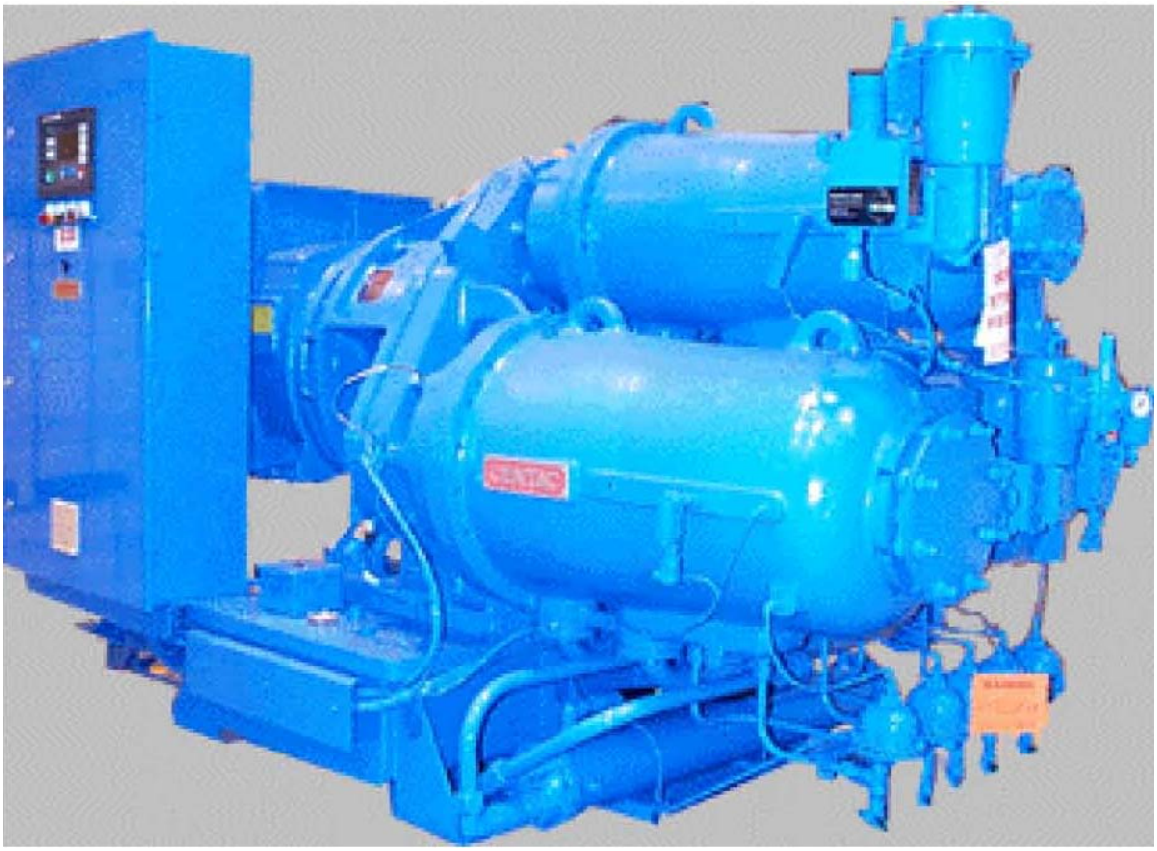
CENTAC®

C700 Instruction Manual



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The effects of corrosion, erosion and normal wear and tear are specifically excluded. Performance warranties are limited to those specifically stated within the Seller's proposal. Unless responsibility for meeting such performance warranties are limited to specified tests, the Seller's obligation shall be to correct in the manner and for the period of time provided above.

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* It is understood that when Techtrol Gold III is purchased, the warranty period for the compressor airend bearings, seals, rotors, and bullgear only, less motor, cooler, and accessories, shall be considered revised to read “twenty-four months from the date of start up, or thirty months from the date of shipment, whichever first occurs”.

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Date of Issue: 12 November, 2005

NOTICE

On receiving the Centac compressor, be sure to inspect the unit for evidence of damage during shipment. Immediately notify the carrier and the nearest Ingersoll-Rand representative if any damage is noted.

The compressor should be stored on a level floor or supports, in a dry protected area. Based on these conditions, the Centac compressor has been prepared for 180 days of storage. If the unit is to be stored for periods longer then 180 days, it will require additional protection.

Please contact the nearest Ingersoll-Rand Representative prior to shipment for instruction on extended storage and advise them of the proposed period of storage.

WARNING

 Not to be used for breathing air application. Ingersoll-Rand company air compressors are not designed, intended or approved for breathing air applications. Ingersoll-Rand does not approve specialized equipment for breathing air applications and assumes no responsibility or liability for compressors used for breathing air service.

Date of Issue: 18 June, 2005

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Section 1 – Planning & Installation

INTRODUCTION:

The purpose of this manual is to provide a planning tool for new owners of Centac compressors to use before their compressor is delivered. This manual contains valuable information on installation procedures and checkout of equipment before start-up. In addition to this manual, you should have the following:

- General Arrangement Drawing
- Electrical Schematic
- Process & Instrumentation Diagram
- Motor Outline & Data Sheet

A properly installed Centac C700 air compressor, operated in accordance with the manufacturer's instructions will reward its owner with many years of dependable compressed air service.

NOTE
Where found in this manual, the word **must** means that the specification must be met to validate the warranty. The word **should** means that it is a desirable condition, but not mandatory for the operation of the compressor and failure to meet this specification does not necessarily affect the warranty. Deviation from these recommendations may severely limit efficient operation or interfere with the service technician's ability to perform maintenance on the machine.

Safety

This manual contains instructions for planning of the installation, operation and maintenance of your Ingersoll-Rand centrifugal air compressor that has been designed to provide safe and reliable service. However, it is both a pressure system and a rotating machine, therefore, the operator(s) must exercise good judgment and proper safety practices to prevent personal injury and avoid damage to the equipment and surroundings. The instructions in this manual are intended for personnel with a general training in operation and maintenance of centrifugal air compressors.

Safety Program

It is assumed that your safety department has established a safety program based on a thorough analysis of industrial hazards. Before installing, operating or performing maintenance on the compressor and associated components described in this manual, review the safety program to ensure that it covers the hazards that come with high speed rotating machinery.

It is also important to consider the hazards associated with electrical power, hot oil, high pressure and temperature liquids, toxic liquids and gases, and flammable liquids and gases. Proper installation and care of protective guards, shutdown devices, and over pressure protection equipment are also essential parts of any safety program.

Special precautionary measures include:

- Eliminate the possibility of power going to the equipment at any time when maintenance work is in progress.
- Prevent rotation due to reverse flow.
- Ensure that the block valve is closed and tagged during maintenance.

In general, all personnel should be guided by the basic rules of safety associated with the equipment and the process.

Safety Procedures

Throughout this manual, you will encounter boxes with the words WARNING, CAUTION, and NOTE. These are intended to emphasize certain areas where precaution is needed. This is in the interest of personal safety and satisfactory compressor operation and maintenance. The definitions of these words are as follows:

WARNING
 An operating procedure, practice, etc. that, if not correctly followed, could result in severe personal injury, or loss of life.

CAUTION
 An operating procedure, practice, etc. that, if not strictly observed, could result in damage to, or destruction of equipment.

NOTE
An operating procedure, condition, etc. that is essential to highlight.

The information in this manual does not relieve operating and maintenance personnel of the responsibility of exercising normal good judgment in operation and care of the compressor and its components. We suggest that all personnel follow the safety precautions associated with this type of equipment.

In addition to the many obvious safety rules, follow the safety procedures listed below when personnel are operating or maintaining Centac compressors:

1. DO NOT USE THE DISCHARGE AIR FOR BREATHING. IT COULD CAUSE SEVERE INJURY OR DEATH. Consult a filtration specialist for additional filtration and treatment equipment to meet health and safety standards.
2. Pull the main disconnect switch and disconnect any separate power lines before attempting to work or perform maintenance on the unit.
3. Do not attempt to remove any compressor parts without first relieving the entire system of pressure.
4. Do not attempt to service any part while the machine is operating.
5. Do not operate the compressor at pressures in excess of its rating as indicated on the compressor nameplate.
6. Do not operate the compressor at speeds in excess of its rating (or less than its rating) as indicated on the driver nameplate.
7. Do not remove any guards, shields, or screens while the compressor is operating.
8. Periodically check all safety devices for proper operation.
9. Be cautious when using compressed air. Pressurized air can cause serious injury to personnel.
10. Be sure no tools, rags, or loose parts are left on the compressor or drive parts.
11. Do not use flammable solvents for cleaning parts.
12. Exercise cleanliness during maintenance and when making repairs. Keep dirt away from parts by covering parts and exposed openings with clean cloth or kraft paper.
13. Do not operate the compressor without guards, shields, and screens in place.
14. Do not operate compressor in areas where there is a possibility of ingesting flammable or toxic fumes.
15. Shut down the compressor before removing any caps or plugs. Oil or air under pressure can cause severe personal injury, or death.

NOTE
The owner, leaseholder, or operator of the compressor is hereby notified and forewarned that any failure to observe common safety precautions, whether stated herein, or not, may result in damage or injury. Ingersoll-Rand Company expressly disclaims responsibility or liability for any injury or damage caused by failure to observe those specified, or other common precautions or by failure to exercise that ordinary caution, common sense, and due care required in operating or handling the compressor even though not expressly specified above.

Receiving/Handling/Storage

Receiving

Centac compressors are shipped in first class condition. They have been inspected prior to leaving the factory. Loading of the compressor has been supervised by Ingersoll-Rand personnel to ensure that the unit has not been damaged during loading and that all accessory equipment has been properly documented.

Inspect the compressor for shipping damage before removing the compressor from carrier's vehicle. If damage or indication of rough handling is evident, file a claim with the carrier at once, and notify your Ingersoll-Rand representative.

Remove only the shipping notice. Do not remove tags pertaining to lubrication, operation, and storage. Read all tags and instructions.

Document receipt of all items included with the compressor, but packed separately. Make a list of any items that were not received and notify your Ingersoll-Rand representative. Store all items either with the compressor or in an appropriate secured area.

Handling/Lifting

An experienced rigger should move and install the compressor. Adequate rigging and lifting equipment must be provided to safely handle the unit. Use spreader bars to prevent damage to piping, tubing, gauges, and other accessory equipment. Provisions for lifting the unit with a forklift are located at the corners of the baseplate (s*ee Figure 1.1)*.

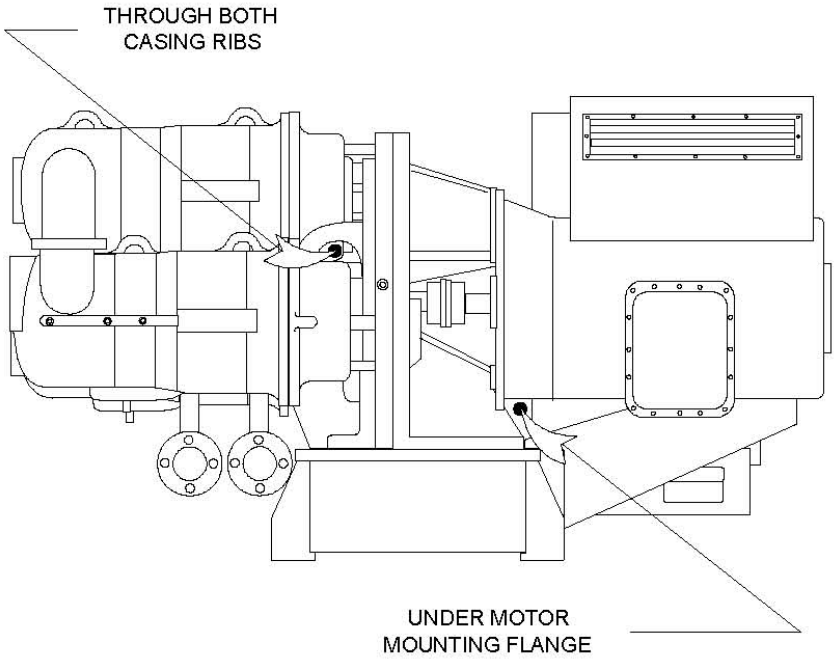


Figure 1.1 Lifting Diagram for Standard Unit

Installation of a Centac compressor can best be done by the use of an overhead crane. The ringing must go through both casing ribs and under the motor mounting flanges as shown in Figure 1. An overhead rail with a chain hoist will also simplify the removal of the largest component parts when maintenance is required.

WARNING

Do not lift the unit by the lifting eyes on the compressor or driver. These eyes are for lifting the individual component parts only. Damage to equipment and injury to personnel could result from misuse of the lifting eyes.

Storage

The compressor, as it is shipped from the factory (flanges blanked and desiccant bags placed at inlet and discharge), can be stored on a level surface in a controlled environment for up to 180 days after the ship date tagged on the compressor unit without requiring long-term storage preparation. The unit must be started within the first 180 days following shipment from Ingersoll-Rand to assure the full 12-month operational warranty after start-up. Store all loose/spare parts in a controlled environment for adequate protection prior to usage.

At the termination of the storage period, the motor should be given continuity and insulation tests before connecting to a power line. Specific motor start-up instructions provided by the motor supplier must be followed.

If the unit is to be stored for periods longer than 180 days, or in an uncontrolled environment, the unit will require additional protection. Consult your local Ingersoll-Rand representative for long term storage requirements and extended warranty coverage.

Consider a unit in storage when:

- It has been delivered to the job site and is awaiting installation.
- It has been installed but operation is delayed pending completion of plant construction.
- There are long periods (30 days or more) between operating cycles.
- The plant (or department) is shut down.

Installation Planning

General

Proper installation is a critical component of satisfactory operation of all rotating machinery. Proper support of the machinery is required to give maximum reliability at minimum operating cost. In addition, a well-designed installation will result in lower installation and operating costs. See the General Arrangement drawing for compressor/customer connection details and lift points. Contact your local Ingersoll-Rand representative for further information.

