

COMPRESSOR INSTALLATION AND OPERATION MANUAL

**for
Ambient Air Compressors
Air Boosters
Gas Compressors**



hycomp

OIL FREE AIR & GAS COMPRESSORS

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WARRANTY - GENERAL

Hycomp warrants that its compressors will be free from defects in material and workmanship for a period of twelve (12) months from the date of purchase.

Hycomp compressors which fail within the 12 month period due to defects in material or workmanship, will be repaired or replaced at Hycomp's discretion provided the Purchaser meets all of the applicable requirements of the warranty and none of the limitations apply.

Any parts subject to wear or abuse are not covered by this limited warranty. These may include, but are not limited to, mechanical seals, bearings, piston rings, valves, packings, and other parts showing signs of abuse.

This limited warranty is void if any product or accessory has been serviced or altered by anyone not authorized by Hycomp.

Additional warranty limitations apply. Please see complete warranty policy for details.

See complete warranty policy for details
(available from the factory)

NOTICE TO HYCOMP CUSTOMERS

Hycomp recommends you order service and replacement parts according to the model number and serial number found on the nameplate of your compressor. Do not order parts from the general descriptions in this manual. Ordering directly from Hycomp or a registered vendor will minimize the possibility of receiving incorrect parts for your compressor.

COMPRESSOR NAMEPLATES

Each Hycomp model has a nameplate attached to the crosshead guide cylinder, usually on the oil-pump end. The information on this nameplate should be available when ordering parts for the compressor or requesting assistance with troubleshooting, maintenance, installation or operation.

Before contacting Hycomp, note who you purchased the compressor from, who installed it, installation date, the purchase date, and model number. This will help Hycomp identify your compressor and any special parts and materials that may have been used. Fill in the information from the new compressor into the spaces provided in the sample nameplate below.

Installed By _____

Installation Date _____

Purchased Date _____

Purchased From _____

Date of Startup _____

Model # _____

Serial # _____

GENERAL INFORMATION

This manual covers the following types of compressors:

Ambient Air Compressors - these are compressors whose inlet source is the ambient air surrounding the compressor.

Air Boosters - these are compressors that compress air that is taken from a source other than the ambient air. Generally the inlet air source is at an elevated pressure, but vacuum applications can also be accomplished. The inlet air is usually taken from customer's existing plant air system.

Gas Compressors - These are compressors pumping any gas other than air. Including the following compressors listed by block.

Ensure that you know what type of compressor you have before using this manual. If the instructions for the different types of compressors differ, this will be noted in the manual.

NOTICE: Hycomp compressors must only be installed in systems which have been designed by qualified personnel. The system **MUST** conform to all applicable federal, state, local and national standards.

This manual is intended to assist qualified technical personnel in the installation, operation and maintenance of Hycomp compressors, and should be kept with the compressor at all times.

Hycomp compressors shall only be serviced and maintained by qualified personnel. Routine inspection and maintenance is highly recommended.

SAFETY

Hycomp insures, from the beginning, that safety is designed into every compressor. A compressor is a precision high speed mechanical piece of equipment. They require caution in operation to minimize hazard to one's self and property. The following is a list of safety precautions that should always be observed:

1. Do not try to service any part of the compressor or accessory while the unit is operating.
2. The main power disconnect switch must be turned off; lockout/tagout the switch before performing any work or maintenance on the unit, per OSHA Regulation 1910.147.
3. Relieve the system of all pressure before attempting to service any part of the unit, per OSHA Regulation 1910.147.
4. The unit must not be operated with any of its safety guards, shields, or screens removed.
5. Do not remove any warning signs or the manufacturer's nameplate.
6. Frequently check pressure relief valves for proper operation.
7. Any changes to the compressor operating parameters should only be made with the approval of Hycomp. Contact the factory should a change be necessary.

Hycomp oil free air boosters and industrial gas compressors can be used for boosting air and a variety of common industrial gases. Depending upon the model of the compressor and the style of the gas packing, intake pressures may range up to 300

psig, while discharge pressures may vary up to 1000 psig. Pressures above 1000 psig are possible with customized units.

Most Hycomp compressors are sized for specific applications; therefore, it is essential to contact the factory before changing running conditions of the compressor.

ALL INDUSTRIAL GASES WILL PROVE FATAL TO PERSONNEL EXPOSED. Some gases are immediately toxic or corrosive, and may cause short term or long term damage, or death, to personnel that are exposed to the gas. Only air is capable of supporting life. Gases that are generally inert to humans (Nitrogen, Helium, Argon, etc.), will not sustain life if personnel are exposed to a pure gaseous atmosphere.

Because there is NO SAFE GAS OTHER THAN AIR, it is imperative that all exposure to industrial gases be closely monitored and regulated. Federal mandate requires specific procedures must be established for any company that deals with industrial gases. This includes, but may not be limited to, gas containment policy, protection required for personnel working with the gas, availability of MSDS's, specific training, emergency spill and/or contact procedures, etc. Always check if there are EPA or OSHA standards that may apply.

Ensure all materials used in the compressor and associated plumbing, including coolers, separators, filters, receivers, regulators, piping, etc. are compatible with the gas being compressed. If unsure, contact the manufacturer of the equipment.

INTRODUCTION TO OIL FREE AMBIENT AIR COMPRESSORS

Hycomp oil free ambient air compressors (compressors taking their inlet from the air around you) are unique in the industry due to their small size, extended lower end life, and open crosshead design. The crankcase is pressure oil lubricated, providing extended bearing life in the main, connecting rod and wrist pin bearings. The open crosshead allows any oil vapors that may escape from the crankcase to be vented to atmosphere, thereby preventing their entrainment in the compressed gas stream.

Hycomp oil free compressors are designed for heavy, industrial duty service. Slower compressor speeds prevent heat buildup, increase valve efficiency, and increase overall life expectancy of wearing parts.

Hycomp's crosshead design places the side thrust

developed by the connecting rod onto the oil lubricated crosshead piston/cylinder. By removing this side thrust from the compression piston, the piston rings provide an extended life expectancy, in comparison to permanently sealed ball bearing, 'oil-less' designs.

Hycomp air compressor cylinders and cylinder heads are single piece iron castings. This significantly decreases warpage problems associated with aluminum cylinders/heads. Additionally, iron is inherently vibration dampening.

All Hycomp air compressors are tested at the factory to ensure they meet contractual requirements. When properly installed, the air compressor should be ready and able to provide the reliable service Hycomp customers have come to trust and appreciate.

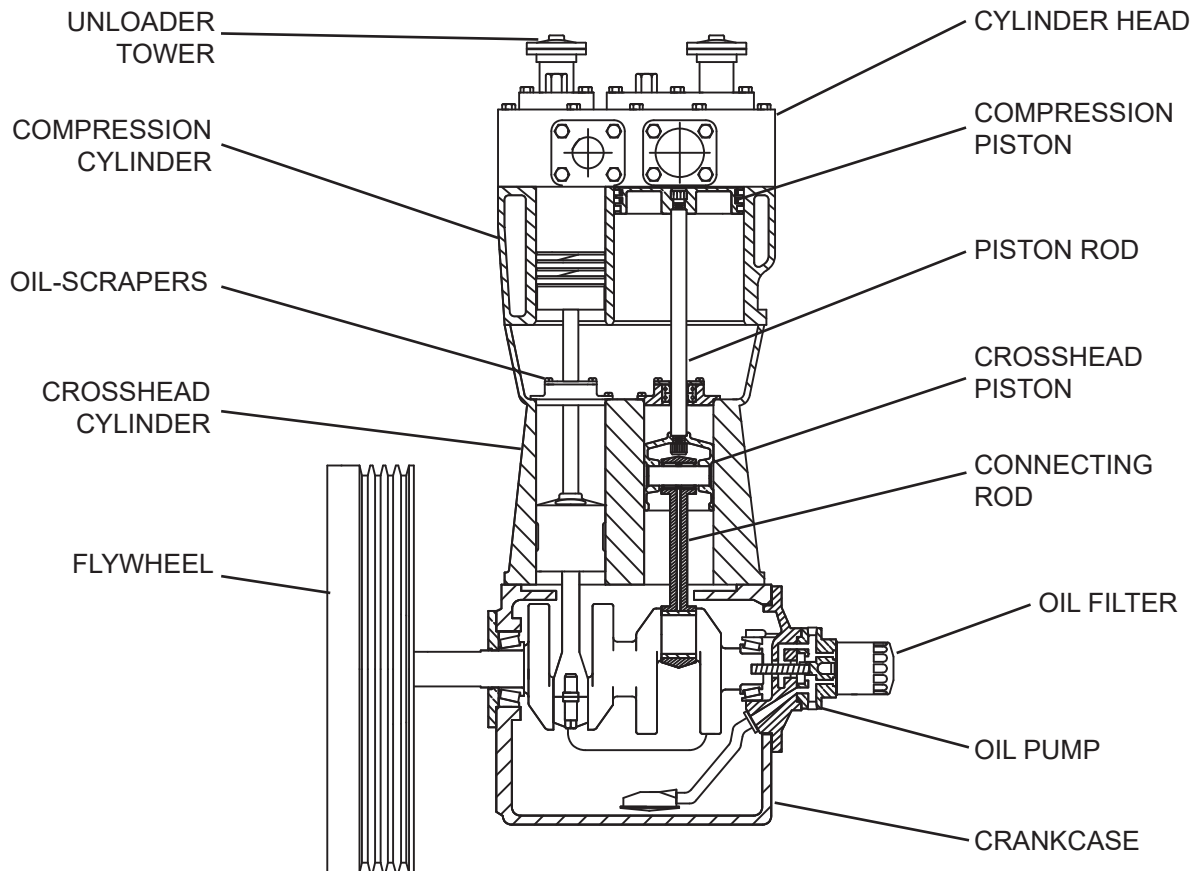


Figure 1: Cutaway of an Ambient Air Compressor

INTRODUCTION TO AIR BOOSTERS AND GAS COMPRESSORS

Hycomp oil free air boosters (compressors taking their inlet from an air source at an elevated pressure) and gas compressors are unique in the industry due to their small size, open crosshead, and gas packing design. The open crosshead allows any oil vapors that may escape from the crankcase to be vented to atmosphere, thereby preventing their entrainment in the compressed gas stream. Hycomp's innovative use of the incoming gas stream to help cool gas packings provides extended performance benefits and service life.

These compressors draw inlet gas from a source that is already at elevated pressure and "boost" it to an even higher pressure. Because these compressors do not draw from atmosphere they require special attention to inlet gas conditions and cleanliness.

Hycomp's gas packing design prevents leakage of gas vapors to the open atmosphere. Hycomp utilizes

self adjusting, segmented packings to seal against the piston rod, and safely contain the gas. This gas can then be vented to a safe location, or a variety of purging, venting or padding options may be used to control the gas leakage. With this system, Hycomp compressors can pressurize flammable and toxic gases.

Hycomp compressors & boosters are specialized and engineered specifically for each application, making them different from other types of compressors offered in the market. They are available in single, two and three stage models with air or water cooling.

All Hycomp boosters & compressors are tested at the factory to ensure they meet contractual requirements. When properly installed, the booster compressor should be ready and able to provide the reliable service that Hycomp customers have come to trust and appreciate.

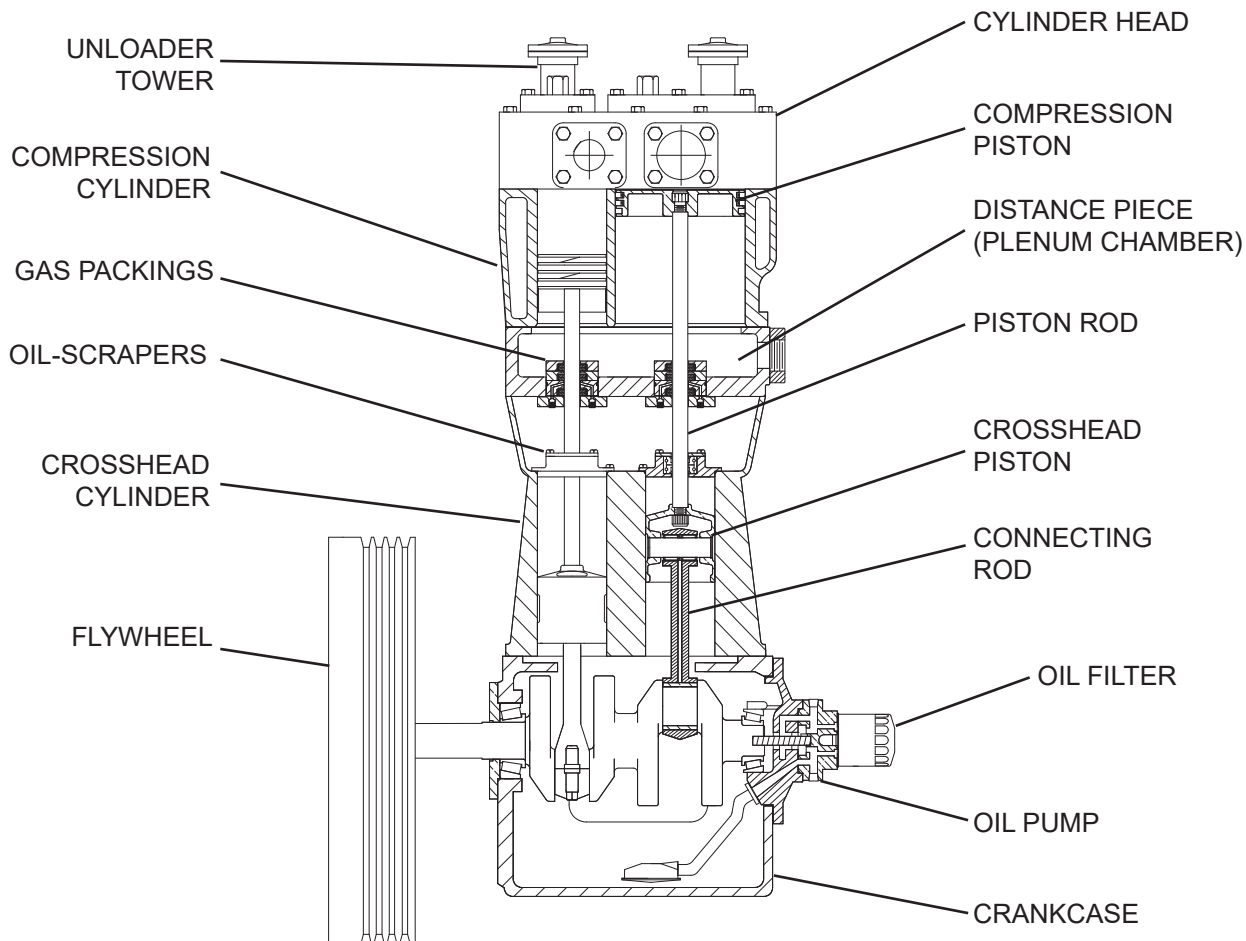


Figure 2: Cutaway of an Air Booster & Gas Compressor

SECTION 1

COMPRESSOR INSTALLATION

RECEIPT OF COMPRESSOR

Immediately upon receipt of the compressor, inspect the unit and associated components for damage that may have occurred during shipment. If any damage is found, demand an inspection from the carrier. Ask the carrier how to file a claim for shipping damages. Shipping damage is not covered by Hycomp.

If concealed damage is discovered at a later date, the carrier typically must be notified within 15 days of initial receipt of the compressor. Check with your local carrier for rules and regulations regarding damaged items. DO NOT attempt to correct damages to compressor units until a representative of the carrier has inspected the damage, or the carrier agrees to pay damages.

Upon receipt of the compressor, read the compressor nameplate to confirm the model ordered. Read the motor nameplate to ensure that the electrical requirements do not exceed existing conditions. Hycomp requires that all personnel in charge of installation, maintenance, or service of a Hycomp compressor read the manual in its entirety.

LOCATION

Locate the compressor in a dry, well ventilated and well lit area that accommodates inspection and maintenance access. Provide an unobstructed machine boundary of at least 18" with adequate air flow and service space around the compressor. Rotating machinery should always display appropriate restrictive warnings and cautions to minimize risk of injury to personnel.

Rotating machinery can be a source of noise, which may require abatement or personnel exposure limits. Understand your service environment and prepare accordingly. Noise from a typical Hycomp compressor will often exceeds 80 dBA @ 3ft.

Installation in locations exposed to ambient subfreezing temperatures is not recommended. Exposure to direct sunlight, rain, wind, dust, snow, moisture, and other adverse environmental elements is not recommended and will reduce service life and increase maintenance requirements. If it is necessary to install the unit out of doors, provide a rain cover or a completely enclosed shed to prevent corrosion.

If it is necessary to install the unit in a location that will experience operating temperatures below 32°F, a properly sized crankcase heater must be installed.

If installation is required in an area exposed to rain or snow, a building or overhead protection should be provided. If the compressor is liquid cooled, suitable freeze protection must be provided for both the coolant and the machine.

FOUNDATION

Permanent installations require the compressor be secured to a concrete foundation pad. The foundation should rest on solid bedrock or compacted earth or gravel, but not a combination of the two. The pad should be composed of 4,000 psi cured concrete reinforced with ASTM A615 #4 billet steel re-bar cross laced on 16" centers located 3" above the base. The amount of concrete used to form the pad should exceed the weight of the compressor by 3 to 5 times. SAE Gr. 5 "J" bolting of appropriate length and size should be used in the pad to provide baseplate mounting. Use of a template to support and position the bolting $\pm 1/16$ " while setting concrete is recommended. Securing bolting to existing foundations with drilled holes and adhesives is not recommended unless expert advice is available. Expert advice is also recommended for installation of other forms of mechanical anchors. See Figure 3 for additional details.

Epoxy based grouting is required to firmly seat and attach the compressor skid to the concrete foundation. ITW Philadelphia Resins brand "Chockfast Red" grout is recommended. Sealing of grouts and concrete is recommended to prevent contamination by oil and moisture. Newly poured concrete must be fully hydrated prior to grouting. The concrete slab should be chipped to remove all latent and 50% of the aggregate exposed to provide a rough bonding surface for the epoxy. Dowels should be installed on new exposed concrete to prevent edge lifting. The

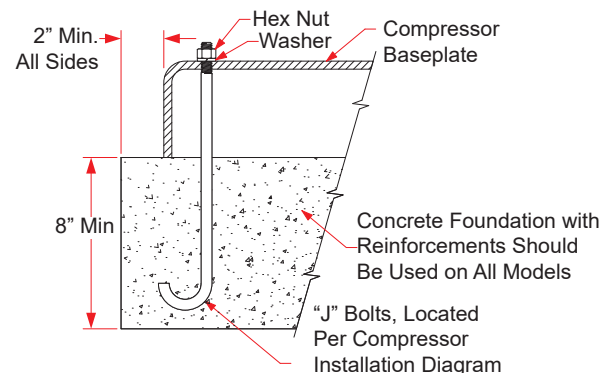


Figure 3: Foundation Requirements

concrete foundation should be dry and free of oil before pouring grout. Sleeve all foundation bolts to prevent adhesion and allow bolt stretch. Steel baseplates should be sanded and cleaned to provide adequate adhesion surface.

Steel fabricated foundations must be adequately engineered to support the weight and vibration of the compressor.

