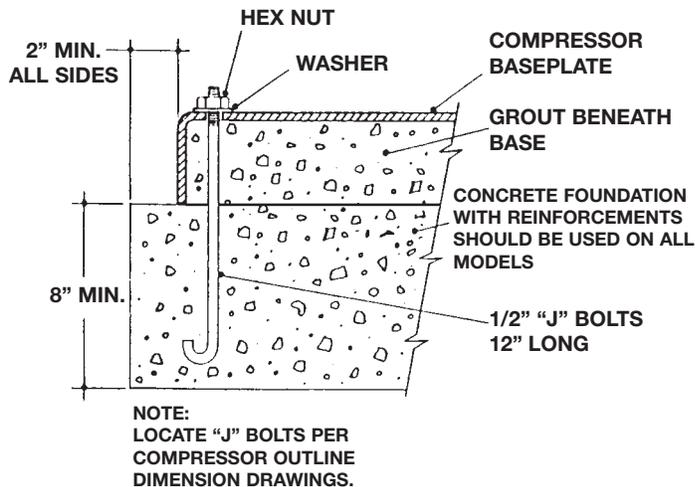


Figure 2.2A: Recommended Foundation Details for Corken Compressors 91 - 691

smooth operation of the compressor. Improper piping installation will result in undesirable transmission of compressor vibration to the piping.

**DO NOT SUPPORT PIPING WITH THE COMPRESSOR.** Unsupported piping is the most frequent cause of vibration of the pipe. The best method to minimize transmission of vibration from the compressor to the piping is to use flexible connectors (see figure 2.3A).

Pipe must be adequately sized to prevent excessive pressure drop between the suction source and the compressor as well as between the compressor and the final discharge point. In most cases, piping should be at least the same diameter as the suction nozzle on the compressor. Typically, LPG/NH<sub>3</sub> liquid transfer systems should be designed to limit pressure drops to 20 psi (1.3 bar). Appendix D shows recommended pipe sizes for each compressor for typical LPG/NH<sub>3</sub> installations.

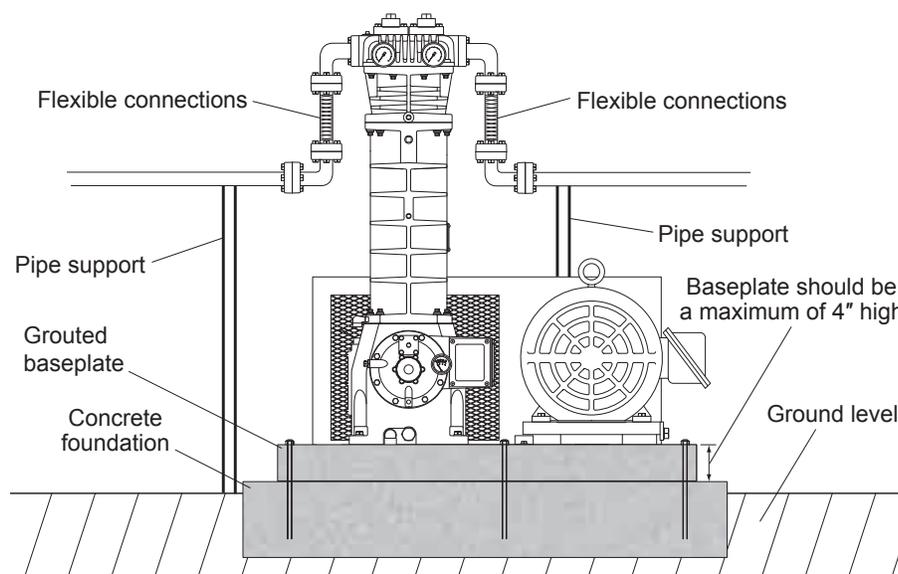


Figure 2.3A: On -107 mountings, the flexible connectors should be located near the four way valve.

Care must be taken if a restrictive device such as a valve, pressure regulator, or back-check valve is to be installed in the compressor's suction line. The suction line volume between the restrictive device and the compressor suction nozzle must be at least ten times the swept cylinder volume.

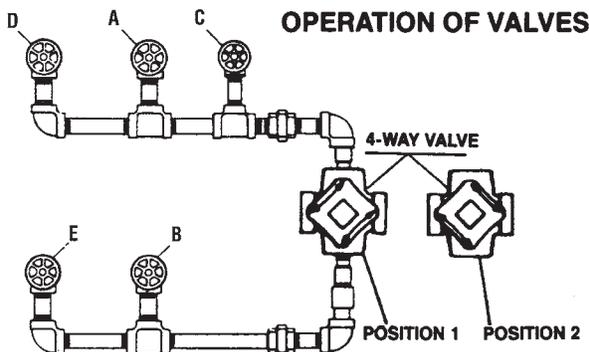
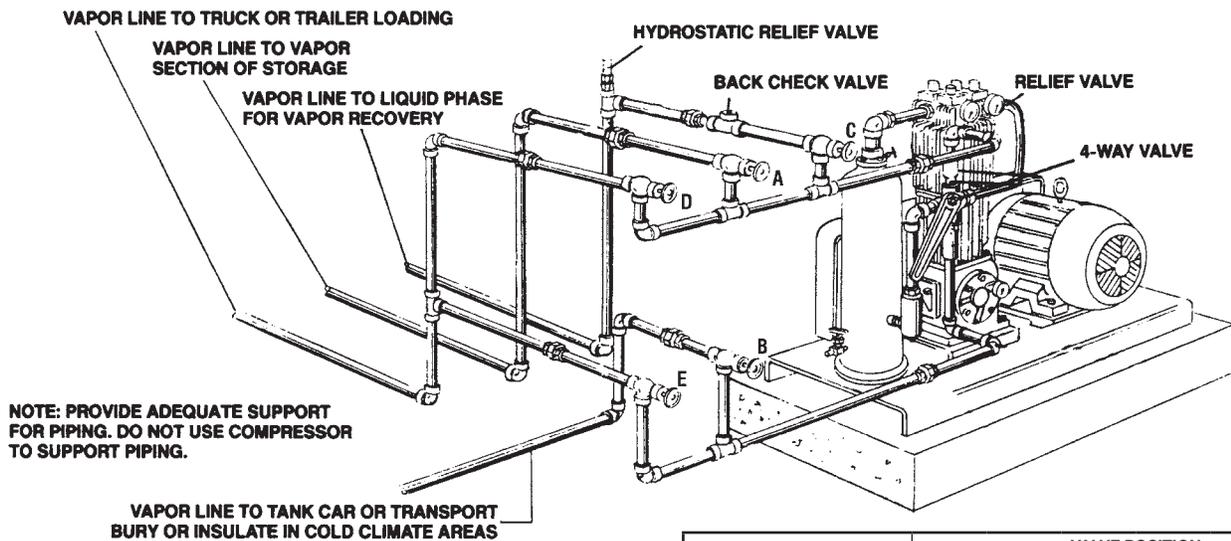
107 style compressors are usually connected using a five-valve (figure 2.3B) or three-valve manifold (figure 2.3C). The five-valve manifold allows the storage tank to be both loaded and unloaded. The three-valve manifold only allows the storage tank to be loaded. Adequate sizing of the liquid and vapor lines is essential to limit the pressure drop in the system to a reasonable level (20 psi or less).

The line size helps determine the plant capacity almost as much as the size of the compressor, and liquid line sizes are a bigger factor than vapor lines. If the pressure gauges on the head indicate more than a 15 to 20 psi (2.07 to 2.40 bars) differential between the inlet and outlet pressures, the line sizes are too small or there is some fitting or excess flow valve creating too much restriction. The less restriction in the piping, the better the flow. Appendix D shows recommended pipe sizes for typical LPG/NH<sub>3</sub> compressor installation.

A tank car unloading riser should have two liquid hoses connected to the car liquid valves. If only one liquid hose is used, the transfer rate will be slower and there is a good possibility that the car's excess flow valve may close.

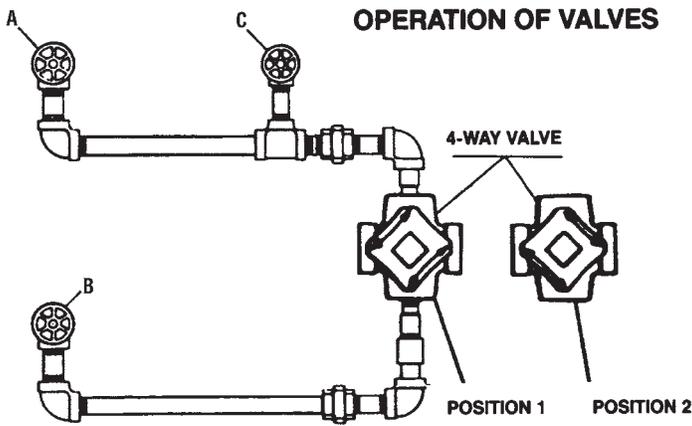
Since the heat of compression plays an important part in rapid liquid transfer, the vapor line from the compressor to the tank car or other unloading container should be buried or insulated to prevent the loss of heat and the compressor should be located as near as possible to the tank being emptied. In extremely cold climates, if the line from the storage tank to the compressor is over 15 feet (4.6 meters) long, it should be insulated to lessen the possibility of vapors condensing as they flow to the compressor. The vapor recovery discharge line is better not insulated. Placing the compressor as close as possible to the tank being unloaded will minimize heat loss from the discharge line for the best liquid transfer rate.

Unloading stationary tanks with a compressor is quite practical. Delivery trucks and other large containers can be filled rapidly if the vapor system of the tank to be filled will permit fast vapor withdrawal, and if the liquid piping system is large enough. Many older trucks (and some new ones) are not originally equipped with vapor excess flow valves large



SERVICE TO PERFORM	VALVE POSITION					
	4-WAY	A	B	C	D	E
1. Unload Tank Car into Storage Tank	Position One	Open	Open	Close	Close	Close
2. Recover Vapors from Tank Car into Storage Tank	Position Two	Close	Open	Open	Close	Close
3. Unload Transport or Truck into Storage Tank	Position One	Open	Close	Close	Close	Open
4. Recover Vapors from Transport or Truck into Storage Tank	Position Two	Close	Close	Open	Close	Open
5. Load Truck or Field Tank from Storage Tank	Position Two	Open	Close	Close	Close	Open
6. Load Truck or Field Tank from Tank Car	Position One	Close	Open	Close	Open	Close
7. Equalize Between Tank Car and Storage Tank without using Vapor Pump	—	Open	Open	Close	Open	Open
8. Equalize Between Truck or Field Tank and Storage Tank without using Vapor Pump	—	Open	Close	Close	Open	Close

Figure 2.3B: Five-Valve Manifold Piping System



SERVICE TO PERFORM	VALVE POSITION			
	4-WAY	A	B	C
1. Unload Tank Car into Storage Tank	Position One	Open	Open	Close
2. Recover Vapors from Tank Car into Storage Tank	Position Two	Close	Open	Open

Figure 2.3C: Three-Valve Manifold Piping System

enough to do a good job and these should be replaced by a suitable size valve. The liquid discharge should be connected to the tank truck pump inlet line rather than the often oversized filler valve connection in the tank head.

It is of extreme importance to prevent the entry of liquid into the compressor. The inlet of the compressor should be protected from liquid entry by a liquid trap (see section 2.4). It is of equal importance to protect the discharge of the compressor from liquid. This may be done by installing a check valve on the discharge and designing the piping so liquid cannot gravity-drain back into the compressor. Make sure to install a check valve on vapor lines discharging to the liquid space of the tank.

All piping must be in accordance with the laws and codes governing the service. In the United States, the following codes apply:

For LP Gas – The National Fire Protection Association Pamphlet No. 58, Standard for the Storage and Handling of Liquefied Petroleum Gases.

For Ammonia – The American National Standards Institute, Inc., K61.1-1989, Storage and Handling of Anhydrous Ammonia.

Copies of these are available from NFPA, 60 Baterymarch Street, Boston, Mass, 02110 and ANSI, 1430 Broadway, New York, N.Y., 10018. Install, use and maintain this equipment according to Corken instructions and all applicable federal, state, and local laws and previously mentioned codes.

## 2.4 Liquid Traps

Compressors are designed to pressurize gas, not to pump liquids. The entry of even a small amount of liquid into the compressor will result in serious damage to the compressor.

On liquefied gas applications, a liquid trap **must** be used to prevent the entry of liquid into the compressor.

Corken offers three types of liquid traps for removal of entrained liquids. The simplest is a mechanical float trap (see figure 2.4A). As the liquid enters the trap the gas velocity is greatly reduced, which allows the entrained liquid to drop out. If the liquid level rises above the inlet, the float will plug the compressor suction. The compressor creates a vacuum in the inlet piping and continues to operate until the operator manually shuts it down. The trap must be drained and the vacuum-breaker valve opened before restarting the compressor, to allow the float to drop back. This type of trap is only appropriate for use where the operator keeps the compressor under fairly close observation. This trap is provided with the 109 and 107 compressor packages (see Appendix D for details on standard Corken compressor packages).

When the compressor will not be under more-or-less constant observation an automatic trap is recommended

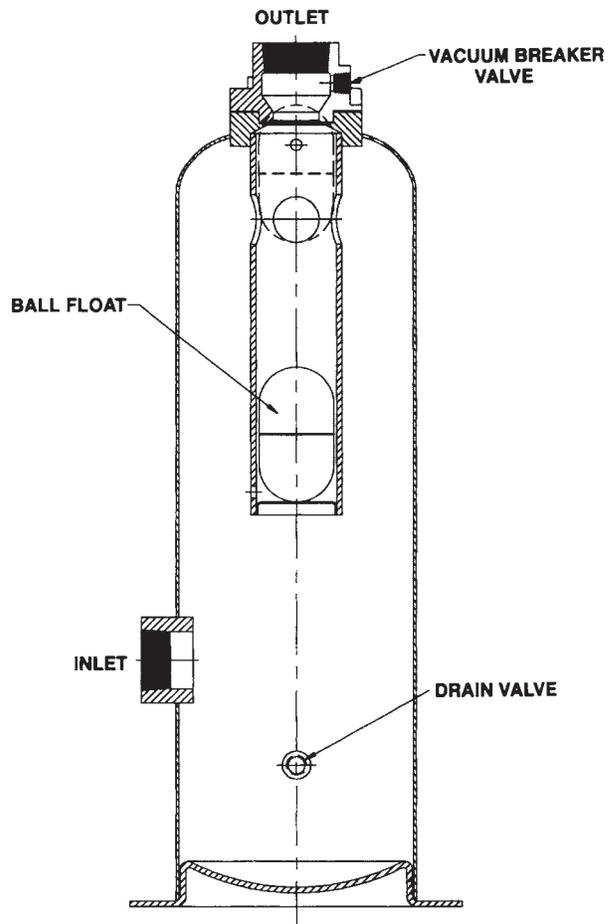


Figure 2.4A: Mechanical Trap

(see figure 2.4B). The automatic trap replaces the float with electrical float switches. If the liquid level should rise too high, the level switch will open and disconnect the power to the motor starter, stopping the compressor. This design ensures the machine will be protected even when it is not under close observation and is standard in the 109A and 107A mounting configurations.

Corken's most sophisticated trap provides the most thorough liquid separation (see figure 2.4C). This trap is larger and is ASME code stamped. It contains two level switches, one for alarm and one for shutdown. In some cases the alarm switch is used to activate a dump valve (not included with trap) or sound an alarm for the trap to be manually drained by the operator. This trap also contains a mist pad. A mist pad is a mesh of interwoven wire to disentrain fine liquid mists. The ASME code trap is standard in the 109B and 107B mounting configurations.

A typical wiring diagram for the liquid level switch is shown in figure 2.4D.

**NOTE: The level switch MUST be removed from the trap before grounding any welding devices to the trap or associated piping! Failure to do so will damage the switch contacts.**

**If your compressor is equipped with a liquid trap of other than Corken manufacture, make sure it is of adequate size to thoroughly remove any liquid entrained in the suction stream.**

### Typical Float Switch Wiring Diagram

- (1) = Common, black
- (2) = Normally closed, blue
- (3) = Normally open, red

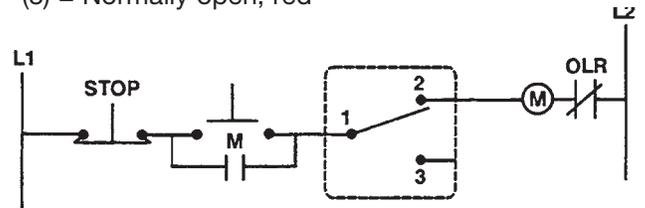


Figure 2.4D: Typical Float Switch Wiring Diagram

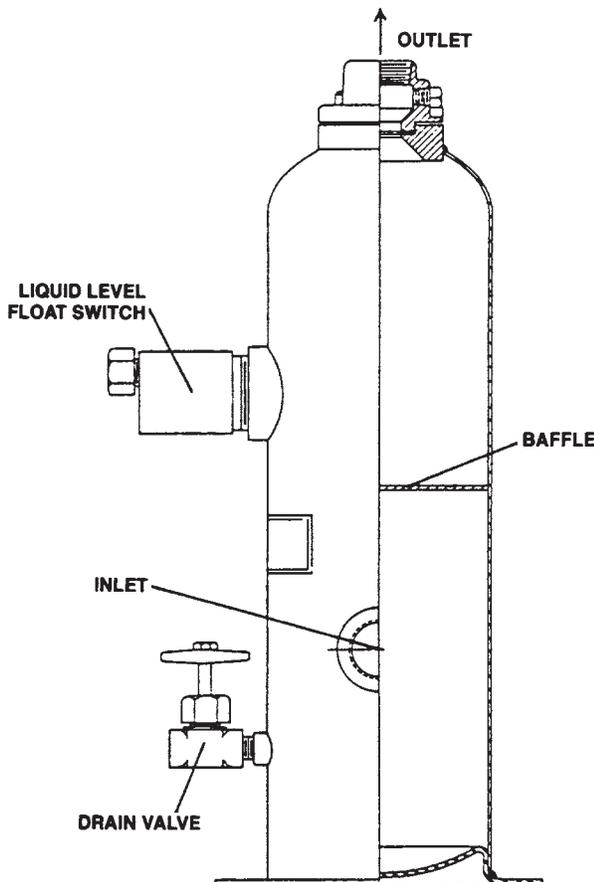


Figure 2.4B: Automatic Liquid Trap

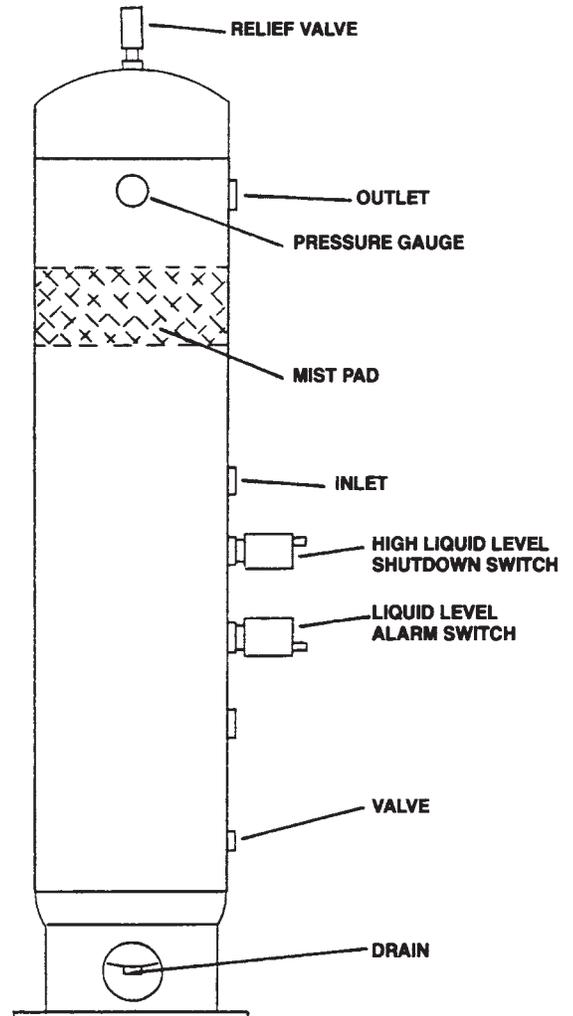


Figure 2.4C: ASME Automatic Liquid Trap

## 2.5 Driver Installation / Flywheels

Corken vertical compressors may be driven by either electric motors or combustion engines (gasoline, diesel, natural gas, etc.). Corken compressors are usually V-belt driven but they are also suitable for direct drive applications as well. Direct drive applications require an extended crankshaft to allow the attachment of a rigid metal coupling.

**NOTE: Flexible couplings are not suitable for reciprocating compressors. Never operate a reciprocating compressor without a flywheel.**

Drivers should be selected so the compressor operates between 350 to 825 RPM. The unit must not be operated without the flywheel or severe torsional imbalances will result that could cause vibration and high horsepower requirement. The flywheel should never be replaced by another pulley unless it has a higher wk2 value than the flywheel.

A humid climate can cause problems, particularly in explosion proof motors. The normal breathing of the motor, and alternating between being warm when running and being cool when stopped, can cause moist air to be drawn into the motor. This moist air will condense, and may eventually add enough water inside the motor to cause it to fail. To prevent this, make a practice of running the motor at least once a week on a bright, dry day for an hour or so without the V-belts. In this period of time the motor will heat up and vaporize the condensed moisture, driving it from the motor. No motor manufacturer will guarantee their explosion proof or totally enclosed (TEFC) motor against damage from moisture.

For installation with engine drivers, thoroughly review instructions from the engine manufacturer to assure the unit is properly installed.

## 2.6. Crankcase Lubrication

Non-detergent oil is recommended for Corken vertical compressors. Detergent oils tend to keep wear particles and debris suspended in the oil, whereas non-detergent oils let them settle in the bottom of the crankcase. When non-detergent oils are not available, detergent oils may usually be successfully substituted, although compressors handling ammonia, amine, or imine gases are notable exceptions. These gases react with the detergent and cause the crankcase oil to become corrosive and contaminated. Figures 2.6A and 2.6B show recommended oil viscosities and crankcase capacities.

Synthetic lubricants are generally not necessary. Please consult your lubricate supplier if you are considering the use of synthetic oil.

Acceptable Crankcase Oil Products for Corken Compressors				
Constant Weight - Non-Detergent - R&O Inhibited				
Oil product	ISO	VI	SAE	Ambient Temp.
<b>Exxon®</b>				
TERESTTIC	100	95	30	65° - 100° F
	68	95	20+	45° - 70° F
	46	95	20	35° - 50° F
<b>Mobil®</b>				
RARUS 427 Reciprocating Compressor Oil	100	95	30	65° - 100° F
DTE Oil Heavy Medium	64	95	20+	45° - 100° F
Dectol R&O Oil	44	95	20	35° - 50° F
<b>Conoco®</b>				
Dectol R&O Oil	100	98	30	35° - 50° F
	68	97	20+	45° - 70° F
	46	99	20	35° - 50° F
<b>Texaco®</b>				
Regal R&O Oil	100	92	30	65° - 100° F
	68	97	20+	45° - 70° F
	46	102	20	35° - 50° F
<b>Sun®</b>				
SunVis 900 Oil	100	100	30	65° - 100° F
	68	100	20+	45° - 70° F
	46	100	20	35° - 50° F

Figure 2.6A: Oil Selection Chart

Compressor Model	Approximate Quarts	Capacity Liters
91	0.9	0.8
291	1.5	1.4
491	3.0	2.8
691	7.0	6.6

Figure 2.6B: Oil Capacity Chart

## 2.7 Relief Valves

An appropriate relief valve **must** be installed at the compressor discharge. On Corken 107-style mounted units a relief valve should be fitted in the piping between the compressor discharge and the four-way valve (see figure 1.3A). Relief valves should be made of a material compatible with the gas being compressed. Local codes and regulations should be checked for specific relief valve requirements. Also, relief valves may be required at other points in the compressor's system piping.

## 2.8 Truck Mounted Compressors

Corken compressors are may be mounted on trucks to perform liquid transfer operations as described in section 1.1. The compressor should be mounted so the inspection plate is accessible for packing adjustment. The compressor must be protected against liquid as explained in section 2.4 and a relief valve must be installed in the discharge piping before the first downstream shutoff valve.

Three types of mountings are typically used. The inside mounting (figure 2.8A) drives the compressor directly off the PTO shaft. The PTO must be selected to drive the compressor between 400 and 800 RPM. An extended compressor crankshaft is required so the U-joint yoke may connect to the compressor without removing the flywheel. Do not operate the compressor without a flywheel. Use a U-joint with a splined joint and make sure the connections are parallel and in line. The U-joint angle should be less than 15 degrees (see figure 2.8B). Always use an even number of U-joints.

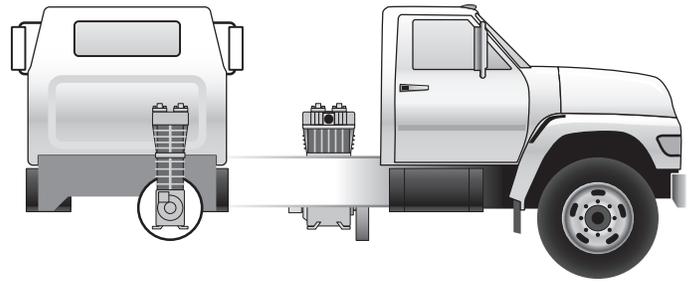


Figure 2.8A: Inside Transport Mounting

Depending on the truck design, the compressor may be outside or top mounted as shown in figures 2.8C and 2.8D to be V-belt driven. Power is transmitted through a U-joint drive shaft, jackshaft with two pillow block bearings, V-belt sheave and V-belts. An idle pulley may be used under the truck frame.

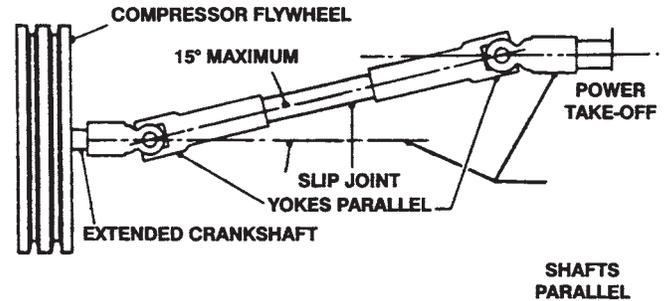


Figure 2.8B: U-joint Drive for Compressor

## 2.9 Shutdown/Alarm Devices

For many applications, shutdown/alarm switches will provide worthwhile protection that may prevent serious damage to your compressor system. All electronic devices should be selected to meet local code requirements. Shutdown/alarm devices typically used on Corken compressors are:

**Low Oil Pressure Switch:** Shuts down the unit if crankcase oil pressure falls below 12 psi due to oil pump failure or low oil level in crankcase.

**High Temperature Switch:** Shuts down the unit if the normal discharge temperature is exceeded. This is strongly recommended for all applications. Typically, the set point is about 30°F (-1°C) above the normal discharge temperature.

**Low Suction, High Discharge Pressure Switch:** Shuts down the unit if inlet or outlet pressures are not within preset limits.

**Vibration Switch:** Shuts down the unit if vibration becomes excessive. Recommended for units mounted on portable skids.

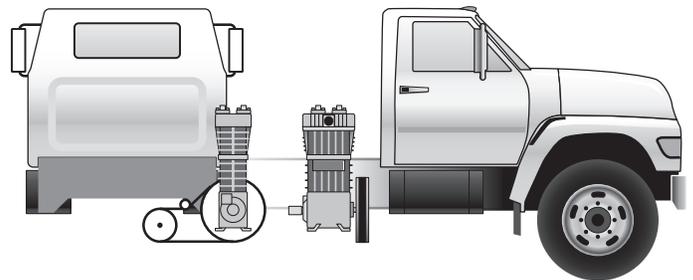


Figure 2.8C: Outside Transport Mounting

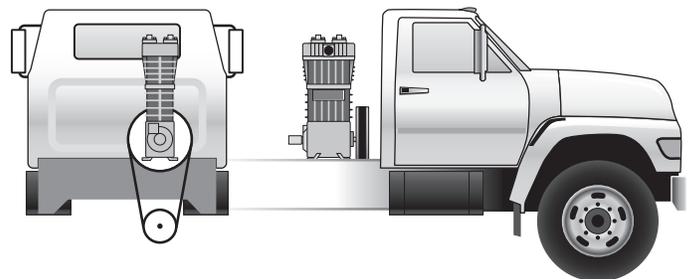


Figure 2.8D: Top Transport Mounting

## Chapter 3—Starting Up Your Corken Compressor

**NOTE:** Before initial startup of the compressor be sure the principal of using a compressor for liquid transfer by vapor differential pressure is understood (see section 1.1). Read this entire chapter, then proceed with the startup checklist.

### 3.1 Inspection After Extended Storage

If your compressor has been out of service for a long period of time, you should verify that the cylinder bore and valve areas are free of rust and other debris (see chapter 5 of this IOM manual for valve and/or cylinder head removal instructions).

Drain the oil from the crankcase and remove the nameplate and crankcase inspection plate. Inspect the running gear for signs of rust and clean or replace parts as necessary. Replace the crankcase inspection plate and fill crankcase with the appropriate lubricant. Squirt oil on the crossheads and rotate the crankshaft by hand to ensure that all bearing surfaces are coated with oil.

Rotate unit manually to ensure running gear functions properly. Replace nameplate and proceed with startup.

### 3.2 Flywheel and V-belt Alignment

Before working on the drive assembly, be sure that the electric power is disconnected. When mounting new belts, always make sure the driver and compressor are close enough together to avoid forcing.

Improper belt tension and sheave alignment can cause vibration, excessive belt wear and premature bearing failures. Before operating your compressor, check alignment of the V-grooves of the compressor flywheel and driver sheave. Visual inspection often will indicate if the belts are properly aligned, but use of a square is the best method.

The flywheel is mounted on the shaft via a split, tapered bushing and three bolts. These bolts should be tightened in an even and progressive manner until torqued as specified below. There must be a gap between the bushing flange and the flywheel when installation is complete. **Always check the flywheel runout before startup and readjust if it exceeds the value listed in Appendix C.**

Bushing Size	Diameter In. (cm)	Bolt Torque Ft.-lb. (kg-meter)
SF	4.625 (11.7)	30 (4.1)
E	6.0 (15.2)	60 (8.3)
J	7.25 (18.4)	135 (18.7)

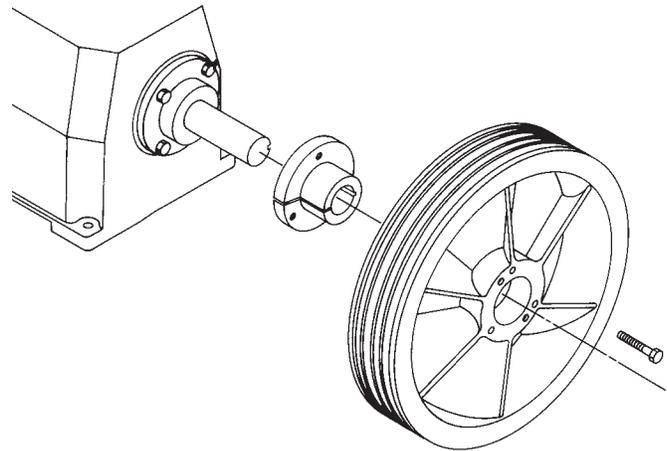


Figure 3.2A: Flywheel Installation

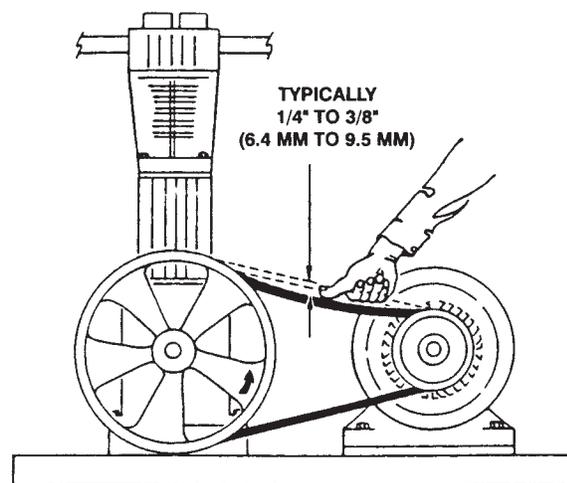


Figure 3.2B: Belt Tension

Tighten the belts so that they are taut, but not extremely tight. Consult your V-belt supplier for specific tension recommendations. Belts that are too tight may cause premature bearing failure. Refer to figure 3.2B.

### 3.3 Crankcase Oil Pressure Adjustment

Corken compressor models 291 through 891 are equipped with an automatically reversible gear type oil pump (if your compressor is the splash lubricated Model 91, proceed to section 3.4). It is essential to ensure the pumping system is primed and the oil pressure is properly adjusted in order to assure smooth operation.

Before starting your compressor, check and fill the crankcase with the proper quantity of lubricating oil.

When the compressor is first started, observe the crankcase oil pressure gauge. If the gauge fails to indicate pressure within 30 seconds, stop the machine.

Remove the pressure gauge. Restart the compressor and run it until oil comes out of the pressure gauge opening. Reinstall the gauge.

The oil pressure should be about 20 psi (1.4 bars) minimum for normal service. If the discharge pressure is above 200 psi (14.8 bars) the oil pressure must be maintained at a minimum of 25 psi (1.7 bars). A spring-loaded relief valve mounted on the bearing housing opposite the flywheel regulates the oil pressure. As shown in figure 3.3A, turn the adjusting screw clockwise to increase the oil pressure and counterclockwise to lower it. Be sure to loosen the adjusting screw locknut before trying to turn the screw and tighten it after making any adjustment.

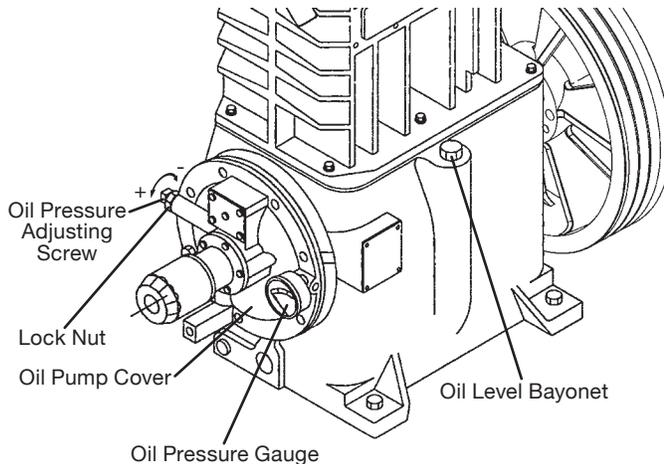


Figure 3.3A: Oil Pressure Adjustment

## 3.4 Startup Check List

**Please verify all of the items on this list before starting your compressor! Failure to do so may result in a costly (or dangerous) mistake.**

### Before Starting the Compressor

1. Become familiar with the function of all piping associated with the compressor. Know each line's use!
2. Verify that actual operating conditions will match the anticipated conditions.
3. Ensure that line pressures are within cylinder pressure ratings.
4. Clean out all piping.
5. Check all mounting shims, cylinder and piping supports to ensure that no undue twisting forces exist on the compressor.
6. Verify that strainer elements are in place and clean.
7. Verify that cylinder bore and valve areas are clean.
8. Check V-belt tension and alignment. Check drive alignment on direct drive units.
9. Rotate unit by hand. Check flywheel for wobble or play.
10. Check crankcase oil level.
11. Drain all liquid traps, separators, etc.
12. Verify proper electrical supply to motor and panel.
13. Check that all gauges are at zero level reading.
14. Test piping system for leaks.
15. Purge unit of air before pressurizing with gas.
16. Carefully check for any loose connections or bolts.
17. Remove all stray objects (rags, tools, etc.) from vicinity of unit.
18. Verify that all valves are open or closed as required.
19. Double-check all of the above.

### After Starting Compressor

1. Verify and note proper oil pressure. Shut down and correct any problem immediately.
2. Observe noise and vibration levels. Correct immediately if excessive.
3. Verify proper compressor speed.
4. Examine entire system for gas, oil or water levels.
5. Note rotation direction.
6. Check start-up voltage drop, running amperage and voltage at motor junction box (not at the starter).
7. Test each shutdown device and record set points.
8. Test all relief valves.
9. Check and record all temperatures, pressures and volumes after 30 minutes and 1 hour.
10. After 1 hour running time, tighten all head bolts, valve holddown bolts, and baseplate bolts. See Appendix C for torque values.

## Chapter 4—Routine Maintenance Chart

Item to Check	Daily	Weekly	Monthly	Six Months	Yearly
Crankcase oil pressure	●				
Compressor discharge pressure	●				
Overall visual check	●				
Crankcase oil level			● <sup>2</sup>	● <sup>2</sup>	
Drain liquid from accumulation points		● <sup>3</sup>			
Drain distance pieces		●			
Clean cooling surfaces on compressor and intercooler (if any)		●			
Lubricator supply tank level (if any)		●			
Check belts for correct tension			●		1
Inspect valve assemblies				●	
Lubricate motor bearings in accordance with manufacturers' recommendations				●	
Inspect motor starter contact points					●
Inspect piston rings <sup>1</sup>				● <sup>1</sup>	● <sup>1</sup>

<sup>1</sup> Piston ring life varies greatly, depending on application, gas, and operating pressures. Consult factory for additional recommendations for your specific application.

<sup>2</sup> Change oil every 2,200 hours of operation or every 6 months, whichever occurs first. If the oil is unusually dirty, change it as often as needed to maintain a clean oil condition. Change replacement filter 4225 with every oil change.

<sup>3</sup> Liquid traps should be drained prior to startup.

# Chapter 5—Routine Service and Repair Procedures

**CAUTION:** Always relieve pressure in the unit before attempting any repairs. After repair, the unit should be pressure tested and checked for leaks at all joints and gasket surfaces.

If routine maintenance is performed as listed in chapter 4, repair service on your Corken gas compressor is generally limited to replacing valves or piston rings. When it comes time to order replacement parts, be sure to consult the part details appendix in the back of this Installation, Operation & Maintenance (IOM) manual for a complete list of part numbers and descriptions.

## 5.1 Valves

Test the compressor valves by closing the inlet piping valves while the unit is running; however, do not allow the machine to operate in this way very long. If the inlet pressure gauge does not drop to zero almost immediately, one or more of the valves is probably either damaged or dirty. It is possible, of course, that the pressure gauge itself is faulty.

Inspect valves for breakage, corrosion, and scratches on the valve disc and debris. In many cases, valves may simply be cleaned and reinstalled. If the valves show any damage, they should be repaired or replaced. Replacement is usually preferable, although individual parts are available. If valve discs are replaced, seats should also be lapped until they are perfectly smooth. If more than .005 in. must be removed to achieve a smooth surface, the valve should be discarded. If discs are replaced without relapping the seat, rapid wear and leakage may occur.

Each suction and/or discharge valve assembly is easily removed as a unit for inspection. If any part of the valve assembly is broken, the valve assembly should be replaced. See valve assembly parts details in the appendices for a complete list of part numbers and descriptions.

If a valve is leaking due to dirt or any other foreign material that keeps the valve plate and seat from sealing, the valve may be cleaned and reused. New gaskets and/or O-rings should be used to assure a good seal.

The valve holddown assemblies and valve assemblies on the following pages show the various specifications used on models 91, 291, 491, 691 and 891 compressors. Since more than one suction valve arrangement is available for each model of compressor, it is necessary to know your complete model number so you can identify the valve type specification number (see example listed below). In most cases for liquid transfer and/or vapor recovery compressors, the valve type will be spec. 3.

Model number 491AM <span style="border: 1px solid black; padding: 0 2px;">3</span> FBANSNN
Valve type = spec 3 ———┐

**Valve Holddown Assemblies:** Depending on your model of compressor, the valve holddown assembly has all or a combination of the following:

1. Valve cap
2. Valve cap O-ring
3. Holddown screw
4. Valve cover plate
5. Valve cover plate bolts
6. Valve cover plate O-ring
7. Valve spacer (model 491 only)
8. Valve cage
9. Valve assembly
10. Valve gasket

**Valve Assemblies:** Depending on your valve specification, the valve assembly has all or a combination of the following:

1. Gasket
2. Adjusting screw
3. Relief ball spring
4. Relief ball
5. Valve seat
6. Valve plate
7. Spacers
8. Washer
9. Valve spring
10. Suction valve post
11. Valve bumper
12. Valve gasket

See valve holddown and valve assembly part details in the appendix for a complete list of part numbers and descriptions.

### Valve Inspection and/or Replacement for Models 91 and 291 Compressors

Before removing and inspecting the valves, begin by depressurizing and purging (if necessary) the unit.

---

## Disassembly

1. Unscrew the valve cap and remove O-ring.
2. With the special wrench supplied with your compressor at time of purchase, remove the holddown screw.
3. After the holddown screw has been removed, the valve assembly and valve gasket can be lifted out.
4. Carefully inspect for dirt or broken/damaged parts.
5. Inspect valves for breakage, corrosion, debris and scratches on the valve disc or plate. In many cases, valves may simply be cleaned and reinstalled. If the valves show any damage, they should be repaired or replaced. Replacement is usually preferable although repair parts are available. If valve plates are replaced, seats should also be lapped until they are perfectly smooth. If more than .005 in. must be removed to achieve a smooth surface, the valve should be discarded. If plates are replaced without relapping the seat, rapid wear and leakage may occur.

## Assembly

1. Insert metal valve gasket into the suction and/or discharge opening of the head. The metal valve gasket should always be replaced when the valve is reinstalled.
2. Insert cleaned or new valve assembly. Make sure the suction and discharge valves are in the proper suction and discharge opening in the head. NOTE: The spec 3 suction valves for a model 91 and 291 compressor are pre-set so no adjustments to liquid relief pressure are necessary.
3. Replace the holddown screw and tighten to the value listed in Appendix C to ensure the valve gasket is properly seated. NOTE: Gaskets and O-rings are not normally reusable.
4. Replace the O-ring (or gasket) and valve cap and tighten to the value listed in Appendix C. O-rings sealing the valve caps should be replaced.
5. Check bolts and valve holddown screws after first week of operation. Re-torque if necessary. See Appendix C for torque values.

## Valve Inspection and/or Replacement for Models 491, 691 and 891 Compressors

Before removing and inspecting the valves, begin by depressurizing and purging (if necessary) the unit.

## Disassembly

1. Unscrew the valve cap/nut and remove the gasket from the coverplate.
2. Remove the valve cover plate, O-ring and holddown screw by removing each of the four bolts. NOTE: Since

the holddown screw has been secured with an impact wrench at the factory, you will probably need to wait to remove the holddown screw until after the cover plate has been removed. At this point in time, the holddown screw can be easily removed from the cover plate. The holddown screw on model 691 and 891 is most easily removed with the special wrench supplied with your compressor at time of purchasing.

3. After the cover plate and O-ring have been removed, the valve spacer (model 491 only), valve cage, valve assembly and valve gasket can be lifted out.
4. Inspect valves for breakage, corrosion, debris and scratches on the valve plate. In many cases, valves may simply be cleaned and reinstalled. If the valves show any damage, they should be repaired or replaced. Replacement is usually preferable although repair parts are available. If valve plates are replaced, seats should also be lapped until they are perfectly smooth. If more than .005 in. must be removed to achieve a smooth surface, the valve should be discarded. If plates are replaced without relapping the seat, rapid wear and leakage may occur.

## Assembly

1. Insert metal valve gasket into the suction and/or discharge opening of the head. The metal valve gasket should always be replaced when the valve is reinstalled.
  2. Insert cleaned or new valve assembly. Make sure the suction and discharge valves are in the proper suction and discharge opening in the head.
  3. Insert the valve cage and valve spacer (NOTE: spacer applies to model 491 compressor only).
  4. Replace the O-ring and valve cover plate. Torque bolts to the value listed in Appendix C. CAUTION: Be sure the holddown screw has been removed.
  5. Insert the holddown screw and tighten to the value listed in Appendix C to ensure the valve gasket is properly seated. NOTE: Gaskets and O-rings are not normally reusable.
  6. Replace the O-ring (or gasket) and valve cap/nut and tighten to the value listed in Appendix C. O-rings sealing the valve cap should be replaced if they show signs of wear or damage. Valve caps sealed by flat metals gaskets should be reinstalled with new gaskets.
  7. NOTE: Spec 3 suction valves have an adjusting screw to set the liquid relief pressure. To set the liquid relief pressure, tighten the adjusting screw until it bottoms, then back out 3/4 turn.
  8. Check bolts and valve holddown screws after first week of operation. Re-torque if necessary. See Appendix C for torque values.
-

## 5.2 Heads

A compressor head very seldom requires replacement if the compressor is properly maintained. The primary cause of damage to a head is corrosion and the entry of solid debris or liquid into the compression chamber. Improper storage can also result in corrosion damage to the head (for proper storage instructions see chapter 6).

Many compressor repair operations require removal of the head. While the compressor is disassembled, special care should be taken to avoid damage or corrosion to the head. If the compressor is to be left open for more than a few hours, bare metal surfaces should be coated with rust preventative.