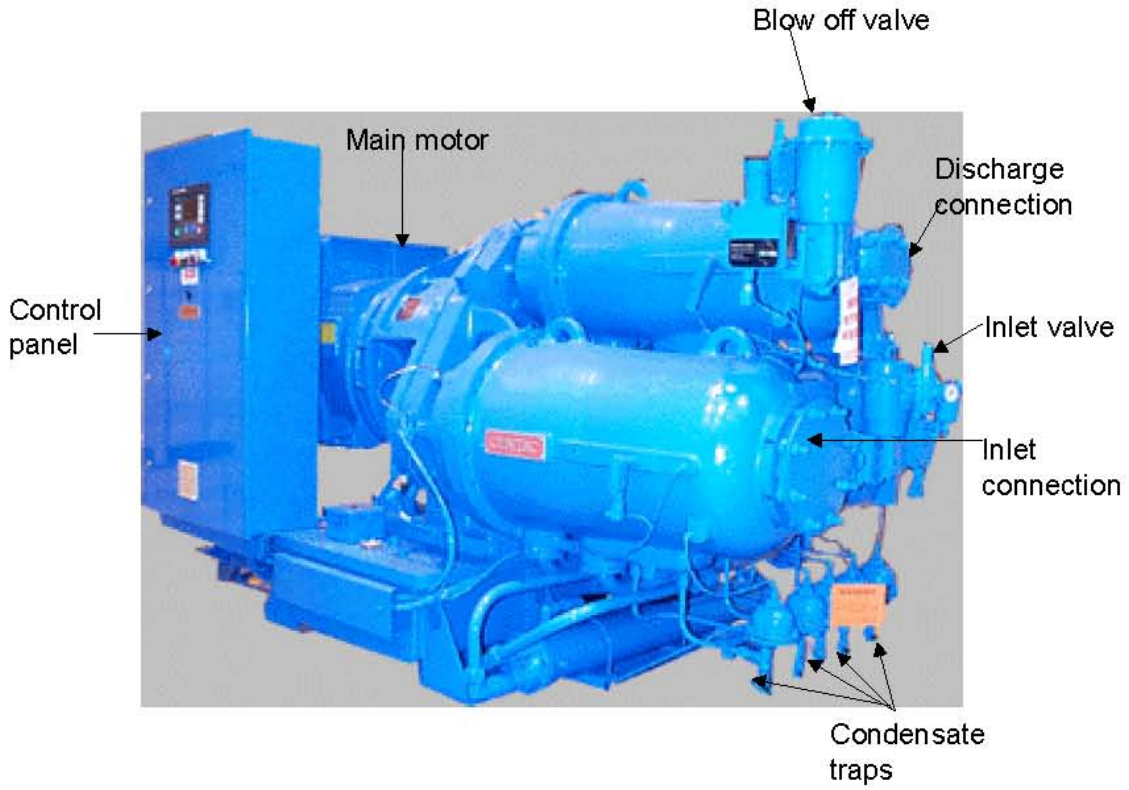


Figure 1.2

Typical C700 Compressor

Plant Layout

The location of a packaged centrifugal compressor within a plant facility is very important. The compressor should be located in an area that is accessible to operators and maintenance personnel.

Machinery should be installed where it is easily accessible for observation and maintenance. Operation and maintenance personnel will generally give better attention to a compressor located in a well planned, accessible area. Compressors installed in elevated locations or in pits should have stairways, catwalks, etc. for easy access to the machinery.

During installation, machinery can best be handled with overhead crane facilities. Adequate space should be provided to permit easy handling of the unit during installation (see the General Arrangement drawing for compressor maintenance space). Provide floor space in the vicinity of machinery where parts may be placed during periodic inspection of the rotating elements and internal parts. Make provisions for clearance requirements specified on the General Arrangement drawing.

Indoor/Outdoor Installation

The unit may be installed indoors or outdoors. For an outdoor installation, protective measures are necessary for the motor, control panel, and other items. It is important when the compressor package is purchased that Ingersoll-Rand is made aware of plans and makes any necessary recommendations for outdoor installation.

If the unit is an indoor installation, a heated building is preferred. Provide adequate space for ease of handling during installation.

Ventilation

Ventilation around the unit is important. The unit should not be installed in a damp or dusty atmosphere or where corrosive vapors may enter the compressor or driver.

On motor driven units the heat radiated to air in the room will be approximately 6% of the total horsepower: 1HP=42.4 BTU/MIN – 1 KW=56.9 BTU/MIN

Noise

In areas where noise could be a problem, it is important to treat hard reflective surfaces in the area. Avoid installing the unit in an area with low hard ceilings and walls.

Foundation

The compressor foundation does not need to be massive but should be sufficient to provide support for the unit.

Since there are no out-of-balance forces (such as reciprocating or shock loads) all loads on the foundation may be considered as static loads. If the unit is to be located in an area with other machinery, it is essential that vibrations are not transmitted to the compressor. Isolation pads are recommended in these instances.

For the Centac compressor package, a simple continuous concrete pad or steel support structure is recommended for each compressor. Precautions should be taken to ensure a reasonably uniform base around the pad. Uneven settling or thermal expansion could cause machinery misalignment. Appropriate bolting must be used to keep the compressor in place. Refer to the General Arrangement drawing for location and size of anchor bolt holes.

NOTE
The design of the foundation is the responsibility of the customer. These comments are offered as an aid to assure a successful installation, but Ingersoll-Rand Company cannot assume the responsibility for the design. We recommend that the customer consult a specialist skilled in the design of machinery foundations.

Leveling

The Centac compressor should be leveled at the time of installation. To level the unit, place it over the anchor bolts with the feet resting on steel wedges or shims, if necessary (see *Figure 1.3*).

The unit may be leveled using a machinist level or transit level. When a machinist level is used, start at one end of the unit and work side to side toward the opposite end, placing the level on the machined baseplate compressor pads. The compressor should be level from 0 to 0.1 inch/foot (0 to 8 mm/M).

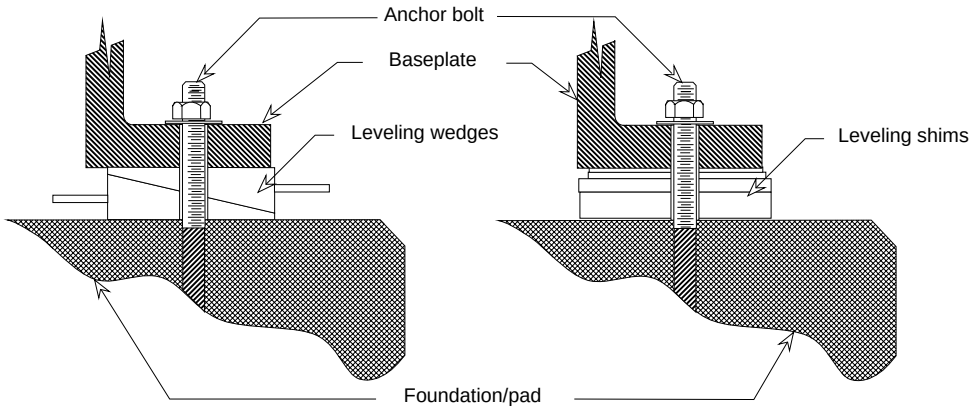


Figure 1.3.
Wedge and shim placement

Grouting

The C700 compressor does not require base grouting as long as there is full base-plate support contact with the pad and the machine is within the specification for level. However, grouting does enhance the ease of housekeeping and overall appearance of the installation. Grouting this configuration serves no structural purpose and is not necessary as long as the base is supported and level. On these machines there is little flexibility possible between the compressor and the driver. The drive and driven shafts are aligned by the flange that rigidly holds the two together. The exception to this is when the foundation pad is not level. In this instance grouting the base to a specified level plane is required.

The supporting surfaces (underside) of the C700 compressor are not considered a machined surface. The small imperfections in this surface relative to a “machined surface” are insignificant regarding the ability to support weight. Similarly the small imperfections in a “smooth” concrete surface are insignificant in terms of its ability to support the compressor weight.

Air Piping

A well-designed air piping configuration requires proper planning and execution. This section covers the following topics:

- Inlet air piping and filters
- Bypass air piping
- Expansion joints
- Discharge air piping
- Discharge air piping for multi-compressor installation
- Receivers
- Control air piping / filtration
- Instrument air piping

Centac products have no design provision for accepting the full weight of external piping connections. The discharge, inlet, bypass, water, and other piping connected to the machine must be self-supporting. Adequate piping supports are necessary to prevent excessive dead loads on the flanges of rotating machinery.

Piping alignment to the compressor mating flanges is essential. The piping must be installed and supported to avoid strains on the casing. Misalignment, which is a frequent cause of vibration, can often be traced directly to piping strains. Three sources of piping strains are:

- Dead weight of the piping itself
- Expansion or contraction of the piping as it undergoes temperature change
- Pressure within the piping

In the practical sense, if any pipe needs to be levered or pried into position to match up the flange face with the compressor, there will be excessive pipe strain. A properly matched up pipe flange will have just enough space to slip in a gasket, will allow all flange fasteners (bolts, studs, etc.) to pass through the flange bolt bores without adjustment of the mating flanges, and does not twist in any plane when the fasteners are tightened.

All piping connected to the Centac compressor should have provisions for compressor maintenance. This usually means that there are flanged sections or unions in the connecting pipe. A sufficient number of removable sections of pipe should be provided to allow ease of maintenance and repair. Failure to make provisions for repair will result in difficulty during disassembly.

Summarizing, a satisfactory piping arrangement can normally be obtained by giving proper attention to:

- Providing adequate support for all parts of the piping system.
- Allowing for expansion in a manner that will avoid piping strains on the compressor.
- Installing a sufficient number of anchors in the piping system so that direction and magnitude of expansion are controlled.
- Designing the inlet and discharge piping so as to provide smooth flow with minimum pressure drop and uniform velocity over the entire area of piping.

NOTE
The design of the piping system is the responsibility of the customer. Data and comments are offered as an aid to ensure a successful installation, but Ingersoll-Rand cannot assume responsibility for its design or installation. We recommend that the customer consult a specialist skilled in the design of piping systems to supplement and interpret the piping information and to ensure a successful installation. The inlet pipe and filter must be inspected before startup by an Ingersoll-Rand factory certified service representative.

NOTE
All air and water piping to and from the inlet and discharge port connections must take into account vibration, pulsations, temperature, maximum pressure applied, corrosion, and chemical resistance. Where compatibility questions may exist, contact your Ingersoll-Rand representative.

Inlet Air Piping

Inlet air is the lifeline of any compressor. It is imperative that the compressor receives clean filtered air to function correctly with low maintenance. A well thought out piping design will save many hours and dollars in maintenance.

Whether the inlet air piping is supplied with the compressor or by others it must be inspected for cleanliness by an Ingersoll-Rand factory certified service technician prior to start-up.

Maintenance

It is advisable that you install spool pieces that allow the casing sections to be removed and the piping to be out of the way of personnel for maintenance. The inlet pipe will be removed for inspection at start-up.

The importance of always operating the compressor with clean air inlet piping must be stressed. No compressor will accept the ingestion of foreign material into the operating components without possible damage or loss of performance.

Inlet Air Filter

An inlet air filter should be mounted by the customer at a suitable location. At minimum, it should be a high efficiency two-stage unit designed to remove 99.97% of all particles larger than 2 microns and 90% of all particles larger than 0.4 microns. For adverse environmental conditions, a more efficient inlet air filter is recommended.

The inlet filter is normally oversized to increase the time between element changes and to reduce the velocity through the filter to give a lower noise level.

Routine inspection of the filter is recommended and the addition of instrumentation to indicate pressure drop across the filter elements is also suggested. When this drop increases substantially, the elements should be cleaned or replaced.

Remote Inlet Air Filter (Panel Type)

When the filter is mounted at a remote location with the inlet air piping supplied by others, the following recommendations should be observed.

The remote inlet air filter should be, at minimum, a high efficiency unit designed to remove 99.97% of all particles at 2 microns or larger. For adverse environmental conditions it is recommended that you use a special filter, such as:

- A 0.3 micron inlet air filter
- An inertial spin filter
- A chemical type filter

Check with your Ingersoll-Rand representative for specific filter information.

The air filter should be located as close to the unit as possible to minimize pressure drop. If the filter is located outside the compressor building, the inlet housing should be at least 8 to 10 feet above the ground or roof and 6 feet away from the side of a wall. *(See Figure 1.4*)

Access to the filter should be provided with ample room around the filter for maintenance. A permanent platform should always be built around elevated filters to provide safety for personnel assigned to changing filter elements.

For best performance the inlet air piping should conform to the following recommendations:

- The inlet piping, from the inlet filter to the compressor, must be clean and made from a non-rusting material such as stainless steel, aluminum, or PVC, and suitably flanged so that it may be inspected in sections.
- Inlet piping should be short and direct, with the combined filter and piping pressure drop less than 0.3 psi (2.1 kPa[a]).
- Always use long radius elbows.
- Transitions in pipe diameters should be gradual.
- Any horizontal run of pipe should be installed so that condensation in the piping will run away from the compressor.
- Drain valves should be installed in the inlet piping at low points to allow the removal of condensation.

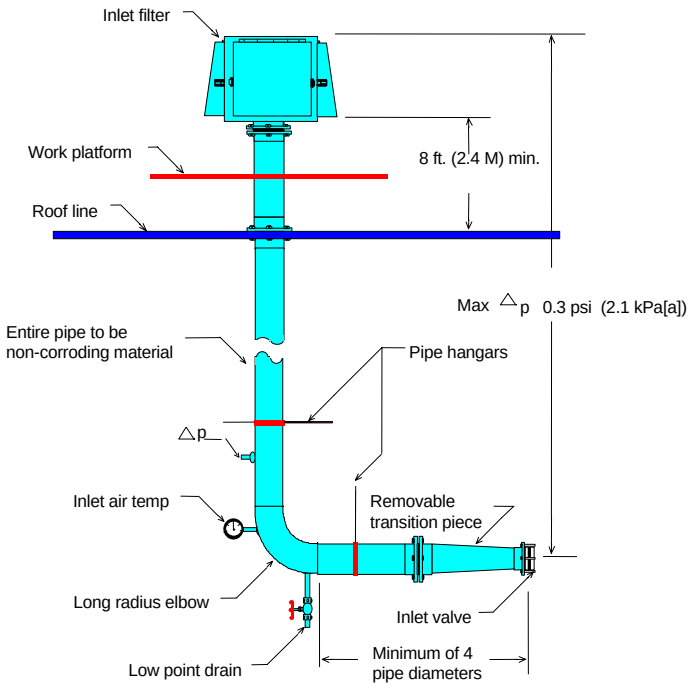


Figure 1.4
Inlet Air Piping – Air Filter

Bypass Air Piping

Atmospheric bypass piping vents the compressed air when the compressor is running unloaded or at partial load. Bypass piping should be well supported to minimize loading on the compressor flange. Care should be taken in the piping design so that all alignments can be made in the piping.

A bypass silencer should be installed in the atmospheric bypass line to reduce noise. A suitable silencer is offered as an option with the compressor package and is customer mounted. The silencer has acoustic absorption material at a controlled density. The silencer is usually installed close to the compressor and the vent piped outside. Alternately, the silencer may be installed outside the building. Consult the certified drawings for complete details of the silencer.

For sound attenuation in piping, a straight horizontal run of pipe from the compressor flange, at least 8 pipe diameters long, is suggested before entering a long radius elbow (see *Figure 1.5*). The silencer should be kept as close to the compressor as possible and the total length of pipe kept short. In noise critical areas, the discharge piping from the silencer may be lagged to further reduce sound.