INLET PIPING & INLET FILTRATION

Compressor life can be substantially increased by providing clean, dry, cool gas to the compressor inlet.

Ambient Air Compressors – In most cases, the standard air filter furnished from the factory is sufficiently large to meet normal operating conditions when periodically serviced. Where the compressor inlet is to be piped to the outside, a hood or shroud must be installed to prevent rain from entering the filter or pipe. In severe environmental conditions, it may be necessary to consider a non-standard inlet filter. Contact the factory for assistance in this case.

Large runs of intake piping require an increase in piping

size to maintain compressor efficiency; pipe size should be increased one size for each 10 feet of intake pipe and each 90° bend.

Air Boosters & Gas Compressors – The inlet piping may be at a pressure above atmospheric, and must be rated for the working pressure of the inlet gas, and protected with a properly sized safety valve set at 20 to 30 PSI above the maximum operating pressure but below the maximum allowable working pressure of the pipe.

An inlet filter must be placed in-line with the inlet, to ensure clean gas (or air) to the booster. The filter should be a 1.0 micron or better, coalescing type, sufficiently sized for twice the full flow of the booster with minimal pressure drop. Inlet filters should be installed on the upstream side of an inlet receiver to prevent pulsation damage. The inlet receiver and piping must be cleaned of any foreign residue before compressor startup. Unless otherwise indicated, air boosters and gas compressors do NOT come with an inlet gas filter. Damage to the machine will occur if contamination is drawn into the booster compressor and will void the warranty!

Hycomp air boosters and gas compressors require an inlet receiver to be installed just upstream of the

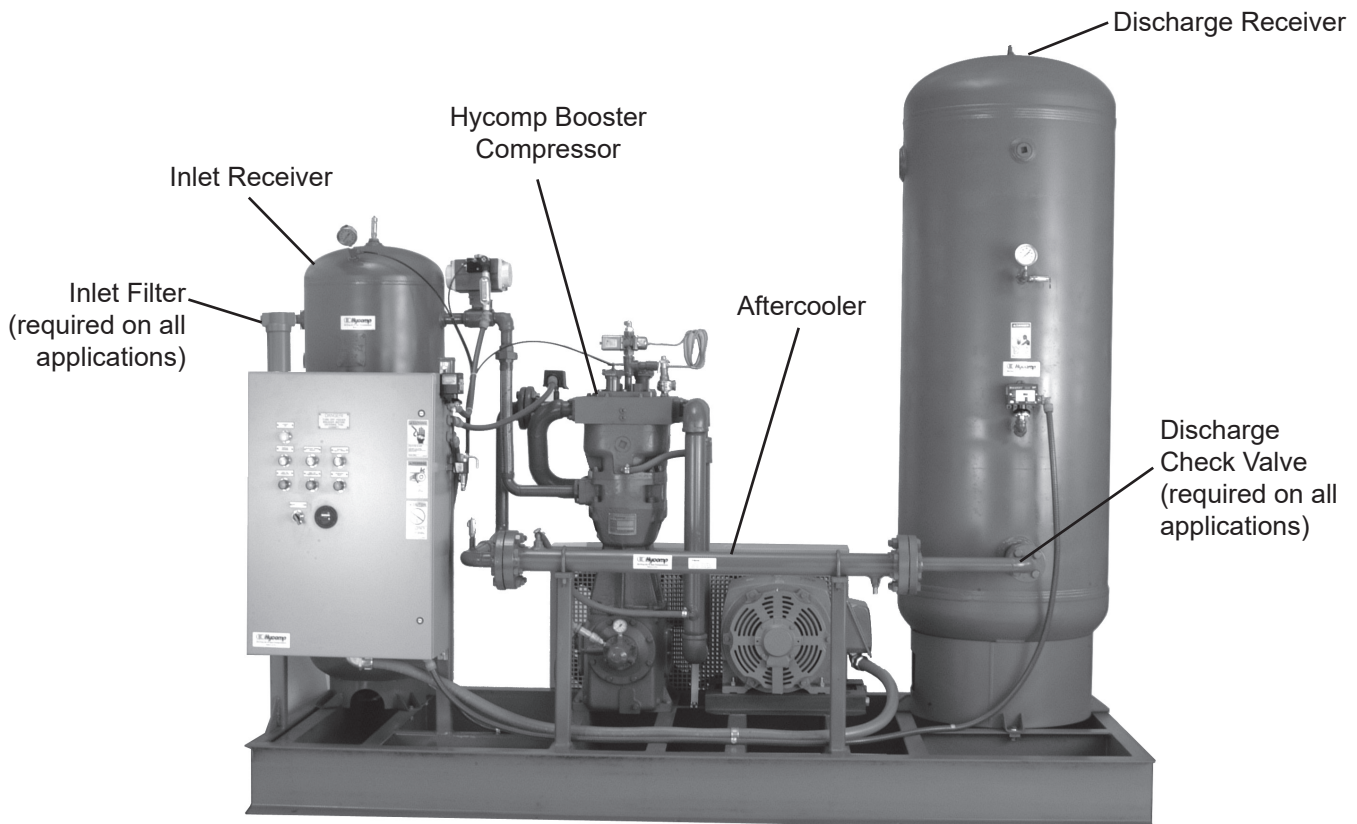


Figure 4: Basic System Configuration of an Air Booster or Gas Compressor

booster compressor. See RECEIVERS (Air Boosters & Gas Compressors) for additional sizing details. See Figure 4 for additional details.

Compressors are not designed to pump any liquids. Liquids are non-compressible and even the slightest amount of liquid can cause high-impact stresses resulting in serious damage to the compressor. The use of a liquid trap in the suction line is required where the presence of entrained liquids in the suction gas is a possibility.

DISCHARGE PIPING

Recommended practice is to have a compressor aftercooler, discharge safety valve, discharge check valve, and an air receiver. To prevent undesirable pressure drops in piping, pipe size should be increased one size for each 100 feet of run. Sweat type copper fittings, when compatible with the gas being compressed, will give much less pressure loss than the equivalent size steel pipe. All horizontal pipe runs should be sloped away from the compressor at about one quarter inch per foot. All low points in the piping system should have a drain leg to catch any accumulation of condensation in the piping.

It is extremely important that a properly sized safety valve, set at 10% or 20 to 30 PSI above the maximum operating pressure but below the maximum allowable working pressure of the system components, be placed at the discharge receiver and upstream of the aftercooler. Never place a line valve in the discharge piping between the compressor discharge and the safety valve.

A discharge check valve must be placed between the aftercooler and the discharge receiver. This is especially important on booster compressors, as high pressure gas (or air) may leak back through the compressor to the suction side of the system, causing dangerously high pressures in the suction side receivers, piping, etc.

On initial start-up of the compressor, bubble test all piping connections for leaks with a soap-water solution. All piping must be leak free.

Flexible expansion joints must be placed within 36 inches of the compressor to help compensate for expansion/contraction of the pipes, as well as isolate the vibration of the compressor from the rigid piping. All piping must be adequately supported to ensure no piping loads are placed upon the compressor (see Figure 5). Failure to do so may cause a dangerous break in the rigid pipe caused by vibration in the piping.

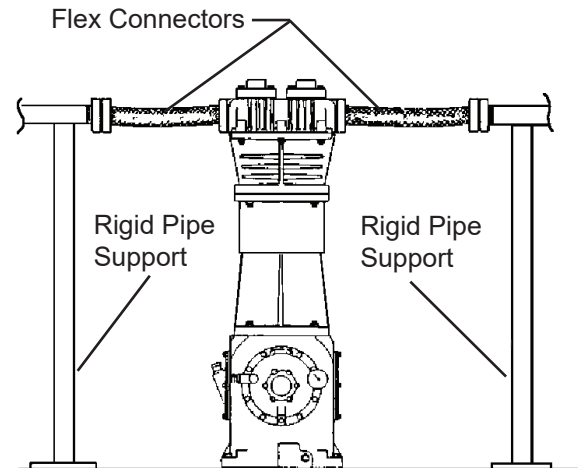


Figure 5: Piping Connections

All piping must be compatible with the gas being compressed, and must be rated above the working pressure of the system.

RECEIVERS

Ambient Air Compressors - In general, larger receivers give better service from a compressor. Ideally, the receiver should be large enough so that the compressor will run long enough to reach normal operating temperatures before shutting down. The following formulas may also be applied, where Start-Stop Operation is defined as any operation with more than six (6) starts/stops per hour:

LOAD / UNLOAD OPERATION:

$$\text{Tank size (gal)} = \text{Compressor CFM} \times 1.5$$

START-STOP OPERATION:

$$\text{Tank size (gal)} = \text{Compressor CFM} \times 3.0$$

Air Boosters and Gas Compressors - Reciprocating compressors create pressure pulsation of both the inlet and discharge gas streams. To minimize the effects of pulsation phenomena Hycomp air boosters and gas compressors operate best with both an upstream pulsation tank (sometimes called a buffer or inlet receiver tank) and a discharge receiver tank.

Discharge receiver tanks must be separated from the compressor with a check valve to prevent high pressure gas from flowing back into the compressor and suction side when shut down. Consult your local supplier for check valve application advice.

Receivers should be sized as follows:

MINIMUM INLET RECEIVER SIZE:

Tank size (gal) = Compressor SCFM

MINIMUM DISCHARGE RECEIVER SIZE:

Tank size (gal) = 2 X Compressor SCFM

For example, a 97 scfm air booster compressor would require a minimum 120 gallon inlet receiver, and a minimum 200 gallon discharge receiver. Whether for inlet or discharge, a larger receiver is always better.

COMPRESSOR COOLING

Air Cooling - The Hycomp air cooled compressor relies on convection air current to dissipate heat from the compression cylinder and head. Normal operating temperatures must not exceed 340°F. Installation in a shaded or cool indoor area with air movement is preferred. Installation in direct sunlight can result in higher than normal operating temperatures and should be avoided. For continuously operating compressors, a fan directed to move air across the cylinder and head can be used to lower operating temperatures, decrease maintenance, and increase compressor life. Keep the cylinder and head clean and free from dust and debris to help maximize heat dissipation. Air cooled intercoolers and aftercoolers are generally located in close proximity to the flywheel, which is designed to move air in the direction of the compressor crankcase. The cooler fins must also be kept clean. Check the fasteners securing the cooler mounts, as they are often subject to loosening due to vibration.

Water Cooling - The Hycomp water cooled compressor relies on circulating liquid coolant (water or other) through the cylinder, head and heat exchangers to dissipate heat. Coolant piping must be secure and connected to and from the compressor components with braided steel flex hose to isolate piping from vibration.

Water quality should be maintained by a 30 mesh strainer on the inlet to the compressor. Water velocity should not exceed 15 ft/s. Additional water quality guidelines are outlined in Table 2.

Water flow should be opposite to the direction of gas flow, and must be throttled to obtain a maximum discharge water temperature of 125°F to 150°F. It is important the discharge water temperature be maintained at least 25°F above the maximum inlet air or gas temperature. If the discharge water is allowed to cool much below 25°F above inlet gas temperature, condensation may form in the cylinder and head, leading to possible corrosion problems downstream.

Appearance	Clear Water / Glycol
Smell	None / Glycol
Bacteria	Bacteriologically Safe
pH	7.0 – 9.0
Hardness °dH	4.5 – 8.5
Conductivity	< 500 µS/cm
Dissolved Solids	< 150 ppm
Maximum Particle Size	< 0.0234" (#30 mesh)
Ammonia (NH ₃)	< 1.0 ppm
Carbon Dioxide (CO ₂)	< 50 ppm
Carbonic Acid (H ₂ CO ₂)	< 20 ppm
Chloride (Cl ⁻)	< 110 ppm @ 122F
Free Chlorine	< 0.5 ppm
Hydrogen Carbonate / Suphate ratio ([HCO ₃]/[SO ₄])	> 1.0
Hydrogen Sulfide (H ₂ S)	< 0.05 ppm
Iron (Fe)	< 0.2 ppm
Manganese (Mn)	< 0.1 ppm
Nitrate (NO ₃)	< 100 ppm
Nitrite (NO ₂)	< 0.1 ppm
Phosphate (PO ₄)	< 2.0 ppm
Sulfur Dioxide (SO ₂)	< 50 ppm
Sulphate (SO ₄)	< 100 ppm
Sulphides (S ₂ ⁻)	< 1.0 ppm

Table 1: Recommended Water Quality

Generally, a good approximation of cooling water requirements is 1 GPM of 70°F water per 5 HP (i.e. a 20 HP compressor should require approximately 4 GPM of cooling water). This gives an approximate 20°F rise in the water temperature through the compressor.

A visual flow indicating device is highly recommended at one or more locations on the coolant inlet and/or discharge lines. Check discharge coolant piping backpressure. Excessive backpressure will result in the compressor overheating. Compressors exposed to sub-freezing temperatures must be protected from damage caused by coolant freezing.

Hycomp recommends the use of the following valves and devices to regulate cooling water:

Solenoid Shutoff Valve – Solenoid actuated valves control the flow of water through the compressor system, preventing flow at start-up, during shutdown, or between compressor cycle times.

Thermoregulating Valve – Modulating valves regulate the flow of water to the compressor to maintain a desired exiting water temperature. They open automatically when temperature increases at the sensing bulb. No external power source is required to actuate the valve. The sensing bulb should be placed in the discharge water stream, while the main valve body should be placed in front of the compressor.

Visual Flow Indicator – Flow indicators display to the operator when there is water flow through the

compressor. On large scale water tower systems, backpressures within the system can prevent water flow through the compressor, causing overheating and/or freezing problems. A well monitored flow indicator can assure the user that water is flowing properly through the system.

COMPRESSOR CONTROL PANEL

Your Hycomp compressor may be provided with a factory installed compressor control panel. Optional accessories specific to the control application requirements may also be included. A Hycomp compressor control system electrical schematic is included, if applicable, as well as a basic piping and instrument diagram (P&ID) for reference by installation and operations personnel. Instructions specific to each unique configuration of control system is provided with the compressor. Components generally common to many forms of compressor control schemes require installation as follows:

Control Panel Enclosure – The enclosure must be of appropriate NEMA rating for the application. Observe all enclosure warnings when dealing with the enclosure and its contents. Follow proper UL, NEMA, and NEC codes when penetrating or installing the enclosure.

Motor Starter – The motor starter must have appropriate electrical service brought to it by a qualified electrician. Hycomp control panels list the electrical service required on a sticker near the starter.

Gas Pressure Transducers – Generally located in the control panel, these are used to provide control feedback to maintain pressure setpoints. Gas pressure sensing lines of appropriate pressure rating must be plumbed to the transducer from an appropriate point of origin. Use minimum 3/8" tubing. The transducers must be plumbed to a NON-PULSING source to prevent false readings. Ideally, the point of origin will be the inlet and discharge receivers. It is NOT ACCEPTABLE to plumb these transducers to the compressor inlet and discharge piping, as the gas in this piping pulses.

Unloader Device – The Hycomp control system generally includes an unloader device to allow loading and unloading of the compressor system. See the next section for unloader methods and proper installation of the device.

UNLOADER CONTROLS

Hycomp compressors are often supplied with an unloading device of some type. This unloading device allows the compressor to load and unload based upon

discharge and suction pressures, as well as allowing the compressor to start and stop unloaded. Even if the unit does not include a control system from the factory, many Hycomp compressors have unloader devices installed. A piping and instrument diagram (P&ID) is generally included with every Hycomp compressor system, showing unloader installation

SUCTION VALVE UNLOADING

Suction valve unloaders utilize unloading towers attached to the compressor cylinder head, and a three way valve to supply air pressure to the unloader towers to actuate them. The tower forces the suction valve open, allowing the compressor to unload. The three-way valve supplies gas pressure to the unloader towers, or dumps that pressure out of the unloader towers.

Unloader Tower – Provided on all pressure lubricated Hycomp model ambient air compressors and provided on some air booster and gas compressors. If the unit unloads via Suction Valve Unloading, this item is included. Located on the inlet valve covers, the tower provides the mechanical motion (pneumatically driven via a diaphragm) to physically open the inlet valve(s). One, two, or four towers are employed depending upon the model of compressor. This tower must be supplied with gas pressure to operate the suction valve unloaders. The unloader gas pressure must exceed the inlet pressure by a minimum of 30 psig in order for the unloader mechanism to operate effectively. If the unit comes with an unloading valve of some type, the plumbing from the valve to the towers is done at the factory. If no unloading valve device is present, use a minimum of 1/4" tube of appropriate pressure rating, to supply unloading gas/air to the unloader towers.

Three-Way Unloader Control Solenoid Valve

– Provided on air boosters and gas compressors with suction valve unloading (see Figure 6). The three way unloader control solenoid receives an electrical signal from a pressure switch to engage or release (load or unload the compressor). The valve is designed so that if electrical power is lost or the solenoid fails, the valve will unload the compressor. There are three gas ports on the unloader valve, as well as an electrical connection. Port # 1 is the vent port. Port # 2 is connected to the Unloader Towers or 3-Way Check Valve. Port #3 is connected to the unloader pressure source. If the port configuration is different than that listed above, it will be noted on the Piping and Instrumentation Diagram.

If the unloader gas is air or a non-contaminating gas, the solenoid can vent (Port #1) the gas to atmosphere. If the unloading gas is a contaminating gas that cannot be vented to atmosphere, then the solenoid must vent this gas to the booster compressor suction line, or a

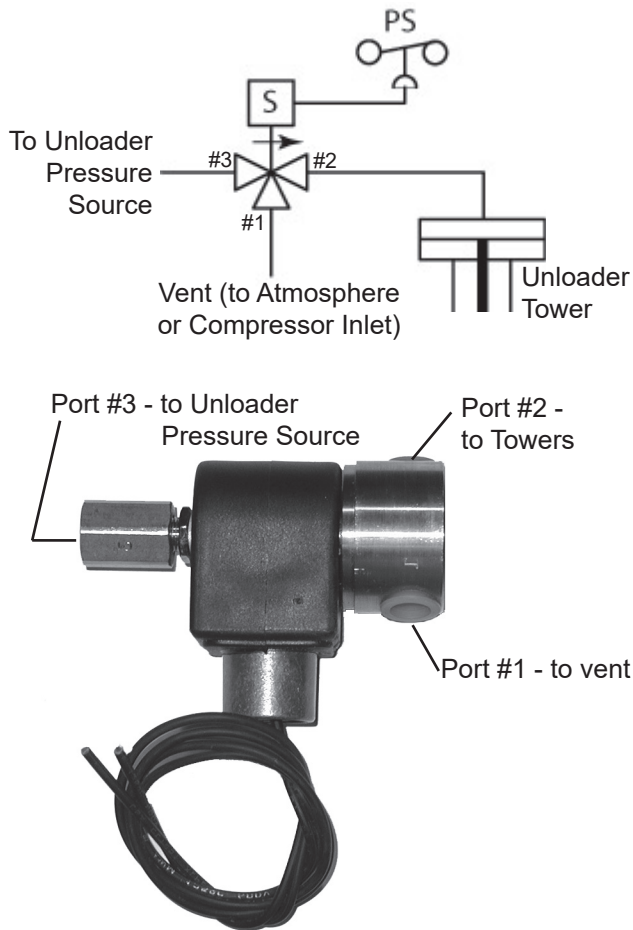


Figure 6: Three Way Unloader Solenoid Valve Plumbing

safe location. If this valve is part of a factory assembled controls system, this port will be pre-plumbed or tagged with piping instructions.