When reassembling the compressor, make sure the bolts are retightened as shown in Appendix C.

## 5.3 Piston Rings and Piston Ring Expanders

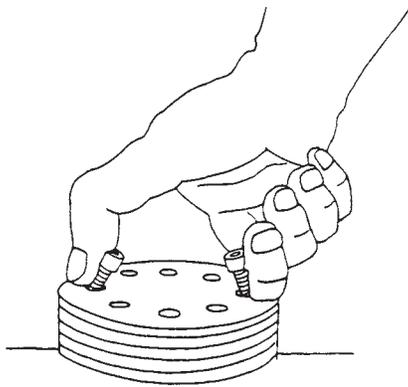


Figure 5.3A: Piston Removal

Piston ring life will vary considerably from application to application. Ring life will improve dramatically at lower speeds and temperatures.

1. To replace the piston rings, depressurize the compressor and purge if necessary.
2. Remove the head to gain access to the compressor cylinder.
3. Loosen the piston head bolts. Remove the piston as shown in figure 5.3A by pinching two loose bolts together.
4. Piston rings and expanders may then be easily removed and replaced. Corken recommends replacing expanders whenever rings are replaced. To determine if rings should be replaced, measure the radial thickness and compare it to the chart in Appendix C.

## 5.4 Pistons

1. To replace the pistons, depressurize the compressor and purge if necessary.
2. Remove the compressor cylinder and head (see section 5.2).
3. Remove the piston head by loosening and removing the socket head bolts holding the piston head to the piston platform (see figure 5.3A).
4. Next, remove the roll pin with a pair of needle nose pliers. The castellated nut may then be removed and the piston platform lifted off the end of the piston rod.
5. Check the thrust washer and shims for damage and replace if necessary.
6. Before installing the new piston, measure the thickness of the existing shims. For Models 91 through 491, the shims are placed between the thrust washer and piston platform. For model 691, the shims are placed between the platform and piston head (see figures 5.4A and 5.4B).
7. Reinstall the piston platform with the same thickness of shims as before, **BUT DO NOT REINSTALL THE ROLL PIN.**
8. Replace the cylinder and install the piston heads with new piston rings and expanders.
9. Now measure dimension "X" shown in the illustration. If this measurement does not fall within the tolerances shown in Appendix C, remove the piston, adjust the shims as necessary and remeasure the "X" dimension.
10. When the piston is properly shimmed, tighten the castellated nut as shown in Appendix C.
11. Now install a new roll pin to lock the castellated piston nut in place.

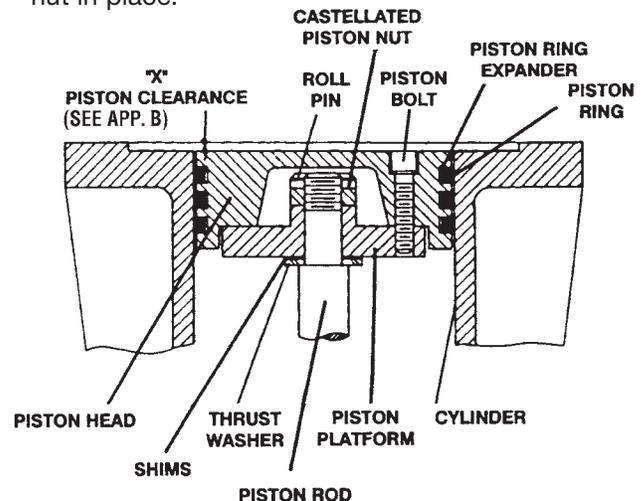


Figure 5.4A: Piston Cross Section  
Model Sizes 91 Through 491

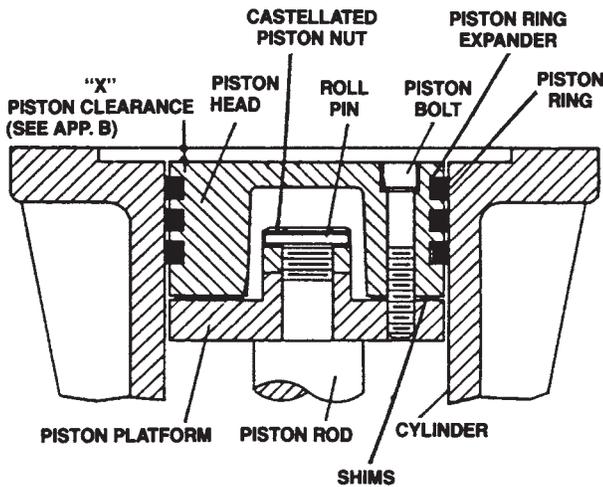


Figure 5.4B: Piston Cross Section  
Model 691

12. Install the piston head and tighten the socket head bolts in an alternating sequence.
13. Reinstall the head (see section 5.2) and follow standard startup procedure. (Note: Some compressors may have self-locking nuts without roll pins.)

## 5.5 Piston Rod Packing Adjustment

Piston rod packing should be adjusted or replaced whenever leakage becomes noticeable. Typically, it is a good idea to replace piston rod packing and piston rings at the same time. For instructions on adjusting and replacing the piston rod packing, see section 5.6.

NOTE: Inspection of the rod packing is generally not productive, since packing that cannot be adjusted to an acceptable leakage rate should be replaced.

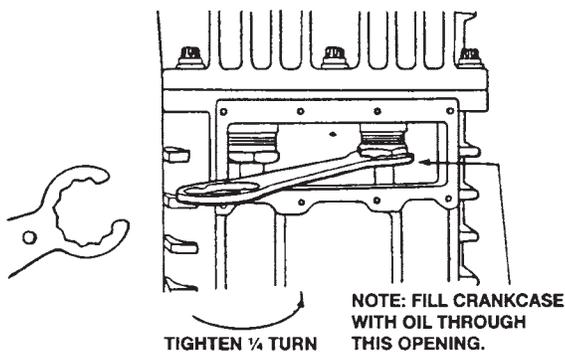


Figure 5.5A: Packing Adjusting Nuts

## 5.6 Cylinder and Packing Replacement

Cylinders very seldom require replacement if the compressor is properly maintained. The primary cause of damage to cylinders is corrosion and the entry of solid debris or liquid into the compression

chamber. Improper storage can also result in corrosion damage to cylinder (for proper storage instructions see chapter 6).

If the cylinder does become damaged or corroded, use a hone to smooth the cylinder bore and then polish it to the value shown in Appendix C. If more than .005 in. must be removed to smooth the bore, replace the cylinder. Cylinder liners and oversized rings are not available. OVERBORING THE CYLINDER WILL RESULT IN GREATLY REDUCED RING LIFE.

Many compressor repair operations require removal of the cylinder. While the compressor is disassembled, special care should be taken to avoid damage or corrosion to the cylinder. If the compressor is to be left open for more than a few hours, bare metal surfaces should be coated with rust preventative.

When reassembling the compressor, make sure the bolts are retightened as shown in Appendix C.

### Packing Replacement Instructions

Caution: Bleed all pressure from the compressor and piping, and purge (if necessary), before starting to install new piston rod packing. After repair, the unit should be pressure tested and checked for leaks at all joints and gasket surfaces. When the compressor is being used with toxic, dangerous, flammable or explosive gases, this pressure and leak testing should be done with air or a dry, inert gas such as nitrogen.

For simplicity, heads, pistons, and inspection plates are not shown. For specific construction details and actual part numbers, consult the appendix in the back of this IOM manual. Use instructions below that apply to the MODEL and SERIAL NUMBER of your compressor. Be careful to arrange packing sets in the proper order.

### Cleanliness:

Sealing a reciprocating piston rod is a very difficult task. Keep all parts, tools and your hands clean during installation. Your new packing needs every chance it can get, so keep it clean.

### Workmanship:

Your Corken compressor is a precision piece of equipment with very close tolerances. Treat it as such. Never beat on it to get parts in or out.

### Model 91 Compressor

(Refer to Appendix G for packing assembly details)

### Disassembly of Packing

1. Depressurize and open the compressor.
2. Remove head, piston, cylinder, inspection plate and crosshead guide.

- 
3. Loosen adjusting screw and remove retainer ring, washers, packing spring and old packing from crosshead guide.

### **Assembly of Packing**

1. Clean, then lightly oil, packing area inside the crosshead guide.
2. Slightly thread in the adjusting screw into the crosshead guide.
3. Install packing rings including male and female packing rings one at a time as shown in Appendix G. Push in each one completely before adding the next ring. The quantity of packing rings required will vary due to tolerances; a good rule of thumb is to put in as many as are removed.
4. Insert thin packing box washer, packing spring and thicker washer into the top of the crosshead guide.
5. Tighten adjusting screw until plastic locking device engages the first thread in the crosshead guide.
6. Oil piston rod and install the packing installation cone (part number 4005) over the threaded end of the piston rod.
7. Carefully slip the crosshead guide over the piston rod; otherwise, you may damage the lips of the packing rings.
8. Remove packing installation cone.
9. Install the crosshead guide O-ring, cylinder, piston and head.

### **Model 291 Compressor (serial no. SS55685 and later)**

### **Model 491 Compressor (serial no. XC30633 and later)**

(Refer to Appendix H or I for packing assembly details)

### **Disassembly of Packing**

1. Depressurize and open the compressor.
2. Remove head, pistons and cylinder.
3. Remove cartridge holddown screw with special wrench supplied with the compressor and packing box cartridge.
4. Loosen adjusting screw and remove retainer ring, washers, packing spring and old packing from packing box cartridge.

### **Assembly of Packing**

1. Clean, and then lightly oil, packing area inside packing box cartridge.

2. Slightly thread in adjusting screw.
3. Install packing rings including male and female packing rings, one at a time, as shown in Appendix H or I. Push in each one completely before adding the next ring. The quantity of packing rings required will vary due to tolerances; a good rule of thumb is to put in as many as are removed.
4. Insert thin packing box washer, packing spring and thicker washer.
5. Push down on washer and insert retainer ring.
6. Tighten adjusting screw until plastic locking device engages the first thread in the packing box cartridge.
7. Oil piston rod and replace cartridge O-ring.
8. Install packing installation cone part number 4005 over the threaded end of the piston rod.
9. Carefully slip the packing cartridge over the piston rod; otherwise, you may damage the lips of the packing rings.
10. Remove packing installation cone.
11. Install and tighten cartridge holddown screw with special wrench.
12. Install cylinder O-ring, cylinder, pistons and head.

### **Model 691 Compressor**

(Refer to Appendix J for packing assembly details)

### **Disassembly of Packing**

1. Depressurize and open the compressor.
2. Remove head, pistons and cylinder.
3. Remove cartridge holddown screw with special wrench supplied with the compressor and packing box cartridge.
4. Loosen adjusting screw and remove retainer ring, washers, packing spring and old packing from packing box cartridge.

### **Assembly of Packing**

1. Clean then lightly oil packing area inside packing box cartridge.
2. Thread in adjusting screw until locking device is engaged into first thread of the packing cartridge.
3. Install packing rings, including male and female packing rings, one at a time, as shown in Appendix J. Push in each one completely before adding the next ring.

4. Insert a packing washer, packing spring and another packing washer.
5. Push down on washer and insert retainer ring.
6. Oil piston rod and replace cartridge O-ring.
7. Install packing installation cone part number 3905 over the threaded end of the piston rod.
8. Carefully slip the packing cartridge over the piston rod; otherwise, you may damage the lips of the packing rings.
9. Install and tighten cartridge holddown screw with special wrench.
10. Replace cylinder O-ring, cylinder, pistons and head.

### Model D891 Compressor

(Refer to Appendix K for packing assembly details)

#### Disassembly of Packing

1. Depressurize and open the compressor.
2. Remove the cylinder cap, heads, pistons and cylinder.
3. To remove the packing barrels, pry upward under each one and lift entire barrel/cartridge assembly up from piston rod.
4. Remove the four socket head screws that hold the packing cartridge to the barrel.

#### Assembly of Packing

1. Replace packing as required. The segmented packing and cups are in the barrel. The V-ring packing is in the cartridge. Note the arrangement of the particular packing set for the model machine you have.
2. Reattach the cartridges to the barrels using the four socket head screws.
3. Install cartridge barrel assemblies, noting the alignment of the barrels as they sit on the crosshead guide. The valve scallops on the barrels must align properly with the valves of the cylinder.
4. Replace cylinder, pistons, heads and cap. See piston assembly details for proper clearance values.
5. Rotate unit by hand to ensure proper assembly.

## 5.7 Bearing Replacement for Crankcase and Connecting Rod

1. To replace the crankcase roller bearings, wrist pin bushing and connecting rod bearings, begin by

removing the head, cylinder, piston, crosshead guide and crosshead assembly.

2. Drain the crankcase and remove the inspection plate(s).
3. Before disassembly, choose and mark one connecting rod and the corresponding connecting rod cap. DO NOT MIX CONNECTING RODS AND CAPS. Loosen and remove the connecting rod bolts in order to remove the crosshead and connecting rod assembly.

### 5.7.1 Wrist Pin Bushing Replacement

1. To replace the wrist pin bushing, remove the retainer rings that position the wrist pin in the crosshead.
2. Press out the wrist pin so the crosshead and connecting rod may be separated. Inspect the wrist pin for wear and damage and replace if necessary.
3. Press out the old wrist pin bushing and press a new bushing into the connecting rod. DO NOT MACHINE THE O.D. OR I.D. OF THE BUSHING BEFORE PRESSING INTO CONNECTING ROD.
4. Make sure the lubrication hole in the bushing matches the oil passage in the connecting rod. If the holes do not align, drill out the bushing through the connecting rod lubricant passage with a long drill. Bore the wrist pin bushing I.D. as indicated on the respective connecting rod assembly details. These pages are located in the appendices. Over boring the bushing can lead to premature failure of the wrist pin bushing.
5. Inspect the oil passage for debris and clean thoroughly before proceeding.
6. Press the wrist pin back into the crosshead and wrist pin and reinstall retainer rings. NOTE: The fit between the wrist pin and bushing is tighter than ordinary lubricated air compressors and combustion engines.

### 5.7.2 Replacing Connecting Rod Bearings

Connecting rod bearings are easily replaced by removing the semicircular bearings. Make sure the indentations in the connecting rod bearing and connecting rod line up when installing the new bearings. MAKE SURE THE ARROW AND/OR ALIGNMENT NOTCH ON CONNECTING ROD AND CAP ARE ALIGNED.

Before reinstalling the crosshead/connecting rod assembly, make sure the crankshaft throw and bearing surface are clean and lubricated. Tighten the connecting rod bolts to the torques listed in Appendix C.

### 5.7.3 Replacing Crankcase Roller Bearings

To inspect the roller bearings, remove the flywheel from the crankshaft and then remove the bearing carrier and crankshaft from the crankcase. If corrosion or pitting is

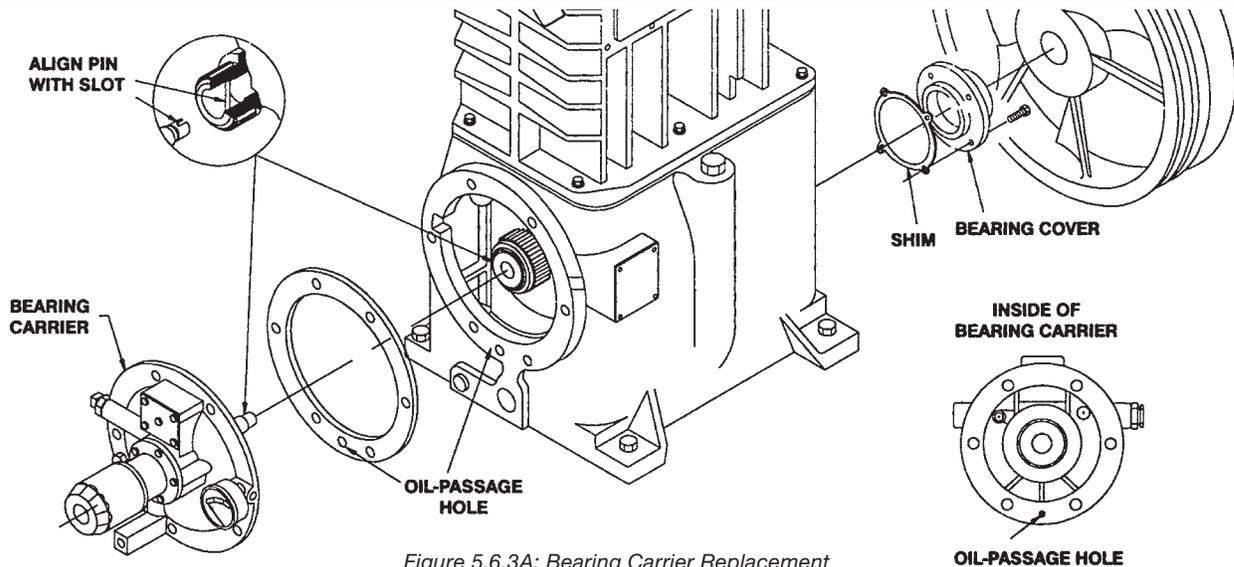


Figure 5.6.3A: Bearing Carrier Replacement

present, the roller bearings should be replaced. When replacing roller bearings, always replace the entire bearing, not just the cup or the cone.

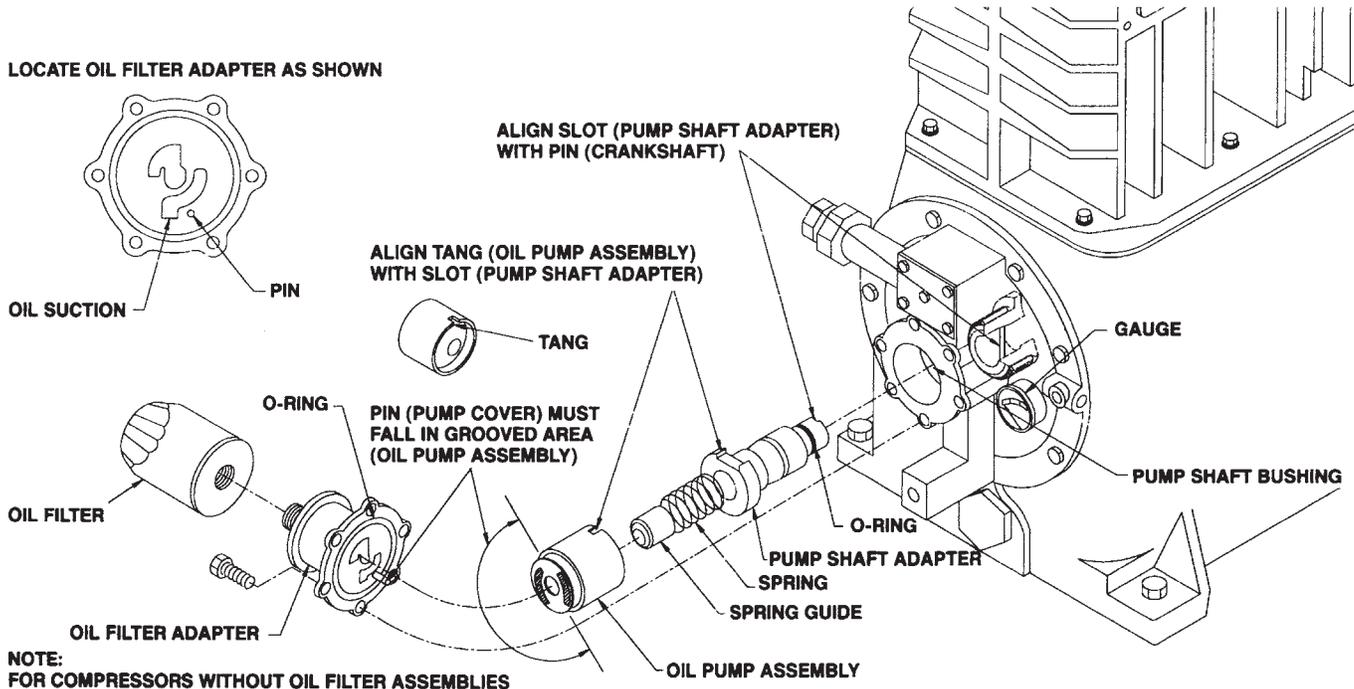
1. To replace the bearings, press the cups out of the crankcase and bearing carrier and press the cones off the crankshaft.
2. Press the new bearings into position and reassemble the crankshaft and bearing carrier to the crankcase. When reinstalling the bearing carrier, make sure the oil pump shaft slot is aligned with the pin in the crankshaft. Make sure to install the bearing carrier gasket so the oil passage hole is not blocked (see figure 5.6.3A).
3. In order to check the crankshaft endplay, the oil pump must first be removed (see section 5.8).
4. Press the end of crankshaft towards the crankcase; if a clicking noise or motion is detected, the crankshaft has too much endplay. See Appendix C.
5. To reduce endplay, remove the bearing cover and remove a thin shim. Recheck the endplay after replacing the bearing cover.
6. When there is no detectable endplay, the shaft must still be able to rotate freely. If the crankshaft sticks or becomes abnormally warm, then the crankshaft bearings are too tight. If the crankshaft is too tight, add more shims, but make sure not to over shim. (Appendix C lists the proper crankshaft endplay). When the crankshaft can be rotated freely by hand with proper endplay, the rest of the compressor may be reassembled. If the crankshaft roller bearings are too tight or too loose, premature bearing failure will result.
7. Reinstall the flywheel on the crankshaft and check the run out as shown in Appendix C.

## 5.8 Oil Pump Inspection

If the compressor operates for a prolonged period with dirty or contaminated crankcase oil, damage to the oil pump may result.

1. To check the oil pump, unbolt the pump cover and remove the oil pump, spring guide, spring and oil pump shaft adapter as shown in figure 5.8A.
2. Inspect the gears in the oil pump for corrosion or pitting and replace if necessary.
3. Check the oil pump shaft bushing in the bearing carrier. If the bushing is corroded, pitted or worn, the oil pump shaft bushing should be replaced.
4. Before reassembling the oil pump mechanism, replace the O-rings in the oil pump cover and on the oil pump adapter shaft (see figure 5.8A).
5. Rotate the drive pin in the crankshaft to a vertical position for easiest reassembly.
6. Insert the shaft adapter so it engages the drive pin.
7. Next, insert the spring, spring guide and oil pump assembly. The tang on the oil pump must align with the slot in the shaft adapter.
8. Install the pump cover so the pin on the case is in the opening on the oil pump assembly as shown in figure 5.8A. When you are sure the pin is properly aligned, install the cover bolts finger tight.
9. Rotate the crankshaft by hand to ensure smooth operation. Then rotate it in opposite directions, listening for a click, which indicates proper alignment of the oil pump's pins and slots.
10. Finally, tighten the bolts in an alternating sequence. See section 3.3 for directions on oil pressure adjustment.

LOCATE OIL FILTER ADAPTER AS SHOWN



**NOTE:**  
FOR COMPRESSORS WITHOUT OIL FILTER ASSEMBLIES  
USE OPTIONAL PUMP COVER. ASSEMBLY  
INSTRUCTIONS ARE THE SAME AS ABOVE.

Figure 5.8A

## 5.9 Servicing the Four-Way Valve

Unlike older units, new Corken compressors mounted in the -107 arrangement are being supplied with a non-lube four-way valve. No maintenance is normally required on this valve. If you have reason to disassemble the valve, please follow the instructions below (see figures 5.9A and 5.9B).

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

### Before Disassembly:

1. Record the position marks on the end of the rotor shaft.
2. Record the positions of the handle stops on the cap.

**NOTE:** A small amount of silicone grease applied to each part before assembly facilitates assembly if allowed.

### Disassembly

Refer to the drawing for item description.

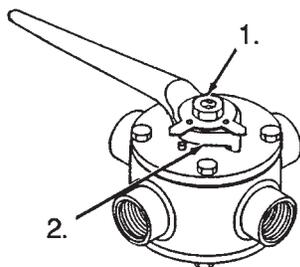


Figure 5.9A

1. Remove the hex nut, indicator plate and handle from the rotor shaft.
2. Remove the four hex head bolts and the cap from the body. The cap should be rotated until free; do not pry. Inspect cap for wear and damage (see figure 5.9C).

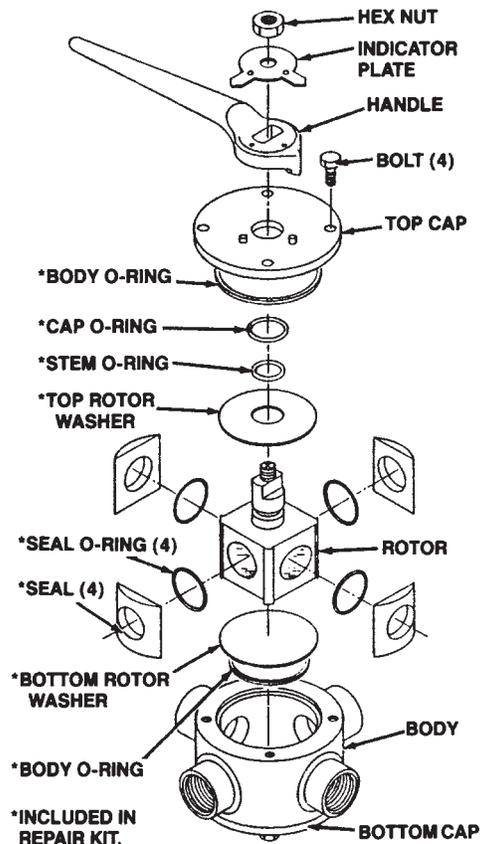


Figure 5.9B

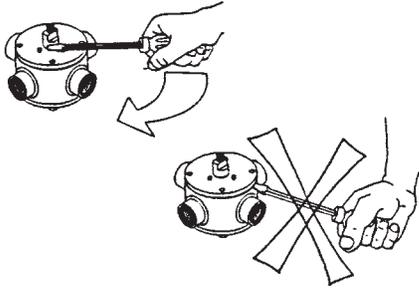


Figure 5.9C

3. Remove the body O-ring, stem O-ring, cap O-ring, and top rotor washer and discard.
4. Remove the rotor and four seals as a unit from the body. **IMPORTANT:** Because of the close tolerance, care must be taken to remove the rotor on its axis to prevent damage to the rotor and body. Rotating the handle with a lifting action will help remove the rotor as shown in figure 5.9D.

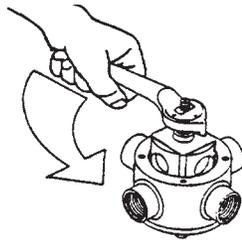


Figure 5.9D

5. Discard the four seals. Inspect the rotor for wear and damage.
6. Remove the bottom rotor washer and discard. Inspect the body for wear and damage.

### Assembly

Refer to figure 5.9B. Have the repair kit laid out.

1. Place the new bottom rotor washer into the body.
2. Assemble the four seals and O-rings onto the appropriate surfaces of the rotor.
3. Assemble the rotor and seal assembly into the body. **IMPORTANT:** Because of the close tolerance, care must be taken to press the rotor on its axis to prevent damage to the rotor and body. A ring compressor is helpful. Be sure that the rotor is bottomed in the body.
4. Rotate the rotor so that the position marks on the end of the rotor shaft are the same as recorded before disassembly.
5. Assemble the new top rotor washer and cap O-ring, onto the shoulder of the rotor.

6. Assemble the new stem O-ring and the body O-ring into their grooves in the rotor and body.
7. Place the cap over the rotor shaft.
8. Rotate the rotor so the position of the handle stops on the cap is the same as recorded before disassembly.
9. Assemble the four hex head bolts through the cap and into the body. Be sure that the body O-ring is in the proper position and tighten the hex head bolts.
10. Reassemble the handle, indicator plate and hex nut. Be sure that the handle is assembled so that the stop on the handle mates with the stops on the cap.

## Chapter 6 Extended Storage Procedures

Following a few simple procedures will greatly minimize the risk of the unit becoming corroded and damaged. Corken recommends the following precautions to protect the compressor during storage:

1. Drain the crankcase oil and refill with rust inhibiting oil.
2. Operate for a few minutes while fogging oil into the compressor suction.
3. Relieve V-belt tension.
4. Plug all openings to prevent entry of insects and moisture. (The cylinders may also be protected by the use of a vapor phase inhibitor, silica gel, or dry nitrogen gas. If the silica gel is used, hang a tag on the unit indicating that it must be removed before start-up.)
5. Store in a dry area, off the ground if possible.
6. Rotate the flywheel every two weeks if possible.

# Appendix A—Repair Kits and Gasket Sets

## Compressor Repair Kits

Part Number	3549-X1	3550-X1	3551-X1	3552-X1	3552-X2	5578-X2A
Model Number	90J3, 91J3	290K3, 291M3	490K3, 491M3	690K3, 690P3	690M3, 691M3	891M3
Suction valve assembly	3483-1X	3483-1X (2) <sup>2</sup>	2532-1X	3948-X (2) <sup>2</sup>	3948-X (2) <sup>2</sup>	3732-X
Discharge valve assembly	3485-X	3485-X (2) <sup>2</sup>	2439-X (2) <sup>2</sup>	3857-X (2) <sup>2</sup>	3857-X (2) <sup>2</sup>	3733-X
Valve cage	—	—	2448 (4) <sup>2</sup>	2797 (4) <sup>2</sup>	2797 (4) <sup>2</sup>	—
Connecting rod bearing (pair)	1367	1367 (2) <sup>2</sup>	1491 (2) <sup>2</sup>	1719 (2) <sup>2</sup>	3542 (2) <sup>2</sup>	3542 (2) <sup>2</sup>
Packing set	1452-1X1	1452-1X1 (2) <sup>2</sup>	1452-1X1 (2) <sup>2</sup>	1725-2X (2) <sup>2</sup>	1725-2X (2) <sup>2</sup>	1725-2X, 3810-X1
Piston rings	1772 (3) <sup>2</sup>	1772 (6) <sup>2</sup>	1773 (6) <sup>2</sup>	1739 (6) <sup>2</sup>	1739 (6) <sup>2</sup>	1739 (8) <sup>2</sup>
Ring expanders	1775 (3) <sup>2</sup>	1775 (6) <sup>2</sup>	1776 (6) <sup>2</sup>	1740 (6) <sup>2</sup>	1740 (6) <sup>2</sup>	1740 (8) <sup>2</sup>
Gasket set <sup>1</sup>	2526-XA <sup>1</sup>	1281-XA <sup>1</sup>	1481-X6A <sup>1</sup>	1744-X1A <sup>1</sup>	1744-X1A <sup>1</sup>	3970-X1A
O-ring <sup>1</sup>	—	—	—	—	2-261A (2) <sup>1, 2</sup>	—
O-ring <sup>1</sup>	—	—	2-242A (2) <sup>1, 2</sup>	—	—	—
O-ring <sup>1</sup>	—	—	2-253A (2) <sup>1, 2</sup>	—	—	—
Oil seal	3259	1278	1507 (490 only)	—	3526	3526
Oil seal	—	—	4438 (491 only)	—	—	—
Adapter plate gasket	—	—	1486	—	—	—

<sup>1</sup> All repair kits are furnished with Buna-N O-rings which are suitable for LPG and NH<sub>3</sub> applications

<sup>2</sup> Quantities larger than 1 are shown in parenthesis

## Four-Way Valve Repair Kits

Description	Trim	Part Number	Connection Sizes
Four-Way Valve Repair Kits	PTFE and Buna-N trim	3122-X	1"
		3123-X	1¼"
		3130-X	2"

## Gasket Sets

### Model 91 Gasket Set (2526-XA)

Part Number	Description	Quantity
2-235A	O-ring, Buna-N	2
2526	Crankcase gasket	1
2717	Valve gasket, aluminum	2
2729	Crankcase inspection plate gas	1
2-031A	O-ring, Buna-N	2
2244	Inspection plate gasket	1
2716	Valve cap gasket, aluminum	2
2725	Bearing carrier gasket	1

### Model 291 Gasket Set (1281-XA)

Part Number	Description	Quantity
1281	Filter screen screw gasket	1
1651	Inspection plate gasket	1
2-113A	O-ring, Buna-N	2
2-228A	O-ring, Buna-N	1
2702	Crankcase gasket	1
2716	Valve cap gasket, aluminum	4
2732	Center headbolt gasket - steel	2
1190	Adapter plate gasket	2
1285	Bearing carrier gasket	1
2-031A	O-ring, Buna-N	4
2-135A	O-ring, Buna-N	2
2-235A	O-ring, Buna-N	4
2713	Crankcase inspection plate gas	1
2717	Valve gasket, aluminum	4

## Appendix A—Repair Kits and Gasket Sets (continued)

### Model 491 Gasket Set (1481-X6A)

Part Number	Description	Quantity
1418	Valve gasket, aluminum	4
1480	Center headbolt gasket - steel	2
1488	Inspection plate gasket	1
1511	Crankcase inspection plate gas	1
2-139A	O-ring, Buna-N	2
2-228A	O-ring, Buna-N	1
1281	Filter screen screw gasket	1
1478	Valve cap gasket, steel	4
1481	Head gasket	1
1489	Crankcase gasket	1
1513	Bearing carrier gasket	1
2-143A	O-ring, Buna-N	4
2-243A	O-ring, Buna-N	2

### Model 891 Gasket Set (3970-X1A)

Part Number	Description	Quantity
1281	Filter screen screw gasket	1
1761	Crankcase gasket	1
2-036A	O-ring, Buna-N	8
2-231A	O-ring, Buna-N	4
2-238A	O-ring, Buna-N	2
2114	Valve gasket, aluminum	8
2131	Bearing carrier gasket	1
4127	Lubricator gasket	1
1760	Inspection plate gasket	1
2-031A	O-ring, Buna-N	8
2-228A	O-ring, Buna-N	1
2-235A	O-ring, Buna-N	8
2-246A	O-ring, Buna-N	4
2123	Crankcase inspection plate gas	1
3874	Access cover gasket	2
3906	Gasket spiral wound	2

### Model 691 Gasket Set (1744-X3A)

Part Number	Description	Quantity
1760	Inspection plate gasket	1
2-031A	O-ring, Buna-N	4
2-231A	O-ring, Buna-N	2
2-235A	O-ring, Buna-N	4
2-261A	O-ring, Buna-N	2
2123	Crankcase inspection plate gas	2
2131	Bearing carrier gasket	1
2716	Valve cap gasket, aluminum	4
4127	Lubricator gasket	1
1281	Filter screen screw gasket	1
1761	Crankcase gasket	1
2-228A	O-ring, Buna-N	1
2-233A	O-ring, Buna-N	2
2-247A	O-ring, Buna-N	2
2114	Valve gasket, aluminum	4
2129	Oil inlet gasket	1
2177	Flange gasket	2
3874	Access cover gasket	2

# Appendix B

## Vertical Single-Acting Model Number Identification Code

Base Model	91	291	491	691
Inlet	3/4" NPT	3/4" NPT	1-1/4" NPT	2" NPT
Outlet	3/4" NPT	3/4" NPT	1-1/4" NPT	1-1/2" NPT
Base Model	F91	F291	F491	F691
Inlet	3/4" ANSI	3/4" ANSI	1-1/4" ANSI	2" ANSI
Outlet	3/4" ANSI	3/4" ANSI	1-1/4" ANSI	2" ANSI

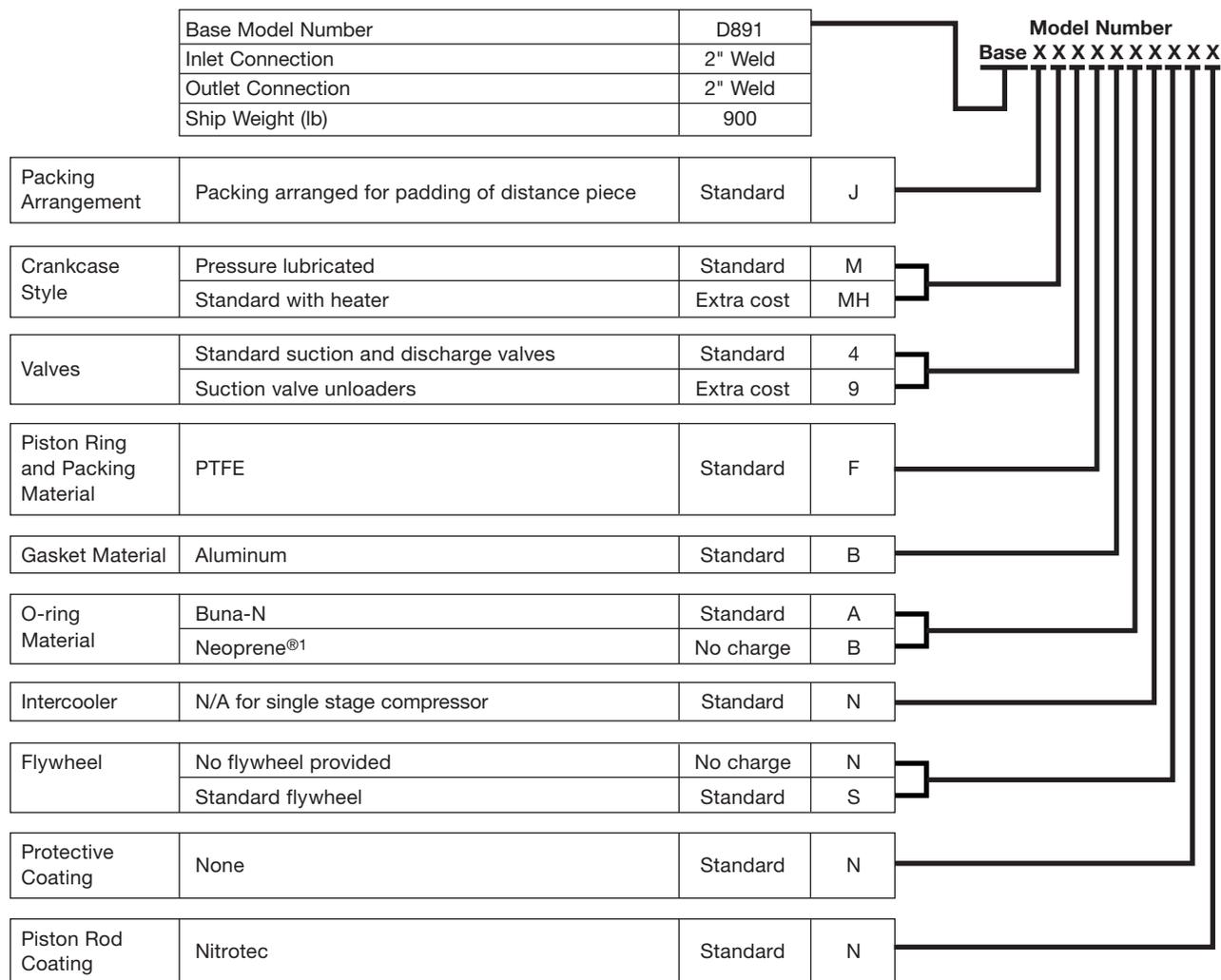
Model Number  
Base X X X X X X X X X

Packing Arrangement	Pressurized inlet	Standard				A
Crankcase Style	Splash lubricated	Standard	N/A	N/A	N/A	J
	Extended crankshaft	Extra cost	Extra cost	Extra cost	N/A	E
	Pressure lubricated	N/A	Standard	Standard	Standard	M
	Standard with heater	N/A	Extra cost	Extra cost	Extra cost	MH
Valves	Liquid relief suction	Standard				3
	Standard valves	No extra cost				4
Piston Rings and Packing	PTFE	Standard				F
	Alloy 50	Extra Cost				G
Gasket Material	Aluminum	Standard				B
	Copper	No extra cost				C
	Lead-iron	No extra cost				D
O-ring Material	Buna-N	Standard				A
	Neoprene <sup>®1</sup>	No extra cost				B
	Viton <sup>®1</sup>	Extra cost				D
	PTFE	Extra cost				E
Intercooler	None	N/A for single stage compressor				N
Flywheel	14" flywheel used with extended crankshaft	No charge			N/A	E
	Heavy duty	Extra cost	Extra cost	Extra cost	Extra cost	H
	No flywheel	No extra cost				N
	Standard flywheel	Standard				S
Protective Coating	No coating	Standard				N
Piston Rod Coating	Nitrotec	Standard				N
	Chrome oxide	Extra cost				C

<sup>1</sup> Registered trademark of the DuPont company.  
See Appendix D for mounting options.

# Appendix B

## Vertical Double-Acting Model Number Identification Code



<sup>1</sup> Registered trademark of the DuPont company.

### Mounting Selections

<b>103 Mounting</b> includes: Steel baseplate, adjustable driver slide base, V-belt drive and enclosed steel belt guard. Pressure gauges are mounted on the compressor. <sup>3</sup>
<b>107 Mounting</b> includes: Steel baseplate, mechanical liquid trap, non-lube 4-way valve, interconnecting piping, strainer, adjustable driver slide base, V-belt drive and enclosed steel belt guard. Pressure gauges are mounted on the compressor.
<b>107A Mounting</b> includes: All items on the 107 replacing the mechanical float in the liquid trap with a NEMA 7 liquid level switch.
<b>107B Mounting</b> includes: All items on the 107 replacing the liquid trap with a larger ASME code liquid trap with 2 NEMA 7 liquid level switches set for alarm and shutdown.
<b>107TR Mounting</b> includes: All items on the 107 set up to be used as a transport unit. Note that the compressor must have the optional 14" flywheel and extended crankshaft to use this mounting. <sup>2</sup>
<b>109 Mounting</b> includes: Steel baseplate, mechanical liquid trap, interconnecting piping, adjustable driver slide base, V-belt drive and enclosed steel belt guard. Pressure gauges are mounted on the compressor. <sup>3</sup>
<b>109A Mounting</b> includes: All items on the 109 replacing the mechanical float in the liquid trap with a NEMA7 liquid level switch. <sup>3</sup>
<b>109B Mounting</b> includes: All items on the 109 replacing the liquid trap with a larger ASME code liquid trap with 2 NEMA 7 liquid level switches set for alarm and shutdown. <sup>3</sup>
<b>109TR Mounting</b> includes: All items on the 109 set up to be used as a transport unit. Note the compressor must have the optional 14" flywheel and extended crankshaft to use this mounting. <sup>2,3</sup>

<sup>2</sup> Not suitable for 691 or D891.

<sup>3</sup> Discharge relief valves are required but not included in these mountings.

# Appendix C—Vertical Single-Acting Specifications

## Models 91–691

### Equipment Type & Options

Single-acting, vertical, reciprocating piston type vapor compressor  
 Single packed rod  
 NPT or 300# ANSI connections

### Applications

Bulk transfer  
 Vapor recovery  
 Tank evacuation  
 Gas scavenging

### Features and Benefits

Self-lubricating piston rings:	Non-lubricated operation to minimize oil in gas
NPT or 300# ANSI connections:	Versatility for your application
Multiple mounting configurations:	Versatility for your application
High efficiency valves:	Quiet, reliable operation
Reversible oil pump:	Allows operation in either direction
Simplified top down design:	Routine maintenance is minimally invasive

### Specifications

Specification	Model Number			
	91	291	491	691
Bore of cylinder inches (mm)	3.0 (76.2)	3.0 (76.2)	4.0 (101.6)	4.5 (114.3)
Stroke inches (mm)	2.5 (63.5)	2.5 (63.5)	3.0 (76.2)	4.0 (101.6)
Piston displacement cfm (m <sup>3</sup> /hr)				
minimum @ 400 RPM	4.0 (6.8)	8.0 (13.6) 16.5	17.2 (29.2) 35.5	29.2 (49.6)
maximum @ 825 RPM	8.3 (14.1)	(28.0)	(60.3)	60.2 (102.3)
Maximum working pressure psig (bar g) <sup>1</sup>	335 (23.1)			
Maximum brake horsepower (kW)	7.5 (5.6)	15 (11)	15 (11)	35 (26.1)
Maximum rod load lb (kg)	3,600 (1,632.9)	3,600 (1,632.9)	4,000 (1,814.4)	7,000 (3,175.1)
Maximum outlet temperature °F (°C)	350 (177)			
Bare unit weight lb (kg)	115 (52.2)	160 (72.6)	260 (117.9)	625 (283.5)
Maximum flow—propane gpm (m <sup>3</sup> /hr)	50 (11.4)	101 (22.9)	215 (48.8)	361 (82.0)

<sup>1</sup> These numbers specify pressure-containing abilities of the compressor cylinder and head. For many applications, factors other than the pressure rating will limit the maximum allowable discharge pressure to lower values. These factors include horsepower, temperature and rod load.