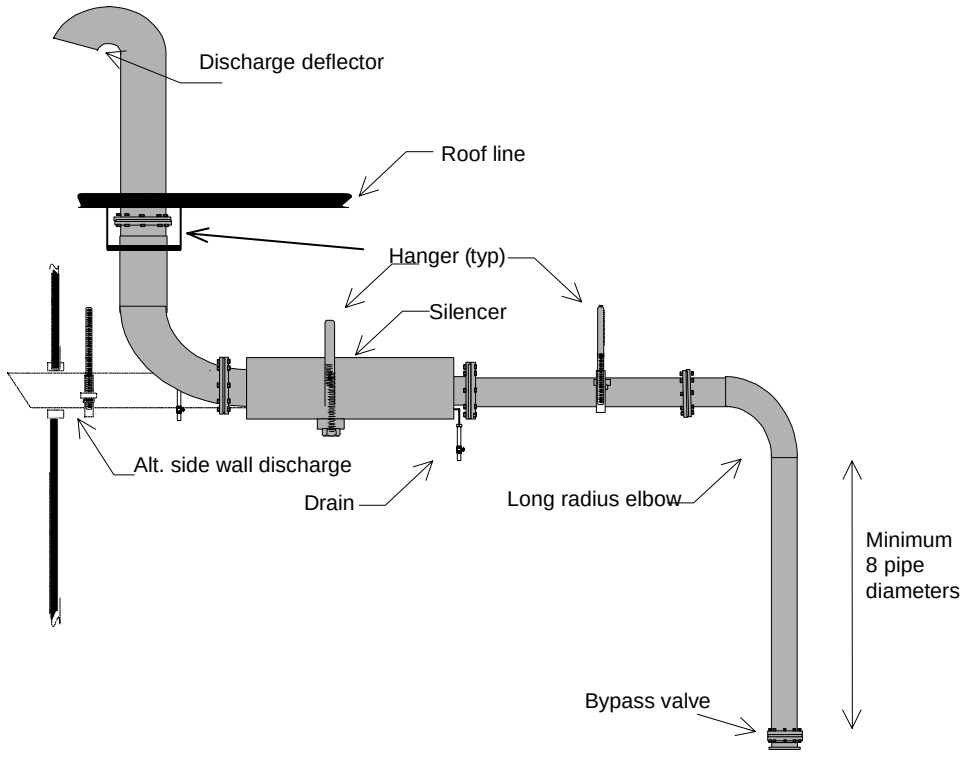


Figure 1.5
Model Bypass Pipe

Discharge piping from the silencer should be sized so that the maximum backpressure on the silencer is 5 psi or 35 kPa (a). Standard silencers are equipped with ANSI 150# standard flanges. Bypass piping to the silencer should be of the same diameter or larger than the bypass valve. Piping from the bypass silencer should be of the same size or larger than the silencer discharge. Refer to the certified drawing for complete details of silencer.

The bypass piping should be suitably flanged so that a minimum amount of pipe needs to be removed during major maintenance. This will reduce maintenance time.

The end of the pipe should be turned down or have a short run of pipe to prevent rain and snow from entering the bypass piping. Expanded metal should be installed on the end of the pipe to prevent large objects and animals from entering the pipe when the compressor is stopped. To remove condensation from the piping, install a drain in the lowest part.

Expansion Joints

With proper piping layout and installation, expansion joints may not be required on all compressors. However, expansion joints are required on

- All hot air discharge compressors (no internal after-cooler).
- All steam turbine drivers - on both the inlet and discharge piping.

Ingersoll-Rand can provide an expansion joint to meet your specifications. Expansion joint installers must consult the manufacturer's instructions to ensure correct installation.

WARNING

Improperly applied and/or installed expansion joints can result in severe injury, death, or property damage due to over stressing and fatiguing of the bellows material.

NOTE

While Ingersoll-Rand may recommend or even supply an expansion joint, proper installation is the customer's responsibility.

Discharge Air Piping

For the best performance, a straight run of pipe which is at least 3 pipe diameters long should be interposed between the discharge check valve and a long radius elbow to allow for smooth operation of the check valve. The piping should be the full size of the compressor discharge connection. Where pipe diameter conversion is necessary, the transition should be gradual. The use of long radius elbows is recommended and piping may be sized by normal methods.

On all compressors it is necessary to install a spool piece that will allow parts of the compressor to be removed and piping to be out of the way of maintenance personnel. The customer should install a block valve in the discharge line to isolate the unit for maintenance. A safety relief valve should be installed between the block valve and the compressor (see *Figure 1.6*).

NOTE

Drain valves should be installed in piping low points to remove condensation, which might form during periods of shutdown. Piping should be designed so that the condensation will not drain back to the compressor.

WARNING

The use of plastic piping, soldered copper fittings, or rubber hose, as part of the discharge piping is not recommended. In addition, flexible joints and/or flex lines can only be considered for such purposes if their specifications fit the operating parameters of the system. Failure to adhere to these recommendations can result in mechanical failure, property damage, and serious injury or death.

It is the responsibility of the installer and owner to provide the appropriate service piping to and from the machine.

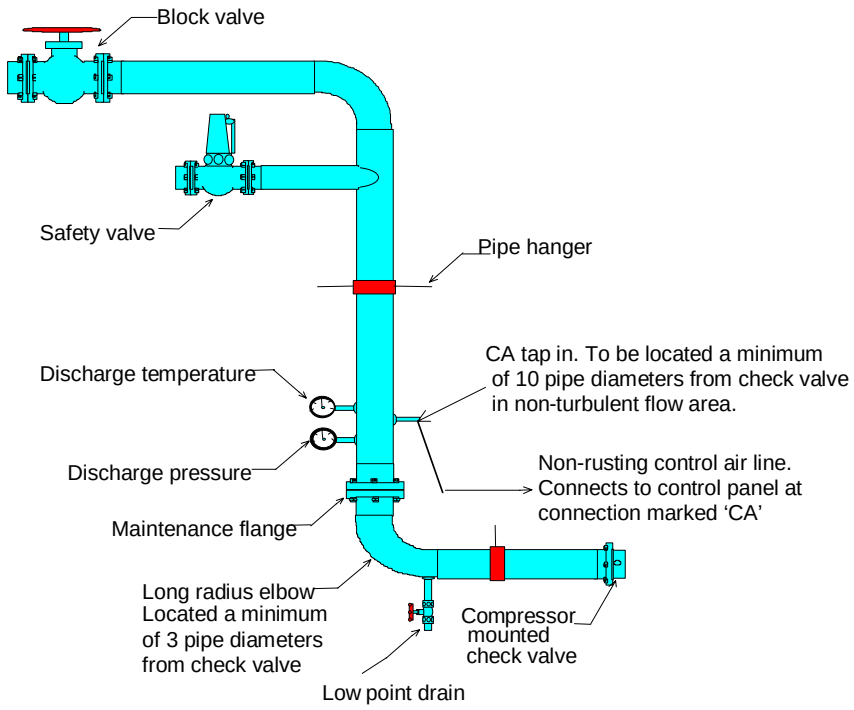


Figure 1.6

Model Discharge Pipe

Adequate piping support is needed to prevent excessive dead loads on the compressor flange. Provisions should be made in the discharge piping so that all alignments are made in the piping and not the compressor.

Discharge Air Piping for Multi-Compressor Installation

Parallel Operation with Positive Displacement Compressors

The steep performance curve of the Centac compressor allows for operation in parallel with piston or rotary screw compressors (s*ee Figure 1.7)*. However, piping layout design should isolate the Centac compressor from the pulsations in the discharge produced by these compressors. Piping the Centac compressor into the discharge header downstream of the pulsation bottle or receiver effectively eliminates pulsation problems.

Fast valve operation allows the lagging compressors to supply huge quantities of air at system pressure. Proper consideration to the entry of this added capacity into the system will eliminate control or surging problems commonly associated with this type of installation.

Discharge piping from the compressor should enter the system header by way of long radius elbows or at an angle in the direction of flow. By staggering entry into the header the added capacity will have no detrimental effect on the other units already on line.

Centac compressor connections and sizes are located on the certified customer prints. Refer to the General Arrangement Drawing and the Process and Instrumentation Diagram for further detail.

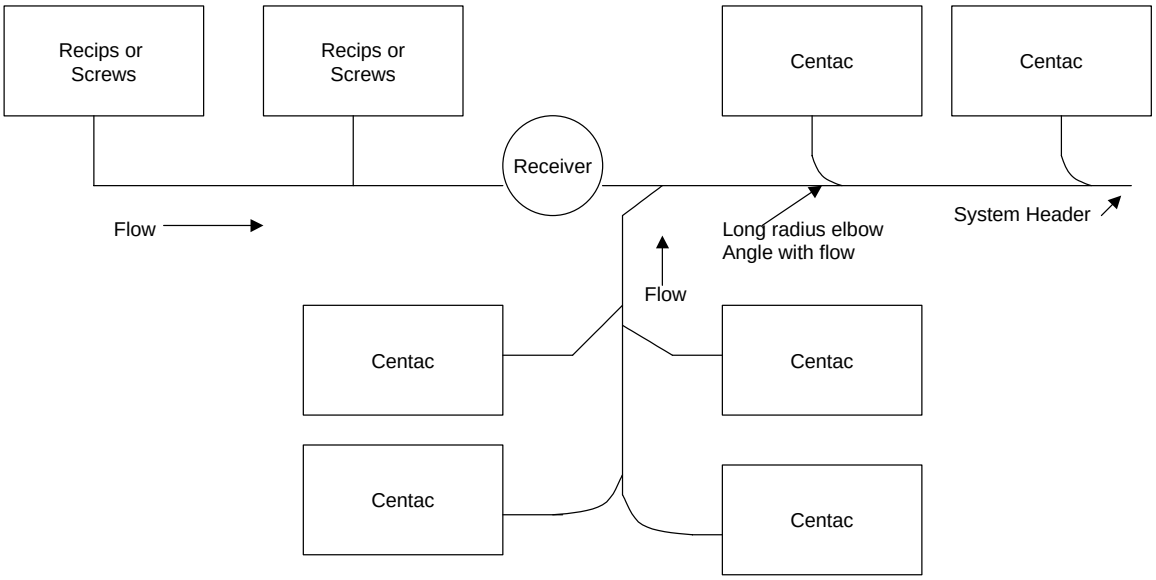


Figure 1.7

Centrifugal and Positive Displacement Piping Arrangement

Receivers

Receivers store compressed air for systems in which air demand fluctuates over a short period of time. A properly sized receiver will decrease the number of times the compressor loads and unloads. This will increase the compressor's efficiency and decrease wear on valve components. Receivers can be installed as "Wet" (before the dryer) or "Dry" (after the dryer) receivers or in both locations. Contact your local Ingersoll-Rand representative for assistance in properly sizing and locating this equipment.

A receiver may also be used to isolate centrifugal compressors (or other equipment) from pulsations created by positive displacement air compressors. A pulsation bottle may be needed to eliminate pulsations more effectively.

Control Air Piping

The control air pipe connection is made at a minimum of 10 pipe diameters downstream of the discharge check valve in the discharge pipe (*see Figure 1.6*). The control air line connects to the control panel bulkhead fitting marked ‘CA’ *(see Figure 1.8)*, which is a 1/2 inch NPT connection. The control air line should be a minimum of 1/2 inch diameter, made of a non-rusting material such as stainless steel, aluminum, or copper. If the control air line is to be installed in a horizontal run of discharge pipe, it should be located at the top of the discharge pipe to minimize condensate or debris buildup in the line. The control air line should be routed to the control panel in such a manner that the line will not have to be disconnected in order to perform major maintenance. A drip leg with a drain valve, which can be used to remove condensate, is recommended as part of the customer’s control air line.

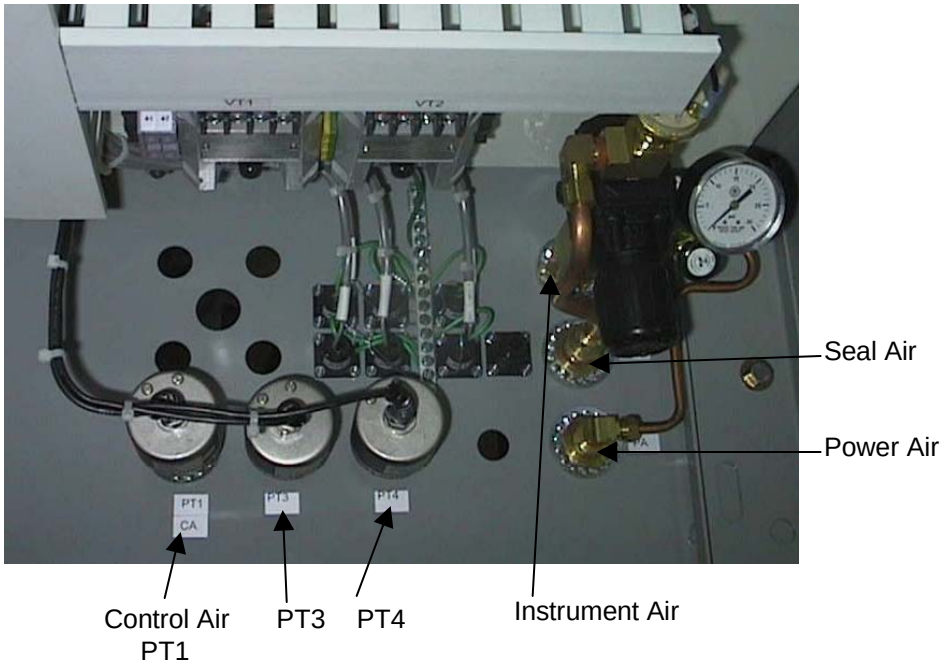


Figure 1.8
Control Panel Connections

Instrument Air Piping

Instrument air must be provided for the operation of the pneumatic control valves and for the seal buffer air. The air used must be clean dry instrument quality air. For best results, piping should be connected to a refrigerated air dryer and filter prior to connection on the unit. The Centac compressor normally requires 10 SCFM (0.33 m^3/m) of air at 60-120 PSIG (414-827 kPa).

The final filtering medium should be rated at a theoretical efficiency of 99.9999%, particle size of 0.01 micron, and a minimum or 25 SCFM (0.82 m^3/m). This filter should be located close to the control panel. An isolation valve may be located ahead of the filter.

Piping from the instrument air source should be constructed of 1/2 inch minimum non-corroding material to limit the possibility of corrosion products entering the system. Instrument air piping connects to the control panel at the 1/2 inch NPT bulkhead fitting marked “IA”.

Water System Piping

The water piping section consists of the following topics:

- Cooling water piping – provides cooling water to the air and oil coolers of the compressor
- Cooling water specifications – gives recommendations for clean water
- Air cooler vent and drain – connects air vents and cooler drains
- Condensate drain piping – provides a means of removing condensate from the moisture removal sections

Cooling Water Piping

Unless otherwise stated, water flows are based on the design conditions of the compressor for rated discharge pressure with 80°F cooling water temperature.

Sizing of water pipe may be done by conventional methods based on the GPM flows given. The size of pipe may be determined so as to hold flow velocities in the range of 6 to 7 ft/sec. The pipe design must allow for a minimum water pressure of 35 PSIG and the maximum water pressure of 75 PSIG (*see General Arrangement Drawing for connection locations.)*.

A throttle valve is recommended on the discharge line to aid in temperature control. Placing the throttle valve on the discharge line helps ensure that the coolers operate full of water. In addition, gate valves should be fitted at the inlet of the water system to allow isolation of the compressor when necessary.

In dirty or silt laden water systems, a piping arrangement that will allow for backflushing the coolers must be used. The backflush valve arrangement is one where water flow may be reversed in the coolers and foreign matter flushed out (*see Appendix A for diagram of Cooling Water System Backflush).*

Regardless of the cooling system used, a strainer should be installed in the water supply line.

Cooling Water Specification

Water used for cooling should be clean and free of corrosive elements. It is best that the water used is filtered and treated to fall within the following specification:

- Total hardness expressed as $CaCO_3$ should be less than 100 PPM.
- Acidity should be within the 6.0 to 8.5 pH range.
- Suspended solids should not exceed 50 PPM.
- The langelier saturation index should be between +0.5 and +1.0.