Port # 2 must be plumbed to the unloader towers. If included as part of a Hycomp controls package, the unloader valve (Port #2) is already plumbed.

Port #3 must be connected to the gas source that provides pressure for unloading. Use a minimum 3/8" line to connect this port to the pressure source. If part of a Hycomp controls package, this port may already be plumbed to a 'Tee' connected to the discharge pressure sensor, so only one line needs to be brought back to the unloader valve/pressure switch.

The Three-Way Unloading Solenoid Valve requires an electrical signal (check the side of the solenoid for the voltage requirement - usually either 120 VAC or 24 VDC) to operate. When power is applied to the solenoid, it will cause the compressor to load. When power is removed from the solenoid, it will cause the compressor to unload.

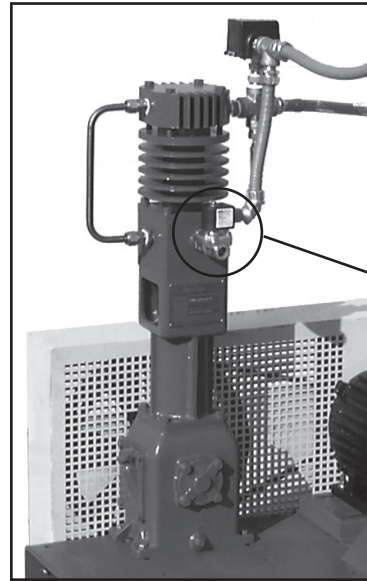
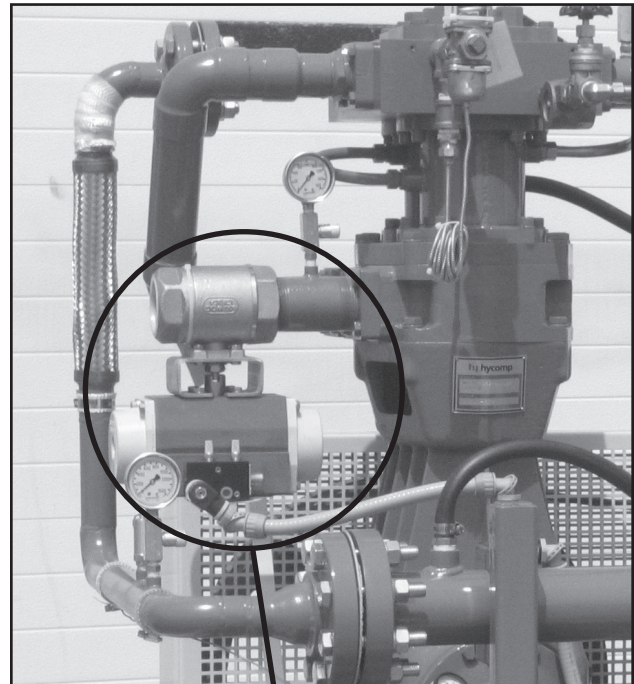


Figure 7: Inlet Shutoff Solenoid Valve Unloading



Actuated Inlet Ball Valve. This valve is wired and plumbed to the compressor inlet, but still requires plumbing to gas inlet piping, and a pneumatic pressure source.

Figure 8: Actuated Inlet Ball Valve Unloading

INLET SHUTOFF VALVE UNLOADING - This unloading method utilizes an actuated valve to close off inlet flow to the compressor, thereby preventing the compressor from loading. The actuated valve is either a direct acting electrical solenoid valve, or an actuated ball valve that uses a three way solenoid valve to pneumatically operate a ball valve.

Solenoid Valve - A direct acting inlet solenoid shutoff valve requires very simple wiring/plumbing (see Figure 7). The valve is a Normally Closed type valve (compressor is unloaded), that requires an electrical signal to open (compressor is loaded). Check the side of the solenoid for the voltage requirement - usually either 120 VAC or 24 VDC. The Inlet Solenoid is plumbed between the inlet gas piping and the inlet to the compressor. The inlet solenoid is specially sized for the pulsing flow requirements of a booster compressor.

Actuated Ball Valve - The actuated ball valve type of inlet shutoff valve requires both an electrical signal to operate, as well as a pneumatic pressure source of 50-150 psig, unless otherwise indicated on the valve (see Figure 8). Check the solenoid for the voltage requirement - usually either 120 VAC or 24 VDC. The port requiring a pressure source will be labeled as such. Use a minimum of 3/8" tubing of appropriate pressure

rating to connect to the pressure source. All other ports will be connected. The valve is set to close (unload the compressor) when there is no power or unloader pressure present. When the valve is energized and has a pneumatic pressure source, the valve will open, thereby loading the compressor. The actuated valve is specially sized for the pulsing flow requirements of a booster compressor.

SAFETY DEVICES

The following devices may be included with your Hycomp compressor system (see Figure 9). However, if they are not included, it is required that they be installed and properly adjusted, prior to operation of the compressor. Lack of these safety devices will void the compressor warranty. In addition, damage to equipment & personnel may occur if these devices are not properly installed. Additional safety devices not listed here may be necessary to properly protect equipment and personnel.

Temperature Sensor - Excessive discharge temperatures will cause premature failure of compressor components and will void any factory warranty. All compressors must have a temperature shutdown device placed as near to the compressor discharge

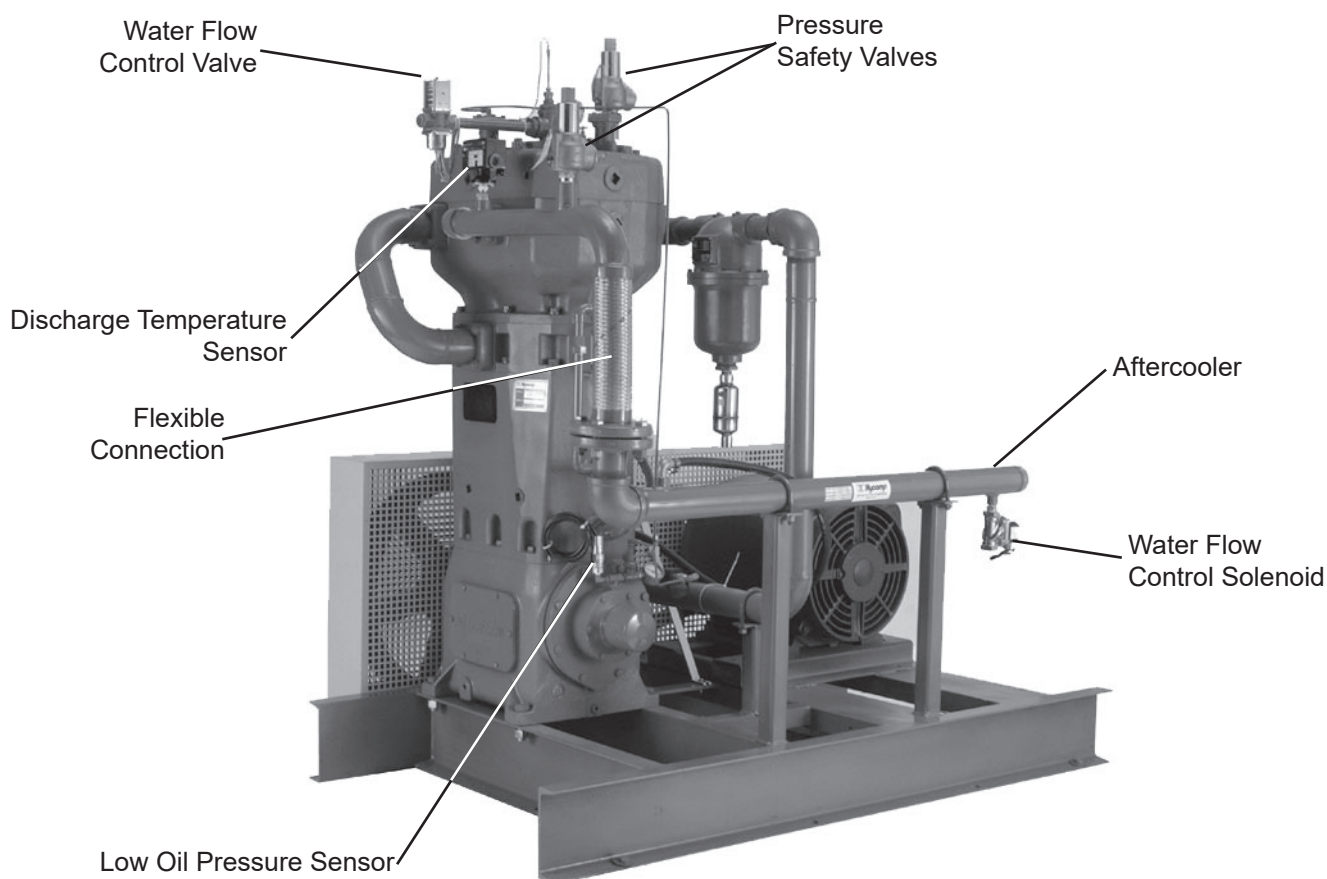


Figure 9: Gas Compressors with Multiple Safety Devices

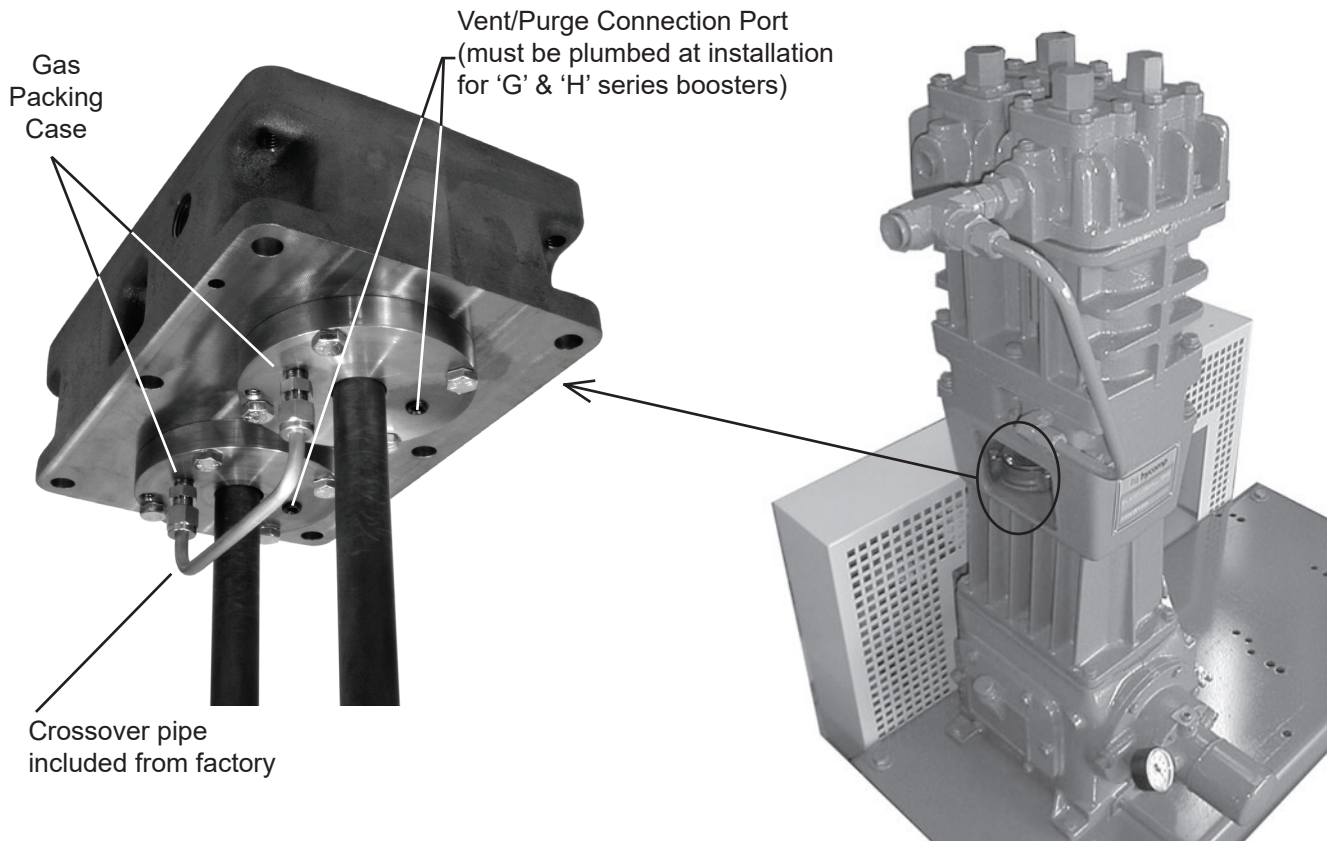


Figure 10: Gas Packing Plumbing Requirements for 'G' and 'H' Series Gas Compressors

as possible. The device should be set to shutdown the compressor just above its maximum normal operating temperature. Elevated temperatures may be a result from wear and the first signs of valve and ring failure. Temperature shutdown devices can be used as a detection method to help prevent unexpected compressor failures. Discharge temperature fault setting must NEVER exceed 340° F.

Low Oil Pressure Sensor – While oil pressure loss in the crankcase is a rare event, it can result in extensive and costly damage to the compressor. A low oil pressure sensor set to shut down the compressor at 3-5 PSIG below proper pressure may be installed at the oil pump to shutdown the compressor in case of lubrication failure. A 5-10 second delay timer should be used to lock out the fault at start-up.

Pressure Safety Valve – Pressure safety relief valves prevent dangerous over-pressurization by relieving system pressure when compressed air/gas reaches the maximum operating pressure of the system. Failure to provide properly sized pressure relief valves can cause property damage, personal injury, or death. Pressure safety valves are preset by the manufacturer and the settings should not be changed by anyone other than the manufacturer or an authorized service facility.

Any line leading to or from a compressor that can be blocked by a valve or other device, whether during normal operation or during a failed operation, MUST be equipped with a safety relief device. The safety valve must be of a material compatible with the gas being compressed, and must be able to handle a flow in excess of the maximum flow of the compressor. For toxic or flammable gases, the relief valve must have a plumbed outlet that is piped to a safe release area (outdoors, flare stack, etc), per local or federal codes.

PLUMBING OF AIR BOOSTER AND GAS COMPRESSOR PACKINGS

Hycomp gas compressors utilize piston rod gas packings to maintain a pressure on the backside of the compression piston, creating a fully reversing piston rod load, as well as sealing the gas within the booster itself.

Hycomp piston rod packings are bidirectional, but must be properly arranged for specific applications. The packing set is pinned together to prevent rotation of individual packings, thereby preventing leakage and excessive wear. The packings include a leaf type spring that must be on the side of the packing towards the higher pressure. For elevated inlet pressure applications, the spring must be above the packing. For vacuum type applications, the spring must be below the packing.

More packings generally means tighter gas control. A vent/purge port between the packings can be used to add additional gas leakage control.

Three main styles of rod-packing arrangements are used on Hycomp oil-free air boosters and gas compressors: the 'B' series, used for air and non-contaminant gas boosting; the 'G' series, used to boost most other industrial gases; and the 'H' series, used with gases that require the highest degree of containment.

To operate effectively, the packing cases must be properly plumbed (see Figure 10). If your booster compressor is of the 'B' configuration, you do not need to add any additional plumbing. If your booster compressor is of the 'G' or 'H' configuration, you must add additional piping to vent or purge any gas leakage. This piping will not be installed from the factory.

The gas vent/purge ports are 1/8" NPT. Hycomp suggests the use of minimum 1/4" tubing to vent or purge the ports. Use proper tubing practices for vent/purge line installations.

Venting - If it is safe to vent the gas to atmosphere, run a vent line to allow gas to escape to the atmosphere. Review all federal, local and fire codes to ensure that venting is a safe option. For instance, venting nitrogen to the local atmosphere can be dangerous in small enclosed areas as asphyxiation can occur. Contact local OSHA representatives for assistance in determining safety requirements for different gases.

Purging - It may be necessary to purge the packings with an inert gas like nitrogen. Purging requires a loop, whereby the purge gas, at pressure, can be routed to

a safe location for disposal of the mix of purge and process gases.

Padding - A pad gas like nitrogen can be used to pressurize the packings at a pressure higher than the suction pressure of the booster compressor. Any leakage of the pad gas will enter the process gas stream contaminating the gas stream. However, the pad gas will prevent the process gas from leaking to atmosphere. This is often done in situations where very tight gas control is required. As the pad gas may leak to local atmosphere, precautions must be taken to ensure it will not endanger personnel, property, or equipment. Contact local OSHA representatives for assistance in determining safety requirements for different gases.

'B' SERIES BOOSTERS - The 'B' series booster compressor is designed to compress air or nonhazardous/non-contaminating gases, as follows (see Figure 11):

B201 - Two pairs of tangent-tangent segmented packings per rod, set for suction pressures above ambient and below 100 psig.

B301 - Three pairs of tangent-tangent segmented packings per rod, for inlet pressures of 100 psig to 165 psig.

B202 - Two pairs of tangent-tangent segmented packings per rod, set for suction pressures at or below ambient.

B302 - Three pairs of tangent-tangent segmented packings per rod, set for suction pressures at or below ambient, with tighter leakage control than the B202 arrangement.

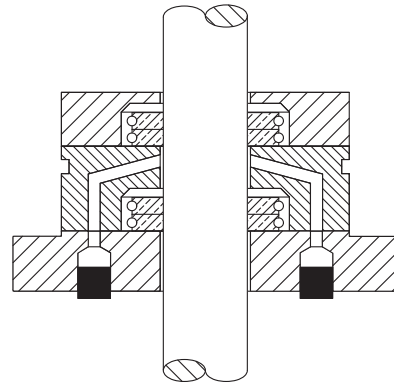
Additional 'B' style packing arrangements can be engineered for specialty applications. If your 'B' style compressor does not match to the four listed above, contact the factory for assistance.

The 'B' series of gas packings does not allow for a vent or purge option. Therefore, there is no protection if gas escapes past the packings -the gas releases into the open crosshead piece, and will escape to the surrounding atmosphere. This may be acceptable for gases other than air, depending upon the location of the compressor (indoor/outdoor), how well the compressor is ventilated with fresh air, and the gas itself. Contact your local OSHA representative and fire marshall for assistance in determining safety requirements for all gases.

Remember: There is no safe gas other than air!