## Appendix C—Vertical Single-Acting Specifications

### Models 91–691 Material Specifications

Part	Model	Standard Material	Optional Material
Head, Cylinder	All	Ductile iron ASTM A536	None
Crosshead guide crankcase, flywheel, bearing carrier	All	Gray iron ASTM A48, Class 30	None
Flange	691	Ductile iron ASTM A536	Steel weld flange
Valve seat & bumper	91, 291	17-4 PH stainless steel	
	491	Ductile iron ASTM A536	None
	691	17-4 PH stainless steel	
Valve plate	91, 291	410 stainless steel	
	491	17-7 PH stainless steel	None
	691	410 stainless steel	
Valve spring	91, 291, 691	17-7 PH stainless steel	None
	491	Inconel	
Valve gaskets	All	Soft aluminum	Iron-lead, Copper
Piston	All	Gray iron ASTM A48, Class 30	None
Piston rod	All	C1050 steel Nitrotec coated	Chrome oxide
Crosshead	All	Gray iron ASTM 48, Class 30	None
Piston rings	All	PTFE, glass and moly filled	Alloy 50
Ring expanders	All	302 stainless steel	None
Head gasket	All	O-ring, Buna-N	PTFE, Viton <sup>®1</sup> , Neoprene <sup>®1</sup>
Packing cartridge, connecting rod	All	Ductile iron ASTM A536	None
Packing rings	All	PTFE, glass and moly filled	Alloy 50
Crankshaft	All	Ductile iron ASTM A536	None
Con. rod bearing	All	Bimetal D-2 babbitt	None
Wrist pin	All	C1018 steel	None
Wrist pin busing	All	Bronze SAE 660	None
Main bearing	All	Tapered roller	None
Inspection plate	All	Aluminum	None
O-rings	All	Buna-N	PTFE, Viton <sup>®1</sup> , Neoprene <sup>®1</sup>
Retainer rings	All	Steel	None
Misc. gaskets	All	Coroprene	None

<sup>1</sup> Registered trademark of the DuPont company.

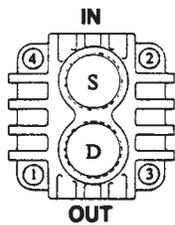
# Appendix C—Vertical Single-Acting Specifications

## Bolt Torque Values

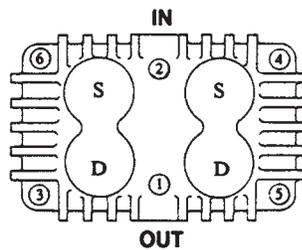
Model	Conn. Rod Bolt ft•lb	Bearing Carrier ft•lb	Bearing Cover ft•lb	Crank-case Inspec Plate ft•lb	X-Head Guide ft•lb	Cyl. to Head (1.2) ft•lb	Valve Cover Plate Bolt ft•lb	Valve Hold-down Screw 2 ft•lb	Piston Lock Nut Torque ft•lb	Piston Screw Torque in•lb	Valve Cap Torque (w/ Gaskets) ft•lb	Valve Cap Torque (w/ O-rings) ft•lb
91	28	38	38	15	30	20	—	40	45	50	40	25
291	28	30	30	13	25	20	—	40	45	50	40	25
491	30	26	35	8	33	33	35	40	45	100	40	25
691	40	40	40	9	40	30	37	40	60	100	40	25

<sup>1</sup> Preliminary tightening – snug all head bolts in the sequence shown. Final torquing – torque all head bolts in the sequence shown to the listed value.

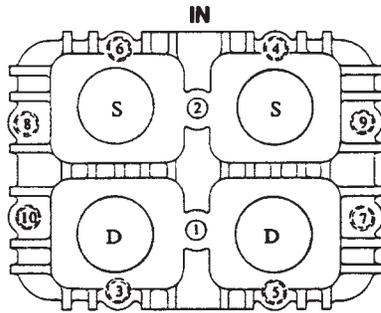
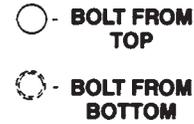
<sup>2</sup> Retorque to the listed value after 2 – 5 hours running time.



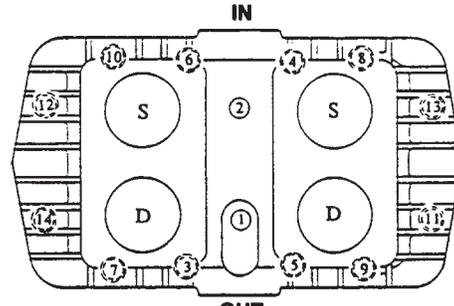
**MODEL 91**



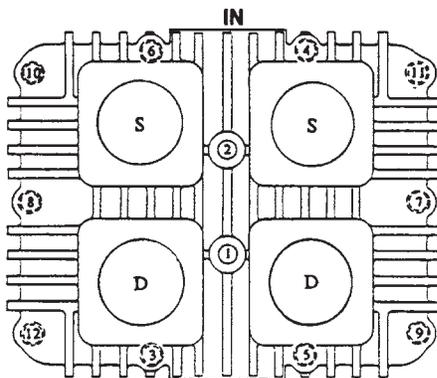
**MODELS 290 AND 291**



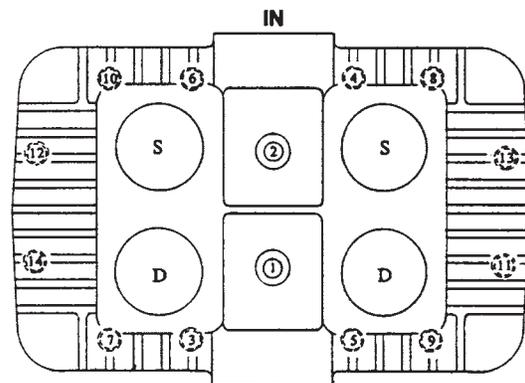
**MODEL 490**



**MODEL 491**



**MODEL 690**



**MODEL 691**

## Appendix C—Vertical Single-Acting Specifications

### Clearances and Dimensions

	91	291	491	691/D891 (M crankcase)
**Clearance: “X” piston figure 5.4A & 5.4B	0.020 0.044	0.020 0.044	0.000/0.020 0.024/0.044	0.000/0.015 0.012/0.027
Clearance: connecting rod bearing to crankshaft journal	0.0005 0.0025	0.0005 0.0025	0.0005 0.0025	0.0019 0.0035
Clearance: wrist pin to wrist pin bushing* (max)	0.0009	0.0009	0.0009	0.0020
Cylinder bore diameter (max)	3.009	3.009	4.011	4.515
Cylinder finish (RMS)	16-32	16-32	16-32	16-32
Piston ring radial thickness (min)	0.082	0.082	0.082	0.082
Clearance: oil pump adapter shaft to bushing* (max)	0.0050	0.0050	0.0050	0.0050
Crankshaft end play (cold)	0.000 0.002	0.000 0.002	0.000 0.002	0.002 0.003
Flywheel runout at O.D. (max)	0.020	0.020	0.020	0.020
Clearance: crosshead to crosshead guide bore (max)	0.011	0.011	0.012	0.013
Crosshead guide bore finish	32 RMS (limited number of small pits and scratches are acceptable)			

\* Dimensions for honing are included with new bushings (which must be installed, then honed).

\*\* Clearance should be set with machine cold.

# Appendix C—Vertical Double-Acting Specifications

## Model D891

### Equipment Type & Options

Double-acting, vertical, reciprocating piston type vapor compressor  
 Double packed rod  
 Slip-on weld connections

### Applications

Bulk transfer  
 Truck, tank, railcar, barge unloading  
 LTVR and scavenger applications  
 Emergency evacuation

### Features and Benefits

Self-lubricating piston rings:	Non-lubricated operation to minimize oil in gas
Multiple materials and configurations:	Versatility for your application
Multiple mounting configurations:	Versatility for your application
High efficiency valves:	Quiet, reliable operation
Reversible oil pump:	Allows operation in either direction
Simplified top down design:	Routine maintenance is minimally invasive

### Operating Specifications

Bore of cylinder inches (mm)	4.5 (113)
Stroke inches (mm)	4.0 (101.6)
Piston displacement cfm (m <sup>3</sup> /hr)	
minimum @ 400 RPM	56.6 (96.2)
maximum @ 825 RPM	113.2 (192.0)
Maximum working pressure psig (bar g)	465 (32.1)
Maximum brake horsepower (kW)	45 (34)
Maximum rod load lb (kg)	7,000 (3,175.2)
Maximum outlet temperature °F (°C)	350 (177)
Bare unit weight lb (kg)	855 (387.8)
Maximum flow—propane gpm (m <sup>3</sup> /hr)	694 (157.6)

## Appendix C—Vertical Double-Acting Specifications

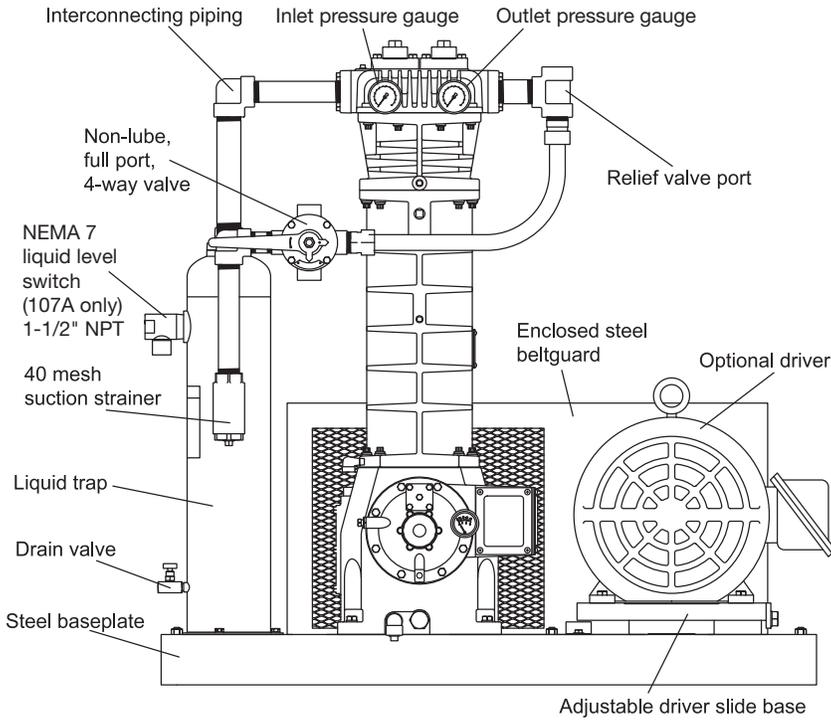
### Model D891 Material Specifications

Part	Standard Material	Optional Material
Head, cylinder	Ductile iron ASTM A536	
Distance piece	Gray iron ASTM A48, Class 30	
Crosshead guide		
Crankcase, flywheel		
Bearing carrier		
Flange	ASTM A36 carbon steel	
Valve seat, bumper	17-7 PH stainless steel	
Valve plate	410 stainless steel	
Valve spring	17-7 PH stainless steel	
Valve gaskets	Soft aluminum	Copper, iron-lead
Piston	Ductile iron ASTM A536	
Piston rod	C1050 steel, Nitrotec	
Crosshead	Gray iron ASTM A48, Class 30	
Piston rings	PTFE, glass and moly filled	Alloy 50
Piston ring expanders	302 stainless steel	
Head gasket	O-ring, Buna-N	PTFE, Viton <sup>®1</sup> , Neoprene <sup>®1</sup>
Adapter plate	Ductile iron ASTM A536	
Packing cartridge		
Connecting rod		
Packing rings	PTFE, glass and moly filled	Alloy 50
Crankshaft	Ductile iron ASTM A536	
Connecting rod bearing	Bimetal D-2 Babbitt	
Wrist pin	C1018 Steel	
Wrist pin bushing	Bronze SAE 660	
Main bearing	Tapered roller	
Inspection plate	Aluminum	
O-rings	Buna-N	PTFE, Viton <sup>®1</sup> , Neoprene <sup>®1</sup>
Retainer rings	Steel	
Miscellaneous gaskets	Coroprene	

<sup>1</sup> Registered trademark of the DuPont company.

# Appendix D—Compressor Selection

## Compressor Mounting Selections



### Standard 107 Items

- Steel baseplate
- V-Belt drive
- Adjustable driver slide base
- Enclosed steel belt guard
- Inlet and outlet pressure gauges
- 40 Micron strainer
- Non-lube 4-way valve
- Interconnecting piping
- Liquid trap as specified below

#### 107 Mounting

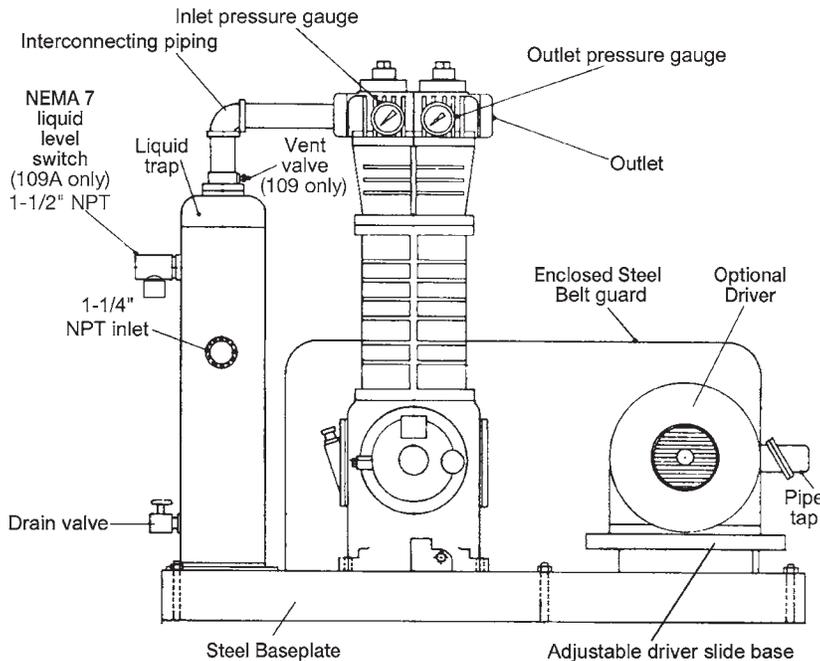
Mechanical liquid trap with ball float

#### 107A Mounting

Automatic liquid trap with one NEMA 7 liquid level switch

#### 107B Mounting

Automatic liquid trap (ASME code) with two NEMA 7 liquid level switches



### Standard 109 Items

- Steel baseplate
- V-Belt drive
- Adjustable driver slide base
- Enclosed steel belt guard
- Inlet and outlet pressure gauges
- Interconnecting piping
- Liquid trap as specified below

#### 109 Mounting

Mechanical liquid trap with ball float

#### 109A Mounting

Automatic liquid trap with one NEMA 7 liquid level switch

#### 109B Mounting

Automatic liquid trap (ASME code) with two NEMA 7 liquid level switches

# Appendix D—Compressor Selection

## Butane Compressor Selection Table

Service	Capacity gpm <sup>1</sup>	Displacement cfm	Compressor		Driver Sheave Size Pitch Diameter (inches) <sup>2</sup>		Driver Horsepower				Piping Size <sup>3</sup>	
							Liquid Transfer & Residual Vapor Recovery		Liquid Transfer Without Residual Vapor Recovery			
							100°F	80°F	100°F	80°F		
Model	RPM	1,750 RPM	1,450 RPM					Vapor	Liquid			
Small bulk plants	13	4	91	400	A 3.0	A 3.6	3	3	3	3	3/4	1-1/4
	17	5	91	505	A 3.8	B 4.6	3	3	3	3	3/4	1-1/4
	20	6	91	590	B 4.6	B 5.6	3	3	3	3	1	1-1/4
	24	7	91	695	B 5.4	B 6.6	5	5	5	5	1	1-1/2
	23	7	290, 291	345	A 3.0	A 3.6	2	2	2	2	1	1-1/2
Unloading single tank car or transport	27	8	91	795	B 6.2	B 7.4	5	5	5	5	1	1-1/2
	26	8	290, 291	390	A 3.4	B 4.0	2	2	2	2	1	1-1/2
	30	9	290, 291	435	A 3.8	B 4.6	3	3	3	3	1	1-1/2
	33	10	290, 291	490	B 4.4	B 5.2	3	3	3	3	1	2
	36	11	290, 291	535	B 4.8	B 5.8	3	3	3	3	1	2
	39	12	290, 291	580	B 5.2	B 6.2	5	3	5	3	1	2
	42	13	290, 291	625	B 5.6	B 6.6	5	5	5	5	1-1/4	2
	47	14	290, 291	695	B 6.2	B 7.4	5	5	5	5	1-1/4	2
	50	15	290, 291	735	B 6.6	B 8.0	5	5	5	5	1-1/4	2-1/2
	50	15	490, 491	345	A 3.0	A 3.6	5	5	5	5	1-1/4	2-1/2
53	16	290, 291	780	B 7.0	B 8.6	7-1/2	5	7-1/2	5	1-1/4	2-1/2	
53	16	490, 491	370	A 3.2	A 3.8	5	5	5	5	1-1/4	2-1/2	
Unloading two or more tank cars at one time or large transport with excess flow valves of adequate capacity	56	17	490, 491	390	A 3.4	B 4.0	5	5	5	5	1-1/4	3
	60	18	490, 491	415	A 3.6	B 4.4	5	5	5	5	1-1/4	3
	63	19	490, 491	435	A 3.8	B 4.6	5	5	5	5	1-1/4	3
	65	20	490, 491	445	B 4.0	B 4.8	5	5	5	5	1-1/4	3
	68	21	490, 491	470	B 4.2	B 5.0	5	5	5	5	1-1/4	3
	71	22	490, 491	490	B 4.4	B 5.2	7-1/2	5	7-1/2	5	1-1/4	3
	75	23	490, 491	515	B 4.6	B 5.6	7-1/2	5	7-1/2	5	1-1/4	3
	77	24	490, 491	535	B 4.8	B 5.8	7-1/2	7-1/2	7-1/2	7-1/2	1-1/4	3
	81	25	490, 491	560	B 5.0	B 6.0	7-1/2	7-1/2	7-1/2	7-1/2	1-1/4	3
	84	26	490, 491	580	B 5.2	B 6.2	7-1/2	7-1/2	7-1/2	7-1/2	1-1/4	3
	87	27	490, 491	605	B 5.4	B 6.4	7-1/2	7-1/2	7-1/2	7-1/2	1-1/4	3
	91	28	490, 491	625	B 5.6	B 6.6	7-1/2	7-1/2	7-1/2	7-1/2	1-1/2	3
	94	29	490, 491	650	B 5.8	B 7.0	10	7-1/2	10	7-1/2	1-1/2	3
	97	30	490, 491	670	B 6.0		10	7-1/2	10	7-1/2	1-1/2	3
	94	30	690, 691	400	B 4.4	B 5.2	7-1/2	7-1/2	7-1/2	7-1/2	1-1/2	3
100	31	490, 491	695	B 6.2	B 7.4	10	7-1/2	10	7-1/2	1-1/2	3	
98	31	690, 691	420	B 4.6	B 5.6	10	7-1/2	10	7-1/2	1-1/2	3	
107	32	490, 491	740	B 6.6	B 8.0	10	10	10	10	1-1/2	3	
Unloading large tank cars, multiple vessels, barges or terminals	103	32	690, 691	440	B 4.8	B 5.8	10	7-1/2	10	7-1/2	1-1/2	3
	110	33	490, 491	760	B 6.8	B 8.0	10	10	10	10	1-1/2	3
	113	34	490, 491	780	B 7.0	B 8.6	10	10	10	10	1-1/2	3
	107	34	690, 691	455	B 5.0	B 6.0	10	10	10	10	1-1/2	3
	111	35	690, 691	475	B 5.2	B 6.2	10	10	10	10	1-1/2	3
	119	36	490, 491	825	B 7.4	B 8.6	15	10	15	10	1-1/2	3
	116	36	690, 691	495	B 5.4	A 6.4	10	10	10	10	1-1/2	3
	120	38	690, 691	510	B 5.6	B 6.8	10	10	10	10	1-1/2	4
	124	39	690, 691	530	B 5.8	B 7.0	10	10	10	10	1-1/2	4
	129	41	690, 691	550	B 6.0	A 7.0	10	10	10	10	1-1/2	4
	133	42	690, 691	565	B 6.2	B 7.4	10	10	10	10	2	4
	137	43	690, 691	585	B 6.4	A 7.4	10	10	10	10	2	4
	142	45	690, 691	605	B 6.6	B 8.0	15	10	15	10	2	4
	145	46	690, 691	620	B 6.8		15	10	15	10	2	4
	150	47	690, 691	640	B 7.0	A 8.2	15	10	15	10	2	4
	158	48	690, 691	675	B 7.4	B 8.6	15	15	15	15	2	4
	171	54	690, 691	730	B 8.0	B 9.4	15	15	15	15	2	4
184	58	690, 691	785	B 8.6		15	15	15	15	2	4	
193	60	690, 691	820	TB 9.0	A 10.6	15	15	15	15	2	4	
260	82.1		D891	580	5V 7.1	5V 8.5	20	20	20	20	3	6
359	113.3		D891	800	5V 9.75	5V 11.8	25	25	25	25	3	6

<sup>1</sup> The capacities shown are based on 70°F, but will vary depending upon piping, fittings used, product being transferred and temperature. The factory can supply a detailed computer analysis if required.

<sup>2</sup> Driver sheaves: 91 (2 belts); 290, 291, 490, 491 (3 belts); 690, 691 (4 belts).

<sup>3</sup> The piping sizes shown are considered minimum. If the length exceeds 100 ft., use the next larger size.

NOTE: Please consult factory for compressors with higher flows.

# Appendix D—Compressor Selection

## Propane Compressor Selection Table

Service	Capacity gpm <sup>1</sup>	Displacement cfm	Compressor		Driver Sheave Size Pitch Diameter (inches) <sup>2</sup>		Driver Horsepower				Piping Size <sup>3</sup>	
							Liquid Transfer & Residual Vapor Recovery		Liquid Transfer Without Residual Vapor Recovery			
							100°F	80°F	100°F	80°F		
Small bulk plants	23	4	91	400	A 3.0	A 3.6	5	3	3	3	3/4	1-1/4
	29	5	91	505	A 3.8	B 4.6	5	5	5	5	3/4	1-1/4
	34	6	91	590	B 4.6	B 5.6	5	5	5	5	1	1-1/4
	40	7	91	695	B 5.4	B 6.6	5	5	5	5	1	1-1/2
	39	7	290, 291	345	A 3.0	A 3.6	3	3	3	3	1	1-1/2
Unloading single tank car or transport	45	8	91	795	B 6.2	B 7.4	7-1/2	7-1/2	7-1/2	7-1/2	1	1-1/2
	44	8	290, 291	390	A 3.4	B 4.0	5	3	3	3	1	1-1/2
	50	9	290, 291	435	A 3.8	B 4.6	5	5	3	3	1	1-1/2
	56	10	290, 291	490	B 4.4	B 5.2	5	5	5	5	1	2
	61	11	290, 291	535	B 4.8	B 5.8	5	5	5	5	1	2
	66	12	290, 291	580	B 5.2	B 6.2	7-1/2	5	5	5	1	2
	71	13	290, 291	625	B 5.6	B 6.6	7-1/2	5	7-1/2	5	1-1/4	2
	79	14	290, 291	695	B 6.2	B 7.4	7-1/2	7-1/2	7-1/2	7-1/2	1-1/4	2
	84	15	290, 291	735	B 6.6	B 8.0	10	7-1/2	10	7-1/2	1-1/4	2-1/2
	84	15	490, 491	345	A 3.0	A 3.6	7-1/2	7-1/2	5	5	1-1/4	2-1/2
89	16	290, 291	780	B 7.0	B 8.6	10	10	10	10	1-1/4	2-1/2	
89	16	490, 491	370	A 3.2	A 3.8	7-1/2	7-1/2	7-1/2	5	1-1/4	2-1/2	
Unloading two or more tank cars at one time or large transport with excess flow valves of adequate capacity	95	17	490, 491	390	A 3.4	B 4.0	7-1/2	7-1/2	7-1/2	7-1/2	1-1/4	3
	101	18	490, 491	415	A 3.6	B 4.4	10	7-1/2	7-1/2	7-1/2	1-1/4	3
	106	19	490, 491	435	A 3.8	B 4.6	10	7-1/2	7-1/2	7-1/2	1-1/4	3
	108	20	490, 491	445	B 4.0	B 4.8	10	7-1/2	7-1/2	7-1/2	1-1/4	3
	114	21	490, 491	470	B 4.2	B 5.0	10	7-1/2	7-1/2	7-1/2	1-1/4	3
	119	22	490, 491	490	B 4.4	B 5.2	10	10	7-1/2	7-1/2	1-1/4	3
	125	23	490, 491	515	B 4.6	B 5.6	10	10	10	7-1/2	1-1/4	3
	130	24	490, 491	535	B 4.8	B 5.8	15	10	10	10	1-1/4	3
	136	25	490, 491	560	B 5.0	B 6.0	15	10	10	10	1-1/4	3
	141	26	490, 491	580	B 5.2	B 6.2	15	10	10	10	1-1/4	3
	147	27	490, 491	605	B 5.4	B 6.4	15	10	15	10	1-1/4	3
	152	28	490, 491	625	B 5.6	B 6.6	15	15	15	15	1-1/2	3
	158	29	490, 491	650	B 5.8	B 7.0	15	15	15	15	1-1/2	3
	163	30	490, 491	670	B 6.0	B 7.0	15	15	15	15	1-1/2	3
	163	30	690, 691	400	B 4.4	B 5.2	15	15	10	10	1-1/2	3
	168	31	490, 491	695	B 6.2	B 7.4	15	15	15	15	1-1/2	3
	171	31	690, 691	420	B 4.6	B 5.6	15	15	10	10	1-1/2	3
179	32	490, 491	740	B 6.6	B 8.0	15	15	15	15	1-1/2	3	
178	32	690, 691	440	B 4.8	B 5.8	15	15	10	10	1-1/2	3	
186	34	690, 691	455	B 5.0	B 6.0	15	15	15	10	1-1/2	3	
193	35	690, 691	475	B 5.2	B 6.2	15	15	15	10	1-1/2	3	
200	36	690, 691	495	B 5.4	B 6.4	15	15	15	15	1-1/2	3	
Unloading large tank cars, multiple vessels, barges or terminals	208	38	690, 691	510	B 5.6	B 6.8	20	15	15	15	1-1/2	4
	215	39	690, 691	530	B 5.8	B 7.0	20	15	15	15	1-1/2	4
	223	41	690, 691	550	B 6.0	A 7.0	20	15	15	15	1-1/2	4
	230	42	690, 691	565	B 6.2	B 7.4	20	15	15	15	2	4
	237	43	690, 691	585	B 6.4	A 7.4	20	15	15	15	2	4
	245	45	690, 691	605	B 6.6	B 8.0	20	15	15	15	2	4
	252	46	690, 691	620	B 6.8	B 8.0	20	20	15	15	2	4
	260	47	690, 691	640	B 7.0	A 8.2	20	20	20	15	2	4
	275	48	690, 691	675	B 7.4	B 8.6	25	20	20	20	2	4
	297	54	690, 691	730	B 8.0	B 9.4	25	20	20	20	2	4
	319	58	690, 691	785	B 8.6	B 9.4	25	20	25	20	2	4
	334	60	690, 691	820	TB 9.0	A 10.6	30	25	25	20	2	4
	452	82	D891	580	5V 7.1	5V 8.5	30	30	30	30	3	6
	623	113	D891	800	5V 9.75	5V 11.8		40	40	30	3	6

<sup>1</sup> The capacities shown are based on 70°F, but will vary depending upon piping, fittings used, product being transferred and temperature. The factory can supply a detailed computer analysis if required.

<sup>2</sup> Driver sheaves: 91 (2 belts); 290, 291, 490, 491 (3 belts); 690, 691 (4 belts).

<sup>3</sup> The piping sizes shown are considered minimum. If the length exceeds 100 ft., use the next larger size.

NOTE: Please consult factory for compressors with higher flows.

# Appendix D—Compressor Selection

## Ammonia Compressor Selection Table

Service	Capacity gpm <sup>1</sup>	Displacement cfm	Compressor		Driver Sheave Size Pitch Diameter (inches) <sup>2</sup>		Driver Horsepower				Piping Size <sup>3</sup>	
							Liquid Transfer & Residual Vapor Recovery		Liquid Transfer Without Residual Vapor Recovery			
							100°F	80°F	100°F	80°F		
Model	RPM	1,750 RPM	1,450 RPM					Vapor	Liquid			
Small bulk plants	23	4	91	400	A 3.0	A 3.6	5	3	3	3	3/4	1-1/4
	29	5	91	505	A 3.8	B 4.6	5	5	5	3	3/4	1-1/4
	34	6	91	590	B 4.6	B 5.6	5	5	5	5	1	1-1/4
	40	7	91	695	B 5.4	B 6.6	5	5	5	5	1	1-1/2
	43	7	290, 291	345	A 3.0	A 3.6	5	3	3	3	1	1-1/2
Unloading single tank car or transport	46	8	91	795	B 6.2	B 7.4	7-1/2	5	5	5	1	1-1/2
	45	8	290, 291	390	A 3.4	B 4.0	5	3	3	3	1	1-1/2
	50	9	290, 291	435	A 3.8	B 4.6	5	5	3	3	1	1-1/2
	56	10	290, 291	490	B 4.4	B 5.2	5	5	5	3	1	2
	62	11	290, 291	535	B 4.8	B 5.8	7-1/2	5	5	5	1	2
	67	12	290, 291	580	B 5.2	B 6.2	7-1/2	5	5	5	1	2
	72	13	290, 291	625	B 5.6	B 6.6	7-1/2	5	5	5	1-1/4	2
	80	14	290, 291	695	B 6.2	B 7.4	7-1/2	7-1/2	7-1/2	5	1-1/4	2
	85	15	290, 291	735	B 6.6	B 8.0	10	7-1/2	7-1/2	7-1/2	1-1/4	2-1/2
	85	15	490, 491	345	A 3.0	A 3.6	7-1/2	7-1/2	5	5	1-1/4	2-1/2
	90	16	290, 291	780	B 7.0	B 8.6	10	7-1/2	7-1/2	7-1/2	1-1/4	2-1/2
90	16	490, 491	370	A 3.2	A 3.8	10	7-1/2	5	5	1-1/4	2-1/2	
Unloading two or more tank cars at one time or large transport with excess flow valves of adequate capacity	96	17	490, 491	390	A 3.4	B 4.0	10	7-1/2	5	5	1-1/4	3
	102	18	490, 491	415	A 3.6	B 4.4	10	7-1/2	7-1/2	7-1/2	1-1/4	3
	107	19	490, 491	435	A 3.8	B 4.6	10	7-1/2	7-1/2	7-1/2	1-1/4	3
	110	20	490, 491	445	B 4.0	B 4.8	10	7-1/2	7-1/2	7-1/2	1-1/4	3
	115	21	490, 491	470	B 4.2	B 5.0	10	7-1/2	7-1/2	7-1/2	1-1/4	3
	120	22	490, 491	490	B 4.4	B 5.2	15	10	7-1/2	7-1/2	1-1/4	3
	126	23	490, 491	515	B 4.6	B 5.6	15	10	7-1/2	7-1/2	1-1/4	3
	131	24	490, 491	535	B 4.8	B 5.8	15	10	10	7-1/2	1-1/4	3
	138	25	490, 491	560	B 5.0	B 6.0	15	10	10	7-1/2	1-1/4	3
	142	26	490, 491	580	B 5.2	B 6.2	15	10	10	7-1/2	1-1/4	3
	148	27	490, 491	605	B 5.4	B 6.4	15	10	10	10	1-1/4	3
	153	28	490, 491	625	B 5.6	B 6.6	15	10	10	10	1-1/2	3
	160	29	490, 491	650	B 5.8	B 7.0	15	15	10	10	1-1/2	3
	165	30	490, 491	670	B 6.0		15	15	15	10	1-1/2	3
	165	30	690, 691	400	B 4.4	B 5.2	15	15	10	10	1-1/2	3
	170	31	490, 491	695	B 6.2	B 7.4	15	15	15	10	1-1/2	3
	173	31	690, 691	420	B 4.6	B 5.6	15	15	10	10	1-1/2	3
181	32	490, 491	740	B 6.6	B 8.0	15	15	15	15	1-1/2	3	
180	32	690, 691	440	B 4.8	B 5.8	15	15	10	10	1-1/2	3	
188	34	690, 691	455	B 5.0	B 6.0	20	15	10	10	1-1/2	3	
195	35	690, 691	475	B 5.2	B 6.2	20	15	10	10	1-1/2	3	
203	36	690, 691	495	B 5.4	B 6.4	20	15	15	10	1-1/2	3	
Unloading large tank cars, multiple vessels, barges or terminals	211	38	690, 691	510	B 5.6	B 6.8	20	15	15	10	1-1/2	4
	218	39	690, 691	530	B 5.8	B 7.0	20	15	15	15	1-1/2	4
	226	41	690, 691	550	B 6.0	A 7.0	20	15	15	15	1-1/2	4
	233	42	690, 691	565	B 6.2	B 7.4	20	15	15	15	2	4
	240	43	690, 691	585	B 6.4	A 7.4	20	20	15	15	2	4
	248	45	690, 691	605	B 6.6	B 8.0	20	20	15	15	2	4
	255	45	690, 691	620	B 6.8		25	20	15	15	2	4
	263	47	690, 691	640	B 7.0	A 8.2	25	20	15	15	2	4
	278	48	690, 691	675	B 7.4	B 8.6	25	20	15	15	2	4
	301	54	690, 691	730	B 8.0	B 9.4	25	20	20	15	2	4
	323	58	690, 691	785	B 8.6		30	25	20	20	2	4
	338	60	690, 691	820	TB 9.0	A 10.6	30	25	20	20	2	4
	459	82	D891	580	5V 7.1	5V 8.5	40	30	30	30	3	6
633	113	D891	800	5V 9.75	5V 11.8		40	40	30	3	6	

<sup>1</sup> The capacities shown are based on 70°F, but will vary depending upon piping, fittings used, product being transferred and temperature. The factory can supply a detailed computer analysis if required.

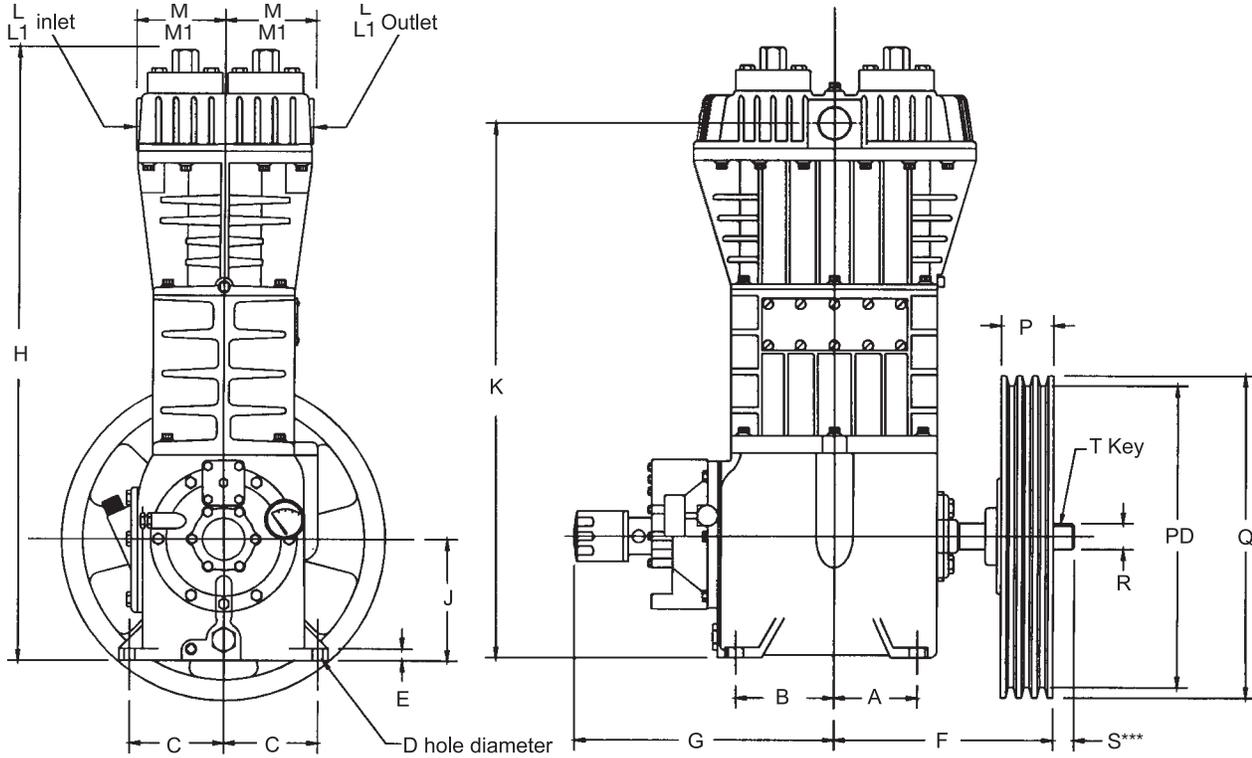
<sup>2</sup> Driver sheaves: 91 (2 belts); 290, 291, 490, 491 (3 belts); 690, 691 (4 belts).

<sup>3</sup> The piping sizes shown are considered minimum. If the length exceeds 100 ft., use the next larger size.

NOTE: Please consult factory for compressors with higher flows.

# Appendix E—Outline Dimensions

## Models 91–691 and F91–F691 Bare with Flywheel



**Outline Dimensions—Inches (Centimeters)**

Model	A	B	C	D	E	F	G	H	J	K
91, F91	1-13/16 (4.6)	2-3/8 (6.0)	3-11/16 (9.4)	13/32 (1.03)	5/8 (1.59)	6-1/4 (15.9)	3-7/8 (9.8)	25-5/16 (64.3)	5 (12.7)	22-11/16 (57.6)
291, F291	3-3/8 (8.6)	4-1/8 (10.5)	3-11/16 (9.4)	13/32 (1.11)	5/8 (1.59)	9-13/16 (24.9)	12 (30.4)	25-13/16 (65.2)	5-3/8 (13.7)	23-3/8 (59.4)
491, F491	4-1/8 (10.5)	5 (12.7)	4-11/16 (11.9)	1/2 (1.27)	11/16 (1.75)	10-11/16 (27.2)	13 (33.1)	29-11/16 (75.4)	5-7/8 (14.9)	26-3/16 (66.5)
691, F691	4-3/4 (12.1)	5 (14.0)	5-3/8 (13.7)	9/16 (1.5)	1 (2.5)	14 (35.6)	14-3/8 (35.6)	39-1/8 (99.4)	8-1/4 (21.0)	35-1/8 (89.2)

Model	L*	L1**	M*	M1**	P	Q	R	S***	T	"PD" Flywheel Pitch Diameter			
										A-belt Groove	B-belt Groove	B-belt Groove	B-belt Groove
91, F91	3/4 NPT	3/4-300 lb ANSI	2-3/8 (6.0)	4-1/4 (10.8)	3 (7.6)	14 (35.6)	1-1/8 (2.8)	1-1/4 (3.2)	1/4 (0.63)	13.2 (33.5)	2 (34.5)	13.6 (34.5)	2
291, F291	3/4 NPT	3/4-300 lb ANSI	2-11/16 (6.8)	4-1/4 (10.8)	3 (7.6)	16 (40.6) 14 <sup>1</sup> (35.6)	1-1/4 (3.2)	1-1/4 (3.2)	1/4 (0.63)	15.2 (38.6) 13.21 (33.5)	3 (39.6) 2 (34.5)	15.6 (39.6) 13.6 <sup>1</sup> (34.5)	3 (39.6) 2 (34.5)
491, F491	1-1/4 NPT	1-1/4-300 lb ANSI	3-7/8 (9.9)	5-5/8 (14.3)	3 (7.6)	16 (40.6) 14 <sup>1</sup> (35.6)	1-3/8 (3.5)	1-1/4 (3.2)	5/16 (0.79)	15.2 (38.6) 13.21 (33.5)	3 (39.6) 2 (34.5)	15.6 (39.6) 13.6 <sup>1</sup> (34.5)	3 (39.6) 2 (34.5)
691, F691	2 <sup>2</sup> NPT	2-300 lb ANSI	6-3/8 (16.1)	6-15/16 (17.6)	3-13/16 (9.7)	19-1/2 (49.5)	2-1/8 (5.4)	—	1/2 (1.27)	—	—	19-1/8 (48.5)	4

<sup>1</sup> Optional flywheel

<sup>2</sup> Optional flanges: 1-1/4", 1-1/2" NPT, 1-1/4", 1-1/2" or 2" Weld

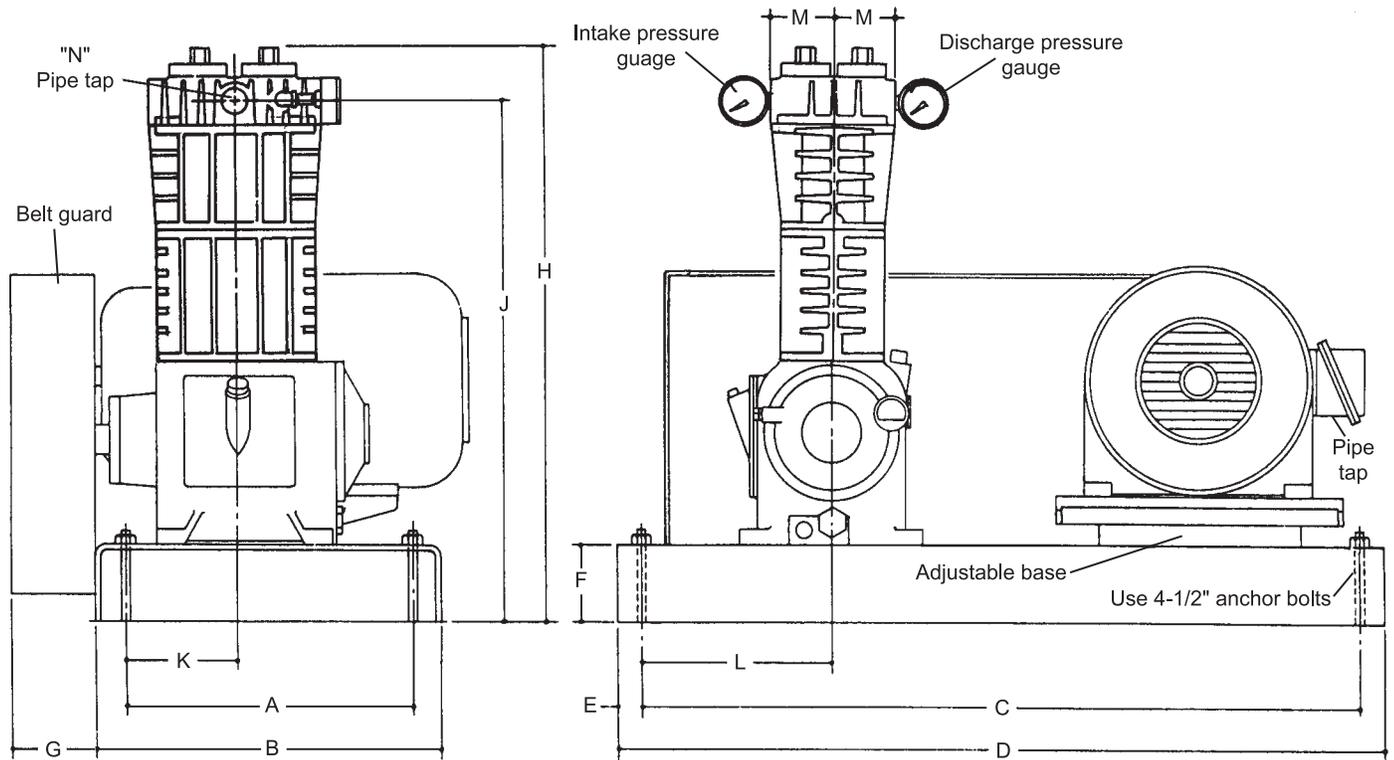
\* 91, 291, 491, 691 only

\*\* F91, F291, F491, F691 only

\*\*\* With extended crankshaft option only

# Appendix E—Outline Dimensions

## Models 91–691 with 103 Mounting



**Outline Dimensions—Inches (Centimeters)**

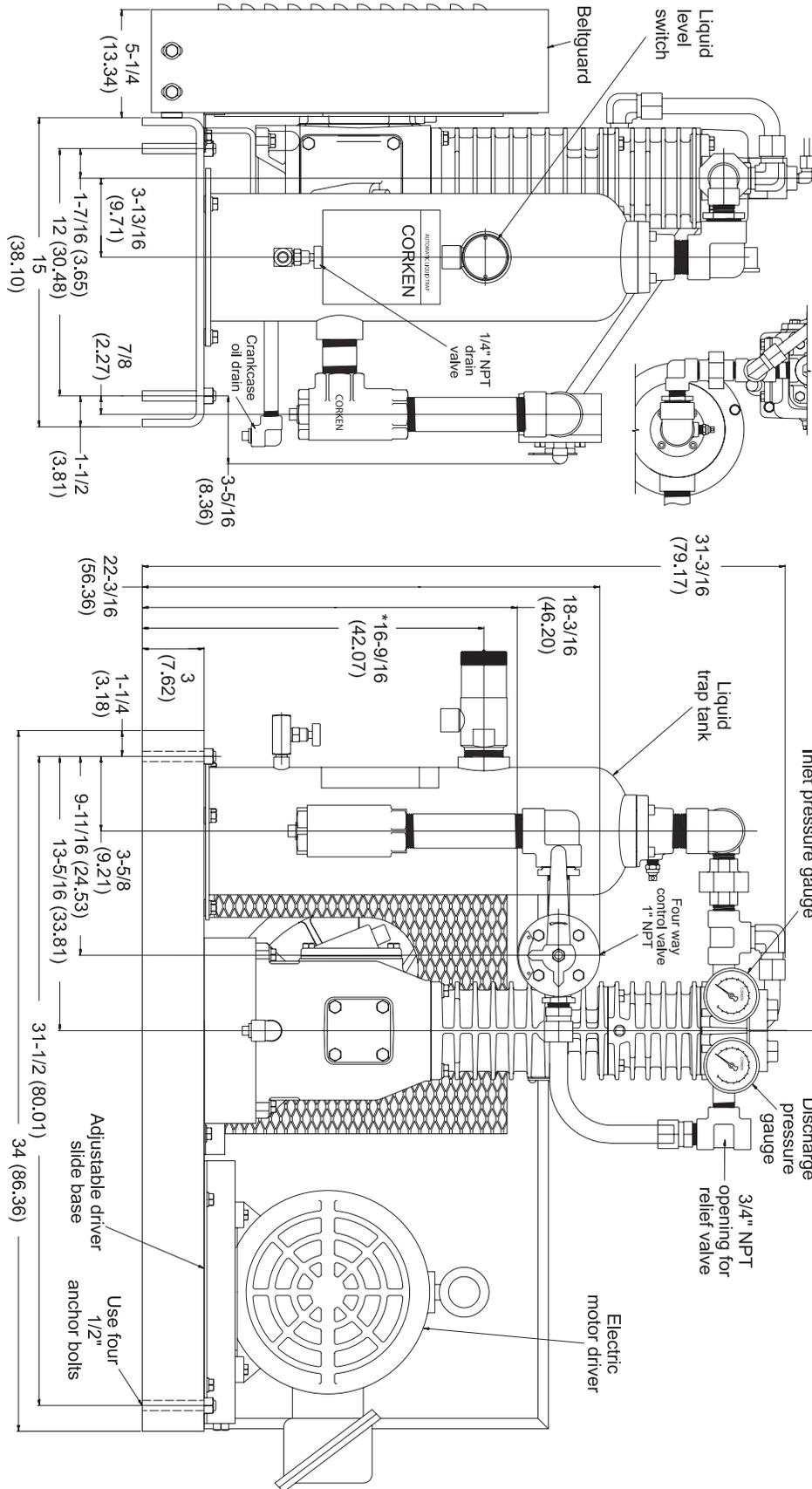
Model	A	B	C	D	E	F	G
91-103	12 (30.4)	15 (38.1)	27-1/2 (69.8)	30 (76.2)	1-1/4 (3.1)	3 (7.6)	5-1/4 (13.34)
291-103	12 (30.5)	15 (38.1)	31-1/2 (80.0)	34 (86.4)	1-1/4 (3.2)	3 (7.6)	5 (12.7)
491-103	15 (38.1)	18 (45.7)	37-1/2 (95.3)	40 (101.6)	1-1/4 (3.2)	4 (10.2)	5-1/4 (13.3)
691-103	17 (43.2)	20 (50.8)	39-1/2 (100.3)	42 (106.7)	1-1/4 (3.2)	4 (10.2)	5.5 (14.0)

