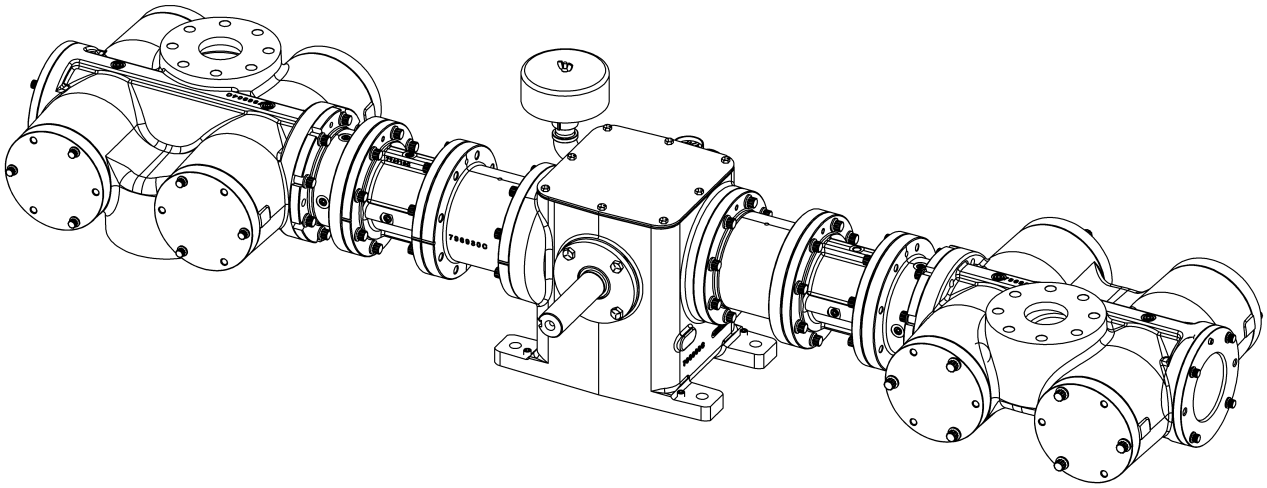
BLACKMER NGH COMPRESSORS

Installation, Operation, and Maintenance Instructions

Models: NGH100

960494
INSTRUCTIONS 602-A00

Section	602
Effective	May 2023
Replaces	Oct 2019



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SAFETY DATA

This is a SAFETY ALERT SYMBOL.
When you see this symbol on the product, or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

DANGER

Warns of hazards that WILL cause serious personal injury, death or major property damage.

WARNING

Warns of hazards that CAN cause serious personal injury, death or major property damage.

CAUTION

Warns of hazards that CAN cause personal injury, or property damage.

NOTICE

Indicates special instructions which are very important and must be followed.

NOTICE

Blackmer compressors **MUST** only be installed in systems which have been designed by qualified engineering personnel. The system MUST conform to all applicable local and national regulations and safety standards.

These instructions are intended to assist in the installation and operation of Blackmer compressors and **MUST** be kept with the compressor.

Blackmer compressor service and maintenance shall be performed by qualified technicians ONLY. Service and maintenance shall conform to all applicable local and national regulations and safety standards.

Thoroughly review this manual, all instructions and hazard warnings, **BEFORE** performing any work on the compressor.

Maintain **ALL** system and compressor operation and hazard warning decals.

For handling liquefied gas, NFPA Pamphlet 58 should be consulted.

SAFETY DATA

NOTICE

The NGS Models are designed for use in Sour Gas Applications. Persons maintaining, repairing, or working near the compressor or surrounding area must have adequate safety training and protection.

DANGER

H_2S atmospheres can cause serious personal injury or death.

H_2S atmospheres can cause serious personal injury or death.

DANGER

Flammable gas can cause death, serious personal injury or property damage

Flammable gas and/or liquid can form explosive mixtures with air causing property damage, serious personal injury or death

WARNING

Hazardous pressure can cause serious personal injury or property damage

Failure to relieve system pressure prior to performing compressor service or maintenance can cause serious personal injury or property damage.

WARNING

Hazardous machinery can cause serious personal injury.

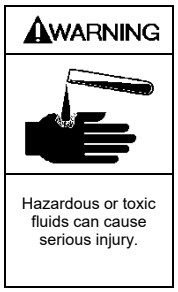
Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death

WARNING

Hazardous voltage. Can shock, burn or cause death.

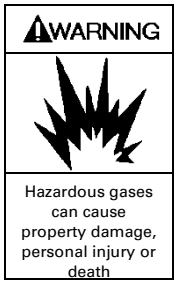
Failure to disconnect and lockout electrical power before attempting maintenance can cause shock, burns or death

COMPRESSOR DATA

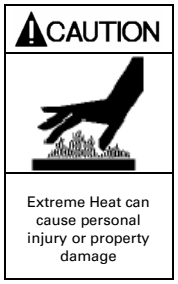


If handling hazardous or toxic fluids, system must be flushed and decontaminated, inside and out, prior to performing service or maintenance

Disconnecting fluid or pressure containment components during compressor operation can cause serious personal injury, death or major property damage



Explosive gas can cause property damage, personal injury, or death.



Extreme heat can cause personal injury or property damage

PERFORMANCE DATA

	Triple Seal	NGH1013 NGH1023
6.00 Inch Cylinder MAWP - psia (Bar) 3.25 Inch Cylinder MAWP – psia (Bar)		500 (34.4) 1500 (103.4)
Displacement CFM (m^3/hr) @ 500 rpm (Minimum Speed) @ 1800 rpm (Maximum Speed) *	 6.0” x 6.0” 3.25” x 3.25” 6.0” x 3.25” 6.0” x 6.0” 3.25” x 3.25” 6.0” x 3.25”	 96 (163) 26.7 (45) 48.0 (81.5) 345.8 (587.5) 96 (163) 172.9 (294)
Max. BHP (kw)		100 (74)
Maximum Discharge Temperature		350°F (176°C)
Rotation Direction		Either Direction (CW or CCW)
Bore x Stroke, Double-Acting Cylinders, in. (mm)		6 x 3 (152.4 x 76.2) 3.25 x 3 (82.5 x 76.2)
Critical Dimensions		See document CB331
Type: Single and Two-stage, horizontal, air-cooled, non-lubricated, reciprocating compressor.		

* NOTE: Reduce maximum speeds by 9% for continuous duty operation.

Table 1 - Compressor Data

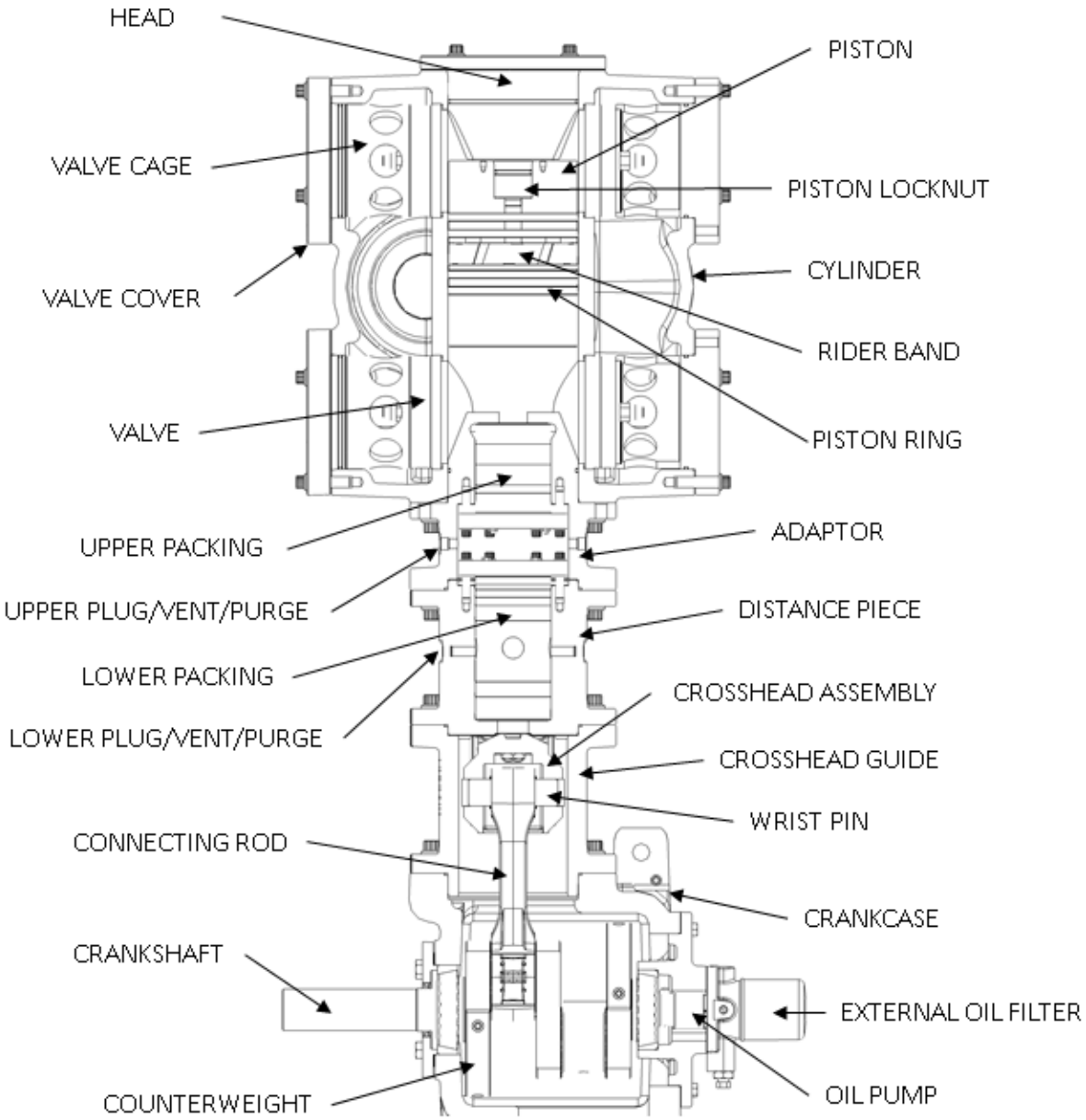


Figure 1 – NGH100 Compressor

MODEL: NGH _____ ID#: _____ SERIAL NO: _____

Before proceeding:

1. Note the nameplate data in the space provided above.
2. Obtain the appropriate parts lists for the model in question.

Manuals and Parts Lists for Blackmer products may be obtained from Blackmer's website (www.blackmer.com) or be contacting Blackmer's Customer Service.

NAMEPLATE DATA

A nameplate is attached to the side of all Blackmer compressors showing the Model No., I.D. No., and Serial No. These numbers should be available when information or parts are needed for a particular unit.

The basic size and type of compressor is indicated by "Model No." A suffix letter is used on most models to indicate the version

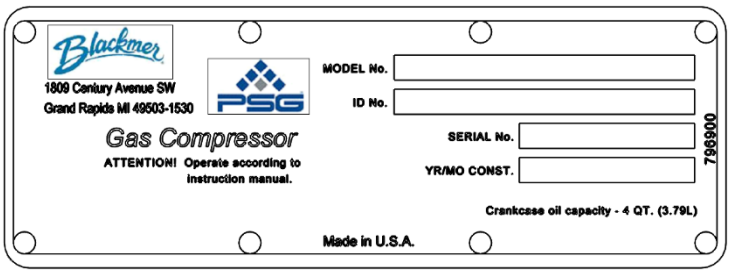


Figure 2 - Compressor Nameplate

CYLINDER NAMEPLATE DATA

An 11 character "I.D. No." identifies the construction of the compressor.