The Langelier's index is a technique of predicting whether water will tend to dissolve or precipitate calcium carbonate. If water precipitates calcium carbonate, scale formation may result and this water will have a corrosive tendency. Other factors that contribute to corrosion include:

- Temperature differences within a system.
- Changing operating conditions.
- Presence of chemical treatment in the water.
- Presence of dissolved oxygen in the water

Air Cooler Vent Lines

Air cooler vents with valves are provided at the highest point on the air cooler casings. They are supplied to ensure that the coolers are full of water when the compressor is operating and no air pockets form in the coolers. If part of the cooler is starved for water, overheating may occur resulting in damage.

The vents should remain open at all times. The connections must be piped, by the customer, to a drain or suitably connected to the compressor water discharge with a sight flow indicator for each air cooler (s*ee Figure 1.9).*

Figure 1.9
Visual indicator of water flow through vent lines

Do not connect the vent lines together. When a closed cooling water system is utilized, casing vents should be piped to the lower pressure discharge water line to ensure flow through the vent piping.

Condensate Drain Piping

Air entering the first stage of the unit carries with it a certain amount of moisture. The amount of moisture depends on the temperature and relative humidity. The maximum moisture content occurs on days of high temperature and high relative humidity.

Moisture is removed from the air as it passes through each stage of compression. As the air passes through the coolers, water vapor in the air is condensed and collected in the moisture separator. This condensation is removed by condensate traps to prevent water carryover into the next stage of compression. Excessive water carryover may create problems.

Condensate traps with bypass valves for each stage are factory installed (when ordered). Each condensate trap must be provided with a separate drain. In addition, each trap discharge should be piped to a drain that will allow a visual check of the individual trap function *(see Figure 1.10)*.

The location and size of the trap discharge connection is listed on the General Arrangement Drawing. The piping arrangement is shown on the Process and Instrumentation Diagram.

If the unit is unattended or in a location where maintenance is minimal, a high-level condensate and shut down alarm should be used. If the traps become clogged, water carry-over in the unit will result.

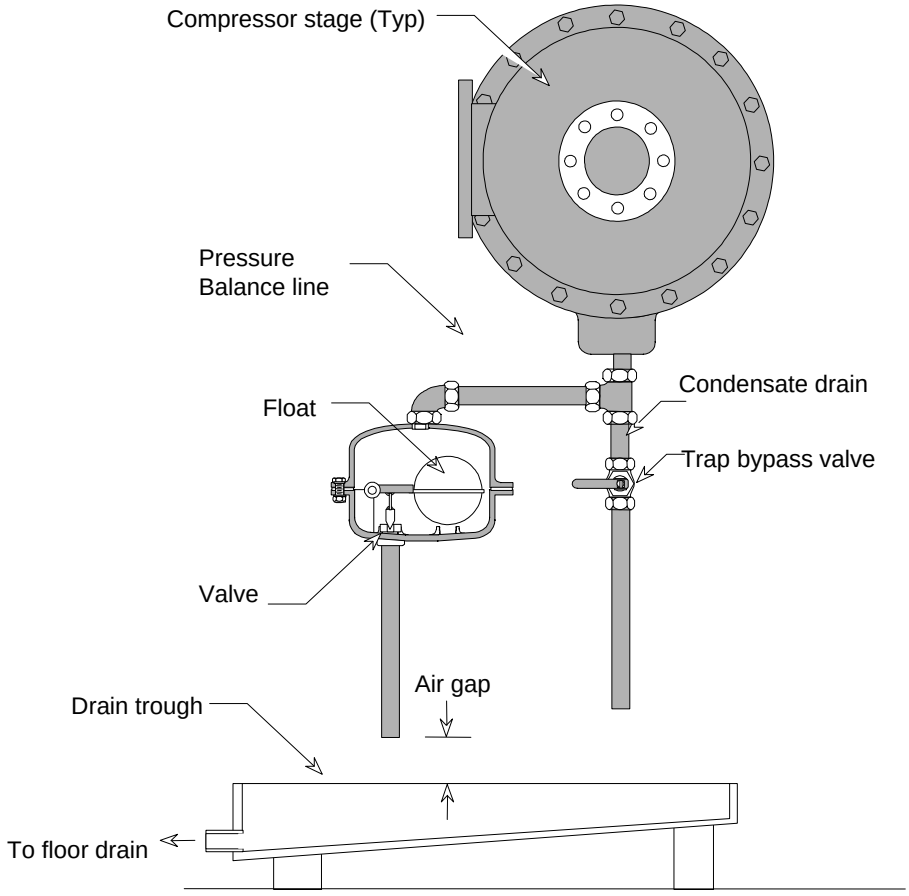


Figure 1.10
Standard Condensate Trap and Drain Arrangement

External compressor Piping Notice

CAUTION

All air and water pipes, to and from the inlet and discharge port connections, must take into account: vibration, pulsations, temperature, maximum pressure applied, corrosion and chemical resistance. In addition, it should also be noted that lubricated compressors discharge some oil into the air stream, therefore, compatibility between discharge piping, system accessories, and software must be assured. Where compatibility questions exist, contact your nearest Ingersoll-Rand office.

It is the responsibility of the installer and owner to provide the appropriate service piping to and from the machine.

Electrical Connections

Introduction

The following electrical connections are required to the extent referenced in the supplied General Arrangement and Electrical Schematic drawings:

- Control panel power
- Starter interface
- Main driver connections
- Heater contactor
- Oil pump starter
- Current transformer
- Optional switches

WARNING

Electrical-trade personnel must perform electric installation on the Centac compressor. Electricity can cause serious injury or even death if proper handling and installation procedures are not observed. Contact a qualified electrical installation contractor for help installing and/or maintaining any electrical services to this compressor.

CAUTION

 The unit must be properly grounded. There must be at least one grounding strap from the compressor skid or baseplate. The connection must be made to an independent ground and not to a plant system ground. Inadequate grounding, or lack of grounding, may result in operational problems. Additional grounding may be required for the compressor driver. Further information may be obtained from the National Electric Code or other electrical information sources.

NOTE

Design and installation of disconnect, overvoltage, short circuit, and overload protection is the responsibility of the customer.

Control Panel Power

The standard Centac compressor control circuitry is designed for a 120 VAC source. If the customers source is greater than 120 VAC, a control transformer must be used. Check the Electrical Schematic to determine whether the control transformer has been factory installed.

To properly make electrical connections to the control panel, refer to the Electrical Schematic to identify the proper terminals for wire connection, and refer to the panel outline drawing for conduit entry size. Incoming power should be connected to the appropriate terminal blocks in the control panel as shown by the Electrical Schematic.

Ensure the breaker is sized adequately to handle the in-rush current as well as the operational current. The operational current will include the service factor of the motor.

Starter Interface

The standard starter connections are panel mounted.

The remote starters are optional and they require two interface points:

1. A feedback circuit, which indicates a running condition, is connected to the control circuits inside of the compressor's control panel. This is done by the customer.
2. The starter’s on/off circuit is connected with the panel’s start control relay. Local start pushbuttons on the starter should not be used. The starter’s 120 VAC control circuit should be connected to the control panel start circuit. Do not exceed 720 VAC. The circuit must be wired in series with the starter. The starter must not be powered by any other source other that Ingersoll-Rand’s control panel.

Main Driver Connections

Three-phase power must be connected to the starter and the three-phase wiring must also be connected from the starter to the main motor. The motor will be furnished with leads terminating in a junction box on the side of the motor to which the three-phase wiring from the starter is to be terminated. Refer to the main motor nameplate and manufacturer's data sheet to properly size the three-phase wiring that connects the starter to the motor. The customer should ensure that the incoming voltage matches the voltage on the main motors nameplate. Before wiring and applying power to the main motor, it must be meggered to ensure the integrity of the insulation.

Heater Contactor

This device is required for operation of the oil reservoir heater. It must be sized according to the electrical information found on the oil reservoir heater nameplate. Ingersoll-Rand supplied oil reservoir heaters have thermostats mounted within the housing for "pilot" type operation of the contactor. Ingersoll-Rand supplied contactors are mounted inside the control panel enclosure.

Prelube Pump Starter

This device is required for operation of the prelube pump driver. It must be sized according to electrical information found on the prelube pump motor nameplate. Ingersoll-Rand supplied prelube pump starters are mounted inside the control panel enclosure.

WARNING

 Do not disconnect secondary wiring during operation. Anytime secondary side of the current transformer is disconnected from its load, a jumper must be placed across secondary terminals to prevent injury or death of personnel and/or damage to equipment.

Current Transformer

This device may be required to provide a 0-5 ampere signal to one or more devices located in the control panel. When supplied by Ingersoll-Rand, the current transformer is often shipped loose for installation by the customer.

Refer to the unit's electrical drawings, motor nameplate data, motor manufacturers data sheet and starter manufacturers data sheet to properly size the current transformer.

WARNING

 An appropriate grounding strap should be attached to the motor and a suitable ground. DO NOT CONNECT TO A PLANT GROUND CIRCUIT.

Optional Switches

Optional switches such as pressure, temperature, flow, etc. supplied by Ingersoll-Rand but mounted by the customer must be connected to the control panel. Information on how to wire these devices to the control panel is shown on the Electrical Schematic.

Lubrication

NOTE
The initial fill of lubricant for the Centac compressor should be installed under the supervision of an authorized Ingersoll-Rand Technical representative.

Cleanliness of the lubrication system is of vital importance to the Centac air compressor. The system is flushed and fully tested at the factory. The sump access cover should be wire sealed as shipped from the factory.

Piping Flush

1. Remove the sump access cover. Thoroughly clean the sump of any shipping oil and dry with lint free rags.
2. Fill with recommended oil to the proper level and replace sump access cover.
3. Disconnect the oil piping at the entrance to the gear casing and use a flexible oil line to route the oil to the sump in the baseplate.
4. Circulate the oil for a minimum of one hour using the prelube pump. Optimum flushing temperature is 100 °F.
5. Tap any welded piping with a plastic or lead hammer during oil circulation to dislodge any foreign material lodged at the welded joints.
6. Change position of the transfer valve at 15 minute intervals, on systems having dual oil filters and/or coolers.
7. Shut of the prelube pump.

WARNING
 An appropriate grounding strap should be attached to the motor and a suitable ground. DO NOT CONNECT TO A PLANT GROUND CIRCUIT.

8. Drain oil filer and inspect the element(s). Continue with one of the following:
   - If foreign material is found in the filter housing or element, replace the oil filter and repeat step 4 through 8 until filter housing and element are clean upon inspection.
   - If no foreign material is found go to step 9.

9. Replace the oil filter element(s) and inspect the housing for cleanliness. Continue with Casing Flush.

Casing Flush

1. Reconnect lube piping to the gear casing.
2. Apply instrument quality air to the seals (6 PSIG [41 kPa] minimum).
3. Restart prelube pump and circulate oil for one hour.
4. Tap any welded piping with a plastic or lead hammer during oil circulation to dislodge any foreign material lodged at welded joints.
5. Change position of the transfer valve at 15-minute intervals, on systems having dual oil filters and/or coolers.
6. Shut off the prelube pump.
7. Drain oil filter and inspect the element(s). continue wit one of the following:
   - If foreign material is found in the filter housing or element, replace the oil filter and repeat step 3 through 7 until filter housing and element are clean upon inspection.
   - If no foreign material is found go to step 9.
8. Replace the oil filter element(s) and inspect the housing for cleanliness.
9. Fill sump to the proper level with recommended oil.
10. Replace sump access cover and secure.

Recommended Lubricant

Lubrication for the compressor system should be a synthetic lubricant. The lubricant must have unusual oxidation stability and contain defoaming inhibitors and be free of inorganic acids or alkali. There must be no tendency toward permanent emulsification and a minimum tendency to oxidize or form sludge when agitated at operating temperatures when mixed with air and water. Ingersoll-Rand highly recommends Techtrol Gold III a synthetic lubricant is specifically formulated for Centac compressors.

CAUTION

 Some lubrication mixtures are incompatible with each other and result in the formation of varnishes, shellacs or lacquers which may be insoluble. Such deposits may cause serious trouble, including clogging of the oil filter. Avoid mixing lubricants of the same type, but of different brands. A brand change is best made at the time of a complete lubrication change.

CAUTION

 Lubricant obtained by the user for operation of this equipment must comply with the following specification and perform satisfactorily in the compressor. The Ingersoll-Rand Company assumes no responsibility for damages caused by non-compliance to this specification within the period of its standard equipment guarantee or thereafter. On subsequent purchases of lubricant for use with this equipment, the user is cautioned to be on the alert for any changes in the lubricant that may deviate from this specification thereby causing equipment damage.

Physical and Chemical Requirements for Techtrol Gold III Coolant.

Property	ASTM Test Method	Limits
PHYSICAL:		
ISO Viscosity Grade	D2422	32
Viscosity Index	D2270	139
Viscosity, cSt (SUS)		
@ 0°F/-17.8°C	D445	895 (4195)
@100°F/37.8°C	D445	30 (142)
@104°F/40°C	D445	28 (133)
@210°F/98.9°C	D445	5.6 (45)
@212°F/100°C	D445	5.5(44)
Pour point, °F (°C)	D97-87	-40 (-40)
Flash Point, COC °F (°C)	D92	450 (232)
Flash Point, PMCC °F (°C)	D93-85	390 (199)
CHEMICAL:		
Total acid number, mg KOH/g, max.	D664	0.1
pH	D664	8
Density (Grams per cc @25 °C	D941	0.988
Specific Gravity	D941	0.99
Copper Strip Corrosion, 3 hrs. @ 212°F/100°C	D130	1
Ferrous Metal Corrosion (Rust Test)	D665A	Pass
Foam Tendency (Sequence I,II,III)	D892	0 (Nil)

NOTE
The initial lubricant supply required for the compressor installation is not normally supplied with the compressor.

NOTE
Failure to meet this specification may result in damage to internal compressor components.

NOTE
The Pour point specification **must** be met unless there is a means available for heating the oil when used in low temperature areas.

NOTE
Lubrication specifications are constantly being reviewed. Verify that correct lubricant is used by consulting appropriate serial number manual. Ingersoll-Rand does not endorse any other trade name product or any individual oil company.

Reservoir Capacities

Model Number	Sump Capacity (Gallons)	Sump Capacity (Liters)
C700	84	318

Actual capacities will vary with specific sumps. The above listed values are for standard Centac models. Review of the Specification section of the compressor Operation Manual is recommended for exact capacity of a specific unit. The above values do not apply to API style sumps.

Standard Oil Cooler and Filter Data

Lube Oil Cooler

Water side design pressure	150 PSIG	1034 kPa
Shell side design pressure	150 PSIG	1034 kPa

Lube Oil Filter

Dual Element	10 Micron

Recommended Oil Temperatures

Minimum Oil Temperature for:

Starting	95°F	35°C
Operating Bearing Inlet Oil Temp.	100°F to115°F	37.5°C to 46°C

Weights and Dimensions

Specific machine weights and dimensions will vary according to motor selected and any additional special options purchased. The weights and dimensions provided are to be used for estimating purposes only for the C700 compressor. Refer to the specific General Arrangement drawing for actual dimensions.

