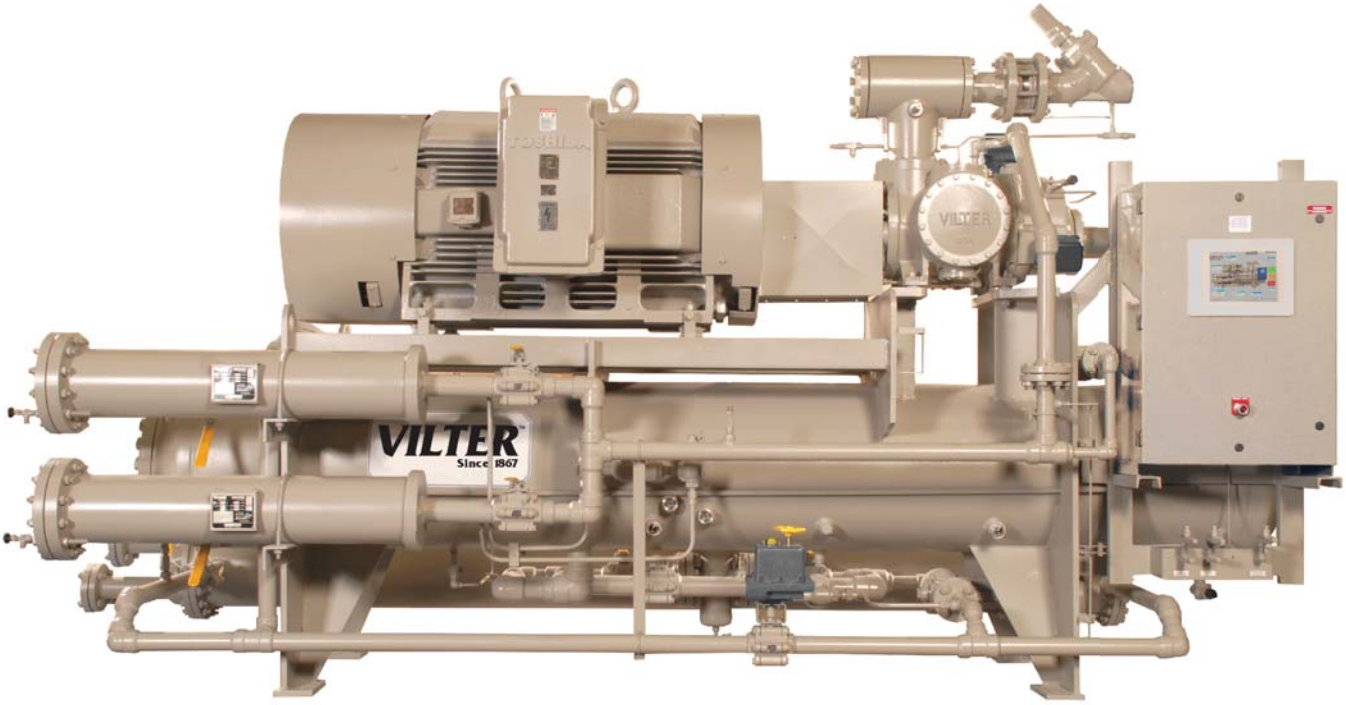
VSG/VSSG compressor unit

Installation, operation & maintenance manual



VILTER™
Since 1867

EMERSON™
Climate Technologies

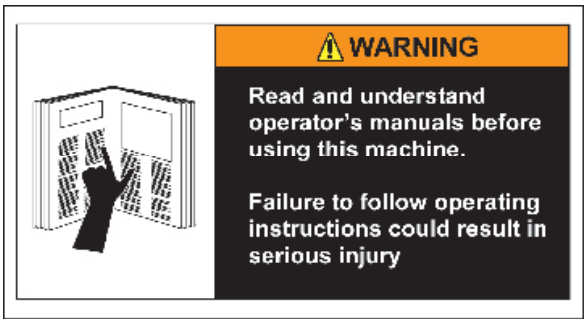
VSG/VSSG Standard Vilter Warranty Statement

Seller warrants all new single screw gas compression units and bareshaft single screw compressors manufactured by it and supplied to Buyer to be free from defects in materials and workmanship for a period of (a) eighteen (18) months from the date of shipment or (b) twelve (12) months from the date of installation at the end user's location, whichever occurs first.
If within such period any such product shall be proved to Seller's satisfaction to be defective, such product shall be repaired or replaced at Seller's option. Such repair or replacement shall be Seller's sole obligation and Buyer's exclusive remedy hereunder and shall be conditioned upon (a) Seller's receiving written notice of any alleged defect within ten (10) days after its discovery, (b) payment in full of all amounts owed by Buyer to Seller and (c) at Seller's option, Buyer shall have delivered such products to Seller, all expenses prepaid to its factory. Expenses incurred by Buyer in repairing or replacing any defective product (including, without limitation, labor, lost refrigerant or gas and freight costs) will not be allowed except by written permission of Seller. Further, Seller shall not be liable for any other direct, indirect, consequential, incidental, or special damages arising out of a breach of warranty.

This warranty is only applicable to products properly maintained and used according to Seller's instructions. This warranty does not apply (i) to ordinary wear and tear, damage caused by corrosion, misuse, overloading, neglect, improper use or operation (including, without limitation, operation beyond rated capacity), substitution of parts not approved by Seller, accident or alteration, as determined by Seller or (ii) if the product is operated on a gas with an H2S level above 100 PPM. In addition, Seller does not warrant that any equipment and features meet the requirements of any local, state or federal laws or regulations. Products supplied by Seller hereunder which are manufactured by someone else are not warranted by Seller in any way, but Seller agrees to assign to Buyer any warranty rights in such products that Seller may have from the original manufacturer. Labor and expenses for repair are not covered by warranty.

THE WARRANTY CONTAINED HEREIN IS EXCLUSIVE AND IN LIEU OF ALL OTHER REPRESENTATIONS AND WARRANTIES, EXPRESS OR IMPLIED, AND SELLER EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

Any description of the products, whether in writing or made orally by Seller or Seller's agents, specifications, samples, models, bulletins, drawings, diagrams, engineering sheets or similar materials used in connection with Buyer's order are for the sole purpose of identifying the products and shall not be construed as an express warranty. Any suggestions by Seller or Seller's agents regarding use, application or suitability of the products shall not be construed as an express warranty unless confirmed to be such in writing by Seller.



READ CAREFULLY BEFORE INSTALLING AND STARTING YOUR COMPRESSOR.

The following instructions have been prepared to assist in installation, operation and removal of Vilter Single Screw Compressors. Following these instructions will result in a long life of the compressor with satisfactory operation.

The entire manual should be reviewed before attempting to install, operate, service or repair the compressor.

A compressor is a positive displacement machine. It is designed to compress gas. The compressor must not be subjected to liquid carry over. Care must be exercised in properly designing and maintaining the system to prevent conditions that could lead to liquid carry over. Vilter Manufacturing is not responsible for the system or the controls needed to prevent liquid carry over and as such Vilter Manufacturing cannot warrant equipment damaged by improperly protected or operating systems.

Vilter screw compressor components are thoroughly inspected at the factory. However, damage can occur in shipment. For this reason, the equipment should be thoroughly inspected upon arrival. Any damage noted should be reported immediately to the Transportation Company. This way, an authorized agent can examine the unit, determine the extent of damage and take necessary steps to rectify the claim with no serious or costly delays. At the same time, the local Vilter representative or the home office should be notified of any claim made.

All inquires should include the Vilter sales order number, compressor serial and model number. These can be found on the compressor name plate on the compressor.

All requests for information, services or parts should be directed to:

Vilter Manufacturing LLC
Customer Service Department
P.O. Box 8904
5555 South Packard Ave
Cudahy, WI 53110-8904 USA
Telephone: 1-414-744-0111
Fax:1-414-744-3483
e-mail: info.vilter@emerson.com

Equipment Identification Numbers:

Vilter Order Number: _____Compressor Serial Number: _____
Vilter Order Number: _____Compressor Serial Number: _____
Vilter Order Number: _____Compressor Serial Number: _____
Vilter Order Number: _____Compressor Serial Number: _____

Table of Contents

Section Title **Section Number**

Table of Contents

Section Title **Section Number**

Section 4 • Operation

Section 5 • Maintenance/Service

Section 6 • Troubleshooting

List of Tables and Figures

Section Title **Section Number**

Section 7 • Warranty and Parts

Appendices

Table/Figure **Section Number**

Tables

Figures

List of Tables and Figures

Table/Figure **Section Number**

How To Use This Manual

This manual contains instructions for gas compressor units. It has been divided into eight sections:

Section 1: General Information

Section 2: Theory of Operation

Section 3: Installation

Section 4: Operation

Section 5: Maintenance & Service

Section 6: Troubleshooting

Section 7: Warranty and Parts

Appendices

It is highly recommended that the manual be reviewed prior to servicing system parts.

Figures and tables are included to illustrate key concepts.

Safety precautions are shown throughout the manual. They are defined as the following:

NOTICE - Notice statements are shown when there are important information that shall be followed. Not following such notices may result in void of warranty, serious fines, serious injury and/or death.

WARNING - Warning statements are shown when there are hazardous situations, if not avoided, will result in serious injury and/or death.

CAUTION - Caution statements are shown when there are potentially hazardous situations, if not avoided, will result in damage to equipment.

NOTE - Notes are shown when there are addtional information pertaining to the instructions explained.

Additional installation, operation and maintenance instructions can be found in the associated software manual and bareshaft compressor manual.

Gas Compressor Unit Model Designations

The compressor unit model designation can be found on the nameplate. For nameplate location, see Component Identification on section page 1-4.

Figure 1-1. Gas Compressor Unit Model Designation

1. Compressor Model

VSG = Vilter Single Screw Compressor

VSSG = Vilter Single Screw Compressor

(Compressor models 291, 341, 451 & 601 - these are 240mm diameter rotors with counter clockwise rotation)

VRSG = Vilter Twin Screw

2. Size

CFM - Nominal CFM displacement of the compressor at 3600 rpm

3. Slide Arrangement

VVR = Variable Volume Ratio; Parallex™

4. Gas Compressed

L = Landfill Gas

D = Digester Service Site Application

N = Natural Gas (Primarily Methane)

G = Other Gas Type

5. Application

HP = High Stage with Oil Pump

HN = High Stage no Oil Pump

6. Driver

VFD = Variable Frequency Drive

EMD = Electric Motor Drive

ENG = Engine Drive

7. Separator Type

16 = 16 inch diameter
20 = 20 inch diameter
24 = 24 inch diameter
30 = 30 inch diameter
36 = 36 inch diameter
42 = 42 inch diameter
48 = 48 inch diameter
54 = 54 inch diameter

H = Horizontal
SH = Special Horizontal
V = Vertical
SV = Special Vertical

8. Economizer

NEC = No Economizer, Economizer Ports Plugged

HEC = Holes drilled in Economizer Plug for Oil or Unloading

9. Oil Cooler

PLT = Plate

ST = Shell and Tube

REM = Remote

10. Oil Cooling Medium

REF = Refrigerant

WTR = Water

GL = Glycol

AIR = Air

System Unit Identification

To keep definitions of units simple and consistent, Vilter has defined the following three:

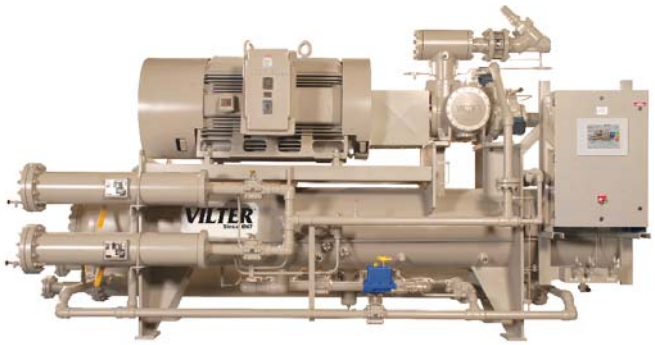
- Bare Shaft Compressor
- Compressor Unit
- Package Unit

Bare Shaft Compressor

A bare shaft compressor is just the compressor with no coupling and motor nor foundation.

Compressor Unit

A compressor unit consists of the bare shaft compressor with the coupling, motor, oil separator, frame, micro-controller system and oil system. A compressor unit typically a single screw compressor unit, is not mounted on a structural steel base.



Package Unit

A package unit is a complete system mounted on a structural steel base with interconnecting piping.

Compressor Unit Component Identification

Each gas compressor unit may differ, but below are typical components that can be found on each unit.

1 - Motor
2 - Coupling
3 - Suction Strainer
4 - Suction Check Valve
5a - Suction Stop Valve
5b - Suction Stop Butterfly Valve
(Typically Shipped Loose)
6 - Compressor
7 - Discharge Pipe
8 - PLC Panel
9 - Block & Bleed Assembly
10 - Oil Pump
11 - Oil Heater
12 - Oil Separator
13 - Oil Temperature Control Valve (Oil Mixing Valve)
14 - Oil Pump Strainer
15 - Oil Sight Glass
16 - Oil Filter
(Optional Dual Oil Filters Shown)
17 - Discharge Connection
18 - Oil Separator Inspection Port
19 - Thermal/Acoustic Oil Separator Blanket
(Optional Per Application)
20 - Nameplate
21 - Heat Trace Insulation
(Optional Per Application)
22 - Frame
23 - Oil Cooler (Shell and Tube Heat Exchanger)

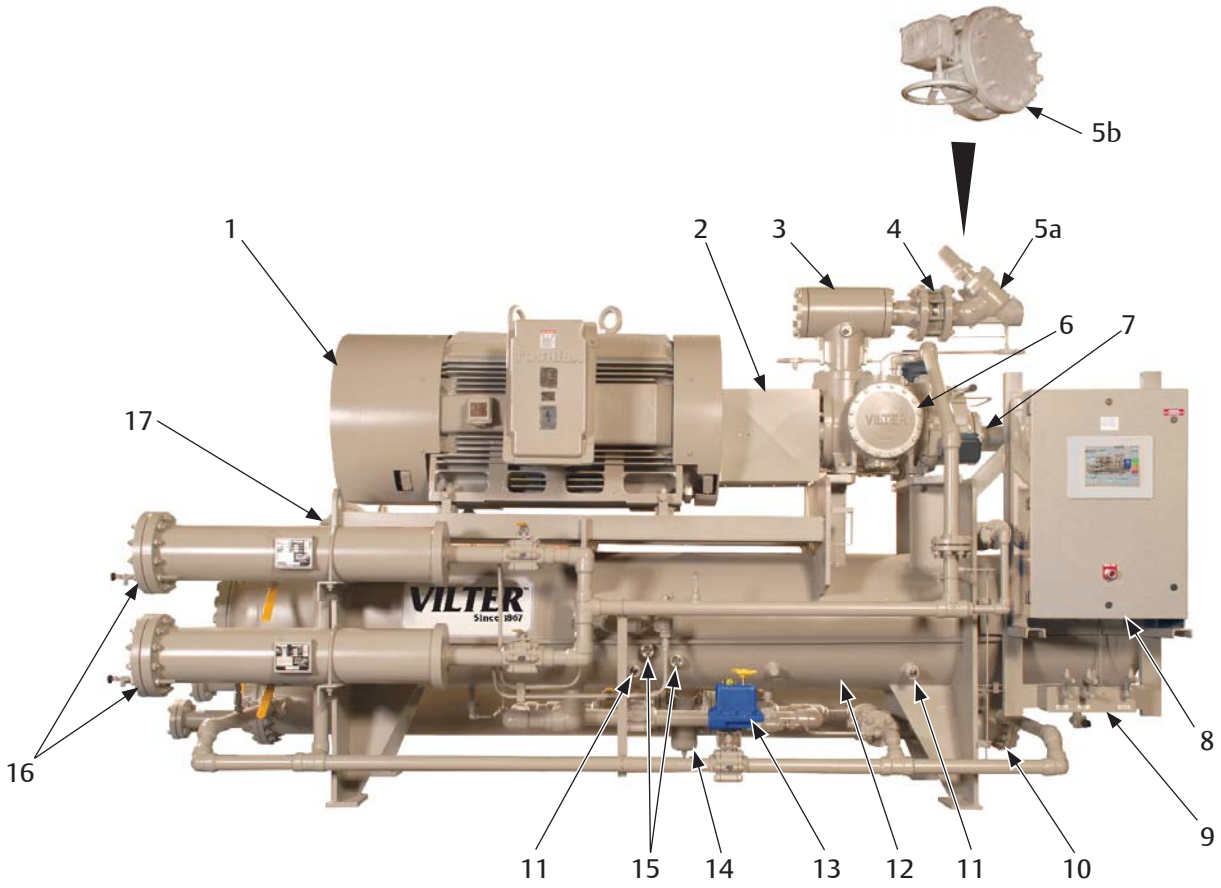


Figure 1-2. Gas Compressor Unit Components (1 of 3)

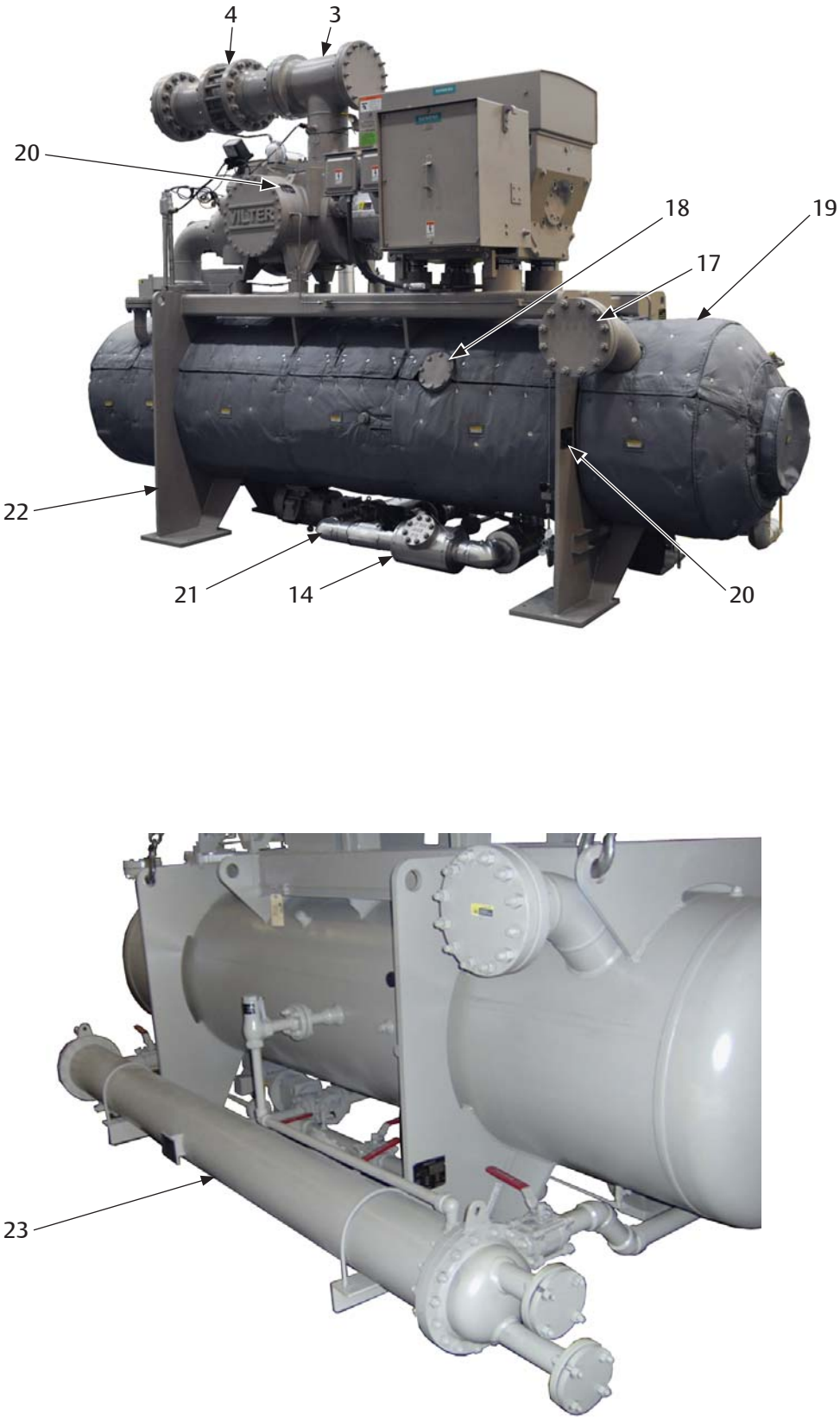


Figure 1-2. Gas Compressor Unit Components (2 of 3)

Component Identification (Continued)

24 - RTD (Oil Filter Outlet)

25 - Pressure Transducer (Oil Injection Temperature)

26 - Volume Slide Valve Actuator

27 - RTD (Discharge)

28 - RTD (Suction)

29 - Capacity Slide Valve Actuator

30 - Pressure Transducers (Discharge, Oil Filter Inlet and Outlet)

31 - Block & Bleed Assembly

32 - Remote Oil Cooler (Finned Fan Heat Exchanger)

33 - RTD (Oil Separator)

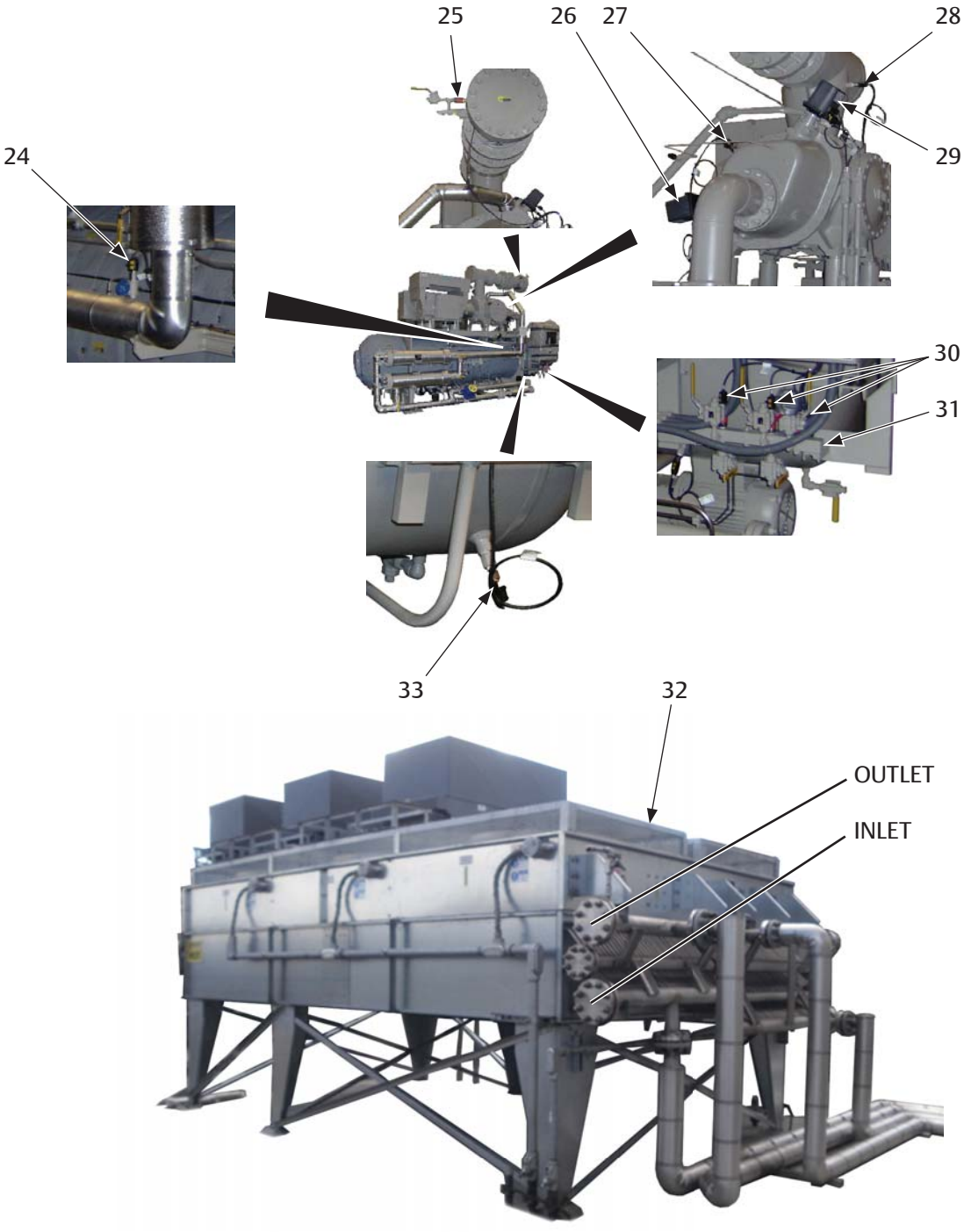


Figure 1-2. Gas Compressor Unit Components (3 of 3)

Piping & Identification Component Tags

Use this list to identify components shown in the Piping & Identification Diagram.