**Outline Dimensions—Inches (Centimeters)**

Model	H	J	K	L	M	N
91-103	28-11/16 (72.9)	26-3/8 (67.0)	4-15/16 (12.5)	7.75 (19.7)	2-11/16 (6.8)	3/4 NPT
291-103	28-22/32 (72.9)	26-6/16 (67.0)	4-15/16 (12.5)	7-3/4 (19.7)	2-11/16 (6.8)	3/4 NPT
491-103	33-11/16 (85.6)	30-3/16 (76.7)	5-3/4 (14.6)	10 (25.4)	3-15/16 (10.0)	3/4 NPT
691-103	43-1/8 (109.5)	39-1/8 (99.4)	8.25 (21.0)	9.25 (23.5)	6-3/8 (16.2)	2 NPT

# Appendix E— Outline Dimensions

Models 91 with -107 or -107A Mounting (model -107A shown below)

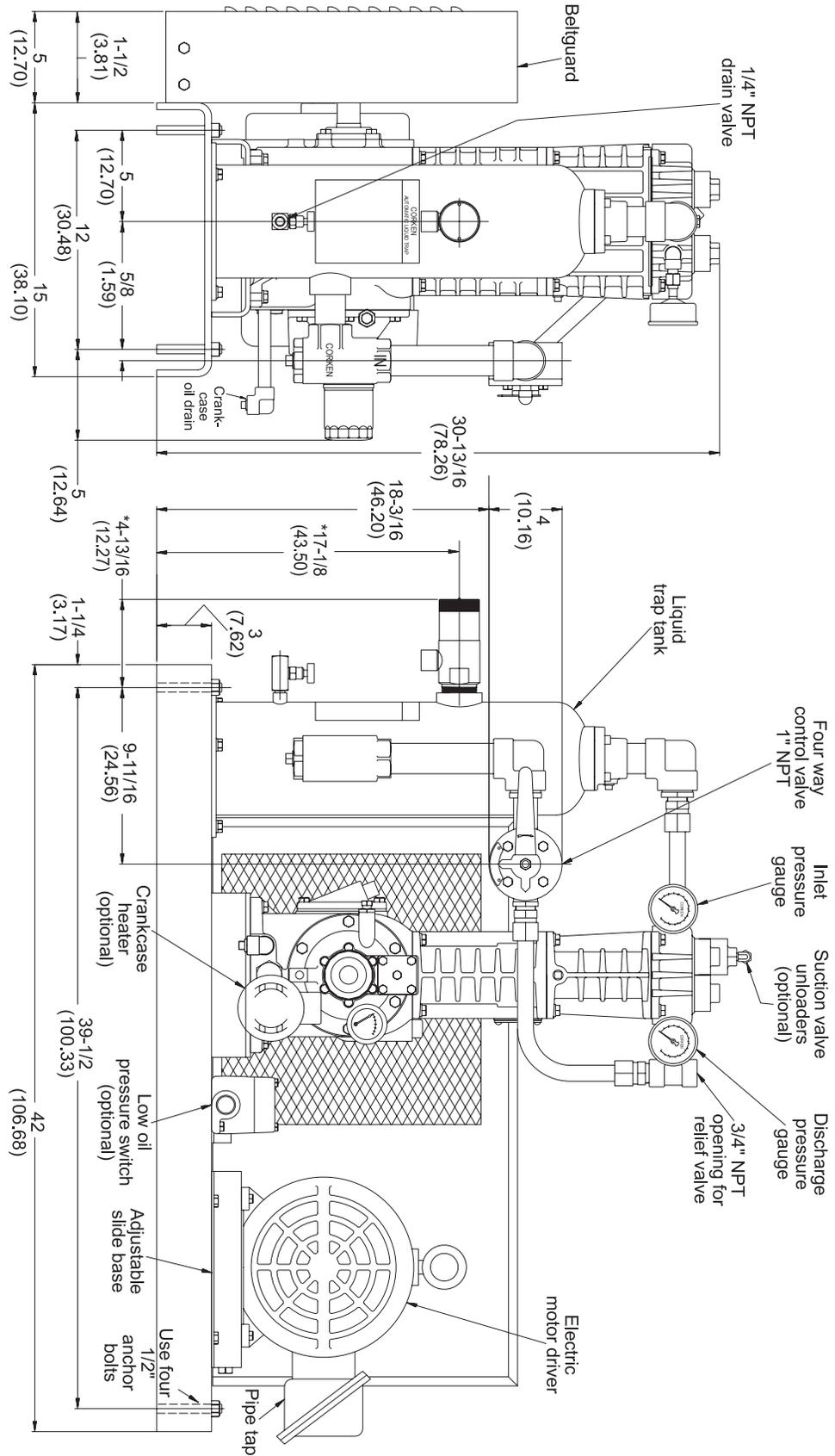


Inches (Centimeters)

\* Dimensions apply to -107A mounting only

# Appendix E— Outline Dimensions

Model 291 with -107 or -107A Mounting (model -107A shown below)

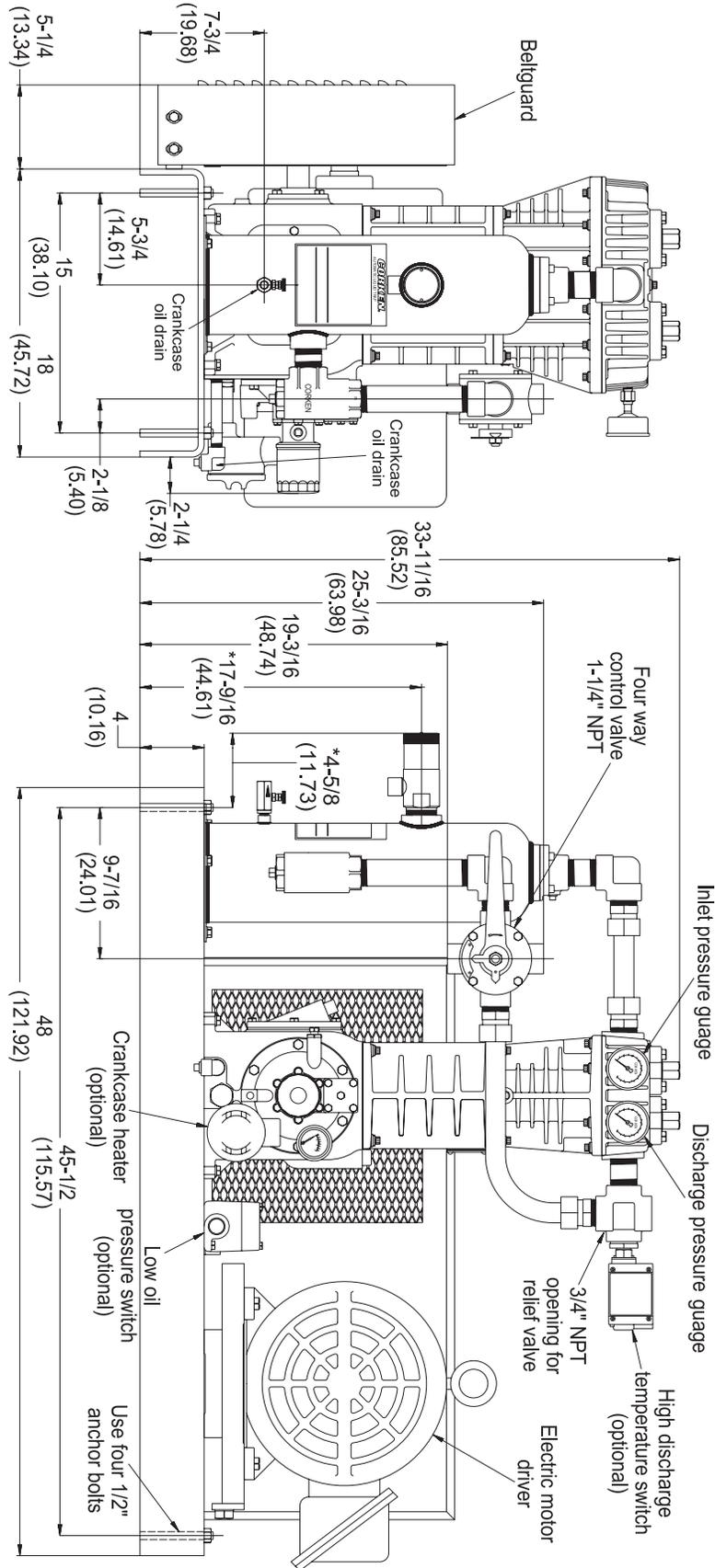


Inches (Centimeters)

\* Dimensions apply to -107A mounting only

# Appendix E— Outline Dimensions

Model 491 with -107 or -107A Mounting (model -107A shown below)

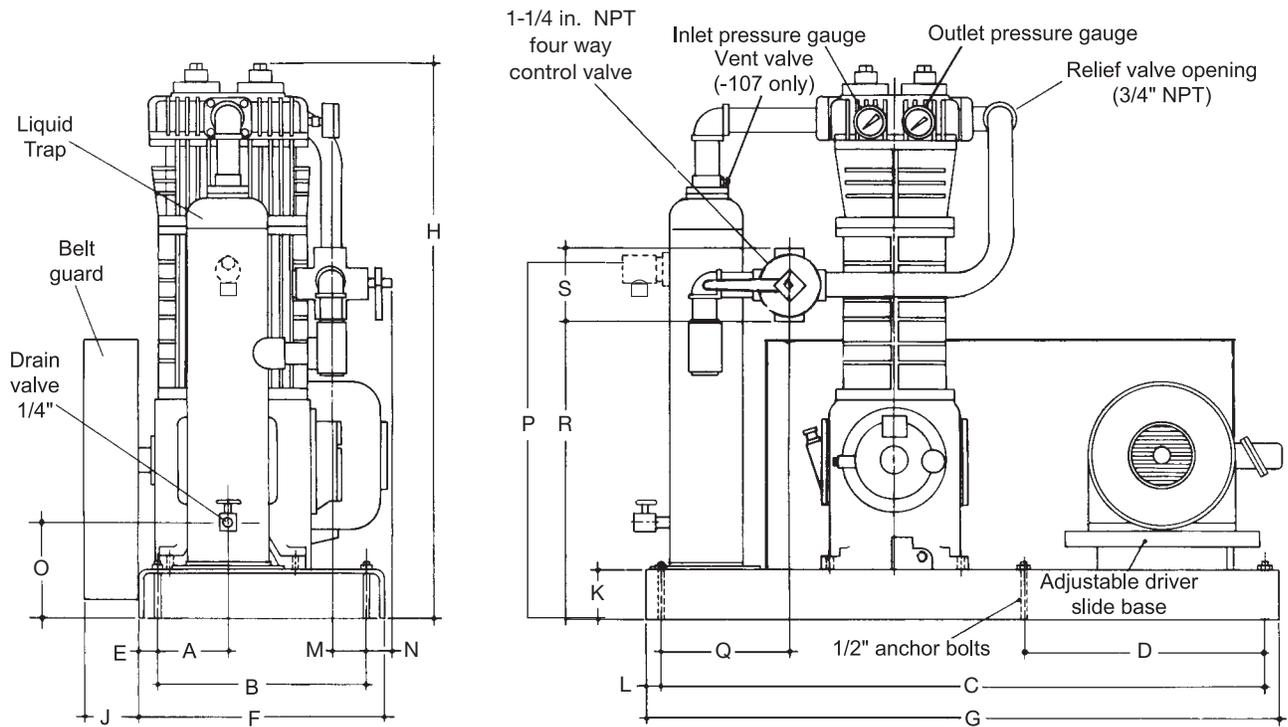


Inches (Centimeters)

\* Dimensions apply to -107A mounting only

# Appendix E—Outline Dimensions

Model 691 with -107 or -107A Mounting (model -107A shown below)



Inches (Centimeters)

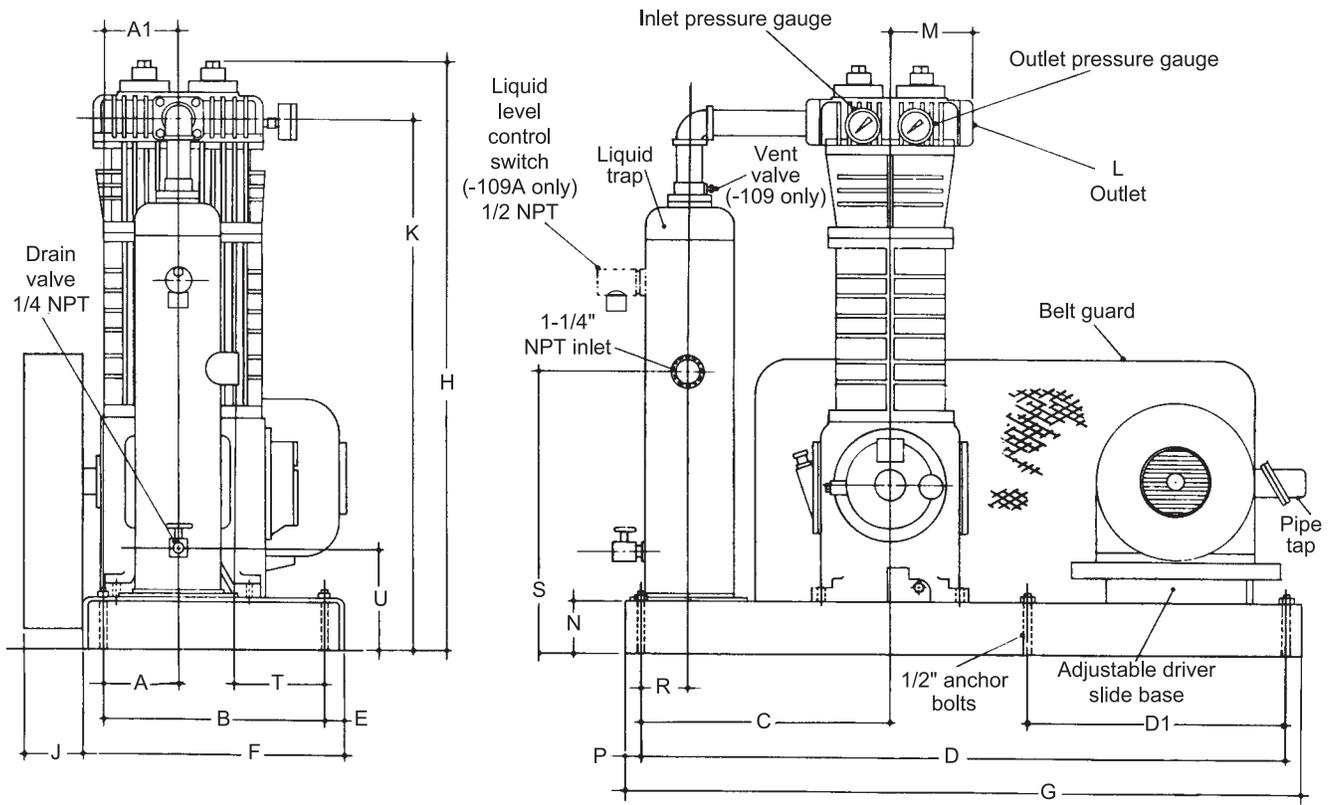
Outline Dimensions—Inches (Centimeters)									
Model	A	B	C	D	E	F	G	H	J
691-107, -107A	8-1/4 (21.0)	17 (43.1)	49-1/2 (126)	19-3/4 (50.1)	1-1/2 (3.8)	20 (50.8)	52 (132)	43-1/4 (110)	5-1/2 (14)

Outline Dimensions—Inches (Centimeters)									
Model	K	L	M	N	O	P	Q	R	S
691-107, -107A	4 (10.1)	1-1/4 (3.2)	1/4 (0.63)	2-11/16* (6.8)*	7-3/4 (19.6)	29 (73.0)	10-1/2 (26.6)	24-1/4 (61.0)	6 (15.0)

\* Dimensions apply to -107A mounting only

# Appendix E—Outline Dimensions

Model 91–691 with -109 or -109A Mounting (model -109A shown below)

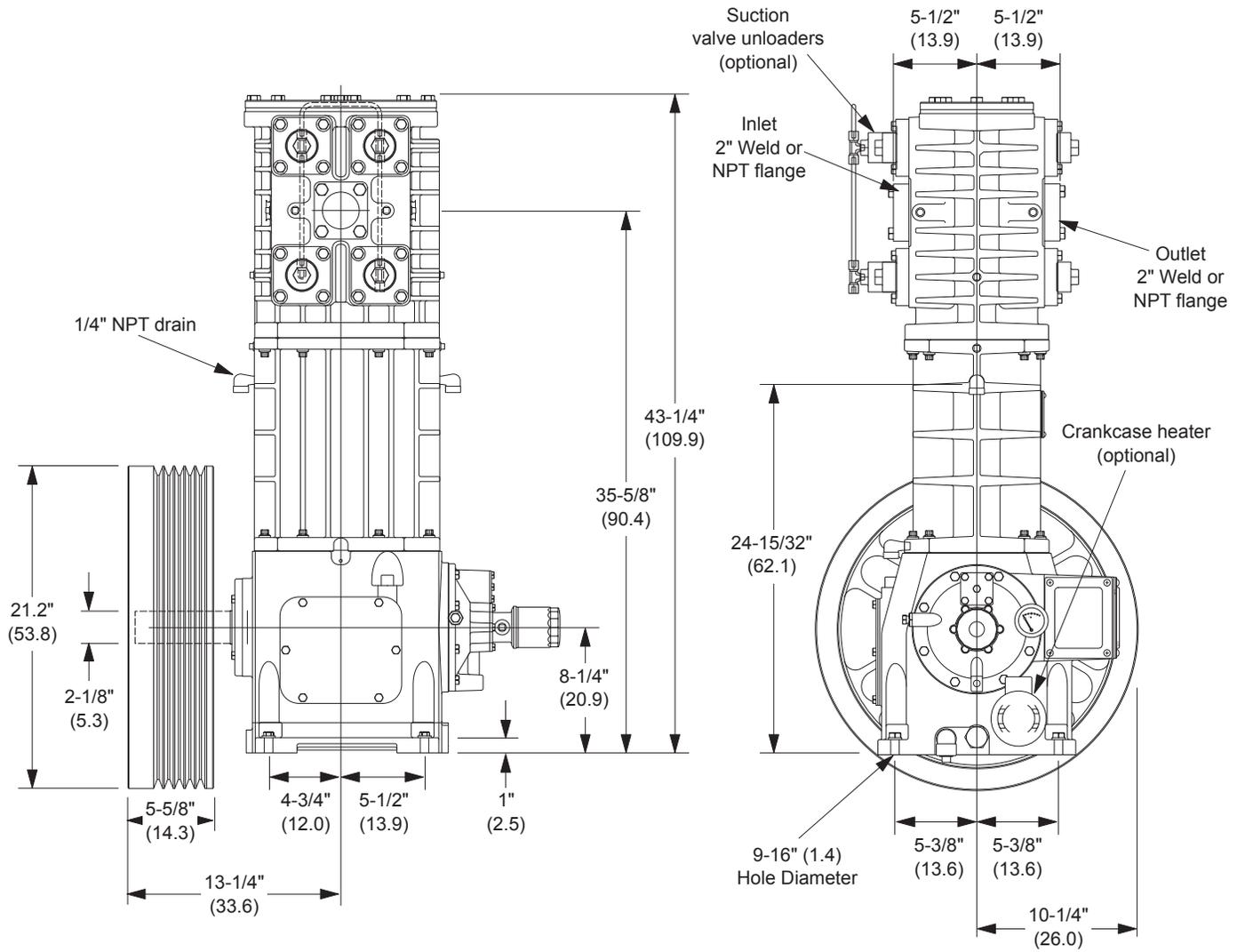


Outline Dimensions—Inches (Centimeters)											
Model	A	A1	B	C	D	D1	E	F	G	H	J
91-109, -109A	1-3/16 (3.7)	5-1/4 (13.4)	12 (30.5)	13-5/16 (33.8)	31-1/2 (80.0)	—	1-1/2 (3.8)	15 (38.1)	34 (86.4)	31-3/16 (79.2)	5-1/4 (13.3)
291-109, -109A	5 (12.7)	—	12 (30.5)	15-3/4 (40.0)	39-1/2 (100.3)	—	1-1/2 (3.8)	15 (38.1)	42 (106.7)	30-7/8 (78.4)	5-1/4 (13.3)
491-109, -109A	5-3/4 (14.6)	—	15 (38.1)	18 (45.7)	45-1/2 (115.6)	—	1-1/2 (3.8)	18 (45.7)	48 (121.9)	33-3/4 (85.7)	5-1/4 (13.3)
691-109, -109A	8-1/4 (30.0)	—	17 (43.2)	19-1/4 (48.8)	49-1/2 (125.7)	19-3/4 (50.1)	1-1/2 (3.8)	20 (50.8)	52 (132)	43-3/16 (109.6)	5-1/2 (14.0)

Outline Dimensions—Inches (Centimeters)										
Model	K	L	M	N	P	R	S	T	U	
91-109, -109A	28-3/16 (71.6)	3/4 NPT	2-5/16 (5.9)	3 (7.6)	1-1/4 (3.2)	3-5/8 (9.2)	9-1/2 (24.1)	2-3/4 (6.9)	6-3/4 (17.1)	
291-109, -109A	28-1/2 (72.4)	3/4 NPT	2-11/16 (6.8)	3 (7.6)	1-1/4 (3.2)	3-7/8 (9.9)	9-1/2 (24.1)	4-1/2 (11.4)	6-3/4 (17.1)	
491-109, -109A	30-1/8 (76.5)	1-1/4 NPT	4 (10.2)	4 (10.2)	1-1/4 (3.2)	4 (10.2)	10-1/2 (26.7)	5.25 (13.3)	7-3/4 (19.7)	
691-109, -109A	39-1/8 (99.3)	1-1/2 NPT	6-3/8 (16.1)	4 (10.2)	1-1/4 (3.2)	4-1/8 (10.4)	21-7/16 (54.4)	7-1/4 (18.4)	7-3/4 (19.7)	

# Appendix E— Outline Dimensions

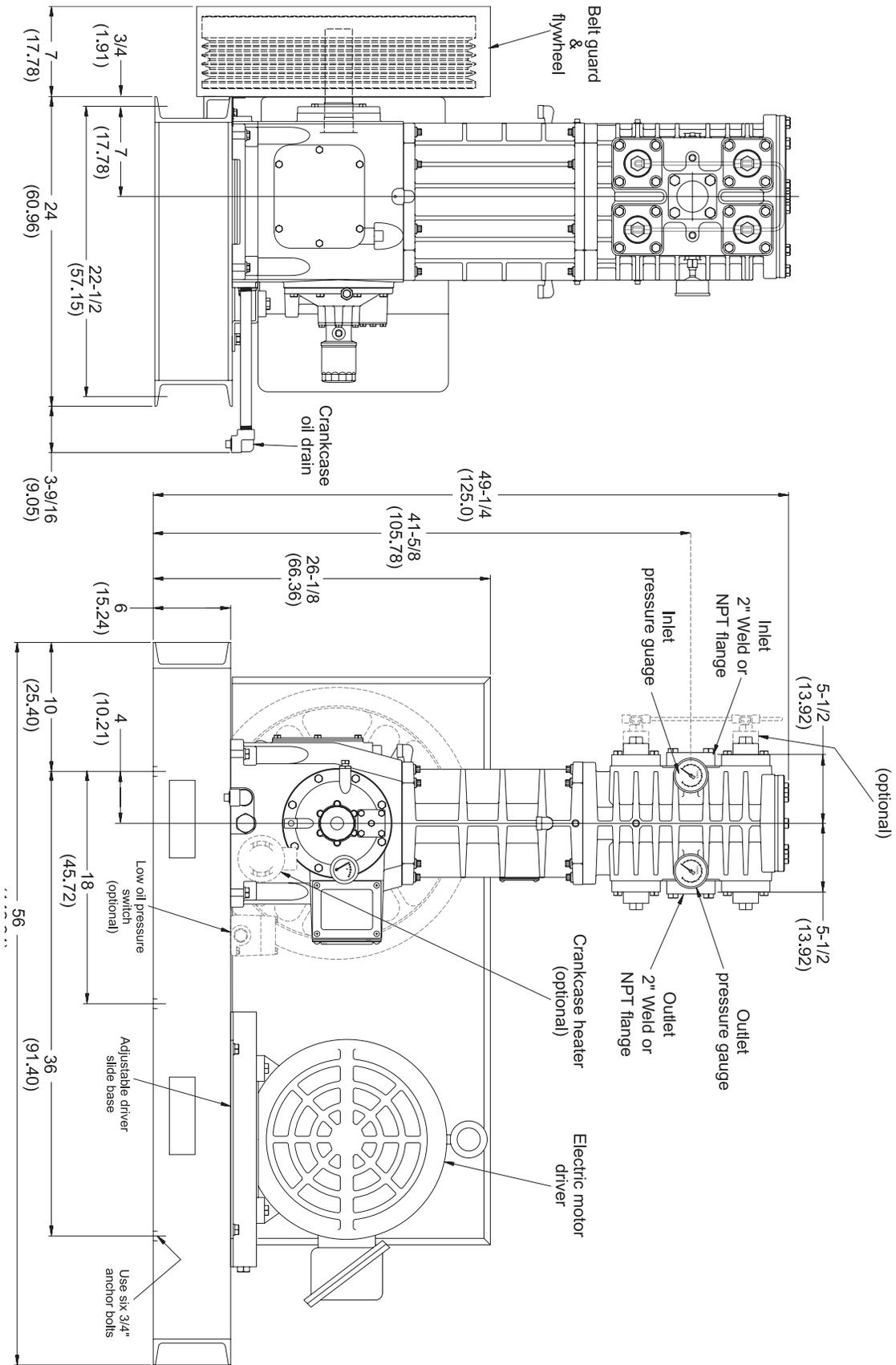
## Model D891 Bare with Flywheel



Inches (Centimeters)

# Appendix E—Outline Dimensions

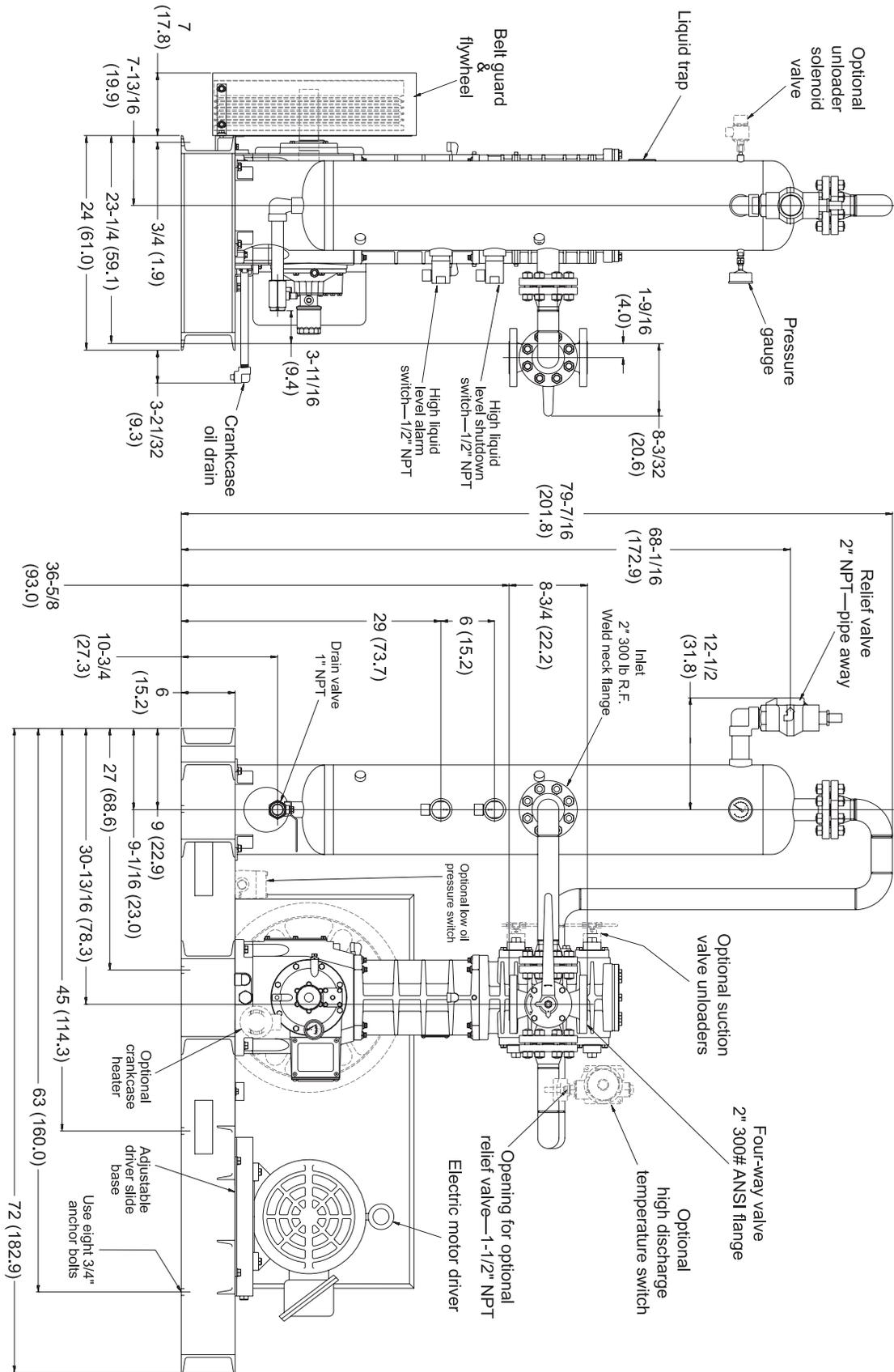
## Model D891 with 103 Mounting



Inches (Centimeters)

# Appendix E—Outline Dimensions

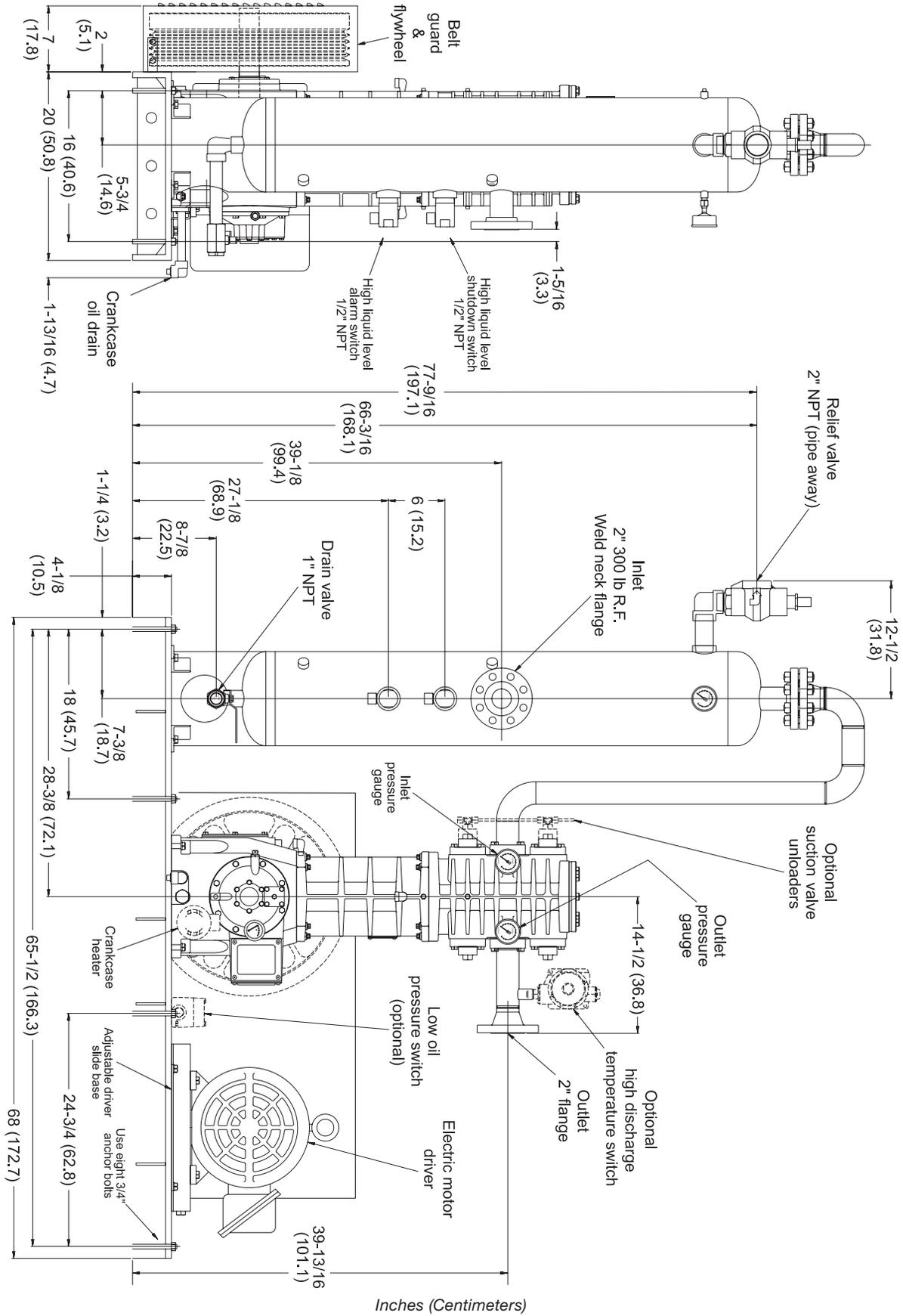
## Model D891 with 107B Mounting



Inches (Centimeters)

# Appendix E—Outline Dimensions

## Model D891 with 109B Mounting



## Appendix F—Troubleshooting

In most cases, problems with your Corken gas compressor can be solved quite simply. This chart lists some of the more frequent problems that occur with reciprocating

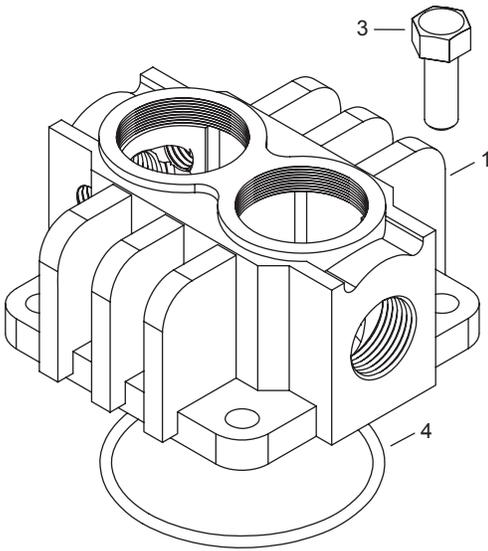
compressors along with a list of possible causes. If you are having a problem which is not listed, or if you cannot find the source of the problem, consult the factory.

Problem	Possible Cause
Low capacity	1, 2, 3, 4, 16
Overheating	1, 2, 3, 5, 6, 11, 15
Knocks, rattles and noise	1, 7, 9, 10, 11, 14
Oil in cylinder	8, 14
Abnormal piston-ring wear	1, 3, 5, 6, 11, 14, 15
Product leaking through crankcase breather	8, 14
Product leakage	4, 8, 14, 16
Oil leakage around compressor base	17, 18
No oil pressure	19, 20
Excessive vibration	1, 7, 9, 10, 11, 12, 13, 28
Motor overheating or starter tripping out	21, 22, 23, 24, 25, 26, 27, 28

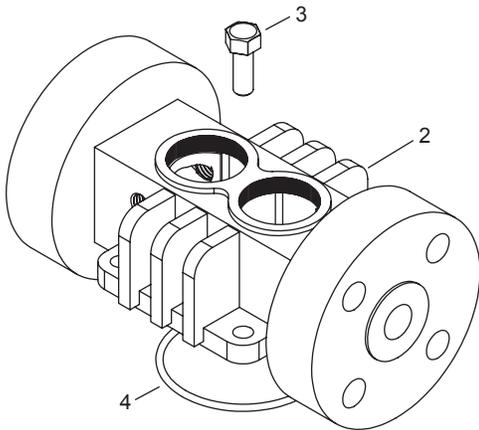
Ref.	Possible Causes	What To Do
1.	Valves broken, stuck or leaking	Inspect and clean or repair
2.	Piston ring worn	Inspect and replace as necessary
3.	Inlet strainer clogged	Clean or replace screen as necessary
4.	Leaks in piping	Inspect and repair
5.	Inlet or ambient temperature too high	Consult factory
6.	Compression ratio too high	Check application and consult factory
7.	Loose flywheel or belt	Tighten
8.	Worn piston-rod packing	Replace
9.	Worn wrist pin or wrist-pin bushing	Replace
10.	Worn connecting-rod bearing	Replace
11.	Unbalanced load	Inspect valve or consult factory
12.	Inadequate compressor base	Strengthen, replace or grout
13.	Improper foundation or mounting	Tighten mounting or rebuild foundation
14.	Loose valve, piston or packing	Tighten or replace as necessary
15.	Dirty cooling fins	Clean weekly
16.	4-way control valve not lubricated	Inspect and lubricate
17.	Leaking gas blowing oil from crankcase	Tighten packing
18.	Bad oil seal	Replace
19.	No oil in crankcase	Add oil
20.	Oil-pump malfunction	See oil-pressure adjustment
21.	Low voltage	Check line voltage with motor nameplate. Consult power company
22.	Motor wired wrong	Check wiring diagram
23.	Wire size too small for length or run	Replace with correct size
24.	Wrong power characteristics	Voltage, phase and frequency must coincide with motor nameplate. Consult with power company.
25.	Wrong size of heaters in starter	Check and replace according to manufacturer's instructions
26.	Compressor overloading	Reduce speed
27.	Motor shorted out	See driver installation
28.	Bad motor bearing	Lubricate according to manufacturer's instructions

# Appendix G—91 and F91 Head and Valve Assembly Details

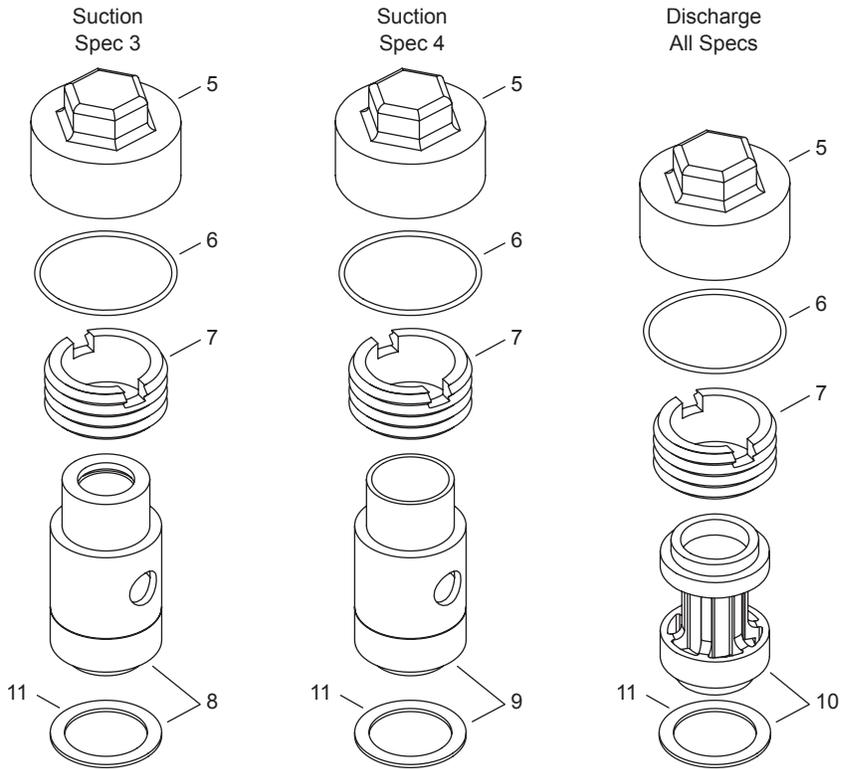
## 91 Head Assembly



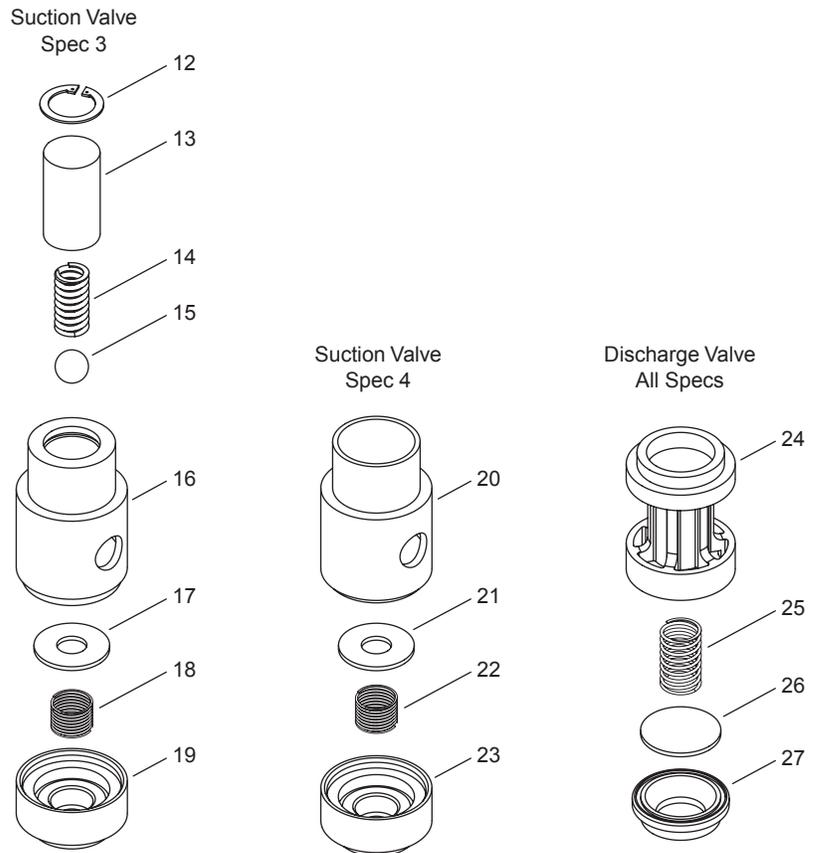
## F91 Head Assembly



## Valve Holddown Assemblies



## Valve Assemblies



# Appendix G—91 and F91 Head and Valve Assembly Details

## Head and Valve Bill of Materials

Ref No.	Part No.	Description
1.	2374	Head model 91
	2374-X <sup>a</sup>	Head assy. for model 91 (spec 3)
	2374-X1	Head assy. for model 91 (spec 4)
2.	4302	Head model F91 (ANSI flange)
3.	7001-037 NC100A	Bolt, 3/8-16 x 1" Gr.5 hex head
4.	2-235 <sub>c</sub>	O-ring
5.	2714-1	Valve cap
6.	2-031 <sub>c</sub>	O-ring
7.	2715	Holddown screw
8.	3483-1X	Suction valve assy. (spec 3)
	3483-1X1 <sup>b</sup>	Same as above but with copper gaskets
	3483-1X2 <sup>b</sup>	Same as above but with iron-lead gaskets
9.	3483-X	Suction valve assy. (spec 4)
	3483-X1 <sup>b</sup>	Same as above but with copper gaskets
	3483-X2 <sup>b</sup>	Same as above but with iron-lead gaskets
10.	3485-X	Discharge valve assy. (all specs)
	3485-X1 <sup>b</sup>	Same as above but with copper gaskets
	3485-X2 <sup>b</sup>	Same as above but with iron-lead gaskets
11.	2717	Valve gasket (aluminum)
	2717-1 <sup>b</sup>	Valve gasket (copper)
	2717-2 <sup>b</sup>	Valve gasket (iron-lead)
12.	5000-77	Retainer ring (spec 3)
13.	3977	Suction valve relief housing (spec 3)
14.	1411	Spring (spec 3)
15.	1410	Ball (spec 3)
16.	3483-1	Suction valve seat (spec 3)
17.	3972	Suction valve plate (spec 3)
18.	4009	Suction spring (spec 3)
19.	3484	Suction valve bumper (spec 3)
20.	3483	Suction valve seat (spec 4)
21.	3972	Suction valve plate (spec 4)
22.	4009	Suction spring (spec 4)
23.	3484	Suction valve bumper (spec 4)
24.	3486	Discharge valve bumper
25.	4008	Discharge spring
26.	3973	Discharge valve plate
27.	3485	Discharge valve seat

O-ring Code	
A	Buna-N
B	Neoprene <sup>®d</sup>

<sup>a</sup> Not shown.