Length (in/mm):	Width (in/mm):	Height (in/mm):	Weight (lb./Kg) without motor
140/3556	73/1854	73/1854	16050/7280

Compressor Connections:

Inlet Air Connection:	8 in. 125# ANSI FF Flange
Discharge Air:	4 in. 125# ANSI FF Flange
Discharge Air Connection (Hot Air Discharge):	6 in. 125# ANSI FF Flange
Bypass Air Connection:	3 in. 125# ANSI FF Flange
Bypass Air Connection (Hot Air Discharge):	4 in. 125# ANSI FF Flange
Water Manifold Connections:	4 in. 150# ANSI RF Flange

Recommended Tools

The following list of standard mechanic's tools is provided as a guide for maintenance and installation of a Centac compressor.

- Lifting Device (1/2 ton, or 500 kilos minimum)
- Allen wrenches
- Feeler gauges
- Drive sockets with extensions
- Open end and box wrenches
- Adjustable wrenches
- Pipe wrenches
- Torque wrench (to 200 ft-lb or 300 Nm)
- Vise grips
- Channel locks
- Rubber or Lead hammer
- Dial indicator with magnetic base
- Digital Multimeter
- Machinist scale
- Transit Level
- Micrometer

Section 2 – Description

Introduction

The Centac compressor is a reliable and efficient centrifugal compressor that is designed to provide oil-free compressed air or nitrogen. Each compressor is fully packaged on a common fabricated steel baseplate and is equipped with a self-contained lube oil system and a state-of-the art control panel. Some of the outstanding features and benefits are:

Features	Benefits
Small rigid baseplate	No special foundation required
Mounted control valves	Machine mounted
Mounted intercoolers and aftercooler	Compact efficient design
Baseplate mounted control panel	Prewired and factory tested
Fewest electrical hookups	Minimal installation time and cost

How a compressor works

The Centac compressor is a dynamic centrifugal type compressor. As shown in Figure 2.1, air enters the compressor through the machine mounted inlet control valve and flows to the first stage where the impeller (1) imparts velocity to the air. The air proceeds through the stationary diffuser section (2) that converts velocity to pressure. The built-in intercooler (3) removes the heat of compression, which improves efficiency. Air then passes through a stainless steel moisture separator (4) in a low velocity zone to remove condensate. Entrained moisture in the air is reduced when the air is forced through stainless steel moisture separators. This sequence repeats in each succeeding stage until the compressor achieves the desired operating pressure.

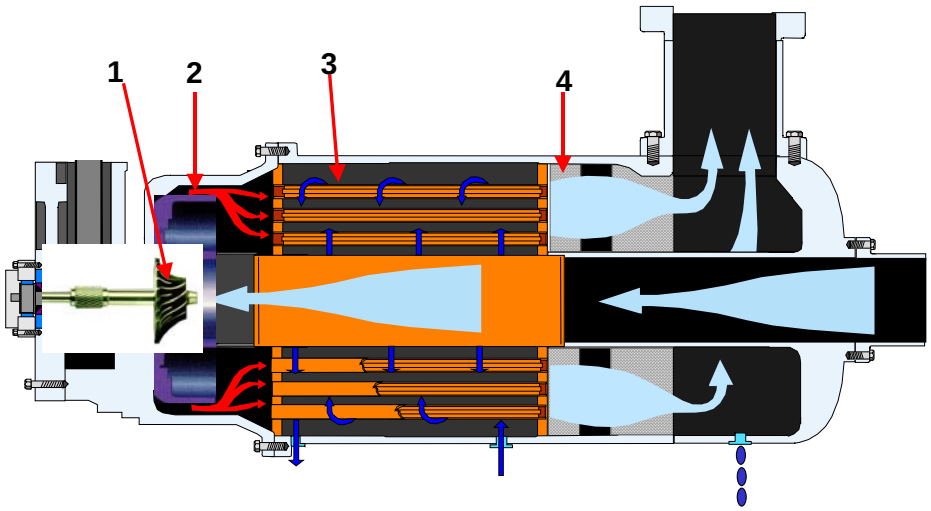


Figure 2.1
How a Centac Compressor Works

Machine Description

The Centac compressor is a centrifugal air compressor driven by an electric motor. The compressor and driver are direct coupled and the entire unit is mounted on a common baseplate with its own lube system, control system, and auxiliaries.

The compressor package contains:

- A main driver that directly drives a bullgear that is common to all stages.
- Compression stages consisting of an impeller mounted on its own shaft, enclosed within a common cast iron casing
- Rotors consisting of an integral pinion gear driven at its optimum speed by a common bullgear.
- An intercooler that is mounted within each stage.
- A moisture separator and a moisture removal system are supplied after each cooler to remove condensate.
- In some compressor configurations an aftercooler is also mounted on the package.

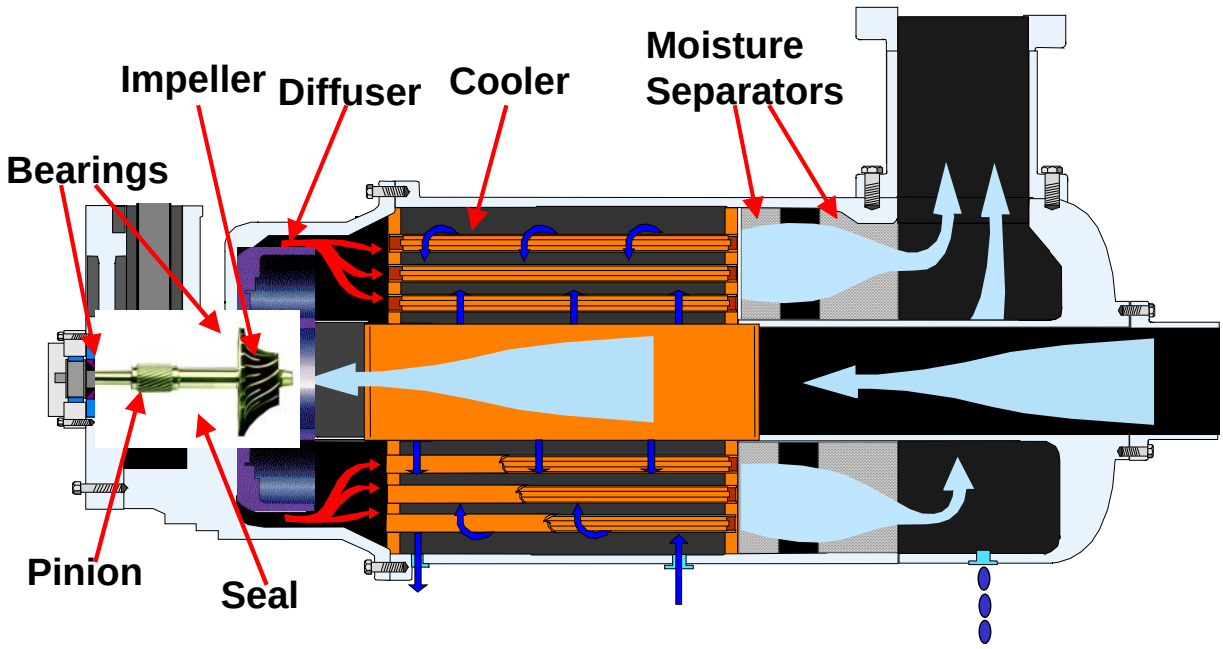
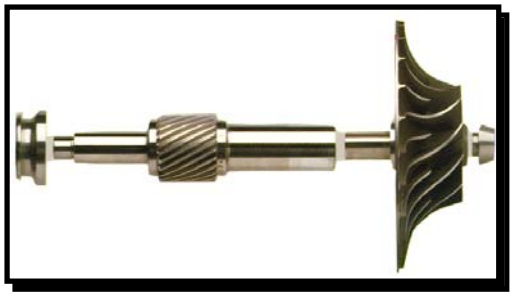


Figure 2.2
Centac Compressor Package

Rotor Assemblies

Each rotor assembly consists of an efficient and high quality stainless steel impeller and a removable thrust collar mounted on a helical geared pinion shaft. The impeller is secured to the shaft by a taper attachment and the thrust collar is secured to the shaft with a polygon attachment. All rotating parts are dynamically balanced as a complete assembly.



Bearings

Thrust Bearing

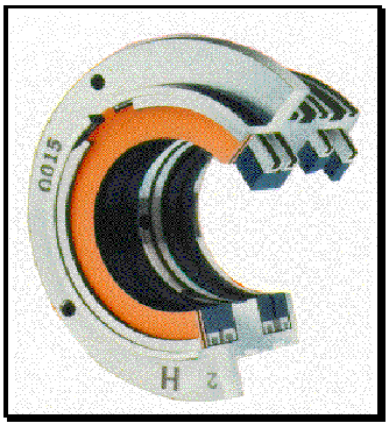
Thrust loads are absorbed at each pinion by a hydrodynamic thrust bearing. The thrust bearings are designed to maximize load carrying capacities and to minimize power loss.

The journal bearings are babbitt lined, fixed tilted pad design for maximum stability and load capacity with minimum power loss.

Bullgear bearings for Centac compressor models incorporate a hydrodynamic design.

Seals

A single cartridge seal is mounted in the plain bearing housing behind each impeller. Each cartridge consists of three, one piece, fully floating non-contact carbon rings. One ring is used as an air seal and the remaining two as oil seals. Buffer air supplies air to the oil seals assuring that lube oil is not drawn past the seals, thus ensuring oil free air.

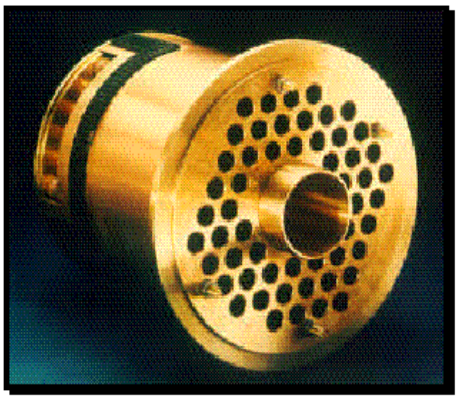


Diffusers

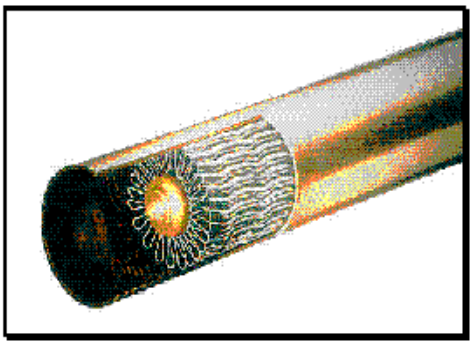
A diffuser is located between each impeller and cooler. The diffusers are designed for maximum efficiency while limiting physical size, thereby keeping the compressor as compact as possible.

Intercoolers

The Centac cartridge cooler is internal to the compressor casing. The coolers are donut type, with the water over the tubes. The tubes are internally finned. Air passes through the tubes while the water makes a number of counter passes to the air flow. This arrangement results in highly efficient heat transfer or exchanger.



The internal fin design, along with the straight through tube design, produces the best heat transfer and lowest pressure drop.



Cooler Design Features:

- Lead-free cooler design and construction
- Straight tube design
- Rolled tube to header bond
- Large diameter tubes equally spaced for accessibility during cleaning.
- TEMA constructed leak free brass headers

Moisture Separators

The moisture separator is a stainless steel mesh screen type construction. The thickness of the separator is designed to separate the maximum amount of moisture at a minimal pressure drop. The separators are located at points in the compressor where air velocities are relatively low permitting effective moisture separation.

Vibration Probes

A non-contacting vibration probe is mounted each stage next to the plain bearing. The vibration probe measures the radial vibration of each rotor assembly. The probe is connected to a vibration transmitter. First stage vibration protection is provided as standard on all compressors.

Casing

The gear case consists of a casing and casing cover. The joint between the casing and cover is vertical. This bolted assembly is only opened for servicing the bullgear or its bearings. The cooler assemblies, which are mounted onto the casing, can be easily removed for inspection or for dismantling the rotor assemblies, diffusers, bearings, or seals.

Compressor Driver

The Centac compressor is furnished with an electric motor that is flange mounted and direct coupled to the compressor bullgear. Motor alignment is fixed by the flange design and no adjustment is required.

Safe and efficient operation of the main driver is of prime importance to the overall performance of the compressor package. Because operation of the main driver is critical, manufacturer's literature is supplied as part of the compressor package. The customer should refer to the driver instructions for a detailed description of the driver supplied.

Lubrication System

The lubrication system for the compressor is completely self-contained and mounted on the baseplate. This system is designed to provide clean lubricant to the compressor bearings and gears for operation. See the Process & Instrumentation Diagram for the oil flow schematic.

The lubricant is drawn from the oil reservoir located in the baseplate and passes through the oil pump. Two oil pumps are provided: a prelube pump and a main oil pump.

Prelube Pump:

- Serves to prime the main oil pump, lubricate the compressor bearings and gears, and fill the oil lines before the compressor starts.
- Is driven by an electric motor.
- Starts when the control panel is energized and runs until the compressor is upto speed and the main oil pump increases oil pressure.
- Shuts down automatically by a pressure transmitter that stops the pump after the main oil pump is supplying the required system pressure. When the unit trips on the shutdown cycle, the prelube pump will start immediately and will continue to run until the panel is de-energized.

- Cools down the compressor. After the compressor shuts down, the prelube pump should be allowd to run 20 – 30 mins to cool down the compressor bearings.
- A seal air pressure transmitter interlock prevents the prelube pump from operating if a seal air pressure is not established.

Main oil pump:

- An oversized gerotor type pump driven by the main shaft
- The discharge pressure is controlled by a relief valve downstream of the oil filter and cooler.
- In the event of the main driver or power failure, the main oil pump will continue to supply oil to the bearings and gears during coast down.

The oil pumps are equipped with an inlet strainer for protection against foreign particles. Check valve in the discharge line of the prelube pump and on the inlet of the main pump are provided to prevent reverse flow through the pumps

Oil passes from the oil pump to the oil cooler, where the oil is cooled between 105 and 115 Deg F.

Oil from the cooler is mixed with the hot oil in the thermostatic control valve.

Oil then flows to the oil filter. Oil filter supplied is a 10 micron treated paper type element type of filter.

Oil passes from the oil filter to the bullgear, pinion bearings and relief valve to the reservoir. The relief valve allows the input pressure to the compressor to be raised or lowered by adjusting the valve setting.

The remainder of the lubricant passes through the compressor and drains into the reservoir.

All the necessary instruments and safety devices are included in the lubrication system to protect the compressor. The compressor protection devices in the lubrication system include:

- A pressure transmitter senses oil pressure and the compressor low oil pressure.
- An RTD and temperature-transmitter senses abnormal oil temperature. An interlock is also provided to prevent the unit from being started if oil temperature is below the minimum.
- A wet element type lube oil reservoir heater is supplied to ensure adequate oil temperature for compressor start-up.
- The lube oil reservoir has provisions for a lube oil drain with plug. The customer may install a valve on the connection to facilitate changing lubricant.
- An oil temperature control device is supplied that automatically regulates proper oil temperature to the bearings by mixing hot and cold lubricant.

Section 3 – Operation

Safety

Follow all safety instructions listed in Section 1 of this manual. Also refer to the driver instruction manual for proper safety practices for the driver.

NOTE
The owner, leaseholder, or operator of the compressor is hereby notified and forewarned that any failure to observe common safety precautions, whether stated herein, or not, may result in damage or injury. Ingersoll-Rand Company expressly disclaims responsibility or liability for any injury or damage caused by failure to observe those specified, or other common precautions or by failure to exercise that ordinary caution, common sense, and due care required in operating or handling the compressor even though not expressly specified above.