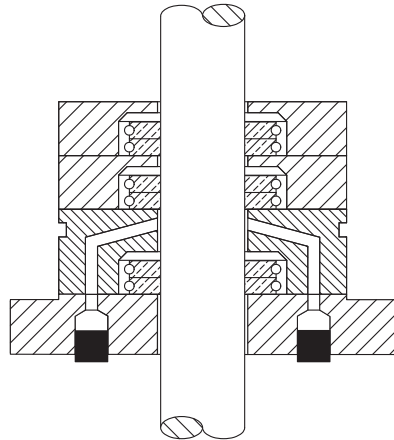
B201 Series:

No. of Packings per Rod: 2
Pressure Side: Top
Vents: Plugged
Maximum Inlet Pressure: 99 psig
Minimum Inlet Pressure: 1 psig



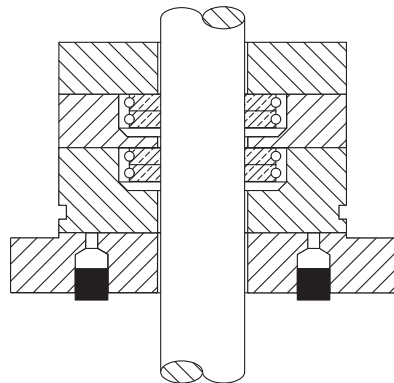
B301 Series:

No. of Packings per Rod: 3
Pressure Side: Top
Vents: Plugged
Maximum Inlet Pressure: 165 psig
Minimum Inlet Pressure: 1 psig



B202 Series:

No. of Packings per Rod: 2
Pressure Side: Bottom
Vents: Plugged
Maximum Inlet Pressure: \leq atmospheric
Minimum Inlet Pressure: 8 psia



B302 Series:

No. of Packings per Rod: 3
Pressure Side: Bottom
Vents: Plugged
Maximum Inlet Pressure: \leq atmospheric
Minimum Inlet Pressure: 8 psia

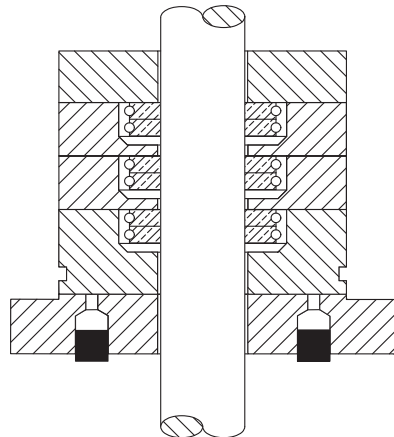


Figure 11: Gas Packing Arrangements for 'B' Series Air Boosters and Gas Compressors

‘G’ SERIES BOOSTERS - The ‘G’ series booster compressor is designed to compress standard industrial gases and allows for venting or purging of the packings. This gives a much greater degree of leakage control. In the ‘G’ series, there are two sets of gas packings, the upper and the lower. The upper set is used to control the blow-by past the piston rings. Ideally, little or no gas should escape past these packings. What gas does leak by the upper set of packings is trapped in a vented area by the lower set of packings. The vented area must be piped to an appropriate location outside for safe release to atmosphere or it may be purged by an inert gas like dry nitrogen with the outlet purge mix piped to a suitable location (i.e. a low pressure flare). An inert gas purge must be at a pressure below the suction pressure and above local ambient pressure. If the purge gas cannot meet these pressure requirements, or if it is necessary to pad the packing at a pressure higher than the inlet pressure, the packing arrangement must be reversed. Contact the factory if assistance is required. Three or more pairs of tangent-tangent segmented packings are used per rod, as follows (see Figure 12):

G211/G221 - Three/four packings per rod, with a purge/vent chamber between the top sets and the bottom-most set, configured for suction pressures above ambient. G221 provides more leakage control than G211.

G321 - Five sets of packings per rod may be used to increase leakage control, with a purge/vent chamber between the top three packings and the bottom two packings. Configured for suction pressures above ambient. Provides tighter leakage control than G211/G221 configurations.

G212/G222 - Three/four packings per rod, with a purge/vent chamber between the top sets and the bottom-most set, configured for suction pressures at or below ambient. G222 provides more leakage control than G212.

G322 - Five sets of packings per rod may be used to increase leakage control, with a purge/vent chamber between the top three packings and the bottom two packings. Configured for suction pressures at or below ambient. Provides tighter leakage control than G212/G222 configurations.

Vacuum applications may plumb the vent/purge line to the discharge or second stage inlet. Additional ‘G’ style packing arrangements can be engineered for specialty applications. If your ‘G’ style compressor does not match to one of those listed above, contact the factory for assistance.

‘H’ SERIES BOOSTERS - The ‘H’ series compressor is designed to compress difficult to contain or extremely toxic or hazardous, industrial gases. Two distinct isolation chambers provide the maximum leakage control available. Two pairs of tangent-tangent packings per rod provide the first isolation of the process gas. A second plenum chamber is added, through which purge gas may be run. Three pairs of tangent-tangent segmented packings per rod with a purge chamber between the top two and the bottom-most packings are located in the bottom of the lower plenum chamber. This combination of ‘B’ and ‘H’ series options provides the standard H2211 configuration. Additional quantities of packings may be added for tighter control. Application where the suction pressure is lower than the pressure in the upper vent/purge chamber (vacuum or high pressure padding) can also be handled in standard configuration.

For special applications, additional configurations are available. Contact factory for further configuration details.

FACTORY ASSISTANCE

It cannot be stressed enough that any installation questions should be referred to the factory. Proper installation of the compressor will add years to the life of the compressor and system. Improper installation can cause future problems that are expensive and difficult to solve without completely reinstalling the compressor and may void the warranty. Call the factory for assistance.

G211 Series:

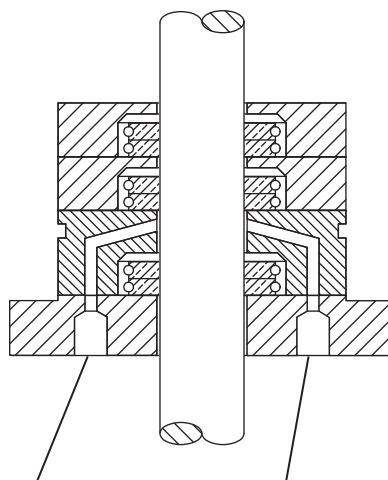
No. of Packings: 2 Upper
1 Lower

Pressure Side: Top

Vent Pressure: \geq Atmospheric
< Suction

Maximum Inlet Pressure: 99 psig

Minimum Inlet Pressure: 10 psig



1/8" NPT Vent ports must be plumbed to safe vent location, purged, or padded.

G221 Series:

No. of Packings: 2 Upper
2 Lower

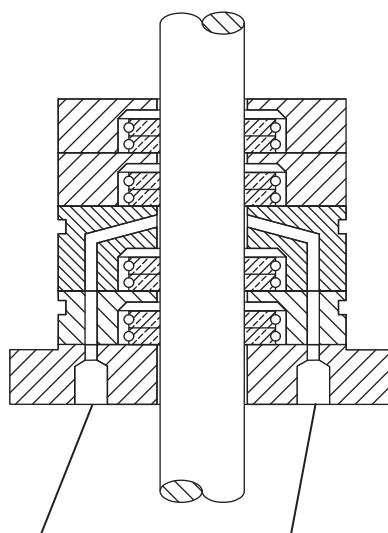
Pressure Side: Top

Vent Pressure: \geq Atmospheric
< Suction

Maximum Inlet Pressure: 99 psig

Minimum Inlet Pressure: 10 psig

Note: Tighter gas control



1/8" NPT Vent ports must be plumbed to safe vent location, purged, or padded.

G321 Series:

No. of Packings: 3 Upper
2 Lower

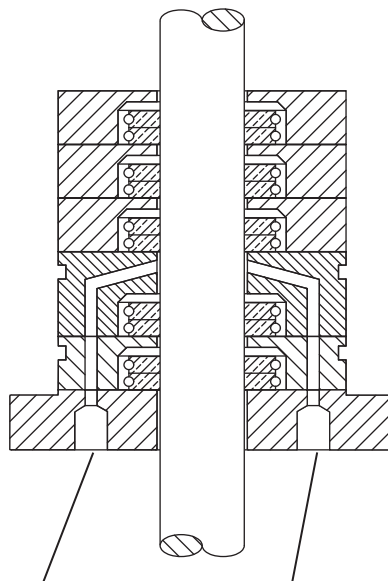
Pressure Side: Top

Vent Pressure: \geq Atmospheric
< Suction

Maximum Inlet Pressure: 165 psig

Minimum Inlet Pressure: 10 psig

Note: Tightest gas control

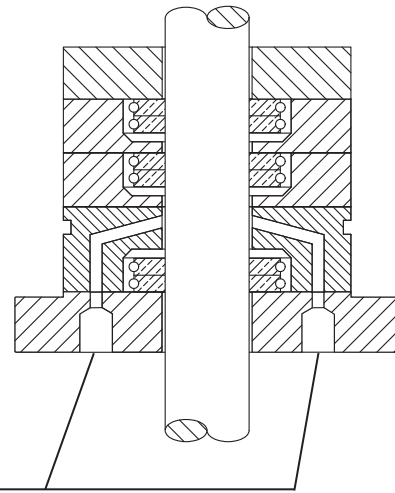


1/8" NPT Vent ports must be plumbed to safe vent location, purged, or padded.

Figure 12: Gas Packing Arrangements for 'G' Series Gas Compressors

G212 Series:

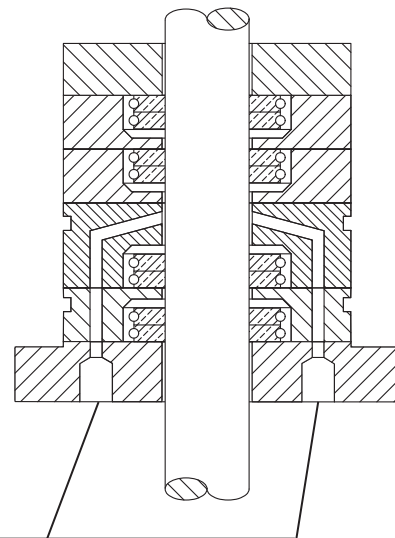
No. of Packings:	2 Upper 1 Lower
Pressure Side:	Bottom
Vent Pressure:	\geq Atmospheric > Suction
Maximum Inlet Pressure:	10 psig
Minimum Inlet Pressure:	0 psig



1/8" NPT Vent ports must be plumbed to safe vent location, purged, or padded.

G222 Series:

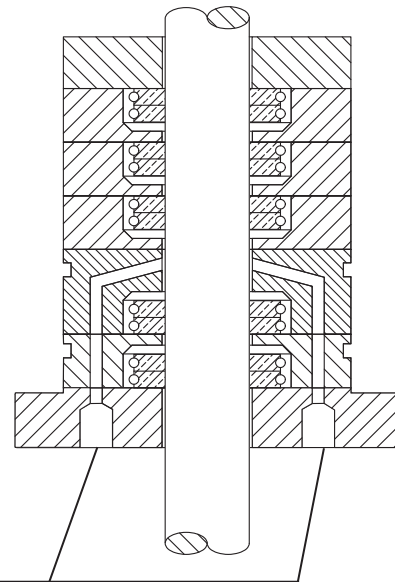
No. of Packings:	2 Upper 2 Lower
Pressure Side:	Bottom
Vent Pressure:	\geq Atmospheric > Suction
Maximum Inlet Pressure:	10 psig
Minimum Inlet Pressure:	0 psig
Note:	Tighter gas control



1/8" NPT Vent ports must be plumbed to safe vent location, purged, or padded.

G322 Series:

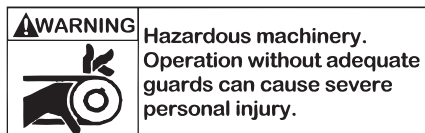
No. of Packings:	3 Upper 2 Lower
Pressure Side:	Bottom
Vent Pressure:	\geq Atmospheric > Suction
Maximum Inlet Pressure:	10 psig
Minimum Inlet Pressure:	0 psig
Note:	Tightest gas control



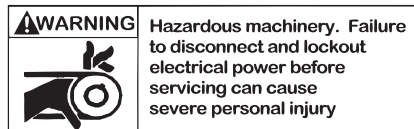
1/8" NPT Vent ports must be plumbed to safe vent location, purged, or padded.

Figure 12: Gas Packing Arrangements for 'G' Series Gas Compressors (Continued)

SECTION 2



COMPRESSOR STARTUP



INSTALLATION CHECKLIST - REVIEW BEFORE CONTINUING

- ☐ Verify that the actual operating conditions will match expected conditions.
- ☐ Reciprocating compressors installed at permanent locations must be mounted on a reinforced concrete foundation (6 bag / 4000 psi mix) weighing at least twice the weight of the bare compressor. Fill a permanent mounted baseplate/skid with epoxy grout.
- ☐ Allow for 18" of clearance for air circulation and service access around the compressor.
- ☐ Outdoor compressor installations must be protected from the effects of the environment with a suitable enclosure or overhead protection.
- ☐ A power disconnect for the machine must be installed as per NEC & local code.
- ☐ Check the compressor oil level.
- ☐ Lockout/tagout the compressor control panel and tighten all electrical connections within the control panel (if provided) before startup. Connections can come loose during shipping leading to intermittent faults.
- ☐ Bump the compressor and check for proper rotation (Clockwise viewed from oil pump end).
- ☐ Use flexible braided metal hose connections of proper pressure and temperature rating, to the compressor and system inlet and discharge ports. Do not use rubber hose.
- ☐ Ensure Gas Packing cases are properly plumbed to vent/pad/purge locations.
- ☐ All Air Booster and Gas Compressors must have an inlet receiver sized per Hycomp installation manual. Ensure that inlet and discharge receiver tanks are secured and bolted down.
- ☐ Air Booster and Gas compressors must have a properly sized filter installed at the suction receiver inlet to protect the booster from system contamination. Filter should be 1 micron or better, sized for minimal pressure drop.
- ☐ Ambient Air Compressors must have an inlet filter installed.
- ☐ Ensure properly sized pressure safety valves are protecting the inlet and discharge piping systems and are placed between the compressor and any isolation ball valve, per ASME Code.
- ☐ A properly sized check valve must be located in the discharge line, after the aftercooler.
- ☐ Protect personnel from high temperature piping/tubing by insulating, warning, and/or restricting access to the machine boundary.
- ☐ Instrument lines to control sensors, unloader controls, etc., must be 3/8" tubing and drawn from a receiver, not from the compressor inlet/discharge piping.
- ☐ Install an oil seep drain line and container to route and contain drainage from the crosshead cylinder. A hose barb is provided for this purpose.
- ☐ Double nut, Nyloc nut, or Loctite foundation bolting. Check all bolting after the first few hours and days of operation for tightness.
- ☐ Compressors are shipped with ISO 68 / SAE 30 weight oil. Refer to installation manual to ensure this is appropriate for your environmental conditions.
- ☐ Check your system for leaks and fix as required. Remove all pressure from system and isolate and drain before attempting fixes.
- ☐ Complete the Hycomp Warranty Registration Card and return it to Hycomp. Call 24/7 with questions.

INSPECTION AFTER EXTENDED STORAGE

If the compressor has been out of service for an extended length of time, verify that the cylinder bores and valve pockets are free of rust and other debris. Inspect the crosshead bores for signs of rust.

Drain the oil from the crankcase and remove the inspection cover plate. Inspect inside the crankcase for signs of rust or contamination. Clean and/or replace parts if they exhibit signs of corrosion. Refill the crankcase with the proper weight and amount of oil. Squirt oil onto all bearing areas and ensure all bearings have fresh oil.

Squirt oil onto the piston rod oil scrapers by removing the oil scraper cover. Apply enough oil to ensure that the crosshead cylinder bores receive oil. Remove the oil scraper case if necessary to ensure oil is applied to the crosshead bores.

Rotate the unit manually to ensure everything rotates smoothly and no interference or friction can be felt.

COMPRESSOR SPEED

The lubrication systems of Hycomp model compressors are designed to operate at speeds of 400 RPM and above. Do not operate below 400 RPM without consulting factory.

Hycomp compressors should not be run at speeds above 700 RPM without consulting factory. While these compressors have been operated at speeds in excess of 700 RPM, reduced volumetric efficiencies and shortened valve and piston ring life result. Hycomp recommends keeping compressor speed below the maximum recommended for optimum service life and warranty compliance.

CRANKCASE LUBRICATION

Hycomp compressors ship with HYSYN SAE 30/ISO 68 synthetic compressor oil in the crankcase, unless otherwise requested. All Hycomp compressor models have fully pressurized crankcase lubrication system fed by a gerotor type constant pressure oil pump, with the exception of the 'A' block compressors which are splash lubricated. With the HySyn, oil change requirements are every 8,000 hours of run time or 12 months, whichever occurs first. In any case, oil should be changed whenever the oil becomes visibly contaminated. Check oil level weekly on continuous run units. Oil level should be maintained between the two marks on the oil dip stick located on the side of the running gear or a small air bubble on top of the oil

Ambient Temperature	Oil Viscosity
0 to 32°F (-18 to 0°C)	SAE 10W / ISO 32
32 to 80°F (0 to 27°C)	SAE 20W / ISO 46
Above 80°F (>27°C)	SAE 30W / ISO 68

Table 2: Oil Viscosity

level gauge located on the oil pump side of the 'F' block. Do not flush the crankcase with solvents, as this will dilute the oil. All pressure oil lubricated compressors come standard with a spin-on oil filter. This filter must be replaced at the same time the oil is changed.

When an alternate oil is required, Hycomp can also supply HYLUBE, a single viscosity non-detergent R&O compressor oil, available in several standard viscosities for different ambient conditions. In this situation, the oil filter and oil change requirement is 2,000 hours of run time or 6 months, whichever occurs first.

Oils come in several viscosities suitable for different operating conditions. See Table 3 for SAE oil viscosity recommendations and Table 4 for crankcase capacities.

At ambient temperatures below 0°F (-18°C), a crankcase heater must be installed. Hycomp recommends a 70°F (21°C) thermostat setpoint, with SAE30/ISO68 oil.

NOTE: DO NOT MIX SYNTHETIC OIL WITH TRADITIONAL COMPRESSOR OIL.

Suitable oils for use in Hycomp compressors include:

HYSYN synthetic compressor oil (8000 hr)

No direct replacements available

HYLUBE compressor oil (2000 hr)

Conoco Multipurpose R&O

Exxon/Mobil Rarus 427

Chevron Machine Oil R&O

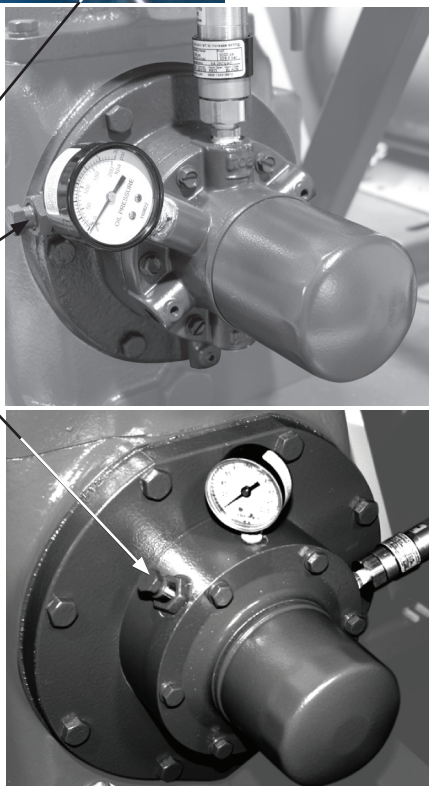
Shell Turbo Oils T

Block	Quarts
A	7/8
B	1-1/2
C	2
D, G	6
E, H	9
F	9
V	9

Table 3: Oil Capacity by Block



Oil Pressure
Adjusting
Screw



'F' Block- as of 1/1/09

Figure 13: Oil Pump - 'B', 'C', 'D', 'E', 'F', 'G', 'H', and 'V' Blocks (Including 'F' Blocks as of 1/1/09)

OIL PRESSURE REGULATION

Oil pressure regulation on 'B', 'C', 'D', 'E', 'F', 'G', 'H' (including 'F' blocks as of 1/1/09) and 'V' blocks is accomplished by an adjustable, spring loaded valve located in the bearing carrier on the end of the compressor opposite the flywheel. Pressure is controlled by an adjusting screw and lock nut. Adjustment must be made while the compressor is running.