A	Atmosphere
AN	Anode - Sacrificial
AV	Angle Valve
BFV	Butterfly Valve
BDV	Automatic Blowdown Valve
BV	Ball Valve
C	Compressor
CPL	Coupling
CRR	Cooling Refrigerant Liquid Return
CRS	Cooling Refrigerant Liquid Supply
CS	Carbon Steel or Cold Side
CV	Check Valve
CWR	Cooling Water Return
CWS	Cooling Water Supply
D	Drive Motor or Drain
E	Heat Exchanger
EQ	Equalizing Line
F	Fan
FC	Fail Closed or Flow Controller
FG	Flow Switch Indicator or Glass
FI	Flow Indicator
FIT	Flow Indicating Transmitter
FO	Fail Open
FSI	Flow Sight Indicator
FT	Flow Transmitter (Blind)
FV	Flow Control Valve (Pneumatic Actuator)
GLV	Globe Valve
GTV	Gate Valve
HS	Hand Switch or Hot Side
HEV	Hand Expansion Valve
HV	Hand Valve
IA	Instrument Air
II	Current Indicator
IT	Current Transmitter
JB	Electrical Terminal Box or Junction Box
LC	Level Control
LE	Level Probe
LI	Level Indicator or Gauge
LIT	Liquid Level Indicating Transmitter
LO	Lube Oil or Lock Open
LP	Local Panel
LSH	Level Switch High
LSHH	Level Switch Shutdown High High
LSL	Level Switch Low
LSLL	Level Switch Shutdown Low Low
LV	Level Control Valve - Pneumatic Actuator
MCC	Motor Control Center or Motor Starter
MV	Motor Operated Valve
MGV	Manifold Gauge Valve
MI	Moisture Indicator
N	Nitrogen
NC	Normally Closed
NO	Normally Open
NV	Needle Valve
P	Pump or Process
PDI	Differential Pressure Indicator - Gauge
PDIT	Differential Pressure Indicating Transmitter
PDSH	Differential Pressure Switch High
PDSHH	Differential Pressure Switch Shutdown High High
PDSL	Differential Pressure Switch Low
PDSLL	Differential Pressure Switch Shutdown Low Low
PDT	Differential Pressure Transmitter - Blind
PDV	Differential Pressure Control Valve - Pneumatic Actuator
PI	Pressure Indicator or Gauge
PIT	Pressure Indicating Transmitter
PSH	Pressure Switch High
PSHH	Pressure Switch Shutdown High High
PSL	Pressure Switch Low
PSLL	Pressure Switch Shutdown Low Low
PSV	Pressure Safety Relief Valve
PT	Pressure Transmitter - Blind
PV	Pressure Control Valve
QE	Heater Element - Immersion Heater
R	Refrigerant
RD	Rupture Disc
SDV	Automatic Shut-off Valve
SG	Sight Glass
SS	Stainless Steel or Heat Exchanger Shell Side
STR	Strainer
SV	Safety Relief or Slide Valve
SW	Selector Switch
TE	Temperature Element - RTD or Thermocouple

TI	Temperature Indicator or Thermometer
TIT	Temperature Indicator Transmitter
TRV	Transfer Valve - 3-way or 6-way Valve
TS	Heat Exchanger Tube Side
TSH	Temperature Switch High
TSHH	Temperature Switch Shutdown High High
TTSL	Temperature Switch Low
TSLL	Temperature Switch Shutdown Low Low
TT	Temperature Transmitter - Blind
TV	Temperature Control Valve
TW	Thermowell
V	Vent
VG	Gauge Valve
VTRI	Venturi
VLV	Stop Valve
XV	Solenoid Valve
YE	Vibration Probe
YSH	Vibration Switch High
YSHH	Vibration Switch Shutdown High High
YT	Vibration Transmitter
YU	Vibration Monitoring System
YZE	Axial Proximitor Probe - Axial Displacement
YZT	Axial proximitor Transmitter - Axial Displacement
YZU	Axial Proximitor Monitoring System
ZE	Position Element - Positioner
ZI	Position Indicator
ZIT	Position Indicating Transmitter
ZT	Position Transmitter - Blind

Symbols and Identifications

Use this list to identify components shown in the Piping & Identification Diagram.


3-Way Valve


Angle Valve


Globe Valve


Gate Valve


Butterfly Valve


Ball Valve


Schrader Valve


Pressure Safety Relief Valve


Spring-Closing Drain Valve


Block & Bleed Manifold

Solenoid Valve

3-Way Solenoid Valve


Needle Valve


Check Valve


Strainer


Suction Strainer

Motorized Valve

3-Way Thermostatic Valve


Hand Expansion Valve


Restriction Orifice


Rupture Disc


Inlet Pressure Regulating Valve


Outlet Pressure Regulating Valve


Differential Pressure Regulating Valve


Pneumatic Actuator Control Valve Fail Close


Pneumatic Actuator Control Valve Open


Diaphragm Actuator


Diaphragm Spring-Opposed


Diaphragm Pressure-Balanced


Vilter Venturi Injector Nozzle


Flange Set


Pipe Reducer

Thermowell


Drive Coupling

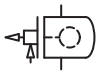
Insulation Not by Vilter

Insulation by Vilter


Vibration Absorber

Heater

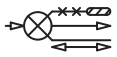

Heat Trace


Low Side Float Valve


High Side Float Valve


Steady-Mount

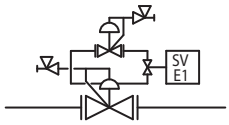
Bulb & Capillary


Thermostatic Expansion Valve

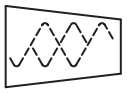
Pilot Light (Color Inside)

Man-Way Cover

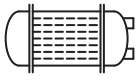
Scope of Supply



Economizer Regulator

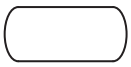

Compressor

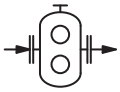

Motor


Heat Exchanger


Fan

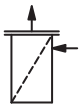

Vertical Tank/Drum Vessel


Horizontal Tank/Drum Vessel


Positive Displacement Pump


Centrifugal Pump


Rotary Pump


Filter

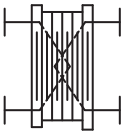


Plate & Frame Heat Exchanger


Discrete Instrument, Field Mounted


Discrete Instrument, Remote, Mount, Normally Accessible to Operator


Discrete Instrument, Local Rack Mounted, Normally Accessible to Operator


Shared Display/Control, Field Mounted

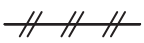

Shared Display/Control, DCS or Remote Control Panel Normally Accessible to Operator


Shared Display/Control, Local Control Panel Normally Accessible to Operator


Programmable Logic Control, Field Mounted


Programmable Logic Control, DCS or Remote Control Panel, Normally Accessible to Operator


Programmable Logic Control, Local Control Panel, Normally Accessible to Operator


Pneumatic Signal

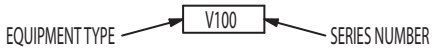
Capillary Tube


Electrical Signal

Internal System Link (Software or Data Link)

Mechanical Link

Hydraulic Signal



Equipment Number Identification

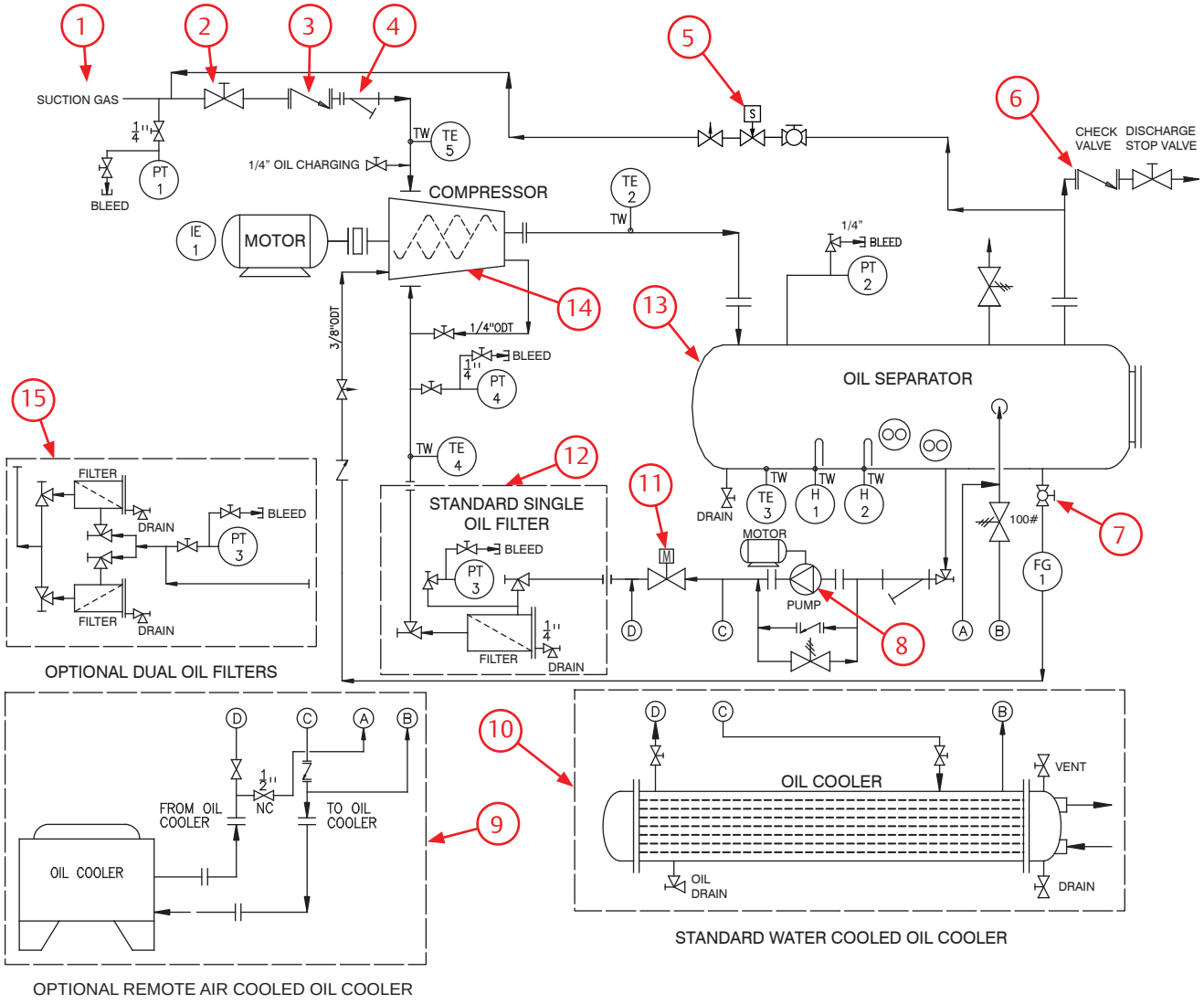


Figure 2-1. Gas Compressor Unit P&ID

The gas and oil systems work in unison, but each one will be explained separately. Reference Figure 3 - Gas Compressor Unit P&ID for gas and oil flow descriptions.

Gas Flow

The gas compression process begins as processed gas enters the suction inlet (1). The processed gas flows through a stop valve (2), check valve (3) then through a suction line strainer (4) to the compressor (14). The processed gas is then pressurized through the compressor and discharged as high pressure gas vapor into the oil separator (13). In the oil separator, the oil is then separated from the discharged gas vapor by impingement separation. The high pressure gas flows out to the aftercooler and scrubber for cooling while the oil is pumped or syphoned back to the compressor.

Moreover, check valves (3) and (6) are provided between the oil separator to prevent gas vapor or liquid from flowing back to the compressor during shutdown periods.

An equalizing line is also installed between the high pressure side (oil separator) and low pressure side (suction) to allow .

Oil Life and Oil Flow

The life of the oil is directly affected by the quality of the gas. Proper separation of any liquids must be accomplished to prevent droplets of liquid at the compressor

suction. The discharge temperature of the compressor must be kept a minimum of 30°F (or 17°C) above the discharge gas dew point to prevent the condensing of liquids in the oil separator. The oil separator shell and legs must be insulated when the gas stream has a high probability of having condensables.

Oil in the gas compressor unit serves three primary purposes. They are compressor lubrication, sealing clearances between moving parts, and heat removal resulting from heat of compression and friction. Initially, oil flow is driven by a mechanical gear pump (7). Once the system reaches design conditions, the oil pump is shut off and oil flow is maintained by differential pressure in the gas system.

As the oil is separated from the gas in the oil separator, it is pumped or syphoned through an oil cooler (9), then filtered through a single (11) or dual oil filters (15) and back to the injection port of the compressor (14). The standard oil cooler is a shell and tube water cooled heat exchanger (9). The other option is to air cool oil remotely through a finned fan heat exchanger (8).

Furthermore, to collect oil from the coalescing side of the oil separator (12), a line is installed between the oil separator and the compressor. By opening the shut-off valve (6), this will allow oil dripping off the coalescing filters to be fed back to the compressor. In addition, the oil cooler (8 or 9) is piped in parallel to the oil temperature control valve (oil mixing vlave) (10), which acts as a bypass valve.

On units with a full-time oil pump, oil pressure is regulated by the oil pressure regulator (12). It controls upstream pressure to the compressor bearings and should be adjusted to hold the oil pressure at 20 psig above suction pressure. Excess oil not required for bearing lubrication is passed through the regulator and back into the oil separator (13).

This is a continuous cycle.

Control System

The gas compressor unit is controlled by a Programmable Logic Controller (PLC) panel. This PLC panel's main function is to control the gas compression system from the data that it receives from the sensors around the unit. Refer to Compact Logix PLC manual (35391CL) for additional information.

RTDs and Pressure Transducers

Resistance Thermometers (RTDs) and pressure transducers are instruments used to measure temperatures and pressures at specific locations on the gas compressor unit, see Figure 1-2. Gas Compressor Unit Components. RTDs are typically mounted on the suction pipe, discharge pipe, oil separator and oil filter outlet pipe. Pressure transducers are typically mounted on the block and bleed assembly and directly on the suction pipe. The pressure transducers measure suction pressure, inlet and outlet oil pressure, and oil separator pressure.

Delivery Inspection

All equipment supplied by Vilter are thoroughly inspected at the factory. However, damage can occur in shipment. For this reason, the units should be thoroughly inspected upon arrival, prior to off-loading. Any damage noted should be photographed and reported immediately to the transportation company. This way, an authorized agent can examine the unit, determine the extent of damage and take necessary steps to rectify the claim with no serious or costly delays. At the same time, the local Vilter representative or the home office should be notified of any claims made within ten (10) days after its discovery. Refer to long term storage for additional recommendations.

Rigging and Lifting of Compressor Unit

WARNING

When rigging and lifting a compressor unit, use proper lifting device capable of lifting and maneuvering the weight and size of the compressor unit. Use only qualified personnel and additional personnel and lifting equipment (i.e. spreader bar) as required. Failure to comply may result in death, serious injury and/or damage to equipment.

Only qualified personnel shall operate rigging and lifting equipment. Ensure that the lifting device is capable of lifting the weight of the compressor unit, refer to the supplied Vilter General Assembly (GA) drawing.

To lift the compressor unit, use lifting points on compressor unit frame to attach the lifting device, see Figure 3-1. There are a few points to consider prior to moving the unit:

- Ensure that the weight is evenly distributed amongst the lifting device (i.e. lifting chains and spreader bar) prior to lifting.
- Ensure that the lifting device is not obstructed by any parts of the compressor unit to prevent damage to components.
- Use additional personnel as needed to spot and aid in maneuvering the compressor unit.
- Ensure there is plenty of space to maneuver the compressor unit and a clear path to its location.

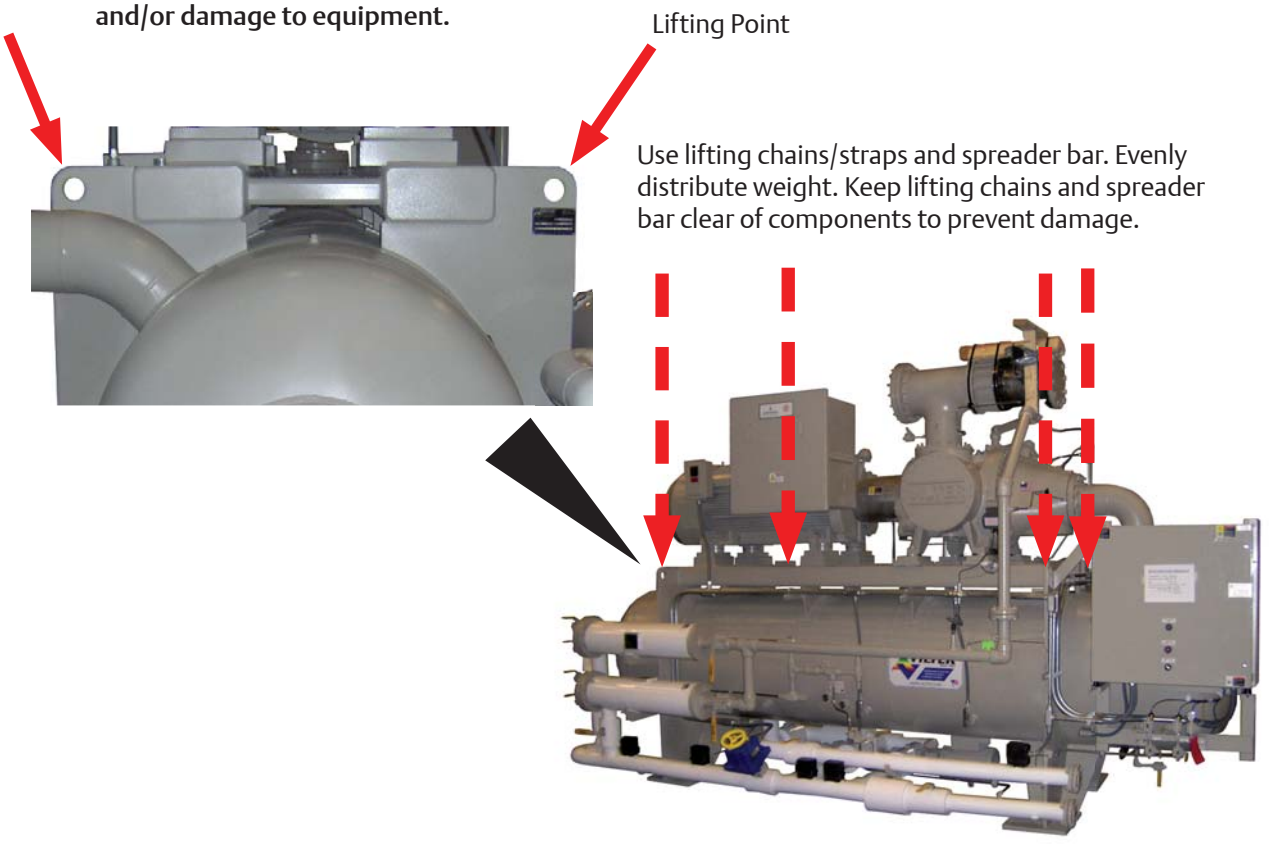


Figure 3-1. Rigging and Lifting Points

Long Term Storage Recommendations

The procedure described is a general recommendation for long term storage (over one month of no operation) of Vilter compressor units. It is the responsibility of the installation firm and end user to address any unusual conditions. Use the supplied long term storage log sheet to help with record keeping, see section page 3-3.

Warranty of the system remains in effect as described at the beginning of this manual, section page i.

The following are recommendations regarding long term storage:

- If the unit is designed for indoor duty, it must be stored in a heated building.
- If the unit is designed for outdoor duty and is to be stored outdoors, a canvas tarp is recommended for protection until installation. Adequate drainage should be provided. Place wood blocks under the base skid so that water does not collect inside the base perimeter or low spots in the tarp.
- All compressor stop valves are to be closed to isolate the compressor from the remainder of the system. All other valves, except those venting to atmosphere, are to be open. The unit is shipped with dry nitrogen holding charge of approximately 5 psi above atmospheric pressure. It is essential that the nitrogen holding charge be maintained.
- The nitrogen or clean dry gas holding charge in the system and compressor are to be monitored on a regular basis for leakage. If not already installed, it is required that a gauge is to be added to help monitor the nitrogen holding charge pressure. If a drop in pressure occurs, the source of leakage must be found and corrected. The system must be evacuated and recharged with dry nitrogen to maintain the package integrity.
- Cover all bare metal surfaces (coupling, flange faces, etc.) with rust inhibitor.
- Desiccant is to be placed in the control panel. If the panel is equipped with a space heater, it is to be energized. Use an approved electrical spray-on corrosion inhibitor for panel components (relays, switches, etc.)
- All pneumatic controllers and valves (Fisher, Taylor, etc.) are to be covered with plastic bags and sealed with desiccant bags inside.

COMPRESSOR MOTOR

The following are general recommendations. Refer to specific motor manufacturer instructions for storage recommendations.

- Remove the condensation drain plugs from those units equipped with them and insert silica-gel into the openings. Insert one-half pound bags of silica-gel (or other desiccant material) into the air inlets and outlets of drip-proof type motors.

NOTE

Bags must remain visible and tagged, so they will be noticed and removed when the unit is prepared for service.

- Cover the motor completely to exclude dirt, dust, moisture, and other foreign materials.
- If the motor can be moved, it is suggested that the entire motor be encased in a strong, transparent plastic bag. Before sealing this bag, a moisture indicator should be attached to the side of the motor and several bags of silica-gel desiccant be placed inside the bag around the motor. When the moisture indicator shows that the desiccant has lost its effectiveness, replace desiccants.
- Whenever the motor cannot be sealed, space heaters must be installed to keep the motor at least 10°F above the ambient temperature.
- Rotate motor and compressor shafts several revolutions (approximately 6) per month to eliminate flat spots on the bearing surfaces. For motors utilizing anti-friction bearings, the shaft should be rotated once every 30 days by hand at 30 RPM for 15 seconds in each direction. Bearings should also be re-lubricated at 2-year intervals using the grease specified on the motor lubrication nameplate.
- If the compressor unit is installed, wired and charged with oil, open all oil line valves and run the oil pump for 10 seconds prior to rotating the compressor shaft. Continue running the oil pump while the compressor shaft is being turned to help lubricate the surfaces of the shaft seal.

For additional storage information, refer to Appendices.

AIR COOLED OIL COOLERS

The following are general recommendations. Refer to specific air cooled oil cooler manufacturer instructions for storage recommendations.

- If the coolers are to be stored or not operated for an extended period of time, the fan motors may ingress moisture if they are not protected or operated regularly. In severe cases, the moisture will reduce the insulation level of the windings or cause rusting of the bearings necessitating removal for repairs at a motor repair facility. This is a common problem with large generating installations when the coolers are often ready but commissioning of the main turbine-generator is delayed for several months.
- The simplest remedy for installed coolers is to operate the fan motors for a few hours every week during the downtime period until regular operation resumes. The fan motors on stored coolers must be protected from the elements by covering them with waterproof tarps.

Compressor Unit Inspections Prior to Storage or Installation

The compressor unit must be inspected prior to installation since components could have come loose and/or damaged during shipment or moving.

- Check for loose bolts, particularly the compressor and motor mounting nuts.
- Check for bent or damaged components. The compressor unit should have also been inspected prior to off-loading, see Delivery Inspection.
- Check that the nitrogen pressure is still holding pressure. The pressure gauge is located at the discharge bleed valve on the block and bleed assembly. Any leaks must be fixed and the system purged and recharged with dry nitrogen.

Recommended Onsite Tools

The tools recommended to have on site are important for troubleshooting, inspections and compressor unit operation. Besides general mechanic tools, these tools are recommended:

- Oil Pump (maximum of 2-3 GPM with motor approved for Division 1 or Division 2 and with ability to overcome suction pressure)
- Infrared Heat Gun
- Torque Wrenches (with ranges from 0 to 600 ft-lbs)
- Sockets and wrenches up to 2-1/2” (63.5 mm)
- Voltmeter

LONG TERM STORAGE LOG

Date: _____

Name: _____ Intial:_____

Company:

Vilter Order No. _____

Compressor Serial Number: _____

Was Compressor Shaft Rotated? _____YES _____ NO HOW OFTEN? _____

Was Air Cooled Oil Cooler Rotated? _____YES _____ NO HOW OFTEN? _____

Was Compressor Motor Rotated? _____YES _____ NO HOW OFTEN? _____

Was Compressor Motor Lubricated? _____YES _____ NO HOW OFTEN? _____

What was the Nitrogen pressure? _____PSIG

Was it necessary to recharge with Nitrogen? _____YES _____NO

If unit needed recharging, was the leak found? _____YES _____NO

Please briefly explain nature of leak:

Is compressor stored in a building that is heated and insulated to prevent condensation of moisture and freezing of Equipment?

_____YES _____NO

Are all machined surfaces exposed to atmosphere coated with a light grease to prevent rusting (compressor shaft)?

_____YES _____NO

Compressor has been placed in operation as of: ***DATE _____***

Foundation

Vilter Single Screw compressor units are low vibration machines. Under most conditions, no elaborate foundation is necessary. However a sound foundation maintains motor alignment and proper elevation, and is therefore required. Provided are recommendations for the foundation and anchoring of the compressor unit. The Vilter foundation supports the entire operating weight of the unit and is suitable for years of continuous duty. Included are specifications for concrete, rebar, aggregate, anchors and grout.

Considerations Prior to Starting

Consult professionals, such as building inspectors, structural engineers, geotechnical engineers and/or construction contractors prior to starting. Below are a few points to consider:

Site Characteristics:

- Soil information
- Site drainage
- Wind data
- Seismic zone
- Ingress and egress
- Power and power lines

Site Layout:

- Plant elevations, grading, drainage and erosion
- Accessibility to compressors for service
- Location of surrounding buildings
- Property lines and roadways
- Power
- Fire safety

Safety:

NOTE

Always check with a safety engineer before proceeding.

- Arranging equipment with adequate access space for safe operation and maintenance
- Wherever possible, arrange equipment to be served by crane. If not feasible, consider other handling methods
- Make all valves and devices safely accessible
- Use special bright primary color schemes to differentiate service lines
- Lightening protection for outdoor installations
- Relief valve venting

Foundation Materials

Materials needed to build the foundation are forms, concrete, sand, rebar, wire, grout, anchor bolts, expansion board and shims. A set of concrete forms will need to be acquired; generally, these can be rented or constructed from dimensional lumber. There should be enough 4,000 psi concrete with one inch aggregate to build the foundation. Also, there should be enough sand to provide a base of compacted sand four inches thick for the foundation to rest on, see Figure 1 - Concrete Pad with Compressor Unit Dimensions - Side View. The rebar required is ASTM 615, grade 60, sizes #4 and #6. Wires will also be needed to tie the rebar together. The recommended grout is Masterflow 648CP high performance non-shirk grout to provide at least a 1" thick pad under each foot. The recommended anchors are 5/8" Diameter HILTI HAS SS threaded rod for outdoor installations or HAS-E rods for indoor installations. Anchor bolts shall have a five inch projection and 12-3/8" embedment. The required adhesive is HIT-ICE/HIT/HY 150 anchoring system. There should be enough one inch expansion boards to go around the perimeter of the foundation. Finally there should be enough shim stock and extra anchor bolt nuts to level the compressor unit.

Building the Foundation

Use the Vilter General Arrangement (GA) and foundation drawings to help secure a building permit and foundation construction. The Vilter GA drawing will have the necessary dimensions required to determine the overall foundation size and where to locate the compressor unit on the foundation. It will also show the dimensions required to form up the housekeeping piers that the compressor unit rests on. The Vilter foundation drawing lists the necessary information to construct a suitable foundation. It includes the rebar requirements and locations. It also shows anchor bolt locations, grouting and the concrete specifications. Using the Vilter GA drawing, Vilter foundation drawing and the information from site characteristics, site layout and safety studies will provide enough data to allow building the foundation to proceed.

The foundation is to be cast and permanently exposed against the earth. Therefore, if constructing on an existing floor, typically indoors, the floor will need to be broken up to get to the earth. If starting from undisturbed soil, it must be also be prepared accordingly. In either case, these are some check points to consider:

- Check the depth of your frost line to ensure the foundation extends below it
- Ensure the foundation rests entirely on natural rock or entirely on solid earth, but never on a combination

of both

- Check the ability of the soil to carry the load
- Check wet season and dry season soil characteristics for static loading limits and elasticity
- Check local codes for Seismic Design requirements

For examples of foundation diagrams, see to Figure 3-2 and Figure 3-3.

trolled level and a surface texture etched in place. Leave the concrete to cure for at least 28 days.