Before Starting the Compressor

Tools needed:

- Dial Indicators (2)
- Alignment Tool
- Machinist Level
- Grease Gun
- Flat Head Screwdriver
- Plastic or Lead Hammer
- Clearance Setting Tool
- Mag Bases for Dial Indicators (2)
- Adjustable Wrench

CAUTION
 The importance of starting and operating the compressor with clean inlet piping cannot be over-emphasized. Loss of performance or physical damage could result from the ingestion of foreign material.

Pre-Start Checklist Summary

All systems on the Centac compressor should be checked prior to initial start-up. This check should be completed under the direction of an Ingersoll-Rand Customer Service Representative.

The operational checklist should be completed in accordance with the individual unit's Operation Manual. The following checklist is provided to prevent over-sights which could delay start up of the unit and additional expense in correcting these.

Check off each section before the initial start-up.

☐ Inspect the following for corrosion and cleanliness just prior to start-up:

a. Oil Reservoir (on compressors that do not have sealed covers)
b. Inlet Air Filter
c. Inlet Air Piping
d. Discharge Piping
e. Bypass Piping
f. Water Piping

☐ Check inlet air filter location and installation.

☐ Check the following on the inlet air piping.

a. Material (stainless steel or non-ferrous)
b. Minimum size
c. Distance to first elbow (minimum of 4 pipe diameters)
d. Facilities for moisture removal on any horizontal run of pipe
e. Piping supports/strain
f. Manometer or differential pressure gages on inlet air filter
g. Gradual transition from larger to smaller pipe diameters

☐ Check the following on the discharge piping:

a. Minimum size
b. Distance to first elbow (minimum of 3 pipe diameters)
c. Piping supports
d. Facilities for moisture removal on any horizontal run of pipe
e. Safety valve (located between block valve and compressor)
f. Block valve
g. Minimum 10 diameter straight run of pipe for PT tap

☐ Check the following on the bypass piping:

a. Minimum size
b. Distance to first elbow (minimum of 8 pipe diameters from bypass valve)
c. Piping supports
d. Location of silencer
e. Facilities for moisture removal on any horizontal run of pipe.

☐ Check the following on the control air piping:

a. Material
b. Minimum size
c. Water and dirt line filter (5 micron)
d. Attached to control panel at bulkhead fitting "CA"
e. Attached to discharge air piping a minimum of 10 pipe diameters from check valve

☐ Check the following on the instrument air piping:

a. Material
b. Minimum size
c. Attached to control panel at bulkhead fitting "IA"
d. Attached to dry, clean air source, 60-120 PSIG (414-827kPa) 10 SCFM (15 Nm^3/hr) per stage minimum
e. Absolute air filter 0.01 micron
f. Shut-off valve

☐ Check the following on the water piping:

a. Minimum size
b. Attachment to compressor
c. Attachment to oil cooler
d. Water pressure between 35-75 PSIG (241-517 kPa)
e. Differential pressure between inlet and outlet flanges on air coolers is normally between 12-15 PSIG (83-103 kPa)
f. Check for water leaks (leave condensate trap bypass valves open)
g. Hand or thermostatic control valves in discharge piping
h. Casing vents open

- ☐ Check piping on condensate traps (piped to open drain).
- ☐ Check compressor lubricant, motor lubricant, and coupling grease for conformance to specifications.
- ☐ Change oil filter elements after flushing.
- ☐ Fill oil reservoir to “Normal” level.
- ☐ Check anchor bolts and grouting.
- ☐ Check unit level.
- ☐ Check for proper grounding.
- ☐ Check electrical power supply to unit.
- ☐ Check all control panel connections per applicable schematics.
- ☐ Check proper grounding of electrical power supply.
- ☐ Manually rotate compressor and driver shafts, checking for free, uncoupled rotation with prelube oil pump running and seal air “on”.
- ☐ Check driver per manufacturer's instructions found in the driver instructions.
- ☐ Check driver electrical connections.
- ☐ Check to see that driver bearings are properly lubricated.
- ☐ Check direction of rotation and magnetic center of main drive on motor driven units prior to coupling to compressor.
- ☐ Lubricate coupling.
- ☐ Check rotation of the prelube oil pump (three phase only).
- ☐ Check vibration monitor per control section (if applicable).
- ☐ Check lubrication system for oil leaks.
- ☐ Check operation and calibration of the inlet and bypass valves.
- ☐ Calibrate all temperature and pressure switches.

- ☐ Functionally test control system.
- ☐ Check operation of main driver trip device.
- ☐ Start and run compressor.
- ☐ Correct any oil, water or air leaks.

Initial Start Preparation

The first time a compressor is started requires a special procedure. Follow the procedures in this section for each of the following:

- Coupling Lubrication
- Main Driver Preparation
- Control System Adjustment
- Inlet Valve / Inlet Guide Vane and Bypass Valve Adjustment
- Lube system Adjustment
- Oil Pressure Setting

NOTE
The preparation for and the initial start-up of the Centac compressor should be done under supervision of an Ingersoll-Rand service supervisor**.**

WARNING
 Coupling lubrication is critical. The use of proper and sufficient lubrication is part of a successful installation. Do not use oil in gear couplings.

WARNING
 Do not run the Centac compressor without lubricating the coupling.

Coupling Alignment

CAUTION

Coupling alignment must be correct for successful operation. Flexible couplings will not compensate for any appreciable misalignment. Rapid wear, noise, vibration, and actual damage to the equipment may be caused by misalignment. Therefore, the coupling must be aligned within the limits given.

WARNING

The driver rotation must be checked before making up coupling. Actual damage to the equipment and personal injury could result from operating the unit with wrong rotation.

The Centac compressor is furnished with a limited end float, spacer coupling between the driver and the compressor. The total axial float on motor driven units is limited to approximately three sixteenths (3/16) of an inch (4.8-mm). Turbine driven units are supplied with the same type coupling without the limited end float feature.

Field coupling alignment is required for all Centac compressors. Before proceeding with coupling alignment, check the unit to see that it is level. The unit must be level and grouted before final alignment of the coupling.

As an aid in coupling alignment, make rigid brackets to bolt to the driver shaft coupling hub and the compressor shaft-coupling hub. The rigid brackets should be long enough to reach the opposite shaft-coupling hub. See Figure 3.1. A dial indicator should be attached to each bracket arm to take readings.

Cold alignments are to be made on the coupling hubs. Alignment readings must be taken on hubs that are free of lubricant or other foreign matter.

Bring the gearbox shaft-coupling hub into horizontal alignment with the compressor shaft-coupling hub, using a dial indicator riding on the outer periphery of the compressor hub.

For couplings other than Ingersoll-Rand's standard gear-type coupling, please refer to the vendor literature section.

CAUTION

The coupling alignment, and the coupling itself, must be checked before operation.

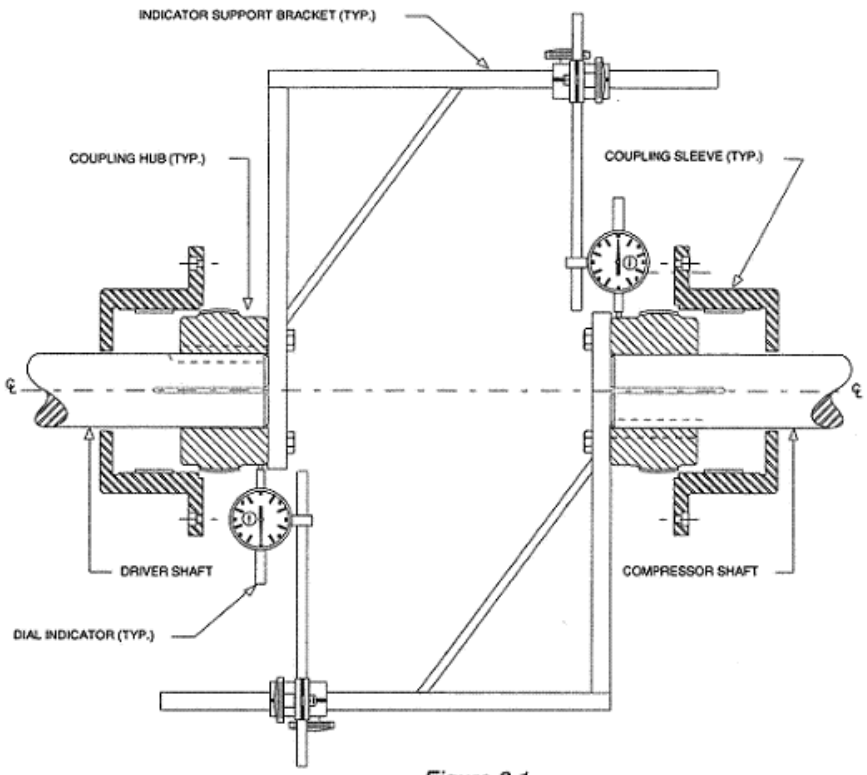


Figure 3.1

Double indicator Alignment

Coupling Lubrication

WARNING
⚠ Do not run the Centac compressor without lubricating the coupling.

Coat the hub and sleeve gear with grease. Slide the sleeve over the hub gear. Insert the gasket. Bolt the sleeves and tighten uniformly.

The coupling **must be** lubricated **before** operation. Hand packing of grease in **each** half of the coupling is recommended. Remove two fittings 180° apart. Rotate the coupling to place the bottom hole 45° off horizontal. Pump or pour lubricant into the top hole until excess appears at the bottom hole. Sufficient lubricant has now been added.

After lubrication, tighten lube plugs to a torque value of 50 lb. ft. See Table below.

CAUTION
⚠ Do not attempt to fill the coupling without venting the interior. An air lock can result in incomplete filling or in damage to the 'o' ring seal.

NOTE
Spacer: limited end float: floating shaft couplings, and some other styles, require each end to be separately lubricated. Do not fill the interior of spacer coupling arrangements. Lubricant capacities for each size and coupling style are given. One-half this amount should be placed in each coupling half.

Grease Quantity Recommendations

SIZE	* GREASE CAPACITY WEIGHT LB. – OZ.	TIGHTENING TORQUE - LB.-IN. SHROUDED BOLTS	EXPOSED BOLTS
H-2	0 - 5	23	50
H-21/2	0 - 8	55	100
H-3	0 - 15	55	100

***** Lubricant capacities for each size and coupling style. This is the total lubricant required for both coupling halves

Cenlube GL Grease

Ingersoll-Rand provides synthetic grease for lubricated couplings. This grease is a non-hazardous anti-friction bearing and coupling grease designed for all speeds of machine between - 40°F and 500°F.

Recommended Lubricants - Gear Coupling

Lubricating greases should equal or exceed these specifications:

Grade:	NLGI #1
Base oil Viscosity Min.:	3000 SSU at 100ºF 160 SSU at 210°F
Dropping Point, Min.:	190°F
Four Ball Wear, ASTM D-2266:	.500mm Maximum
Base oil content:	87% Minimum
K36 Factor, ASTM D-4425:	KSG: K36 = 8/24 = .33
Required:	Rust and Oxidation Inhibitors E. P. Additives

The most reliable test of a suitable lubricant is often the result of user experience and satisfaction. If a lubricant has been known to sludge, separate into heavy components or dry out, consider using other lubricants that meet the minimum specifications.

Main Driver Preparation

The preparation of the **main driver** shall include but not be limited to:

- Check the bolted joints for signs of looseness.
- Check to make sure the bearings have been properly lubricated and the bearing reservoirs filled.
- Rotate the shaft by hand to insure there is freedom of movement.
- Check the control device connections to make sure they agree with the wiring diagrams.
- Refer to the manufacturer's instructions for detailed initial starting and stopping instructions.

Control System Adjustment

Centac compressor control systems may be ordered with a wide variety of monitoring, control, and protection features. Many options are available to meet specific needs of customer.

Pre-start adjustment may vary considerably depending on features ordered. Therefore, see the control panel instructions and electrical prints for necessary adjustments.

Inlet Valve / Inlet Guide Vane and Bypass Valve – Current To Pressure (I/P) Transducer Adjustment

1. Turn off power to the panel and disconnect the current to pressure (I/P) transducer wires.
2. Connect to the I/P a DC power supply with a 4mA to 20mA output capability. Observe for correct polarity.

   Alternatively, the microcontroller may be used to supply the 4mA and 20mA signals to the I/P transducers. To do this the unit must be prepared for a simulated run. A simulated run is accomplished with the block valve closed and the motor controller locked open. Also, the lube oil pressure shutdown setpoint must be adjusted to zero.

   The microcontroller will send a 4mA signal to the transducers when the control panel is energized. The microcontroller will send a 20mA signal to the transducers after the start pushbutton is depressed and the start cycle times out. (Note: mode selector switch should be in the "modulate" position.)
3. Apply 80 PSIG (551 kPa) instrument air to the I/P supply connections.
4. Apply a 4mA signal to the transducers:
   a. Adjust zero screw on inlet valve I/P to obtain 7 PSIG output.
   b. Adjust zero screw on bypass valve I/P to obtain 3 PSIG output.
5. Apply a 20mA signal to the transducers:
   a. Adjust the span screw on inlet valve I/P to obtain 15 PSIG output.
   b. Adjust the span screw on bypass valve I/P to obtain 10 PSIG output.
6. Repeat steps 4 and 5 until correct outputs are obtained at signal inputs of 4mA and 20mA. NOTE: Readjust low oil pressure shutdown setpoint.

Lube System Adjustment

Cleanliness of the lubricating system is of paramount importance to the Centac compressor. Although the system is flushed and fully tested at the factory, the following steps should be taken prior to initial startup.

Oil Pressure Setting

The Centac compressor lube system is designed to operate between 20 and 30 PSIG (138-207 kPa). When setting the system oil pressure, attention must be given to both the lube pump internal relief valve and the pressure sensing valve (PSV) mounted in the lube system piping.

The following procedure should be followed to set lube system pressure:

1. Start the prelube pump with instrument air applied to the seals, and the reservoir filled to proper level with recommended oil.
2. Observe the oil pressure indication on the CMC panel. Turn the system PSV adjusting screw (CCW) to reduce pressure or the (CW) to increase pressure. Set at 25 PSIG [179 kPa].
3. Start the compressor and allow oil to reach operating temperature.
4. Readjust system PSV to obtain 25 PSIG [172 kPa] (nominal).
5. Lock down adjusting screw.

WARNING

 Operation of the unit without proper lubrication can result in overheating of the bearings, bearing failures, pump seizures and equipment failure exposing operating personnel to personal injury.

Routine Start/Stop

WARNING

 The unit must not be operated unless coupling guard is in place. Failure to observe this warning could result in personal injury to operating personnel.

CAUTION

 Never attempt a restart until the compressor has completely come to rest.

Prior to starting, the operator should become familiar with the operation of the main driver. Refer to the driver manufacturer's instructions. The operator should also be familiar with all the accessory equipment and optional equipment contained on the unit.

Personnel who are unfamiliar with the compressor package should not start, operate or tamper with the equipment. Only fully trained personnel should be allowed to start and operate this compressor. The following procedure is a guideline for the fully trained operator.