For 'B', 'C', 'D', 'E', 'G', 'H' and 'V' Blocks - Increase in pressure is accomplished by a clockwise rotation of the adjusting screw. Set the oil pressure to 18-22 PSIG with the compressor at normal operating temperature.

'F' Blocks Built Prior to 2009 - Oil pressure regulation on 'F' block models built prior to 1/1/09 is factory set. Adjustment on 'F' blocks built prior to 2009 is accomplished by removing the oil pump and changing the number of valve discs under the oil pressure relief spring. Adding more valve discs will increase pressure, while removing valve discs will decrease pressure. Each valve disc changes the oil pressure by approximately 2.5 PSIG.

'F' Blocks Made After 1/1/09 - The oil pressure can be changed using the adjusting screw, see Figure 13. Set the oil pressure to 45 - 50 PSIG with compressor at normal operating temperature.

V-BELT TENSION AND ALIGNMENT SETTINGS

Improper pulley alignment and belt tension will cause motor overload, excessive vibration, and premature belt and bearing failure. The belt must be routinely inspected for cracks, burns, frays, or any unusual wear and replaced if necessary. Routinely check the motor sheave and compressor flywheel for oil, grease, or burrs. Clean or replace when necessary. Make sure all mountings are securely fastened. The drive belt grooves of the sheave and flywheel must line up with each other. The motor drive shaft must be parallel to the compressor crankshaft. Hycomp recommends banded belts rather than multiple individual belts.

Angular Misalignment - The motor shaft and Compressor crankshaft are not parallel. This is typically due to an alignment error at motor or motor adjusting base. Correct alignment by shifting the motor to bring the motor shaft parallel with the crankshaft. (See Figure 15.)

Parallel Misalignment - The sheave is not properly located on the motor shaft. This is typically caused by improper location of the motor drive sheave on the motor shaft. Loosen and reposition sheave until properly aligned with flywheel. (See Figure 14.)

Figure 14: Misalignment

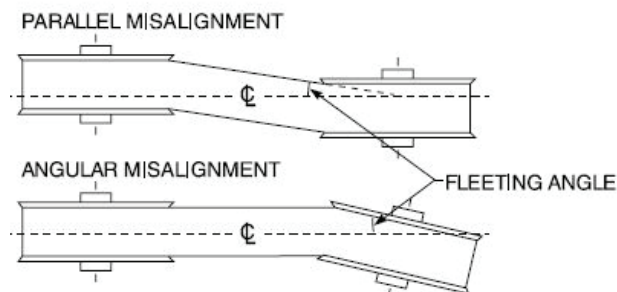




Figure 15: Alignment Evaluation

Sheave Wobbling on Shaft - Sheave or bushing not installed on motor shaft correctly.

Note: Sheave alignment can be checked by using several methods. Alignment on v-belt drives should be less than $1/2^\circ$ or $1/10''$ per foot of center to center distance.

Straight Edge Method - This method can be used to align the motor sheave and compressor flywheel.

1. Confirm that the compressor, motor and motor mount are squared up with the skid face and all mounting bolts are secure.
2. Install bushing and sheave on the motor shaft.
3. Place the belt(s) on the motor sheave and compressor flywheel and temporarily tighten belt by adjusting the motor base mount. Note: Banded v-belts may need to be installed at the same time as the motor sheave for ease of assembly.
4. Place a straight edge across the face of the compressor flywheel, spanning the motor sheave. An angular misalignment will be observed as an angle between the straight edge and the face of the motor sheave. A parallel misalignment will be observed as an offset between the center line of a belt on the flywheel and motor sheave. Resolve angular misalignment prior to making corrections in parallel misalignment, as angular corrections require repositioning of the motor.

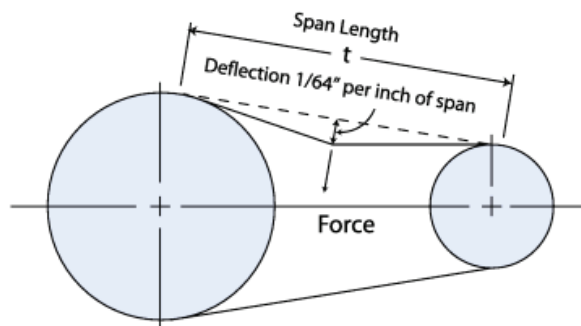


Figure 16: V-Belt Deflection Measurement

Alignment Evaluation - (See Figure 15.)

Angular Alignment: Place a straight edge across the compressor flywheel with the loose end of the straight edge **not** in contact with the motor sheave. Observe alignment of the face of the motor sheave with the line of the straight edge. Adjustment of the motor and/or mounting base will be required to correct angular alignment.

Parallel Alignment - Place a straight edge across the compressor flywheel with the loose end of the straight edge **not** in contact with the motor sheave. Place a straight edge across the compressor flywheel with the loose end of the straight edge not in contact with the motor sheave. Measure from straight edge to a marked reference point on the belt at the flywheel. Rotate belt to shift the marked reference point at the motor sheave. Adjust sheave on motor shaft to obtain equal measurements.

The belt can now be tightened via the motor base, refer to specific v-belt manufacturer tension ratings. An example of deflection force tensioning follows:

Measure span length (t). See Figure 16.

Use an appropriate sized v-belt tension gauge, on the scale reading "Deflection Inches", set the O-ring to show a deflection of $1/64''$ per inch of span length (t). For example a span length of 32" will require a deflection of $32/64''$ or $1/2''$. (See Figure 17.)

At the center of the span (t), apply force using the

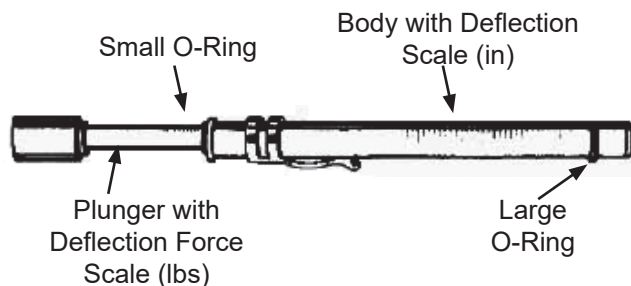


Figure 17: V-Belt Tension Gauge

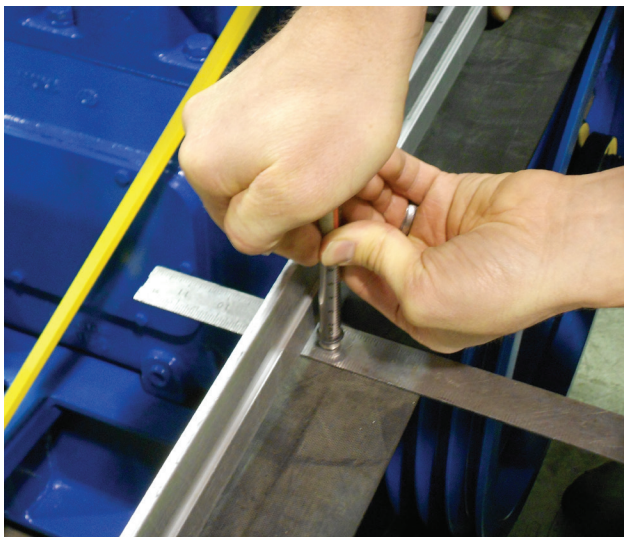


Figure 18: Tension Gauge Example

tension tester perpendicular to the span. For banded belts, place a piece of steel or angle iron across the band width and deflect the entire width of the band evenly.

Use the straight edge placed across the sheave and flywheel above the belt to establish a reference line. Deflect the belt until the bottom edge of the lower o-ring is at the correct deflection distance. Find the deflection force on the upper scale of the tension tester. The sliding rubber O-ring will move up the scale as the tester is compressed. See Figure 18.

Compare the deflection force with the range of forces recommended. See Table 5. If less than minimum the belt should be tightened. **Note: There normally will be a rapid drop in tension during the run in period and the belt must be inspected periodically to ensure the belt tension is within the specified range.**

For example if you have a 4B belt with a motor sheave of 5.4" diameter and a span of 32", you would deflect the belt 32/64" (1/2") from the reference line. At that amount of deflection the force applied should be 36.4 lbs. max. With new belts, start near the maximum deflection force value and check the tension periodically during the first 24 to 48 hours of service duty. You must adjust to run in the range of 24.8 lbs. to 36.4 lbs. See Table 5.

Care should be taken during tension adjustments to assure that the alignment is maintained.

Upon completion of alignment and tension adjustment, all mounting hardware should be re-checked for proper tightness.

V-Belt Cross Section	Small Sheave Diameter Range (in.)	Recommended Deflection Force (lbs.)	
		MIN.	MAX.
2B	4.6	10.2	14.8
	5.0 - 5.2	11.6	17
	5.4 - 5.6	12.4	18.2
	6.0 - 6.8	14.2	20
	7.4 - 9.4	16.2	24
3B	4.6	15.3	22.2
	5.0 - 5.2	17.4	25.5
	5.4 - 5.6	18.6	27.3
	6.0 - 6.8	21.3	30
	7.4 - 9.4	24.3	36
4B	4.6	20.4	29.6
	5.0 - 5.2	23.2	34
	5.4 - 5.6	24.8	36.4
	6.0 - 6.8	28.4	40
	7.4 - 9.4	32.4	48
4C	7.0	36.4	52
	7.5	38.8	56
	8.0 - 8.5	44	64
	9.0 - 10.5	48	72
	11.0 - 16.0	56	84

Table 4: Typical V-Belt Deflection Forces

CONTROL PANELS

Most Hycomp packages are supplied with a proprietary control panel; this panel contains the electric and electronic components used to control the package or system. Hycomp supplies only high quality components, they are reliable and robust, however because of the delicate nature of any electronic component great care must be taken to keep the control panel and its internal components free of debris, dust and moisture. (See Figure 19.)

Human Machine Interface (HMI) – Your control panel may be supplied with an HMI, this is the display on the outside of the panel used to monitor and control the functions of your Hycomp system. See Figures 20 and 21.

Hycomp engineers packages and systems to specific customer needs, please refer to your control panel manual for your Hycomp system, and HMI model for specific information. Some of the user functions displayed on the HMI may include the following information, depending on application.

Real time unit run conditions.

Real time pressures and temperatures.

- Discharge Temperature
- Interstage Temperature (if applicable)
- Discharge Pressure
- Interstage Pressure (if applicable)
- Suction Pressure
- Oil Pressure

Unit load and unload status.

- Unit enabled/disabled.
- Unit standby and run conditions.
- Active and historic alarms.
- Active and historic faults.
- Pressure and temperature set point adjustments.
- Fault and alarm set points.
- Timing set points.

Programmable Logic Controller (PLC) – If your Hycomp system is supplied with a Hycomp factory control panel it will contain a PLC. This acts as the “brain” of the system; it contains proprietary software and programming specific to your Hycomp unit. The HMI is the interface to the PLC to input user options, acknowledge and clear alarms or faults, and monitor the run conditions of your Hycomp system. Refer to your specific Hycomp control panel manual for further information.

Note: The PLC and HMI are not field serviceable, please contact Hycomp factory support with any questions or issues.

Resistance Temperature Detector (RTD) – If your Hycomp system was provided with a Hycomp factory controls panel it will have calibrated RTD(s). This device is used to monitor temperature at various points on the Hycomp unit including discharge temperature and interstage temperature. **Note: Your Hycomp compressor or booster must not exceed 340 F under any circumstance, exceeding this will cause rapid failure of your Hycomp unit!**

The RTD uses resistance to read temperature and transmits that resistance to the PLC where it will be converted to F (Fahrenheit) or C (Celsius). **Note: Do not modify the wires on the RTD, doing so will change the calibrated resistance of the RTD and it will no longer accurately read temperature.**

Pressure Transducer - If your Hycomp system was provided with a Hycomp factory control panel, it will have pressure range specific transducers. These are used to monitor system pressures at certain points, examples of these points include suction pressure, discharge pressure, interstage pressure (if applicable), and oil pressure.

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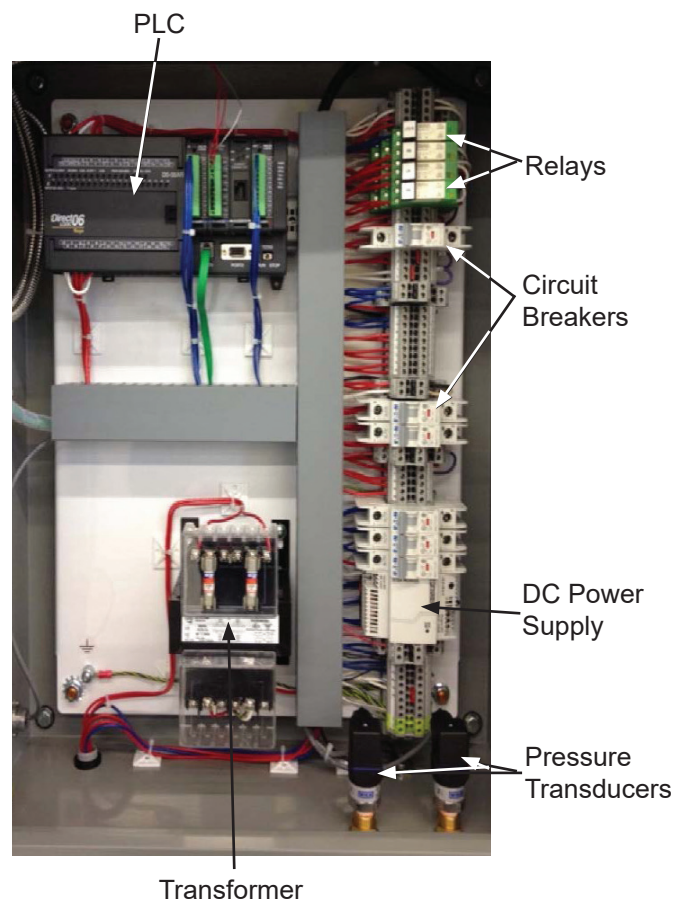


Figure 19: Control Panel and Parts

The transducer sends a signal in millivolts to the PLC where it is converted into PSIG, PSIA, Bar, kPa depending on your specific requirements.

Note: Only use Hycomp supplied transducers, a transducer with the incorrect range can damage your Hycomp unit. Never offset or scale a transducer without first contacting Hycomp factory service for advice.

Motor Contactor and Overload Protection – If your Hycomp system was provided with a Hycomp factory controls panel it will have a motor contactor and overload protection (motor starter). This device is what starts and powers the drive motor on your Hycomp system. It is controlled by the PLC and a run relay. When the coil on the contactor receives current the coil pulls the high voltage contact closed and completes the high voltage circuit to the drive motor. In the event of a motor high amp draw condition the overload will interrupt the low voltage to the coil causing the high voltage contacts to open breaking the high voltage circuit to the motor. This protects both the motor and Hycomp compressor or booster. **Note: The motor contactor is a high voltage component. Great care and proper isolation and Lockout/Tagout procedures of incoming electrical power must be followed before any service or troubleshooting. Failure to follow proper procedures can result in serious injury or death.**

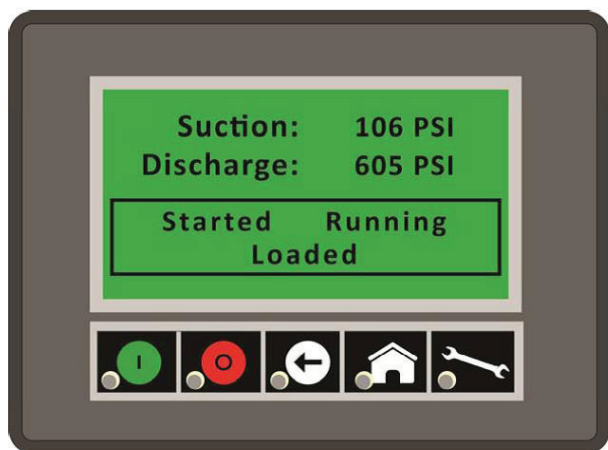


Figure 20: HDC1 HMI Screen

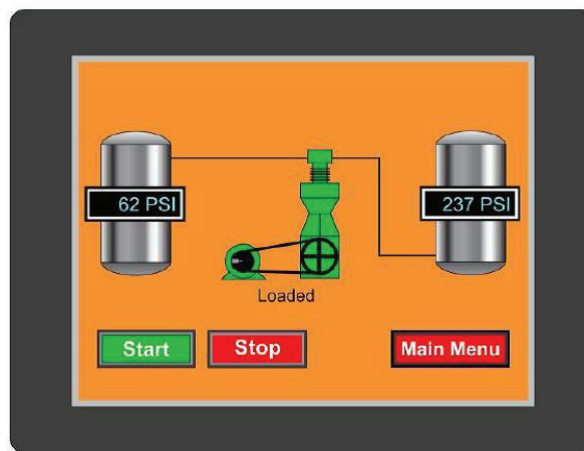


Figure 21: HDC2 HMI Screen

Transformer – If your Hycomp system was provided with a Hycomp factory controls panel it may have a transformer, this device “steps down” high voltage to low voltage used to power low voltage components in the panel.

Relays – If your Hycomp system was provided with a Hycomp factory controls panel it will have relays, these take a signal from the PLC and relay power to a specific system control component, some examples of these relays might include the following:

“RR” or run relay sends current to the motor contact coil.

“LR” or load relay controls the load/unload mechanism.

“FR” or fault relay, this can also be used as a user defined fault in some applications, please contact Hycomp factory support for details on your specific unit.

Other relays may be used in specific applications, please refer to your factory supplied electrical drawings or contact Hycomp factory support for advice.

DC Power Supply – If your Hycomp system was provided with a Hycomp factory controls panel it will have a DC power supply, this is used to convert AC current to DC current for the transducers and other DC powered components.

Circuit Breakers – If your Hycomp system was provided with a Hycomp factory controls panel it will have circuit breakers, these are used to protect components downstream of the breaker in the event of a short or high amp draw.

Note: Panel circuit breakers should not be used as positive electrical isolation when servicing components on the circuit, please follow proper isolation and Lockout/Tagout procedures. Failure to do so could result in serious injury or death.

Caution: The control panel summary only applies to Hycomp factory supplied controls. Any user supplied control is not the responsibility of Hycomp and any damage to the Hycomp booster or compressor is not the responsibility of Hycomp.

Caution: Refer to the Hycomp supplied Control Panel Manual for complete information regarding the details of your system.

PRE-STARTUP CHECKLIST

WARNING: Failure to perform the pre-start-up checklist may result in mechanical failure, property damage, serious personal injury, or even death. Steps 1-14 must be performed prior to connecting the unit to a power source.