Compressor Unit Installation

Once the foundation has cured, the compressor unit can be placed on the foundation, see Figure 3-5 and Figure 3-6. With the appropriate material handling equipment, lift the compressor unit by locations shown on the Vilter GA drawing and slowly place it on the

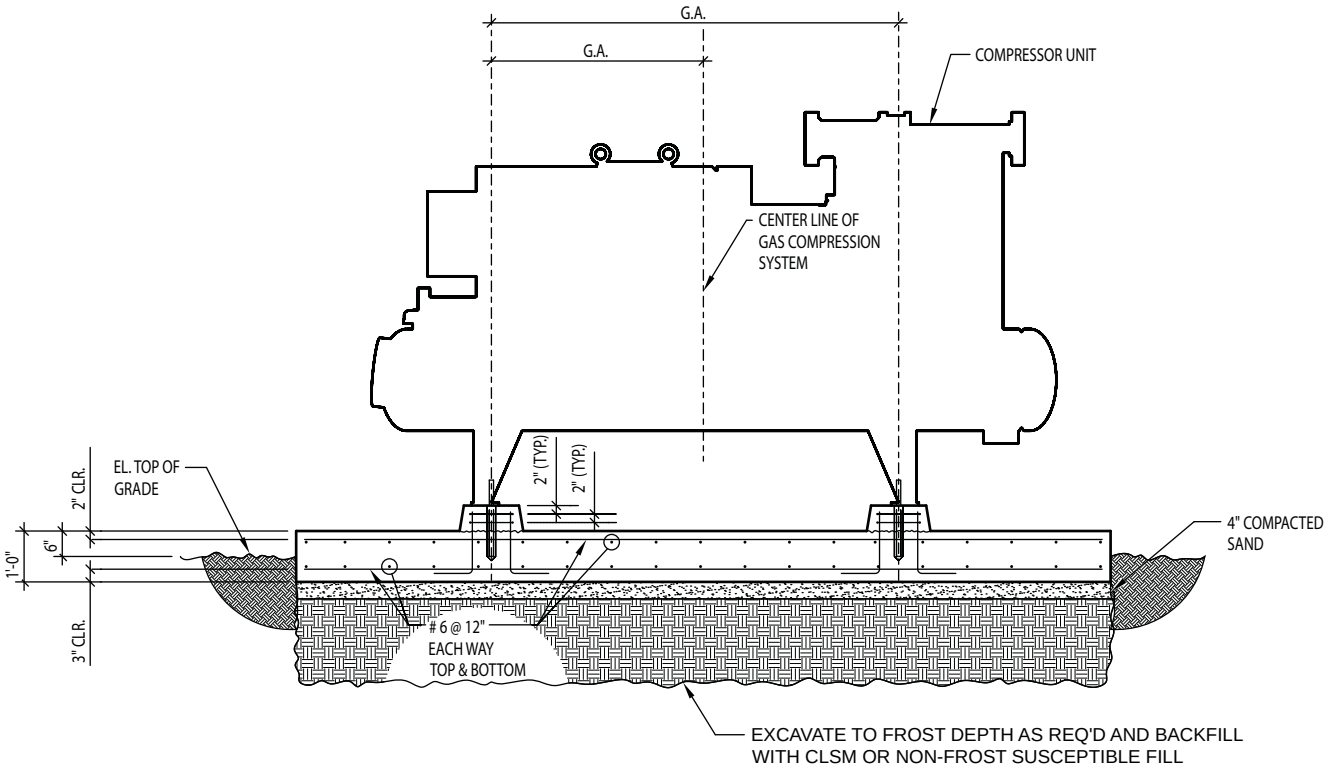


Figure 3-2. Concrete Pad with Compressor Unit Dimensions - Side View

NOTE

In Figures 3-3 and 3-8, the recommended housekeeping height of 6" is to allow maintenance/ service of the oil strainer and oil pump.

Once the site has been excavated and prepared, place four inches of sand down on the bed where the foundation will rest. The sand must be compacted before placing the forms and rebar. After the sand is compacted, use the Vilter GA drawing to construct the forms for the foundation. With forms in place, install expansion boards on the inside of the forms, for example, see Figure 3-4. Next, place your rebar in the forms as per the Vilter foundation drawing. When all rebars are in place the concrete can be poured. The concrete must then be foundation housekeeping piers. As per the Vilter GA drawing, ensure the compressor unit is correctly placed on the foundation. Once placed, use the spherical washers directly under the compressor as the surface to level the compressor unit, see Figure 3-7. Place shims under the feet of the compressor unit, as needed, until it is leveled, see Figure 3-8. Select the correct drill bit and drill thru the anchor bolt hole in the mounting feet of the compressor unit to the depth called for on the Vilter foundation drawing. Finally using the HILTI instructions, put your anchor bolts in place and wait for them to cure. Then place the nuts on the anchor bolts to finger tight and prepare to grout.

Leveling and Grouting

The unit should be level in all directions. Wet the concrete pad according to the grout manufacturer's directions. Mix a sufficient amount of grout. The grout must be an expanding grout rather than shrinking to provide a tighter bond. Follow the manufacturer's recommendations for setting, precautions, mixing, and grout placement, finishing and curing. The grout must be worked under all areas of the feet with no bubbles or voids. If the grout is settled with a slight outside slope, oil and water can run off of the base. Once the grout has cured, torque the anchor bolts as per HILTI instructions.

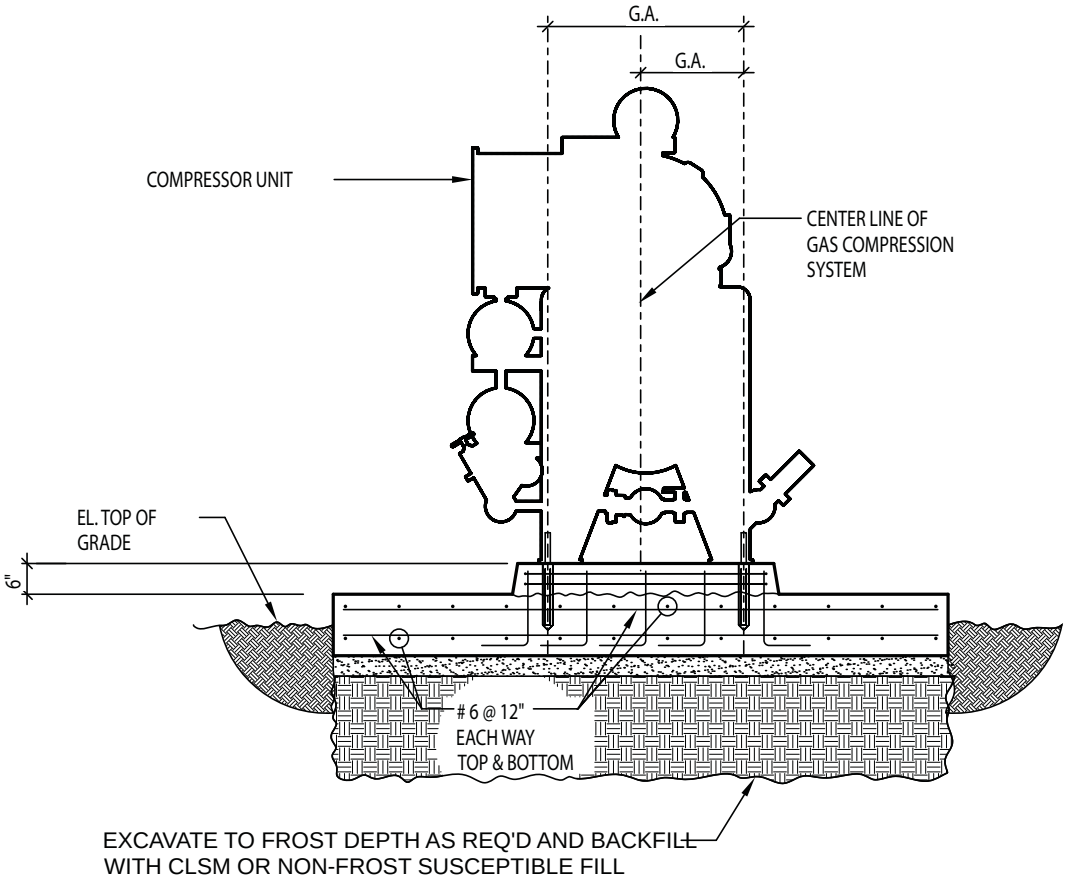


Figure 3-3. Concrete Pad with Compressor Unit Dimensions - Front View

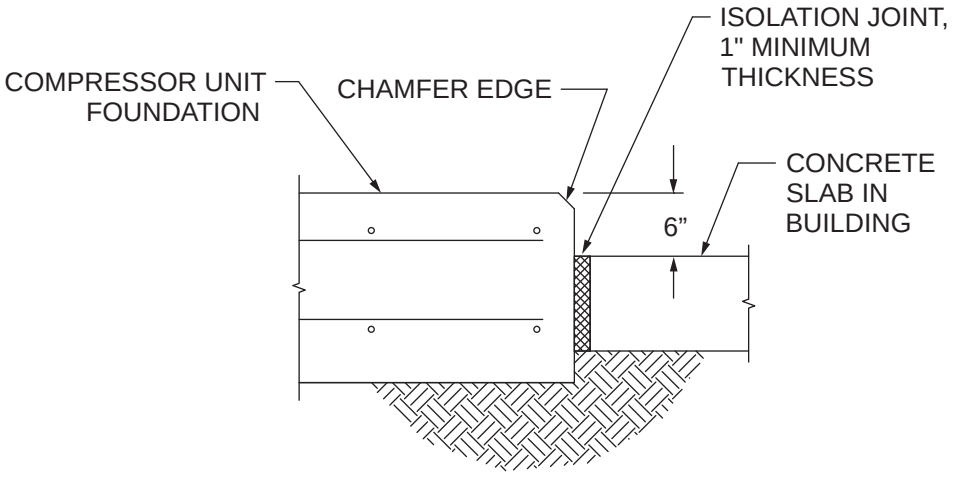


Figure 3-4. Interior Foundation Isolation

Additional Information

Codes and Standards

Vilter followed the following codes and standards when designing your foundation:

- ACI
- ASTM
- ASCE 7
- IBC 2006

Operation and Performance

The foundation was designed for:

- Outside environment severe exposure
- Ambient temperature -10 degrees F to 105 degrees F
- Unit weight 20,000 lbs
- RPM 3600
- Soil bearing capacity 1,500 lbs/sq.ft.
- Wind speed 120 MPH
- Exposure factor D
- Wind importance factor 1.15
- Concrete poured on and permanently cast against the earth

General Design Requirements

The compressor foundation is designed to:

- Maintain the compressor in alignment and at proper elevation.
- Minimize vibration and prevents its transmission to other structures
- Provide a permanently rigid support
- Provide sufficient depth to dampen vibrations.

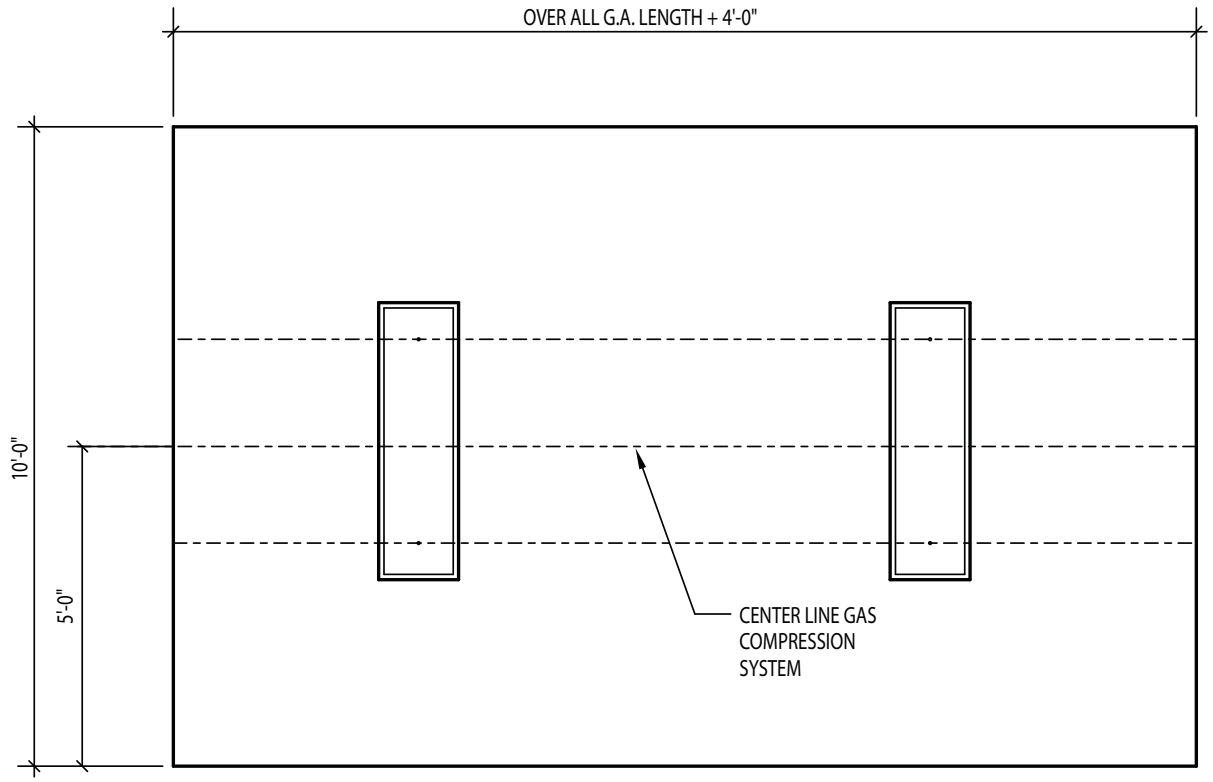


Figure 3-5. Foundation with Housekeeping Pads Dimensions - Top View

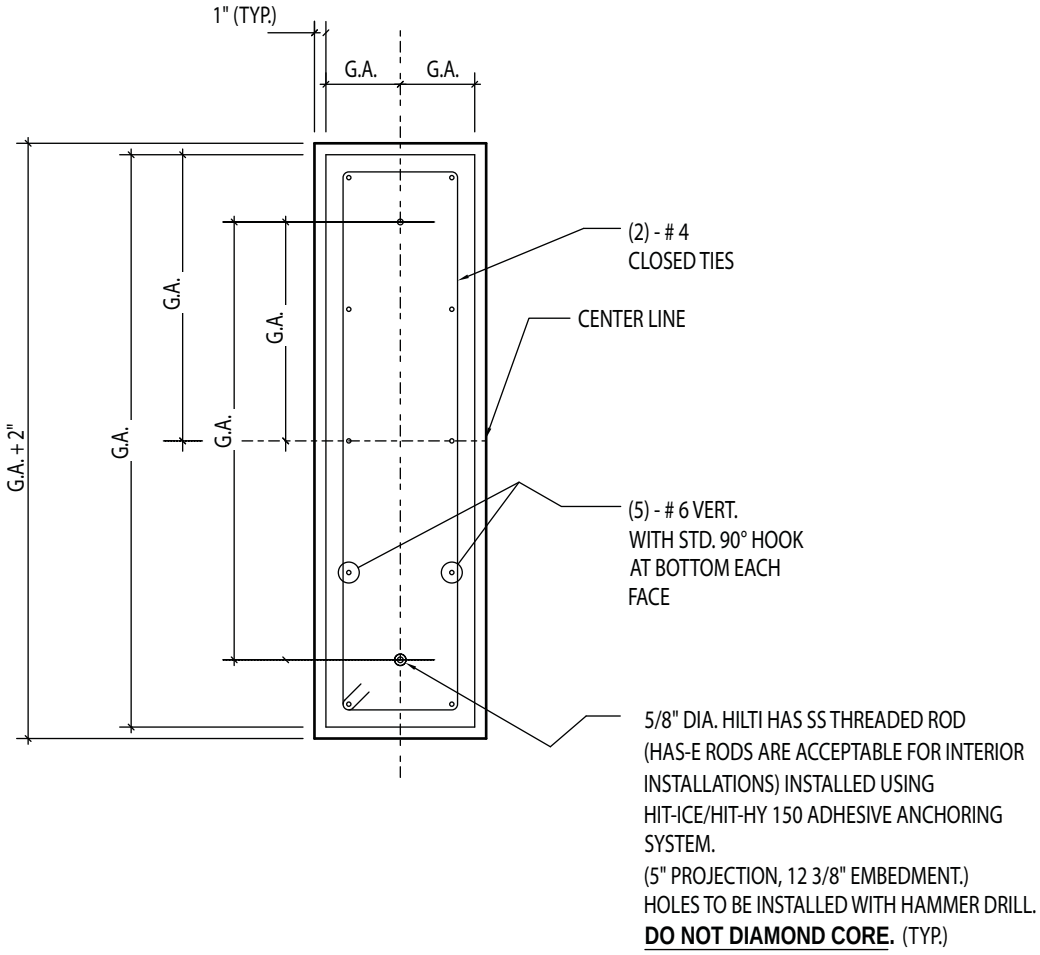


Figure 3-6. Housekeeping Pad Dimension Detail - Top View

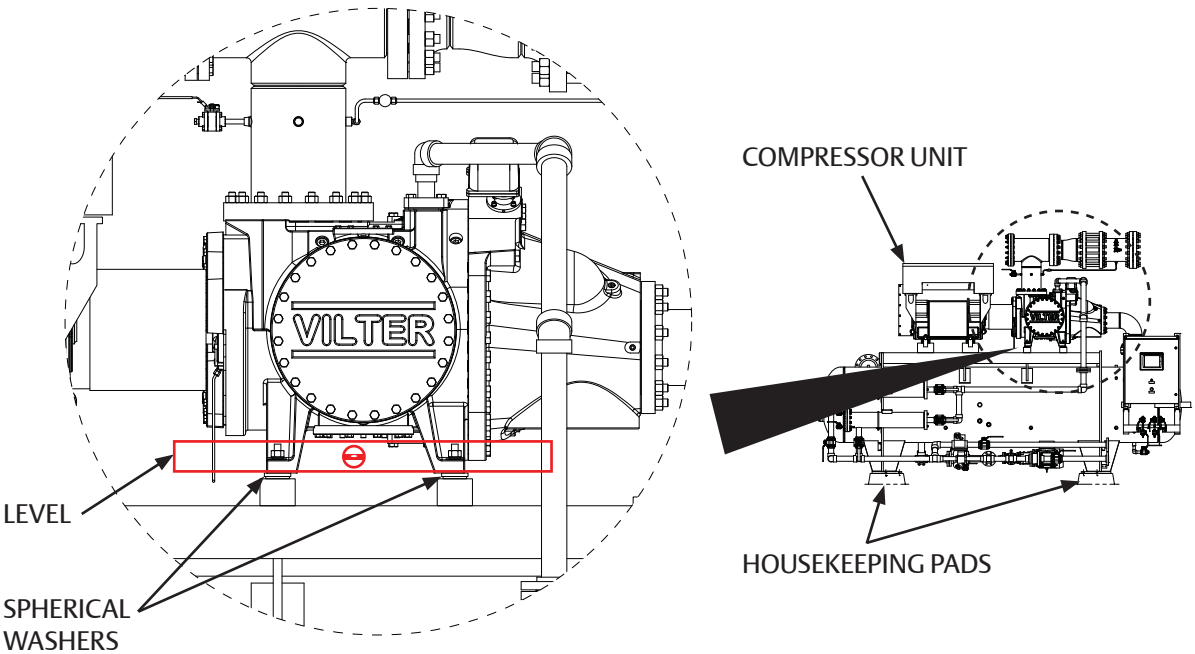


Figure 3-7. Level Compressor Unit Using Top Surface of Spherical Washers

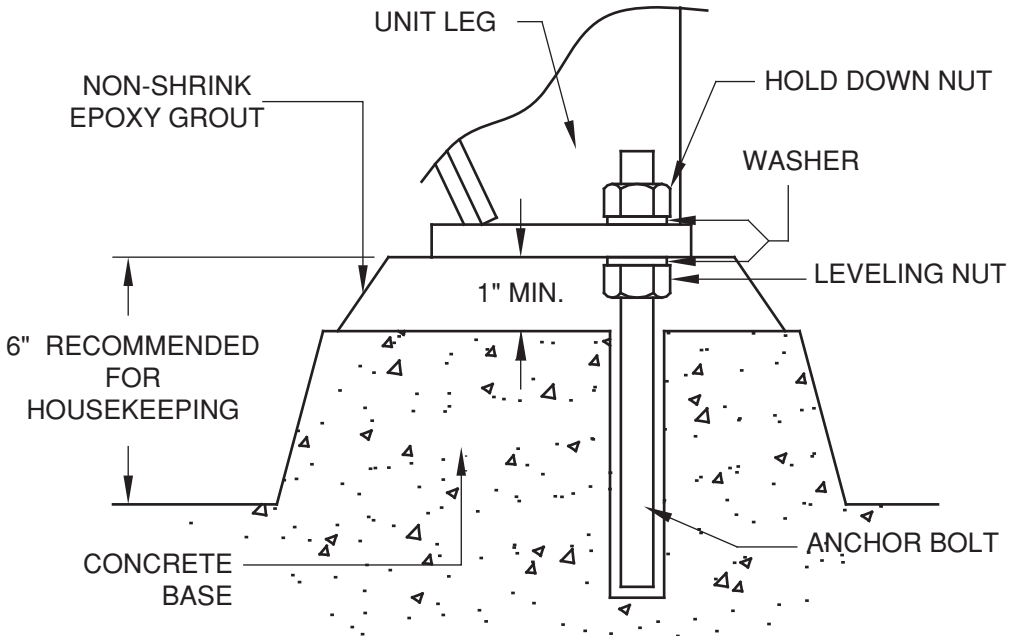


Figure 3-8. Concrete Pad Housekeeping Detail

Piping

The ideal load applied to flanges of the compressor unit is zero. However, it's not practical to expect that no loads will be applied to unit connections. Thermal, dead, live, wind & seismic loads must be considered and even tolerated. Well supported external piping connected to the compressor will still result in some loads applying forces and moments in three axes to unit flanges.

The most important issue is the motor-compressor misalignment caused by external forces (F in lbf) and moments (M in ft-lbf) imposed by plant piping. In Figure 3-9 and Table 3-2, are the maximum allowable forces and moments that can be applied to compressor flanges when the compressor is mounted on an oil separator.

It must be noted that it is necessary to check for compressor shaft movement when the job is complete. In no case shall the attached piping be allowed to cause more than 0.002" movement at the compressor shaft. If more than 0.002" movement is detected the piping must be adjusted to reduce the compressor shaft movement to less than 0.002". For example, the compressor shaft should not move more than 0.002" when piping is removed or connected to the compressor.

IMPORTANT – piping elements shall be supported per the requirements of ASME B31.5 / B31.3 as applicable. See guidelines below, particularly with concern to minimizing loads on check valves.

Header Piping and Drains

Header drains should also be installed to allow drainage of liquids from the discharge and suction headers. See Appendices for Recommended Header Piping.

CAUTION

Accumulated liquid in the suction header can damage the compressor if not drained. Always drain headers (suction and discharge headers) prior to start-ups. Failure to comply may result in damage to equipment.

Remote Air Cooled Oil Cooler Piping

If equipped with a remote air cooled oil cooler, it is important that the piping be installed correctly to and from the compressor unit and remote air cooled oil cooler. See Appendices for Recommended Air Cooled Oil Cooler Piping.

Table 3-2. Maximum Allowable Flange Loads

Nozzle Dia. (in.)	Fz (lbf)	Fy (lbf)	Fx (ft-lbf)	Mzz (ft-lbf)	Myy (ft-lbf)	Mxx (ft-lbf)
4	400	400	400	300	300	300
6	600	600	600	500	500	500
8	900	900	900	1000	1000	1000
10	1200	1200	1200	1200	1200	1200
12	1500	1500	1500	1500	1500	1500
14	2000	2000	2000	2000	2000	2000

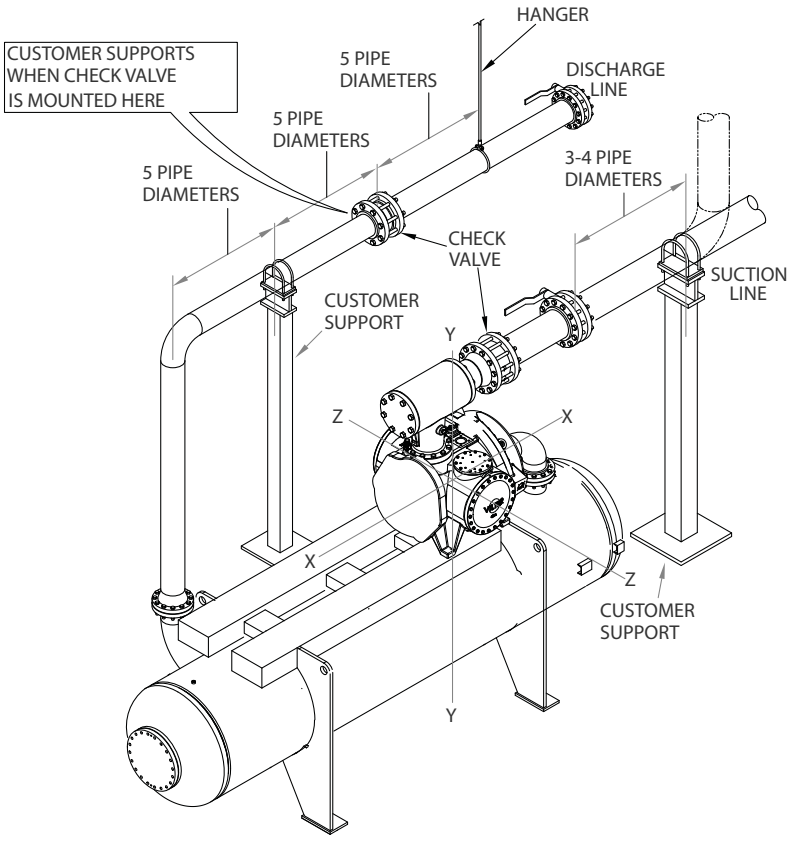


Figure 3-9. Maximum Allowable Flange Loads

General Installation Guideline for Multiple Air Coolers Installed in a Common Area

NOTE

This general installation guideline applies to all air coolers on site, whether if they are supplied by or not supplied by Vilter.