P	B	B	F	M	A	T	A	4	C	A

VALVES, SS, PEEK	Code	Fields 1 & 2
Low Suction Pressure	TBD	
High Suction Pressure	TBD	
O-RINGS		Field 3
Buna-N	TBD	
Neoprene	TBD	
PTFE	TBD	
Fluorocarbon (FKM)	TBD	
Ethylene-Propylene	TBD	
GASKETS		Field 4
Aluminum	TBD	
Iron	TBD	
Copper	TBD	
PISTON RINGS		Field 5
Filled PTFE	TBD	
PEEK	TBD	
PACKING ARRANGEMENT		Field 6
Standard	TBD	
Purge	TBD	
Pad	TBD	
PACKING MATERIAL		Field 7
Filled PTFE	TBD	
PEEK	TBD	
CYLINDER AND HEAD		Field 8
Ductile Iron	TBD	
PISTON RODS		Field 9
Black Surface Steel	TBD	
CRANKSHAFT & OIL FILTER		Field 10
Standard	TBD	
ADJUSTABLE POCKETS		Field 11
None	TBD	
Adjustable Clearance Pocket	TBD	

Table 2 - ID Number Key

MAXIMIZING COMPRESSOR LIFE

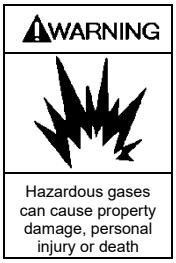
Life of critical compressor components such as piston rings, valves and packing will vary considerably with each application, installation, and operating procedures. Premature failure of wear parts can often be attributed to one of the following causes:

Excessive Temperatures

Primary causes are:

- Operating at pressures other than those originally specified.
- Handling a different gas than originally specified.
- Clogged strainer or filter elements.
- Line sizes too small, or other flow restrictions.
- Excessive ambient temperature or suction gas temperature.
- Valve problems. (See Foreign Material.)
- Badly worn piston rings. (See Foreign Material.)

Lower operating temperatures will increase valve and piston ring life significantly.



Extreme temperatures caused by abnormally high discharge pressure or valve problems can be a source of ignition in explosive atmospheres causing severe personal injury or death.

Foreign Material

Solid particles in the gas stream will:

- Rapidly wear the piston rings and score the cylinder wall.
- Destroy the rod packing causing excessive leakage and score the piston rods.
- Lodge in the valves causing loss of capacity and broken valve plates and springs.

Liquid in the gas stream may:

- Cause broken valve plates and springs.
- Destroy the compressor if present in sufficient quantity.

New Installations

On new installations, the valves and piston rings should be inspected after the first few hundred hours of operation. This will give an early indication of any abnormal problems and allow for corrective action to be taken before a costly failure results. Although piston ring life will vary from application to application, wear will be fairly consistent on subsequent sets of rings.

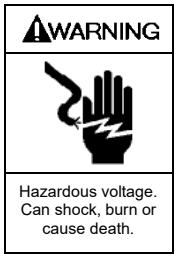
INSTALLATION

NOTICE:

Blackmer compressors must only be installed in systems designed by qualified engineering personnel. System design must conform with all applicable regulations and codes and provide warning of all system hazards.

NOTICE:

This compressor shall be installed in accordance with the requirements of NFPA 58 and all applicable local, state and national regulations.



- **Install, ground and wire to local and National Electrical Code requirements.**
- **Install an all-leg disconnect switch near the unit motor.**
- **Disconnect and lockout electrical power before installation or service**

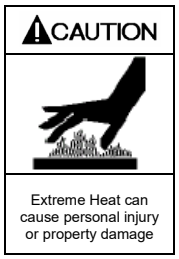
- **Electrical supply MUST match motor nameplate specifications.**
- **Motors equipped with thermal protection automatically disconnect motor electrical circuit when overload exists. Motor can start unexpectedly and without warning.**

LOCATION AND PIPING

Compressor life and performance can be significantly reduced when installed in an improperly designed system. Before starting layout and installation of the piping system, consider the following:

1. All piping must be leak free to a pressure of 1.5 times the maximum system pressure.

   NOTICE: If the system is to be hydro-statically tested, the compressor MUST be isolated. Liquid entering the compressor will cause damage and void the warranty.
2. A strainer should be installed in the inlet line to protect the compressor from foreign matter. A #30 mesh screen or finer is recommended. Strainers **must** be cleaned every 180 days, or more frequently if the system requires.
3. Expansion joints, placed within 36" (0.9 m) of the compressor, will compensate for expansion and contraction of the pipes. Contact the flexible connector/hose manufacturer for required maintenance/care and design assistance in their use.
4. Piping **must** be adequately supported to ensure that no piping loads are placed upon the compressor.
5. Both suction and discharge piping should slope down from the compressor. The compressor should not be placed at a low point in the piping system.



Discharge piping surface temperatures may be hot during operation (over 158°F, 70°C). Temperatures should be monitored and adequate warnings posted.

MOUNTING THE COMPRESSOR UNIT

A solid foundation reduces noise and vibration, and will improve compressor performance. On permanent installations, it is recommended the compressor be secured by anchor bolts as shown. This arrangement allows for slight shifting of position to accommodate alignment with the mounting holes in the base plate.

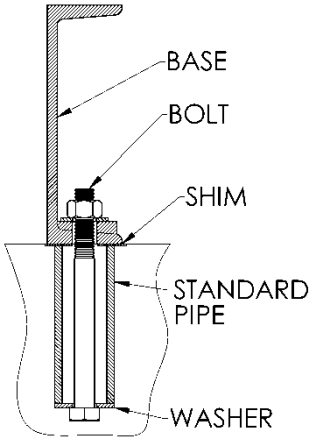


Figure 3 - Anchor Bolt

Set the anchor bolts in concrete for new foundations. When compressors are to be located on existing concrete floors, holes should be drilled into the concrete to hold the anchor bolts.

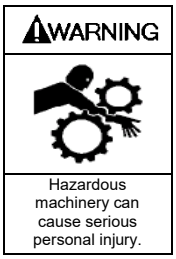
To keep vibration at a minimum, in addition to a solid concrete foundation, it is important that the concrete be located on a stable soil foundation. The base must have complete contact along its entire length with the foundation. Visible separations will result in vibrations which are magnified in the upper part of the unit.

The NGH100 is equipped with mounting points on the bottom end of each cylinder. It is mandatory that these be utilized for anchoring points to the foundation or skid for operation over 1150 rpm and highly recommended at lower rpm. These will reduce overall vibration at certain conditions. A torsional vibration analysis is recommended to determine unsafe running conditions for the exact application.

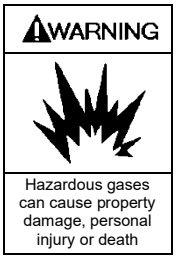
Check compressor mounting bolts and baseplate anchor bolts regularly.

See CB220 “Compressor Bases, Skids and Foundations” for additional information.

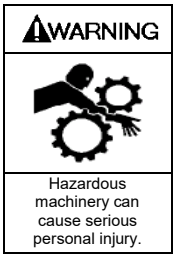
COMPRESSOR DRIVE SYSTEMS



Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death



Flywheel guard contact with moving parts may be a source of ignition in explosive atmospheres causing severe personal injury or death



Operation without guards in place can cause serious personal injury, major property damage or death.

FLYWHEELS

Blackmer compressors are fitted with flywheels which MUST be used for belt drive applications. Two types of flywheels are available, a low speed for compressors running at 1150 RPM and below and high speed for compressor running up to 1800 RPM. Refer to Direct Drive section if a v-belt and flywheel system is not being implemented.

LOW SPEED FLYWHEELS – 1150 RPM MAX

Low Speed Flywheels must be properly installed and aligned:

1. Ensure that the mating surface between the hub and flywheel are clean and dry – do not use a lubricant.
2. Install the hub and key on clean compressor shaft, flange end first.
3. Tighten the hub setscrew just enough to prevent it from sliding on the shaft – do not overtighten.
4. Place the flywheel on the hub and loosely thread the capscrews with lock washers into the assembly. Do not use lubricant on the capscrews.
5. Tighten all capscrews evenly and progressively in rotation to the torque value in Table 3. There must be a gap between the hub flange and the flywheel with installation is complete. **Do not over-torque. Do not attempt to close gap between hub flange and flywheel.**

Hub Size	Capscrew Size	Torque ft-lbs. (Nm)
SF	3/8 – 16	30 (40.7)
E (std)	1/2 - 13	60 (81)
F	9/16 – 12	75 (101)

Table 3 – Flywheel Hub Torque Values

6. Ensure that the radial and axial runout values at the rim do not exceed the following values:
   Radial O.D. Runout: 0.016 in. (0.4046 mm)
   Axial Rim Runout: 0.021 in. (0.5334 mm)
7. Ensure that the compressor flywheel guard is properly installed before operation. The guard must not contact moving parts.

HIGH SPEED FLYWHEELS – 1800 RPM MAX

High Speed Flywheels must be properly installed and aligned:

1. Ensure that the mating surface between the flywheel clamp hub and crankshaft are clean and dry – do not use a lubricant.
2. Install the key and flywheel on the compressor shaft. The flywheel bore is a machined to size clamp hub.
3. Tighten clamp hub bolts to specified torque of 188 ft*lbs (254.9 Nm)
4. Flywheel is two plane dynamically balanced but verify Radial O.D. Runout and Axial Rim Runout is equal to or less than: 0.010 in (0.127 mm)

V-BELT DRIVES

Most Blackmer compressors are driven via V-belts which must be properly designed, aligned, and tensioned.

1. Lay a straight edge along the face of the motor sheave and compressor flywheel.
2. Adjust either as needed to provide alignment.
3. Tighten the V-belts such that they are taut, but not overly tight. Consult your V-belt supplier for specific values. It is recommended that a belt tension meter or sonic meter be used during tensioning for the most accurate results.
4. Check the belt tension after 24 - 48 hours run-in. Recheck the tension periodically, and tighten the belts as required.

Caution should be used to avoid overtightening belts, which can shorten bearing and belt life. Belts should be inspected periodically for signs of excessive wear and replaced if necessary.

DIRECT COUPLE MOTOR DRIVES

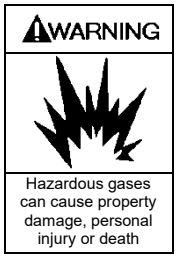
Consult factory for direct drive applications. It is recommended that a torsional vibration analysis be completed on the specified system for best results.

DIRECT COUPLE ENGINE DRIVES

Consult factory for direct drive applications. It is recommended that a torsional vibration analysis be completed on the specified system for best results.

SEAL ARRANGEMENTS

The seal arrangement type is noted by the 6th digit of the compressor's ID Number on the nameplate. Refer to the section 'SEAL REPLACEMENT' for seal arrangement drawings.



Improper seal installation could release explosive gas to the atmosphere creating an explosion hazard, possibly causing severe personal injury or death.

The adaptor and distance piece castings each include four 1/4" NPT openings into the upper and lower distance piece area. This is the area separating the upper, middle, and lower packing.

Both distance piece openings may be used to drain any oil/condensate that might accumulate in the distance piece. If used, a normally closed valve must be fitted in the drain line. Opening the valve could result in some product leakage.