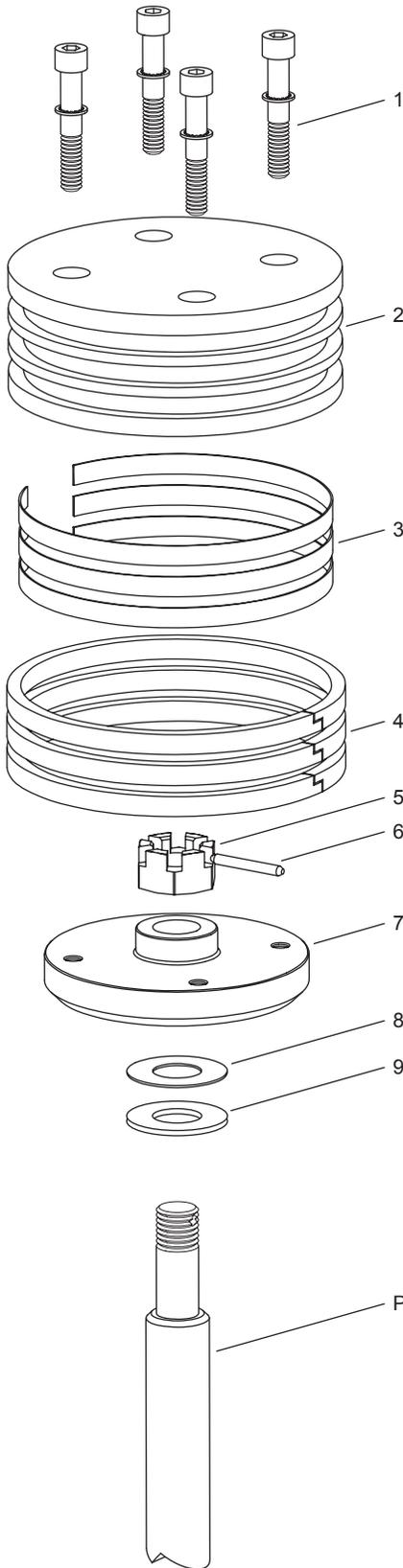
<sup>b</sup> Optional

<sup>c</sup> \_ denotes O-ring code. See O-ring chart to the left for details.

<sup>d</sup> Registered trademark of the DuPont company.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix G—91 and F91 Piston Assembly Details



**Piston Assembly Number 1983-X Bill of Materials  
Piston Diameter 3" (7.62 cm)**

Ref No.	Part No.	Description	Qty
1.	7002-010OC100A	Screw, socket head	4
	7207-010A	Lock washer	4
2.	1983	Head, iron	1
3.	1775	Ring expander	3
4.	1772	Piston ring	3
5.	1482	Locknut	1
6.	1483	Lock pin	1
7.	1984	Piston platform	1
8.	1528	Shim washer, thick	As Req.
	1528-1	Shim washer, thin	
9.	1527	Thrust washer	1

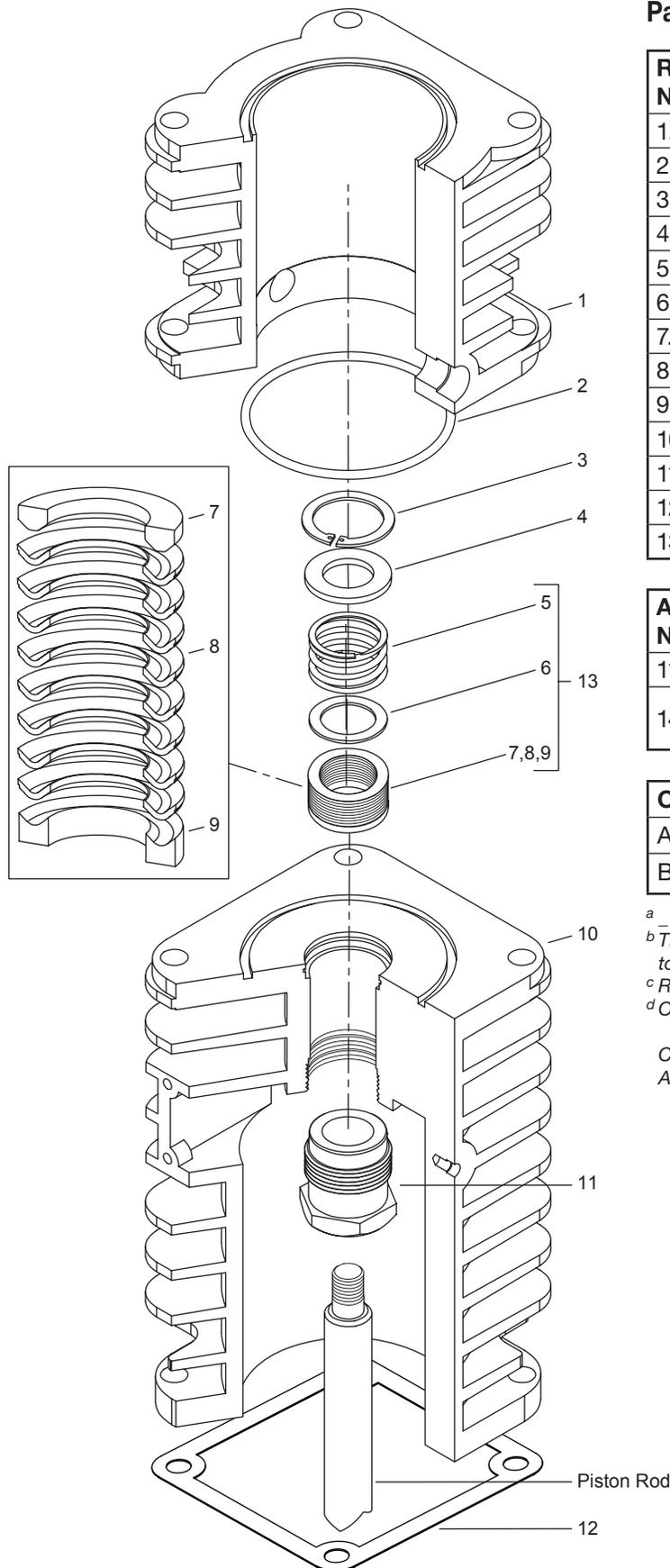
**Piston Clearance (Cold)<sup>a</sup>**

Model	Minimum	Maximum
91	0.020" (0.51 mm)	0.044" (1.12 mm)

<sup>a</sup> The distance from the bottom of the head to the top of the piston.

*CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.*

# Appendix G—91 and F91 Packing Assembly Details



## Packing Assembly Bill of Materials

Ref No.	Part No.	Description	Qty
1.	2242	Cylinder	1
2.	2-235_ <sup>a</sup>	O-ring for cylinder	1
3.	5000-137	Retainer ring	1
4.	1012	Washer	1
5.	1628	Packing spring	1
6.	1714	Packing box washer	1
7.	1453-1	Male packing ring	1
8.	1454 <sup>b</sup>	Packing ring	8
9.	1452-1	Female packing ring	1
10.	2240	Crosshead guides	1
11.	1387	Adjusting screw	1
12.	2526	Crankcase gasket	1
13.	1452-1X1	Packing set	1

Assembly Number	Assembly Name
1132-X2	Crosshead - piston-rod assembly
1452-2X1 <sup>d</sup>	Packing set (alloy 50) with 1452-1, 1453-1, 1454-2 (8), 1626, 1714

O-ring Code	
A	Buna-N
B	Neoprene <sup>®c</sup>

<sup>a</sup> \_ denotes O-ring code. See O-ring chart above for details.

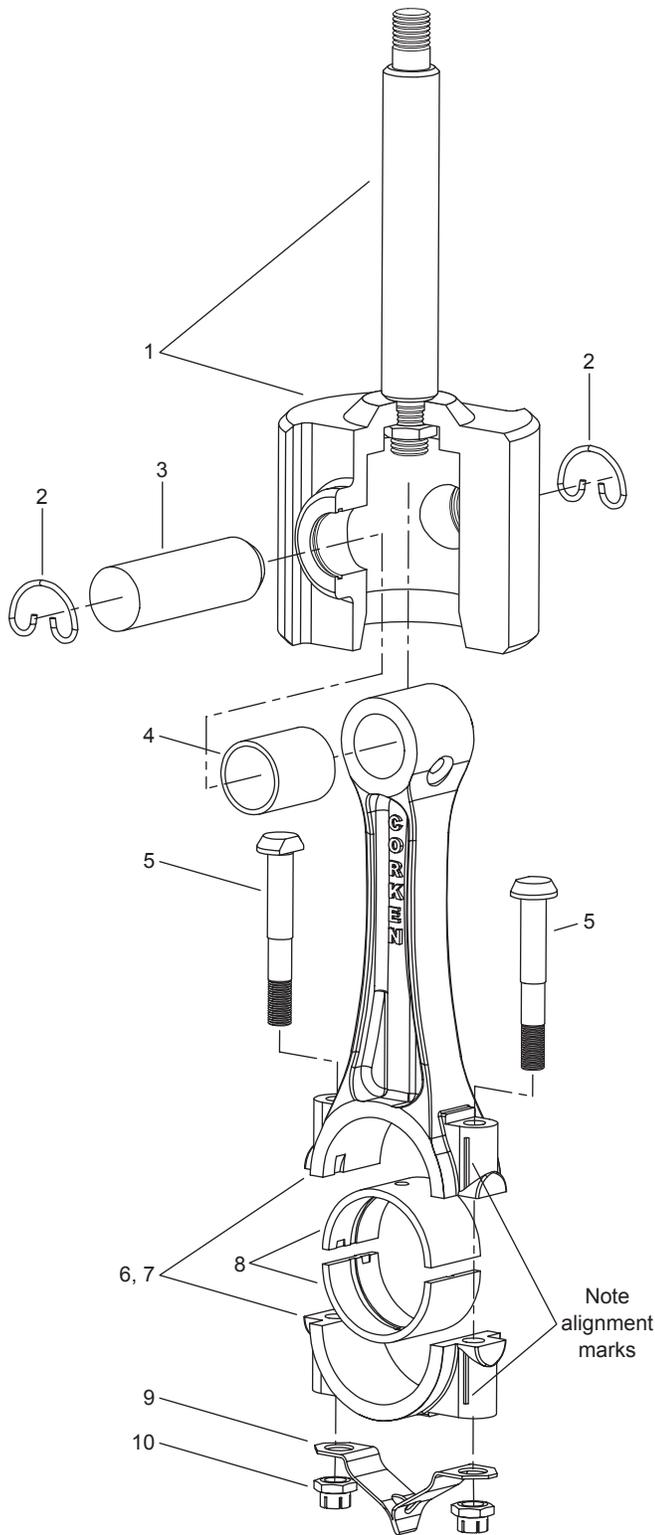
<sup>b</sup> The quantity of 1454 packing rings required will vary due to tolerances. Use cone 4005 for installation of packing.

<sup>c</sup> Registered trademark of the DuPont company.

<sup>d</sup> Optional equipment

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix G—91 and F91 Connecting Rod Assembly Details



## Connecting Rod Assembly Bill of Materials

Ref No.	Part No.	Description
1.	1132-X2	Crosshead assembly
2.	1498	Retainer ring
3.	2505	Wrist pin
4.	1846-X <sup>a,b</sup>	Wrist pin bushing
5.	1599 <sup>b</sup>	Bolt
6.	1889-1X	Connecting rod assembly
7.	1889-1 <sup>b</sup>	Connecting rod
8.	1367 <sup>b</sup>	Connecting rod bearing
9.	2011 <sup>b</sup>	Dipper
10.	1600 <sup>b,c</sup>	Nut

<sup>a</sup> Must be rebored after replacing (0.8754/0.8751 dia.)

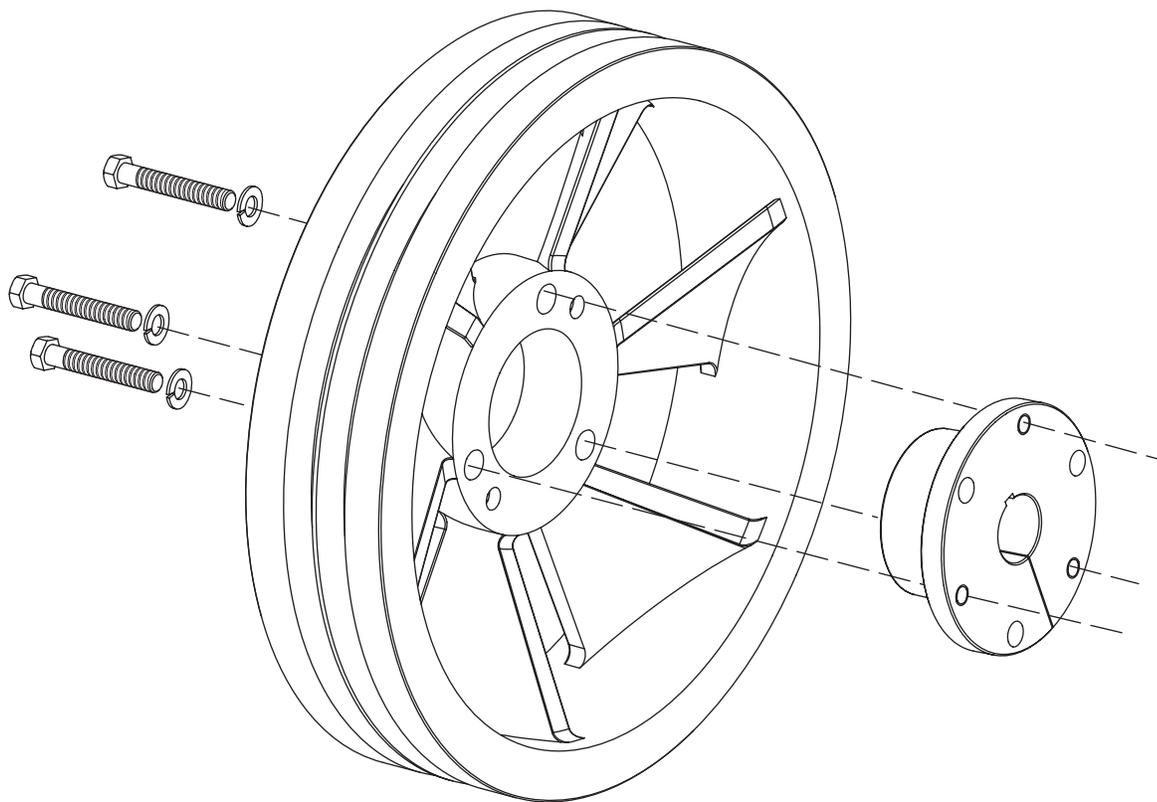
<sup>b</sup> Included with connecting rod assembly

<sup>c</sup> Torque connecting rod nut to 28 ft. lbs.

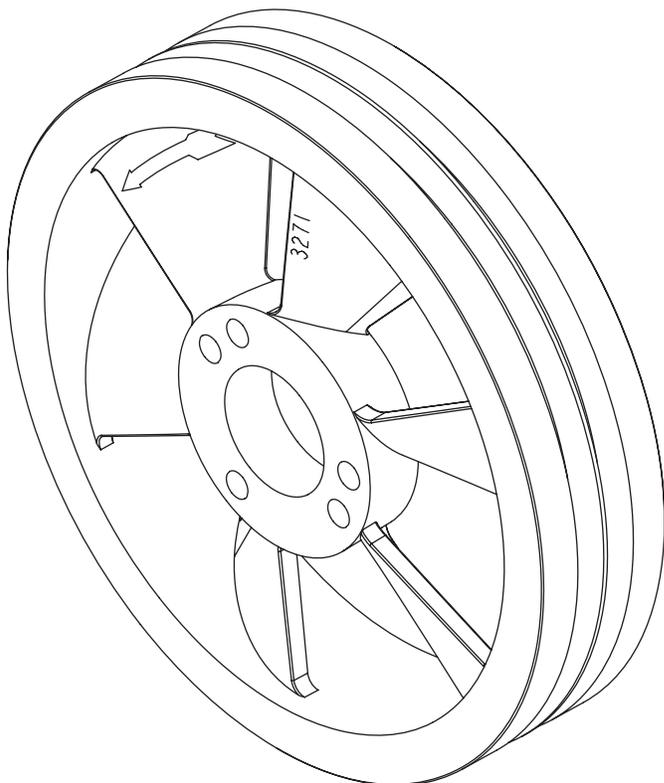
Never attempt to separate the piston rod and crosshead. When repair becomes necessary, the entire crosshead assembly must be replaced.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix G—91 and F91 Flywheel Assembly Details



Back Side

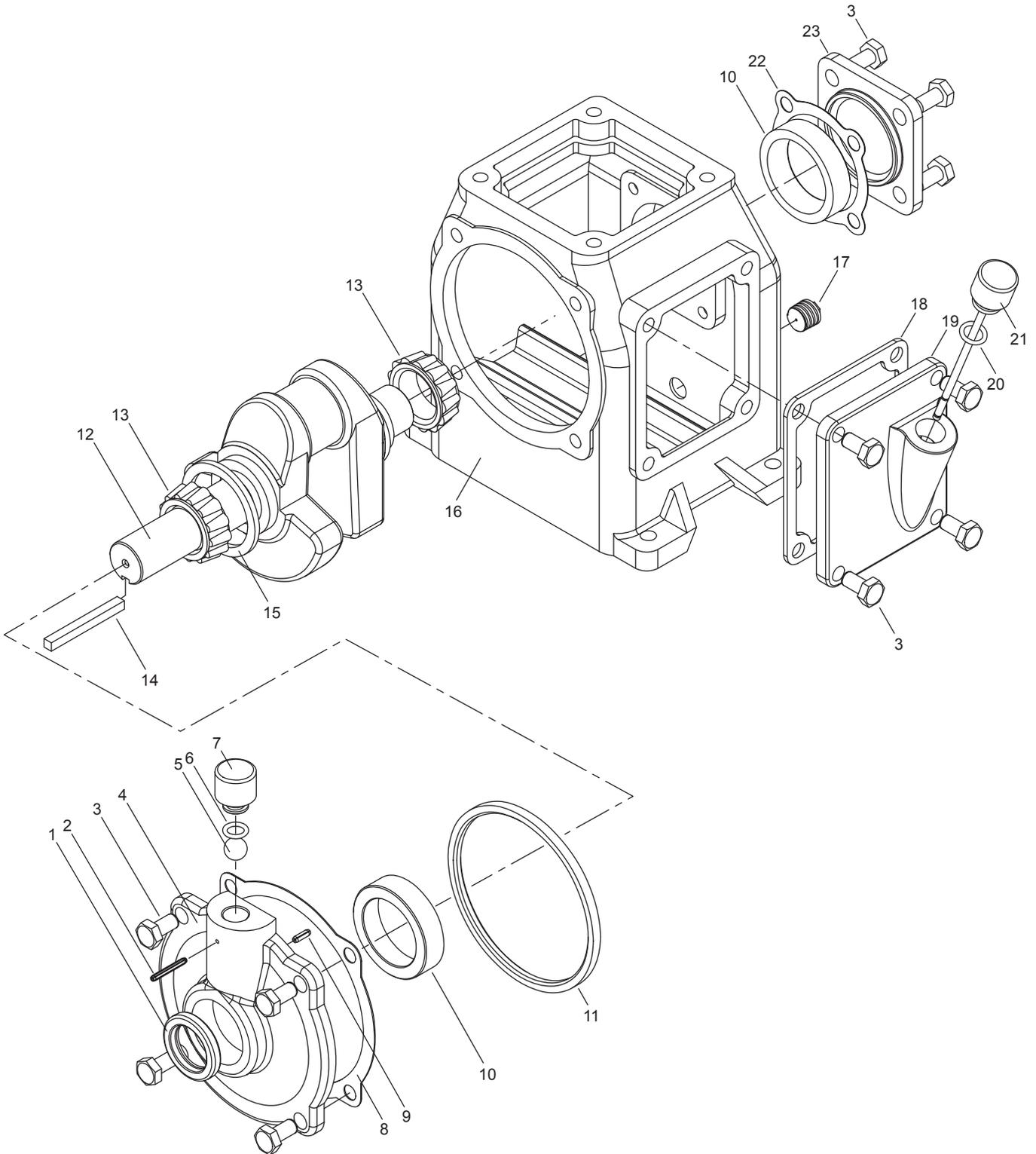


Front Side

## Flywheel Assembly Bill of Materials

Assembly Number	Assembly Name
3271-X2	Flywheel assembly (flywheel, hub, and three bolts)
3271	Flywheel: 14" O.D., 2 groove
H SF-1.125	Hub with three bolts and lockwashers

# Appendix G—91 and F91 Crankcase Assembly Details



# Appendix G—91 and F91 Crankcase Assembly Details

## Crankcase Assembly Bill of Materials

Ref No.	Part No.	Description
1.	3259	Oil seal
2.	1483	Roll pin - 1/8 x 1"
3.	7001-037NC075A	Hex head 3/8-16 x 3/4", Gr 5
4.	3260	Bearing carrier
5.	2796	Breather ball
6.	1279-X	O-ring (part of bearing cap assembly)
7.	1279-X	Breather cap assembly (with O-ring - ref. no. 6)
8.	2725	Bearing carrier gasket
9.	1807	Roll pin - 1/8 x 5/8"
10.	2718	Bearing cup
11.	2723	Oil circulating ring
12.	2476	Crankshaft
13.	2719	Bearing cone
14.	2289	Flywheel key
15.	2290	Oil ring retainer washer
16.	2554 <sup>a</sup>	Crankcase
17.	1661	Pipe plug - 3/8 NPT sq. or hex
18.	2729	Inspection plate gasket
19.	2728	Crankcase inspection plate
20.	2-112_ <sup>c</sup>	O-ring
21.	1368-X1	Oil bayonet assembly (with O-ring)
22.	2721	Bearing adjustment shim (0.005)
	2721-1	Bearing adjustment shim (0.007)
	2721-2	Bearing adjustment shim (0.020)
23.	2720	Bearing cap

## Other Assemblies

Assembly Number	Assembly Name
2476-X	Crankshaft assembly with 2476, 2290 and 2719
2476-SX <sup>b</sup>	Extended crankshaft assembly with 2719 (2) and 2290, (optional)
3260-X	Bearing carrier assembly with 3260, 2718, 3259, 1279-X, 2-111, 1483, 2796 and 1807
3271-X2 <sup>b</sup>	Flywheel assembly 14" - 2 groove with H SF-1.125 and 3271

O-ring Code	
A	Buna-N
B	Neoprene <sup>®c</sup>

<sup>a</sup> Crankcase capacity: 0.9 quarts (0.8 liters)

<sup>b</sup> Optional

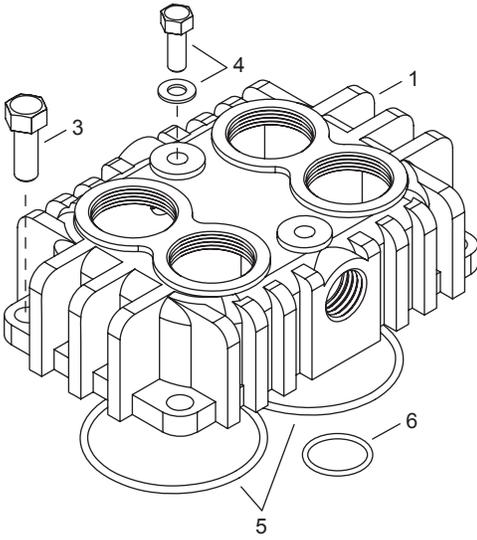
<sup>c</sup> \_ denotes O-ring code. See O-ring chart above for details.

<sup>d</sup> Registered trademark of the DuPont company.

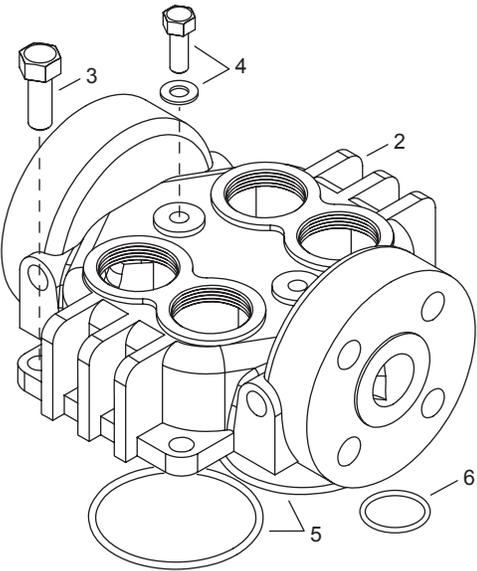
**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix H—291 and F291 Head and Valve Assembly Details

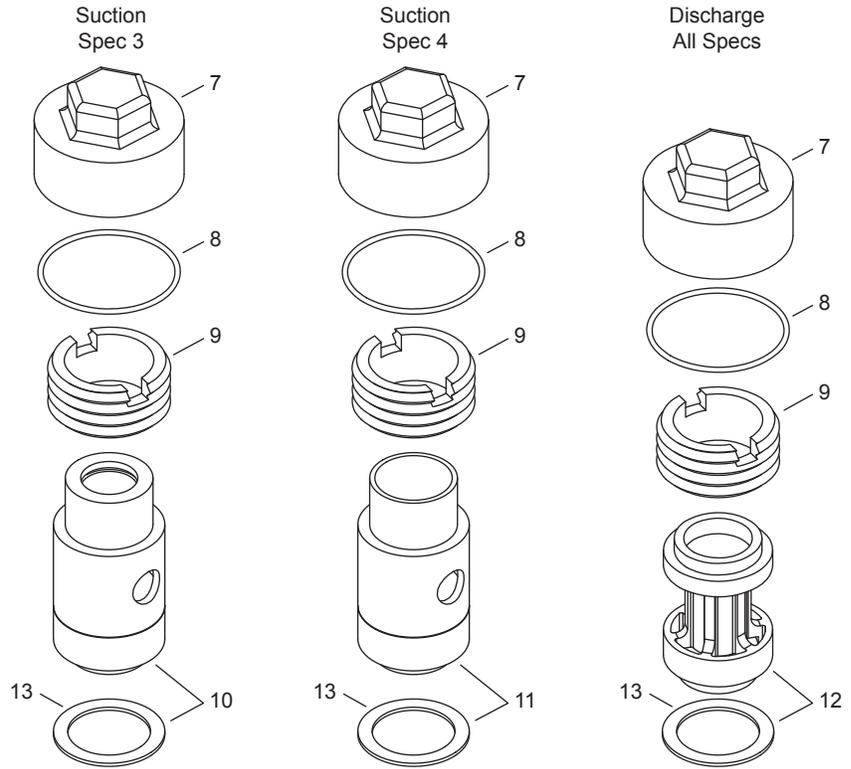
## 291 Head Assembly



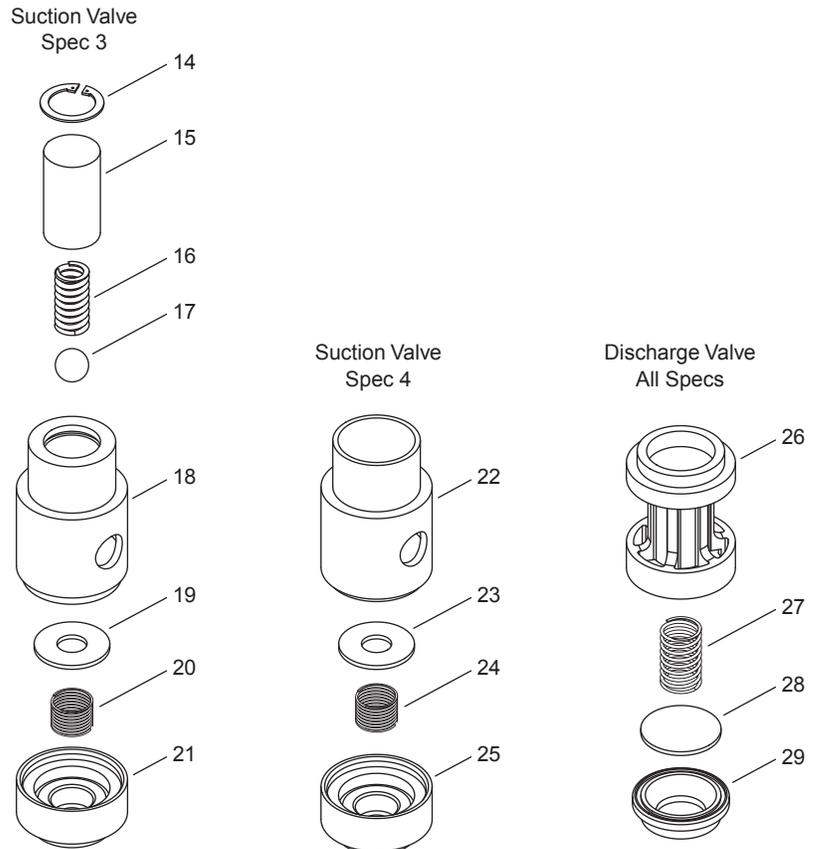
## F291 Head Assembly



## Valve Holddown Assemblies



## Valve Assemblies Details



# Appendix H—291 and F291 Head and Valve Assembly Details

## Head and Valve Bill of Materials

Ref No.	Part No.	Description
1.	2912	Head model 291
	2912-X1	Head assy. for model 291 (spec 3)
	2912-X2	Head assy. for model 291 (spec 4)
2.	4300	Head model F291 (ANSI flange)
3.	7001-037 NC100A	Bolt, 3/8-16 x 1" Gr.5 hex head
4.	2731	Center headbolt
	2732	Gasket for center headbolt
5.	2-235 <sub>b</sub>	O-ring
6.	2-113 <sub>b</sub>	O-ring
7.	2714-1	Valve cap
8.	2-031 <sub>b</sub>	O-ring
9.	2715	Holddown screw
10.	3483-1X	Suction valve assy. (spec 3)
	3483-1X1 <sup>a</sup>	Same as above but with copper gaskets
	3483-1X2 <sup>a</sup>	Same as above but with iron-lead gaskets
11.	3483-X	Suction valve assy. (spec 4)
	3483-X1 <sup>a</sup>	Same as above but with copper gaskets
	3483-X2 <sup>a</sup>	Same as above but with iron-lead gaskets
12.	3485-X	Discharge valve assy. (all specs)
	3485-X1 <sup>a</sup>	Same as above but with copper gaskets
	3485-X2 <sup>a</sup>	Same as above but with iron-lead gaskets
13.	2717	Valve gasket (aluminum)
	2717-1 <sup>a</sup>	Valve gasket (copper)
	2717-2 <sup>a</sup>	Valve gasket (iron-lead)
14.	5000-77	Retainer ring (spec 3)
15.	3977	Suction valve relief housing
16.	1411	Spring (spec 3)
17.	1410	Ball (spec 3)
18.	3483-1	Suction valve seat (spec 3)
19.	3972	Suction valve plate (spec 3)
20.	4009	Suction spring (spec 3)
21.	3484	Suction valve bumper (spec 3)
22.	3483	Suction valve seat (spec 4)
23.	3972	Suction valve plate (spec 4)
24.	4009	Suction spring (spec 4)
25.	3484	Suction valve bumper (spec 4)
26.	3486	Discharge valve bumper
27.	4008	Discharge spring
28.	3973	Discharge valve plate
29.	3485	Discharge valve seat

O-ring Code	
A	Buna-N
B	Neoprene <sup>®c</sup>

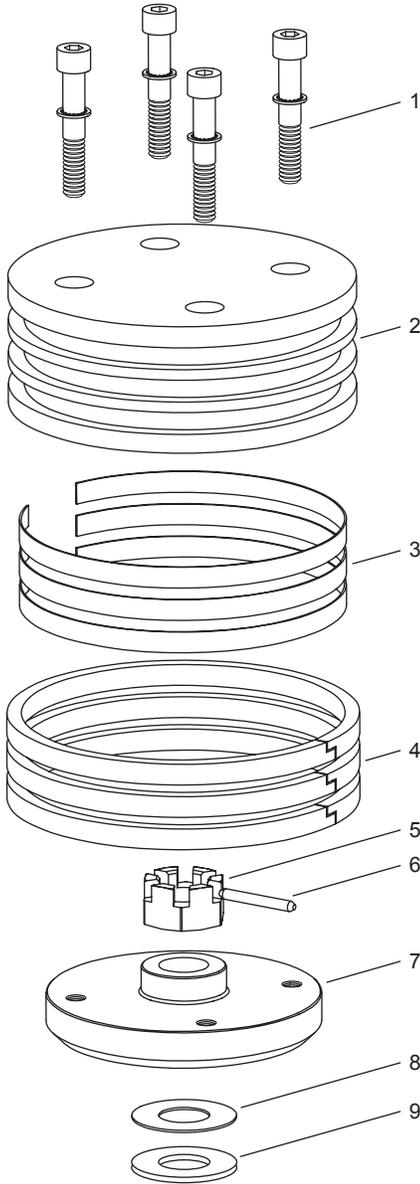
<sup>a</sup> Optional

<sup>b</sup> \_ denotes O-ring code. See O-ring chart to the left for details.

<sup>c</sup> Registered trademark of the DuPont company.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix H—291 and F291 Piston Assembly Details



**Piston Assembly Number 1983-X Bill of Materials  
Piston Diameter 3" (7.62 cm)**

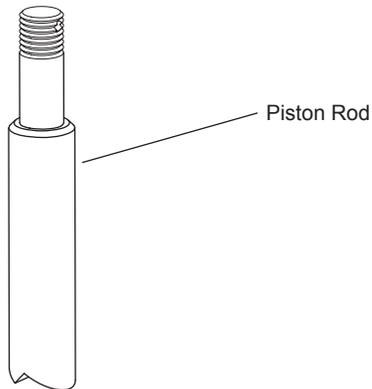
Ref No.	Part No.	Description	Qty
1.	7002-0100C100A	Screw, socket head	4
	7207-010A	Lock washer	4
2.	1983	Head, iron	1
3.	1775	Ring expander	3
4.	1772	Piston ring	3
5.	1482	Locknut	1
6.	1483	Lock pin	1
7.	1984	Piston platform	1
8.	1528	Shim washer, thick	As Req.
	1528-1	Shim washer, thin	
9.	1527	Thrust washer	1

## Piston Clearance (Cold)<sup>a</sup>

Model	Minimum	Maximum
291	0.020" (0.51 mm)	0.044" (1.12 mm)

<sup>a</sup> The distance from the bottom of the head to the top of the piston.

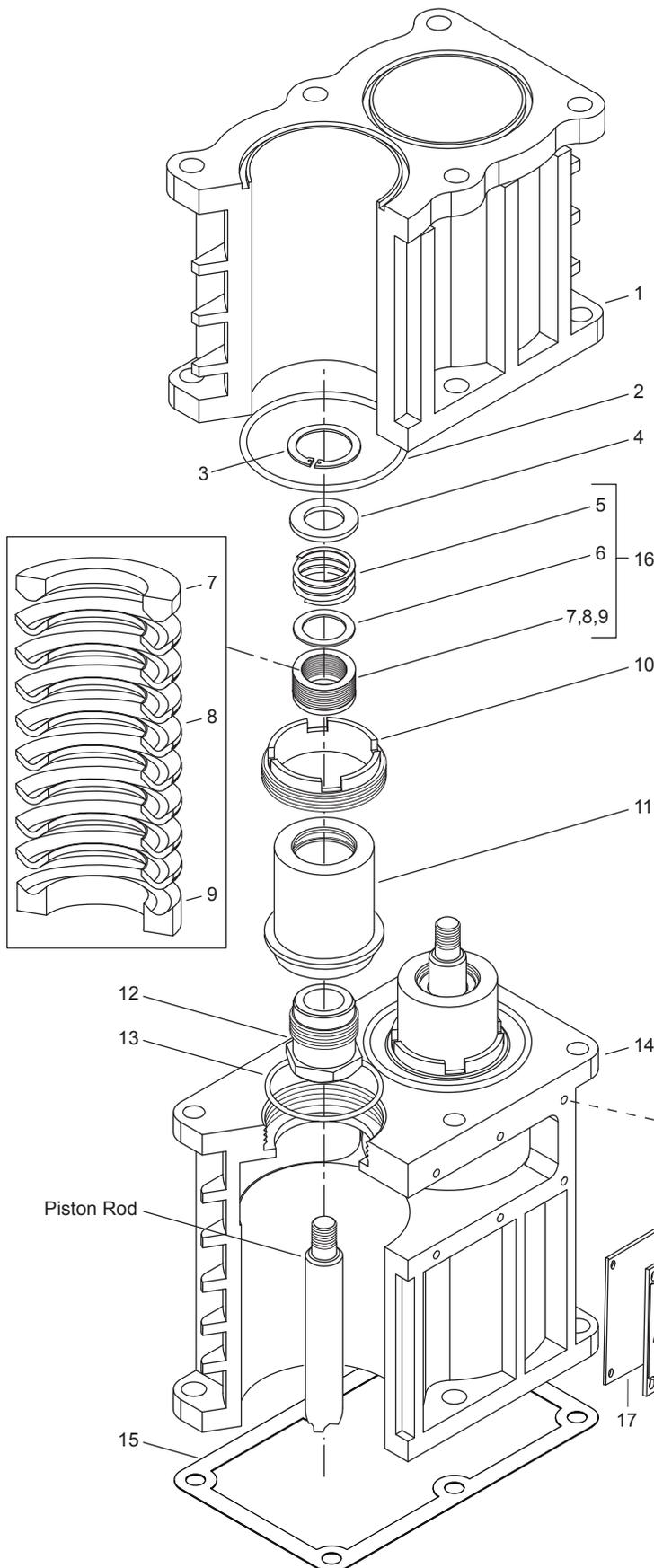
**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.



# Appendix H—291 and F291 Packing Assembly Details

## Packing Assembly Bill of Materials

Ref No.	Part No.	Description	Qty
1.	2913-1	Cylinder	1
2.	2-235_a	O-ring for cylinder	2
3.	5000-137	Retainer ring	2
4.	1012	Washer	2
5.	1628	Packing spring	2
6.	1714	Packing box washer	2
7.	1453-1	Male packing ring	2
8.	1454 <sup>b</sup>	Packing	6
9.	1452-1	Female packing ring	2
10.	4398	Cartridge holddown screw	2
11.	4394	Packing box cartridge	2
12.	1387	Adjusting screw	2
13.	2-135_a	O-ring (packing cartridge)	2
14.	4393	Crosshead guide	1
15.	2702	Crankcase gasket	1
16.	1452-1X1	Packing set	2
17.	1651	Inspection plate gasket	1
18.	1650	Inspection plate	1
19.	7003-025NC037E	1/4-20x3/8"	4
not shown	1192	Locking device	4



## Other Assemblies

Assembly Number	Assembly Name	Qty
1132-X2	Crosshead assembly	2
1452-1X1	Packing set with 1452-1, 1453-1, 1454 (8), 1628, 1714	2

O-ring Code	
A	Buna-N
B	Neoprene <sup>®c</sup>

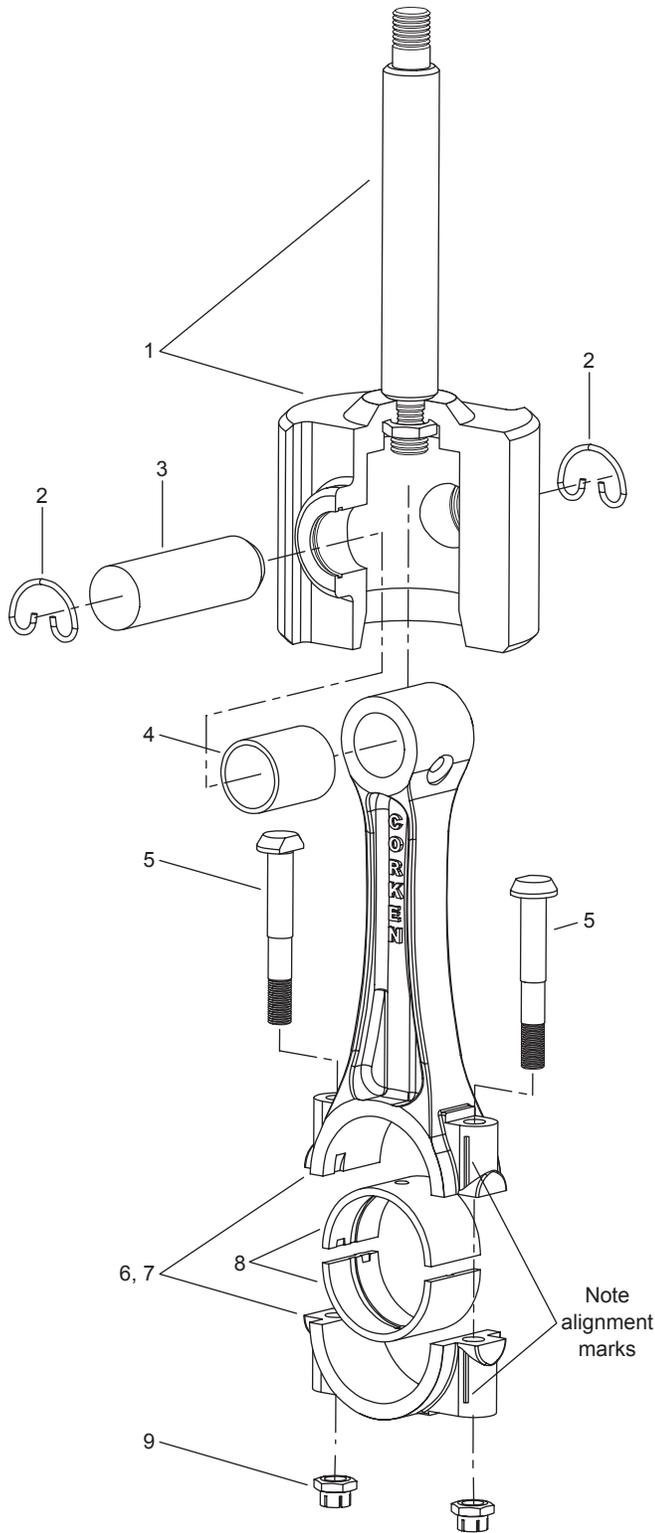
<sup>a</sup> \_ denotes O-ring code. See O-ring chart above for details.

<sup>b</sup> The quantity of 1454 packing rings required will vary due to tolerances. Use Cone 4005 for installation of packing.