1. Become familiar with the function of all piping associated with the compressor. Know the use of each line, valve and control device!
2. Verify that actual operating conditions will match conditions the unit was originally designed for. If conditions do not match, contact your local representative or the factory.
3. Remove all tools from the compressor and check for installation debris. Loose tools/debris may be thrown upon start-up and injure personnel.
4. Check motor pulley and compressor sheaves for alignment and proper belt tension. Typically 1/4" to 3/8" belt deflection is acceptable. Contact the belt manufacturer for more details.
5. Manually rotate compressor sheave through several full rotations to be sure there is no mechanical interference felt.
6. Check inlet piping installation and all pressure connections for tightness.
7. Make sure all pressure relief valves are properly installed and free to operate.
8. Be sure all belt guards are in place and secure.
9. Check fuses, circuit breakers and thermal overloads for proper sizing.
10. Open all manual shut-off valves downstream of the compressor discharge.
11. Fill water cooling system (if applicable), and check for leaks. Purge of air.
12. Check oil levels in crankcase. If low, fill with a high quality non-detergent oil of the proper viscosity.
13. Check for loose connections or loose fasteners.
14. **DOUBLE CHECK ALL THE ABOVE!**
15. Connect unit to a proper power source.

INITIAL STARTUP AND OPERATION (AMBIENT AIR COMPRESSORS)

Ambient Air Compressors are compressors whose inlet source is the ambient air surrounding the compressor. All air compressors are broken in and tested at the factory prior to shipment. In most cases, it is not necessary to perform any special start-up procedures on a new compressor. Occasionally the unit may need an extended amount of 'break-in' time to seat the piston rings and create proper wear patterns. Units that have been in storage for an extended length of time may require special attention. Refer to sections in this manual on Inspection After Extended Storage, and Compressor Storage, or contact the local representative or the factory.

With the pre-start-up checklist completed and satisfied, turn the compressor on briefly (1-2 seconds) to check the direction of rotation. Be sure it agrees with the rotation arrow embossed on the compressor sheave (counterclockwise when viewed from the flywheel side of the compressor). If the compressor is not turning in the proper direction, it will not achieve oil pressure and will shut down. Fix the problem before re-starting.

Start the compressor. Watch and listen for excessive vibration and strange noises. If either exist, stop the compressor immediately.

Watch the oil pressure gauge to be sure the oil pressure is adequate. Oil pressure should rise to working pressure within 10-15 seconds. If there is a question about oil pressure, stop the compressor and investigate. Refer to Section 4, "Maintenance and Troubleshooting" for assistance if operation is not normal.

Check the air receiver pressure gauge or system pressure gauges for proper readings. If inadequate or excessive air pressure conditions occur, shutdown the compressor.

Observe the compressor operation closely for the first hour of operation and then frequently (every 1/2 hour) for the next 7 hours. As the compressor comes to normal operating conditions, temperature distortion may cause changes in the operating parameters, excessive vibration or previously unnoticed noises. **THIS IS NOT NORMAL.** Shutdown the compressor and investigate the problem.

Test each shutdown device, unloader device, dump valve and safety valve. Record the actual setpoints and adjust as necessary.

After the first eight hours of operation, the compressor should be monitored at least once every 6-8 hours.

After two days of operation, check the belt tension, oil level and inspect for leaks.

On new and newly rebuilt units, the valve hold-down screws, valve cover bolts and cylinder head bolts must be re-torqued after 8 and 36 hours of running time. Also check all mounting bolts, flywheel bolts, etc. The standard two day check period should be used after this initial run-time. Units run in extreme environments and air temperature ranges may require special attention. Expansion and contraction of parts due to the unit warming up from lower temperatures may cause bolts and screws to loosen at an accelerated rate.

INITIAL STARTUP AND OPERATION (AIR BOOSTERS AND GAS COMPRESSORS)

Air Boosters - these are compressors that compress air that is taken from a source other than the ambient air. Generally the inlet air source is at an elevated pressure, but vacuum applications can also be accomplished. The inlet air is usually taken from customer's existing plant air system.

Gas Compressors - These are compressors pumping any gas other than air.

All air boosters and gas compressors are broken in and tested at the factory prior to shipment. In most cases, it is not necessary to perform any special start-up procedures on a new unit. Occasionally it may need an extended amount of 'break-in' time to seat the piston rings and create proper wear patterns. Units that have been in storage for an extended length of time may require special attention. Refer to sections in this manual on Inspection After Extended Storage, and Compressor Storage, or contact the local representative or the factory.

With the pre-start-up checklist completed and satisfied, turn the compressor on briefly (1-2 seconds) to check the direction of rotation. Be sure it agrees with the rotation arrow embossed on the compressor sheave (counterclockwise when viewed from the flywheel side of the compressor). If the compressor is not turning in the proper direction, it will not achieve oil pressure and will shut down. Fix the problem before re-starting.

Start the compressor. Watch and listen for excessive vibration and strange noises. If either exist, stop the compressor immediately.

Watch the oil pressure gauge to be sure the oil pressure is adequate. Oil pressure should rise to working pressure within 10-15 seconds. If there is a question about oil pressure, stop the compressor and

investigate. Refer to the Section titled "Maintenance and Troubleshooting" for assistance if operation is not normal.

Check the pressure gauges or system pressure gauges for proper readings. If inadequate or excessive pressure conditions occur shutdown the compressor. Design conditions must be met before the compressor will operate properly.

Observe the compressor operation closely for the first hour of operation and then frequently (every 1/2 hour) for the next seven hours. As the compressor reaches normal operating conditions, temperature distortion may cause changes in the operating parameters, excessive vibration or previously unnoticed noises. THIS IS NOT NORMAL. Shutdown the compressor and investigate the problem.

After the first eight hours of operation, the compressor should be monitored at least once every 6-8 hours. After two days of operation, check the belt tension, oil level and inspect for leaks.

Test each shutdown device, unloader device, dump valve and safety valve. Record the actual setpoints and adjust as necessary.

On new and newly rebuilt units, the valve hold-down screws, valve cover bolts and cylinder head bolts must be re-torqued after 8 and 36 hours of running time. Also check all mounting bolts, flywheel bolts, etc. The standard two day check period should be used after this initial run-time. Units run in extreme environments and air temperature ranges may require special attention. Expansion and contraction of parts due to the unit warming up from lower temperatures may cause bolts and screws to loosen at an accelerated rate.

Gas packings require a period of run-time to seat in, as do piston rings depending upon running conditions. All Hycomp compressors have been tested at the factory for a minimum of four hours, but more time may be needed to fully break in the packings and rings into their wear patterns. When gas packings are pressurized under static (unloaded/idle) conditions there will be an audible minor leakage sound.

At initial start-up, and any time after replacement of the packings and/or rings, the compressor must be closely monitored for leakage past the packings. If leakage occurs in amounts beyond safe limits, then the compressor must be broken in with a gas that can be released to the local atmosphere like air, or nitrogen if it acceptable to release it locally.

If a break-in period is required, the compressor must

be completely isolated from the supply gas. If the air or nitrogen break-in gas will adversely affect the downstream system, it too must be isolated.

Since all industrial gases are dangerous to human life, it must be ensured that there are no leaks in the system that would compromise the safety of personnel or property.

Leak detection may be accomplished with a 'bubble test' or an electronic sniffer that determines the amount of the gas in the surrounding air.

Any leaks that are found must be fixed at once, before standard operation of the compressor is resumed.

DAILY STARTUP CHECKLIST

1. Check the oil level in the crankcase.
2. Drain liquid from the air receiver and moisture traps (if equipped).
3. Turn on cooling water (if not regulated by the system).
4. Start compressor per previous section.
5. Check system pressure.
6. Check oil pressure.
7. Check relief valves for proper operation.
8. Check control system for proper operation.

SECTION 3

MAINTENANCE AND TROUBLESHOOTING

⚠ WARNING



Hazardous pressure can cause property damage, serious personal injury or death

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

WARNING: Never assume a compressor is safe to work on just because it is not operating. It could restart at any time. The following procedures should be used when stopping to maintain or service a compressor.

1. Per OSHA regulation 1910.147: *The Control of Hazardous Energy Sources* (lockout/tagout), disconnect and lockout the main power source. Display a sign in clear view at the main power switch stating that the compressor is being serviced.
2. Isolate the compressor from the compressed air/gas supply by closing any manual shut-off valves upstream and downstream from the compressor. Display signs in clear view at the shut-off valves stating that the compressor is being serviced.
3. Lock open a pressure relief valve within the pressurized system to allow the system to completely depressurize.
4. Shut off the cooling water supply (where applicable).
5. Open all drain valves within the area to be serviced.
6. Wait for the unit to cool before servicing. Temperatures above 120°F can cause burns to the skin.

MAINTENANCE SCHEDULE (AMBIENT AIR COMPRESSORS)

To insure maximum performance and service life of your compressor, a routine preventive maintenance schedule should be developed and followed. Table 6 contains a maintenance/inspection schedule for compressors housed within a weather proof building, with relatively clean ambient air and 75°F ambient temperatures, running 8 hours per day. Time frames may need to be shortened in harsher environments.

⚠ WARNING



Hazardous machinery. Operation without adequate guards can cause severe personal injury.

A general PM Schedule is included in every parts book, to assist with ordering of parts.

Contact the factory or your closest authorized Hycomp dealer for questions about designing a maintenance schedule to fit requirements differing from the listed conditions. Reasonable judgement in the frequency of maintenance and the stocking of spares must be exercised by the customer. Facilities that cannot afford to be shutdown without excessive costs or hardships must provide a more rigorous schedule and larger quantity of spares than facilities that can do without the compressor for a short period of time.

MAINTENANCE SCHEDULE (AIR BOOSTERS & GAS COMPRESSORS)

To insure maximum performance and service life of your compressor, a routine preventive maintenance schedule should be developed and followed. As gas compressors have the possibility of causing great damage to personnel and property, a proper maintenance schedule must be created and rigorously adhered to. Table 6 contains a maintenance schedule for compressors housed within a weather proof building, with relatively clean inlet conditions (no acidic components, filtered to 0.1 micron) and 75°F ambient temperatures, running 8 hours per day. Time frames may need to be shortened in harsher environments.

Contact the factory or your closest authorized Hycomp dealer for questions about designing a PM schedule to fit requirements differing from the listed conditions. Reasonable judgement in the frequency of maintenance and the stocking of spares must be exercised by the customer. Facilities that cannot afford to be shutdown without excessive costs or hardships must provide a more rigorous schedule and larger quantity of spares than facilities that can do without the compressor for a short period of time.

The gas packings need only periodic inspection once the compressor has been broken in. As the packings are the heart of the leakage control system, it is imperative that they not be allowed to deteriorate beyond reasonable limits. Once the lifetime of the packings are known in an application, they can be replaced prior to failure.

	DAILY	WEEKLY	MONTHLY	BIANNUALLY	ANNUALLY
VISUALLY CHECK THE COMPRESSOR	X				
CHECK OIL PRESSURE	X				
CHECK DISCHARGE PRESSURE	X				
DRAIN THE CONDENSATE FROM PIPING SYSTEM, DRAIN LEGS AND AIR RECEIVER	X				
CHECK FOR OIL IN DISTANCE PIECE		X			
CHECK THE CRANKCASE OIL LEVEL		X			
CHECK FOR LEAKS IN THE PIPING SYSTEM		X			
MANUALLY OPERATE ALL SAFETY VALVES			X		
CLEAN CYLINDER, INTERCOOLER AND AFTERCOOLER COOLING SURFACES			X		
CHECK V-BELT TENSION				X	
REPLACE INTAKE FILTER ELEMENT				X	
CHANGE OIL AND OIL FILTER *					X
INSPECT VALVES, REPLACE GASKETS ON REASSEMBLY				X	
INSPECT UNLOADER DIAPHRAGMS/PISTONS				X	
INSPECT ALL CONTROL SWITCHES				X	
INSPECT MOTOR STARTER CONTACTS					X
LUBRICATE MOTOR BEARINGS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS**					X
REPLACE RINGS, VALVES, PACKINGS (not on Ambient Air Compressors), OIL SCRAPERS					X

* OIL AND FILTER (IF APPLICABLE) SHOULD BE REPLACED EVERY 8,000 HOURS OR ANNUALLY, WHICHEVER COMES FIRST.

** HUMID CLIMATES AND CERTAIN OPERATING CONDITIONS CAN CAUSE MOISTURE TO BE DRAWN INTO THE MOTOR. THE MOTOR SHOULD BE RUN ON A CLEAR DAY WITHOUT THE V-BELTS FOR AT LEAST AN HOUR. DURING THIS TIME THE MOTOR SHOULD HEAT UP ENOUGH TO VAPORIZE THE MOISTURE WITHIN THE MOTOR.

Table 5: Maintenance Schedule

TROUBLESHOOTING

WARNING: The compressor MUST be locked out from all energy sources prior to inspection, and all pressure MUST be relieved from unit to prevent unexpected release.

There are times when any compressor, no matter how well built and how accurately maintained, will exhibit some trouble. While Hycomp engineers are available to assist any customer experiencing compressor difficulties, the following tables are provided to assist with initial diagnostics.

Find the section describing the general problem exhibited, then check the probable cause.

If it is not possible to diagnose the cause of the problem, contact Hycomp or a Hycomp authorized dealer for assistance.

The only additional problem encountered with the gas compressors is excess loss of gas through the packings. Generally the problem is caused by improper maintenance of the gas packings. However, if the gas packings have been well maintained, and leaks still persist, contact the factory.

INSUFFICIENT AIR PRESSURE OR VOLUME

PROBABLE CAUSE	SUGGESTED REMEDY
AIR LEAKS	LOCATE AIR LEAKS BY SOUND OR SOAP BUBBLE TEST. TIGHTEN OR REPLACE LEAKING FITTINGS ONLY AFTER REDUCING AIR PRESSURE TO ZERO.
LEAKING VALVES	REMOVE VALVES AND INSPECT FOR DAMAGE TO VALVE SEAT OR VALVE DISC. REPLACE SUSPECT COMPONENTS AND REINSTALL VALVES USING NEW VALVE SEAT GASKETS AND COVER GASKETS.
PISTON RING NOT SEALING	REMOVE PISTON RINGS AND CHECK FOR WEAR. IF RING THICKNESS HAS BEEN REDUCED TO 3/16 INCH OR LESS AT ANY SPOT, THE RINGS SHOULD BE REPLACED. DO NOT BORE OR HONE THE CYLINDER UNLESS IT IS BADLY SCORED OR PITTED.
RESTRICTED AIR INLET	REPLACE THE AIR FILTER ELEMENT. CHECK FOR ANY OBSTRUCTIONS IN INLET AIR PIPING.
BLOWN GASKETS	CHECK CYLINDER HEAD AND VALVE GASKETS - REPLACE AS NECESSARY.
VALVE UNLOADERS NOT FUNCTIONING PROPERLY	WITH THE COMPRESSOR RUNNING, DISCONNECT THE TUBING TO THE VALVE UNLOADER ON THE CYLINDER HEAD. IF AIR DOES NOT ESCAPE, BUT THE COMPRESSOR CONTINUES TO RUN PARTIALLY OR COMPLETELY UNLOADED, REMOVE THE UNLOADER ASSEMBLIES AND VALVES AND INSPECT. IF AIR DOES ESCAPE FROM THE DISCONNECTED TUBING WITH THE COMPRESSOR RUNNING CHECK FOR LOW OIL PRESSURE. IF AIR ESCAPES BUT OIL PRESSURE IS NORMAL, REMOVE THE HYDRAULIC UNLOADER AND PILOT VALVE AND CHECK THEIR VALVE SEATS. IT IS NORMAL FOR AIR TO LEAK FROM THE DISCONNECTED TUBE WHEN THE COMPRESSOR IS STOPPED IF A HYDRAULIC UNLOADER IS USED.

KNOCKING OR THUMPING SOUNDS

PROBABLE CAUSE	SUGGESTED REMEDY
LOW OIL LEVEL	CHECK FOR PROPER OIL LEVEL. IF LOW, CHECK FOR DAMAGE TO BEARINGS.
NO OIL PRESSURE	CHECK ALL POSSIBLE REMEDIES LISTED UNDER "LOW OIL PRESSURE" IN THIS SECTION.
LOOSE FLYWHEEL OR MOTOR PULLEY	CHECK FOR TIGHTNESS OF FLYWHEEL AND PULLEY CLAMPING BOLTS.
WORN BEARINGS	INSPECT CONNECTING ROD INSERTS AND WRIST PIN BUSHINGS FOR EXCESSIVE WEAR. REPLACE AS NECESSARY.
LOOSE ROLLER MAIN	CHECK FOR CRANKSHAFT END PLAY BY PUSHING AND PULLING ON FLYWHEEL. IF PLAY CAN BE FELT CHECK FOR DAMAGE TO ROLLER BEARINGS. IF NO DAMAGE IS EVIDENT TO THE BEARINGS, PROCEED WITH REMOVING CRANKSHAFT END PLAY PER SERVICE SECTION.
LOOSE GUIDE PISTON	CHECK DIAMETER OF GUIDE PISTON. IF WITHIN SPECIFICATION, GUIDE CYLINDER MAY BE WORN.
WORN COMPRESSION PISTON GUIDE RING	REPLACE GUIDE RING BY REMOVING CYLINDER HEAD AND PISTON. CHECK COMPRESSION CYLINDER AND PISTON FOR DAMAGE.
VALVE ASSEMBLIES LOOSE	REMOVE VALVES AND INSPECT VALVE AND CYLINDER HEAD FOR DAMAGE. USING A NEW VALVE SEAT GASKET, TIGHTEN VALVE COVER, THEN VALVE CLAMP SCREW.
PISTON HITTING CYLINDER HEAD	REMOVE COMPRESSOR CYLINDER HEAD AND INSPECT FOR FOREIGN MATERIAL ON PISTON TOP. ADJUST PISTON TO PROPER CYLINDER HEAD CLEARANCE. REPLACE USING NEW GASKETS.

Table 6: Troubleshooting

LOW OR NO OIL PRESSURE

PROBABLE CAUSE	SUGGESTED REMEDY
LOW OIL LEVEL	FILL CRANKCASE TO FULL MARK.
CLOGGED OIL STRAINER	REMOVE AND CLEAN OIL STRAINER.
DEFECTIVE OIL PRESSURE REGULATING VALVE	'B', 'C', 'D', 'E', AND 'V' BLOCKS: REMOVE REGULATING VALVE ADJUSTING SCREW, SPRING AND BALL. CHECK FOR WEAK OR BROKEN SPRING OR DAMAGED SEAT. REPLACE OR REPAIR AS NECESSARY. 'F' BLOCK: REMOVE OIL PUMP AND INSPECT REGULATING VALVE PLATE, SPRING, AND SEAT. REPLACE OR REPAIR DAMAGED PARTS AS NECESSARY.
WORN OUT OIL PUMP	REPLACE OIL PUMP.
OIL PUMP SUCKING AIR DUE TO GASKET FAILURE	CHECK GASKET OR SEAL IN OIL PICKUP LINE. REPLACE AS NECESSARY.
DEFECTIVE OIL PRESSURE GAUGE	CHECK GAUGE AND REPLACE AS NECESSARY.
INCORRECT FLYWHEEL ROTATION	CHECK THAT THE FLYWHEEL FAN IS CLOCKWISE WHEN VIEWED FROM THE OIL PUMP END, IF NOT, CHECK WITH A COMPETENT ELECTRICIAN TO SEE IF THE MOTOR ROTATION CAN BE CHANGED BY RECONNECTING THE MOTOR LEADS.