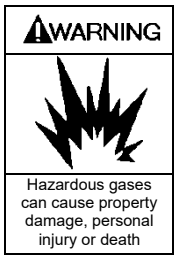
The distance piece and adaptor include a vent, and two purge/pad connections.

RELIEF VALVES

A relief valve of a type, material and pressure rating suitable to the installation, MUST be installed. The relief valve shall be installed in the discharge line between the compressor head and the first block valve.

Compressor operating against closed valve can cause system component failure, personal injury or property damage.

Since all systems differ in design, care must be taken to ensure the relief valve is installed to safely vent away from sources of ignition and personnel. This can be accomplished by either orientation or a pipe away, consult the Relief Valve manufacture for assistance.



Operation of the relief valve can release explosive gas to the atmosphere creating an explosion hazard, possibly causing personal injury or death

Should the Relief Valve actuate, the cause MUST be determined and corrected before continuing operations. See the 'Troubleshooting' section.

Blackmer offers various relief valves for gas and application compatibility:

- Brass for LP-Gas service
- Aluminum for anhydrous ammonia
- Steel, A.S.M.E. code stamped for both services, and other applications.

4-WAY VALVES

Many liquefied gas compressors are used for both liquid transfer and vapor recovery operations. An optional 4-way valve is used to reverse the direction of flow through the system when changing from liquid transfer to vapor recovery. Both lubricated and non-lubricated models are available. Lubricated models should be lubricated every 6 months.

PRESSURE GAUGES

Install pressure gauges in the discharge and inlet lines to verify actual suction and discharge pressures.

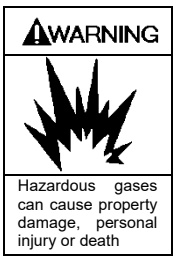
INTERSTAGE PIPING / COOLING

2-Stage Models: Generally, an interstage cooler should be used between the 1st stage discharge and the 2nd stage. Cooling must be sufficient to prevent excessive temperatures in the 2nd stage; typically 100 – 125°F (38 – 52 C°). If interstage cooling is sufficient to cause condensation, the resultant liquid must be removed prior to entering the 2nd stage (see LIQUID TRAPS).

SUCTION VALVE UNLOADERS

Compressors may be fitted with suction valve unloaders to provide loadless start or capacity control functions. Blackmer unloaders are basically a piston and a plunger atop the suction valve. When pressure is applied to the top of the unloader piston, it and the plunger move downward, pushing the suction valve off its seat and unloading the compressor. When the pressure signal is removed, the unloader spring pushes the piston and plunger back up and the suction valve will resume normal operation.

1. In order for the unloaders to function, the unloader pressure must be at least 30 psi (2.1 Bar) above suction pressure.
2. Do not operate unloaders for longer than 10 minutes as gas recirculation through the suction valves will cause overheating.



Excessive gas recirculation using suction valve unloaders can be a source of ignition in explosive atmospheres causing severe personal injury or death

3. Do not place a restrictive device such as a back check valve in the suction line near the compressor. If such a device must be installed, the volume in the piping between the device and the compressor must be at least 10 times the cylinder swept volume.

LIQUID TRAPS

Compressors handling gases that contain condensates or other liquids MUST be protected from entry of the liquid. Liquid can also enter the compressor from the discharge piping, particularly if the piping slopes down toward the compressor. To prevent liquid from entering the compressor and causing major damage, it is necessary to carefully consider the system design and have strict procedures for operation.

NOTICE: Liquid in the compressor cylinder can cause destruction of the compressor.

Suction liquid traps collect liquid entrained in the suction gas stream, preventing it from entering the compressor. The most common liquid trap is an ASME code vessel (approx. 12" diameter X 50" tall) fitted with an internal stainless steel mist pad, a relief valve, a manual drain valve, and one or two electric float switches. This type trap is needed if level gauges or automatic drain systems are to be used.

If the liquid level rises too high in the trap, a float switch is tripped, sending a signal to stop the compressor or sound an alarm. The trap must then be drained before the compressor can be restarted. The cause of the high liquid level should be found and the problem corrected.

TEMPERATURE SWITCHES

Excessive discharge temperature is a leading cause of premature component failure and is often an early warning sign of impending problems.

Optional temperature switches should be installed with a thermowell as close to the compressor discharge as possible. The switch should be set to actuate at a temperature just above the maximum operating temperature of the compressor.

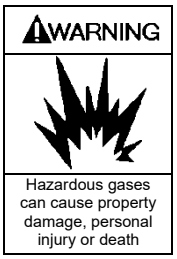
ATEX compliant compressors **must** have a temperature switch installed.

LOW OIL PRESSURE SWITCHES

Loss of crankcase oil pressure is a rare occurrence, but can result in costly damage. An optional low oil pressure switch set at about 15 psig (1 bar-g) may be installed to shut down the compressor in the event of a lubrication failure. A 10 second delay timer should be used to lock the low oil pressure switch out during compressor startup.

PRESSURE SWITCHES

Pressure switches may be installed in the suction or discharge gas stream as protective devices, for compressor control, or for other uses varying with each application and system design.



Optional liquid trap level switches, temperature switches, pressure switches or other electrical devices must be properly specified for applications using explosive gases.

OIL COOLING AND CONTROL

Oil temperature and pressure monitoring is recommended on all units. An increase in oil temperature can be caused by oil breakdown, improper filtration, or dirty oil.

An oil cooler is recommended on all machines running at 1200 or more RPM. An oil cooler is typically supplied with these units and should be installed using an oil cooler sandwich adaptor (installed on oil pump cover).

A crosshead guide oil injection system is supplied and installed on all machines.

WARNING: IF OIL COOLER SANDWICH ADAPTOR IS INSTALLED, SANDWICH ADAPTOR MUST BE CONNECTED TO AN APPROVED OIL COOLER. IF OIL COOLER SANDWHICH ADAPTOR IS NOT CONNECTED TO AN APPROVED OIL COOLER, THE SANDWICH ADAPTOR MUST BE REMOVED FROM COMPRESSOR ASSEMBLY BY A QUALIFIED TECHNICIAN. FAILURE TO DO SO WILL POTENTIALLY RESULT IN LOW OIL PRESSURE, WHICH MAY RESULT IN CATASTROPHIC DAMAGE TO THE COMPRESSOR.

To Remove Oil Cooler Sandwich Adaptor (See Figure 4):

1: Remove Oil Filter from assembly.
2: Remove Oil Filter Adaptor from assembly.
3: Remove Oil Cooler Sandwich Adaptor and O-Ring from assembly
4: Assure that Oil Filter Fitting is tight.
5: Reassemble Oil Filter to Oil Filter Fitting.

TIP: Fill Oil Filter with approved compressor oil per **Table 8** to help with oil system priming at compressor startup.

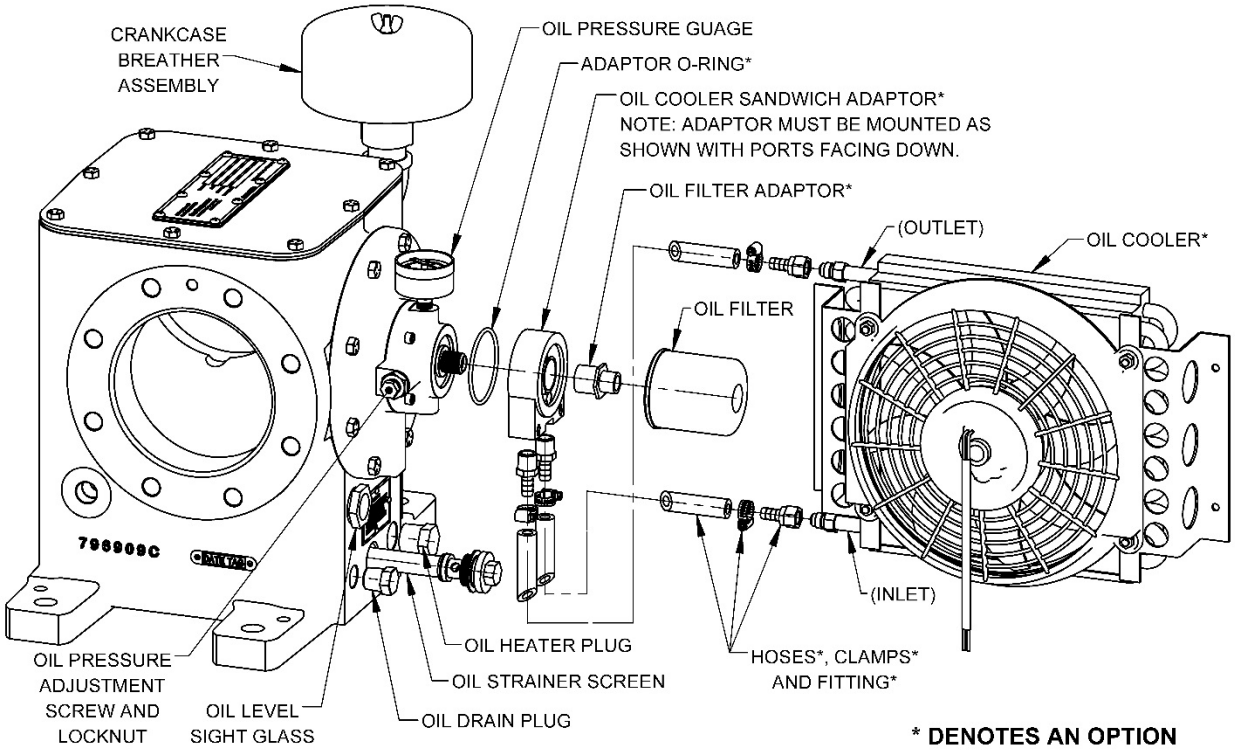
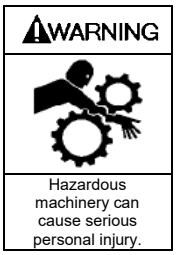
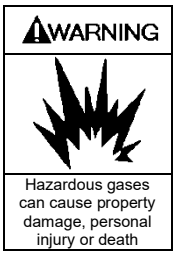


Figure 4 – Recommended Optional Oil Cooler Assembly

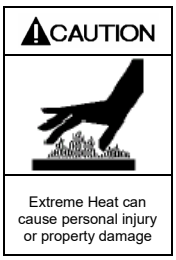
PRE-STARTUP CHECK LIST



Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death

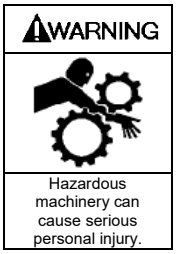


Failure to properly leak test the compressor installation may result in leakage of explosive gas to the atmosphere creating an explosion hazard, possibly causing severe personal injury or death.

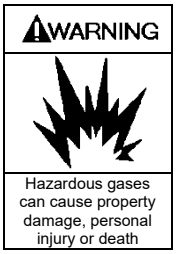


Discharge piping surface temperatures may be hot during operation (over 158°F, 70°C). Temperatures should be monitored and adequate warnings posted.