<sup>c</sup> Registered trademark of the DuPont company.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix H—291 and F291 Connecting Rod Assembly Details



## Connecting Rod Assembly Bill of Materials

Ref No.	Part No.	Description
1.	1132-X2 <sup>a</sup>	Crosshead assembly
2.	1498	Retainer ring
3.	2505	Wrist pin
4.	1846-X <sup>a,b</sup>	Wrist pin bushing
5.	1599 <sup>b</sup>	Bolt
6.	1889-X	Connecting rod assembly
7.	1889 <sup>b</sup>	Connecting rod
8.	1367 <sup>b</sup>	Connecting rod bearing
9.	1600 <sup>b,c</sup>	Nut

<sup>a</sup> Must be rebored after replacing (0.8754/0.8751 dia.)

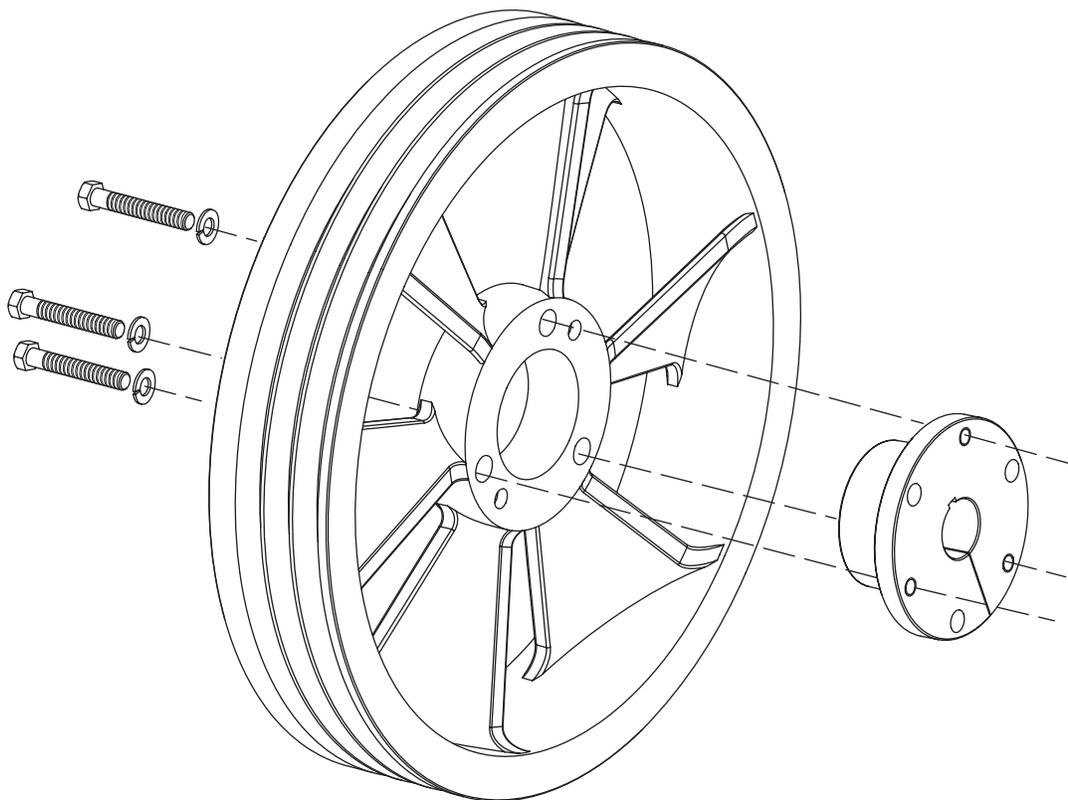
<sup>b</sup> Included with connecting rod assembly

<sup>c</sup> Torque connecting rod nut to 28 ft. lbs.

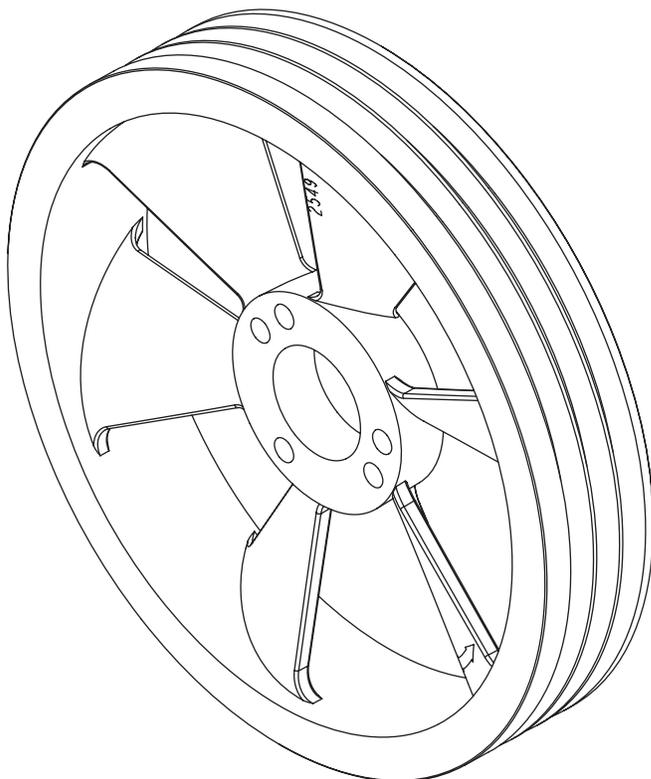
*Never attempt to separate the piston rod and crosshead. When repair becomes necessary, the entire crosshead assembly must be replaced.*

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix H—291 and F291 Flywheel Assembly Details



Back Side

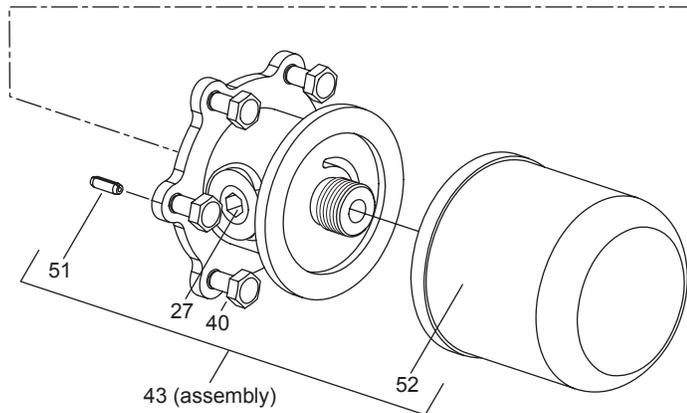
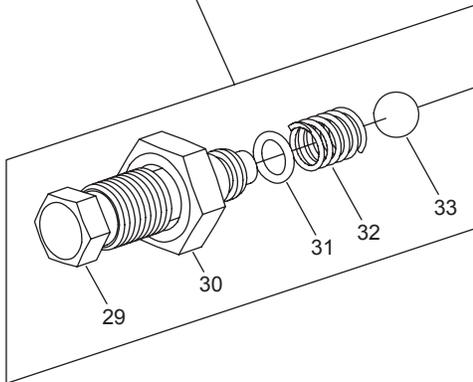
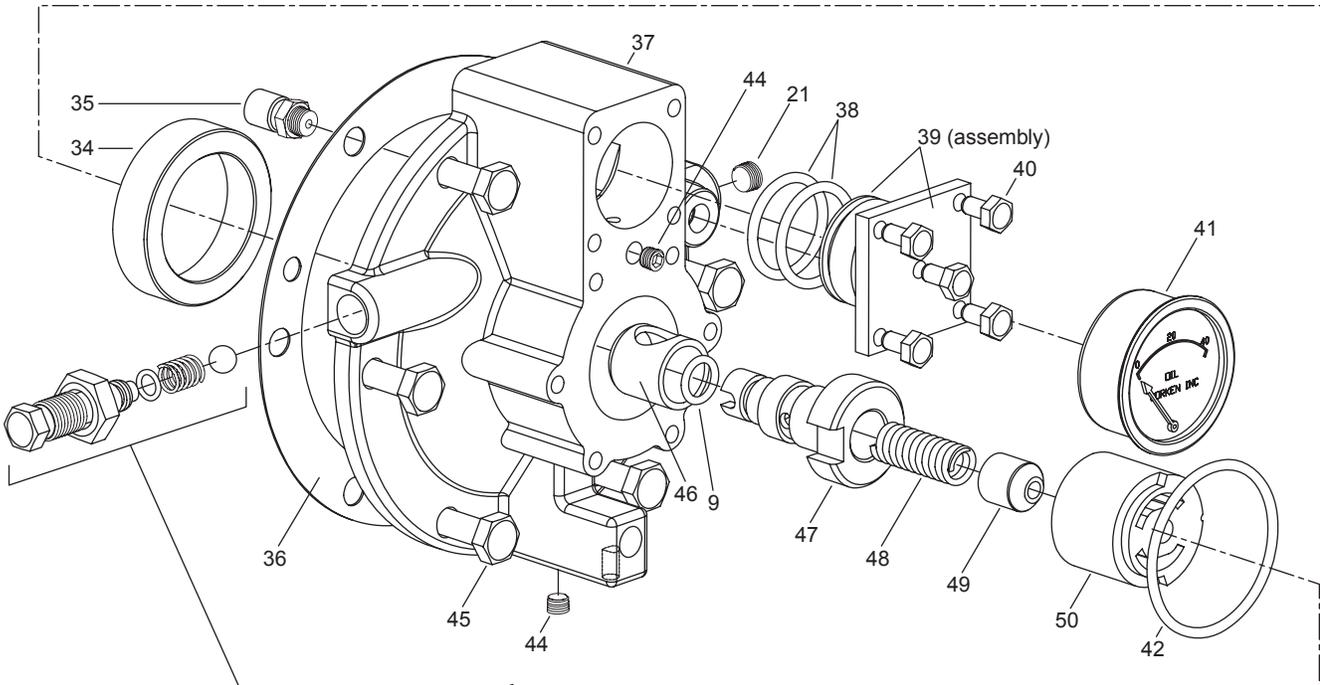
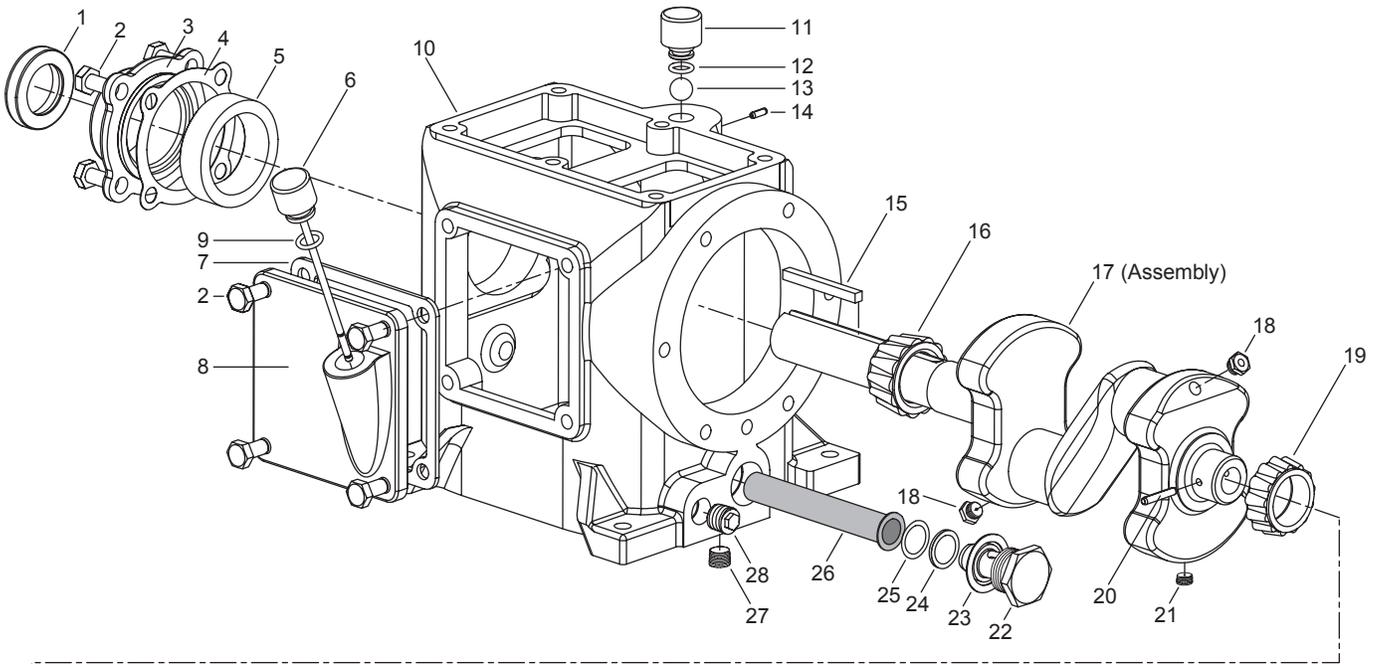


Front Side

## Flywheel Assembly Bill of Materials

Assembly Number	Assembly Name
2549-X1	Flywheel assembly (flywheel, hub, and three bolts)
2549	Flywheel: 16" O.D., 3 groove
H SF-1.250	Hub with three bolts and lockwashers

# Appendix H—291 and F291 Crankcase Assembly Details



# Appendix H—291 and F291 Crankcase Assembly Details

## Crankcase Assembly Bill of Materials

Ref No.	Part No.	Description
1.	1278	Oil seal
2.	7001-037NC075A	Bolt, 3/8-16 x 3/4, hex head
3.	2957	Bearing cover
4.	1273	Bearing adjustment shim (0.005")
	1273-1	Bearing adjustment shim (0.007")
	1273-2	Bearing adjustment shim (0.020")
5.	1500	Bearing cup
6.	1368-X	Oil bayonet
7.	2713	Crankcase inspection plate gasket
8.	2958	Crankcase inspection plate
9.	2-112 <sub>c</sub>	O-ring
10.	2955 <sup>a,b</sup>	Crankcase
11.	1279	Breather cap
12.	2-111 <sub>c</sub>	O-ring (breather cap)
13.	2796	Breather ball
14.	1483	Lock pin - 1/8 x 1"
15.	1671	Flywheel key
16.	1501	Bearing cone
17.	1341-X1	Crankshaft assembly with 1284 (2), 1286, 1341, 1501, 2590, 2719
18.	1284	Crankshaft orifice (2)
19.	2719	Bearing cone
20.	1286	Pump shaft drive pin
21.	2590	Pipe plug - 1/8 NPT, flush seal
22.	1280	Filter screen screw
23.	1281	Filter screen screw gasket
24.	2-116 <sub>c</sub>	O-ring (filter screen)
25.	1276	Filter screen washer
26.	1275	Oil filter screen
27.	3289	Pipe plug - 1/4 NPT, flush seal
28.	1661	Pipe plug - 3/8 NPT
29.	1290	Relief valve adjusting screw
30.	1291	Adjusting screw locknut
31.	2-011 <sub>c</sub>	O-ring (relieve valve adjustment screw)
32.	1292	Relief valve spring
33.	1293	Relief valve ball
34.	2718	Bearing cup
35.	2961-X	Air release valve assembly with 2961, 2962, 2963
36.	1285	Bearing carrier gasket
37.	2956	Bearing carrier
38.	2-218 <sub>c</sub>	O-ring (closure body) (2 required) (Spec 3, 4, 8, 9 only)
39.	1515-X	Closure cap assembly including 2-218A(2) (Spec 3, 4, 8, 9 only)
40.	7001-025NC050A	Bolt, 1/4-20 x 1/2, hex head
41.	1302	Oil pressure gauge
42.	2-228 <sub>c</sub>	O-ring (pump cover)
43.	4222-X	Oil filter assembly
44.	1629	Pipe plug - 1/16 NPT, flush seal
45.	7001-037NC100A	Bolt, 3/8-16 x 1, hex head
46.	2805	Pump shaft bushing
47.	2850	Pump shaft adapter
48.	2852	Oil pump spring
49.	2851	Spring guide
50.	2849-X	Oil pump assembly (individual pump parts not available)
51.	2798	Pump cover pin with 2848-X
	2848-X	Pump cover (includes pin)
52.	4225	Filter

## Other Assemblies

Assembly Number	Assembly Name
1279-X	Breather cap assembly with 1279, 2-111A
1341-X1	Crankshaft assembly with 1284 (2), 1286, 1341, 1501, 2590, 2719
1342-X1 <sup>a</sup>	Extended crankshaft assembly with 1284 (2), 1286, 1342, 1501, 2590, 2719
1368-X1	Oil bayonet assembly with 1368-X, 2-112A
1515-X	Closure cap assembly including 2-218A (2) (Spec 3, 4, 8, 9 only)
2956-X	Bearing carrier assembly with 1285, 1290, 1291, 1292, 1293, 1515-X, 2718, 2805, 2806 (2), 2848-X, 2849-X, 2850, 2851, 2852, 2956, 2961-X, 2011-A, 2-112A, 2-228A.
2957-X	Bearing cover assembly with 2957 and 1278
2961-X	Air release valve assembly with 2961, 2962, 2963
3271-X1 <sup>a</sup>	Flywheel assembly, 14" O.D. 2 groove with 3218 and 3271 (not part of crankcase assembly) (not shown)

### O-ring Code

A	Buna-N
B	Neoprene <sup>®d</sup>

<sup>a</sup> Optional equipment

<sup>b</sup> Crankcase capacity: 1.5 quarts (1.4 liters)

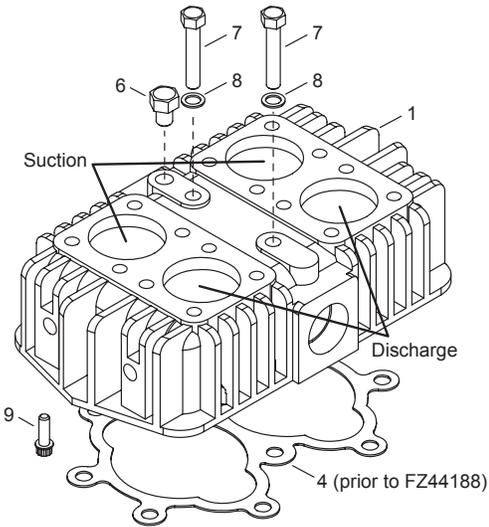
<sup>c</sup> \_ denotes O-ring code. See O-ring chart above for details.

<sup>d</sup> Registered trademark of the DuPont company.

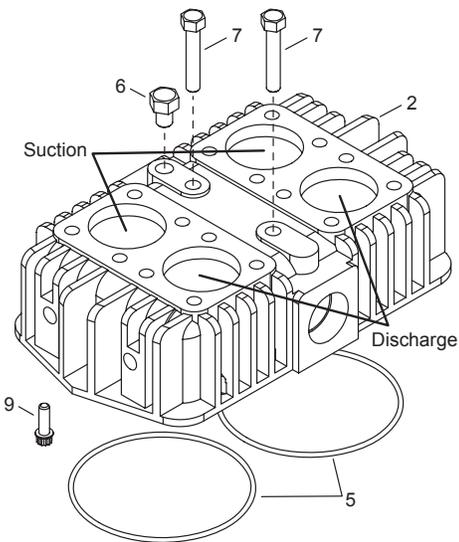
**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix I—490, 491, and F491 Head and Valve Assembly Details

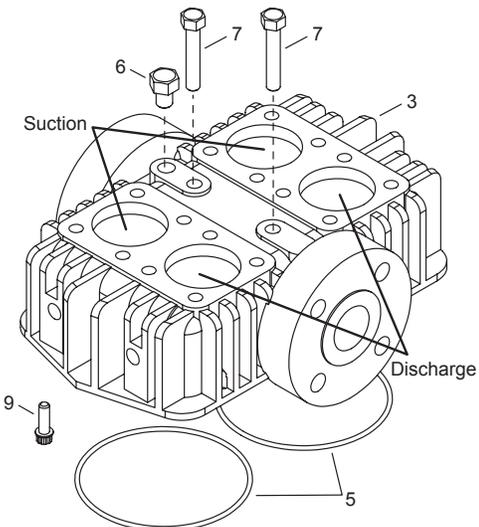
## 490 and 491 Head Assembly



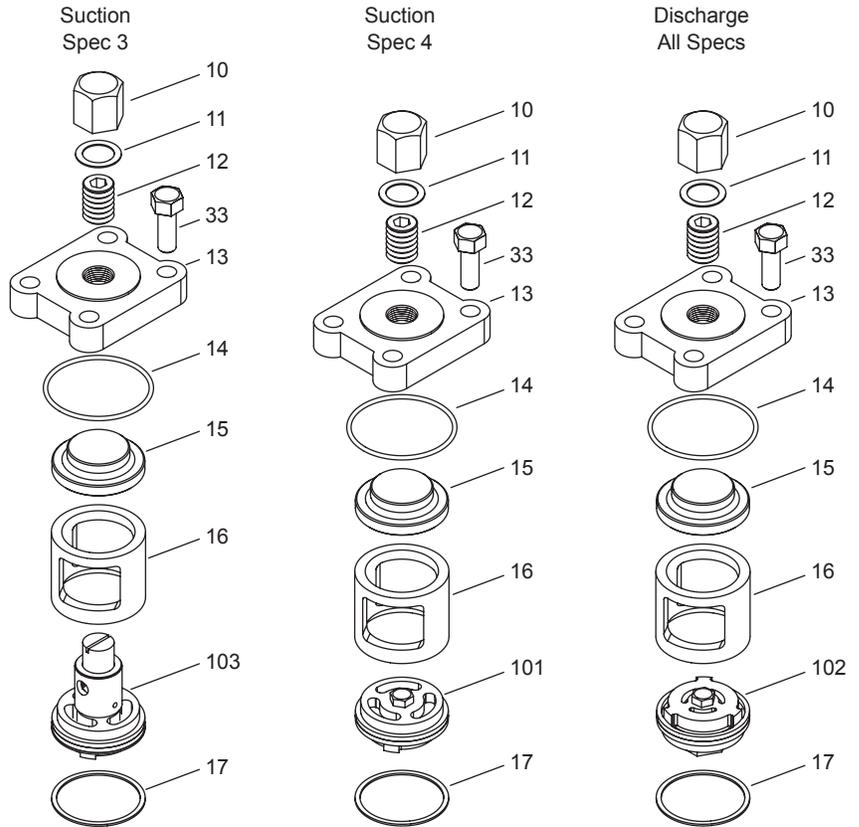
## 491 Head Assembly



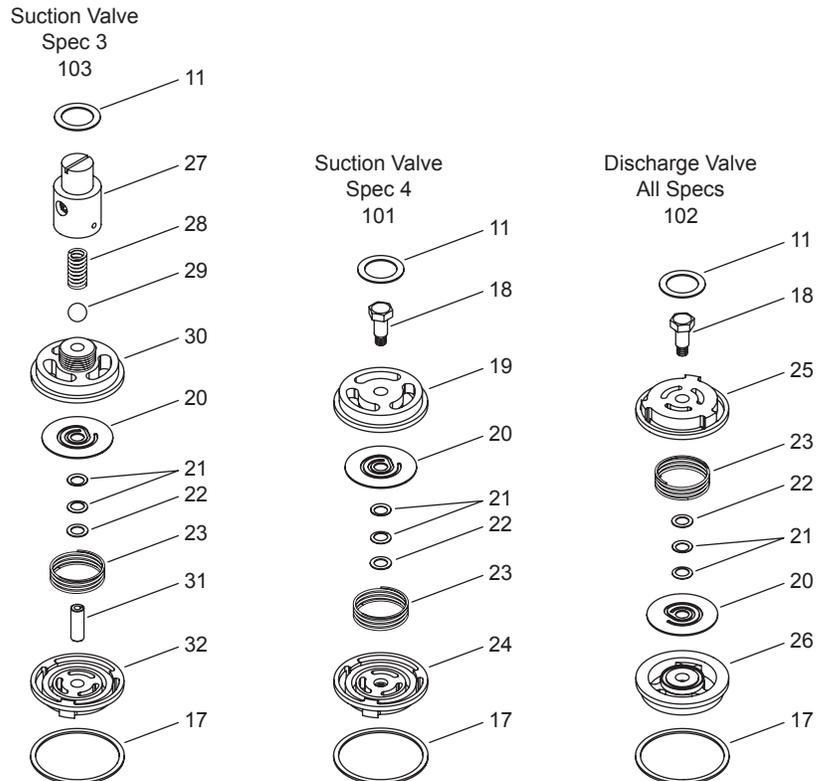
## F491 Head Assembly



## Valve Holddown Assemblies



## Valve Assemblies



# Appendix I— 490, 491, and F491 Head and Valve Assembly Details

## Compressor Head and Valve Bill of Materials

Ref No.	Part No.	Description
1.	2914 <sup>d</sup>	Head—ductile iron (491)
2.	3712 <sup>e</sup>	Head—ductile iron (491)
3.	4297	Head—ANSI flanged (F491)
	4297-1	Head flanged - Din spec. only (F492)
4.	1481 <sup>c</sup>	Head gasket (490 and 491)
5.	2-253_ <sup>b,c,e</sup>	O-ring (491)
6.	3442	Pipe plug—1/4" NPT
7.	1479 <sup>c</sup>	Center head bolt
8.	1480-1 <sup>c</sup>	Center head bolt gasket (copper)
	1480 <sup>c</sup>	Center head bolt gasket (steel)
9.	7005-043NC125A <sup>c</sup>	Bolt, 7/16-14 x 1-1/4" ferry head (490 & 491 prior to serial # FZ44188)
	7005-043NC150A <sup>c</sup>	Bolt, 7/16-14 x 1-1/2" ferry head (491 serial # FZ44188 and later)
10.	1477	Valve screw nut
11.	1478	Gasket (steel)
	1478-1 <sup>a</sup>	Gasket (copper)
	1478-2	Gasket (iron)
12.	1476	Valve holddown screw
13.	1475	Valve cover plate
14.	2-143_ <sup>b</sup>	O-ring for cover plate
15.	1409 <sup>f</sup>	Valve spacer
16.	2448	Cage
17.	1418	Valve gasket (aluminum)
	1418-1 <sup>a</sup>	Valve gasket (copper)
	1418-2 <sup>a</sup>	Valve gasket (iron)
18.	2446	Bolt
19.	2438	Suction valve seat
20.	2442	Valve plate
21.	2445 <sup>f</sup>	Spacer (two per valve)
22.	3355	Washer
23.	1407	Valve spring
24.	2440	Suction valve bumper
25.	2441	Discharge valve bumper
26.	2439	Discharge valve seat
27.	2533-1	Adjusting screw
28.	1411	Relief ball spring
29.	1410	Relief ball
30.	2532-1	Suction valve seat
31.	2534-1	Suction valve post
32.	2447	Suction valve bumper
33.	7001-043NC125A	Bolt (7/16-14 x 1-1/4" hex head)

Ref No.	Valve Assembly No.	Assembly Name
101.	2438-X	Suction valve assembly (see ref. no. 7, 17, 18, 19, 20, 21(2), 22, 23, 24)
	2438-X1 <sup>a</sup>	Same as 2438-X but with copper gaskets
	2438-X2 <sup>a</sup>	Same as 2438-X but with iron-lead gaskets
102.	2439-X	Discharge valve assembly (see ref. no. 7, 17, 18, 20, 21(2), 22, 26, 25)
	2439-X1 <sup>a</sup>	Same as 2439-X but with copper gaskets
	2439-X2 <sup>a</sup>	Same as 2439-X but with iron-lead gaskets
103.	2532-1X	Suction valve assembly (spec. 3) with aluminum
	2532-1X1 <sup>a</sup>	Same as 2532-1X but with copper
	2532-1X2 <sup>a</sup>	Same as 2532-1X but with iron-lead

Head Assembly No.	Model	Valve Specification
2914-X2 <sup>d</sup>	491	4
2914-X4 <sup>d</sup>	491	3
3712-X1 <sup>e</sup>	491	3
3712-X2 <sup>e</sup>	491	4
4297-X1	F491	3
4297-X2	F491	4
4297-1X1	F492	3
4297-1X2	F492	4

O-ring Code	
A	Buna-N
B	Neoprene <sup>®g</sup>

<sup>a</sup> Optional equipment

<sup>b</sup> \_ denotes O-ring code. See O-ring chart above for details.

<sup>c</sup> Not included in Head Assembly.

<sup>d</sup> Prior to S/N FZ44188.

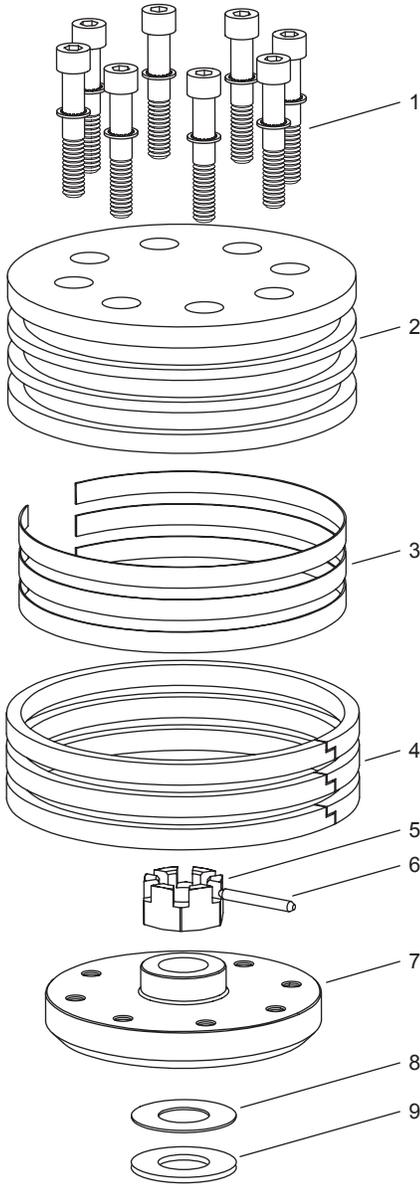
<sup>e</sup> S/N FZ44188 and later.

<sup>f</sup> Place spacers back to back as shown.

<sup>g</sup> Registered trademark of the DuPont company.

**CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.**

# Appendix I—490, 491, and F491 Piston Assembly Details



**Piston Assembly Number 1985-X Bill of Materials**  
**Piston Diameter 4" (10.16 cm)**

Ref No.	Part No.	Description	Qty
1.	7002-025OC125A	Screw, socket head	8
	7207-025A	Lock Washer	8
2.	1985	Head, iron	1
3.	1776	Ring expander	3
4.	1773	Piston ring	3
5.	1482	Locknut	1
6.	1483	Lock pin	1
7.	1986	Piston platform	1
8.	1528	Shim washer, thick	As Req.
	1528-1	Shim washer, thin	
9.	1527	Thrust washer	1

## Piston Clearance (Cold)<sup>a</sup>

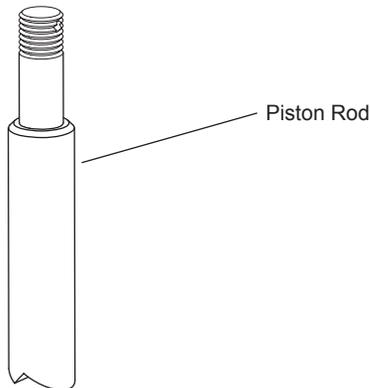
Model	Minimum	Maximum
490	0.000" (0.00 mm)	0.024" (0.61 mm)
491 <sup>b</sup>		
491 <sup>c</sup>	0.020" (0.51 mm)	0.044" (1.12 mm)

<sup>a</sup> The distance from the bottom of the head to the top of the piston.

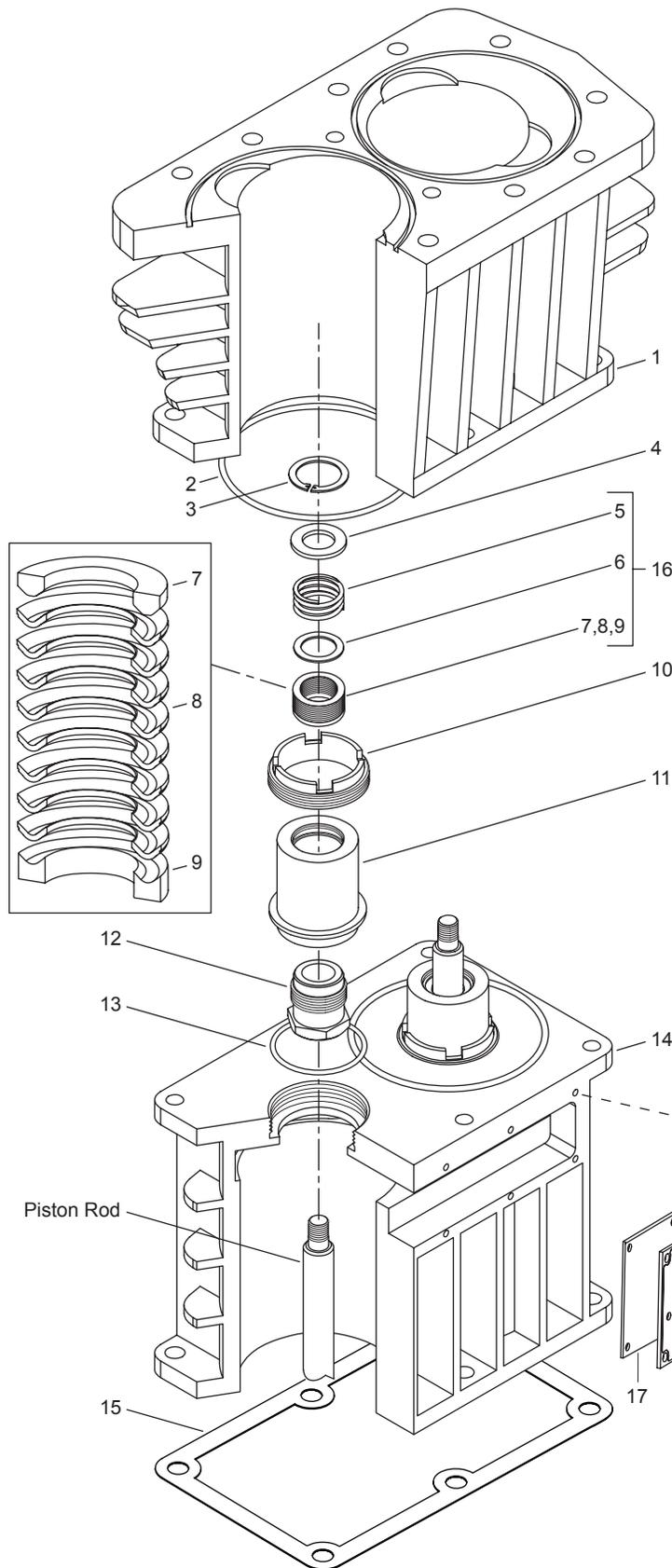
<sup>b</sup> For 491 compressor with flat gasket.

<sup>c</sup> For 491 compressor with head O-rings.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.



# Appendix I—490, 491, and F491 Packing Assembly Details



## Packing Assembly Bill of Materials

Ref No.	Part No.	Description	Qty
1.	3713 <sup>a</sup>	Cylinder (491 w/O-ring)	1
2.	2-243 <sup>b</sup>	O-ring for cylinder	2
3.	5000-137	Retainer ring	2
4.	1012	Washer	2
5.	1628	Packing spring	2
6.	1714	Packing box washer	2
7.	1453-1	Male packing ring	2
8.	1454 <sup>c</sup>	Packing ring	6
9.	1452-1	Female packing ring	2
10.	2801	Cartridge holddown screw	2
11.	2799	Packing box cartridge	2
12.	1387	Adjusting screw	2
13.	2-139 <sup>b</sup>	O-ring (packing cartridge)	2
14.	2765 <sup>d</sup>	Crosshead guide	1
15.	1489	Crankcase gasket	1
16.	1452-1X1	Packing set	2
17.	1488	Inspection plate gasket	1
18.	1487	Inspection plate	1
19.	7003-025NC037E	1/4-20x3/8"	4
not shown	1192	Locking device	4

## Additional Assembly

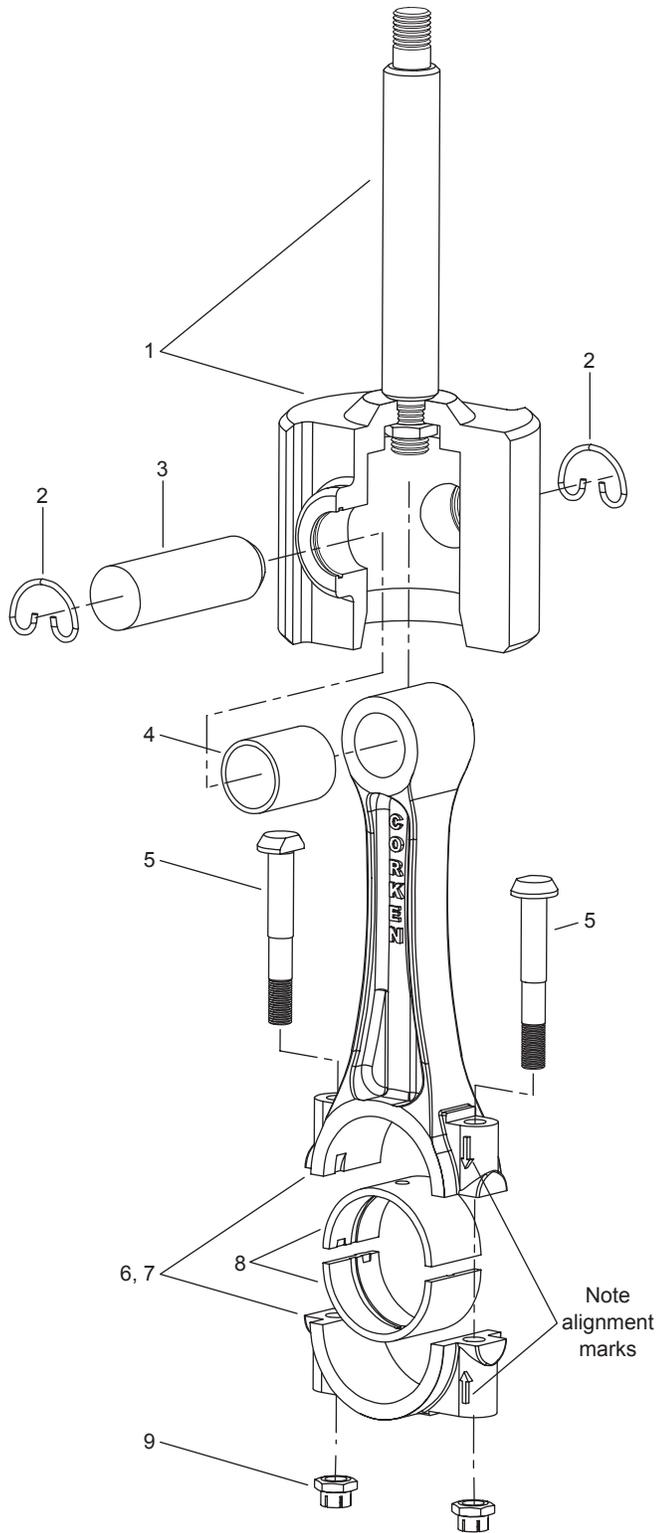
Assembly Number	Assembly Name
1384-X	Crosshead assembly

O-ring Code	
A	Buna-N
B	Neoprene <sup>®e</sup>

- <sup>a</sup> S/N FZ44188 and later  
<sup>b</sup> \_ denotes O-ring code. See O-ring chart above for details  
<sup>c</sup> The quantity of 1454 packing rings required will vary due to tolerances. Use Cone 4005 for packing installation.  
<sup>d</sup> S/N XC30633 and later  
<sup>e</sup> Registered trademark of the DuPont company.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix I—490, 491, and F491 Connecting Rod Assembly Details



## Connecting Rod Assembly Bill of Materials

Ref No.	Part No.	Description
1.	1384-X	Crosshead assembly
2.	1498	Retainer ring
3.	1496	Wrist pin
4.	1495-X <sup>a,b</sup>	Wrist pin bushing
5.	1492 <sup>b</sup>	Bolt
6.	1490-X	Connecting rod assembly
7.	1490 <sup>b</sup>	Connecting rod
8.	1491 <sup>b</sup>	Connecting rod bearing
9.	1493 <sup>b,c</sup>	Nut

<sup>a</sup> Must be rebored after replacing (0.8754/0.8751 dia.)

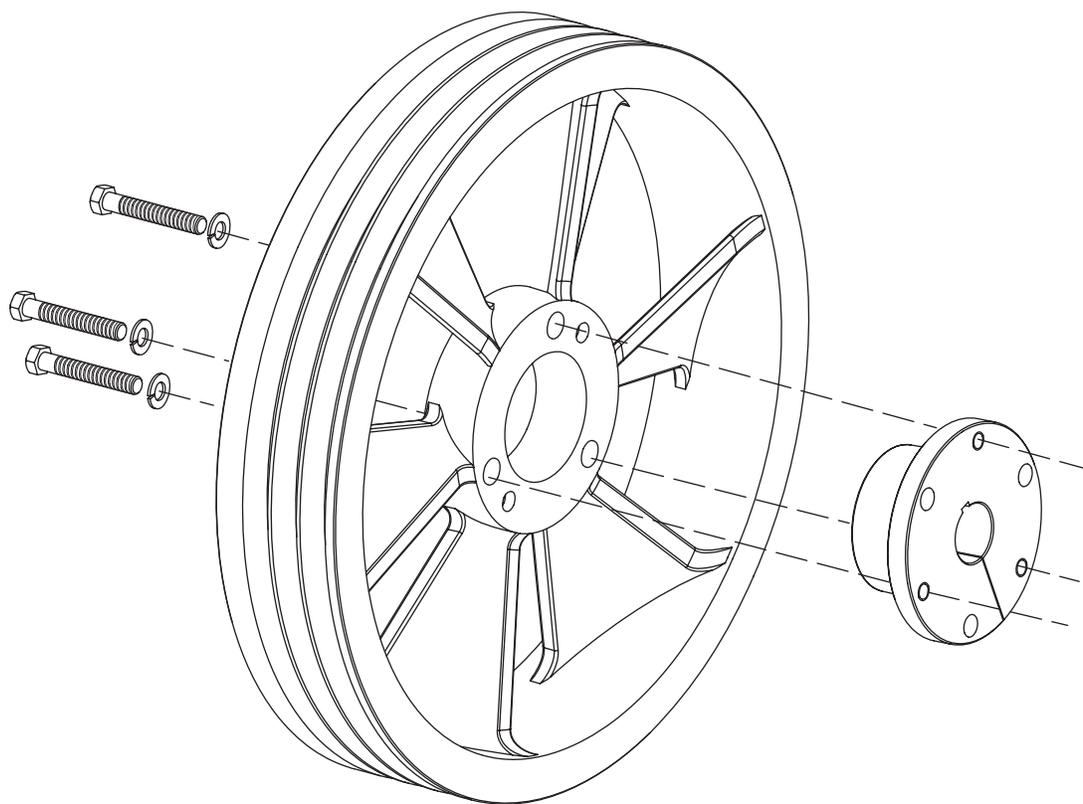
<sup>b</sup> Included with connecting rod assembly

<sup>c</sup> Torque connecting rod nut to 30 ft. lbs.