The purpose of this guideline is providing design information when multiple air cooled heat exchangers are installed in a common area. There are two main focal points of this guideline. One area is free flow area which addresses how much free area is required to prevent air flow "starvation" of the units. The second item provides a guideline as to how multiple air cooled heat exchangers should be arranged to minimize the potential of hot air recirculation due to the environment.

FREE FLOW

There are two basic guidelines that we follow to address free flow area when multiple designs are being installed in a common area.

- Air coolers should be placed at least 1 fan diameter away from the nearest obstruction. This is based on the largest fan diameter in the bay of coolers.
- Intake area to the air cooler should have an intake velocity equal to or below 500FPM as the as the discharge velocity is above 500FPM.

We will look at each rule and provide pictorials and calculations for each guideline. Let's assume the following coolers are being installed in a common area:

- Cooler 1 - 7' wide x 10' long with a 6' fan moving 55,000CFM of air. Face velocity is 785FPM.
- Cooler 2- 8' wide x 12' long with a 7' fan moving 72,000CFM of air. Face velocity is 750FPM.
- Cooler 3- 10' wide x 16' long with a 9' fan moving 120,000CFM of air. Face velocity is 750FPM.

ONE FAN DIAMETER

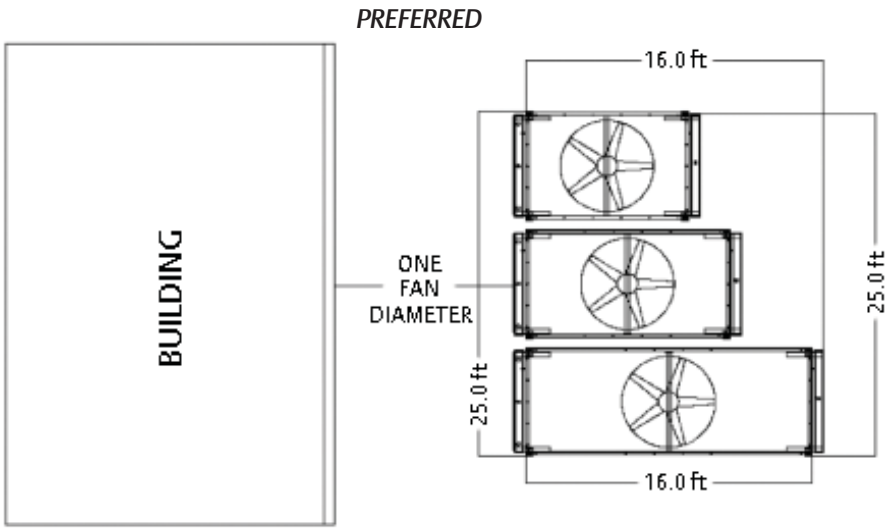
In order to keep the leg height of the installation to a minimum we want to install the coolers at least 1 fan diameter from the nearest obstruction. Referring to Figure 3-10, the nearest obstruction is the building.

Based on the information above, the largest fan diameter in the installation is 9ft. Therefore, the coolers should be placed at least 9' away from the building.

INTAKE VELOCITY

Based on the information above, we are going to solve for the leg height that will provide an intake velocity of 500FPM. We know the following:

- The total airflow of the installation is 247,000CFM
- We have an intake perimeter of 82' for all 4 sides based on the cooler placement.
- Our intake velocity guideline is 500FPM



TOTAL INTAKE PERIMETER = 82 FEET

Figure 3-10. Installation of Coolers - One Fan Diameter Next to Building

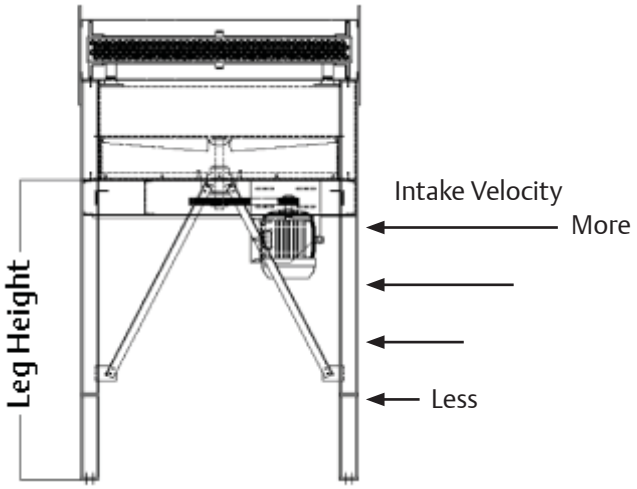


Figure 3-11. Leg Height

The equation used to calculate the leg height in Figure 3-11 is as follows:

Leg Height = (Total Airflow/Intake velocity)/Intake Perimeter

Leg Height = (247,000CFM/500FPM)/82ft

Leg Height = 6ft

In this particular case the calculated minimum height is 6 feet to maintain an intake velocity of 500FPM or less based on having the coolers place 1 fan diameter away from the nearest obstruction. Let's look at an installation where the coolers need to be placed next to the building as in Figure 3-12.

Based on the information above, we are going to solve for the leg height that will provide an intake velocity of 500FPM. We know the following:

- The total airflow of the installation is 247,000CFM
- We have an intake perimeter of 3 sides 16ft, 16ft, and 25ft which totals 57'
- Our intake velocity guideline is 500FPM

The equation used to calculate the leg height in Figure 3-11 is as follows:

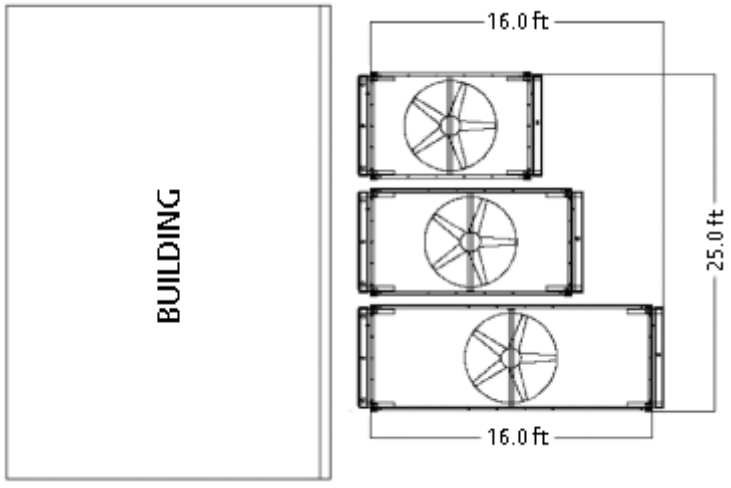
Leg Height = (Total Airflow/Intake velocity)/Intake Perimeter

Leg Height = (247,000CFM/500FPM)/57ft

Leg Height = 8.667ft

We would round the leg height up to 9ft for this particular situation.

NOT PREFERRED



TOTAL INTAKE PERIMETER = 57 FEET

Figure 3-12. Installation of Coolers - Next to Buildling

HOT AIR RECIRCULATION

There are two situations where hot recirculation could occur.

- Intake velocity of the cooler is higher than the discharge velocity
- Environmental issues such as strong cross winds which is installation specific

We addressed how to minimize the opportunity for hot air recirculation involving the operation of the air coolers under the guidelines for the Free Flow section above. However, environmental hot air recirculation is something that is outside of the control of the cooler manufacturer. If the site has the potential for strong cross winds or tunneling then you may want to consider the following items to minimize the potential of hot air recirculation due to the environment.

- All air coolers should discharge at the same elevation.
- If feasible all of the air coolers in a common area should be placed as close to the next cooler as possible.

Unfortunately this comes with a cost. By reducing the intake perimeter available, the leg height increases, which is a cost. In addition there is no guarantee that hot air recirculation can be eliminated due to environmental issues.

Discharge Elevation

In order to minimize the potential for hot air recirculation, it is recommended to install the air coolers so that they all discharge at the same elevation. This is important because not all air coolers have the same plenum heights. You can satisfy the leg height requirements by the calculation above but not satisfy the requirements for discharge elevation. Based on the size of the coolers above, cooler 1 has a plenum height of 36”, cooler 2 has a plenum height of 42”, and cooler 3 has a plenum height of 54”. Plenum heights are calculated from the standard of a 45 degree dispersion angle in API 661. If you would like more details on this calculation please contact engineering.

As you can see in Figure 3-13 in the not preferred configuration. the leg height requirement in the first calculation is satisfied. However, the coolers are not at the same discharge elevation. This could be an issue if there is a cross wind from left to right. Cooler 3 could block the discharge air flow from coolers 1 and 2 and recirculate it back down to the intake of the coolers. The best way to address this is to increase the leg heights on coolers 1 and 2 as shown in the preferred configuration.

This is especially critical if all of the air coolers are not place as close together as possible.

Cooler Placement and Spacing

The concern about cooler placement as far as proximity from one another has to do with the potential for hot air recirculation due to cross winds. Let’s look at only having coolers 1 and 3 in the same area. The leg height requirement of cooler 1 is 3.23ft so we would use a 4ft leg height. The leg height requirement for cooler 3 is 4.61ft but we would put a 7 foot leg height on the cooler due to size and for serviceability. Figure F. shows this installation.

In this case, if you get a strong cross wind from left to right there is the potential that the discharge coming from the top of cooler 1 could easily be pushed into the intake of cooler 3. Thus, in Figure 3-14, the not preferred configuration is more susceptible to the potential of hot air recirculation due to the environment and is not recommended. The preferred configuration is the recommended installation of the coolers with a space between them.

All of the information provided is a general guideline for installing multiple air coolers in a common area. If you minimally follow all of the Free Flow requirements and keep the air coolers discharging at the same elevation then you have a good basis for site layout.

Sometimes due to extenuating circumstances, the above guidelines cannot be followed. Please contact engineering to discuss remedies to accommodate different configurations.

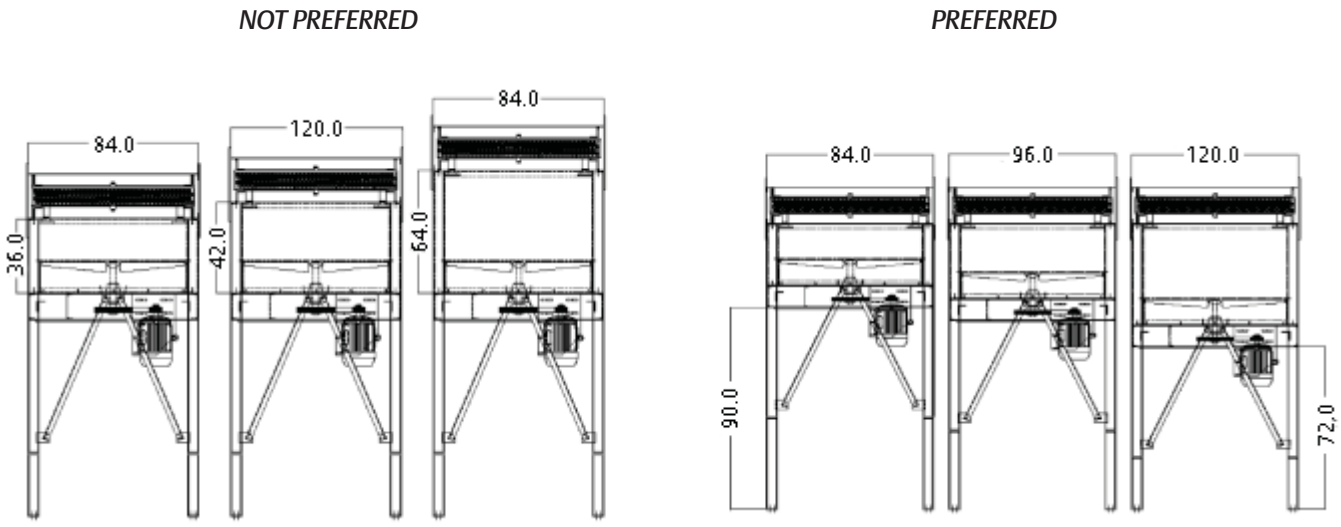


Figure 3-13. Discharge Elevation of Coolers

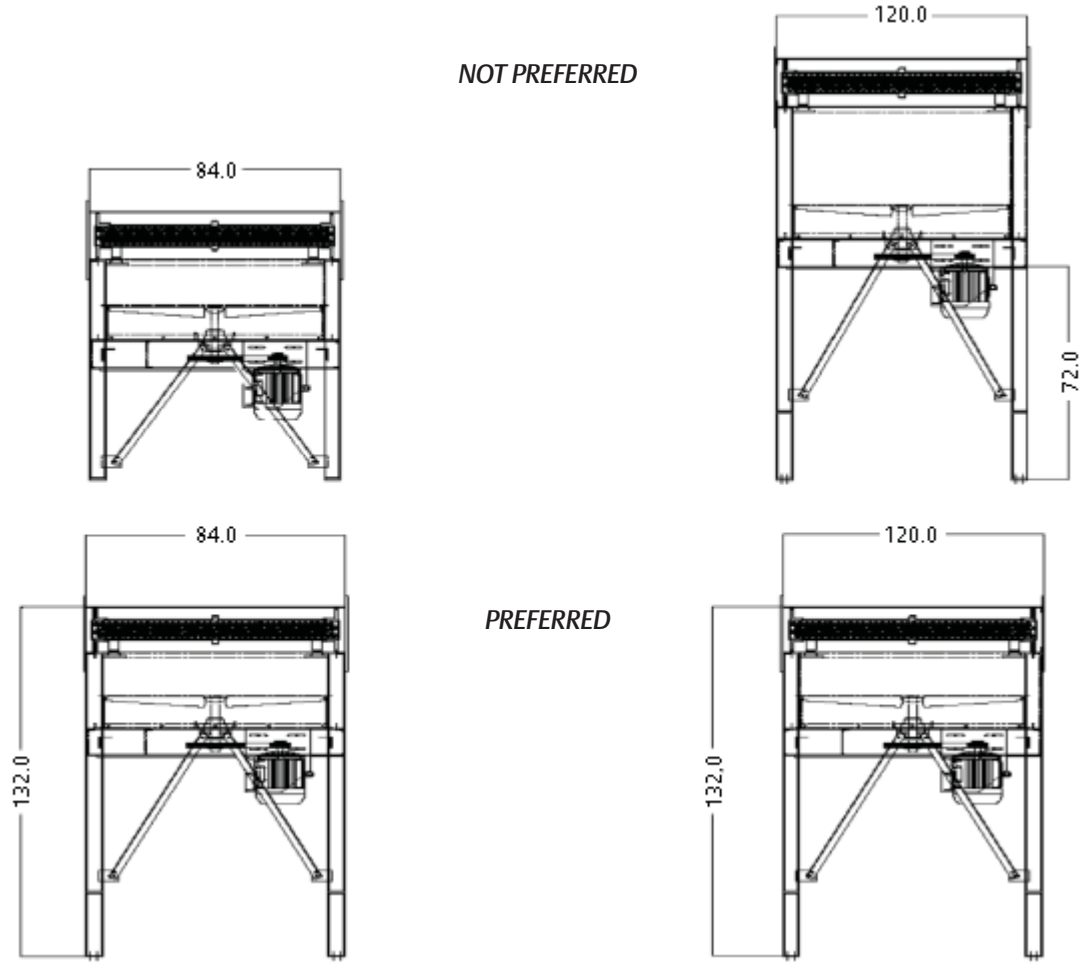


Figure 3-14. Cooler Placement and Spacing

Pressure Testing

CAUTION

Do not hydro test compressur unit. Failure to comply may result in damage to equipment.

CAUTION

The compressor unit along with other system units contain many components with various pressure ratings. Pressure relief protection provided considers the design pressure of a system components. Before replacing a pressure relief valve with a relief valve having a higher presure setting, all system components must be evaluated for acceptability.

Pressure test in compliance with Chapter VI of the ASME B31.3 Process Piping Code.

Initial Oil Charging

Using Non -Vilter Oils

CAUTION

Do not mix oils. Failure to comply may result in damage to equipment.

NOTICE

Vilter does not approve non-Vilter oils for use with Vilter compressors. Use of oils not specified or supplied by Vilter will void the compressor warranty.

Due to the need for adequate lubrication, Vilter recommends only the use of Vilter lubricants, designed specifically for Vilter compressors. With extensive research that has been performed, we are able to offer gas compression lubricating oils. Use of oil not specified or supplied by Vilter will void the compressor warranty.

Please contact your local Vilter representative or the Home Office for further information.

Unit Oil Charging and Priming

WARNING

Avoid skin contact with oil. Wear rubber gloves and a face shield when working with oil. Failure to comply may result in serious injury or death.

NOTICE

Failure to follow these instructions will result in bearing damage and compressor seizing and will void any and all warranties that may apply.

Typically, the compressor unit is shipped from Vilter with no oil charge. The normal operating level is between the two sight glasses on the oil separator, see Figure 3-15. Refer to supplied GA drawing for unit specific oil charge requirement.

For regular oil charging and draining procedures, see Section 5.

Tool Required:

- Oil Pump, Maximum 2-3 GPM with Motor approved for Division 1 or Division 2 and with ability to overcome suction pressure.

(Reference Figure 3-17)

1. At initial start up, compressor unit must be off and depressurized prior to initial oil charging.
2. Using a properly selected oil pump, connect oil pump to oil separator drain valve (4). For oil separator drain valve location, see Figure 3-16.
3. Open oil separator drain valve (4) and fill oil separator (3) to Maximum NON-Operating Level.
4. Once Maximum NON-Operating Level has been reached, shut off oil pump, close oil separator drain valve (4) and remove oil pump.
5. If equipped with remote oil cooler, refer to Priming Remote Oil Cooler and Piping procedure.

PRIMING OIL COOLER (SHELL AND TUBE) AND PIPING

If equipped with a shell and tube oil cooler, continue with the following steps:

6. Close shut-off valve (8) at oil filter inlet. Do the same for second oil filter, if equipped with dual oil filters. For shut-off valve location, see Figure 3-16.
7. Open oil bypass shut-off valve (5). For oil cooler bypass valve location, see Figure 3-16.
8. Energize compressor unit.
9. Close oil mixing valve (oil temp. control valve) (7) via control panel. In Manual Mode, change “Manually Open (%)” value to “0”.

NOTE

The oil cooler is considered primed when the oil level in the separator is constant.

10. Run the oil pump (6) twice for 1-2 minutes. Repeat this step until the oil level (9) is constant.

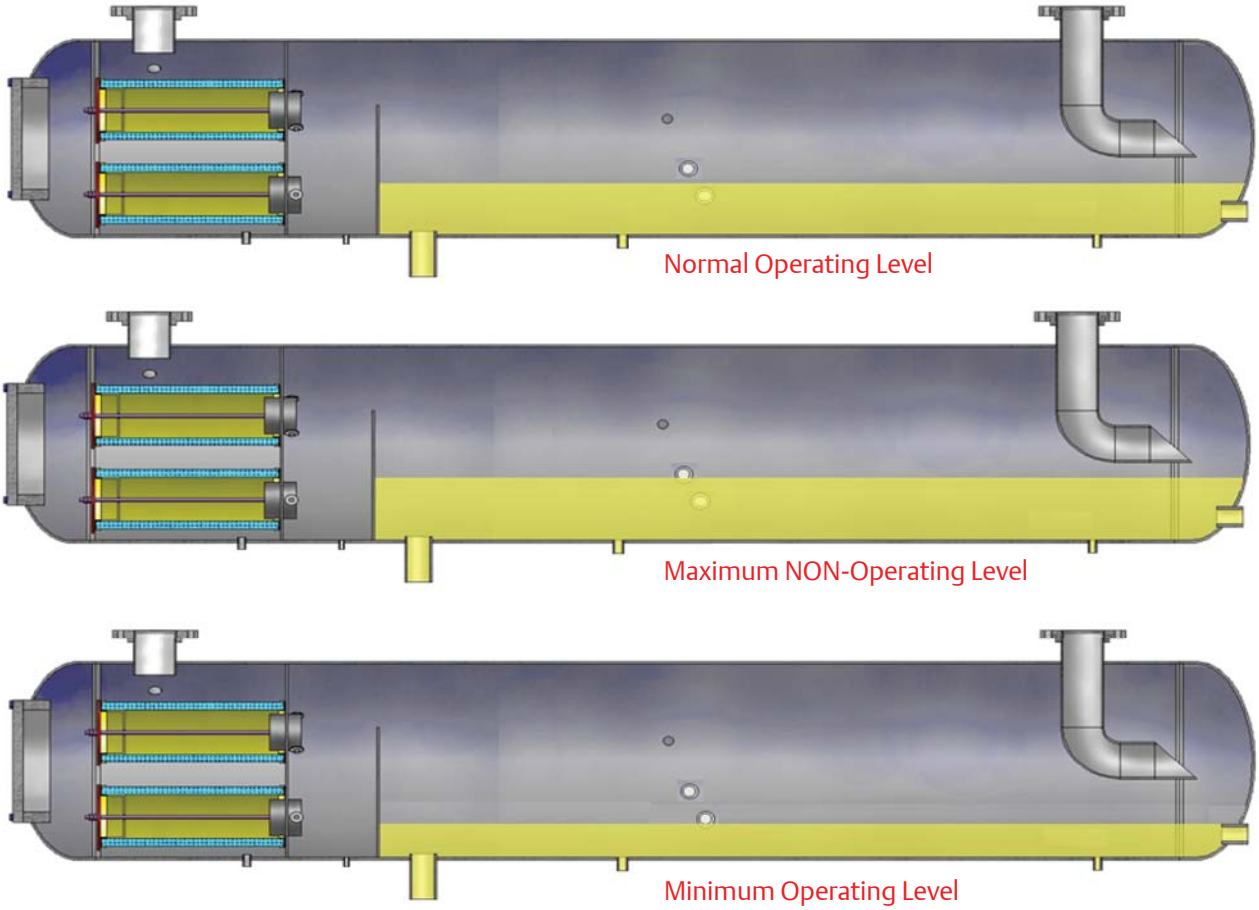


Figure 3-15. Oil Operating Levels

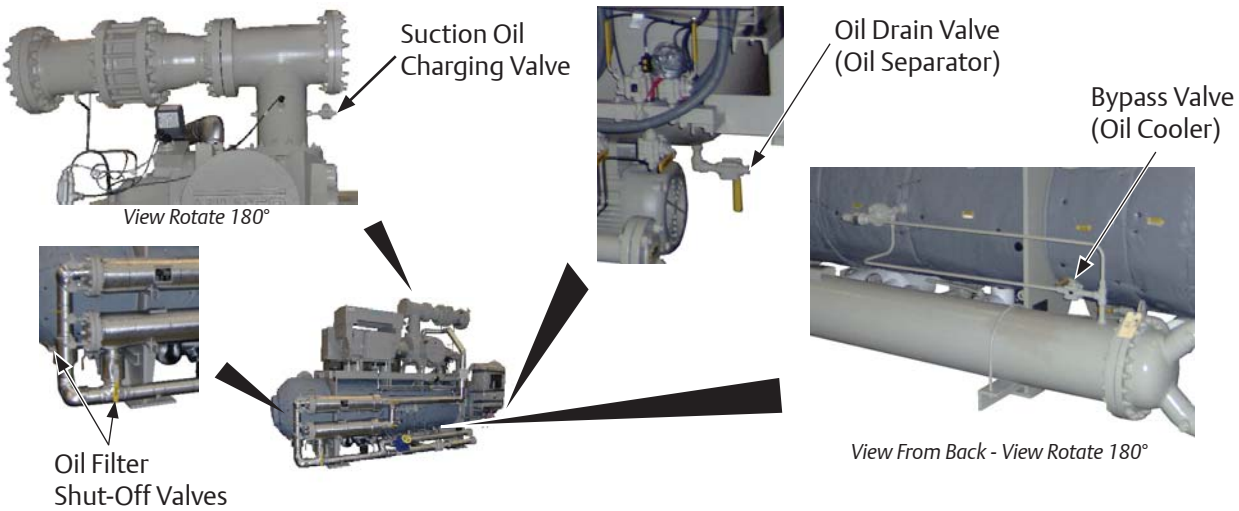


Figure 3-16. Suction Oil Charging Valve, Oil Cooler Drain Valve and Oil Filter Shut-Off Valves

PRIMING COMPRESSOR AND OIL FILTERS

NOTE

Running the compressor oil pump at this point will help lubricate the compressor bearings and shaft seal surfaces.

(Reference Figure 3-19)

11. Open shut-off valve(s) (8) at oil filter inlet(s).
12. Close oil bypass shut-off valve (5).
13. Open oil mixing valve (7) via control panel. In Manual Mode, change "Manually Open (%)" value to "100".
14. Run oil pump (6) for approximately 20 seconds only.
15. Stop oil pump (6) and wait for a minimum of 30 minutes. This will allow oil in the compressor (2) to drain and oil level (9) in separator (2) to settle.

NOTE

Oil mixing valve can remain in Manual Mode since the setpoint will change the mode to Auto when reached. For further details, see PLC Compact Logix manual.

16. Refer to Pre Start-Up Checklist and ensure all items are ready prior to starting the compressor.
17. When ready, run compressor unit and allow it to reach normal operating temperature.
18. Using a properly selected oil pump, connect oil pump to suction oil charging valve (1). For suction oil charging valve location, see Figure 3-16.
19. Open suction oil charging valve (1) and fill oil separator (3) to Normal Operating Level.
20. Once the Normal Operating level has been reached, shut off the oil pump and close the suction oil charging valve (1). Disconnect and remove oil pump.