1. After the compressor is installed in the system, a complete leak test MUST be performed on both the compressor and the piping.
2. Re-check the system piping and the piping supports to ensure that no piping loads are being placed on the compressor.
3. If V-belt driven, check the alignment of the motor and the compressor sheaves. The faces of the sheaves must be parallel.
4. Ensure that pressure gauges are installed on both inlet and discharge of the compressor.
5. Blackmer compressors are shipped from the factory without oil in the crankcase. Fill with a high quality non-detergent oil of the proper viscosity via the compressor nameplate opening. See "Crankcase Lubrication" in this manual.
6. Check the electrical connections for proper wiring, grounding, etc.
7. With the power disconnected, remove the compressor crankcase cover. Squirt oil onto each crosshead while rotating the compressor by hand to verify smooth operation.
8. Ensure that all guarding is properly installed.



Operation without guards in place can cause serious personal injury, major property damage or death.



Flywheel guard contact with moving parts may be a source of ignition in explosive atmospheres causing severe personal injury or death

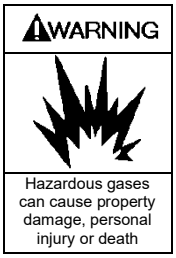
STARTUP PROCEDURE

NOTICE:

Consult the 'Troubleshooting' section of this manual if difficulties during startup are experienced.

1. Start the compressor. Oil pressure should register 50 psig (3.45 bar-g) within 10 seconds.

   If proper oil pressure is not present, stop the compressor and correct the problem.



Operation of the compressor with low or no oil may result in extreme temperature in the crankcase. This could be an ignition source in the presence of explosive gas and could lead to severe personal injury or death.

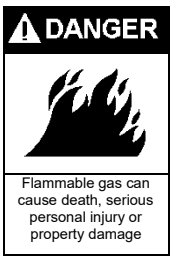
   Operating the compressor with low oil pressure will cause severe damage to the unit. See "Setting the Oil Pressure" in this manual.

   The oil pump on these models will operate in either direction of crankshaft rotation.

2. Verify that the suction and discharge pressures are within the expected ranges.

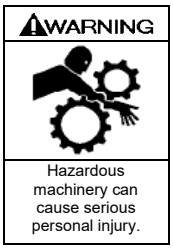
   Operating limits listed in the "Compressor Data" section must not be exceeded.

3. Check for leakage from the piping and equipment, and repair as necessary.
4. On newly rebuilt units, the valve cover bolts, adaptor bolts, and cylinder head bolts MUST have their torque checked after 60 minutes running time. Also re-tighten all hold down bolts, flywheel bolts, etc. after 60 minutes running time. See Table 4 - "Bolt Torque."

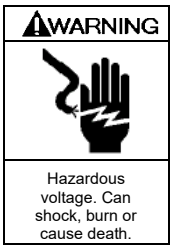


Flammable gas and/or liquid can form explosive mixtures with air causing property damage, serious personal injury or death

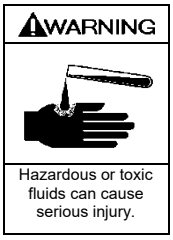
Failure to relieve system pressure prior to performing compressor service or maintenance can cause serious personal injury or property damage.



Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death

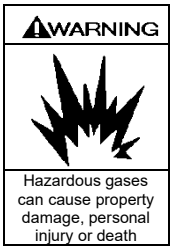


Failure to disconnect and lockout electrical power before attempting maintenance can cause shock, burns or death

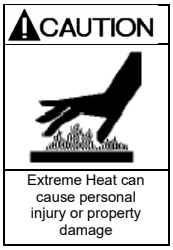


If handling hazardous or toxic fluids, system must be flushed and decontaminated, inside and out, prior to performing service or maintenance

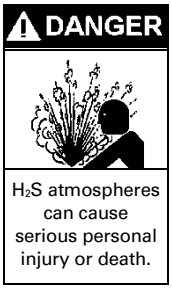
Disconnecting fluid or pressure containment components during compressor operation can cause serious personal injury, death or major property damage



Explosive gas can cause property damage, personal injury, or death.



Extreme heat can cause personal injury or property damage



H_2S atmospheres can cause serious personal injury or death.

NOTICE

Blackmer compressor service and maintenance shall be performed by qualified technicians only. Service and maintenance shall conform to all applicable local and national regulations and safety standards.

BOLT TORQUE FOR MODEL NGH LBS-FT (Nm)

Connecting Rod Bolt	Bearing Carrier	Bearing Cover Plate	Crankcase Inspection Cover	Crosshead Guide	Oil Pump Cover	Cylinder	Head
45 (61.0)	30 (40.7)	40 (54.2)	15 (13.5)	80 (108.5)	12 (16.3)	80 (108.5)	50 (67.8)

Piston Nut	Valve Cover (6.00”)	Valve Cover (3.25”)	Upper / Lower Packing Box Screw	Low Speed Flywheel Hub Bolts	High Speed Flywheel Hub Bolts	VVCP Locknut	VVCP Rod Cover	VVCP Head Cover
175 (237)	50 (67.8)	80 (108.5)	20 (27)	see Table 3	188 (254.9)	175 (237)	175 (237)	50 (67.8)

Table 4 - Bolt Torque

MAINTENANCE

SERVICE SCHEDULE

	Daily	Weekly	Monthly	6 Months	Yearly
Overall Visual Check	X				
Check Crankcase Oil Pressure	X				
Check Suction Pressure	X				
Check Discharge Pressure	X				
Drain Distance Piece		X			
Drain Liquid From Accumulation Points		X			
Clean Compressor Cooling Fins		X			
Check Crankcase Oil Level *			X*		
Check Mounting and Anchor Bolts			X		
Check V-Belt Tension			X		
Change Oil and External Oil Filter *				X*	
Grease VVCP Adjustment Screw				X**	
Check Inlet Filter/Strainer Element				X	
Inspect Valves				X	
Lubricate 4-way Valve				X	
Lubricate Motor Bearings per Manufacturer's Suggestions				X	
Inspect Motor Starter Contact Points					X

* Change oil every 1,000 hours of operation, or every 6 months whichever occurs first. If the oil becomes dirty or diluted, change oil and external filter as often as needed to maintain clean oil.

**If VVCP option is present, Grease Piston Rod (Adjustment Screw) when changing Crankcase oil.

Table 5 - Service Schedule

TOOL LIST

Description	**Used For:**
Blackmer Piston Nut Crossbar (Part # 798024) Blackmer Piston Nut Socket Tool (Part # 798025) Blackmer Piston Nut Socket Tool (Part # 798026)	Piston Lock Nut 6.0” and 3.25” Cylinder Piston Lock Nut 6.0” Cylinder Piston Lock Nut 3.25” Cylinder
Blackmer Packing Installation/Removal Tool (Part # 797049)	Rod-Packing protection during installation.
1/2” Drive 6” Extension	Piston Lock Nut
3/8”, 1/2”, 5/8”, 12 Point Drive Sockets	Main Bolting, Bearing Carrier, Packing Bolts
100 ft*lb 3/8” Drive, 250 ft*lb ½” Drive Torque Wrench	Torqueing All Bolts
Feeler gauges or Depth Micrometer	Piston Clearance
Allen Wrenches: 3/16", 1/4”,5/16”	Oil Pump Cover, NPT Fittings
Screwdriver, Flat Blade	Nameplate screws
Rubber Mallet	
Arbor Press	Wrist Pin Removal
Bearing Puller	Crankshaft Bearings
Hoist (useful)	Major Components
Non-marring Wedge	Connecting Rod Removal
Non-marring Punch	Connecting Rod/Wrist Pin Removal/Installation
10” Crescent Wrench	
10” Pipe Wrench	
Loctite Anti-Seize (non-copper)	
O-Ring Lubricant (Parker)	O-Rings

Table 6 - TOOL LIST

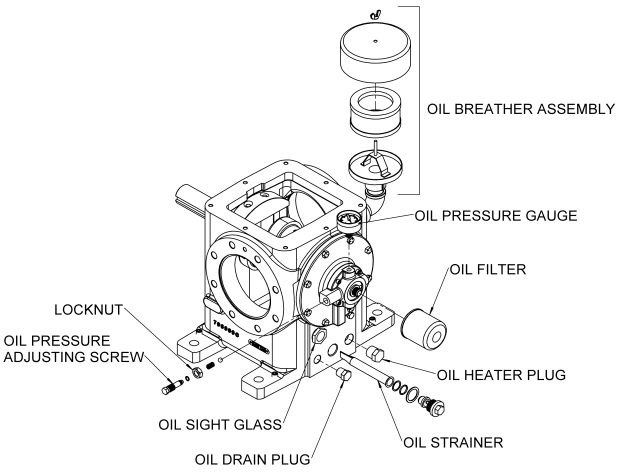


Figure 5: Compressor Lubrication System

CRANKCASE LUBRICATION

Change the crankcase oil every 1,000 hours or 180 days, whichever is shorter. Under severe dusty, sandy or wet operating conditions, the oil should be changed every 500 hours or every 90 days.

If the crankcase oil becomes contaminated or diluted due to gas leakage past the packing seals, the oil must be changed more frequently. In such cases, change the packing seals as soon as possible.

Non-detergent oils are recommended. Detergent oils can be used providing the gas being handled does not react with the detergent in the oil. If using a detergent oil, be sure there is not a compatibility problem. Ammonia, amine and imine gases are known to react with many of the detergents in oil.

The oil used, detergent or non-detergent, should be of high quality such as API grade SJ, SL, SM, SN or similar.

API grade SA, SB, SC or similar oils should never be used. Recycled oils should never be used.

Synthetic oils are acceptable; use the same guidelines as mineral based lubricants. Consult factory for special lubricating requirements.

Before changing the oil, bring the compressor up to normal operating temperature. Remove the crankcase drain plug and drain the oil into an adequately sized container. Remove the oil pickup screen and clean in a suitable solvent. When reinstalling the pickup screen, inspect the metal gasket and the O-ring for damage, replacing as necessary. If equipped, replace the external oil filter. See **Figure 5**.

Oil Cooler

The NGH100 compressor is supplied with an oil cooler and is required. See OIL COOLING AND CONTOL.

Refill the crankcase via the vent pipe or the crankcase cover. A sight glass is located on the lower portion of the crankcase below the oil filter. This should register at the halfway mark. **DO NOT OVERFILL THE CRANKCASE!**

The oil pump on these models will operate in either direction of crankshaft rotation.

Models	Quarts	Liters
NGH100	4	3.785
NGH100 w/oil cooler	5	4.732

Table 7 - Oil Capacity

Mineral Based Oil - API Grade SN, SM, SL, SJ

ISO Grade	SAE	Ambient Temperature	Product (or equivalent)
150	40	120°F and Above (49°C and Above)	Mobil® Rarus 429
100	30	80°F to 120°F (27°C to 49°C)	Mobil® Rarus 427
68/46	20	32 to 80°F (0 to 27°C)	Mobil® Rarus 426/425
32	10	0 to 32°F (-18 to 0°C)	Mobil® Rarus 424
22 - 15	5 - 0	Below 0°F (-18°C)	NA

Synthetic Oil

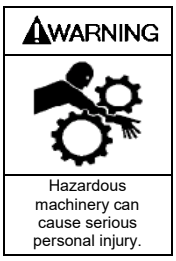
ISO Grade	SAE	Ambient Temperature	Product (or equivalent)
150	40	120°F and Above (49°C and Above)	Mobil® Rarus 829
100	30	80°F to 120°F (27°C to 49°C)	Mobil® Rarus 827
68	20	32 to 80°F (0 to 27°C)	Mobil® Rarus SHC 68

Table 8 - Oil Viscosity

SETTING THE OIL PRESSURE (see Figure 5)

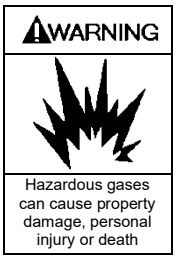
1. The oil pressure should be about 50 psig (3.45 Barg).
2. Loosen the locknut.
3. Increase the pressure setting by turning the adjusting screw inward, CLOCKWISE.
4. Decrease the pressure setting by turning the adjusting screw outward, COUNTER-CLOCKWISE.
5. Retighten the locknut.