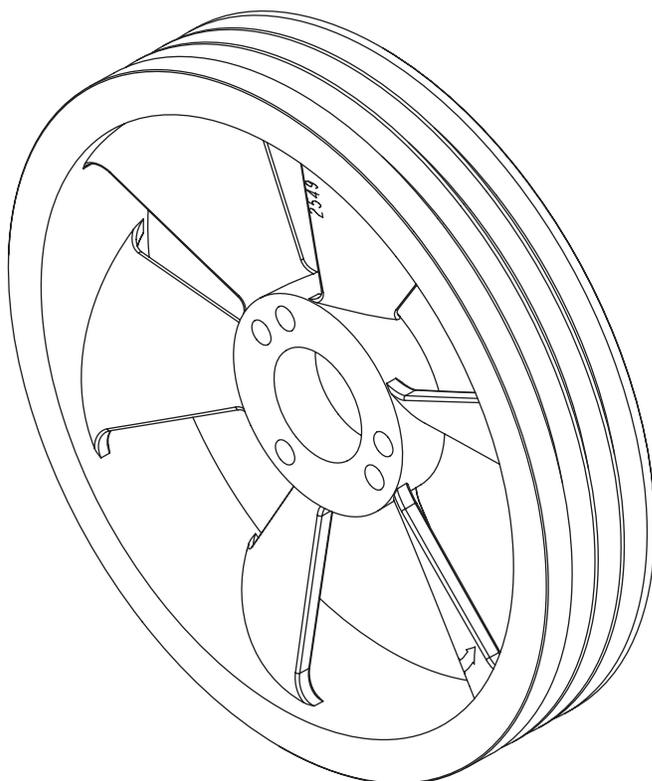
Never attempt to separate the piston rod and crosshead. When repair becomes necessary, the entire crosshead assembly must be replaced.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix I—490, 491, and F491 Flywheel Assembly Details



Back Side

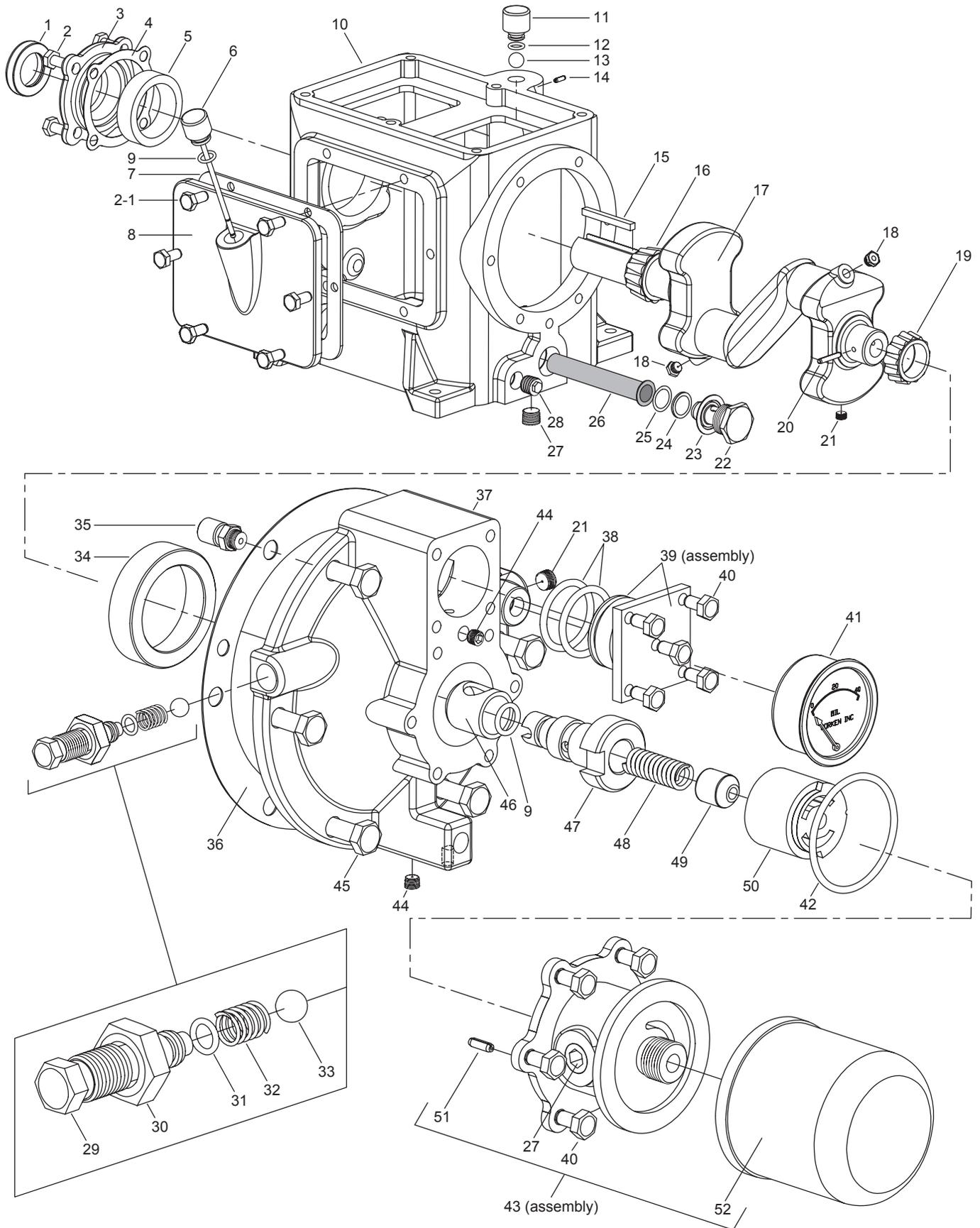


Front Side

## Flywheel Assembly Bill of Materials

Assembly Number	Assembly Name
2549-X	Flywheel assembly (flywheel, hub, and three bolts)
2549	Flywheel: 16" O.D., 3 groove
H SF-1.375	Hub with three bolts and lockwashers

# Appendix I—490, 491, and F491 Crankcase Assembly Details



# Appendix I—490, 491, and F491 Crankcase Assembly Details

## Crankcase Assembly Bill of Materials

Ref No.	Part No.	Description
1.	4438	Oil seal
2.	7001-037NC075A	Hex head bolt 3/8-16 x 3/4
2-1.	7001-031NC075A	Hex head bolt 5/16-18 x 3/4
3.	2847-1	Bearing cover
4.	1504	Bearing adjustment shim (0.005")
	1504-1	Bearing adjustment shim (0.007")
	1504-2	Bearing adjustment shim (0.020")
5.	1502	Bearing cup
6.	1508-X	Oil bayonet
7.	1511	Crankcase inspection plate gasket
8.	2853	Crankcase inspection plate
9.	2-112_ <sup>c</sup>	O-ring (oil bayonet & pump shaft)
10.	2803 <sup>b</sup>	Crankcase
11.	1279	Breather cap
12.	2-111_ <sup>c</sup>	O-ring (breather cap)
13.	2796	Breather ball
14.	1483	Lock pin
15.	1663	Flywheel key
16.	1501	Bearing cone
17.	1499-X	Crankshaft assembly with 1284 (2), 1286, 1499, 1501, 1503, 2590
	1499-SX	Extended crankshaft assembly with 1284 (2), 1286, 1499-S, 1501, 1503, 2590
18.	1284	Crankcase orifice (2)
19.	1503	Bearing cone
20.	1286	Pump shaft drive pin
21.	1459	Crankshaft plug (depends on design)
	2590	Pipe plug (depends on design)
22.	1280	Filter screw
23.	1281	Filter screen screw gasket
24.	2-116_ <sup>c</sup>	O-ring (filter screen)
25.	1276	Filter screen washer
26.	1275	Oil filter screen
27.	3289	Pipe plug
28.	1661	Plug 3/8" NPT
29.	1290	Relief valve adjusting screw
30.	1291	Adjusting screw locknut
31.	2-011_ <sup>c</sup>	O-ring (relief valve adjusting screw)
32.	1292	Relief valve spring
33.	1293	Relief valve ball
34.	1500	Bearing cup
35.	2961-X	Air release valve assembly with 2961, 2962, 2963
36.	1513	Bearing carrier gasket
37.	2804	Bearing carrier
38.	2-218_ <sup>c</sup>	O-ring (closure body) (2) (Spec. 3, 4, 8, 9 only)
39.	1515-X	Closure cap assembly
40.	7001-025NC050A	Hex head bolt 1/4-20 x 1/2
41.	1302	Oil pressure gauge

Ref No.	Part No.	Description
42.	2-228_ <sup>c</sup>	O-ring (pump cover)
43.	4222-X	Oil filter assembly - external
44.	1629	1/16" NPT pipe plug, flush seal
45.	7001-037NC100A	Hex head bolt 3/8-16 x 1
46.	2805-X	Pump shaft bushing
47.	2850	Pump shaft adapter
48.	2852	Oil pump spring
49.	2851	Spring guide
50.	2849-X	Oil pump assembly (individual pump parts not available)
51.	2798	Pump cover pin with 2848-X
	2848-X	Pump cover (includes pin)
52.	4225	Oil filter

### Other Assemblies

Assembly Number	Assembly Name
1279-X	Breather cap assembly with 1279, 2-111A
1499-X	Crankshaft assembly with 1284 (2), 1286, 1499, 1501, 1503, 2590
1499-SX <sup>a</sup>	Extended crankshaft assembly with 1284 (2), 1286, 1499-S, 1501, 1503, 2590
1508-X1	Oil bayonet assembly with 1508-X, 2-112A
1515-X	Closure cap assembly including 2-218A (2), (Spec. 3, 4, 8, 9 only)
2804-X	Bearing carrier assembly with 1290, 1291, 1292, 1293, 1500, 1513, 1515-X, 1629 (2), 2590, 2804, 2849-X, 2850, 2851, 2852, 2961-X, 2-011A, 2-112A, 2-228A, 4222-X
2847-1X	Bearing cover assembly with 2847-1, 3855
3271-X <sup>a</sup>	Flywheel assembly with 3271, 3217 (not part of crankcase assembly (not shown))

### O-ring Code

A	Buna-N
B	Neoprene <sup>®d</sup>

<sup>a</sup> Optional equipment

<sup>b</sup> Crankcase capacity: 3 quarts (2.8 liters)

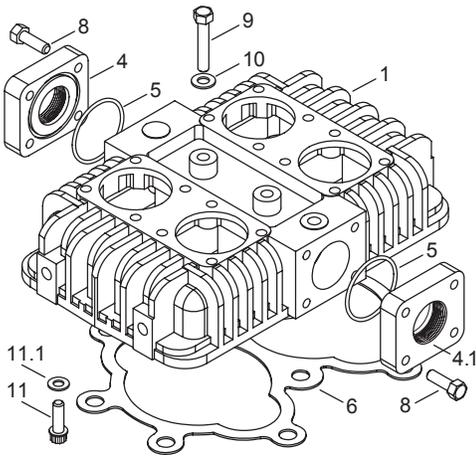
<sup>c</sup> \_ denotes O-ring code. See O-ring chart above for details.

<sup>d</sup> Registered trademark of the DuPont company.

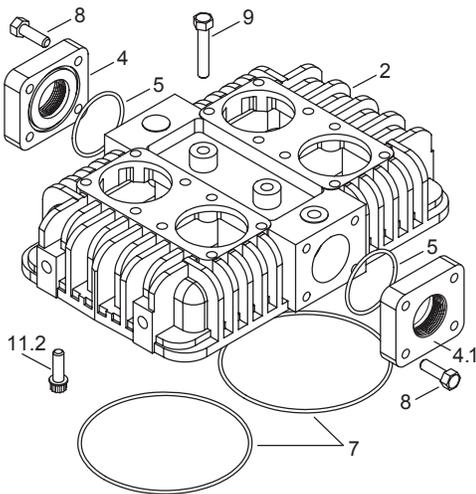
**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix J—691 and F691 Head and Valve Assembly Details

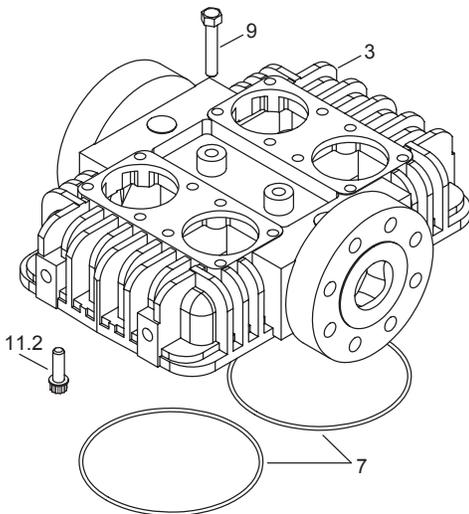
## 690 Head Assembly



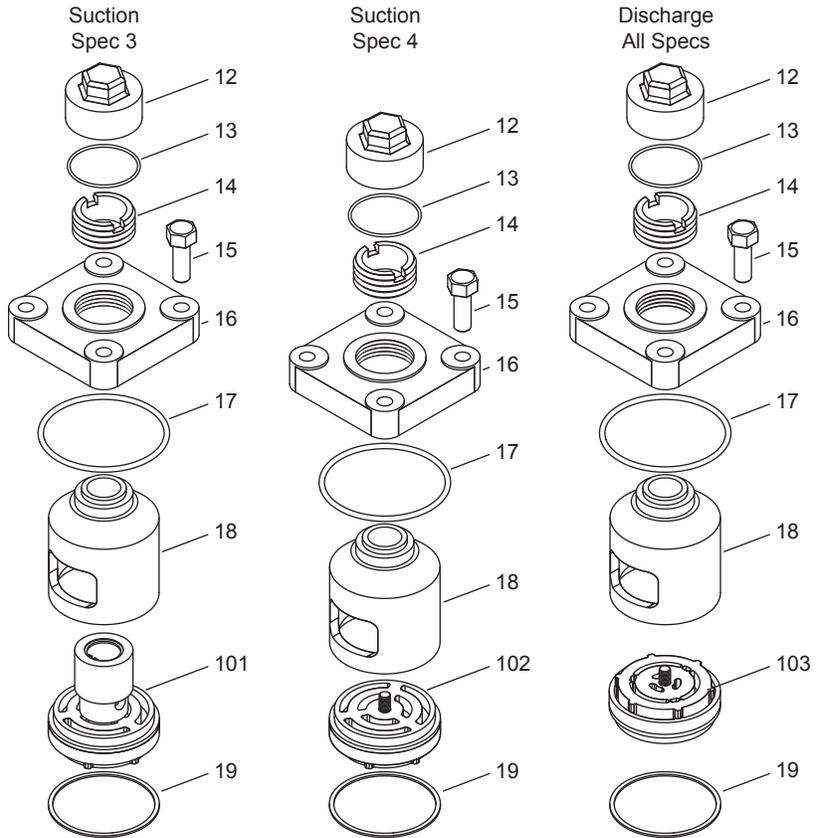
## 691 Head Assembly



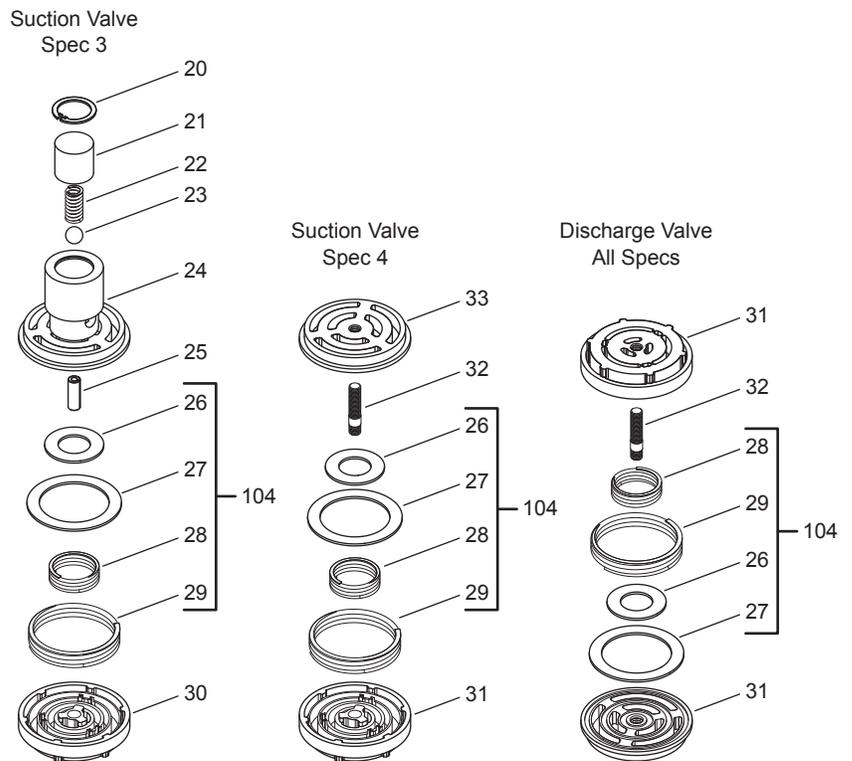
## F691 Head Assembly



## Valve Holddown Assemblies



## Valve Assemblies



# Appendix J—691 and F691 Head and Valve Assembly Details

## Head and Valve Bill of Materials

Ref No.	Part No.	Description
1.	1743	Head (690)
2.	3458 <sup>d</sup>	Head (691)
3.	4299	F691 head
4.	2144-2	Flange (suction) 2" NPT
	2144-2S <sup>c</sup>	Flange 2" weld
4.1	2144-1.5	Flange (discharge) 1-1/2" NPT
	2144-1.5S <sup>c</sup>	Flange 1-1/2" Weld
5.	2-231_ <sup>a</sup>	O-ring
6.	1744 <sup>b</sup>	Head gasket (690)
	1744-1 <sup>b,c</sup>	Head gasket grafoil
7.	2-261_ <sup>a</sup>	O-ring for head (691)
8.	7001-043 NC150A	Bolt, 7/16-14 x 1-1/2" hex head
9.	2136	Center head bolt
10.	1625	Center head bolt gasket (aluminum)
	1625-1 <sup>c</sup>	Center head bolt gasket (copper)
	1625-2 <sup>c</sup>	Center head bolt gasket (iron-lead)
11.	7005-043 NC125A	Bolt, 7/16-14 x 1-1/4" ferry head
11.1	7006-043A	Reg. lockwasher 7/16"
11.2	7005-050 NC150A	Bolt, 1/2-13 x 1-1/2" ferry head
12.	2714	Valve cap
	2714-1	Valve cap, grooved for O-ring
13.	2-031_ <sup>a</sup>	O-ring for valve cap
	2716 <sup>c</sup>	Gasket (aluminum) for valve cap
	2716-1 <sup>c</sup>	Gasket (copper) for valve cap
	2716-2 <sup>c</sup>	Gasket (iron) for valve cap
14.	2715	Holddown screw
15.	7001-043 NC137A	Bolt, 7/16-14 x 1-3/8" hex head
16.	1764	Valve cover plate
17.	2-235_ <sup>a</sup>	O-ring (cover plate)
18.	2797	Valve cage
19.	2114	Valve gasket (aluminum)
	2114-1 <sup>c</sup>	Valve gasket (copper)
	2114-2 <sup>c</sup>	Valve gasket (iron)
20.	5000-77	Retainer ring
21.	3977	Suction valve relief housing (spec 3)
22.	1411	Spring
23.	1410	Relief ball
24.	3948	Valve seat (spec. 3)
25.	2534-1	Suction valve post (spec 3)
26.	3872	Inner valve plate
27.	3871	Outer valve plate
28.	3929	Inner valve spring
29.	3928	Outer valve spring
30.	3949	Valve bumper (spec. 3)
31.	3857	Valve bumper
32.	3920	Valve stud
33.	3856	Valve seat

Ref No.	Valve Assembly No.	Assembly Name
101.	3948-X	Suction valve assembly (spec. 3) (includes valve gasket)
	3948-X1 <sup>c</sup>	Same as above but with copper gasket
	3948-X2 <sup>c</sup>	Same as above but with iron-lead gasket
102.	3856-X	Suction valve assembly (includes valve gasket)
	3856-X1 <sup>c</sup>	Same as above but with copper gasket
	2255-X2 <sup>c</sup>	Same as above but with iron-lead gasket
103.	3857-X	Discharge valve assembly (includes valve gasket)
	3857-X1 <sup>c</sup>	Same as above but with copper gasket
	3857-X2 <sup>c</sup>	Same as above but with iron-lead gasket
104.	3146-X1	Valve repair kit (suction & discharge)

### Other Assemblies

Head Assembly Number	Models	Valve Specification
1743-X	690	3
3458-X	691	3

### O-ring Code

A	Buna-N
B	Neoprene <sup>®e</sup>

<sup>a</sup> \_ denotes O-ring code. See O-ring chart above for details.

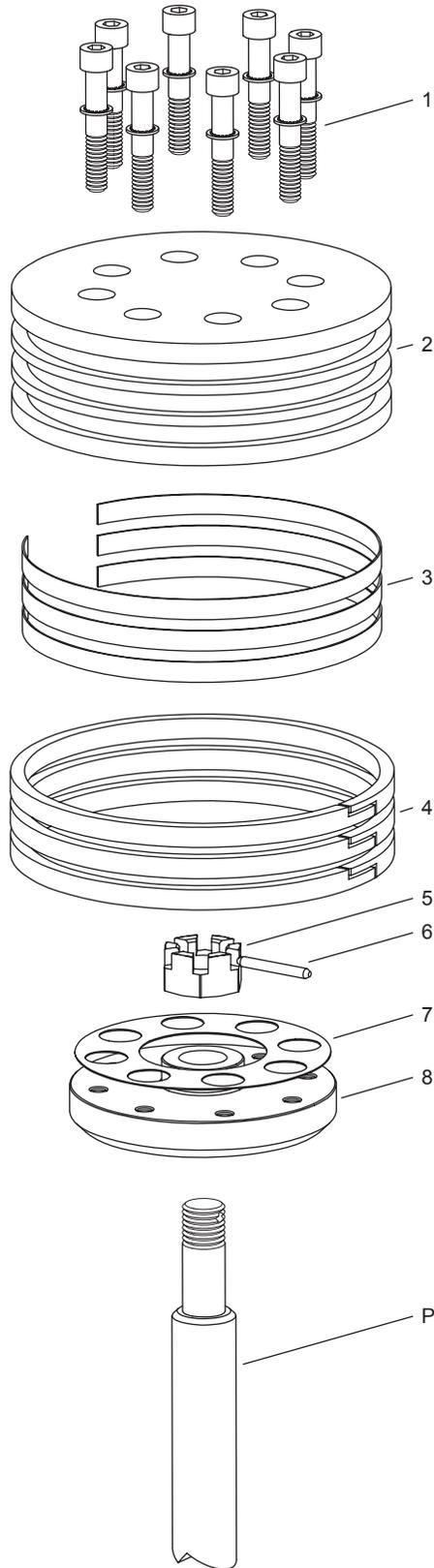
<sup>b</sup> Not included in head assembly.

<sup>c</sup> Optional.

<sup>d</sup> S/N NQ51455 and later. Earlier models use gasket #2177.

<sup>e</sup> Registered trademark of the DuPont company.

# Appendix J—691 and F691 Piston Assembly Details



**Piston Assembly Number 1987-X1 Bill of Materials**  
**Piston Diameter 4.5" (11.43 cm)**

Ref No.	Part No.	Description	Qty
1.	7002-025TP125A	Screw, socket head	8
	7207-025A	Lock washer	8
2.	1987	Head, iron	1
3.	1740	Ring expander	3
4.	1739	Piston ring	3
5.	1482	Locknut	1
6.	1483	Lock pin	1
7.	1735	Shim washer, thick	As Req.
	1735-1	Shim washer, thin	
8.	1986	Piston platform	1

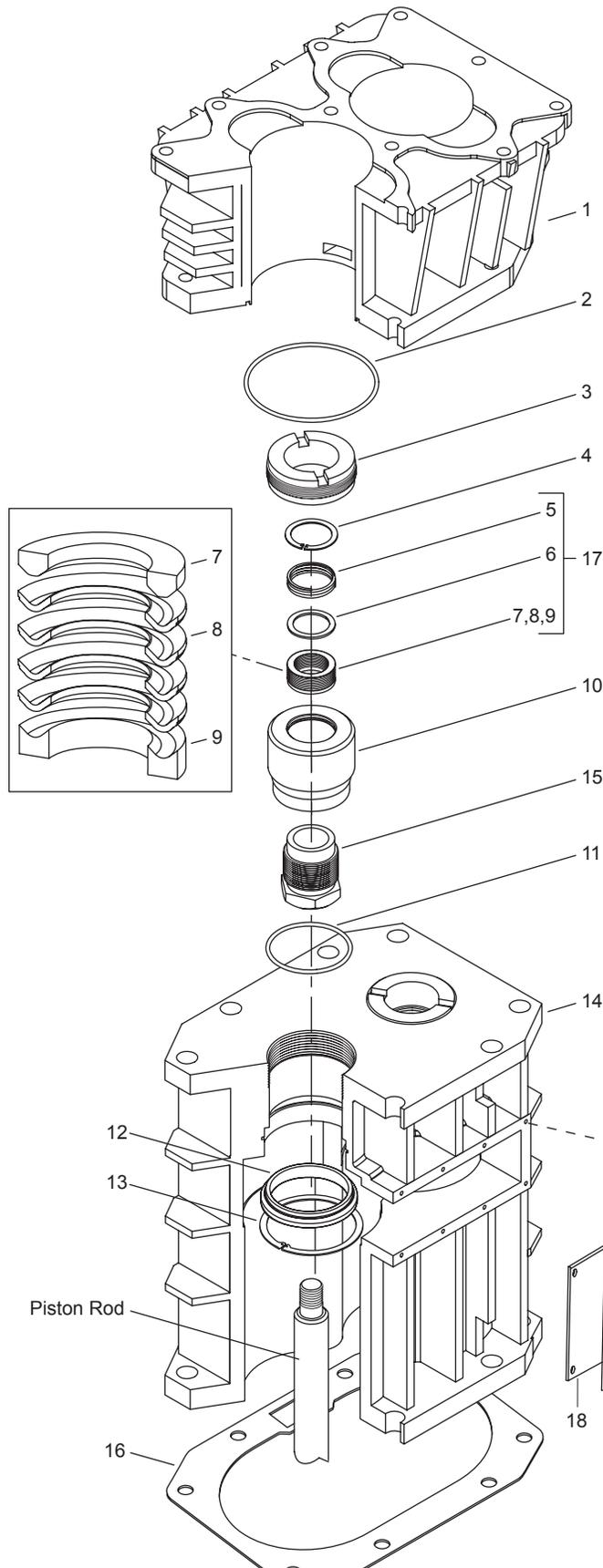
Model	Minimum	Maximum
690	0.000" (0.00 mm)	0.012" (0.30 mm)
691	0.015" (0.38 mm)	0.027" (0.68 mm)

<sup>a</sup> The distance from the bottom of the head to the top of the piston.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix J—691 and F691 Packing Assembly Details

## Packing Assembly Bill of Materials



Ref No.	Part No.	Description	Qty
1.	3457	Cylinder	1
2.	2-247 <sup>a</sup>	O-ring for cylinder	2
3.	1749	Cartridge holddown screw	2
4.	5000-175	Retainer ring	2
5.	1731	Packing spring	2
6.	1728	Packing washer	2
7.	1724	Male packing ring	2
8.	1725	Packing ring	4
9.	1723	Female packing ring	2
10.	2407	Packing box cartridge	2
11.	2-233 <sup>a</sup>	O-ring (packing cartridge)	2
12.	1748	Cartridge plate	2
13.	5000-350	Retainer ring	2
14.	2405	Crosshead guide	1
15.	1722	Adjusting screw	2
16.	1761	Crankcase gasket	1
17.	1725-2X	Packing set	2
18.	1760	Inspection plate gasket	1
19.	1721	Inspection plate	1
20.	7003-025NC037E	Screw-1/4-20x3/8"	4
not shown	1192	Locking device for adj. screw	4
not shown	2893	Locking device cartridge holddown screw	

## Other Assemblies

Assembly Number	Assembly Name
1717-X1	Crosshead assembly "P" style
2405-X	Crosshead guide assembly with 1748 (2), 2405, 5000-350 (2)
3544-X4	Crosshead assembly "M" style

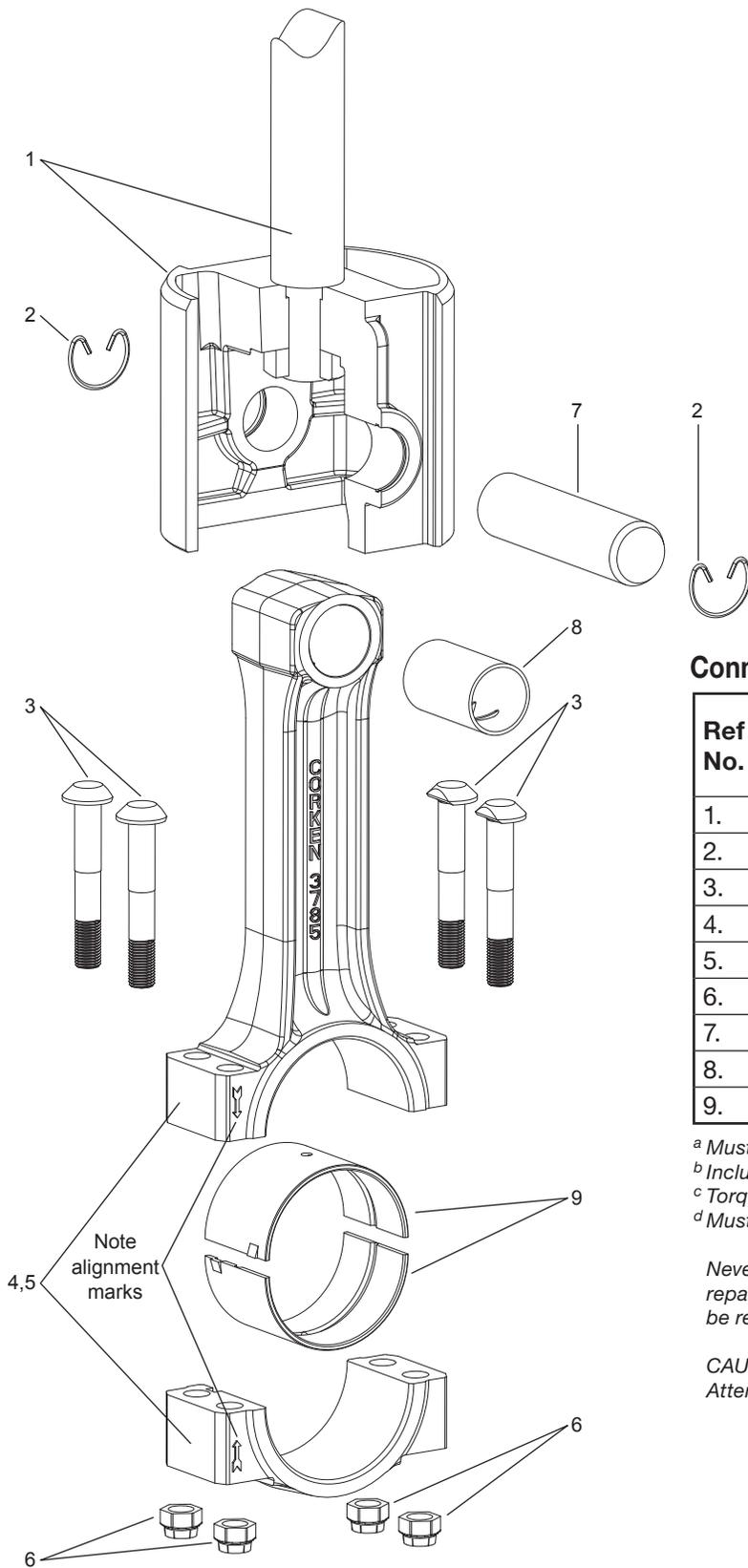
O-ring Code	
A	Buna-N
B	Neoprene <sup>®b</sup>

<sup>a</sup> \_ denotes O-ring code. See O-ring chart above for details.

<sup>b</sup> Registered trademark of the DuPont company.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix J—691 and F691 Connecting Rod Assembly Details



## Connecting Rod Assembly Bill of Materials

Ref No.	Part Number		Description
	Spec. K,P Only	Spec. M Only	
1.	1717-X1	3544-X4	Crosshead assy.
2.	1498	3590	Retainer ring
3.	1718	3540	Wrist pin
4.	1495-X <sup>a,b</sup>	3541-X <sup>b,d</sup>	Wrist pin bushing
5.	1726 <sup>b</sup>	1726 <sup>b</sup>	Bolt
6.	1720-X	3785-X1	Conn. rod assy.
7.	1720 <sup>b</sup>	3785 <sup>b</sup>	Connecting rod
8.	1719 <sup>b</sup>	3542 <sup>b</sup>	Conn. rod bearing
9.	1727 <sup>b,c</sup>	1727 <sup>b,c</sup>	Nut

<sup>a</sup> Must be rebored after replacing (0.8754/0.8751 dia.)

<sup>b</sup> Included with connecting rod assembly

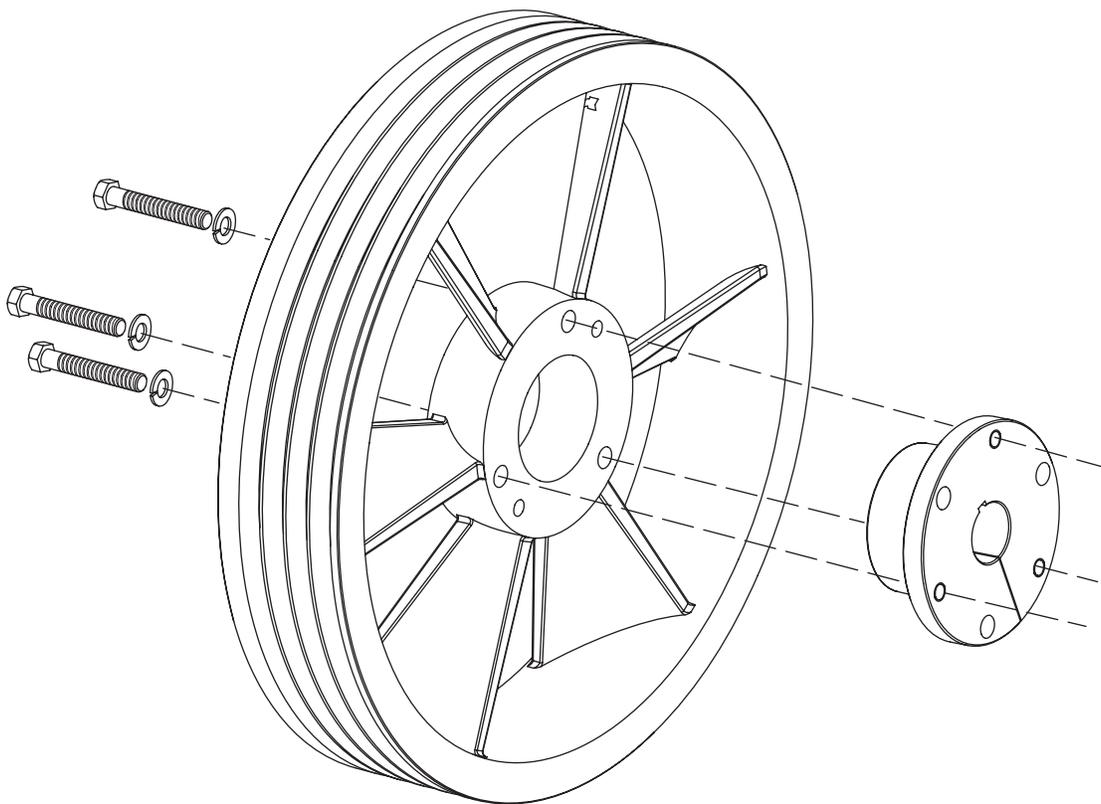
<sup>c</sup> Torque connecting rod nut to 40 ft. lbs.

<sup>d</sup> Must be rebored after replacing (1.1256/1.252 dia.)

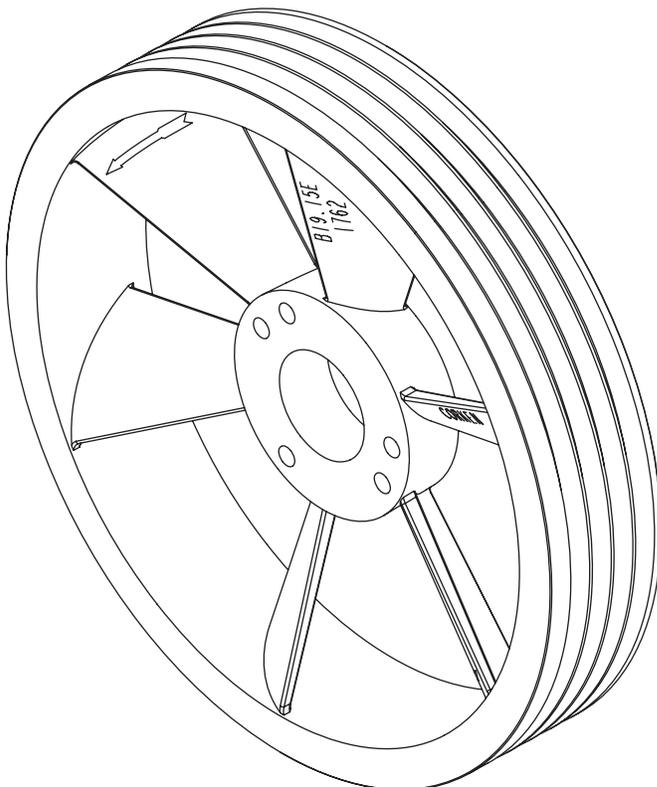
*Never attempt to separate the piston rod and crosshead. When repair becomes necessary, the entire crosshead assembly must be replaced.*

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix J—691 and F691 Flywheel Assembly Details



Back Side

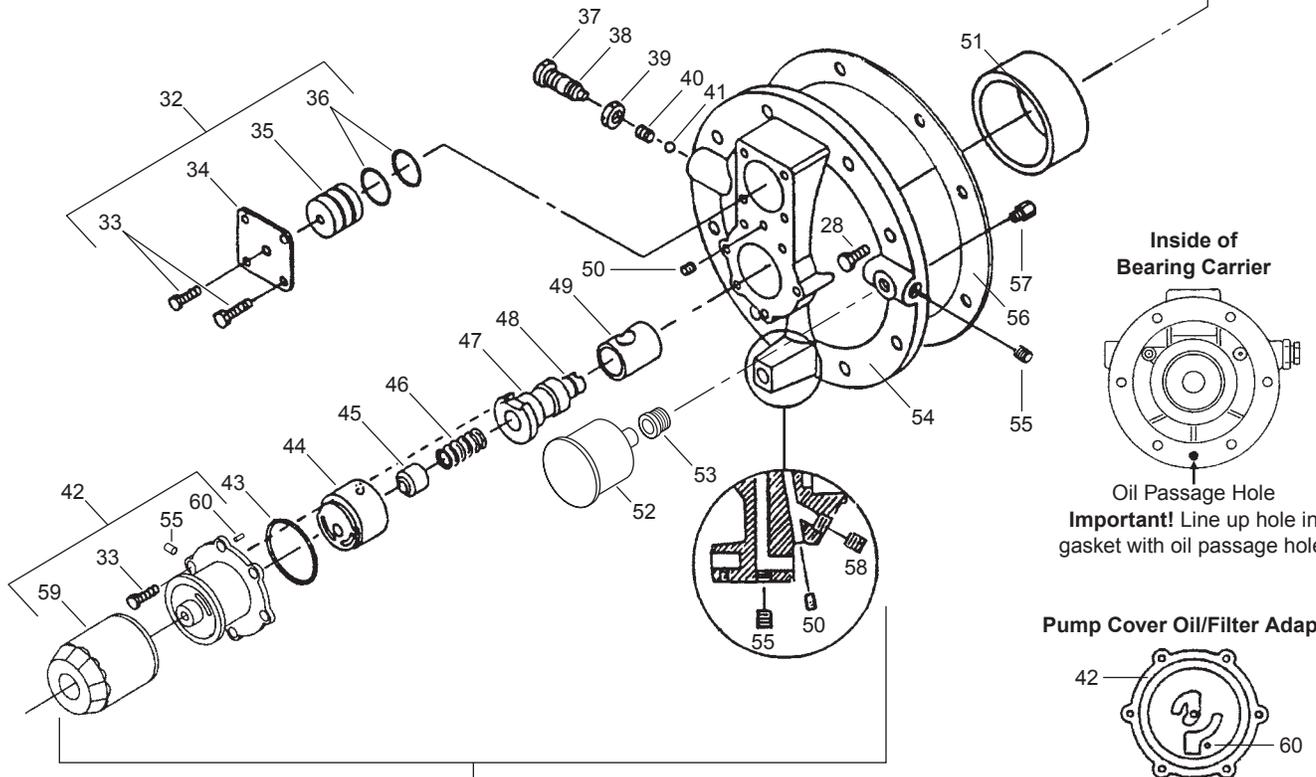
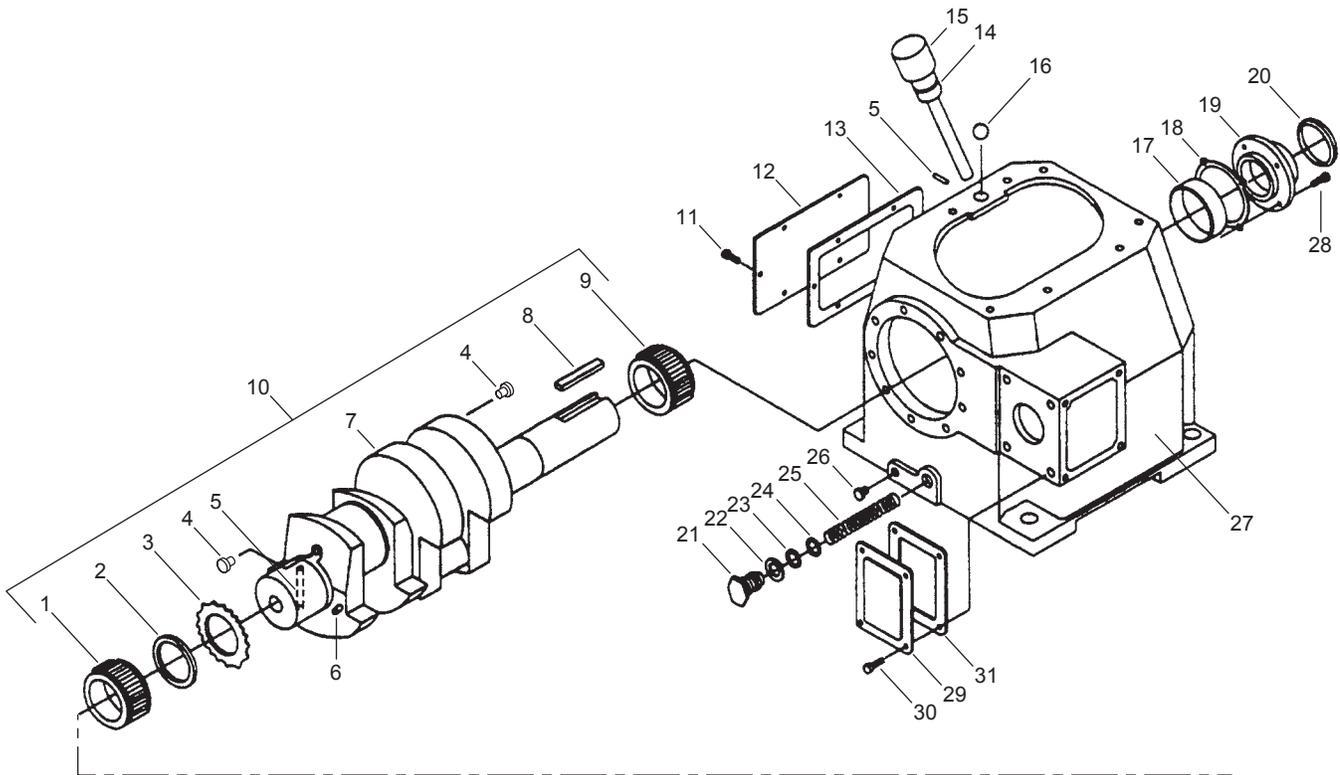


Front Side

## Flywheel Assembly Bill of Materials

Assembly Number	Assembly Name
1762-X	Flywheel assembly (flywheel, hub, and three bolts)
1762	Flywheel: 19.5" O.D., 4 groove
H E-2.125	Hub with three bolts and lockwashers

# Appendix J—691 and F691 Crankcase Assembly Details



61  
 (Includes all parts shown except #52 and #53)

# Appendix J—691 and F691 Crankcase Assembly Details

## Crankcase Assembly Bill of Materials

Ref No.	Part No.	Description
1.	1737	Bearing cone
2.	3638	Spacer
3.	3635	Drive sprocket
4.	1284	Crankshaft orifice
5.	2135	Drive pin
6.	2933	Link pin
7.	3786	Crankshaft
8.	3503	Flywheel key
9.	3580	Bearing cone
10.	3786-X1	Crankshaft assembly
11.	7001-031NC075A	Bolt, 5/16 - 18 x 3/4" hex head
12.	2122	Inspection cover
13.	2123	Gasket, inspection cover
14.	2-210 <sup>d</sup>	O-ring
15.	3225-X1	Oil bayonet assembly (w/O-ring)
16.	2126	Breather ball
17.	3579	Bearing cup
18.	3589	Bearing adjustment shim (.005")
	3589-1	Bearing adjustment shim (.007")
	3589-2	Bearing adjustment shim (.020")
19.	3539	Bearing cover
20.	3526	Oil seal
21.	1280	Filter screw
22.	1281	Gasket, filter
23.	2-116 <sup>d</sup>	O-ring
24.	1276	Washer
25.	1275	Oil filter screen
26.	3443	Pipe plug, 1/2" NPT steel
27.	3221	Crankcase
28.	7001-037NC100A	Bolt, 3/8 - 16 x 1" hex head Gr. 5
29.	3875	Access cover
30.	7003-025NC037E	Screw, 1/4 - 20 x 3/8"
31.	3874	Gasket, access cover
32.	1515-X	Closure cap assembly
33.	7001-025NC050A	Bolt, 1/4 - 20 x 1/2" hex head
34.	1515	Closure cap
35.	1516	Closure body
36.	2-218 <sup>d</sup>	O-ring
37.	1290	Relief valve adjusting screw
38.	2-011 <sup>d</sup>	O-ring
39.	1291	Adjusting screw locknut
40.	1292	Relief valve spring
41.	1293	Relief valve ball
42.	4222-X <sup>c</sup>	Oil filter adapter assembly (w/pin)
43.	2-228 <sup>d</sup>	O-ring
44.	2849-1X <sup>c</sup>	Oil pump assembly
45.	2851	Spring guide
46.	2852	Oil pump spring
47.	3219	Pump shaft adapter

Ref No.	Part No.	Description
48.	2-112 <sup>d</sup>	O-ring
49.	2805-X <sup>d</sup>	Pump shaft bushing
50.	1629	Pipe plug, 1/16 NPT fl. seal
51.	1736	Bearing cup
52.	1302	Oil pressure gauge
53.	1044	Bushing, 1/8 x 1/4 NPT
54.	3220-2	Bearing carrier
55.	3289	Pipe plug, 1/4 NPT fl. seal
56.	2131	Bearing carrier gasket
57.	2961-X	Air release valve assembly
58.	2590	Pipe plug, 1/8 NPT fl. Seal
59.	4225	Filter
60.	2798	Pump cover pin (included w/4222-X)
61.	3220-2X	Bearing carrier assembly M3 style

## Additional Assembly

Assembly Number	Assembly Name
3221-X1 <sup>a</sup>	Crankcase assembly (M3, 4, 8, 9) without lubrication

O-ring Code	
A	Buna-N
B	Neoprene <sup>®e</sup>

<sup>a</sup> Not shown

<sup>b</sup> Must be rebored and honed after replacing (0.876"/0.875" diameter)

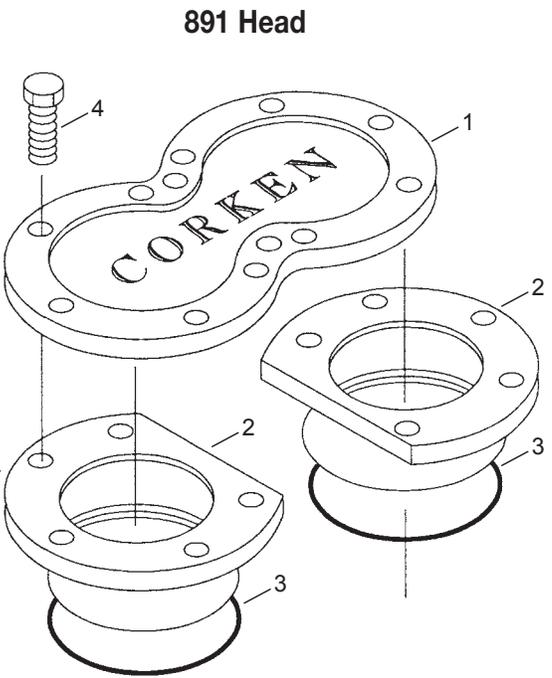
<sup>c</sup> Caution: To avoid damage during assembly, refer to installation Instruction Manual IE400.