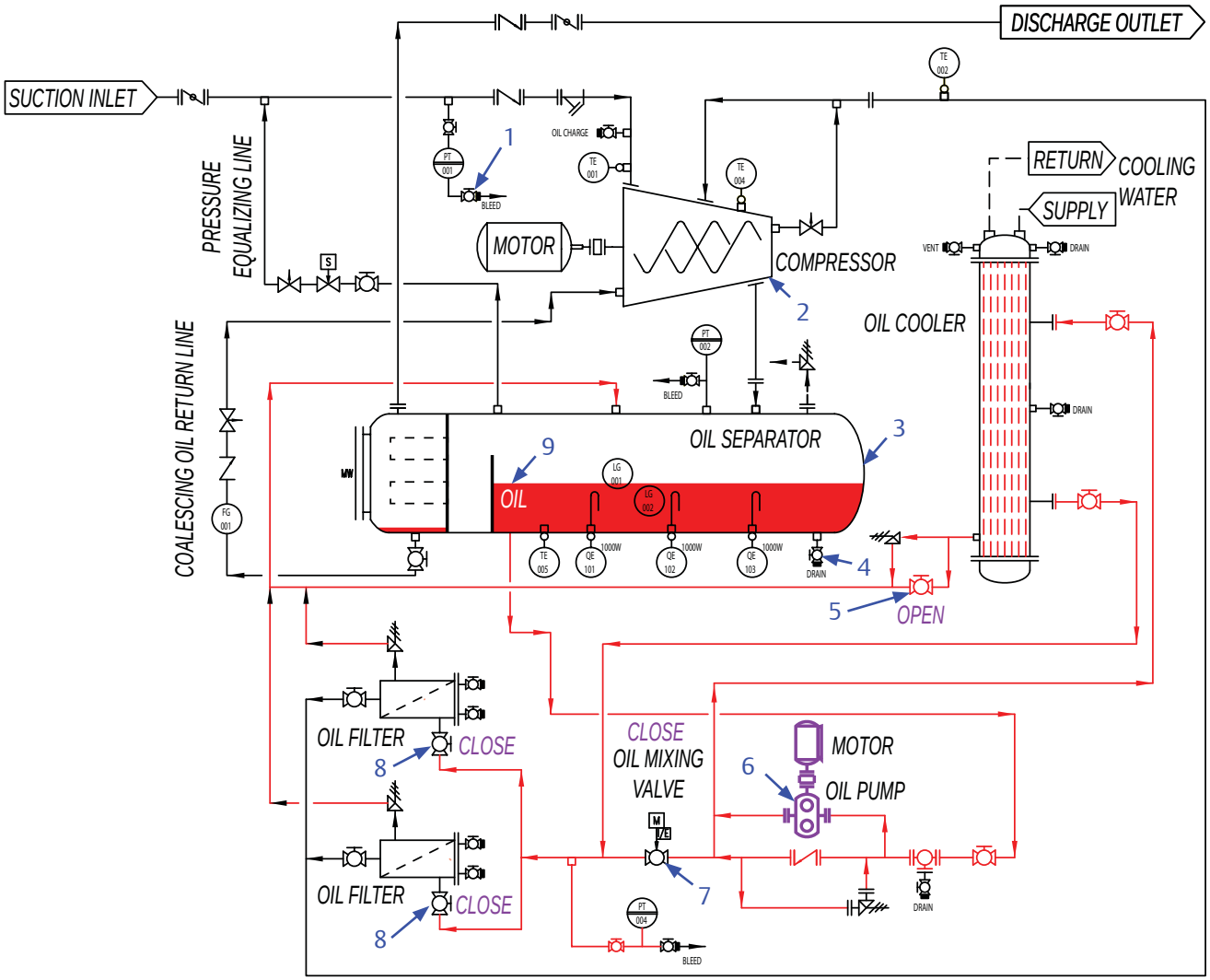


Figure 3-17. Priming Oil Cooler (Shell & Tube) and Piping

NOTE

Oil separator does not need to be filled again until oil level reaches Minimum Operating Level.

Every size of compressor will hold different amounts of oil, so amount of oil draining back into oil separator will vary.

21. More accurate fill levels can be accomplished by marking the level on the oil separator (2) after correct levels have been achieved during the unit operation and when the compressor unit has been down for 1 hour.

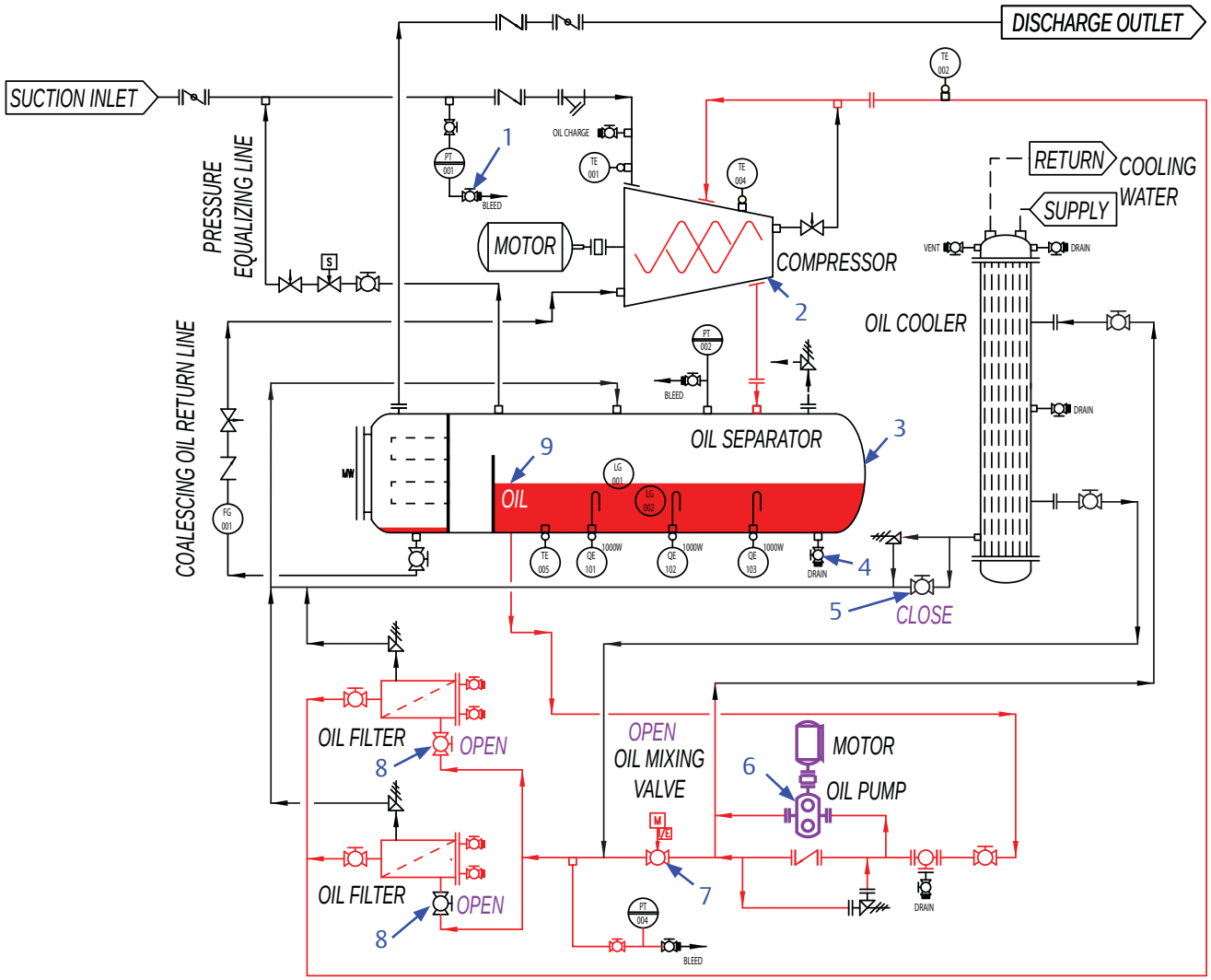


Figure 3-18. Priming Compressor (with Shell & Tube Oil Cooler) and Piping

Priming Remote Oil Cooler and Piping (Initial Oil Charging)

WARNING

Avoid skin contact with oil. Wear rubber gloves and a face shield when working with oil. Failure to comply may result in serious injury or death.

NOTICE

Failure to follow these instructions will result in bearing damage and compressor seizing and will void any and all warranties that may apply.

NOTE

This procedure is for remote oil coolers only.

Piping of oil must enter bottom connection of remote oil cooler and leave from top connection. For remote air cooled oil cooler piping, see Piping section.

(Reference Figure 3-19)

1. Verify oil level (8) is at Maximum Non-Operating Oil Level in separator (3). If oil level is not at Maximum Non-Operating Oil Level, add oil, see Initial Oil Charging - Unit Oil Charging procedure.
2. Close shut-off valve(s) (7) at oil filter inlet(s).
3. Open oil bypass shut-off valve (4).
4. Energize compressor unit.
5. Close oil mixing valve (oil temp. control valve) (6) via control panel. In Manual Mode, change “Manually Open (%)” value to “0”.

NOTE

The oil cooler is considered primed when the oil level in the separator is constant.

6. Run oil pump (5) for a minimum of 5 minutes and as long as needed to purge all gas from oil cooler and piping.
7. When all gas is purged, stop oil pump.

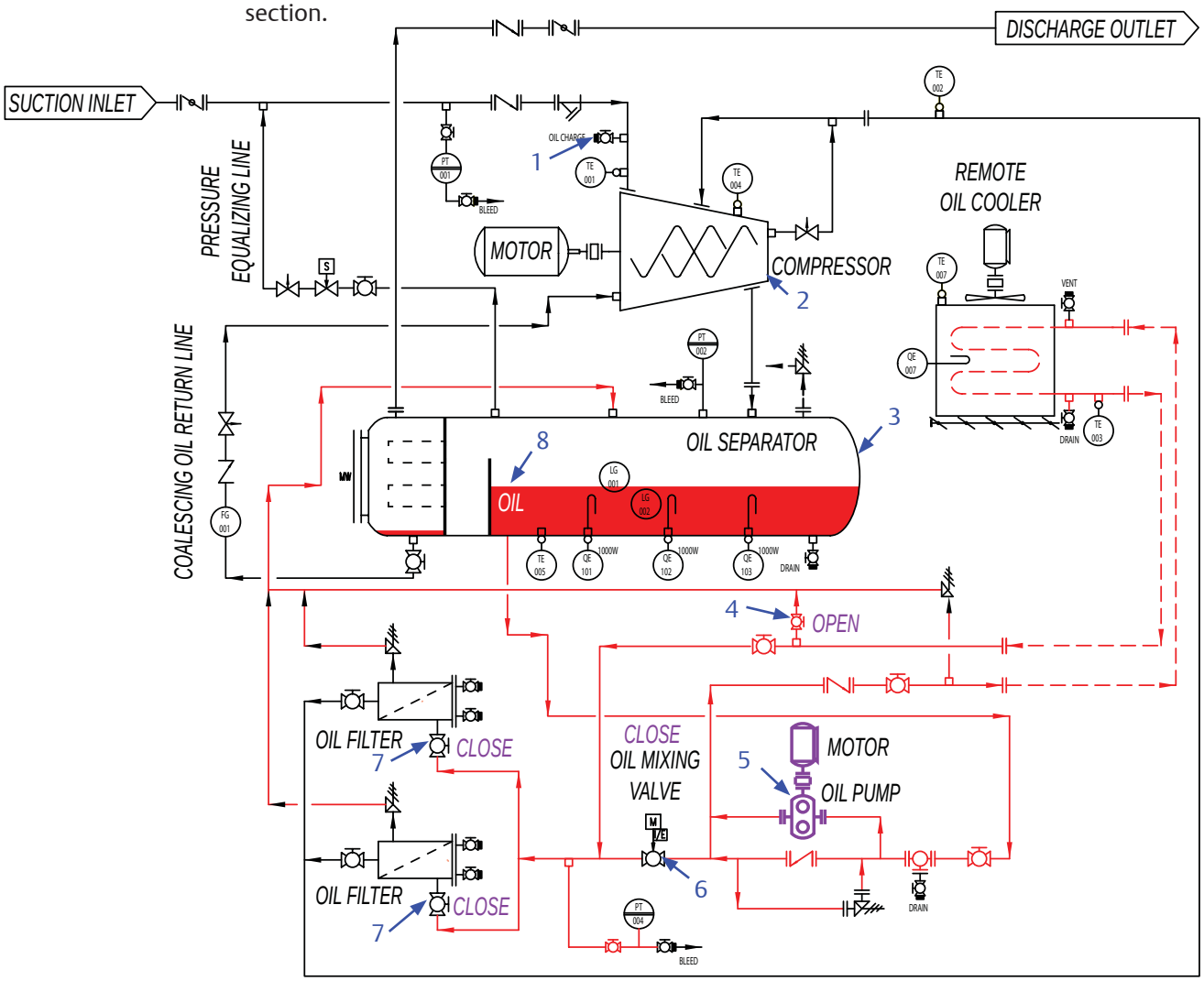


Figure 3-19. Priming Remote Oil Cooler and Piping

PRIMING COMPRESSOR AND OIL FILTERS

NOTE

Running the compressor oil pump at this point will help lubricate the compressor bearings and shaft seal surfaces.

(Reference Figure 3-20)

8. Open shut-off valve(s) (7) at oil filter inlet(s).
9. Close oil bypass shut-off valve (4).
10. Open oil mixing valve (6) via control panel. In Manual Mode, change "Manually Open (%)" value to "100".
11. Run oil pump (5) for approximately 20 seconds only.
12. Stop oil pump and wait for a minimum of 30 minutes. This will allow oil in the compressor (2) to drain and oil level (8) in separator (3) to settle.

NOTE

Oil mixing valve can remain in Manual Mode since the setpoint will change it to Auto mode. For further details, see PLC Compact Logix manual.

13. Refer to Pre Start-Up Checklist and ensure all items are ready prior to starting the compressor.
14. When ready, run compressor unit and allow it to reach normal operating temperature.
15. Using a properly selected oil pump, connect oil pump to suction oil charging valve (1). For suction oil charging valve location, see Figure 3-16.
16. Open suction oil charging valve (1) and fill oil separator (3) to Normal Operating Level.
17. Once the Normal Operating level has been reached, shut off the oil pump and close the suction oil charging valve (1). Disconnect and remove oil pump.

NOTE

Oil separator does not need to be filled again until oil level reaches Minimum Operating Level.

Every size of compressor will hold different amounts of oil, so amount of oil draining back into oil separator will vary.

18. More accurate fill levels can be accomplished by marking the level on the oil separator (2) after correct levels have been achieved during the unit operation and when the compressor unit has been down for 1 hour.

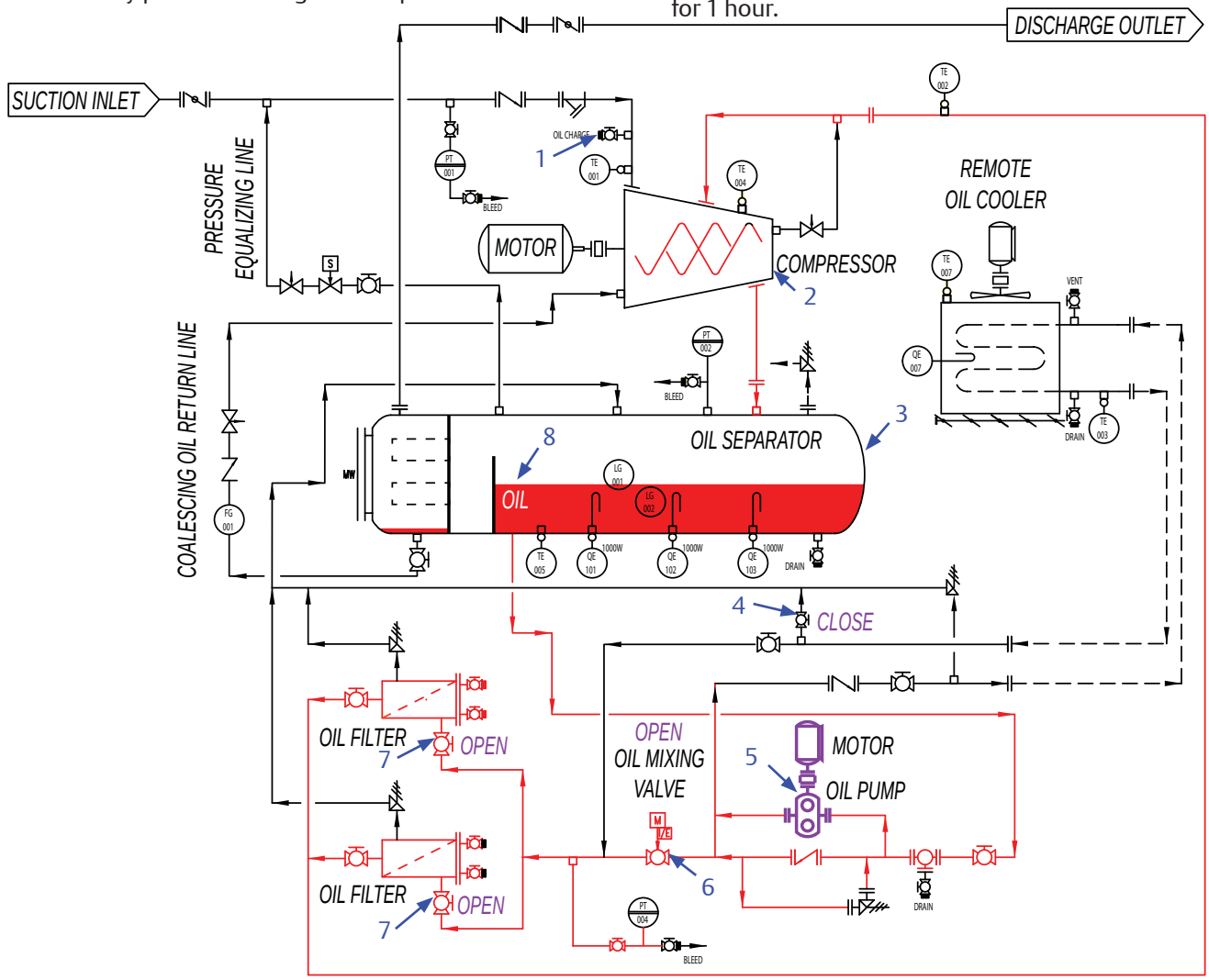


Figure 3-20. Priming Compressor and Oil Filters

Pre Start-Up

The following check list is to help prepare the equipment before the Vilter technician arrives at the jobsite. Vilter recommends that a trained technician go through the following tasks. The operating manuals provided by Vilter can be referenced for any type of questions or special instructions.

Every gas compressor unit includes a Vilter start-up (confirm on P.O.). The following tasks are not included in the Vilter start-up provided in your equipment purchase. Any tasks below that are done by the Vilter technician will take away from the pre-determined time that was provided with the equipment purchase. Vilter suggests that the Vilter technician's time be used during the start-up of the system and not for the below system preparation.

NOTICE

Each item below must be checked-off, signed and returned to Vilter Service Department. Failure to do so will "Null & Void" future warranty considerations.

Pre Start-Up Checklist

Name (Please Print):_____ Signature:_____

Company:_____ Vilter Sales Order Number:_____

Equipment Description:_____ Date (M/D/Y):_____

☐ 1. The unit should be leveled and secured to the concrete pad foundation.

☐ 2. Proper electric supply and grounding need to be supplied to the unit. All power and control lines should be wired to unit. Electric supply to be verified at each device requiring power.

☐ 3. Verify any type of level switches that are on a vessel before the compressor are hardwired and able to shut off the compressor (should be wired to "Aux" on micro-controller and starter).

☐ 4. The suction and discharge line must be piped and properly supported independent of the unit.

☐ 5. The discharge stop and check valve is shipped loose and must be installed. During off periods, liquid can condense in the line downstream of the discharge stop and check valve. It is recommended that the stop and check valve be located horizontally to minimize the quantity of liquid that can accumulate downstream of the check valve.

☐ 6. A dual safety relief valve is shipped loose for field installation. A connection is provided on the oil separator for the relief valve. Refer to ASME Code for proper sizing of relief valves and vent lines.

☐ 7. On water cooled oil coolers, the water lines must be connected to the front head of the oil cooler. Water regulating and solenoid valves are recommended.

(Continued on next page)

- [ ] 8. On air cooled oil coolers, the oil lines from the compressor must be connected to the air cooled oil cooler. Oil cooler fans will need to be wired and checked for proper rotation. Refer to supplied GA drawing for connection points and piping sizes.

- [ ] 9. The oil separator should be charged with oil to the Maximum NON-Operating Level.

- [ ] 10. The center member of the compressor is shipped loose to help facilitate final field alignment and allow for motor rotation check.

- [ ] 11. Both the compressor and motor hubs should be checked for concentricity and perpendicularity.

- [ ] 12. The motor should be checked and shimmed for a soft foot prior to attempting final alignment.

- [ ] 13. The motor should be checked to make sure that it is lubricated properly. Proper re-lubrication amounts/types are provided on the motor's lubrication plate. These instructions should be closely followed to achieve optimum bearing life and to avoid consequential damage to the bearings and motor.

- [ ] 14. The center section of the coupling should be left out to allow the start-up technician to verify the final alignment and motor rotations.

- [ ] 15. Verify that all valves are in the open position.

- [ ] 16. Verfiy that the visual indicator on the Oil Temperature Control Valve (Oil Mixing Valve) position corresponds with "% OPEN" on the control panel. CLOSE position is 0% OPEN, OPEN position is 100% OPEN.

- [ ] 17. A system load should be available at the time of start-up.

- [ ] 18. The unit should be pressure tested and purged with a dry gas. Care should be taken to not pressurize excessively from the suction end of the compressor, as this will drive the compressor in a forward motion without lubrication and may cause damage.

- [ ] 19. Have a qualified electrician present to verify wiring during start-up.

- [ ] 20. Keep a hard copy of the final set points in case the micro-controller gets corrupted or if they are required by Vilter technicians for troubleshooting.

Start-Up

The following check list is to help verify and check equipment prior to start-up. This is the responsibility of the Vilter Technician.

- ☐ 1. Review pre start-up checklist.
- ☐ 2. Check oil pump rotation. This can be done by using the “Diagnostic Force Outputs” from Main Menu. Refer to Compact Logix PLC Software Manual.
- ☐ 3. Check compressor motor rotation (CCW or CW rotation facing compressor shaft). This can be done by using the “Diagnostic Force Outputs” from Main Menu. Refer to Compact Logix PLC Software Manual.
- ☐ 4. Cold and hot alignment. Verify with manufacturer’s limits.
- ☐ 5. Verify capacity slide calibration and correct command shaft rotation, even though it is factory calibrated.
- ☐ 6. Verify volume slide calibration and correct command shaft rotation, even though it is factory calibrated.
- ☐ 7. Check motorized oil mixing valve for proper setup.
- ☐ 8. Starter set up by vendor technician.
- ☐ 9. Blower set up by vendor technician.
- ☐ 10. Verify correct direction of flow for the oil line check valve.
- ☐ 11. Run oil pump to pre-lube the compressor (oil level in the oil separator should drop as lines are filled).
- ☐ 12. Calibrate transducers to atmosphere.
- ☐ 13. Verify operation of all safeties.
- ☐ 14. Set scaling for main motor amps in PLC.
- ☐ 15. Record running data and final set points on data sheets.
- ☐ 16. Instruct Operators.

Operation

All operation (setpoint adjustments, calibrations, monitoring) of the compressor unit is done through the Compact Logix PLC. For additional procedural information, refer to Compact Logix PLC Software Manual (35391CL).

Oil Inspection

WARNING

When working with LFG, NG or other dangerous or flammable gases, ensure there are adequate ventilation and vapor detectors. Refer to national fire and building codes. Failure to comply may result in serious injury or death.

WARNING

Avoid skin contact with any condensate or oil. Wear rubber gloves and a face shield when working with condensate or oil. Failure to comply may result in serious injury or death.

Inspect oil level through sight glasses on the oil separator, see Figure 4-1. Oil Operating Levels. Drain or fill oil as required. For oil draining and filling procedure, see Oil Charging and Oil Draining in Section 5.Oil Flow with Dual Oil Filters

Dual Oil Filters

On compressor units equipped with dual oil filters, only one filter should be in operation at a time.

NOTE

During operation, both oil filter outlet shut-off valves should be open. This will help minimize the sudden loss of oil pressure when switching between oil filters for servicing.

Refer to Oil Filter Replacement in Section 5 for further details.

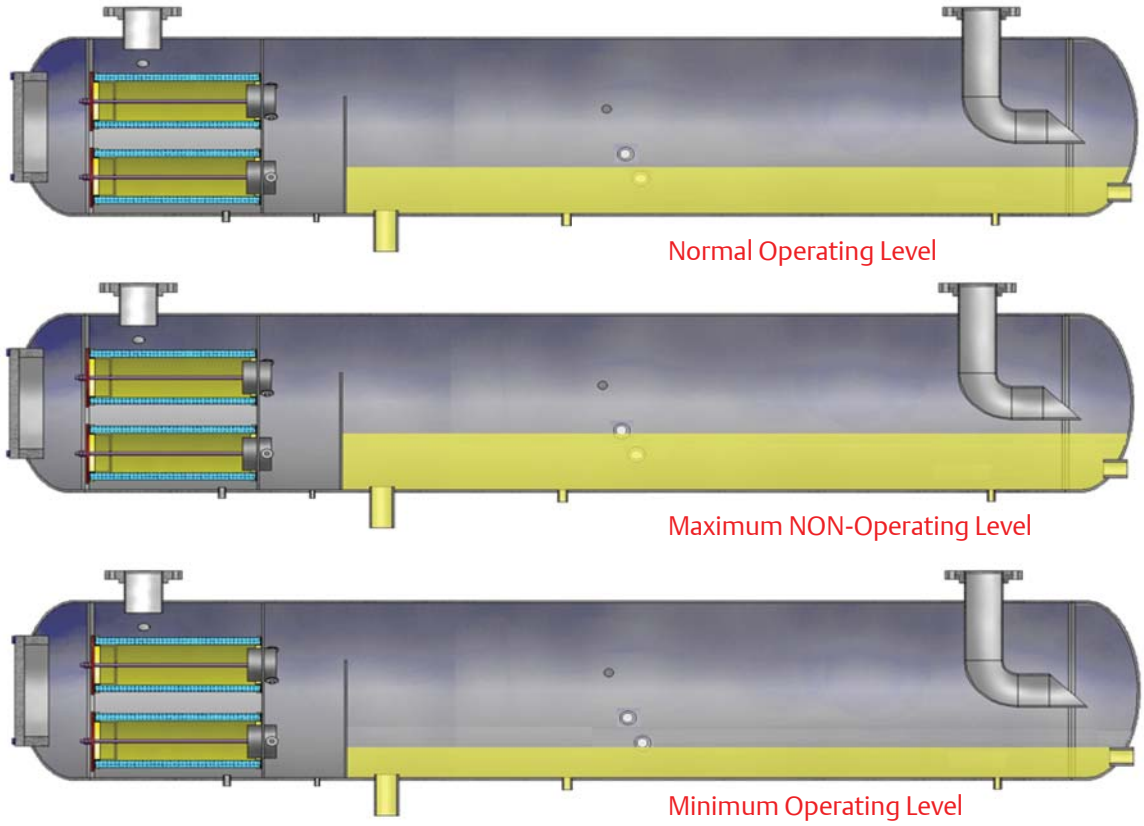


Figure 4-1. Oil Operating Levels

Control System Calibration

Equipped for automatic operation, the screw compressor unit has safety controls to protect it from irregular operating conditions, an automatic starting and stopping sequence, capacity and volume ratio control systems.