COMPRESSOR DISASSEMBLY



Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death

Failure to relieve system pressure prior to performing compressor service or maintenance can cause serious personal injury or property damage.



Venting pressure from the compressor piping could release explosive gas to the atmosphere creating an explosion hazard, possibly causing severe personal injury or death.

NOTICE:
Before starting work on the compressor, make sure all pressure is bled off on both the suction and discharge.

HEAD REMOVAL

1. Remove the head bolts from the head/cylinder.
2. There are 2 threaded jacking holes available if the head is difficult to remove, using the head bolts.
3. Remove the head shims and keep with head for later reassembly.
4. Remove the valves per the "Valve Replacement" section.

PISTON REMOVAL

5. Rotate the crankshaft by hand to bring a piston to the top dead center position.
6. Remove the piston nut with piston nut tool. Refer to Tools List (see Table 6).
7. Remove the piston using the two 1/4" threaded puller holes. (If two 1/4" bolts are not readily available, the oil pump cover bolts may be used.)
8. When removing piston make sure piston shims are accounted for as they must be reinstalled or piston clearance will be too low and clearance must be reset. The clearance is a function of the tolerance stack-up and operating temperature so failure to properly clearance piston may result in damage.
9. Care must be taken during removal of piston so that damage does not occur to the piston rings or rider band. If needed remove valves per the "Valve Replacement" section.
10. Keep the shim sets together to simplify reassembly later, per above.

PISTON RINGS / RIDER BAND REMOVAL

11. Piston rings can be one piece or two piece. Each can be removed by hand. If worn, they must be replaced to maintain proper sealing.
12. Rider bands are sacrificial parts and need to be replaced if worn. There are two designs, 1) One piece, 2) Split. To remove Rider Band from piston design 1, cut or spring band off. To remove Rider Band from design 2, separate piston halves.
13. To remove the Cylinder (Figure 7)
    a. Remove the Cylinder to Adaptor bolts
    b. Slide Cylinder off from Adaptor carefully using a hoist or crane.
    c. Take care to not damage Adaptor O-Ring as the fit is very snug and can be wedged if not