<sup>d</sup> <sub>denotes</sub> O-ring code. See O-ring chart above for details.

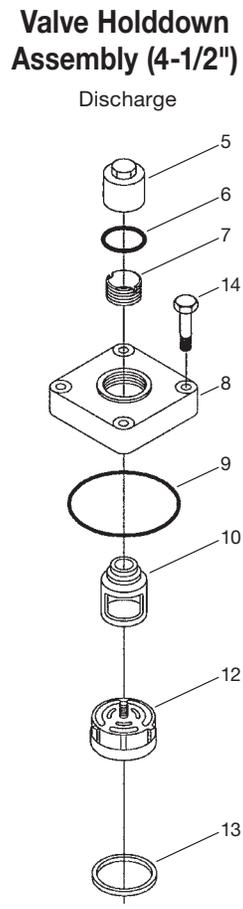
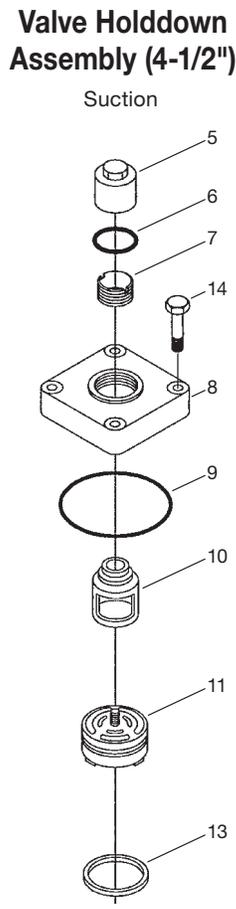
<sup>e</sup> Registered trademark of the DuPont company.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix K—D891 Head and Valve Assembly Details



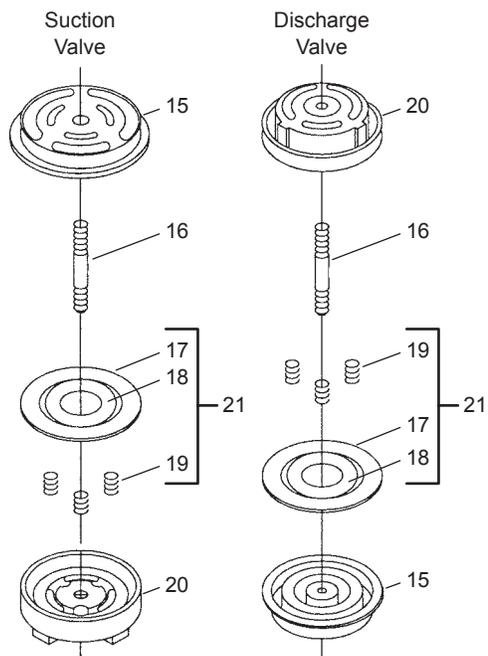
O-ring Code	
A	Buna-N
B	Neoprene <sup>®d</sup>



## Compressor Head and Valve Bill of Materials

Ref No.	Part No.	Description
1.	3923	Cylinder cap
2.	3924	Cylinder head (4-1/2")
3.	2-246_b	O-ring
4.	7001-050 NC150A	Bolt, 1/2 - 13 x 1-1/2" hex head Gr 5 (Torque to 65 ft•lbs)
5.	2714-1	Valve cap
6.	2-031_b	O-ring
7.	2715	Holddown screw
8.	1764	Valve cover plate
9.	2-235_b	O-ring
10.	3570-1	Valve cage
11.	3732-X	Suction valve assembly (4-1/2")
12.	3733-X	Discharge valve assembly (4-1/2")
13.	2114 <sup>a</sup>	Valve gasket
14.	7001-043 NC150A	Bolt, 7/16 - 14 x 1-1/2" hex head (Torque to 37 ft•lbs)
15.	3827	Valve seat (4-1/2")
16.	3828	Stud
17.	3830 <sup>c</sup>	Valve plate, outer
18.	3831 <sup>c</sup>	Valve plate, inner
19.	3829 <sup>c</sup>	Spring
20.	3826	Valve bumper (4-1/2")
21.	3805-X1 <sup>c</sup>	Valve repair kit (1st stage)

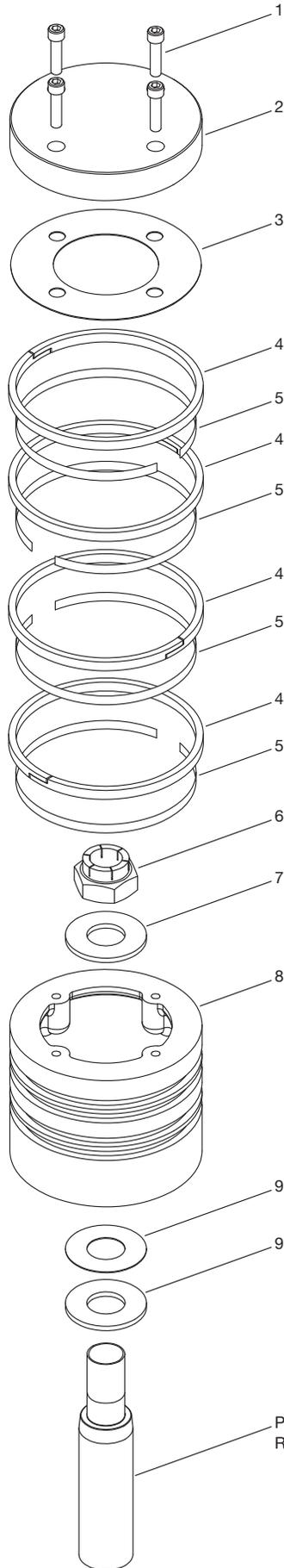
## Valve Assemblies (4-1/2")



<sup>a</sup> Included with valve assembly  
<sup>b</sup> \_ denotes O-ring code. See O-ring chart above for details.  
<sup>c</sup> Included with valve repair kit.  
<sup>d</sup> Registered trademark of the DuPont company.

**CAUTION:** Always relieve pressure in the unit before attempting any repairs.

# Appendix K—D891 Piston Assembly Details



## Piston Assembly Bill of Materials

Ref. No.	Part No.	Description	Qty
	D891 3925-X1 (4-1/2")		
1.	7002-025-TP100A	Screw, orlo gr. 8 (torque to 8 ft•lbs)	4
2.	3927	Piston cap	1
3.	2902	Shim washer, thick	As req.
	2902-1	Shim washer, thin	
4.	1739	Piston rings	4
	1739-2	Alloy 50 rings—opt.	
	1739-3	Peek rings—opt.	
5.	1740	Expander ring	4
6.	3604	Lock nut (torque to 150 ft•lbs)	1
7.	3730	Thrust washer	2
8.	3925 (4-1/2" diameter)	Piston	1
9.	3603	Shim washer, thick	As req.
	3603-1	Shim washer, thin	
10.	3812 (not shown)	Loctite tube—620	1

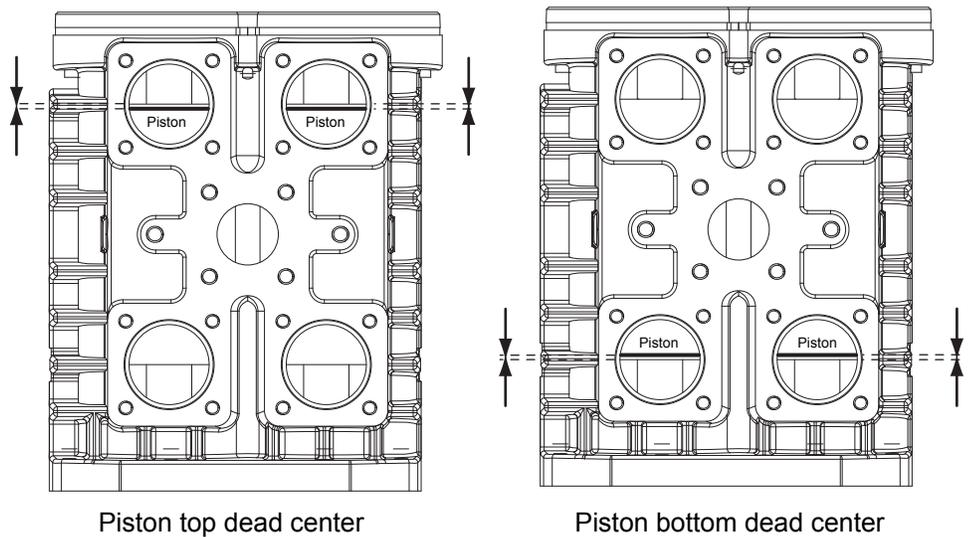
## Piston Clearance (Cold)

Model	Top Min. <sup>a</sup>	Top Max. <sup>a</sup>	Bottom Min. <sup>b</sup>	Bottom Max. <sup>b</sup>
D891	0.084" (2.13 mm)	0.104" (2.64 mm)	0.010" (0.25 mm)	0.020" (0.50 mm)

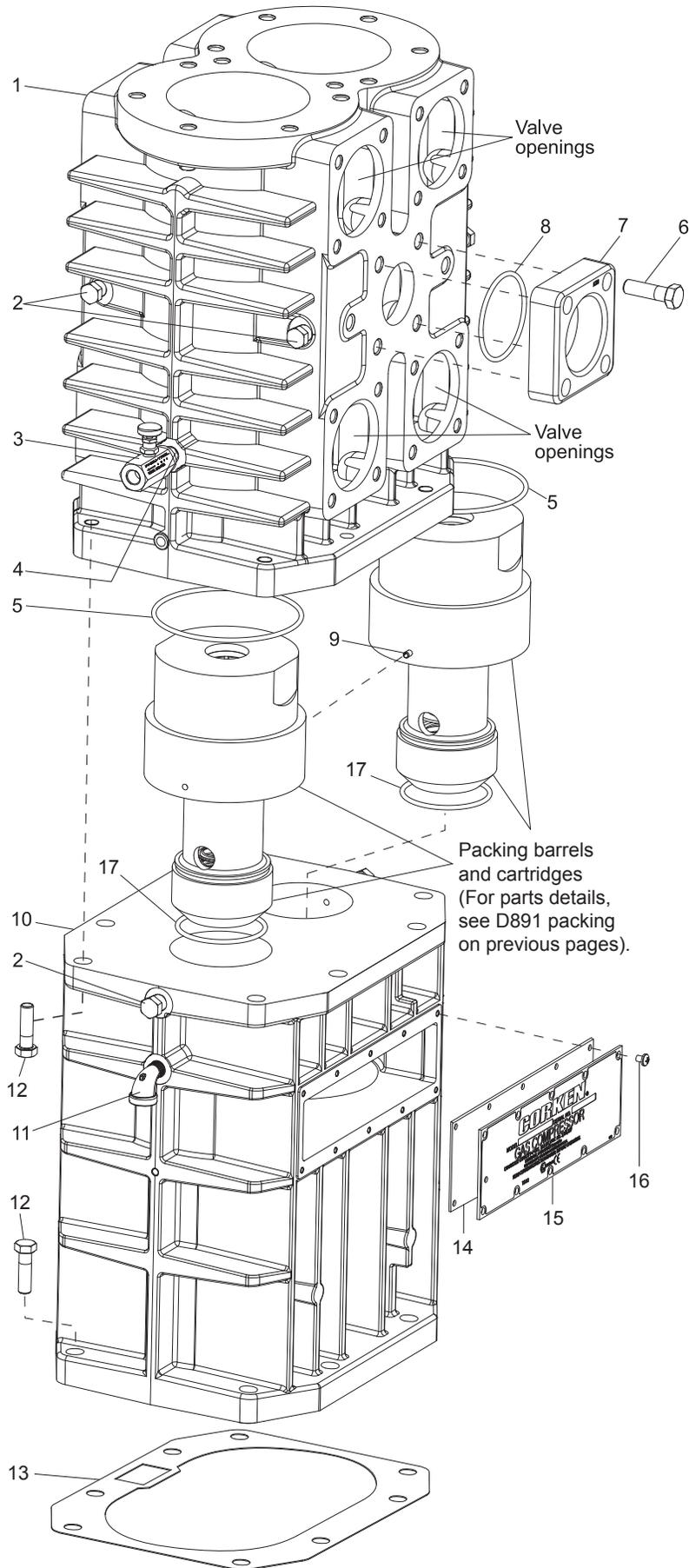
<sup>a</sup> The distance from the bottom of the head to the top of the piston.

<sup>b</sup> The distance from the bottom of the piston to the top of the packing barrel.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.



# Appendix K—D891 Crosshead Guide Assembly Details



# Appendix K—D891 Crosshead Guide Assembly Details

## Crosshead Guide Bill of Materials

Ref No.	Part No.	Description	Qty
1.	3922	Cylinder	1
2.	1054	Drain valve (lubricated models)	1
3.	1071	Nipple, 1/4" x close	1
4.	2-246 <sup>a</sup>	O-ring for cylinder	2
5.	3442	Pipe plug, 1/4" NPT	3
6.	7001-050NC175A	Bolt, 1/2" 13 x 1-3/4" hex head gr 5	24
7.	3793-2S	Flange (inlet/outlet)	2
8.	2-231 <sup>a</sup>	O-ring for flange	2
9.	3253	Roll pin	1
10.	2405-1	Crosshead guide	1
11.	1064	Elbow, 1/4" NPT	1
12.	3974	Tag	1
13.	1761	Gasket, crankcase	1
14.	1760	Gasket, inspection cover	1
15.	1721	Inspection cover	1
16.	7012-010NC025B	Bolt, 10 - 24 x 1/4" Phillip hd.	10

O-ring Code	
A	Buna-N
B	Neoprene <sup>®b</sup>

<sup>a</sup> \_ denotes O-ring code. See O-ring chart above for details.

<sup>b</sup> Registered trademark of the DuPont company.

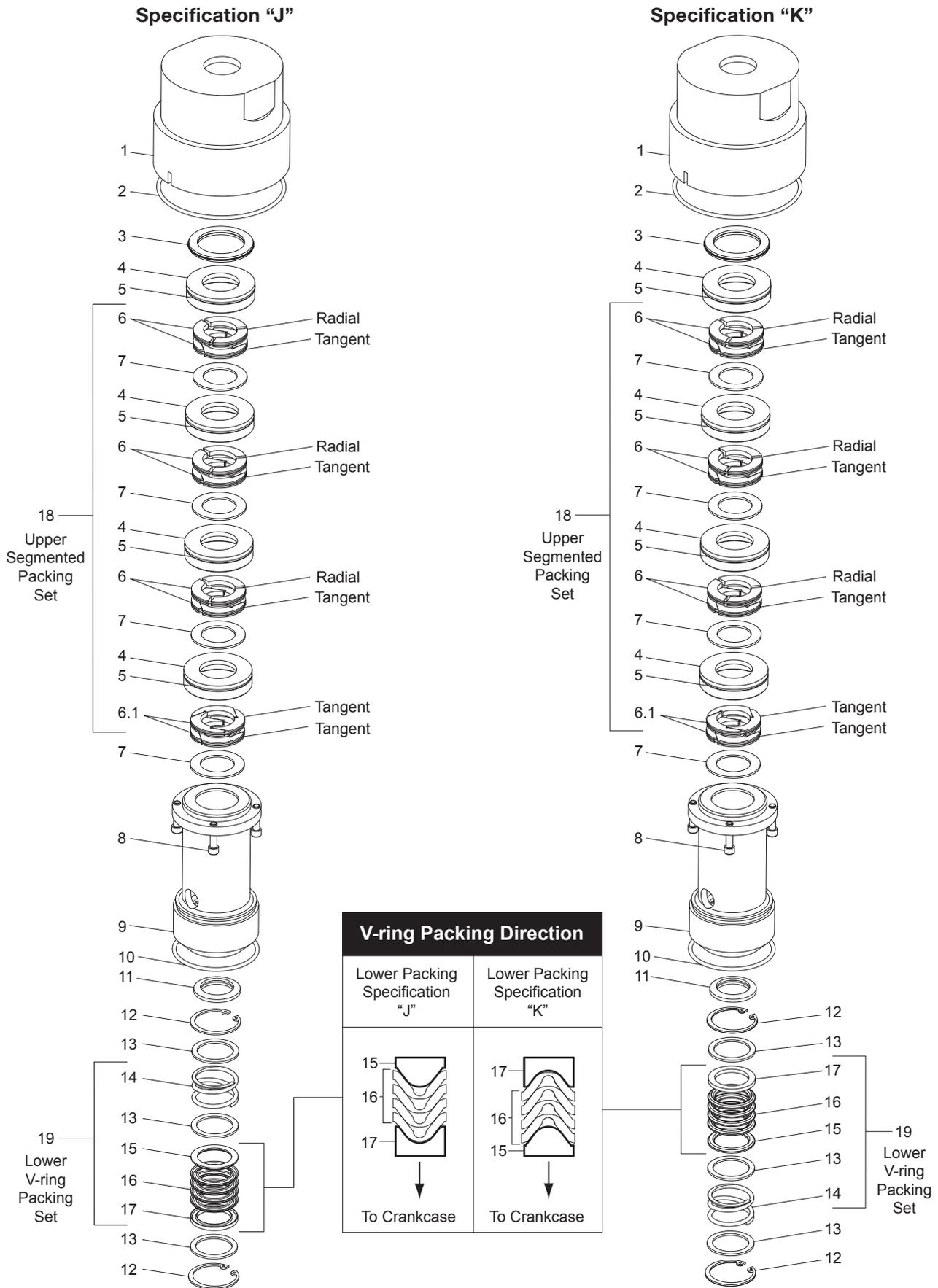
**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

**NOTE:**

*Packing barrel installation:*

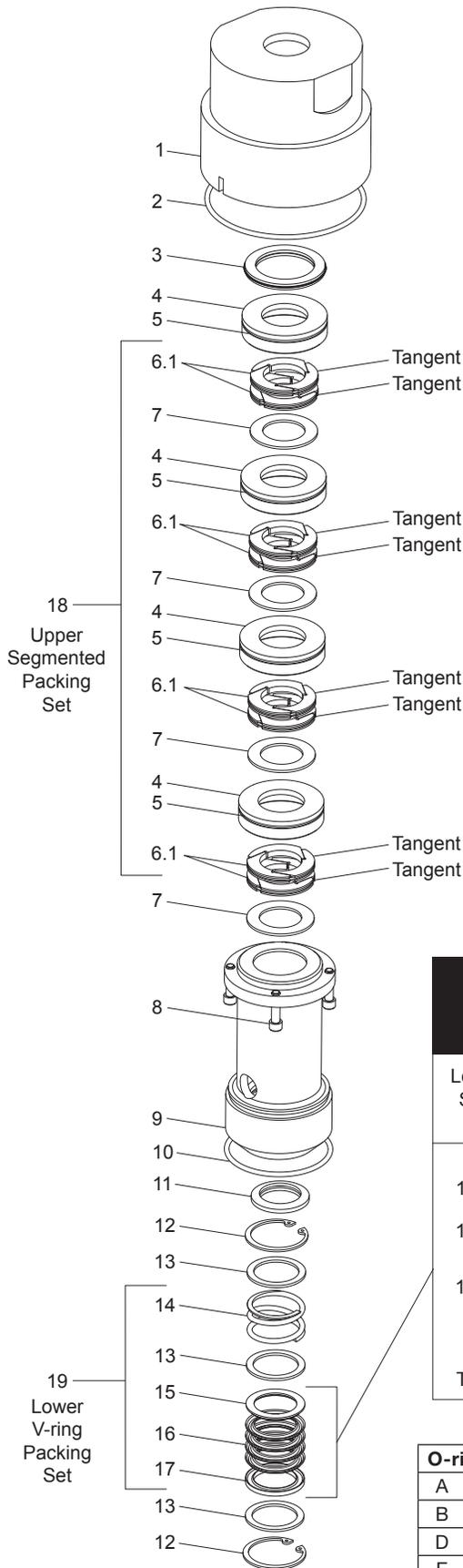
1. Use packing installation cone #905 on the piston rod.
2. Insert small barrel first, use finger holes to align slinger ring on to the rod. Slip the packing barrel into place.
3. Align pin with slot in large packing barrel.
4. Slip large packing barrel in place.

# Appendix K—D891 Packing Assembly Details



# Appendix K—D891 Packing Assembly Details

## Specification "R"



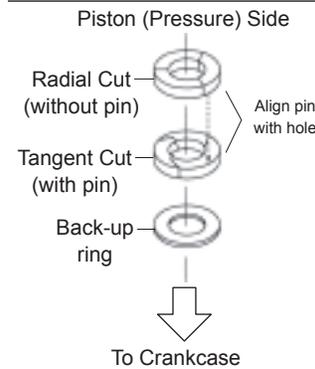
## Packing Assembly Bill of Materials

Ref No.	Part No.	Description
1.	3926	Packing barrel (4-1/2")
2.	2-238 <sup>a,c</sup>	O-ring
3.	3906	Crush gasket
4.	3817	Packing cup (Not included in 3810-X1 packing set)
5.	2-036 <sup>a,d</sup>	Cup O-ring
6.	3810	Segmented packing (radial-tangent) pair
6.1.	3814	Segmented packing (tangent-tangent) pair
7.	3811	Back-up ring
8.	7002-025OC100A	Screw, 1/4-20 x 1" socket head
9.	3885	Cartridge
10.	2-231 <sup>a</sup>	O-ring
11.	1732 <sup>b</sup>	Oil deflector ring
12.	5000-175	Retainer ring
13.	1728	Washer
14.	1731	Spring
15.	1724	Male packing ring
16.	1725	V-ring packing
17.	1723	Female packing ring
18.	3810-X1 <sup>e</sup>	Segmented packing set
19.	1725-2X	V-ring packing set

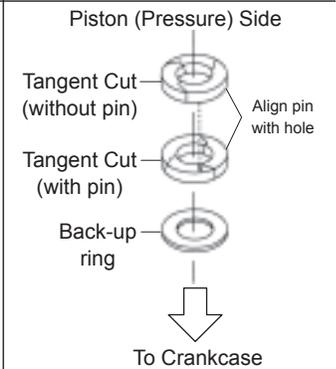
### Identification of Packing Specification

Example: Model Number D891 **J** M4FBA  
 Packing Spec. \_\_\_\_\_

#### Segmented Packing for Specification "J" & "K"



#### Segmented packing for Specification "J", "K", & "R"



**IMPORTANT:** Identify and line up the rings before installing. Be sure they face the way shown here and that the pin and hole are aligned when assembled.

<sup>a</sup> \_ denotes O-ring code. See O-ring chart for details.

<sup>b</sup> Deflector ring is loose within the packing cartridge until fitted on the piston rod. Must be put in from the bottom of the cartridge.

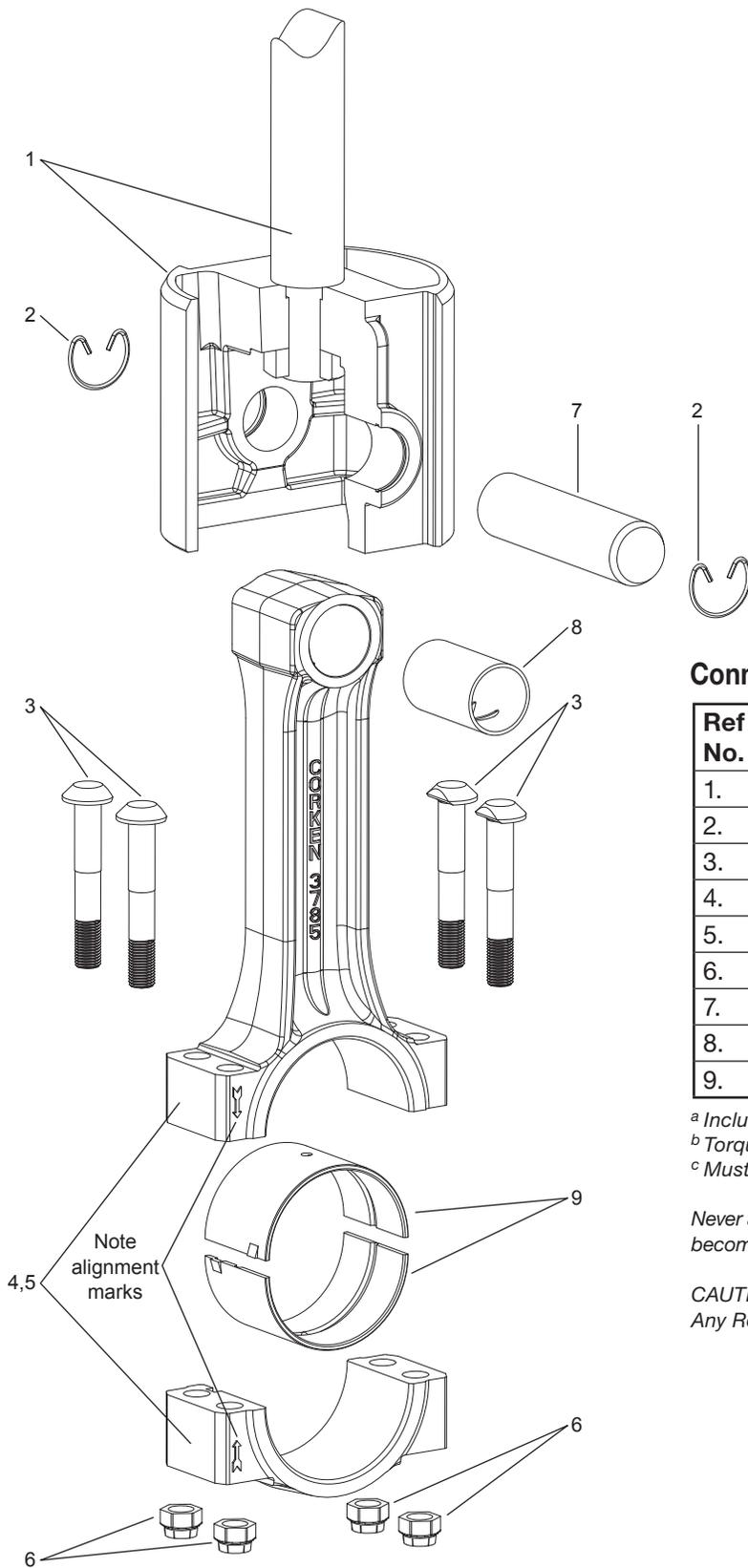
<sup>c</sup> Insert O-ring into the groove in the bottom of the barrel.

<sup>d</sup> Starting with S.N. NN51397.

<sup>e</sup> Packing cup O-ring not included in packing set.

<sup>f</sup> Registered trademark of the DuPont company.

# Appendix K—D891 Connecting Rod Assembly Details



## Connecting Rod Assembly Bill of Materials

Ref No.	Part No.	Description
1.	3544-X3	Crosshead assembly
2.	3590	Retainer ring
3.	3540	Wrist pin
4.	3541-X <sup>a,b</sup>	Wrist pin bushing
5.	1726 <sup>b</sup>	Bolt
6.	3785-X <sup>a</sup>	Connecting rod assembly
7.	3785 <sup>a</sup>	Connecting rod
8.	3542 <sup>a</sup>	Connecting rod bearing
9.	1727 <sup>a,c</sup>	Nut

<sup>a</sup> Included with connecting rod assembly

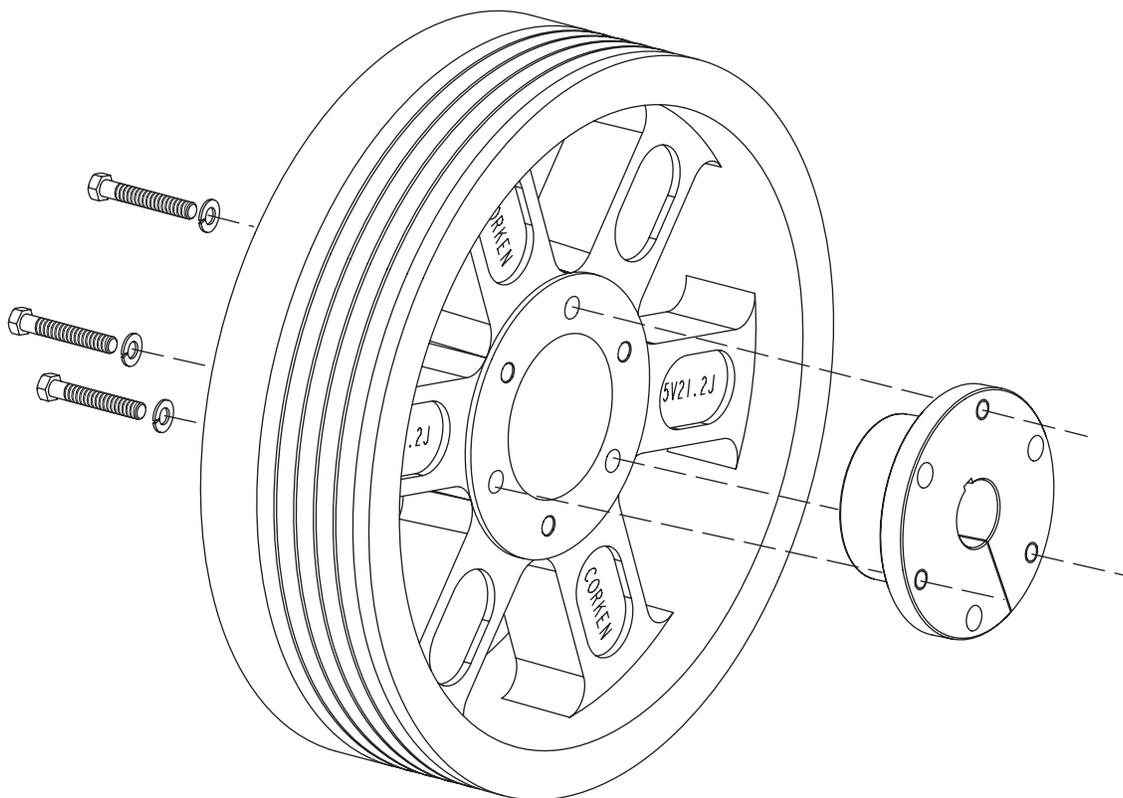
<sup>b</sup> Torque connecting rod nut to 40 ft. lbs.

<sup>c</sup> Must be rebores after replacing (1.1256/1.252 dia.)

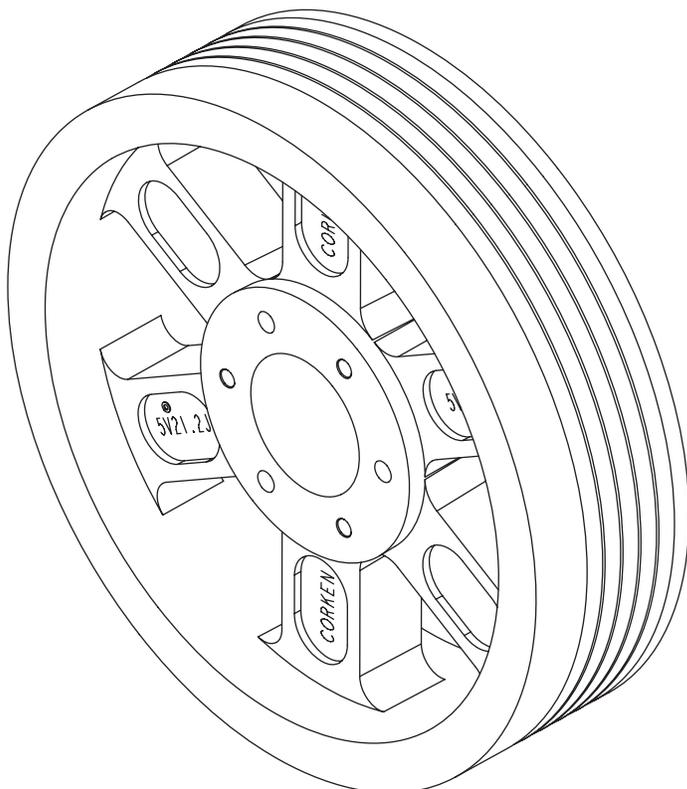
Never attempt to separate the piston rod and crosshead. When repair becomes necessary, the entire crosshead assembly must be replaced.

**CAUTION:** Always Relieve Pressure In The Unit Before Attempting Any Repairs.

# Appendix K—D891 Flywheel Assembly Details



Back Side

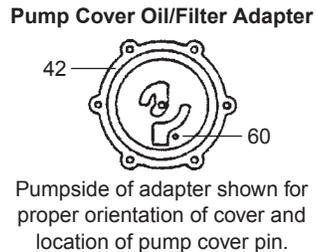
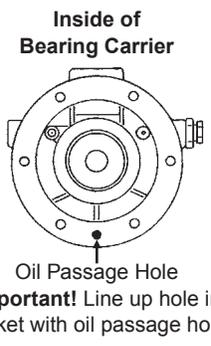
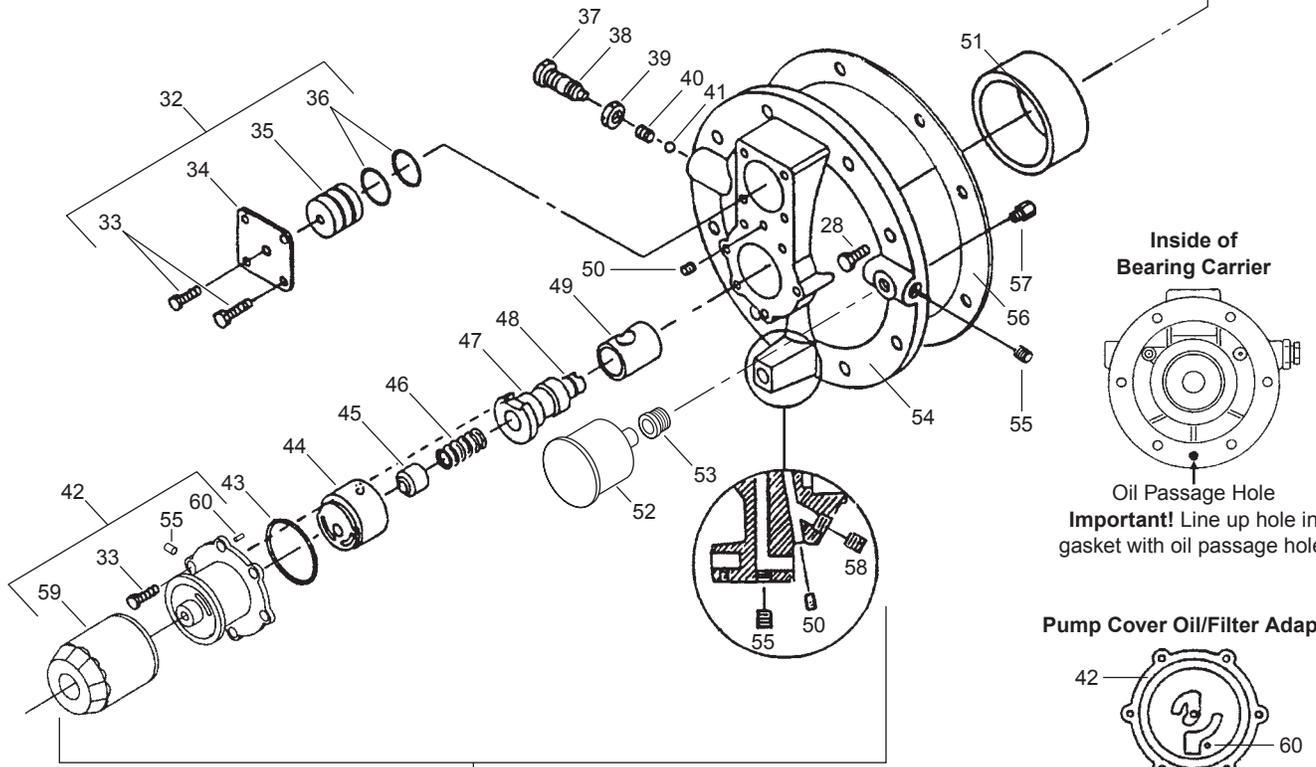
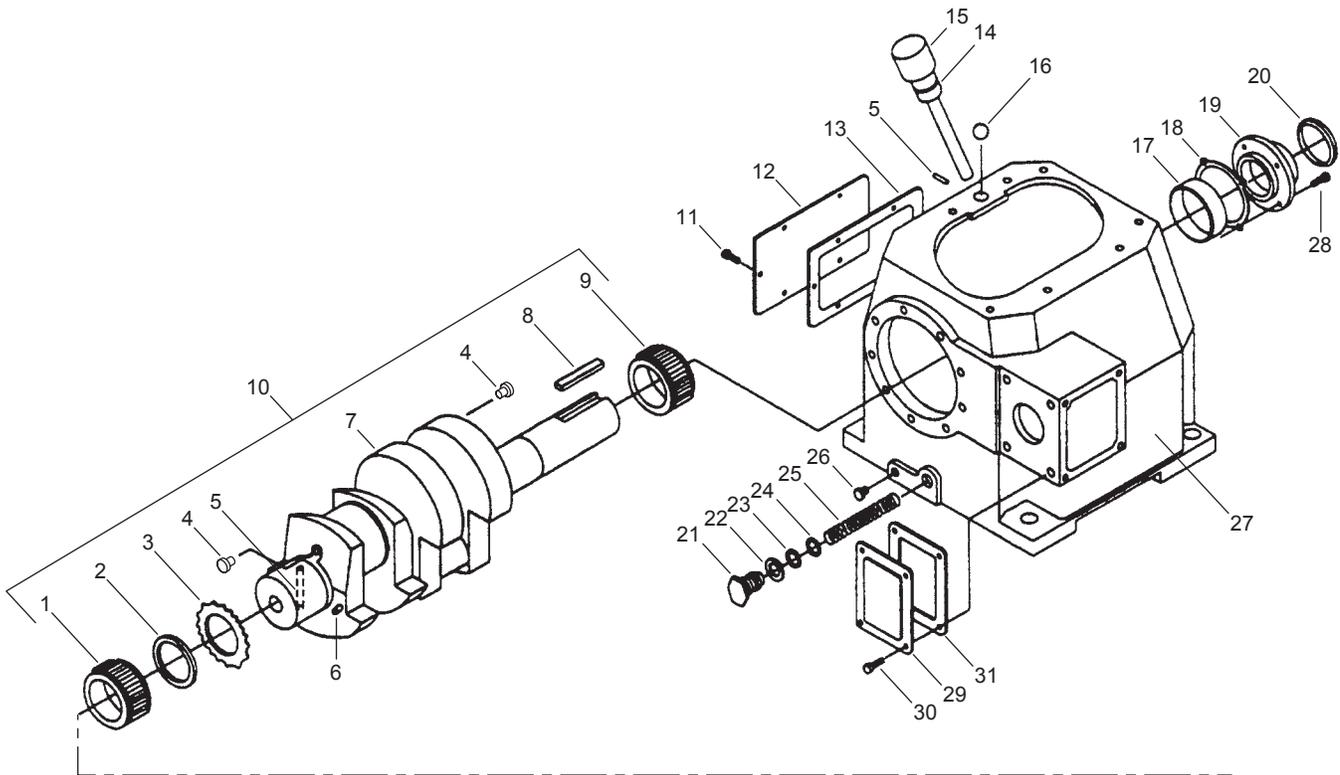


Front Side

## Flywheel Assembly Bill of Materials

Assembly Number	Assembly Name
3852-X	Flywheel assembly (flywheel, hub, and three bolts)
3852	Flywheel: 21.2" O.D., 5 groove
H J-2.125	Hub with three bolts and lockwashers

# Appendix K—D891 Crankcase Assembly Details



61  
(Includes all parts shown except #52 and #53)

# Appendix K—D891 Crankcase Assembly Details

## Crankcase Assembly Bill of Materials

Ref No.	Part No.	Description
1.	1737	Bearing cone
2.	3638	Spacer
3.	3635	Drive sprocket
4.	1284	Crankshaft orifice
5.	2135	Drive pin
6.	2933	Link pin
7.	3786	Crankshaft
8.	3503	Flywheel key
9.	3580	Bearing cone
10.	3786-X1	Crankshaft assembly
11.	7001-031NC075A	Bolt, 5/16 - 18 x 3/4" hex head
12.	2122	Inspection cover
13.	2123	Gasket, inspection cover
14.	2-210 <sup>d</sup>	O-ring
15.	3225-X1	Oil bayonet assembly (w/O-ring)
16.	2126	Breather ball
17.	3579	Bearing cup
18.	3589	Bearing adjustment shim (.005")
	2589-1	Bearing adjustment shim (.007")
	2589-2	Bearing adjustment shim (.020")
19.	3539	Bearing cover
20.	3526	Oil seal
21.	1280	Filter screw
22.	1281	Gasket, filter
23.	2-116 <sup>d</sup>	O-ring
24.	1276	Washer
25.	1275	Oil filter screen
26.	3443	Pipe plug, 1/2" NPT steel
27.	3221	Crankcase
28.	7001-037NC100A	Bolt, 3/8 - 16 x 1" hex head Gr. 5
29.	3875	Access cover
30.	7003-025NC037E	Screw, 1/4 - 20 x 3/8"
31.	3874	Gasket, access cover
32.	1515-X	Closure cap assembly
33.	7001-025NC050A	Bolt, 1/4 - 20 x 1/2" hex head
34.	1515	Closure cap
35.	1516	Closure body
36.	2-218 <sup>d</sup>	O-ring
37.	1290	Relief valve adjusting screw
38.	2-011 <sup>d</sup>	O-ring
39.	1291	Adjusting screw locknut
40.	1292	Relief valve spring
41.	1293	Relief valve ball
42.	4222-X <sup>c</sup>	Oil filter adapter assembly (w/pin)
43.	2-228 <sup>d</sup>	O-ring
44.	2849-1X <sup>c</sup>	Oil pump assembly
45.	2851	Spring guide
46.	2852	Oil pump spring
47.	3219	Pump shaft adapter

Ref No.	Part No.	Description
48.	2-112 <sup>d</sup>	O-ring
49.	2805-X <sup>b</sup>	Pump shaft bushing
50.	1629	Pipe plug, 1/16 NPT fl. seal
51.	1736	Bearing cup
52.	1302	Oil pressure gauge
53.	1044	Bushing, 1/8 x 1/4 NPT
54.	3220-2	Bearing carrier
55.	3289	Pipe plug, 1/4 NPT fl. seal
56.	2131	Bearing carrier gasket
57.	2961-X	Air release valve assembly
58.	2590	Pipe plug, 1/8 NPT fl. Seal
59.	4225	Filter
60.	2798	Pump cover pin (included w/4222-X)
61.	3220-2X	Bearing carrier assembly

### Additional Assembly

Assembly Number	Assembly Name
3221-X1 <sup>a</sup>	Crankcase assembly (M3, 4, 8, 9) without lubrication

O-ring Code	
A	Buna-N
B	Neoprene <sup>®e</sup>

<sup>a</sup> Not shown

<sup>b</sup> Must be rebored and honed after replacing (0.876"/0.875" diameter)

<sup>c</sup> Caution: To avoid damage during assembly, refer to installation Instruction Manual IE400.

<sup>d</sup> \_denotes O-ring code. See O-ring chart above for details.

<sup>e</sup> Registered trademark of the DuPont company.

**CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.**



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