Check all pressure controls with a remote pressure source, to assure that all safety and operating control limits operate at the point indicated on the microprocessor.

The unit is equipped with block and bleed valves that are used to recalibrate the pressure transducers. To use the block and bleed valves to recalibrate the pressure transducers, the block valve is shut off at the unit and the pressure is allowed to bleed off by opening the bleed valve near the pressure transducer enclosure. The transducer can then be calibrated at atmospheric pressure (0 psig), or an external pressure source with an accurate gauge may be attached at the bleed valve.

The discharge pressure transducer cannot be isolated from its pressure source, so it is equipped with only a valve to allow an accurate pressure gauge to be attached and the pressure transducer calibrated at unit pressure.

Recheck the transducers periodically for any drift of calibration, refer to maintenance/service interval table in Section 5.

Starting, Stopping and Restarting the Compressor

Starting

Before the screw compressor unit can start, certain conditions must be met. All of the safety setpoints must be in a normal condition, and the suction pressure must be above the low suction pressure setpoint to ensure a load is present. When the "ON/OFF" switch or "Manual-Auto" button is pressed, the oil pump will start. When sufficient oil pressure has built up and the compressor capacity control and volume ratio slide valves are at or below 10%, the compressor unit will start.

NOTE

The amount of oil pressure that needs to be achieved before compressor start is at least 6 psig above the discharge pressure. For additional information on Low Oil Pressure at Start, see Troubleshooting Guide - General Problems and Solutions in Section 6.

If the compressor is in the automatic mode, it will now load and unload and vary the volume ratio in response to the system demands.

Stopping/Restarting

Stopping the compressor unit can be accomplished a number of ways. Any of the safety setpoints will stop the compressor unit if an abnormal operating condition exists. The compressor unit "On-Off" or stop button will turn the compressor unit off as will the low pressure setpoint. If any of these conditions turns the compressor unit off, the slide valve motors will immediately energize to drive the slide valves back to 5% limit. The control motors will be de-energized when the respective slide valve moves back below 5%. If there is a power failure, the compressor unit will stop. If the manual start on power failure option is selected (see appropriate Microprocessor Instruction Manual), restarting from this condition is accomplished by pushing the reset button to insure positive operator control. If the auto start on power failure option is selected (see Compact Logix PLC manual), the compressor unit will start up after a waiting period. With both options, the compressor slide valves must return below their respective 5% limits before the compressor unit can be restarted.

NOTE

Wait a minimum of 20 minutes (to allow the compressor unit to equalize to suction pressure) between pre-lubing or pushing the start button.

Calibrate Slide Valve Actuators

Slide valve actuators must be installed prior to calibration. Refer to Slide Valve Actuator Installation procedure. The following steps pertain to calibrating one slide valve actuator. Repeat procedure to calibrate other slide valve actuator.

WARNING

After stopping the compressor, allow the compressor and surrounding components to cool down prior to servicing. Failure to comply may result in serious injury.

CAUTION

Do not calibrate in direct sunlight. Failure to comply may result in damage to equipment.

Both the capacity and volume slide actuators should be calibrated when one or more of these have occurred:

- Compressor unit starting up for the first time.
- A new actuator motor has been installed.

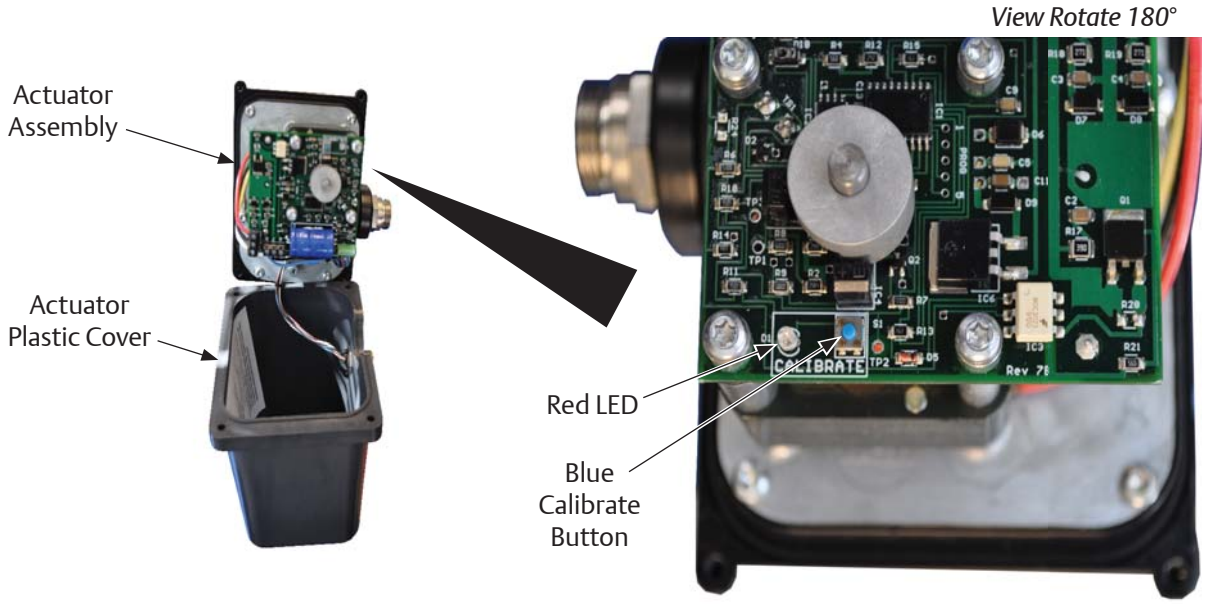


Figure 4-2. Actuator Assembly

- There is an error code flashing on the actuator's circuit board - an attempt to recalibrate should be made.
- The range of travel is not correct and the command shaft travel is physically correct.
- The compressor is pulling high amperage, the calibration of the volume slide should be checked.
- An actuator does not unload below 5%, or an actuator that doesn't move.
- Something is not working properly such as the actuators, RTDs or transducers.

To calibrate optical actuators, continue with the following steps:

1. Stop compressor unit and allow to cool.
2. Remove screws securing actuator cover to actuator assembly. As a reference see Figure 4-2.

CAUTION

Wires are attached to the connector on the actuator cover. Handle actuator cover with care to prevent damage to wires. Failure to comply may result in damage to equipment.

3. Carefully lift actuator cover from actuator assembly and tilt towards Turck connectors. Raise cover high enough to be able to press the blue calibration button and be able to see the red LED on the top of assembly.
4. On the main screen of the PLC, press "Menu" then press the "Slide Calibration" button to enter the slide calibration screen, see Figure 4-3.
5. Logging on with high-level access will prompt the Calibrate button to appear, see Figure 4-4.
6. Press Calibrate button to initiate calibration mode. The Calibrate button turns green and Set Max and Set Min buttons appear.

NOTE

If the INC (increase) and DEC (decrease) buttons do not correspond to increase or decrease shaft rotation, swap the blue and brown wires of the "power cable". This will reverse the rotation of the actuator/command shaft.

7. Press INC and DEC to move the slide valve and check for the correct rotation, see Table 4-1.

NOTE

When the actuator is in calibration mode, it outputs 0V when the actuator is running and 5V when it is still. Thus, as stated earlier, the actuator voltage will fluctuate during calibration. After the actuator has been calibrated, 0V output will correspond to the minimum position and 5V to the maximum position.

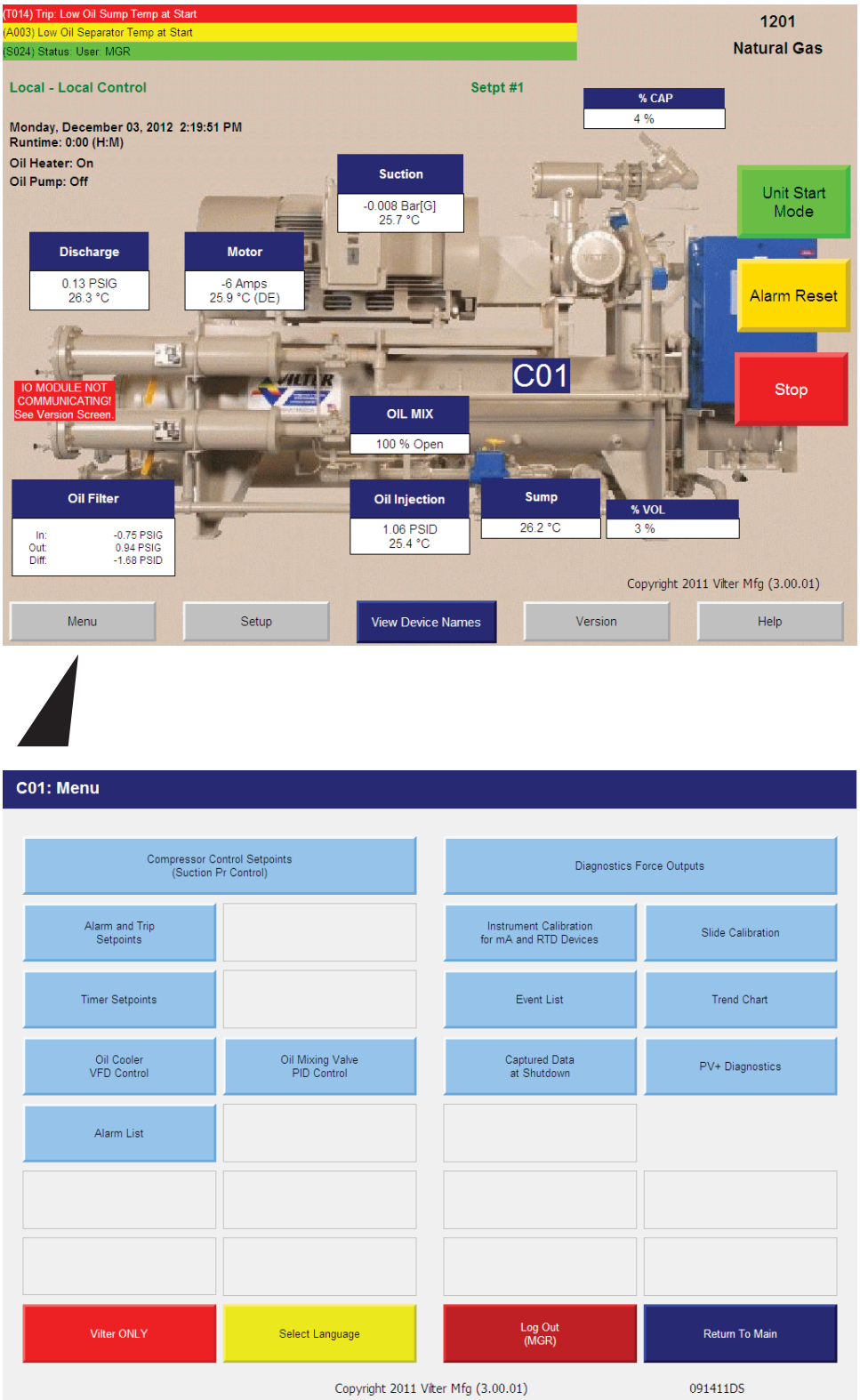


Figure 4-3. Menu Screen and Slide Calibration Button (Compact Logix PLC)

Figure 4-4. Slide Valve Calibration Screen (Compact Logix PLC)

8. Quickly press and release the blue push button on the actuator one time. This places the actuator in calibration mode. The red LED will begin flashing rapidly.

CAUTION

DO NOT CONTINUE TO ENERGIZE THE ACTUATOR MOTOR AFTER THE SLIDE HAS REACHED THE MECHANICAL STOP. Doing so may cause mechanical damage to the motor or shear the motor shaft key. When the slide has reached the mechanical stop position, press the button in the center of the photochopper to release the brake, and thereby release the tension on the actuator motor.

NOTE

The "Slide calibration" screen on the Control Panel has a "Current" window, which displays twice the actuator output voltage. This value, (the % volume and the % capacity) displayed in the "Current Vol" and Current Cap" Windows are meaningless until calibration has been completed.

9. Use the DEC button on the Control panel to drive the slide valve to its minimum "mechanical stop" position. Do not continue to run the actuator in this direction after the slide valve has reached the stop. Doing so may cause damage to the actuator or the slide valve. Press down on the photo-chopper shaft to disengage the brake, releasing tension from the motor mount, see Figure 4-5. Use the INC button to pulse the actuator to where the slide is just off of the mechanical stop and there is no tension on the motor shaft.

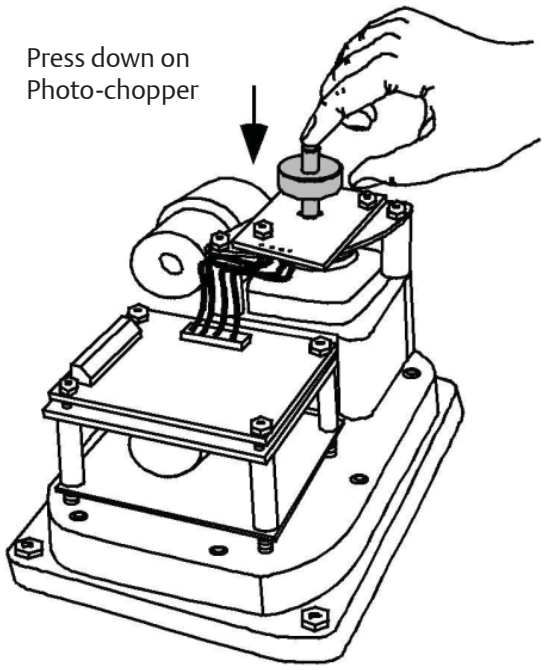


Figure 4-5. Photo-chopper

10. Quickly press and release the blue button on the actuator again. The red LED will now flash at a slower rate, indication that the minimum slide valve position (zero position) has been set.

Table 4-1. Command Shaft Rotation Specifications*

Compressor Model	Command Shaft Rotation				No. of Turns/Rotation			Angle/Slide Travel		
	Capacity		Volume		Capacity			Volume		
	INC	DEC	INC	DEC	Turns	Degrees	Travel	Turns	Degrees	Travel
VSSG 291 VSSG 341 VSSG 451 VSSG 601	CW	CCW	CW	CCW	0.91	328	3.568”	0.52	187	2.045”
VSG 301 VSG361 VSG 401	CW	CCW	CW	CCW	0.80	288	3.141”	0.45	162	1.767”
VSG 501 VSG 601 VSG 701	CCW	CW	CCW	CW	0.91	328	3.568”	0.52	187	2.045”
VSG 751 VSG 901	CCW	CW	CCW	CW	1.09	392	4.283”	0.63	227	2.473”
VSG 791 VSG 891 VSG 1051 VSG 1201 VSG 1301	CCW	CW	CCW	CW	1.22	439	4.777”	0.74	266	2.889”
VSG 1551 VSG 1851 VSG 2101	CCW	CW	CCW	CW	1.48	533	5.823”	0.87	313	3.433”
VSG 2401 VSG 2601 VSG 2801 VSG 3001	CCW	CW	CCW	CW	1.80	648	7.072”	1.36	490	5.341”

*The large gear on the command shaft has 50 teeth. The teeth are counted when moving the command shaft from the minimum stop position to the maximum stop position.

The manual operating shaft on the gear motor should be turned the opposite direction of the desired command shaft rotation.

The capacity and volume control motors are equipped with a brake, if it is necessary to operate the control motors manually, the brake must be disengaged. The brake can be disengaged by pushing on the motor shaft on the cone end. The shaft should be centered in its travel. Do not use excessive force manually operating the motor or damage may result.

11. Use the INC button on the Control panel to drive the slide to its maximum "mechanical stop" position. Do not continue to run the actuator in this direction after the slide valve has reached the stop. Doing so may cause damage to the actuator or the slide valve. Press down on the photo-chopper shaft to disengage the brake, releasing tension from the motor mount. Use the DEC button to pulse the actuator to where the slide is just off of its mechanical stop and there is no tension on the motor shaft.
12. Quickly press and release the blue button on the actuator one more time. The red LED will stop flashing. The actuator is now calibrated and knows the minimum and maximum positions of the slide valve it controls. Now the capacity or volume channel of the PLC can be calibrated.
13. Use the DEC button to move the actuator towards its minimum position while watching the mV readout on the Control Panel screen. Discontinue pressing the DEC button when the mV reading the "Current" window above the "Set Min" button is approximately 500 mV.
14. Now use the DEC and INC buttons to position the slide valve until a value close to 300 mV is on the screen. Then, press the "Set Min" button in the capacity or volume slide valve window to tell the controller that this is the minimum mV position. Note: The value in the "Current Cap" or "Current Vol" window has no meaning right now.
15. Use the INC button to rotate the actuator towards its maximum position while watching the mV readout on the controller screen. Discontinue pressing the INC button when the mV reading in the "Current" window is approximately 4800 mV. You are nearing the mechanical stop position.
16. Pulse the INC button to carefully move the slide valve until the mV readout "saturates", or stops increasing. This is around 4800 mV Record mV maximum reading.
17. Pulse the DEC button until the mV just start to decrease. (This is the point where the channel drops out of saturation). Adjust mV value to 300 mV below recorded maximum mV.
18. Press the "Set Max" button.
19. Press the "Main" button to complete calibration and exit the "Slide Calibration" screen. The controller will automatically energize the actuator and drive it back to its minimum position (below 5%) for pre-start-up.

NOTE

Now the "Current Cap" or the "Current Vol" value will be displayed in the window on the "Main" screen and the "Slide Calibration" screen.

20. Gently lower the plastic cover over the top of the actuator to where it contacts the base and O-ring seal. After making sure the cover is seated properly, gently tighten the four #10 screws. Caution: The plastic cover will crack if the screws are over tightened.
21. Enable the "Slide Non-Movement Alarm" by going to the "Setup" menu and choosing "Alarm Enable" for the "Slide Non-Movement Option".
22. Repeat procedure to calibrate other slide valve actuator.

Oil Temperature Control Valve (Oil Mixing Valve) Operation

Initial Position

The temperature control valve is in the closed position when initially installed.

With the temperature control valve de-energized, the valve is set to its initial position. The temperature control valve will be in the closed position with the actuator indicator displaying CLOSED.

When the temperature control valve is energized, the valve will rotate to fully OPEN.

Operation

With the compressor not running, when electrically energized, the PLC will turn the temperature control valve to fully open (100%).

When the compressor starts, the valve remains fully open (100%) until the oil injection temperature rises above the control setpoint. When the oil injection temperature rises above the control setpoint, the oil temperature control valve will begin to close. The hot oil from the oil separator begins to divert to the oil cooler, mixing the hot and cooled oil flow streams together downstream of the oil temperature control valve. The valve can fully close (0%) diverting the entire oil flow stream to the oil cooler.

As the oil injection temperature drops below the setpoint, the oil temperature control valve begins to open so that the oil injection temperature does not become too cold.

When the compressor stops, the valve returns to fully open (100%).

Fail Position

The temperature control valve remains in the last position when power is removed.

Screen Display

The oil temperature control valve, identified as "OIL MIX" on the main PLC display screen, shows a numerical value with "%" as units. This is to be understood as "% OPEN." It is a direct indication of the position of the ball valve.

100% OPEN

Oil flow stream is entirely bypassing the oil cooler.

99% to 1% OPEN

Oil flow stream is partially bypassing the oil cooler and partially diverted to the oil cooler.

0% OPEN

Oil flow stream is entirely diverted to the oil cooler.

MANUAL OVERRIDE

The actuator of the oil temperature control valve has a handwheel that can be engaged to override the electrically determined position of the ball valve.

1. Push handwheel down and rotate to engage internal slot with flats, see Figure 4-6.

NOTE

Actuator does not have mechanical stops. Do Not rotate past open or close position. Use visual indicator to position actuator.

2. Once engaged, push down handwheel a second time to disengage gear train and rotate *CLOCKWISE* to *OPEN* or *COUNTER CLOCKWISE* to *CLOSE*.
3. To return actuator to normal operation, first check "% OPEN" on control panel. If value is 100%, return actuator to OPEN position as shown on the visual indicator. If value is 0%, return actuator to CLOSE position as shown on the visual indicator.

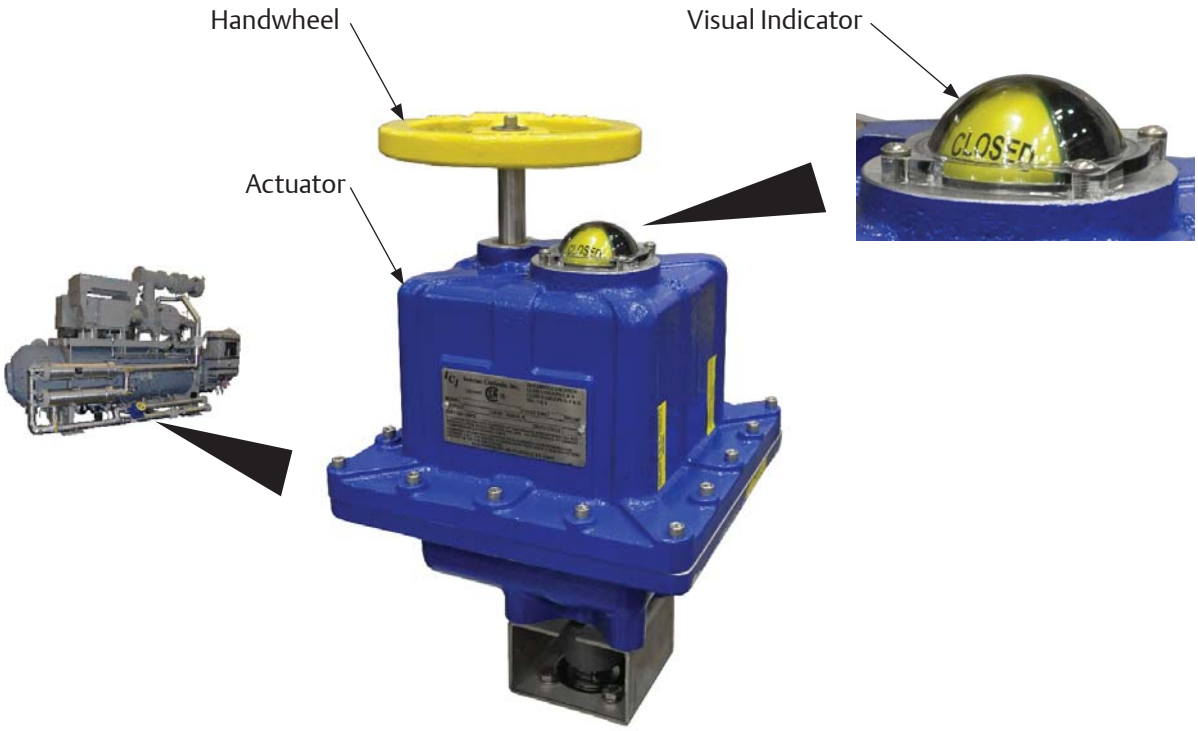


Figure 4-6. Oil Temperature Control Valve (Oil Mixing Valve)

Purging with Dry Nitrogen

Purging is recommended if the compressor will be inactive for 12 hours or more. For additional long term storage information, refer to Long Term Storage Recommendations in Section 3.

PREPARATION

WARNING

When working with LFG, NG or other dangerous or flammable gases, ensure there are adequate ventilation and vapor detectors. Refer to national fire and building codes. Failure to comply may result in serious injury or death.

WARNING

When working pressured systems, always wear safety glasses and/or face shield. Failure to comply may result in serious injury.

1. Press “Stop” button to stop compressor unit, see Figure 4-7.
2. If equipped with equalizing solenoid, allow pressure in compressor unit to equalize to suction pressure, see Figure 4-8.
3. If equipped with manual suction bypass valve and it is not open, open suction bypass valve. Allow pressure in compressor unit to equalize to suction pressure.
4. Close suction and discharge shut-off valves to isolate the compressor unit from house system. Lockout/tagout valves.
5. Slowly open suction oil charging valve to depressurize compressor unit to atmosphere, see Figure 4-8. Keep valve in open position.

NOTE

Plugs are installed on bleed valves. Remove and install plugs prior to and after bleeding. Ensure to keep valves closed when removing and installing plugs.

6. Open discharge bleed valve to allow nitrogen to purge through compressor unit, see Figure 4-8.
7. Refer to PLC main screen for discharge pressure when purging.

PURGE

CAUTION

Do not purge compressor unit with oxygen. Failure to comply may result in damage to equipment.

CAUTION

Do not allow compressor to spin while purging. Regulate purging pressure as needed. Failure to comply may result in damage to equipment.

8. Connect purging hose from nitrogen cylinder to suction oil charging valve.

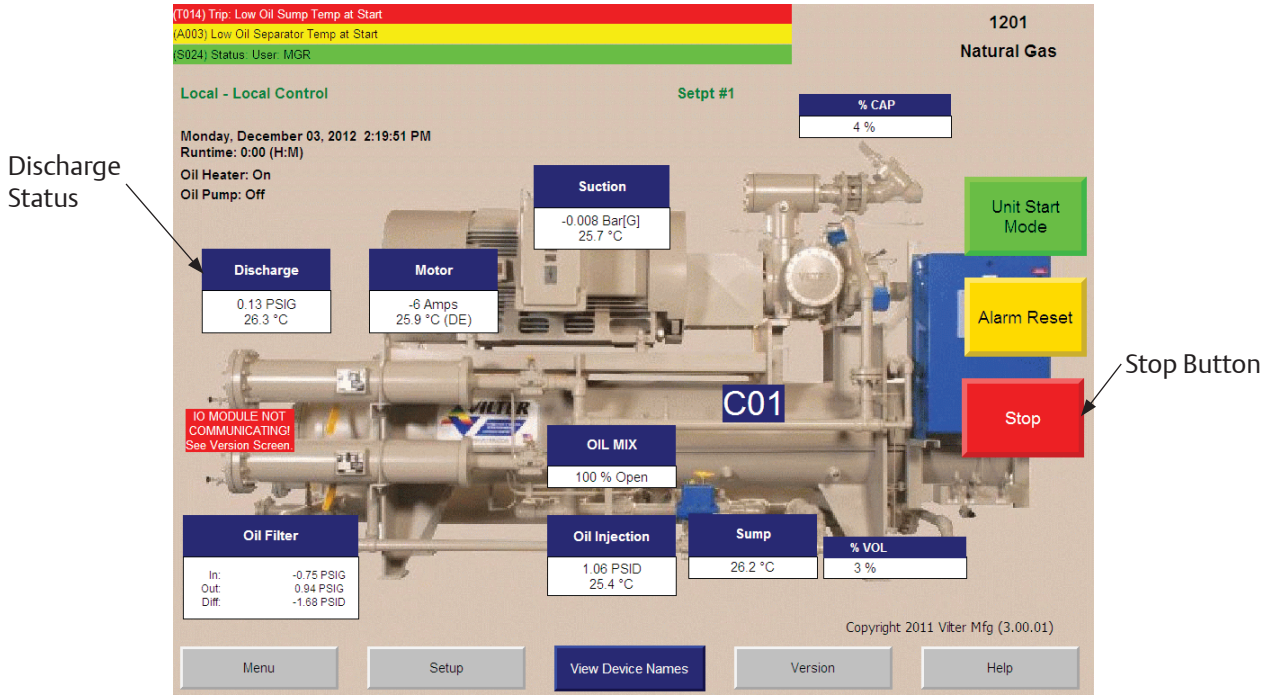


Figure 4-7. PLC Main Screen

NOTE

Purging is performed through the suction oil charging valve so that trapped gas can be pushed out of the compressor. This will help minimize metal surface oxidation of the compressor (due to the gas) while not in service.