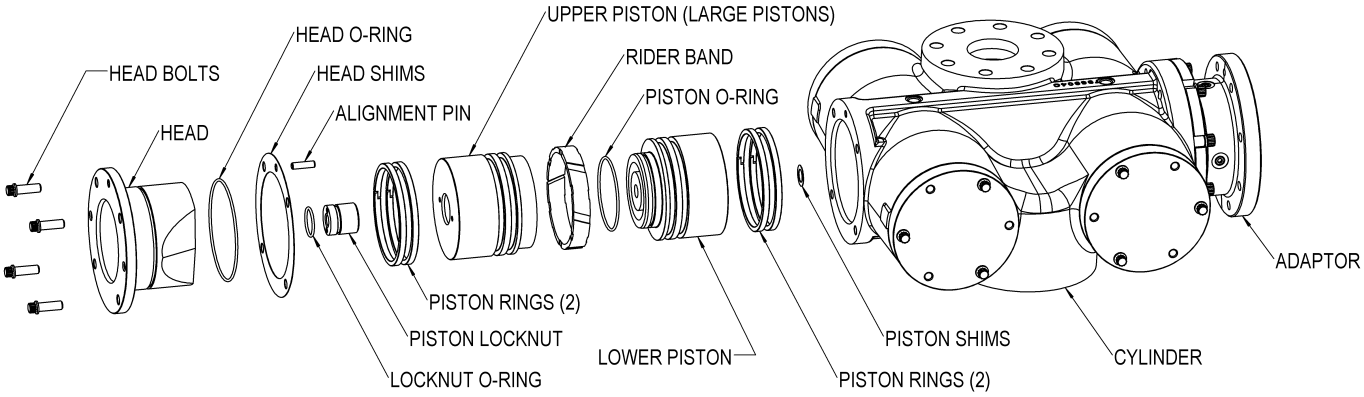


Figure 6 - Cylinder and Piston

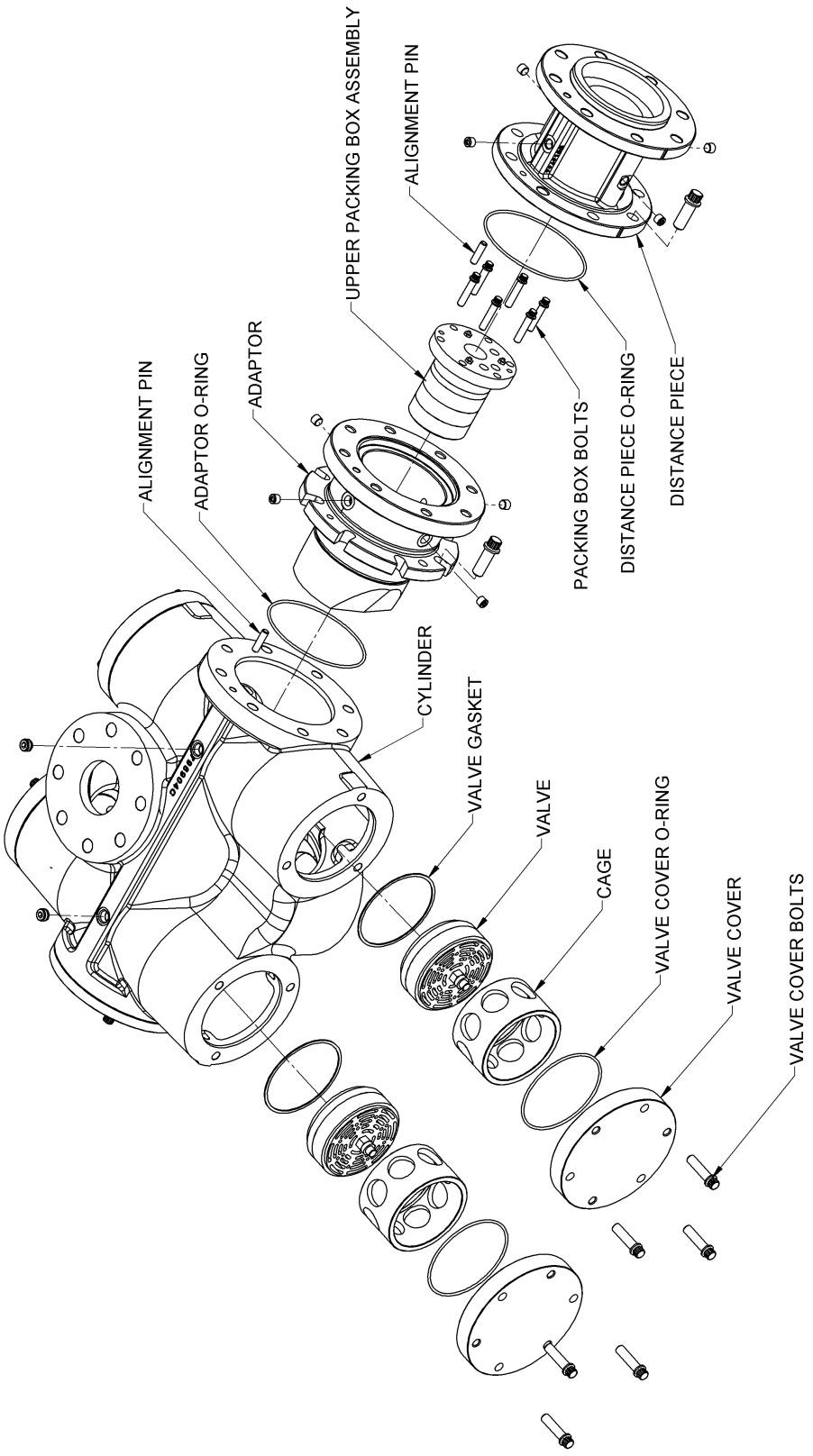


Figure 7 – Upper Compressor Assembly

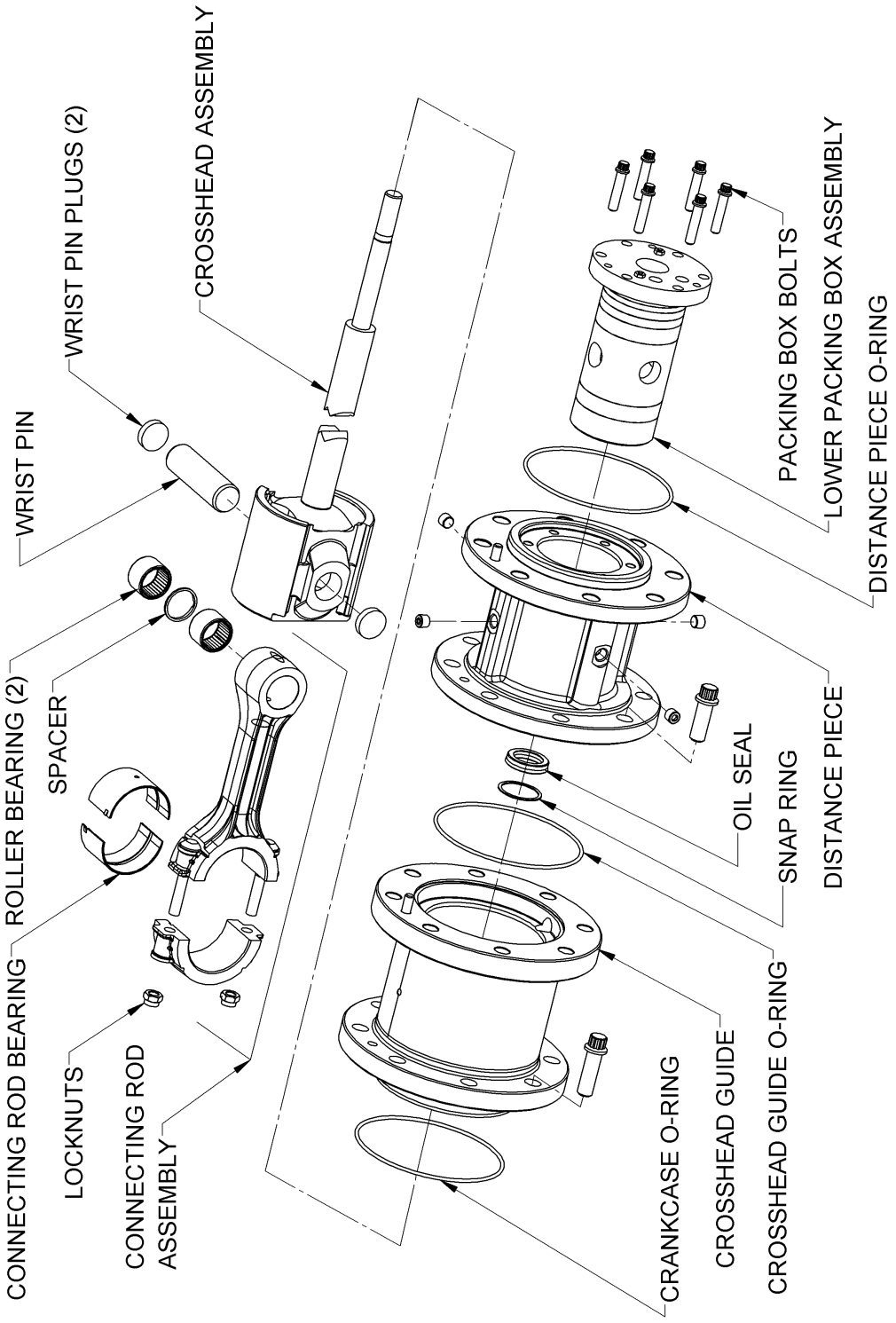


Figure 8 – Lower Compressor Assembly

CYLINDER / ADAPTOR REMOVAL

14. To remove the Adaptor (Figure 7)
    a. Remove the Adaptor to Distance Piece bolts
    b. Install Packing Installation/Removal Tool on the threads of the Piston Rod to deter packing damage.
    c. Slide Adaptor off from Distance Piece carefully making sure only the packing contacts the Piston Rod during removal.
    d. Remove the Adaptor/Cylinder O-Ring
15. To remove Upper Packing Box Assembly (Figure 7)
    a. Verify the Packing Installation/Removal Tool is installed on the Piston Rod
    b. Remove the Upper Packing Box Assembly bolts from the Upper Packing Box flange.
    c. Slide the assembly out of the Adaptor using the threaded holes and two of the bolts.
    d. The packing box will come out as a complete assembly.
    e. Note there is a crush gasket at the bottom of the packing box. Take care not to damage if reuse is planned. Replacement is recommended.
16. To remove Distance Piece (Figure 8)
    a. Remove the Distance Piece O-Ring
    b. Remove Distance Piece to Crosshead Guide bolts.
    c. It is recommended the Distance Piece be removed with the Lower Packing Box still installed to allow for the best control of alignment.
    d. Remove the Distance Piece from the Crosshead Guide carefully as to not damage the piston rod.
17. To remove Lower Packing Box Assembly (Figure 8)
    a. Verify the Packing Installation/Removal Tool is installed on the Piston Rod.
    b. Remove the Lower Packing Box Assembly bolts from the Lower Packing Box flange.
    c. Slide the assembly out of the Distance Piece using the threaded holes and two of the bolts.
    d. The packing box will come out as a complete assembly.
    e. Note there is a crush gasket at the bottom of the packing box. Take care not to damage if reuse is planned. Replacement is recommended.
18. To remove Oil Seal (Figure 8)
    a. On the Crankcase side of the Distance Piece there is an oil seal.
    b. Remove the circular snap ring with a flathead screwdriver carefully.
    c. The seal will be damaged during removal due to the snap ring groove and must be replaced if removed.
19. To remove Crosshead Guides (Figure 8)
    a. Remove the Crosshead Guide O-Ring
    b. Remove the Crosshead Guide to Crankcase bolts except one of the top bolts
    c. Properly support the Crosshead Assembly as it will fall during disassembly and removal of the Crosshead Guide.
    d. Remove the final bolt and remove the Crosshead Assembly carefully. Two people may be necessary to do this safely.
    e. Remove the Crankcase O-Ring

REMOVING THE CONNECTING ROD ASSEMBLIES (with the crossheads attached). The piston rod is permanently attached to the crosshead to form a single assembly. Do not attempt disassembly.

a. Drain the oil from the crankcase.
b. Remove the inspection plate from the crankcase.
c. Remove the locknuts from the two connecting rod bolts. This will release the connecting rod cap (the lower half of the connecting rod) and the two halves of the bearing insert. The connecting rod and the connecting rod cap are marked with a dot on one side so that they can be matched properly when reassembling.
d. Carefully separate the cap from the rod using a soft punch and soft wedge. The rod bolts are a slight press fit and may be difficult to remove.

NOTICE: The connecting rod parts are not interchangeable and must be reassembled with the same upper and lower halves. To avoid confusion, work on one connecting rod at a time, or mark the individual halves with corresponding numbers.

Connecting rods and crosshead assemblies can only be replaced in pairs as they are balanced to each other.

20. Rest the crosshead assembly on a bench. Carefully drive the wrist pin and wrist pin plugs out of the crosshead and connecting rod using a suitable pin driver or an arbor press. Removal of the pin releases the crosshead assembly from the connecting rod.
21. If necessary, the wrist pin bearings can be replaced after the crossheads are removed. The small end of the connecting rod is fitted with two roller bearings separated by a spacer. When properly installed, the roller bearings should protrude 0.075” (1.9 mm) on each side of the conrod.
22. To replace the crankshaft bearings, the crankcase must be disassembled, and the crankshaft removed. Refer to “Bearing Replacement” for disassembly instructions.

Compressor assembly is generally the opposite of compressor disassembly. Before reassembling, clean each part thoroughly. Check all machined surfaces for burrs or roughness, and file lightly if necessary. **Replace any O-rings or gaskets that are removed or disturbed during service.**

1. CRANKCASE ASSEMBLY

After replacing the crankshaft, bearing carrier, and bearing cover plate, the connecting rod and crosshead can be assembled in the crankcase. See the "Bearing Replacement" section.

2. CROSSHEAD AND CONNECTING ROD ASSEMBLY

a. To attach the connecting rod to the crosshead assembly, first coat the wrist pin, the wrist pin bore in the crosshead assembly, and the wrist pin bearing in the connecting rod with grease.
b. Start the wrist pin in the bore of the crosshead assembly until the pin begins to project through to the inside of the crosshead assembly. (Use an arbor press if available.)
c. Slide the connecting rod up inside of the crosshead assembly and align the bearing with the wrist pin.
d. Install the wrist pin through the connecting rod until it is centered in the crosshead assembly. The wrist pin should be snug in the crosshead assembly. The connecting rod should rotate freely on the wrist pin, but should not be loose.
e. Dip the wrist pin plugs in grease and press them against the ends of the wrist pin.

3. CROSSHEAD GUIDE ASSEMBLY

a. Install the crankcase o-ring onto the crosshead guide dowel on the lower end of the crosshead guide.
b. Install the crosshead guide onto the crankcase using the dowel pin to align the crosshead guide to the crankcase.
c. Install the crosshead guide to crankcase bolts and torque properly per the Torque Table.

4. CROSSHEAD INSTALLATION

a. Lubricate the inside bore of the crosshead guide with crankcase oil.
b. Thoroughly inspect the Piston Rods for any damage, scratches, nicks, or rough spots. This will affect the wear and sealing of the packing. Repair any high spots or burrs if present.
c. Place the bearing halves into each half of the connecting rod, aligning the bearing tangs with the slots in the connecting rod. Coat the bearing with grease.
d. With the connecting rod cap removed, carefully set and slide the crosshead assembly into the crosshead guide making sure the connecting rod tabs indicating rod/cap orientation are facing upwards. Take care as alignment is important and avoid binding if at all possible.
e. Slowly slide the crosshead assembly and align the connecting rod with the crankshaft journal. Take care not to scratch the journal surface.
f. Replace the connecting rod cap with the dots on the connecting rod and cap verifying they face upwards.
g. Start the nuts on the connecting rod bolts and torque per Table 4 – "Bolt Torque."
h. Follow this same procedure for the opposite connecting rod.
i. Do not rotate machine unless to tighten the connecting rod nuts. Damage may occur to crosshead assembly surface due to not being fully supported.

5. DISTANCE PIECE ASSEMBLY

a. These instructions are for distance pieces with new lower packing box assemblies. Refer to the SEAL REPLACEMENT section for instructions on rebuild and inspection of the Lower Packing Box assembly.
b. Depending upon type of lower packing box assembly, verify presence of or install the lower gasket or o-ring into the bottom of assembly. If no o-rings or gaskets are present install the proper components before installation.
c. Install the Lower Packing Box assembly into the Distance Piece.
d. Verify that the orientation is facing upwards by rotating the lettering upwards towards the top alignment pin, as to it can be read with pin at top.
e. Install the Lower Packing Box Assembly bolts and torque according to the Torque Table. Note that some packing box assemblies have crush gaskets and may require tightening multiple times in an even crossing pattern.
f. Install the Oil Seal by pushing into bore carefully and squarely to the bottom of the bore Take care as to not damage the outer lip. The springs will be facing outwards and visible during installation.
g. Install the Circular Snap Ring into the snap ring groove by rotating it into the groove one section at a time. Take care as not to damage the inner lip.
h. Install the Packing Installation/Removal Tool onto the Piston Rod.
i. Carefully slide the assembled Distance Piece onto the Piston Rod and push on until the large main dowel engages and the alignment pin is fully engaged.
j. Install the Distance Piece to Crosshead Guide

bolts and torque properly per the Torque Table.

6. ADAPTOR ASSEMBLY

a. These instructions are for Adaptors with new upper packing box assemblies. Refer to the SEAL REPLACEMENT section for instructions of rebuild and inspection of the Upper Packing Box assembly.
b. Depending upon type of upper packing box assembly, verify presence of, or install the upper gasket or o-ring into top of assembly.
c. Install the Upper Packing Box assembly into the Adaptor.
d. Verify that the orientation is facing upwards by rotating the lettering upwards towards the top alignment pin.
e. Install the Upper Packing Box Assembly bolts and torque according to the Torque Table. Note that some packing box assemblies have crush gaskets and may require tightening multiple times in an even crossing pattern.
f. Install the Distance Piece o-ring onto the main dowel.
g. Verify the Packing Installation/Removal Tool is installed onto the Piston Rod.
h. Slide the Adaptor onto the Piston Rod until the main dowel engages with the alignment pin aligned at the top of the parts.
i. Install and torque the Distance Piece to Adaptor bolts per the Torque Table.
j. Remove the Packing Installation Tool from the Piston Rod.

7. CYLINDER ASSEMBLY

a. The Cylinder should be installed with the valves removed.
b. Install the Adaptor o-ring.
c. Add corrosion resistant, copper free, anti-seize lubricant to the Piston Rod threads. See TOOL LIST for detailed specifications.
d. Balance the Cylinder horizontally with a hoist or crane, this will aid in installation.
e. Install the Cylinder onto the Adaptor carefully as binding may occur. O-ring lubricant on o-rings will aid installation.
f. Install the Cylinder to Adaptor bolts and torque to specification, see Bolt Torque Table for values. Use alignment pin for locating the Cylinder to the Adaptor.