Starting

1. Turn on the cooling fluid to the oil cooler(s), air cooler(s), and any other optional heat exchanger. Vent the air coolers if not continuously vented.
2. Open the valve in the instrument air line to the control panel.
3. Check the seal air pressure gauge. The seal air pressure must be between 7-8 PSIG. Adjust the seal air regulator if necessary.
4. Check the main driver and compressor oil level.
5. Turn on the electrical power to the control panel. The prelube pump should start.
6. Check the oil pressure to the compressor casing. This should be 20 PSIG (nominal).
7. Check the oil temperature. This should be 95°F (nominal).
8. Check to see that the inlet valve is closed and the bypass valve is open.
9. Open the isolation block valve in the discharge air line.
10. Drain residual condensate from the compressor casing by opening each condensate trap bypass valve.
11. Drain any condensate from the air inlet piping drip leg.
12. Check the discharge pressure set point. Adjust if necessary.
13. Press the start button on the control panel.

a. If the compressor was started in “unload” mode, it will continue to operate in this mode until another control mode is selected.

b. If the compressor was started in an operating mode other than “unload”, the discharge pressure will increase to the discharge pressure setpoint after the starting time has expired.

14. Observe the oil pressure to the unit. If pressure is not within the recommended operating range, adjust the oil pressure-sensing valve at the sump return.

15. Observe vibration levels. If excessive vibration levels exist, the unit will automatically shut down.

16. Observe the supply oil temperature to the compressor casing. The oil temperature should be between 105 - 115°F with a water supply temperature of 95°F and less.

17. Observe the air cooler water flow rates. Generally water flow should maintain a 25°F water temperature rise across the cooler. At this setting, the air temperature leaving the cooler, with a full load, should no more than 20°F of the inlet water temperature.

The Centac compressor is automatic in operation and contains the following minimum protective devices:

- Low oil pressure shutdown.
- Oil temperature (high and low) shutdown.
- High air temperature shutdown.
- High pinion shaft vibration shutdown.
- Surge alarm.

Refer to the electrical schematic, and Control section of Operation Manual for any additional protective devices.

Stopping

Refer to the main driver manufacturer's instruction for any special instructions for stopping the main driver.

Simply pushing the “Compressor Stop” pushbutton will stop any Centac compressor. Refer to the electrical schematic and the Control section for stopping units with special options.

Unload the compressor before it is shut down. This is the recommended method to allow the operating temperature to stabilize.

Post shut down lubrication is required to allow internal heat to be carried away by the circulating oil.

Cooling fluid should also be permitted to flow about 20 to 30 minutes after the compressor has stopped. Some units may have optional equipment, which automatically stops the flow. This procedure is recommended to allow for controlled cool down of the compressor.

Operating the Compressor in Cold Ambient Temperatures

To facilitate start up and shutdown in cold climates, power to the lube oil heater should be kept on at all times. If power failure is anticipated, it may be desirable to insulate and/or heat trace the lube oil piping from the oil reservoir to the casing. This will speed up the start after extended shutdowns in cold climates.

When the temperature drops down below -20°F (-28.9°C) and/or there is wind driven snow, follow the guidelines listed below:

- Dry nitrogen – when dry nitrogen is used for instrument and control air, no additional protection is required.
- Control Air – when using instrument air as control air, rather than dry nitrogen, insulate and/or heat trace the Instrument air lines and the control air lines. This will prevent condensate from forming, then freezing and causing restricted air flow and possible malfunctions.
- Cooling water – when cooling water is used for drain and vent lines, rather than a water/glycol mixture, heat trace or insulate the following items to prevent possible freezing in the lines that are remote to the compressor.
  - Air cooler vent lines
  - Air cooler drain lines
  - Water Manifold drain lines
  - Oil cooler drain lines

  Heat tracing or insulating these line will allow for proper drainage of water from the system in the case of a shutdown.
- Cooling water – as above. If cooling water (rather than a water/glycol mix) is used and it is possible for the Centac compressor to shut down without draining, the following items may be insulated and/or heat traced to prevent possible freezing of the undrained water.
  - Main casing (air coolers and condensate system)
  - Oil cooler
  - Cooling water manifold

Section 4 – Maintenance

The Centac compressor does not require constant attendance. However, a few items should be checked periodically.

Scheduled preventive maintenance and inspection is essential for continued optimum performance and long service life of the compressor. The following are general requirements and schedules for inspection and preventive maintenance. Since unusual service conditions and environment affect equipment reliability, these items and schedules should be adjusted in time and content as necessary to suit your specific requirements.

Maintenance Schedule Daily and Each Start-Up

1. Check and record instrument air pressure.
2. Check the compressor reservoir oil level.
3. Check and record the oil temperature to the compressor.
4. Check and record the compressor oil supply pressure.
5. Check the main driver oil level. (Does not apply to a driver with anti-friction bearings.) Refer to driver manufacturer's instructions contained in the Operation Manaul.
6. Check the vibration level on each stage of the compressor
7. Check and record all interstage pressures (if available).
8. Check and record all interstage temperatures.
9. Check and record the inlet air temperature (if available).
10. Inspect for tubing/fitting leakage.
11. Check and record the air cooler water temperature, both to and from the coolers (if available).
12. Check and blow down the condensate traps.
13. Check and record the inlet air filter differential pressure.
14. Check to make sure the air coolers are continuously venting. Vent valves are located on top of the casing.
15. Drain the condensate from the inlet air line drip leg. Do not open the valve with the compressor operating.
16. Drain the condensate from the discharge header drip leg.
17. Drain the condensate from the bypass air line drip leg.
18. Drain the drip legs on any other horizontal run of air piping.
19. Check for oil leaks. Correct as necessary.
20. Inspect for gasket / o-ring leakage.
21. Check for water leaks. Correct as necessary.
22. Open the control air line drip leg valve to remove any moisture that may have collected.
23. Check the instrument air line filter. Drain any moisture, which may have collected.
24. Check and record the oil filter differential pressure, if available. Replace the filter element as necessary.

Quarterly Maintenance

1. Inspect instrument air filter.
   - Drain and clean the filter.
   - Replace the element.
2. Drain control air drip leg.
3. Inspect condensate traps.
   - Remove and clean. Replace parts as necessary.
   - Replace trap if necessary.
4. Grease motor bearings.
   - Use correct type and amount of grease.
   - Use hand-pump grease gun only.
   - Bearings should be greased with the motor stopped.
5. Visually inspect the inlet air filter.
   - Clean element.
   - Replace element as necessary.
   - Inspect seams of the filter for cracks for potential bypassing. Seal seams as needed.
6. Change oil mist arrestor element.
   - Add oil to U-tube.
   - Clean element housing.
   - Inspect old element for over-crushing. Add restricting nuts to prevent over-crushing.
   - Eliminate lock washer under wing nut, if installed.
   - Replace seal washer under wing nut.
   - Check to insure the element cover is making good contact with the element. The cover should fit squarely on the housing.
7. Inspect the Mist Eliminator element and replace as needed. Mist Eliminator elements are a long life item and should not require routine replacement.
8. Inspect control panel.
   - Watch for: loose wiring, wrong line filter, damaged line filter, and adequate arc suppressors.
   - Clean panel fan filters and panel.
   - Disconnect and tie back all unused wires from terminal strips.
   - Check the vibration transmitter wires to make sure they run directly to the microcontroller terminal strips.

Semiannual Maintenance

1. Follow the quarterly schedule.
2. Lubricate the main driver coupling. Dry-type coupling components must be inspected.
3. Change oil filter.
4. Leak test the air coolers.
5. Change the driver bearing grease.
6. Obtain an oil sample and have it analyzed (see Technical Flyer in Appendix).
7. Check the control system per the procedure found in the Control section of the Operation Manual.
8. Check the inlet and bypass valve calibration.

Annual Maintenance

1. Inspect the main driver per the manufacturer's instructions found in the Operation Manual.
2. Visually inspect the coupling. Lubricate as required.
3. Manually rotate bullgear to feel for roughness on models with bullgear anti-friction bearings.
4. Inspect and clean the oil reservoir suction screens.
5. Visually inspect the oil cooler tubes. Clean the water side of the oil cooler if necessary.
6. Visually inspect the zinc anodes (pencils) in the oil cooler. Replace if necessary.
7. Visually inspect the inlet throttle valve.
8. Visually inspect the bypass valve.
9. Visually inspect the discharge check valve.
10. Change the oil once a year or after 8,000 hours of use, unless Techtrol Gold III is used. When using Techtrol Gold III, the lubricant must be changed every three years / or after every 24,000 hours of use.

CAUTION

 Servicing of the internal parts is not recommended without the presence of an Ingersoll-Rand service supervisor. For technical assistance, please call your local Ingersoll-Rand representative.

WARNING

 Develop and use a “Red Tag” procedure or similar system whereby maintenance personnel can lock off the power switch during maintenance.

Replacement coolers, rotor assemblies, bearings, and seals are available in a variety of options:

- Exchange for factory trade-ins.
- Return the part for refurbishing.
- Return damaged parts for scrap and obtain credit toward new parts.
- Factory warranty program on all exchange parts.
- Rapid cooler cleaning and hydrotesting.

Maintenance Procedures

The following procedures are added to supplement the information presented earlier in this manual in Section 3, Operation, under the heading Initial Start Preparation.

Main Driver

Depending upon the customer's requirements, different drivers are used with the Centac compressor. Consult the driver manufacturer's literature provided in this manual to insure proper lubrication and maintenance procedures.

Control Panel

The control panel checkout procedure is designed to verify that a control panel is functioning properly. The checkout can be used for initial testing or in conjunction with routine maintenance schedules.

Refer to the control drawings and checkout procedure included with the Control Panel Instructions in this manual to insure proper adjustments and calibrations.

Intake Filter

All filtration systems have a maximum recommended pressure drop at which the filter element should be cleaned or replaced. Because of the many types of atmospheric conditions that exist it is difficult to accurately determine the life of a given filter element. It is therefore advisable and highly recommended that a weekly pressure drop measurement be recorded for both the primary and final stage filter elements to determine the useful element life.

Filter maintenance is a necessary and important part of the entire air system. A properly maintained inlet air filter will result in optimum air compressor operation. An increase in filter differential pressure is an indication that the inlet air filter is performing as intended.

"Panel" Type Inlet Filters

The following maximum pressure differential levels should be followed:

- Primary Stage Element(s). Clean or replace at 4" W.C. differential pressure.
- Final Stage Element(s). Replace at 4" W.C. differential pressure.
- Total differential pressure across filter of 8" W.C.: Clean or replace primary stage element(s) and replace final stage element(s).

When indicated by the above differential pressure data, the filter elements should be removed for either cleaning or replacement. It is recommended that the filter be serviced when the compressor is **not** in operation.

Cleaning Guidelines:

1. Unlatch the weatherhood and swing it up.
2. Grasp the removal strap located on the face of the panel filter and pull straight forward.
3. Install cleaned or new prefilter, making sure the removal strap is facing you and is in a horizontal position.
4. Swing the weatherhood down and secure the latches into the slots on the side of the filter housing.
5. Clean first by using compressed air. Blow off dust by directing the compressed air from back to front. Next, water wash by agitating the panel filter in hot water (approx. 150°F) and mild cleaning agent solution.
6. Rinse with clean water and air dry for at least 12 hours. The panel filter should be completely dry before reinstallation to prevent premature dirt loading.

NOTE
Inspect both front and rear gaskets, making sure they are not damaged. Do not touch the panel filter media portion of the panel element. Handle only by grasping the metal frame.

The panel filter corner angles indicate the bottom, and pull rings indicate the front.

7. Slide the panel filter into housing and latch all latches to the panel filter sides. All latches must be fastened to properly seal the final stage panel filter to the housing.

Final Stage Panel:

1. Remove the primary panel filter as noted above.
2. Unlatch the latches on the side of the filter housing.
3. Grasp the pull devices located on the front sides of the panel filter and pull straight forward.
4. Install a new final stage panel filter.

Final stage panels are **not** cleanable and must be replaced when dirty. Replace at a 4" W.C. differential pressure.

Inlet Valve

Periodically stroke the inlet valve to aid in optimum performance of the compressor. See the Manufacturer's Installation Bulletin located in the Vendor Literature Section of this manual for guidelines on stroking the inlet valve.

CAUTION

 Observe for freedom of movement of the inlet valve during the stroking procedure.

Bypass Valve

Periodically stroke the bypass valve to aid in optimum performance of the compressor. See the Manufacturer's Installation Bulletin located in the Vendor Literature Section of this manual for guidelines on stroking the bypass valve. In addition to stroking, the bypass valve should be removed from the air piping system annually to inspect the seals for damage. Replace damaged seals as required and reinstall valve.

Checking Vibration

Periodically monitor shaft vibration on both sides of the coupling with a vibration analyzer. In normal operation do not run the unit when vibration levels, as measured on the shaft, exceed two (2) mils on three thousand to thirty-six hundred (3000-3600) RPM drivers. If vibration is measured using a non-contacting probe, add one half (1/2) mil to the above levels. If vibration levels exceed the above values shut the unit down and determine the cause of vibration.

Impeller to diffuser clearance

Impeller to diffuser clearances are factory set on new compressors, but the clearance should be checked prior to initial start-up after an overhaul or any start-up after a rotor assembly or bearing has been removed from the unit. This procedure should be done under the supervision of an Ingersoll-Rand service supervisor.

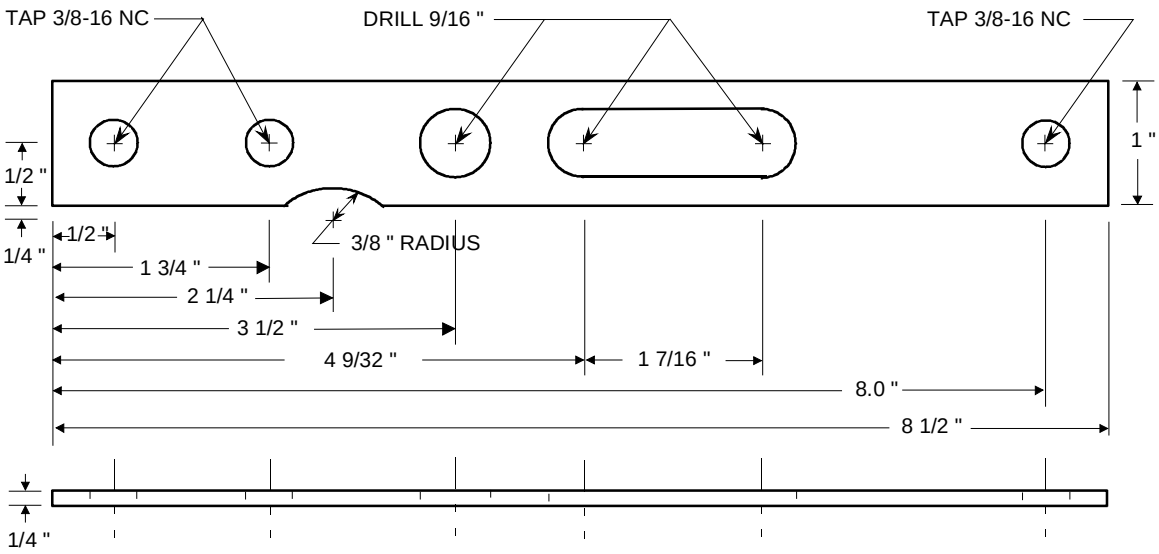
Procedure for **setting impeller clearance for units which require shims**.