OVERHEATING

PROBABLE CAUSE	SUGGESTED REMEDY
DIRTY COOLING SURFACES	CLEAN THE COOLING SURFACES OF THE CYLINDER HEAD, CYLINDERS, INTERCOOLER AND AFTER COOLER INCLUDING ANY WATER PASSAGEWAYS.
INADEQUATE VENTILATION	RELOCATE THE COMPRESSOR TO A MORE SUITABLE AREA HAVING CLEAN, DRY, COOL AIR WITH GOOD VENTILATION. AIR COOLED COMPRESSORS SHOULD NOT BE LOCATED IN HOT OR HIGH HUMIDITY AREAS.
LEAKING SECOND STAGE VALVES CAUSING HIGH FIRST STAGE AIR PRESSURES	CHECK FOR LEAKING VALVES OR VALVE GASKETS ON SECOND STAGE. CORRECT AS NECESSARY.
RESTRICTED AIR LINES	CHECK DISCHARGE PIPING AND INTERCOOLER FOR DAMAGE TO LINES CAUSING RESTRICTION IN AIR FLOW.

EXCESSIVE V-BELT WEAR

PROBABLE CAUSE	SUGGESTED REMEDY
PULLEY NOT PROPERLY ALIGNED	REALIGN MOTOR PULLEY WITH THE COMPRESSOR FLYWHEEL.
BELT TOO TIGHT OR TOO LOOSE	ADJUST BELT TENSION PER TABLE 4, IN SECTION 2, COMPRESSOR STARTUP.
PULLEY WOBBLE	CHECK FOR BENT PULLEY, FLYWHEEL OR SHAFTS.

Table 6: Troubleshooting (Continued)

SECTION 4

⚠ WARNING



Hazardous pressure can cause property damage, serious personal injury or death

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

WARNING: Never assume a compressor is safe to work on just because it is not operating. It could restart at any time. The following procedures should be used when stopping to maintain or service a compressor.

1. Per OSHA regulation 1910.147: *The Control of Hazardous Energy Source* (lockout/tagout), disconnect and lockout the main power source. Display a sign in clear view at the main power switch stating that the compressor is being serviced.
2. Isolate the compressor from the compressed air supply by closing any manual shut-off valves upstream and downstream from the compressor. Display signs in clear view at the shut-off valves stating that the compressor is being serviced.
3. Lock open a pressure relief valve within the pressurized system to allow the system to completely depressurize.
4. Shut off the cooling water supply (where applicable).
5. Open all drain valves within the area to be serviced.
6. Wait for the unit to cool before servicing. Temperatures above 120°F can cause burns to the skin.

Refer to the proper Hycomp compressor parts list to assist with disassembly, reassembly and torque specifications. This section is a general guide to servicing Hycomp oil-free air compressors, air boosters and gas compressors. It is not meant to replace proper training and common sense.

COMPRESSOR SERVICING

⚠ WARNING



Hazardous machinery. Operation without adequate guards can cause severe personal injury.

TORQUE VALUES

Each compressor parts manual lists the torque values required for each bolt within the compressor. Torque values are DRY. The use of lubricant on the bolt threads will cause the bolt pre-tension value to be greatly higher and may lead to bolt failure. Table 8 is supplied as a guideline only for use where a torque setting is not given. The table is not meant to replace researching the proper torque value for the application.

TOOL LIST FOR SERVICING

A list of tools needed for service Hycomp compressors is included in Appendix 1. This is a fairly comprehensive list, but site conditions may require additional tooling not listed here.

CLEARANCES AND TOLERANCES

Clearances and tolerances are given on the following pages for various conditions and compressors. If additional information is required, please contact the factory.

Thread Sizes	Hex Head Grade 5 Dry Torque Values (ft-lb)
1/4-20	6 - 8
5/16-18	13 - 17
3/8 - 16	24 - 30
1/2 - 13	60 - 75
5/8 - 11	120 - 150
3/4 - 10	210 - 260
7/8 - 9	320 - 400
1 - 8	460 - 580

Table 7: General Bolt Torque Specifications for Grade 5 Cap Screws

Crankshaft end play	0.002 loose to 0.003 interference
Oil pump end clearance (ring & rotor)	0.001 to 0.003
Piston rod diameter	0.8735 to 0.8755
Cylinder bore diameter (under 1.50")	0.0015 maximum over nominal
Cylinder bore diameter (1.50" - 3.00")	0.003 maximum over nominal
Cylinder bore diameter (3.25" - 7.50")	0.005 maximum over nominal
Cylinder bore diameter (over 7.50")	0.006 maximum over nominal
HJ Compression Ring radial thickness	0.188 minimum
HL Guide Ring radial thickness (under 8" dia)	0.350 minimum
HL Guide Ring radial thickness (over 8" dia)	0.475 minimum
HM Compression Ring radial thickness	*Contact factory
HN Guide Ring radial thickness	*Contact factory
Compression cylinder wall surface finish	12-16 RMS
Guide cylinder wall surface finish	12-18 RMS

* HM & HN style piston rings are available in a wide variety of materials and designs. Contact the factory if you are unsure if your rings need to be replaced.

Table 8: General Clearances and Tolerances

For all compressors, measured in inches.

MODEL	MINIMUM CLEARANCE
'A' & 'B' Block, General	0.045
'C' Block, General	0.050
'D' Block, General	0.055
'E' Block, General	0.060
'F' Block, General	0.070
'G' Block, General	0.055
'H' Block, General	0.060
'V' Block, General	0.055

Table 9: Compression Piston to Head Clearances

Measured in inches, between top of compression piston and top of cylinder head gasket. Values shown are minimums, Tolerances +0.015/-0.0.

Refer to specific compressor parts manual for model block designation.

Block / Model	Rod Bearing Clearance	Crosshead Piston Clearance	Crosshead Piston Diameter	Crank Pin Diameter	Wrist Pin Bushing Clearance	Wrist Pin Diameter
'A' & 'B' Blocks, General	0.0015 to 0.0025	0.003 to 0.004	2.9960 to 2.9930	1.7500 to 1.7505	0.0003 to 0.0006	0.8745 to 0.8755
'C' Block, General	0.0015 to 0.0030	0.003 to 0.004	2.9960 to 2.9930	1.7500 to 1.7505	0.0003 to 0.0006	0.8745 to 0.8755
'D' Block, General	0.0020 to 0.0035	0.003 to 0.004	2.9960 to 2.9930	2.2475 to 2.2485	0.0003 to 0.0006	0.8745 to 0.8755
'E' Block, General	0.0020 to 0.0035	0.0035 to 0.0050	3.9929 to 3.9950	2.2475 to 2.2485	0.0004 to 0.0008	1.1240 to 1.1255
'F' Block, General	0.0025 to 0.0040	0.0045 to 0.0060	4.9925 to 4.9950	3.2509 to 3.2519	0.0005 to 0.0010	2.0000 to 2.002
'V' Block, General	0.0020 to 0.0035	0.003 to 0.004	2.9960 to 2.9930	2.2475 to 2.2485	0.0003 to 0.0006	0.8745 to 0.8755

Table 10: Crankcase and Crosshead Clearances and Tolerances

Measured in inches.

Refer to specific compressor parts manual for model block designation.

COMPRESSOR DISASSEMBLY

WARNING: Before starting work on the compressor, all pressure must be bled off from both the first and second stages, suction and discharge.

This is only a general outline of how to disassemble a Hycomp compressor. Certain specifics may apply to your compressor that are not listed here. Contact an authorized distributor or the factory for assistance on disassembling your compressor.

CYLINDER HEAD AND COMPRESSION CYLINDER

1. Support the intercooler on two stage models in such a way that it will not fall, causing it to twist at the bottom support and possibly bending the tubes, or damaging the cooling fins. Often it is acceptable to tie the intercooler to the crosshead cylinder.

2. Detach loadless starting and constant speed unloader tubing (if supplied) from the compressor.

3. Remove the intercooler cap screws from the underside of the intercooler flange on two stage models. Remove the center and outboard head cap screws from the cylinder head.

4. Remove the cylinder head assembly and head gasket from the cylinder. The suction and discharge valve assemblies will remain in the head. Remove the intercooler gasket from the intercooler flange. Throw out both gaskets. Be sure the intercooler is securely held.

5. Unbolt and remove the compression cylinder using a suitable hoist and chain as necessary, being careful that the cylinder is lifted vertically until it clears the pistons, and that it does not cock and thereby damage the pistons or rings.

6. 'A' - 'E' & 'V' Blocks: Using an adequate heat source such as a torch, heat the piston rod just below the compression piston to a temperature just below 400° F. This will soften the Loctite so that the rod bolt can be loosened without galling the threads or disturbing the opposite end rod bolt integrity. Wear gloves so as not to burn yourself on the piston or rod. Be careful not to allow the rod to get so hot as to discolor it. A Tempil stick or other temperature measuring device should be used to get appropriate temperatures.

While the rod end is hot, use the special rod clamping tool Cat ID 19284 to hold the rod while removing the rod bolt. Remove the piston and store any shims or

thrust washers with the piston. Repeat this process for the second piston. You may remove the piston rings from the piston at this point.

'F' Block: Use the special rod clamping tool Cat ID 19284 to hold the piston rod while removing the upper piston rod nut. Remove piston from the piston rod. Repeat for the second piston. There are NO shims. You may remove the piston rings from the piston at this point.

PLENUM CHAMBER

Air boosters and gas compressors incorporate a 'Plenum' chamber that sits below the compression cylinder, and above the crosshead guide cylinder. The plenum chamber can be removed with the piston rod packing case still attached, by loosening the bolts that hold the plenum to the crosshead cylinder, and sliding the plenum chamber up the rods.

To remove the gas packing case, remove the four screws per case, and push the case out the bottom of the plenum. The case is sealed to the plenum with an O-ring, and may resist removal. If this is the case, jacking screw ports are provided in the bottom case flange. Use the bolts that were removed from this flange, to jack it out of the plenum case.

CROSSHEAD GUIDE CYLINDER

7. Remove the oil packing box gland (cover) from the oil packing box. Remove the oil packings. Remove the oil packing box from the crosshead guide cylinder. Discard old O-rings.

8. Remove the crosshead guide cylinder cap screws. Rotate the flywheel so that one crosshead piston is up and one is down. Lift the crosshead guide cylinder from the crankcase. Do NOT allow the crosshead pistons to fall against the side of the crankcase as this will damage them.

CROSSHEAD PISTONS & CONNECTING RODS

9. Remove the crankcase inspection cover(s).

10. Remove the locknuts from the connecting rod bolts. It is best to only loosen the locknuts a few turns on both sides evenly, and to then loosen the connecting rod cap by blocking the guide piston on top of the crankcase and rotating the flywheel to cause the crankshaft to push against the connecting rod cap. This procedure will keep the connecting rod cap from jamming on the connecting rod bolts and being damaged.

11. Carefully lift the crosshead piston and connecting rod assembly out of the crankcase. Keep the connecting rod cap with the connecting rod/crosshead assembly. Each cap and connecting rod is marked with a dot or number on one side so they can be properly

realigned during assembly. The connecting rod parts are not interchangeable and must be reassembled with the same mating parts. Work on only one connecting rod at a time to avoid confusion.

12. Remove both snap rings from the guide piston.

13. Heat crosshead piston evenly with a torch until there is clearance between the crosshead piston and wrist pin. Wrist pin should slide easily out of piston. Heat evenly to avoid overheating and warpage. Do not attempt to press out the wrist-pin.

14. Repeat this procedure for the second assembly.

'A' - 'E' and 'V' Blocks: If necessary, the piston rod can be removed from the crosshead piston by heating the piston rod just above the crosshead piston, while the piston rod is clamped with tool Cat ID 19284. When the piston rod reaches a temperature of just under 400° F, the lower piston rod bolt can be safely removed. Wear leather gloves or similar heat resistant protection. See previous step 6 for further information.

15. Bronze wrist pin bushings can be pressed out of the connecting rod and new ones pressed in and honed before use. Roller bearings can be removed by heating the connecting rod end until the bearings slide out.

16. If the crankshaft bearings, crankshaft or oil pump must be replaced, refer to the next section titled "Oil Pump Replacement", or the following "Bearing Replacement".

OIL PUMP REPLACEMENT

1. Follow steps 1-12 of the "Compressor Disassembly" section.

2. Remove oil pressure gauge and hydraulic unloader.

'B' - 'E' and 'V' Blocks:

- a. Remove the hex head cap screws fastening the oil pump cover to the bearing carrier. Remove the oil pump cover.
- b. Check the rotor to cover clearance. There should be 0.001 - 0.003 inches of clearance. Replace rotor/shaft/gear assembly or oil pump cover if necessary.
- c. Remove the hex head cap screws fastening the bearing carrier to the crankcase. Remove the bearing carrier from the crankcase.
- d. Remove the O-ring from the oil pump shaft and slide the shaft/gear assembly through the bearing carrier bushing. Install new shaft/gear

assembly in bearing carrier and replace O-ring. Replace outer rotor in oil pump cover. Place a few drops of oil or grease in the oil pump cover to lubricate at start-up.

Be careful to align valve spring vertically over the center of the valve discs. If not aligned properly, the valve spring will damage the oil pump housing upon final torque of Allen screws. Torque Allen screws.

- e. With the oil pump drive shaft assembly in the bearing carrier, set the oil pump shaft so that the slot in the shaft aligns with the drive pin in the crankshaft when the bearing carrier is mounted to the crankshaft. Replace the bearing carrier gasket, and mount the carrier to the crankcase and install bolts by hand. Rotate the oil pump drive shaft by hand until it is aligned with the drive pin on the crankshaft and the bearing carrier draws flush to the crankcase. Torque bolts to proper specification.
 - f. Set the new oil pump cover O-ring into the recess of the carrier, and set the oil pump cover into the recess. Be sure the cover is rotated so the rotational direction arrow is pointing in the same direction as the flywheel rotation. See the "Oil Pump Direction of Rotation" section in the Operation portion of this manual for more information. Hand-tighten the six oil pump cover bolts. If the oil pump cover can not be drawn flush with the bearing carrier, the rotor/gear or housing/bearing carrier are misaligned. DO NOT tighten with a wrench. Remove and inspect.
 - g. Torque all bolts to proper specification.
- 'F' Block:
- a. Remove the hex head cap screws fastening the oil pump to the carrier. Carefully remove the oil pump.
 - b. Remove the two Allen head cap screws holding the thrust plate to the oil pump housing. Because of the spring force behind the plate, hold the thrust plate against the oil pump housing, either with a C-clamp device, or another set of hands. The oil pressure valve and gerotor assembly should now be accessible.
 - c. To increase the oil pressure, add more valve discs Cat ID 17506. To decrease oil pressure, remove valve discs. There must be at least one valve disc. Each additional valve disc (Cat ID 17506) increases oil pressure approximately 2.5 psig.
 - d. Check rotor to housing clearance. There should be .001 - .003 inches of clearance. Replace rotor/shaft/gear assembly or housing if necessary.
 - e. Replace thrust plate onto oil pump housing.

- f. Replace oil pump shaft O-ring and oil pump housing O-ring.
- g. Set the oil pump shaft so that the slot in the shaft aligns with the drive pin in the crankshaft when the oil pump is mounted to the bearing carrier. Mount the oil pump to the carrier (aligned with dowel pins) and install bolts. Torque to appropriate level.

ALL BLOCKS:

3. Wrap all pressure fittings with fresh Teflon tape before reattaching.

4. Replace pressure gauge and loadless start unloader (also constant speed unloader if furnished with your machine).

'B' - 'E' and 'V' Blocks: Adjust oil pressure regulating screw all the way in, and back out 1.5 turns.

5. Pressurize unloader assembly so the machine will start without load.

6. Start the compressor paying close attention to oil pressure. If pressure doesn't rise to 20 PSIG for 'B' - 'E' and 'V' Blocks or 40-50 PSIG for 'F' Blocks, within thirty (30) seconds, shut the unit down and inspect for leaks.

7. Check oil pressure when machine is hot to be assured the pressure range is between 20 - 25 PSIG for 'B' - 'E' and 'V' Blocks, or 45-50 PSIG for 'F' Blocks. Adjust oil pressure as needed to obtain proper operation.

BEARING REPLACEMENT

NOTICE: When replacing the bearings, the entire bearing assembly including the cup and cone, must be replaced, as well as the oil seal if applicable.

1. Follow steps 1-12 of the "Compressor Disassembly" section.

2. Remove the flywheel and drive key from the crankshaft.

3. Remove the oil pump and/or bearing carrier per the "Oil Pump Replacement" section.

4. Remove the bearing cup from the bearing carrier using a bearing puller.

5. Slide the crankshaft through the oil-pump end of the crankcase. The bearing cones can be removed from the crankshaft with a bearing puller.

6. Remove the bearing cover plate from the flywheel end of the crankcase. The bearing cup is pressed into the crankcase and must be removed with a bearing puller. Remove all shims from the bearing cover plate and crankcase.

7. Grease the outer edges of the new bearing cups. Press the flywheel end bearing cup into the crankcase with the large end of the taper away from you (towards oil pump). Press until the cup is flush with the outside of the crankcase. Press the oil pump end bearing cup into the bearing carrier with the larger end of the taper away from the bearing carrier (toward you) until it stops.

8. Press the proper bearing cone onto each end of the crankshaft with the larger end of the taper towards the center of the crankshaft. The bearing races should rest against the crankshaft shoulder. Lubricate the bearing cones thoroughly with clean, high quality grease.

9. Install the crankshaft through the oil pump end of the crankcase.

10. Install the bearing carrier onto the crankcase with a new bearing carrier gasket. Tighten bolts to specified torque.

11. If the bearings have not been replaced, reinstall the flywheel end bearing plate and the same shims. If new bearings have been installed, use a thicker set of shims. Torque the bearing cover plate bolts to proper tightness.

12. Rotate the crankshaft by hand to be sure it is free to spin. Verify the proper amount of end-play of the crankshaft per Tables 9, 10 and 11. If necessary, remove shims until end play is within tolerance.

13. If the crankshaft binds, or there is no end-play, remove the bearing carrier, crankshaft and bearing plate, and drive the flywheel end bearing cone slightly farther out of the crankcase. Re-install the bearing carrier and crankshaft, and put thicker shims in front of the bearing plate. Replace the bearing plate and torque to proper tightness. Repeat step 12-13 until bearing play is within tolerance.

14. Reinstall the oil pump or oil pump cover per "Oil Pump Replacement".

COMPRESSOR ASSEMBLY

This is only a general outline of how to assemble a Hycomp compressor. Certain specifics may apply to your compressor that are not listed here. Contact an authorized distributor or the factory for assistance on assembling your compressor.

Compressor assembly is generally the opposite of compressor disassembly. Before assembling, clean all parts thoroughly and check surfaces for burrs, nicks, dings or excessive wear patterns. Replace all O-rings and gaskets that were removed during disassembly.

'A' - 'E' and 'V' Blocks: If the crosshead piston and piston rod have been disassembled, it will be necessary to reassemble them first.

Clamp the piston rod into tool Cat ID 19284 and clamp this tool to a work surface. Apply 4 drops of Loctite (Item #266) to end of bolt thread. Do not touch threads with your hands as this will contaminate the Loctite. Attach guide piston to piston rod. Torque bolt to proper specification.