8. PISTON INSTALLATION AND SETTING PISTON CLEARANCE

a. Install the Rider Band onto the Piston.
b. Install the Piston onto the Piston Rod without Piston Rings or Shims.
c. Install the Piston Locknut onto the Piston Rod without the o-ring to ease installation as it will be removed after clearance is measured. Tighten with Piston Locknut Tool hand tight.
d. Rotate the compressor by hand to BDC (Bottom Dead Center) when the piston is at the bottom of the stroke.
e. With feeler gauges, use one of the valve ports to access and measure the clearance between the Adaptor head surface and the Piston face. This is the Crank End Piston Clearance (Lower).
f. See Table 10 for correct clearance values, add Piston shims as necessary to fall in an acceptable range.
g. Shims are made in two sizes .007” and .015”, use the correct combination to match needed clearance.
h. Rotate the compressor by hand to TDC (Top Dead Center) when the piston is at the top of the stroke.
i. Remove the Piston Locknut and Piston from the Cylinder.
j. Install the correct Piston Shims onto the Piston Rod.
k. Install the Piston Rings onto the Piston in an offset pattern as not to have two relief cuts in line with each other.
l. During installation of Piston into Cylinder verify that Rider Band relief cut is located at the top of the bore, and carefully slide the Piston fully onto the Piston Rod down to the shoulder. Do not use excessive force during this process as the piston rings could be damaged by the valve pockets. Verify the rings are not getting held up in the valve pockets during installation.
m. Install Piston Locknut o-ring onto the Piston Locknut and install onto Piston Rod.
n. Torque the Piston Locknut using the Piston Locknut Tool to specification listed in the Torque Table.
o. Install the Head into the Cylinder without the Head O-ring or Head Shims as it will ease disassembly later.
p. Hand tighten the Head bolts onto the Cylinder.
q. Rotate the compressor by hand to TDC (Top Dead Center) when the piston is at the top of the stroke.
r. With feeler gauges, use one of the valve ports to access and measure the clearance between the Head surface and the Piston face. This is the Head End Piston Clearance (upper).
s. See Table 9 for correct clearance values, add Piston shims as necessary to fall in an acceptable range.
t. Install Head o-ring to the Head and install with the shims verifying the dowel pin alignment at top of Cylinder if present.
u. Install and tighten Head Bolts to specified torque in Bolt Torque Table.
v. Repeat for the opposite side cylinder side.
w. Verify all clearances again once assembly is complete.

NGH100	6.00 Piston		3.25 Piston	
Clearance	Upper	Lower	Upper	Lower
Max (in)	0.080	0.015	0.080	0.015
Min (in)	0.065	0.005	0.065	0.005

Table 9 – Piston Clearance

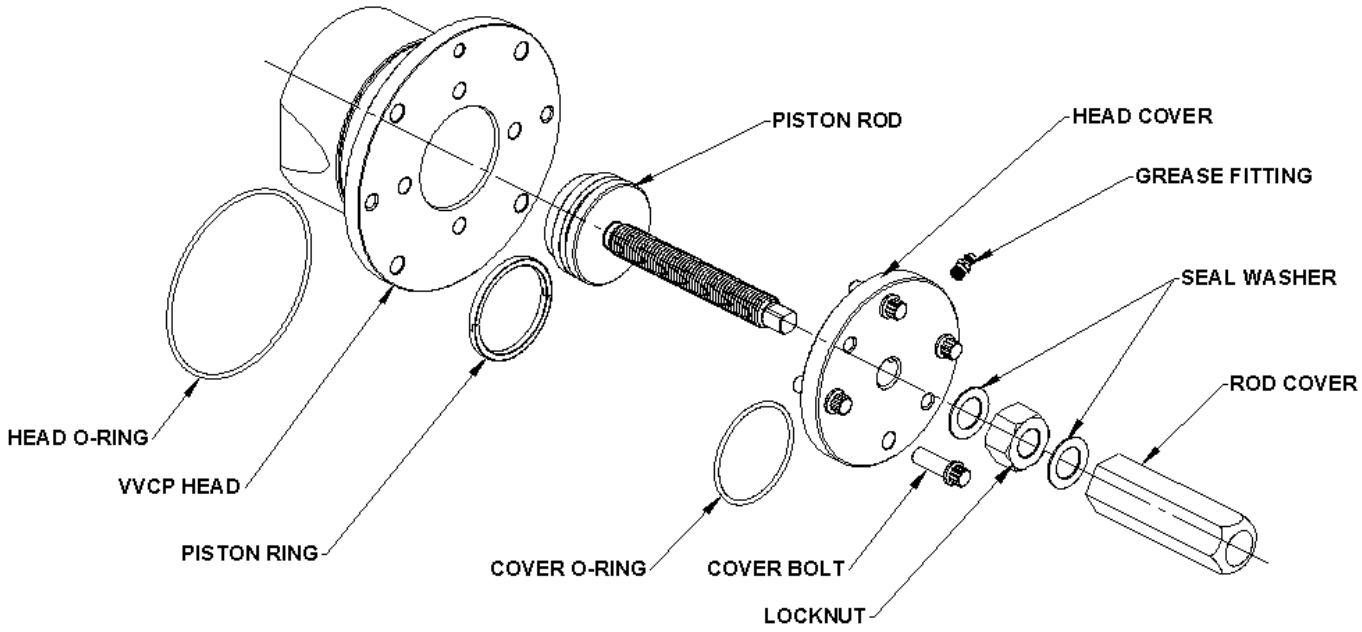


Figure 9 – Variable Volume Clearance Pocket (VVCP) Assembly

9. VARIABLE VALVE CLEARANCE POCKET (VVCP) HEAD ASSEMBLY – OPTIONAL

a. Install Head O-Ring to the VVCP Head and install with the shims verifying the dowel pin alignment at top of Cylinder if present. O-Ring Lubricant may aid in installation

b. Install and tighten Head Bolts to specified torque in Bolt Torque Table.

c. Install Head Cover O-Ring to the Head Cover. O-Ring Lubricant may aid in installation.

d. Thread Head Cover onto Piston Rod until the Piston section is fully seated against the Head Cover. This will assure that the Piston Rod is free to adjust, and not clamped against the VVCP Head.

e. Install Piston Ring to Piston Rod.

f. Assemble Piston Rod and Head Cover into VVCP Head.

g. Install and tighten Head Cover Bolts to specified torque in Bolt Torque Table.

h. Install Seal Washer onto Piston Rod.

i. Thread Locknut onto Piston Rod, and tighten to specified torque in Bolt Torque Table. Confirm no leak is present. Tighten as necessary.

j. Install second Seal Washer onto Piston Rod.

k. Thread Rod Cover onto Piston Rod, and tighten to specified torque in Bolt Torque Table. Confirm no leak is present. Tighten as necessary.

10. ADJUSTING-VARIABLE-VALVE CLEARANCE POCKET (VVCP) – OPTIONAL

a. **BEFORE ADJUSTING VVCP, ASSURE COMPRESSOR IS NOT RUNNING, AND THAT THERE IS NO PRESSURE IN THE CYLINDER. SEVER INJURY MAY OCCUR IF THE PROPER PRECAUTIONS ARE NOT TAKEN.**

b. Loosen and remove Rod Cover.

c. Loosen Locknut far enough along Piston Rod to make the proper adjustments.

d. Use a wrench across flats on end of Piston Rod, and adjust Clockwise to reduce additional Clearance Volume, and Counter-Clockwise to increase Clearance Volume.

e. Tighten Locknut.

f. Thread Rod Cover onto Piston Rod, and tighten.

11. PRE-STARTUP

a. Fill the crankcase with oil. Refer to the “Crankcase Lubrication” section. Squirt oil into the crankshaft, roller bearings, crankshaft journals, and crosshead assemblies to ensure proper lubrication at start up.

b. Attach the inspection plate and the inspection plate gasket to the crankcase.

c. After completion of assembly rotate the machine by hand using the flywheel and verify smooth operation.

d. Refer to the “Pre-Startup Check List”, and “Startup Procedure.”

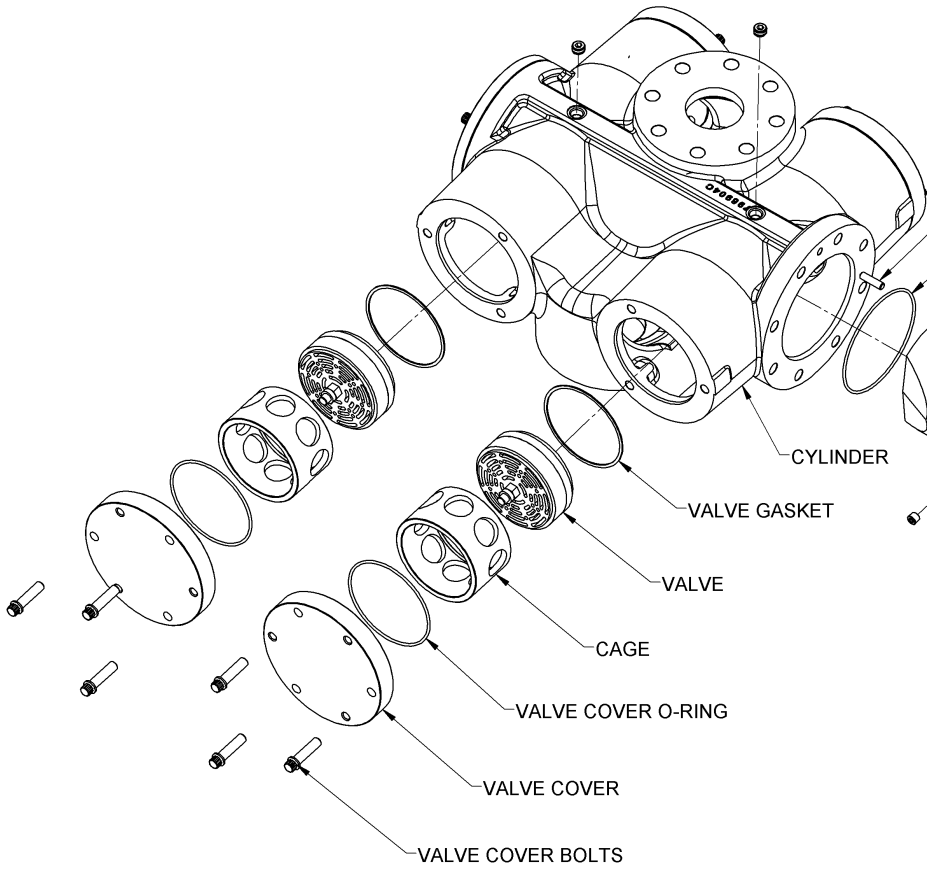
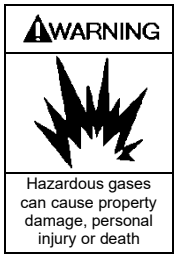
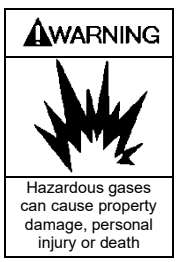


Fig. 10 – Valve Installation – Discharge Shown

Failure to install compressor valves properly can lead to component failure, personal injury or property damage.



Failure to install compressor valves properly can result in leakage of explosive gas creating an explosion hazard, possibly causing severe personal injury or death.



Failure to install compressor valves properly can result in extreme discharge temperatures. This could be an ignition source in the presence of explosive gas possibly causing severe personal injury or death.

Suction and discharge valves MUST be installed in the correct cylinder head locations. See Figure 10.

1. VALVE REMOVAL

a. Remove the Valve Cover bolts. Use the jacking threads and Valve Cover bolts to fully remove Valve Cover.
b. Remove Valve Cover O-ring.
c. Remove the Cage, Valve, and Valve Gasket.
d. Inspect the Valve for wear or breakage.

2. VALVE REPAIR

a. The Valves require a factory rebuild and must be sent in to the factory for refurbishing.

3. VALVE INSTALLATION

The Pistons should be installed and the proper Piston clearance set **before** the valves are installed.

a. Remove the old Valve Gasket and install a new Valve Gasket into the Cylinder.
b. Install the Valve in the Cylinder. Make sure the Valve's orientation and location are correct.
c. In looking at the Valve, the green valve plate should be visible to show direction of flow. Flow will travel through the Valve from the visible green side.

d. Verify carefully Suction and Discharge Valve location prior to installation.
e. It is easiest to install the Valve Gasket, Valve, and Cage at the same time as an assembly.
f. Make sure the assembly is properly seated completely in the valve pocket.
g. Install the Valve Cover O-ring onto the Valve Cover, apply o-ring lubricant to the O-ring to ease installation.
h. Install the Valve Cover into the Cylinder and tighten Valve Cover Bolts. Torque bolts per Bolt Torque Table.