9. Purge compressor unit for 5 minutes. Check discharge pressure on PLC main screen to make sure pressure is increasing.
10. Close discharge bleed valve while still purging.
11. Observe discharge pressure through the PLC main screen. Allow pressure to build to approximately 10 psig.
12. Once pressure is reached, stop purging and close suction oil charging valve. If pressure is greater than 10 psig, crack open discharge bleed valve, as needed, to slowly bleed the system to approximately 10 psig.
13. Wait 10 minutes to make sure there are no leaks and that the pressure is holding.
14. Remove purging hose from suction oil charging valve.

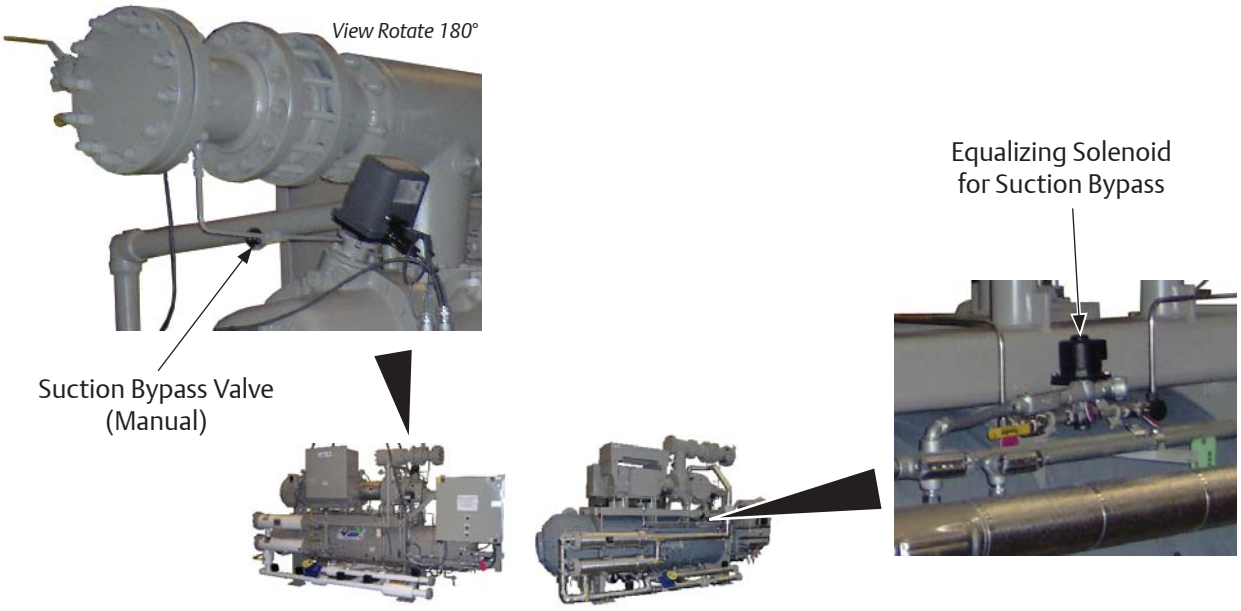


Figure 4-8. Suction Bypass Valve and Equalizing Solenoid

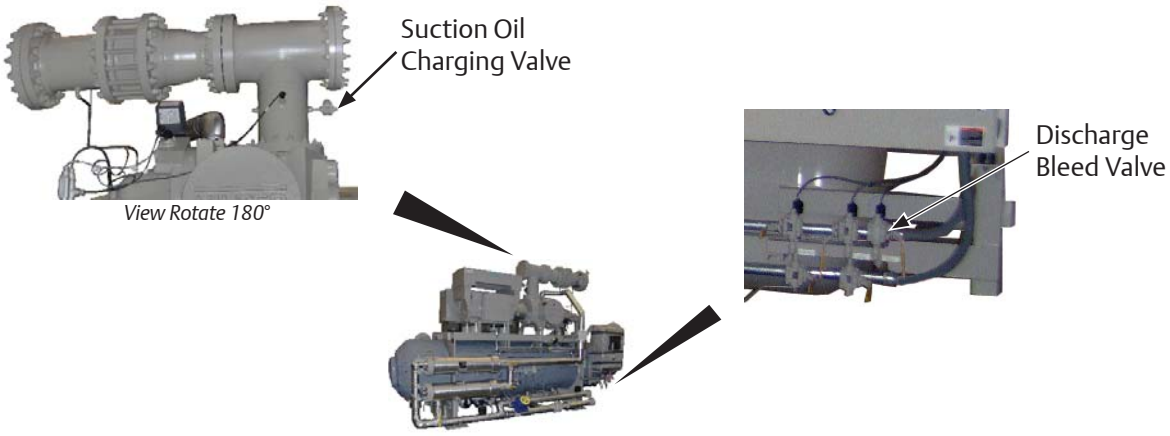


Figure 4-9. Suction Oil Charging Valve and Discharge Bleed Valve

Purging with Dry Gas

Purging is recommended if the compressor will be inactive for 12 hours or more. For additional long term storage information, refer to Long Term Storage Recommendations in Section 3.

PREPARATION

WARNING

When working with LFG, NG or other dangerous or flammable gases, ensure there are adequate ventilation and vapor detectors. Refer to national fire and building codes. Failure to comply may result in serious injury or death.

WARNING

When working pressured systems, always wear safety glasses and/or face shield. Failure to comply may result in serious injury.

NOTICE

To purge the compressor unit using a dry gas (i.e. methane), a purge line must be installed. If there is not enough purge pressure, connect purge line to a lower pressure line or to atmosphere. ***The purge line, associated valves and gauges are not provided from the factory and must be installed by the customer.***

1. Refer to Figure 4-10 for recommended purge line design.
2. Press “Stop” button to stop compressor unit, see Figure 4-11.
3. If equipped with equalizing solenoid, allow pressure in compressor unit to equalize to suction pressure, see Figure 4-12.
4. If equipped with manual suction bypass valve and it is not open, open suction bypass valve. Allow pressure in compressor unit to equalize to suction pressure.
5. Close suction and discharge shut-off valves to isolate the compressor unit from house system. Lockout/tagout valves.

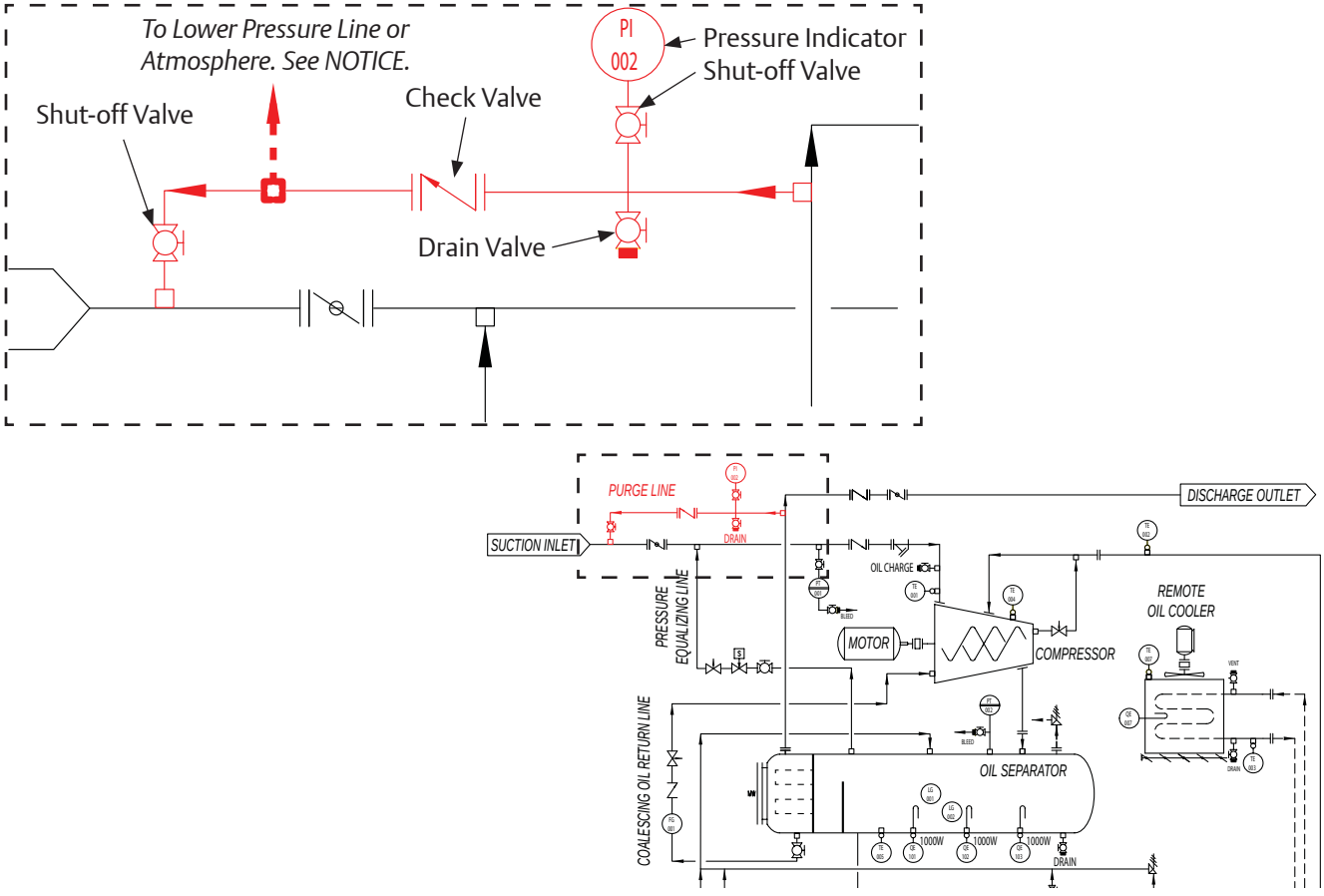


Figure 4-10. Customer Purge Line

NOTE

Plugs are installed on bleed valves. Remove and install plugs prior to and after bleeding. Ensure to keep valves closed when removing and installing plugs.

6. Slowly open suction oil charging valve and bleed remaining pressure in compressor unit to atmosphere, see Figure 4-13. Leave suction oil charging valve in open position.
7. If equipped with pressure indicator on purge line, open shut-off valve to pressure indicator.
8. If not equipped with pressure indicator, refer to PLC main screen for discharge pressure when purging.

PURGE

CAUTION

Do not purge compressor unit with oxygen. Failure to comply may result in damage to equipment.

CAUTION

Do not allow compressor to spin while purging. Regulate purging pressure as needed. Failure to comply may result in damage to equipment.

9. Connect purging hose from gas cylinder to suction oil charging valve.

NOTE

Purging is performed through the suction oil charging valve so that trapped gas can be pushed out of the compressor. This will help minimize metal surface oxidation of the compressor (due to the gas) while not in service.

10. Purge compressor unit for 4 minutes. Check pressure indicator or discharge status on PLC main screen to make sure pressure is increasing.
11. Close shut-off valve on purge line while still purging.
12. Observe discharge pressure of compressor unit through the PLC main screen.
13. Allow pressure to build to approximately 10 psig in the compressor unit.
14. Once pressure is reached, stop purging and close suction oil charging valve.
15. Wait 10 minutes to make sure there are no leaks and that the pressure is holding.
16. Remove purging hose from suction oil charging valve.

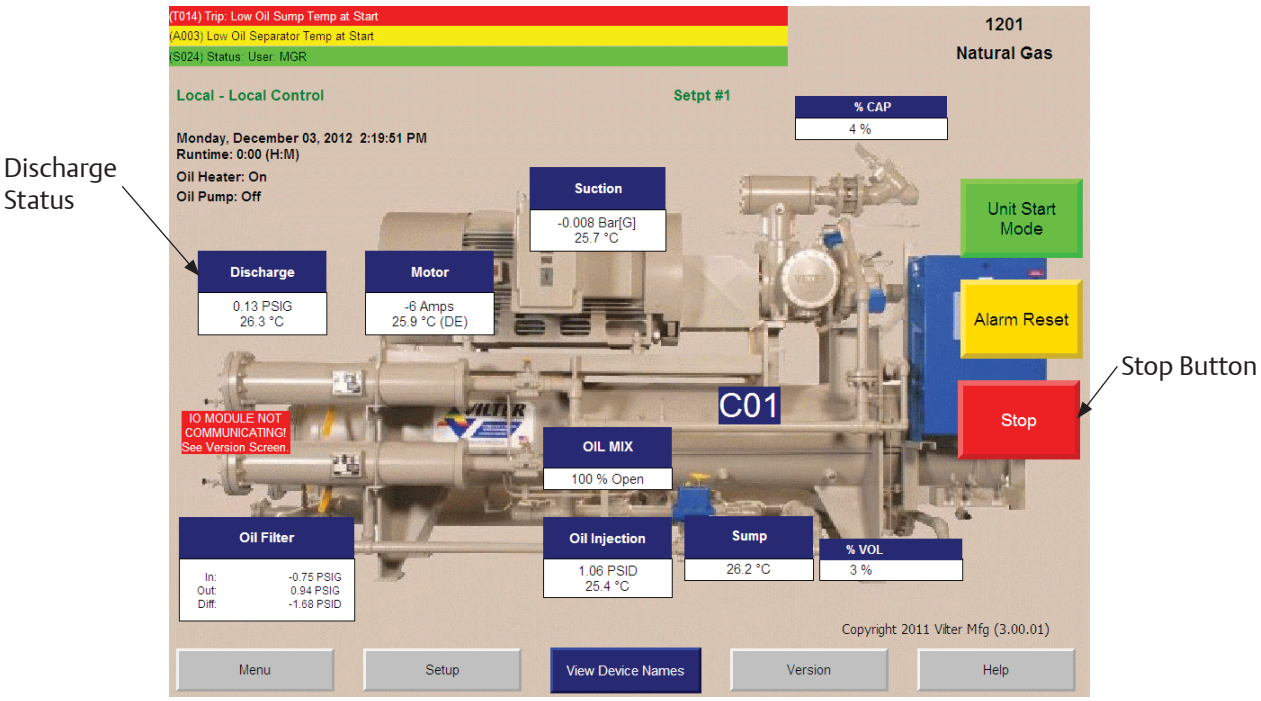


Figure 4-11. PLC Main Screen

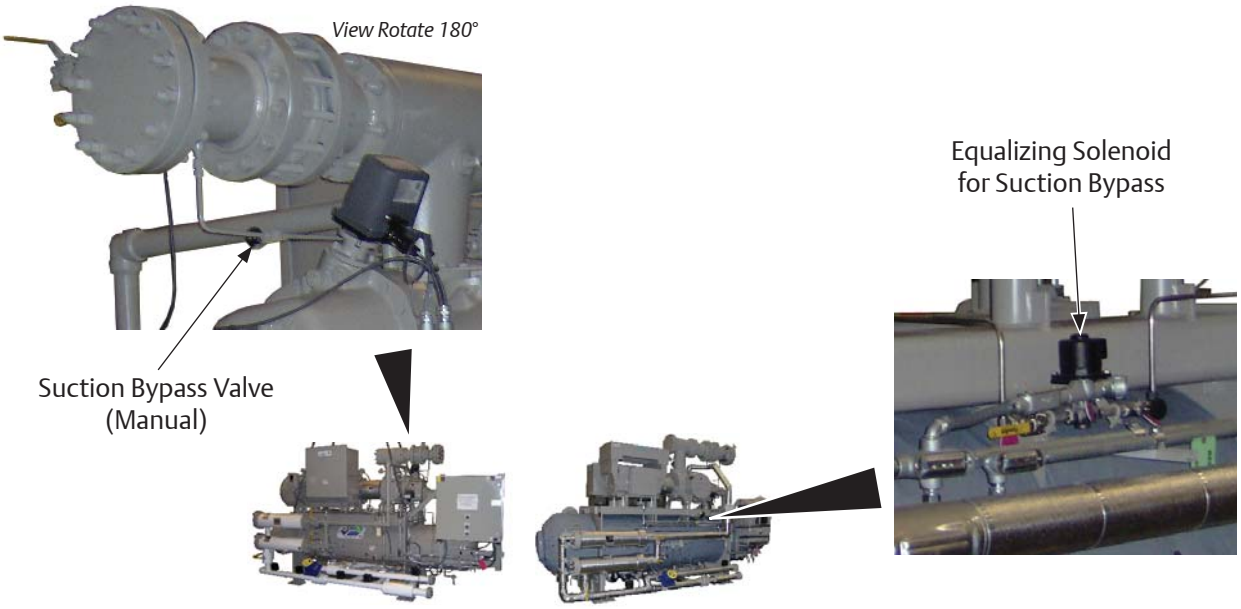


Figure 4-12. Suction Bypass Valve and Equalizing Solenoid

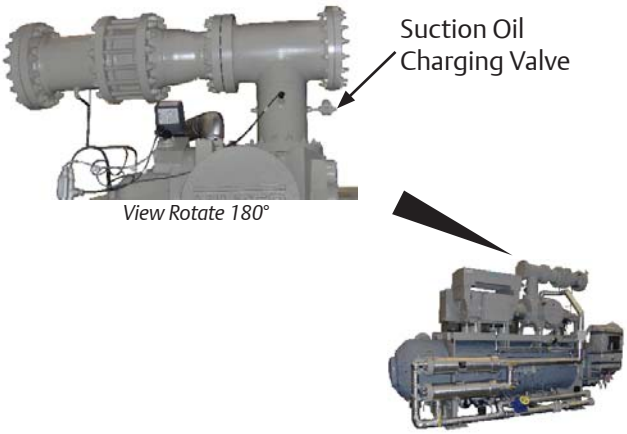


Figure 4-13. Suction Oil Charging Valve

Coalescing Oil Return Line Setup

Over time, oil will accumulate on the coalescing side of the oil separator. As a result, an oil return line with a shut-off valve, sight-glass, check valve and needle valve are installed between the coalescing side and compressor to return this oil back to the compressor.

To adjust the return flow, proceed with the follow procedure:

NOTE

Do not fully open the needle valve unless directed by Vilter Customer Service. Leaving the needle valve fully open will reduce efficiency of the compressor unit.

1. Open shut-off valve on coalescing side of oil separator, see Figure 4-14.
2. While the unit is in operation, crack open needle valve and observe oil flow through sight-glass.
3. Slowly open needle valve more until a small amount of oil is seen in the sight-glass.

NOTE

The sight-glass should never be full with oil.

4. Periodically check oil in the sight-glass and ensure that there is flow.

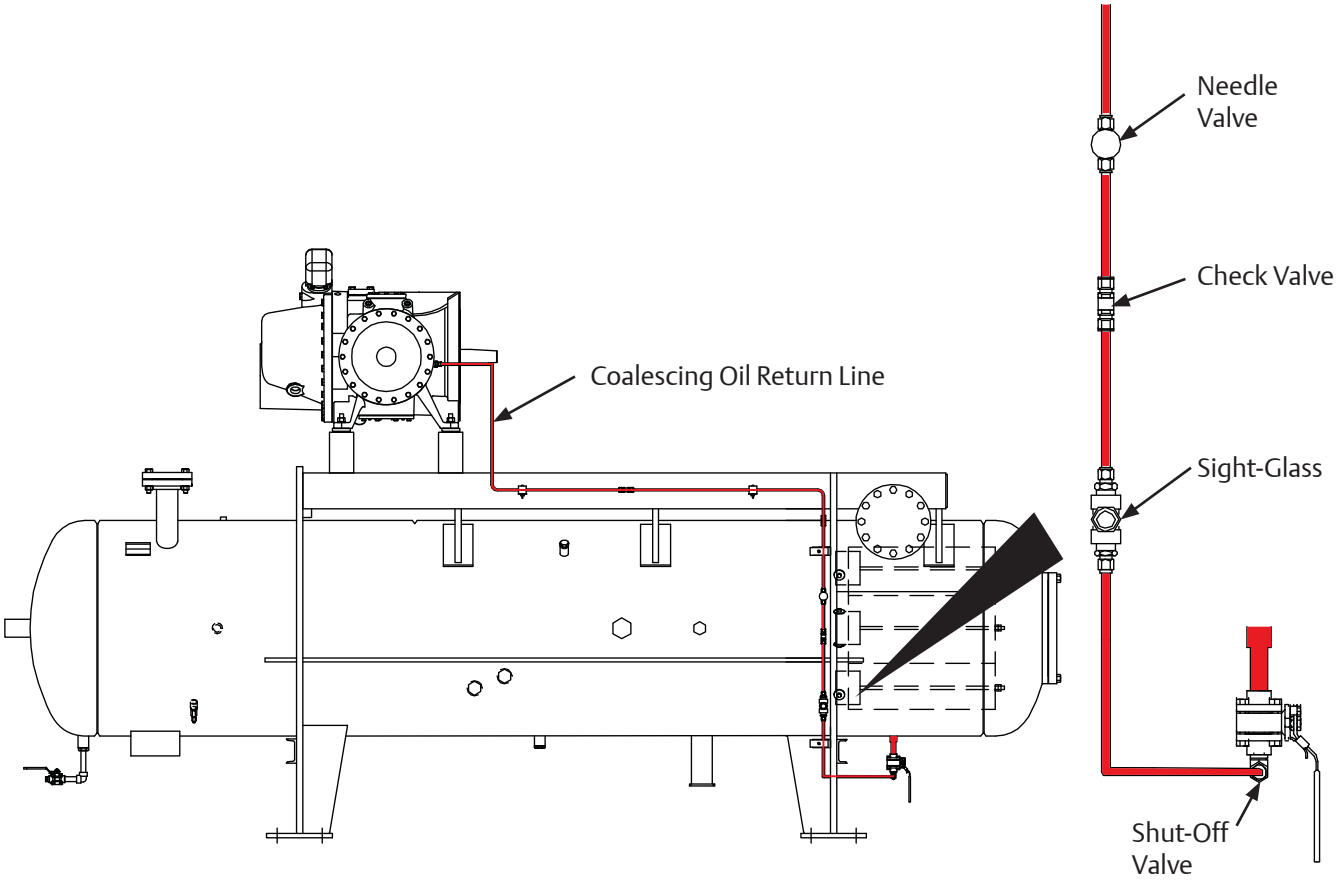


Figure 4-14. Coalescing Oil Return Line

Maintenance and Service Schedule

Follow this table for maintaining and servicing the compressor unit at hourly intervals.

Table 5-1. Maintenance/Service Schedule

Group	Inspection/ Maintenance (2)	Service Interval (Hours) (1) (Based on dry clean gas)													
		200	2,500	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000	45,000	50,000	55,000	60,000
Oil Circuit	Oil Change	Replace oil based on oil analysis report or visual contamination.													
	Oil Analysis	Oil sampling is recommended every 2 to 3 months for the first year. Thereafter, as required, increase sampling time period if contamination of oil is unlikely or decrease sampling time period if contamination of oil is evident. Take an oil sample any time during operation If there's reason to believe that the oil is contaminated. For additional information on oil, refer to Oil and Oil Flow operation.													
	Oil Filters (3)	-	-	-	-	R	-	-	R	-	-	R	-	-	R
	Oil Strainer	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Compressor Unit	Coalescing Filter	-	-	-	-	R	-	-	R	-	-	R	-	-	R
	Coalescing Drain Line	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Suction Screen	I	-	-	I	-	I	-	I	-	I	-	I	-	I
	Coupling Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Motor (Compressor)	See Motor Manual for proper lubrication procedures and service intervals.													
Control Calibration	Transducers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	RTDs	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Slide Valve Motors	Slide valve calibration should be inspected monthly. Inspections can be performed through the control panel. If a Non-Movement Alarm appears, calibrate immediately.													
Compressor (4) (5)	Compressor (6)	-	I	-	I	-	I	-	I	-	I	-	I	-	I
	Bearings	-	-	-	-	-	-	-	-	-	-	-	-	-	I

I = Inspect S = Sampling R = Replace

(1) Vilter recommends that a Preventative Maintenance Program be developed by Vilter GC (Gas Compression) Service Center.
(2) Daily records should be kept on suction, discharge, oil pressures & temperatures, along with ensuring Temp Leaving Oil Separator is above Dew Point.
(3) Replace oil filters when pressure drop reaches 7 PSID (maximum allowable pressure drop is 15 PSID).
(4) The life of the compressor will be increased by purging the compressor unit with dry nitrogen or sweet, dry natural gas at shutdown.
(5) Header drains should periodically be drained for liquid build-up to prevent compressor damage, see Piping in Section 3.
(6) Inspections include: gate rotor inspection, backlash measurement, shelf clearance, end play measurement (main rotor & gate rotor), gate rotor float, slide valve inspection.

Maintaining Proper Operation

To ensure proper operation, the following items should be checked:

- Calibrate all transducer and RTDs.
- Check capacity and volume actuator calibration.
- Check fuses in the PLC panel.
- Check for loose wiring connections in the PLC panel.
- Check relay and contact operation for relays in the PLC panel.
- Verify the operation of the suction and discharge check valves.
- Check for correct rotation of all motors on the package (compressor, oil pump, and fan motors).
- Check that the piping to the oil cooler is correct.
- Check setup of soft starts and VFDs.
- Verify set points in the PLC.
- Check oil heater operation.
- Verify oil line check valve is installed for correct flow .
- Check for loose bolts on the compressor unit. Tighten any loose bolts.

Compressor Unit Isolation for Maintenance/Service

WARNING

When working with LFG, NG or other dangerous or flammable gases, ensure there are adequate ventilation and vapor detectors. Refer to national fire and building codes. Failure to comply may result in serious injury or death.

WARNING

Avoid skin contact with any condensate or oil. Wear rubber gloves and a face shield when working with condensate or oil. Failure to comply may result in serious injury or death.