CONNECTING ROD & CROSSHEAD PISTON

NOTICE: When replacing one crosshead piston or connecting rod, the new part and remaining part must both have the same part number. Differences may lead to unbalanced conditions and excessive vibration.

1. To replace wrist pin bushings in connecting rod, press the new bushing into the connecting rod and hone to proper diameter. To replace wrist pin bearings, heat connecting rod until the bearings slide easily into hole. The side of the bearing with the part number stamped on it should face out. The bearings should go in until they are just flush with the outside of the connecting rod. Do not put bearings in too far as they will block flow from the oil passage through the center of the connecting rod. Liberally grease bearings or bushing with an appropriate assembly grease.

2. Replace one snap ring into crosshead piston. Heat the crosshead piston until the wrist pin slides easily into piston. Slide the connecting rod into bottom of crosshead piston until bearing/bushing is aligned with wrist pin. Allow wrist pin to slide through connecting rod and into other end of the crosshead piston. Put the second snap ring in place. Allow the assembly to cool. Repeat with second assembly.

3. After connecting rod and crosshead assembly have cooled, place the split bearing halves into the connecting rod halves, aligning the bearing tang with the grooves in the connecting rod. Liberally coat the bearing faces with grease.

4. Set the top of the connecting rod/crosshead assembly over the crankshaft journal. Replace the proper connecting rod cap, aligning the dots or numbers on the connecting rod and cap so they are both on the same side. Start the nuts onto the connecting rod bolts and torque to proper tightness. Repeat with second assembly. Do not allow crosshead piston to fall against crankcase as this may damage the piston.

'F' Blocks: Reinstall piston rods into crosshead piston. Screw jam nut all the way up the lower thread of the piston rod. Screw piston rod all the way into crosshead piston and back out 3 full turns. The crosshead piston has locking threads, so expect some resistance. Do not tighten jam nut yet.

CROSSHEAD GUIDE

5. Replace the crosshead to crankcase gasket with a new one.

6. Coat the inside of the crosshead guide cylinder with oil. Lightly grease the outside of the crosshead pistons.

7. Set the crosshead guide cylinder over the crosshead pistons and slowly lower onto crankcase. Make certain the crosshead guide pistons are started straight into the bores of the crosshead guide cylinder to prevent damage. Set crosshead guide cylinder onto crankcase and hand tighten bolts.

8. Replace the oil packing box and new O-rings and hand tighten bolts. Do not fully tighten bolts yet. Slide the oil packings down the piston rod, being certain not to damage the packing face or inner diameter. Replace oil packing box gland and hand tighten bolts.

9. Fill the crankcase with the proper amount of oil. Squirt oil onto the crankshaft bearings and connecting rod bearings.

10. Re-install crankcase inspection plate with new gaskets, and tighten to proper torque.

11. Rotate the crankshaft a few times and then tighten crosshead guide cylinder cap screws to proper torque. Rotate crankshaft again to insure smooth movement.

'A'-'E' Blocks: Tighten the oil packing box bolts and gland bolts to proper torque.

'F' Blocks: Do not tighten oil packing box bolts.

PLENUM CHAMBER & GAS PACKING CASE

Air and gas boosters require the plenum chamber installed on top of the crosshead guide.

Pre-assemble the gas packing case(s), ensuring correct orientation of the gas packings (see diagram that comes with new gas packings). Install a new O-ring on the gas packing case, using a minimum of compatible O-ring lubricant. Insert the case(s) into the plenum chamber and tighten bolts to specified torque.

Rotate the crankshaft so one piston rod is at top dead center (the other will be at bottom dead center). Install tool Cat ID 19286 (packing install tool) onto the top of the highest rod. Orient the plenum chamber so the dowel pins align, and carefully lower the plenum down the piston rods. Once the first set of gas packings is past the top of the rod, remove the install tool (Cat ID 19286) and place on the other rod. Finish lowering the plenum down to the crosshead cylinder. Tighten bolts to specified torque.

COMPRESSION CYLINDER AND PISTONS

12. Install compression cylinder over piston rods. Lower onto crosshead guide cylinder, insuring proper alignment with dowel pins. Torque cap screws to proper tightness.

'A' - 'E' and 'V' Blocks:

- a. Install pistons into cylinder and tighten piston bolt or nut to 20 ft-lbs.
- b. Measure piston to head (top of head gasket) clearance at four points on each piston. Determine necessary head clearance.
- c. Remove pistons and place sufficient .010 inch thick shims (Cat ID 17095) on top of the piston rod to reduce minimum clearance to proper amount.
- d. Place expander rings onto piston with gaps 180° apart from each other. Place compression rings over expander rings, with gaps 180° from expander ring gap. No compression ring gaps should be aligned. Install rider ring onto pistons. Install piston into cylinder.
- e. Place 4 drops of Loctite (Item # 266) near end of thread of each of the two bolts. Being careful not to contaminate Loctite, screw both bolts into rods and tighten to specified torque. Use piston rod tool P/N SA003 to keep piston rod from spinning and loosening lower bolt.
- f. Recheck piston to head clearance.

'F' Blocks:

- a. Remove bolts holding oil packing box to crosshead cylinder. Slide oil packing box up

the piston rods until the crosshead piston is accessible.

- b. Install pistons in cylinder onto piston rod, and tighten piston nut to specified torque while holding the piston rod with the P/N SA003 tool.
- c. Measure piston to head (top of head gasket) clearance at 4 points on each cylinder. Determine proper clearance.
- d. Adjust clearance by screwing piston rod into or out of crosshead piston. Tighten lower piston rod jam nut to full torque when piston clearance is properly adjusted.
- e. Double check cylinder head (top of head gasket) to piston clearance. It may change when tightening the jam nut. Readjust as necessary, following steps c. and d.
- f. Slide oil packing box down onto crosshead guide cylinder and hand tighten bolts. Torque bolts to proper tightness.

CYLINDER HEAD

If the valve assemblies must be removed from the cylinder head, refer to the "Valve Replacement" section.

13. Place a new head gasket on the compression cylinder and intercooler. Use compatible gasket sealant if acceptable. Lower cylinder head down onto compression cylinder.

14. Center bolts that pass through air passages on 'B' - 'E' and 'V' blocks must have a copper bolt gasket installed into the bolts.

15. Install center and outer head bolts as well as intercooler bolts. Tighten head bolts to snug, starting with center bolts, and working outward. When done, retighten to one-half final torque, and then to full torque. Tighten intercooler bolts to final torque.

16. Rotate the compressor by hand to be certain it turns freely and the pistons are not hitting the cylinder head.

17. Follow all procedures listed in the "Compressor Start-up" section.

18. After 1-2 hours of normal operating temperatures, stop the compressor, lock it out from electrical sources, and retighten the valve hold down screws and cylinder head bolts to proper tightness.

VALVE REPLACEMENT

NOTICE: Suction and discharge valves must be installed in the correct cylinder head locations. To avoid confusion, work only on the inlet or the discharge valves at one time, or tag the valves and valve pockets with a note to indicate suction or discharge.

NOTICE: It is critical that the valve hold-down screws be backed out when changing a valve, as the valve cover plate may crack if the new valve is slightly taller than the previous valve and the valve cover plate is torqued to final tightness.

ALL MODELS EXCEPT: 2WN150L, 2WN150H

1. Remove unloader piping from unloader towers and unloader controls.
2. Unloaded suction valves:
 - a. Remove the unloader assembly. Remove and discard unloader gaskets. Remove hold-down screw with appropriate spanner wrench.
 - b. Remove valve cover. Discard valve cover gasket.
 - c. Remove the valve clamp and unloader tube, the unloader platform, and additional valve clamp on certain models. Remove valve assembly and discard valve seat gasket.
 - d. Disassemble the valve and inspect the valve seat, plate, spring, guide and unloader fingers/springs for wear. Repair or replace as necessary. Valve seats can be lapped to remove minor damage. Valve plates should be replaced if damaged. Turning over a damaged valve plate will lead to premature failure of the plate and possible damage downstream from debris. Valve and unloader springs and valve guides should be replaced if in doubt.
 - e. Reassemble the valve in the reverse order it was disassembled. Check for free movement of the valve plate.
 - f. Reinstall a new valve seat gasket into the valve pocket. Install valve assembly, verifying correct valve orientation. The inlet valve plate should move down when pushed from above with a probe.
 - g. Install lower clamp (on certain valve models), unloader fingers, springs & platform. Install valve clamp.

3. Discharge valves and non-unloaded suction valves:

- a. Remove the valve hold-down screw nut (Cat ID 17675 or 17676). Remove the valve hold-down screw with an Allen wrench.
- b. Remove the valve cover and discard valve cover gasket.
- c. Remove the clamp and/or spacer, valve assembly and valve gasket.
- d. Disassemble the valve and inspect the valve seat, plate, spring and/or, guide. Repair or replace as necessary. Valve seats can be lapped to remove minor damage. Valve plates should be replaced if damaged. Turning over a damaged valve plate will lead to premature failure of the plate and possible damage downstream from debris. Valve springs and guides should be replaced if in doubt.
- e. Reassemble the valve in the reverse order it was disassembled. Check for free movement of the valve plate. Tighten valve stud to specified torque.
- f. Reinstall a new valve seat gasket into the valve pocket. Install valve assembly, verifying correct valve orientation. Inlet valves placed upside down act as discharge valves, and vice-versa. The inlet valve plate should move down when pushed from above with a probe. The discharge valve plate should NOT move when pushed from above with a probe.
- g. Install valve clamp and/or spacer.

4. Lightly lap top of valve cover at seating surface for unloader tower assembly or valve hold-down screw nut. Lap mating faces of unloader towers and valve hold-down nut. While the unloader towers use a gasket to seal and do not need fine lapping, the hold-down screw nut, Cat ID 17675, is a metal to metal contact and should be well lapped to insure positive seal. The hold-down screw nut Cat ID 17676 utilizes an O-ring - replace it.

5. Install valve cover with new valve cover gasket. Use compatible gasket sealant if acceptable. Torque cap screws to proper tightness.

6. Install and torque the hold-down screw to proper tightness.

7. Install the valve hold-down screw nut or unloader tower and gasket. Torque to final tightness.

8. Rotate the flywheel by hand to insure there is no interference between the valves and pistons. Also listen for air moving across the valves.

9. Reinstall unloader tubing.

MODELS 2WN150L, 2WN150H

1. Remove unloader piping from unloader towers and unloader controls..

2. Suction valves:

- a. Remove the unloader assembly. Remove and discard unloader gaskets.
- b. Remove valve cover. Discard valve cover O-ring.
- c. Remove the unloader tube and valve assembly and discard valve seat gasket.
- d. Disassemble the valve and inspect the valve seat, plate, spring, guide and unloader finger/spring for wear. Repair or replace as necessary. Valve seats can be lapped to clean up minor damage. Valve plates should be replaced if damaged. Turning over a damaged valve plate will lead to premature failure of the plate and possible damage downstream from debris. Valve and unloader spring and valve guide should be replaced if in doubt.
- e. Reassemble the valve in the reverse order it was disassembled. Check for free movement of the valve plate. Tighten valve nut to specified torque.
- f. Reinstall a new valve seat gasket into the valve pocket. Install valve assembly, verifying correct valve orientation. The inlet valve plate should move down when pushed from above with a probe.

3. Discharge valves:

- a. Remove the valve cover and discard valve cover O-ring. Remove the valve assembly.
- b. Disassemble the valve and inspect the valve seat, plate, and spring. Repair or replace as necessary. Valve seats can be lapped to clean up minor damage. Valve plates should be replaced if damaged. Turning over a damaged valve plate will lead to premature failure of the plate and possible damage downstream from debris. Valve springs should be replaced if in doubt.

- c. Reassemble the valve in the reverse order it was disassembled. Check for free movement of the valve plate. Tighten valve nut to specified torque.
 - d. Reinstall a new valve seat gasket into the valve pocket. Install valve assembly, verifying correct valve orientation. The discharge valve plate should NOT move when pushed from above with a probe.
4. Install valve cover with new valve cover O-ring. Torque cap screws to proper tightness.
5. Install the unloader tower and gasket on suction valve covers. Torque to final tightness.
6. Rotate the flywheel by hand to insure there is no interference between the valves and pistons. Also listen for air moving across the valves.
7. Reinstall unloader tubing.

APPENDIX 1

TOOL LIST

Hycomp compressor assemblies utilize “English Customary Measurements” for sizing tools and specifying torque values, tolerances, and clearances.

Common tools and sizes suitable for Hycomp compressor service include:

- o Open end box wrench set 3/8” to 1-1/4”
- o 12 point 1/2” drive socket set & ratchet 1/2” to 1-1/4”
- o 6 point 1/4” drive socket set & ratchet 3/8” to 3/4”
- o 1/4”, 3/8”, 1/2” socket drive extensions
- o 1/2” drive torque wrench 20-150 ft-lb
- o 3/8” drive torque wrench 5-80 ft-lb
- o 6”, 8”, 12”, 14” adjustable end wrench
- o Flat head screwdriver assortment
- o Phillips head screwdriver assortment
- o Hex head wrench (Allen) assortment 5/32” to 3/8” (socket drive also suggested)
- o Internal snap ring pliers
- o Ball peen hammer
- o Soft head mallet
- o 6” or 8” Precision caliper (.0001 accuracy)
- o Precision depth gauge dial indicator (.001 accuracy)
- o V-belt gauge
- o Gasket scraper tool
- o 6” Rule
- o Flashlight
- o Brass drift
- o Propane torch
- o Multimeter (w/temperature probe desirable)
- o Ammeter
- o Abrasive pad (ScotchBrite or similar)
- o Oil free silicone o-ring lubricant
- o Teflon pipe thread tape and Loctite 545 thread sealant
- o High temperature silicone gasket sealer
- o Thread locking compound (Loctite 242,246,and 266)
- o Pipe wrench and or monkey wrench
- o Pliers & diagonal cutter
- o O-ring pick
- o Lockout / Tagout set for secure power isolation
- o “Short” 3/8” hex head (Allen) wrench - Required on some air cooled cylinders to remove base fasteners.

See specific compressor parts manual for required Hycomp special tools.

APPENDIX 2

COMPRESSOR STORAGE

If a compressor is not to be put into service or is to be taken out of service for an extended length of time, the following procedures should be taken to prevent corrosion and deterioration.

1. Fill the crankcase with rust inhibiting oil. Squirt oil on the piston rods and crosshead pistons.
2. Loosen V-belts to relieve tension on the bearings.
3. Remove valves and place a bag of dust free desiccant inside of each valve pocket. Store valves in a sealed plastic bag with desiccant in each bag. Plug all openings to compressor. Place several bags of desiccant into crosshead area.

NOTICE: Tag the unit with a warning that the compressor is partially disassembled. Copy the tag printed on this page.

4. Store the unit under plastic, off the ground. The box/pallet the unit came in is excellent storage container. Store the unit indoors.
5. When the compressor is to be put into service, change the crankcase oil, remove any desiccant and re-install valves. See the "Pre-Start-up Checklist" and "Start-up Procedure" sections in this manual.

NOTICE: COMPRESSOR IS PARTIALLY DISASSEMBLED AND MAY CONTAIN DESICCANT. CAREFULLY INSPECT VALVE POCKETS AND CROSSHEAD AND REMOVE ANY DESICCANT FOUND BEFORE RUNNING COMPRESSOR. REINSTALL REMOVED VALVES.

APPENDIX 3

CLOSED-LOOP WATER COOLING SYSTEM MAINTENANCE

The water cooling loop should be maintained in order to keep adequate cooling to the compressor system to maintain the life of the compressor components. It is recommended that a 70% Water / 30% Ethylene Glycol mix be used in your cooling loop for maximum heat load rejection. Follow the draining and refilling instructions every 6 months or as needed.

NOTICE: Follow Safety Procedures when draining or filling the cooling loop. Use PPE and follow proper lock out/tag out procedures / company protocol of all energy and pressure sources to avoid injury.

DRAINING THE COOLING LOOP SYSTEM

1. Shut down the compressor and allow to cool to avoid getting burned by the hot plumbing.
2. Place collection buckets under each of the drain ports and unscrew drain plugs. (See Figure 22)
3. Open the fill port to allow air into the system, this will allow the system to drain faster. (See Figure 23)
4. Discard of old cooling fluid in a safe manner.

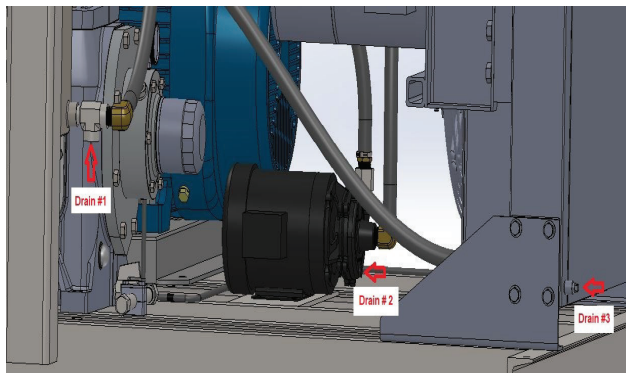


Figure 22: Drain Locations

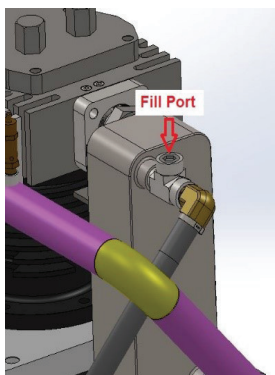


Figure 23: Fill Port Location

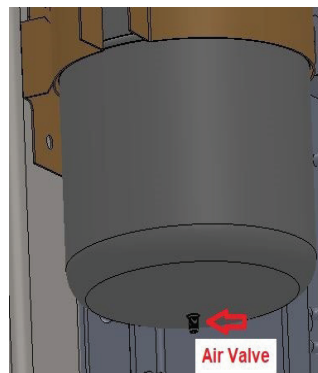


Figure 24: Schrader Valve Location

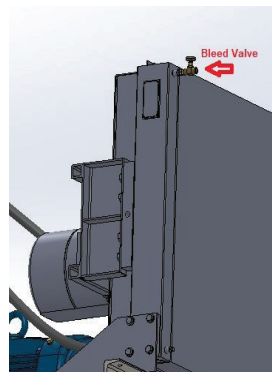


Figure 25: Bleed Valve Location

FILLING THE COOLING LOOP SYSTEM

1. Make sure all of the drain plugs are installed and snug tight. (See Figure 22)
2. Check the pressure on the expansion tank, should be set to 12 psi. Use a pump to adjust as needed. (See Figure 24)
3. Open the fill port and fill with water glycol mix. (See Figure 23)
4. Open the bleed valve while initially filling the system until coolant comes out of the valve to evacuate the air, and then shut the bleed valve and continue to fill. (See Figure 25)
5. Continue filling until glycol mix comes out of the fill port, then plug port.
6. Cycle the water pump ON for 1 minute to allow the cooling mix to fill the water cooling loop.
7. Open the bleed valve to allow air to evacuate the cooling loop system. (See Figure 25)

8. Repeat Steps 5 through 7 until the air is out of the system and the system is full of coolant.

NOTICE: The expansion tank will handle the expansion of the water when it gets hot, it is critical to maintain the air pressure in the expansion tank and check to make sure the diaphragm is still in good condition. If water comes out the air valve when depressed, replace the expansion tank. Also check the condition of all hoses and replace as needed.

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