1. Remove the bearing cover and bearing locking bolts.
2. Tighten the jacking screws until the bearing is free to move, then loosen the jacking screws.
3. Push the bearing in until it seats against the gear case.
4. Push the rotor assembly in by the thrust collar until resistance is felt.

NOTE
Never attempt to set the clearances without an impeller clearance setting tool. See the Centac Clearance Setting Tool diagram on the next page.

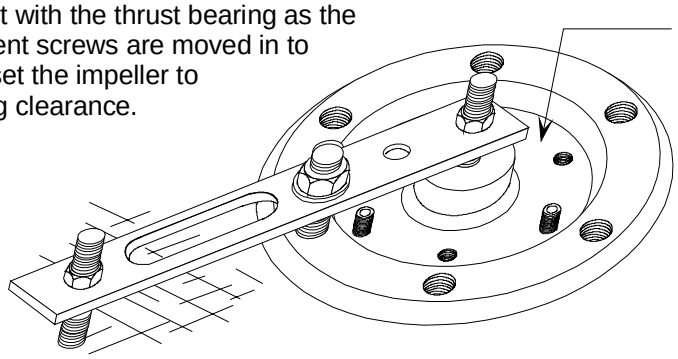
5. Install the clearance setting tool against the thrust bolt using one of the bearing cover bolt holes to support the other end.
6. Install (2) dial indicators on a post installed in one of the other thrust cover bolt holes.
7. Set (1) dial indicator to contact the top of the clearance-setting tool above the thrust bolt. The purpose of this is to show the movement of the rotor.
8. Set (1) dial indicator to contact the thrust bearing flange. The purpose of this indicator is to indicate the movement of the bearing.
9. Zero both indicators.
10. Begin tightening the jacking bolts in sequence. Each turn of the jacking bolt should cause no more than .001 inch (0.03mm) of bearing movement. Gently tap bearing flange near jacking bolt using soft hammer.
11. Note that the bearing moves before the rotor assembly begins to move.
12. Continue to tighten the jacking bolts until the specified pressure tip clearance is indicated on the rotor assembly dial indicator.
13. The reading on the bearing flange dial indicator is the thickness required for the thrust bearing shims.
14. Use specified shims and grind to the correct size -- should be less than .100 inch (.393mm).
15. Install the shims under the 3 locking bolts, back off the jacking bolt (1) full turn and tighten locking bolts.
16. Install the bearing cover.

CENTAC UNIVERSAL CLEARANCE SETTING TOOL



Material: Common 1/4" bar stock

Use any combination of threaded and unthreaded holes in the clearance setting bracket to apply bracket spring pressure on the thrust collar. This action keeps the thrust collar in positive contact with the thrust bearing as the thrust adjustment screws are moved in to establish and set the impeller to diffuser running clearance.



UNIVERSAL CLEARANCE SETTING TOOL METHOD OF USE

Discharge Check Valve

The discharge check valve must be removed from the piping system for inspection. When inspecting the check valve, look for:

1. Rust
2. Broken Springs
3. Damaged Seals
4. Freedom of Movement

Repair or replace as necessary and reinstall discharge check valve.

When check valve is mounted in a horizontal run of pipe, the valve should be oriented so that the stem is vertical.

Oil Suction Screen

The oil suction screen is an open type screen located within the reservoir on the inlet of the oil pump. Each time oil reservoir is drained the suction screen should be removed and cleaned. Rinse screen in solvent to clean.

Oil Filter

A single line type oil filter is furnished as standard equipment on the Centac compressor. Some Centac compressors are furnished, as optional equipment, with a dual line type filter with a transfer valve. Both single and dual filters have throwaway replaceable cartridge elements. The following will serve as guidelines when changing filter elements.

Filter elements should be replaced when the pressure drop exceeds 8 PSIG from when the filter was new.

WARNING

 Lube system pressure may reach 50 PSIG and temperatures of 160°F or more. Do not penetrate lube system while machinery is operating.

WARNING

 Hot oil can cause serious injury to personnel. Precaution must be taken to prevent contact with hot oil. .

Single Filter

1. Provide suitable means of collecting and disposing of used oil
2. Loosen center post to disassemble the filter.
3. Discard the element. Clean remaining parts.
4. Reassemble the housing center post, conical spring and one metal backup washer.

NOTE
Conical spring is to be installed with large end against the housing.

5. Lubricate the two rubber seals received with new element.
6. Install one seal over the center post and against the backup washer.
7. Place new element over the center post and engage the rubber seal into the recess in the element end cap.
8. Install second seal into the recess at the top end of the element.
9. Lubricate seal located on filter head.
10. Position housing assembly into place on filter head and tighten center post.

CAUTION
 Keep housing from rotating while tightening center post to 20 ft. Lbs. Torque.

Oil Cooler

Inspection:

1. Remove bonnets from oil cooler and inspect zinc anode for erosion or oxide deposits. Scrape to brighten surface and replace if more than half is corroded away.
2. Carefully examine tubes for scale and clean if necessary. After cleaning, examine for erosion or corrosion.
3. After maintenance inspection or cleaning, both shell and tube side should be carefully vented and full of liquid.

Cleaning:

The shell side of the oil cooler generally will not need to be cleaned. Flushing a high velocity stream of water through them may clean the tube side of the cooler. For more stubborn deposits, wire brushes or rods can be used.

Mist Arrestor

A reservoir mist arrestor is furnished as standard equipment on the Centac compressor.

The element on the Mist Arrestor must be replaced; it is non-able to be cleaned. To replace element:

1. Remove wing nut on top of breather.
2. Lift off top, exposing element.
3. Remove element. Dispose of properly.
4. Replace with new element.
5. Replace top of breather and wing nut.

Condensate Trap

The condensate trap is a float type liquid drainer and requires periodic inspection and cleaning.

WARNING
 Shut off compressor before performing any maintenance on the condensate system.

During normal operation the trap should have an intermittent discharge, a dribble or semi-continuous discharge, or a constant discharge flow of liquid. Any of these conditions are indications of proper trap operation.

No discharge indicates possible trouble. Open condensate bypass valve. A small amount of condensate discharged indicates a light condensate load to the trap. A large amount of condensate discharge indicates trap has failed and should be repaired.

WARNING
 Condensate bypass valves should be opened slowly as condensate may be discharged at pressures exceeding 125 PSIG. Hearing protection must be worn when bypass valves are open.

Continuous air discharge from the trap indicates it has failed and should be repaired.

To clean the trap:

1. Remove the bolts holding the body together.
2. Carefully remove and clean the internal parts.
3. Inspect orifice seats for any corrosion or undesirable condition.
4. Inspect the leverage system for freedom of movement.

Similar maintenance care should be given to other optional styles of condensate removal systems.

Section 5 –Troubleshooting

Symptom	Possible Cause	Corrective Action
Fail to start	Failure to clear shutdown or interlock devices.	Correct shutdown or interlock condition that is indicated by panel light.
	No primary power to starter.	Check voltage to starter. Check fuses.
	No control panel power to compressor control panel or starter.	Check voltage to panel/starter. Check control transformer.
	Loose or corroded connection or defective power cables.	Check connections. Clean, tighten and replace as necessary.
	Defective motor starter or starting circuit.	Troubleshoot starter per manufacturer's recommendation.
Ineffective prelube Pump	Improper adjustment of lube pump relief valve.	Adjust relief valve for correct pressure.
	Pump not running.	Troubleshoot pump starter. Check for proper voltage.
	Defective motor.	Repair or replace motor.
	Defective pump.	Repair or replace pump.
	No seal air. (Seal air interlock is optional feature.)	Establish seal air.
High Oil Temperature	Low or no water flow to oil cooler.	Establish correct water flow.
	Higher water temperature than realized.	Take necessary steps to lower the water supply temperature.
	Improper temperature device setting.	Calibrate instrument.
	Dirty or plugged oil cooler on water side.	Clean cooler tubes. Provide water strainers as necessary.
Low Oil Pressure	Improper adjustment of system pressure relief valve.	Adjust system pressure relief valve for correct oil pressure.
	Leaking or pinched oil line.	Repair or replace oil line.
	Dirty oil filter.	Replace with clean filter.
	Defective main oil pump.	Repair or replace main oil pump.

Symptom	Possible Cause	Corrective Action
High Air Temperature	Low or no water flow to air cooler.	Establish correct water flow.
	Higher water temperature than realized.	Take necessary steps to lower the water supply temperature.
	Improper temperature device setting.	Calibrate device.
	Dirty or plugged air cooler on water side.	Clean water passages in cooler. Provide water strainers as necessary. Contact Ingersoll-Rand service representative.
Low Seal Air Pressure	Low instrument air pressure.	See “Low Instrument Air Pressure” below.
	Improper adjustment of seal air pressure regulator.	Adjust regulator to obtain correct seal air pressure.
	Excessive bleed off valve adjustment. (If supplied).	Reduce seal air bleed off.
	Worn seals.	Replace seals. Consult Ingersoll-Rand service representative.
Low Instrument or Valve Operating Air Pressure	No supply pressure, pinched or leaking air lines.	Establish instrument air supply pressure. Repair or replace air lines.
	Improper adjustment of air regulator.	Adjust regulator to obtain correct instrument air pressure.
High Vibration	Low oil temperature.	Allow warm-up period for oil.
	Driver to compressor misalignment.	Check and correct alignment (dowel motor feet after alignment).
	Worn coupling or spacer.	Lubricate. Replace coupling and/or spacer.
	Rotor assembly unbalance due to foreign matter build up.	Contact Ingersoll-Rand service representative. Cleaning and balance check required.
	Rotor assembly unbalance due to damaged aero parts.	Contact Ingersoll-Rand service representative. Repair or replacement and balance check required.
	Induced vibration from driver.	Balance motor rotor.

Symptom	Possible Cause	Corrective Action
Fail to Load	Mode selector switch in UNLOAD position.	Turn selector switch to Modulate or Auto-Dual operating mode.
	Low set point on pressure controller.	Adjust controller to desired operating pressure.
	Bypass valve not closed or inlet valve not open.	Correct improper operation of the inlet or bypass valve.
Low System Air	Compressor not loaded.	See “Fail to Load” above.
	Dirty inlet filter.	Change filter elements.
	Low surge.	See "Continual Surging" below.
	Greater demand than realized.	Repair ALL air leaks. Turn off unnecessary demands.
Continual Surge (Pumping)	Discharge block valve closed.	Open block valve.
	Improper calibration of surge sensor.	Calibrate instrument. Insure surge sensor switch is not stuck.
	Dirty inlet filter.	Change filter elements.
	Improper adjustment of throttle limit (LLR, CLL, TL).	Adjust throttle limit.
	High inter stage air temperature.	Establish correct water flow to air coolers.
	Higher water temperature than realized.	Reduce the cooling water temperature.
	Worn or fouled aerodynamics parts.	Contact Ingersoll-Rand service representative.
Excessive Power Consumption	Lower ambient temperature than realized.	Reduce compressor load. Consult Ingersoll-Rand service representative.
	Low primary voltage.	Consult power company. Check power source.
	Reduction in motor efficiency.	Consult motor manufacturer.
	Excessive load.	Reduce load.
High Drive Motor Amperage	Low primary voltage.	Restore voltage to specification.
	High load.	Reduce load.

Section 6 – Parts and Service

CAUTION
The Centac compressor is a high technology product. Service or inspections beyond the procedures given in this manual should not be attempted by operating personnel. Ingersoll-Rand service offices are listed below.

Our commitment to you is unparalleled. Twenty-four hours a day, seven days a week,

Ingersoll-Rand is ready. When you need results, Ingersoll-Rand produces.

Ingersoll-Rand is committed to serving you. If you require information, service or parts, we are strategically located to serve your needs. When you need support for you Centac compressor, contact your local Ingersoll-Rand representative or call the factory direct.

INGERSOLL-RAND

Centac Aftermarket Services:

Centac Customer Training Schools

Centrifugal Diagnostic Services CDS

Air Care – 5 year extended warranty & Preventative Maintenance Plan

Cooler Cleaning Inspection/Repair

Rotor Cleaning Balancing/Repair

CMC® Microprocessor Controls

CEM® Centac Energy Master

Control System Upgrades

Performance Enhancements

Pure Air Chemical Filtration System

Remanufactured Centac Compressors

Return Goods

Contact Centac Customer Care or Reliability Engineering for authorization to return material to the factory. A return number will be issued to tag the returned material. This number will preclude material loss or processing delay at the factory.

Parts Identification

When ordering renewal parts, the information listed below should be given.

- Type and Machine Serial Number from the compressor nameplate.
- The Quantity Required and Part Description.
- The sequence number (and/or part number) as listed on the compressor assembly drawing, process and instrumentation drawing and bill of material which is included in this section.

Assistance

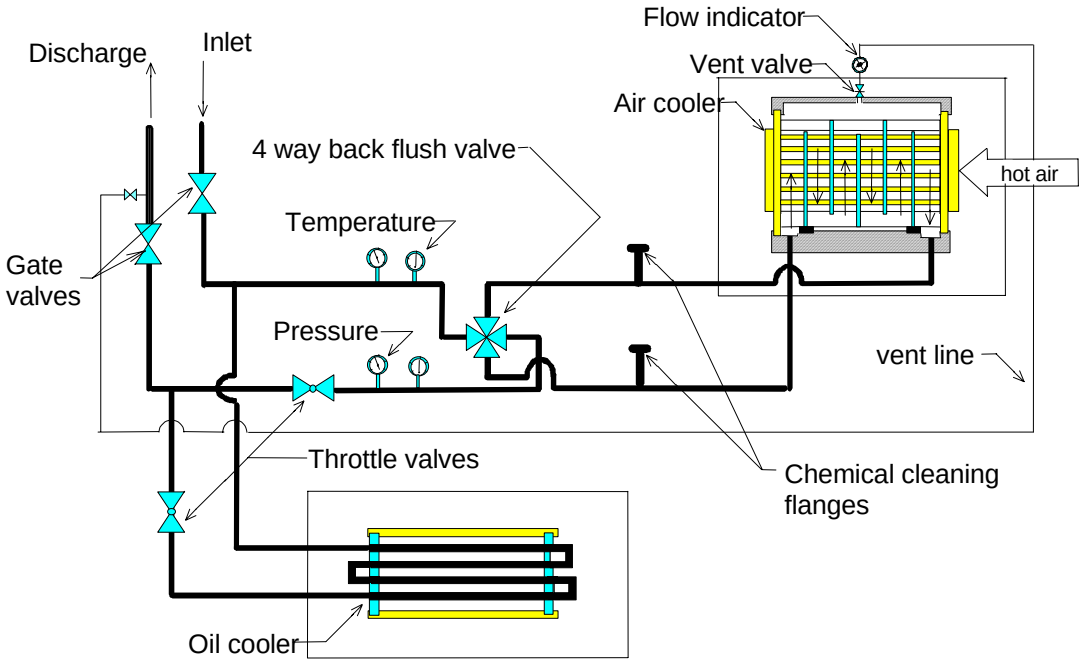
Ingersoll-Rand is committed to serving you. If you require information, service or parts, we are strategically located to serve your needs. When you need support for your Centac compressor, contact your local Ingersoll-Rand representative or **call 24 hours a day for parts or service.**

Phone: **800-247-8640 or 270-247-8640**

Fax: **270-251-1273**

Appendix A

OPTIONAL COOLING WATER SYSTEM BACKFLUSH



* Valves and gauges normally supplied by customer