4. After replacing the Valves, rotate the flywheel by hand to check for interference between the pistons and the valves.
5. After 60 minutes of running time, re-torque the Valve Cover bolts.

SEAL (PACKING) REPLACEMENT

The NGH100 features three seal sets separated each by a distance piece to seal the gas in the cylinder and prevent contamination by the crankcase oil. Each distance piece area contains ports for drain, vent, and 2 purge lines.

The packing assemblies are built as an assembly and can be factory rebuilt. As they are built as a complete sealed assembly in the factory, field rebuilding is not possible. This provides an ease of installation and rebuilding as the assemblies do not need specific tools or servicing.

NOTICE:
When replacing the bearings, the entire bearing assembly, including the bearing cup and the bearing cone, must be replaced and the crankshaft endplay must be readjusted.

1. Follow steps 1 through 12 of the "Compressor Disassembly" section.
2. Remove the Oil Pump per the section titled "Oil Pump Replacement."
3. Remove the flywheel.
4. Remove the bearing carrier and gasket from the outboard end of the crankcase. The outboard bearing cup will come off with the bearing carrier and will need to be removed with a bearing removal tool.
5. Remove the key from the crankshaft and slide the crankshaft through the outboard end of the crankcase. The bearing cones can then be removed with a bearing puller.
6. Remove the bearing cover plate from the inboard end of the crankcase. The inboard bearing cup is pressed into the crankcase and can be removed with the use of a bearing removal tool.

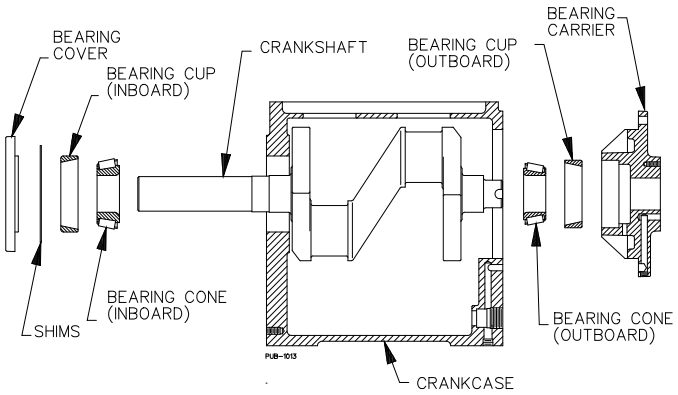


Figure 11 – Bearing Locations

7. To install the bearings:
   a. Grease the outer edges of the bearing cups.
   b. Referring to Figure 18 for the proper orientation, carefully press the inboard bearing cup into the crankcase until it is flush with the outer surface of the crankcase.
   c. Note the proper orientation and carefully press the outboard bearing cup into the bearing carrier assembly.
   d. Press a bearing cone onto each end of the crankshaft with the tapered end outward. The bearing race should rest against the shoulder on the crankshaft.
   e. Lubricate the bearings with grease.
8. Install the crankshaft through the outboard end of the crankcase.
9. With the oil pump assembly **removed**, install the bearing carrier and new gasket. The bolt hole positions ensure proper orientation. Tighten the bolts evenly per Table 4 – Bolt Torque."
10. If the bearings have not been replaced, reinstall the inboard bearing cover plate using the existing shim set. If the bearings have been replaced, use a **thicker** set of shims.
11. Rotate the crankshaft by hand to verify free movement of the shaft.
    a. If the crankshaft has an excessive amount of end play, too many shims have been used. Lateral crankshaft movement (end play) between the bearings should be:

End Play at Room Temperature
0.0015 to 0.0030" (0.038 to 0.076 mm)

    If necessary, remove shims until the end play is within tolerance.
    b. If the crankshaft binds, or will not turn, not enough shims have been used pushing the bearing cup too tight against the bearing cone. Remove the crankshaft from the crankcase and drive the inboard bearing cup out toward the inboard side of the crankcase. Reinstall the crankshaft and the bearing cover plate using additional shims as required.
12. Install the oil pump per the "Oil Pump Replacement" section of this manual.
13. Reassemble the compressor according to the "Compressor Assembly" section.

OIL PUMP REPLACEMENT

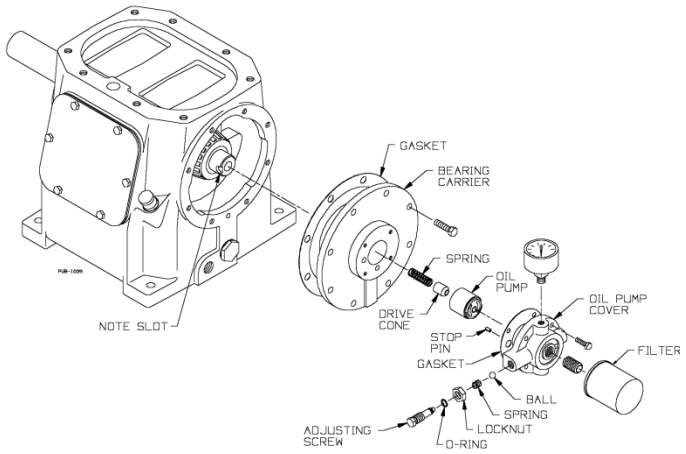


Figure 12 – Oil Pump

1. Remove the oil pump cover bolts and oil pump cover.
2. Remove the oil pump assembly, drive cone and spring.
3. Clean and inspect parts for wear or damage, replace as necessary.
4. Place the spring and the drive cone in the end of the crankshaft.
5. Note the slot in the end of the crankshaft and the drive tab on the back of the oil pump assembly. Install the oil pump assembly into the bearing carrier with the tab and slot aligned.
6. Note the groove around outer edge of the oil pump assembly and the stop pin in the oil pump cover. Position the oil pump cover and new gasket with the pin in the oil pump groove, rotating the oil pump as needed. The bolt hole positions ensure proper orientation of the oil pump cover.
7. BY HAND, tighten the oil pump cover bolts while the pump cover is held flush with the bearing carrier.

   NOTICE: If by hand tightening, the oil pump cover cannot be drawn flush with the bearing carrier, the drive tab or the stop pin are improperly aligned. Do not wrench tighten or the oil pump will be damaged.
8. Once the oil pump cover is secured by hand, the bolts may be evenly tightened per Table 4 – "Bolt Torque."

EXTENDED STORAGE PROCEDURES

If a compressor is not to be put into service for some time, or if a compressor is to be taken out of service for an extended period, care must be taken to protect the compressor. The following steps must be taken for both bare compressors and those already piped into a system.

If proper storage procedures are not followed, damage to the compressor may occur. Complete compressor disassembly and replacement of rod packing, bearings and other parts may be required.

1. Keep a written record storage procedures performed – preferably on the unit itself.
2. Fill the crankcase with rust inhibiting oil. (New compressors leave the factory without oil.) Squirt oil on the piston rods and crossheads through the nameplate opening. Loosen the V-belts to relieve the load on the bearings. Rotate the compressor by hand a few times to distribute the oil.
3. Plug all openings and purge the compressor with an inert gas such as nitrogen or **dry** air at about 10-20 psig (0.7-1.4 bar-g). Be sure to plug the crankcase breather port. This may be done at the factory if requested. Leave the compressor pressurized to prevent air or moisture from entering the unit.

   Check the unit monthly and add additional purge gas as needed.

   NOTICE: Tag the unit with a warning that it is pressurized.
4. If a purge gas is not available, fog oil into the compressor suction while rotating the unit. Then plug all openings to keep out moisture, insects, etc.
5. **Turn the flywheel by hand a few revolutions once a month to distribute the oil.**
6. Store the unit under a plastic wrap on its wooden shipping base up off the ground. If the unit was boxed for export shipment, leave it in its box. An indoor or covered storage area is preferable.
7. **Placing the Compressor back in service.**
   When the compressor is to be put in service, vent the remaining purge gas and change the crankcase oil. Follow the "Pre-Startup Checklist" and "Startup Procedure" sections in this manual.

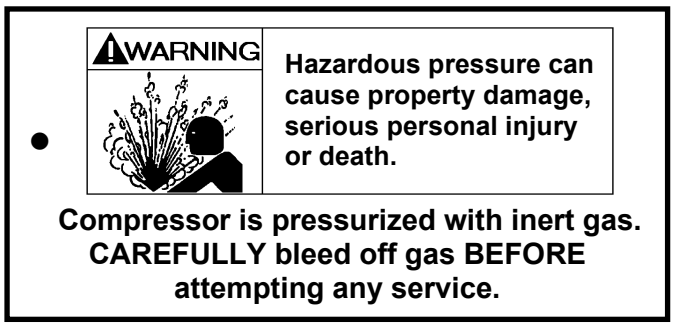


Figure 13 – Pressurized Compressor Tag

Table 10 – Compressor Troubleshooting

PROBLEM	STEP	PROBABLE CAUSE	WHAT TO CHECK	IF PROBLEM STILL EXISTS GO TO STEP ...
Low Transfer Rate	1	4-Way Valve Leaking (when equipped)	Lubricate with a stick lubricant compatible with material being transferred.	2
	2	Worn or Broken Piston Rings	Check condition of rings by restricting discharge line. If pressure increases slowly, rings are probably faulty.	3
	3	Plugged Strainer	Clean screen as necessary.	4
	4	Compressor Valve Faulty	Remove and inspect for broken or worn springs, discs, or bodies. See "Valve Replacement".	5
	5	Compressor Drive Slipping	Tighten belts, check for sheared keys, loose keys or loose flywheel.	6
	6	Piping Improperly Designed or Installed	Use proper pipe sizes.	7
No Flow	7	Excess Flow Valves Slugged	Stop the compressor to let the excess flow open. Installation of a valved bypass line between the suction and discharge lines may be necessary.	3& 4
Knocks or Other Noises	8	Loose Valves	Tighten valve hold-down screws.	9
	9	Worn Internal Parts	Inspect through inspection plates and repair as necessary.	4
No Oil Pressure	10	Oil Pump Relief Valve Not Properly Set.	Set oil pump relief valve.	11
	11	Oil Pump Not Working	Check the Oil Pump drive tab or stop pin for damage.	12
	12	Low Oil Level	Check and fill as necessary	13
	13	Dirty Oil Inlet Strainer	Clean Inlet Strainer	
Gas Leaking from Crankcase Breather	14	Faulty/Worn Packing	Replace Packing.	15
	15	Piston Rod Scored	Replace crosshead assemblies and packing.	16
	16	Improper Seal Arrangement	See "Seal (Packing) Replacement."	---
Relief Valve Actuates	17	Valve Closed Downstream of the Compressor	Open Valve	18
	18	Line Blockage Downstream of the Compressor	Locate Blockage and Correct	---
Shake or Vibration	19	Loose/Broken Mounting or Anchor Bolts	See “Mounting the Compressor Unit“	20
	20	Improper Mounting	Ensure base is supported full length. See "Mounting the Compressor."	21
	21	Improperly Aligned V-belt Sheaves	See "V-Belt Drives"	22
	22	Improperly Installed Flywheel	See "Compressor Flywheel"	23
	23	Nonfunctioning Valves	Replace or repair valves.	---

NOTES:

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