WARNING

At shutdown, open any other valves that may trap liquids to prevent serious injury and/or damage to equipment.

WARNING

Follow local lockout/tagout procedure. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTICE

Recover or transfer all gas vapor in accordance with local ordinances before opening compressor unit to atmosphere.

The compressor unit must be isolated and depressurized to atmosphere prior to servicing.

1. Shut down the compressor unit, refer to Stopping/Restarting procedure in Section 4.

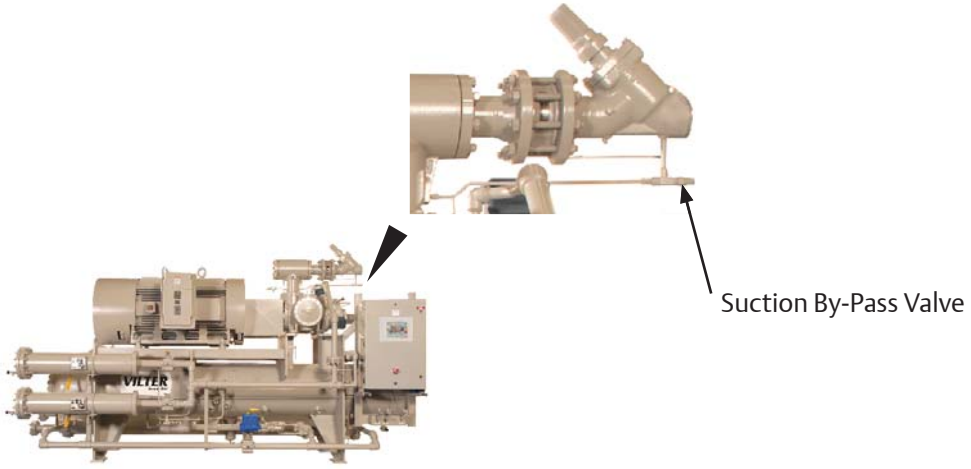


Figure 5-1. Suction By-Pass Valve Location (Manual) (1 of 2)

2. If equipped with equalizing solenoid to control suction by-pass, allow solenoid to remain open until pressures equalize, see Figure 5-1 (2 of 2).
3. Turn motor and oil pump starter disconnect switches into the OFF position. Lockout/tagout disconnect switches.
4. If equipped with manual suction by-pass valve and it is not open, open suction by-pass valve to allow oil separator pressure to vent to low-side system pressure, see Figure 5-1 (1 of 2). Close suction by-pass valve when complete.
5. Isolate the compressor unit by closing all valves to the house system. Lockout/tagout valves.

NOTE

If drain valves are installed on suction and discharge headers, open these valves too to remove build up of liquid during shut-down periods.

6. Open any other valves that may trap liquid. Lockout/tagout valves.
7. Recover or transfer all gas vapors.
8. Open discharge pressure bleed valve at block and bleed assembly and allow remaining pressure in oil separator to equalize to atmospheric pressure.
9. Servicing the compressor unit can proceed at this point. After servicing, ensure to perform a leak check, see Compressor Unit Leak Check procedure.

Compressor Unit Leak Check

The compressor unit must be checked for leaks after servicing to ensure a tight system.

CAUTION

Do not hydro test compressur unit. Failure to comply may result in damage to equipment.

1. If servicing the compressor unit was completed, proceed to step 2. Otherwise, isolate the compressor unit from the house system, see Compressor Unit Isolation procedure.
2. Slowly pressurize compressor unit through suction oil charging port.
3. Check for leaks.
4. Typically, no evacuation is required for open loop systems. If dry nitrogen was used, it can be bled off to atmosphere.
5. If evacuation is required, evacuate from suction oil charging port.
6. Open all valves previously closed and close all valves previously opened. Remove tags as per the local lockout/tagout procedure.
7. Turn the motor and oil pump disconnect switches to the ON position.
8. The compressor unit can now be started, refer to Start-Up procedure in Section 4.

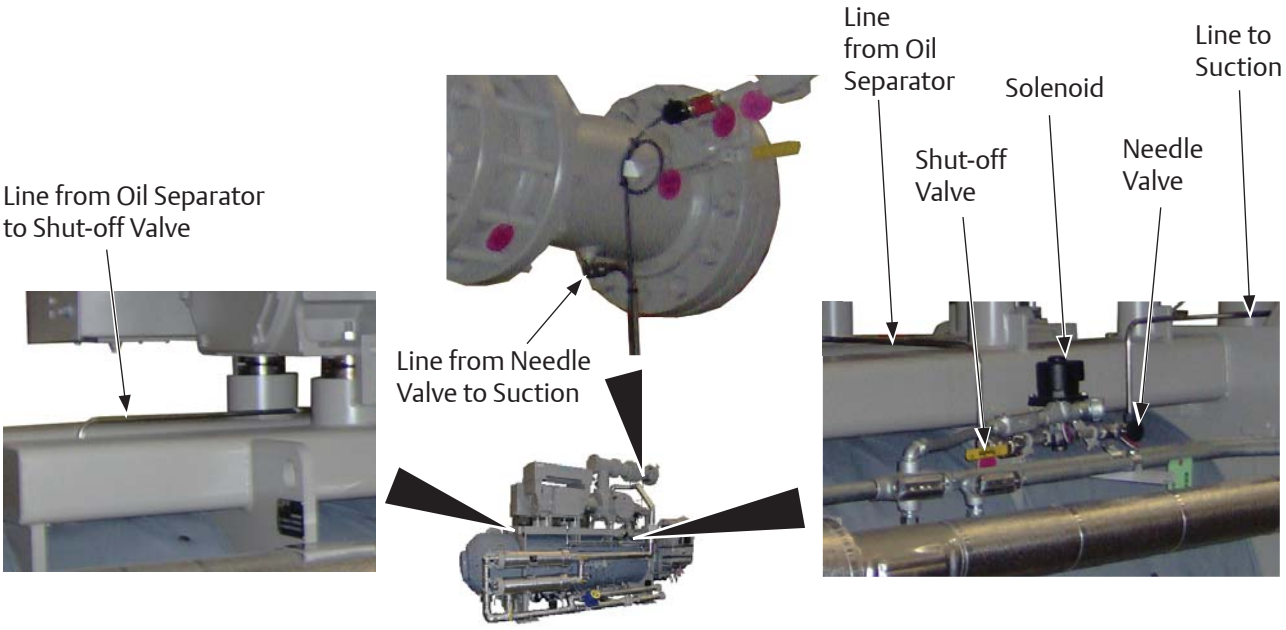


Figure 5-1. Suction By-Pass Valve Location (Equalizing Solenoid) (2 of 2)

Oil System Components

Oil Sampling

WARNING

When working with LFG, NG or other dangerous or flammable gases, ensure there are adequate ventilation and vapor detectors. Refer to national fire and building codes. Failure to comply may result in serious injury or death.

WARNING

Avoid skin contact with any condensate or oil. Wear rubber gloves and a face shield when working with condensate or oil. Failure to comply may result in serious injury or death.

Use Vilter Oil Analysis Kit (VPN 3097A) to collect an oil sample for analysis. For an example, see Figure 5-2. Fill out label for bottle. Place in mailing tube and seal with the preaddressed mailing label. Below are a few points to remember when taking a sample:

- Sample running compressor units, not cold units.
- Sample upstream of the oil filter.
- Create specific written procedures for sampling.
- Ensure sampling valves and devices are thoroughly flushed prior to taking a sample.
- Ensure samples are taken as scheduled in the Maintenance and Service Schedule.
- Send samples immediately to the oil analysis lab after sampling, do not wait 24 hours.

NOTE

A copy of the oil analysis report is also sent to Vilter. See Appendices for a sample of the oil analysis report.

An oil analysis report will show the physical properties of the oil, such as:

- Water content
- Viscosity
- Acid number
- Particle count
- Antioxidant level
- Wear metals
- Contaminate/additive metals

Figure 5-2. Oil Analysis Kit

Oil Charging

WARNING

Avoid skin contact with oil. Wear rubber gloves and a face shield when working with oil. Failure to comply may result in serious injury or death.

CAUTION

Do not add oil to the coalescent side of the oil separator. Failure to comply may result in damage to equipment.

Normal oil level operating range must be maintained for optimum performance and to prevent damage to equipment. See Figure 4-1. for normal operating levels. There are a couple of ways to maintain oil, while the compressor unit is in operation and during shutdown.

Tool Required:

- Oil Pump, Maximum 2-3 GPM with Motor approved for Division 1 or Division 2 and with ability to overcome suction pressure.

Charging During Operation:

During operation, if the oil level is low, add oil to the operating compressor through the suction oil charging valve, see Figure 5-3. Pump oil into the compressor until the oil level reaches the normal operating level. Watch this level carefully to maintain proper operation. Never allow the oil to reach a level higher than the Maximum Operating Level, since this may impair the operation and efficiency.

1. Using a properly selected oil pump, connect oil pump to suction oil charging valve, see Figure 5-3.
2. Open suction oil charging valve and fill oil separator to Normal Operating Level.
3. Once the Normal Operating Level has been reached, shut off the oil pump and close the valve. Disconnect and remove oil pump.

Charging During Shutdown:

During shutdown, if oil is to be added, charging can be performed through the drain valve located underneath the oil separator, see Figure 5-3. During shutdown, oil can be added to the Maximum Non-Operating Level. For shutdown procedure, see Compressor Unit Isolation procedure.

1. Using a properly selected oil pump, connect oil pump to oil separator drain valve.
2. Open oil separator drain valve and fill oil separator to Maximum NON-Operating Level.
3. Once Maximum NON-Operating Level has been reached, shut off oil pump, close oil separator drain valve and remove oil pump.

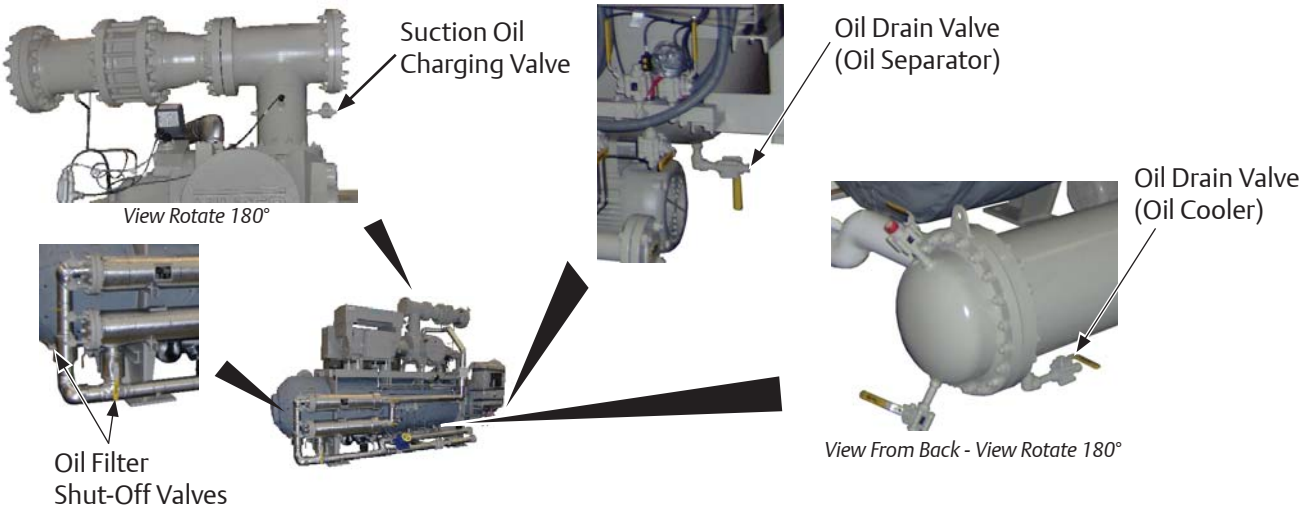


Figure 5-3. Suction Oil Charging Valve, Oil Cooler Drain Valve and Oil Filter Shut-Off Valves

Oil Draining

WARNING

Do not drain oil from drain valve while the compressor unit is running. Shutdown the unit and allow pressures to equalize to suction pressure prior to draining. Failure to comply may result in serious injury.

The compressor unit must be shut down prior to draining due to high pressures in the oil system, see Compressor Unit Isolation procedure.

Draining can be performed through the drain valve located underneath the oil separator, see Figure 5-3. A drain valve is also provided underneath the shell and tube oil cooler.

Draining of the remote oil cooler can be performed at the remote oil cooler drain valves. If equipped with lower level drains on the supply and return lines, these too can be utilized for draining. For additional information, see Recommended Remote Air Cooled Oil Cooler Piping in Appendices.

Oil Filter Replacement

WARNING

Avoid skin contact with oil. Wear rubber gloves and a face shield when working with oil. Failure to comply may result in serious injury or death.

Change the oil filter as outlined in the Maintenance and Service Interval, see Table 5-1. Maintenance & Service Interval.

NOTE

Ensure to check the oil pressure drop and record it daily.

If the compressor unit is equipped with only a single oil filter, the compressor unit must be shut down prior to servicing, see Stopping/Restarting procedure in Section 4.

If the compressor unit is equipped with dual oil filters, then one oil filter can be isolated and serviced one at a time during operation. Each oil filter can have single or dual oil filter elements depending on the size of compressor used, see Table 5-2 and Figure 5-4.

Table 5-2. Oil Filter Elements and Compressor Models

Oil Filter Element Qty.	VSG/VSSG Models
Single Element	301 - 701
Dual Elements	751 - 3001

To replace an oil filter element, continue with the following steps:

Parts Required:

- Oil Filter Element (VPN 1833G)

REMOVAL

NOTE

Both outlet shut-off valves should be open. If the outlet valve is closed for the oil filter that is not in operation, slowly open the outlet shut-off valve until fully open. This will help reduce a sudden pressure drop when switching oil filters for servicing.

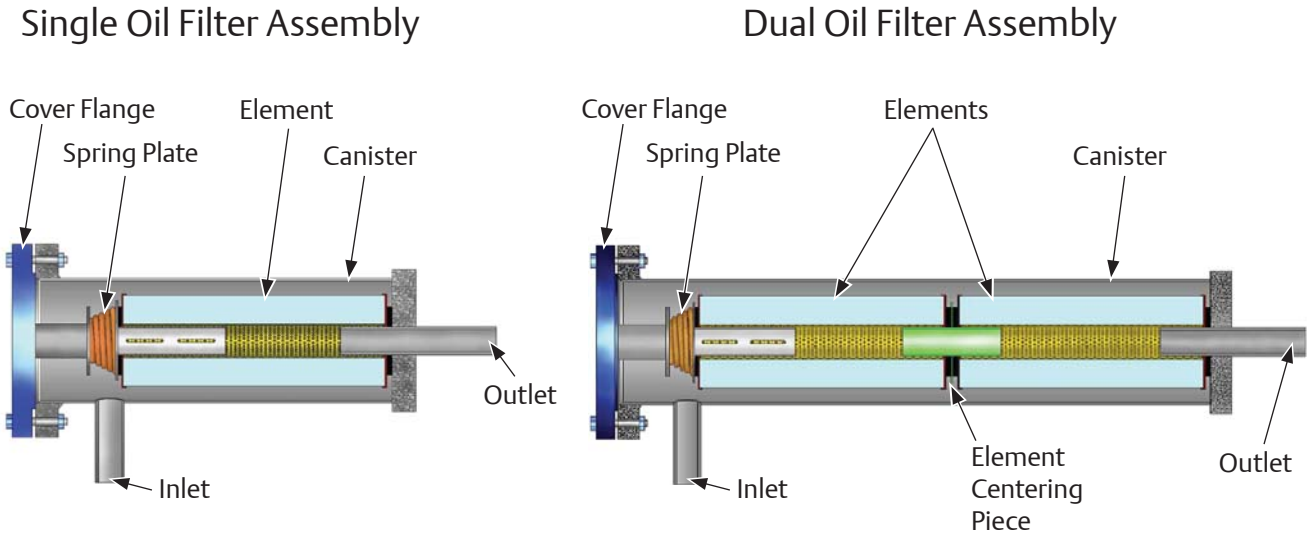


Figure 5-4. Oil Filter Assemblies (Single and Dual)

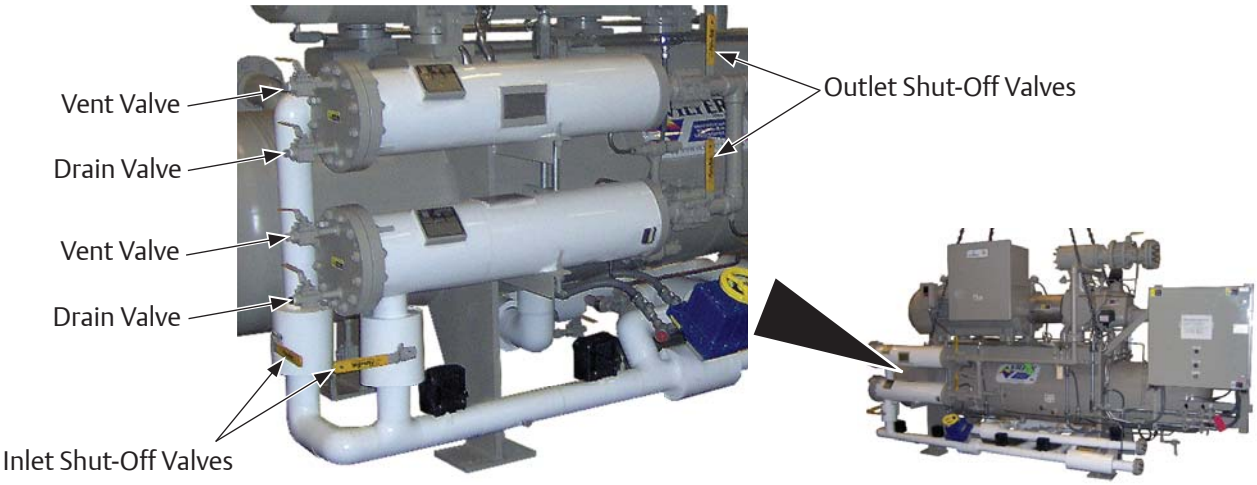


Figure 5-5. Oil Filter Drain, Vent and Shut-Off Valves

1. If equipped with dual oil filters, open inlet shut-off valve for non-operating oil filter to put it into operation, see Figure 5-5.
2. To isolate oil filter for servicing, close inlet and outlet shut-off valves for the oil filter.

NOTE

To reduce unwanted oil splash from a vent or drain valve, connect a hose to the valve port and direct the gas and oil into a drain pan.

3. Slowly release pressure in the oil filter canister by opening the vent valve. Allow pressures to equalize to atmosphere.

NOTICE

Dispose of the oil in a appropriate manner following all Local, State and Federal ordinances regarding the disposal of used oil.

4. Using an drain pan, open drain valve and allow the oil to completely drain from the oil filter canister.

NOTE

Note orientation of components to aid in installation.

5. Remove bolts and nuts securing cover flange to the oil filter canister. Remove cover flange and spring plate. Retain spring plate.
6. If equipped with a single oil filter element, remove filter element from oil filter canister.
7. If equipped with dual oil filter elements, remove two filter elements and filter element centering piece from oil filter canister. Retain filter element centering piece.
8. Thoroughly clean the oil filter canister, spring plate and centering piece. Inspect spring plate and centering piece, if damaged, replace as required.

INSTALLATION

NOTE

Ensure oil filter element on the outlet side is fully seated on the outlet pipe when installed.

9. If equipped with single oil filter element, install oil filter element in canister in orientation noted during removal.
10. If equipped with dual oil filter elements, install two oil filter elements and centering piece in orientation noted during removal.
11. Position spring plate in orientation noted during removal and install bolts and nuts to secure cover flange to oil filter canister.
12. Tighten nuts, see Appendix A.
13. Using dry nitrogen gas, pressurize oil filter canister through vent valve and check for leaks.
14. Close the vent valve and drain valve.
15. Open outlet shut-off valve for the oil filter that is not in operation.
16. Repeat for second oil filter, as required.

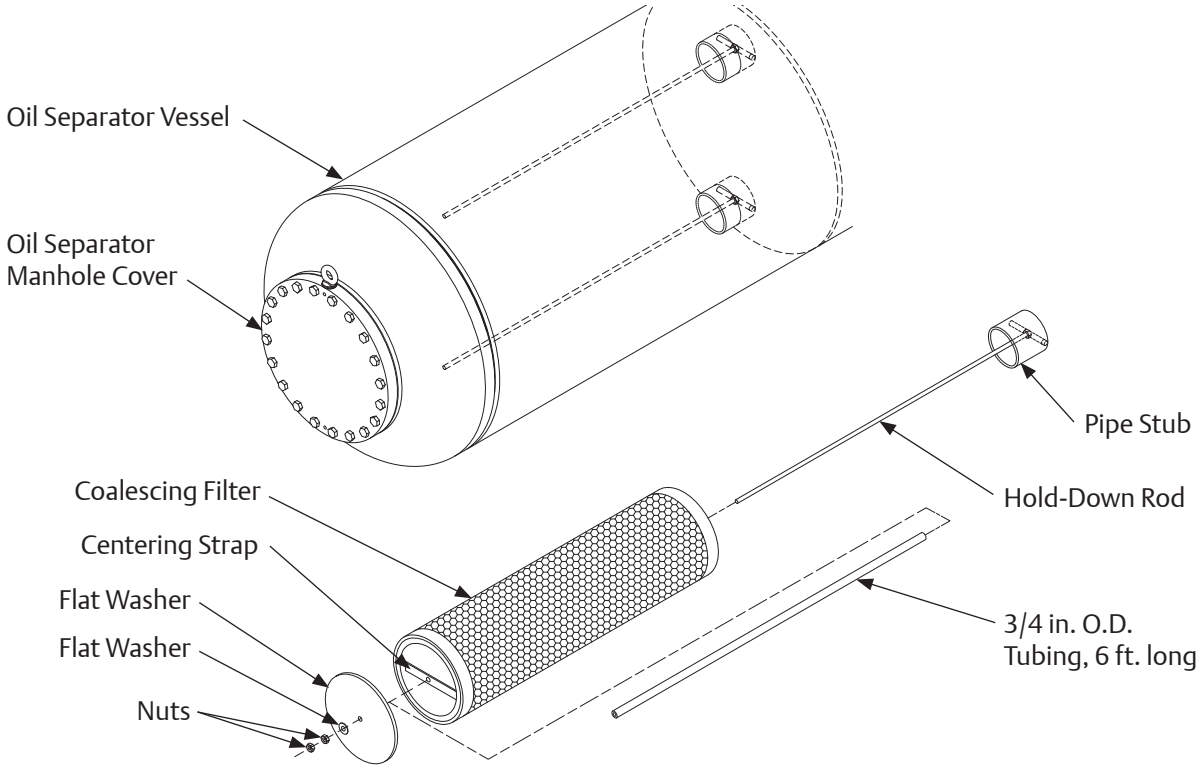


Figure 5-6. Oil Separator Manhole Cover and Coalescing Filter Assembly

Coalescing Filter Replacement

WARNING

Use appropriate lifting devices and additional personnel when lifting heavy components. Ensure lifting devices are capable of lifting the weight of the component. Use lifting points (i.e. bolt holes designated for lifting eye bolts) that are provided on the component. Failure to comply may result in serious injury.

WARNING

Avoid skin contact with any condensate or oil. Wear rubber gloves and a face shield when working with condensate or oil. Failure to comply may result in serious injury or death.

NOTE

For coalescing oil filters (11-7/8 in. O.D.), a tubing (3/4 in. O.D. x 6 ft. long) can be used to aid in removal and installation of the element.

REMOVAL

1. Isolate the compressor unit, see Compressor Unit Isolation procedure.
2. If required, install lifting eyes on oil separator manhole cover, see Figure 5-6.
3. Secure appropriate lifting device to oil separator manhole cover.
4. Remove all bolts except top four bolts securing oil separator manhole cover to oil separator vessel.
5. Adjust lifting device as needed to hold weight of oil separator manhole cover.
6. Remove remaining four bolts and oil separator manhole cover from oil separator vessel.
7. Remove nuts, flat washer and cover plate securing coalescing oil filter to hold-down rod.
8. With assistance of second person, remove coalescing filter from oil separator vessel.
9. Repeat steps 7 and 8 to remove additional coalescing filters, as required.

INSTALLATION

10. Install tubing over hold-down rod. Position tubing as far back as possible.
11. With assistance of second person, position coalescing element over tubing and through hole of centering strap.
12. Push coalescing filter into vessel until fully seated

on pipe stub.

13. Remove tubing.
14. Position cover plate and flat washer on hold-down rod on end of the coalescing filter.
15. Install nut to secure flat washer and cover plate to coalescing filter. Tighten nut to 25 ft-lbs.
16. Install second nut to prevent first nut from moving.
17. Repeat steps 10 to 16 for installing additional coalescing filters.
18. Position oil separator manhole cover on oil separator vessel.
19. Install bolts to secure oil separator manhole cover to oil separator vessel.
20. Tighten bolts, see Appendix A.
21. Perform Compressor Unit Leak Check procedure.

Oil Pump Strainer

NOTICE

Dispose of the oil in a appropriate manner following all Local, State and Federal ordinances regarding the disposal of used oil.

To clean the oil pump strainer, proceed with the following steps.

WARNING

At shutdown, open any other valves that may trap liquids to prevent serious injury and/or damage to equipment.

WARNING

Follow local lockout/tagout procedure. Failure to comply may result in serious injury, death and/or damage to equipment.

WARNING

Avoid skin contact with any condensate or oil. Wear rubber gloves and a face shield when working with condensate or oil. Failure to comply may result in serious injury or death.

1. Shut down the compressor unit, refer to Stopping/Restarting procedure in Section 4.
2. Turn disconnect switches to the OFF position for the compressor unit and oil pump motor starter, if equipped.
3. Close shut-off valves located before the strainer and at the oil filter(s) inlet.
4. Position drain pan under drain valve.
5. Open strainer drain valve and allow oil to completely drain, see Figure 5-7.
6. Remove bolts securing strainer cover to strainer. Remove strainer cover, gasket and element. Retain gasket.
7. Inspect gasket for damage, replace as required.
8. Wash element in solvent and blow it with clean air.
9. Inspect element for damage, replace as required.
10. Clean strainer cavity with clean lint-free cloth.
11. Install in reverse order of removal. For torque specifications, see Appendix A.
12. Close strainer drain valve.
13. Open shut-off valves.
14. Check replaced components for leaks.
15. Turn disconnect switches to the ON position for the compressor unit and oil pump motor starter, if equipped.
16. Start compressor unit.

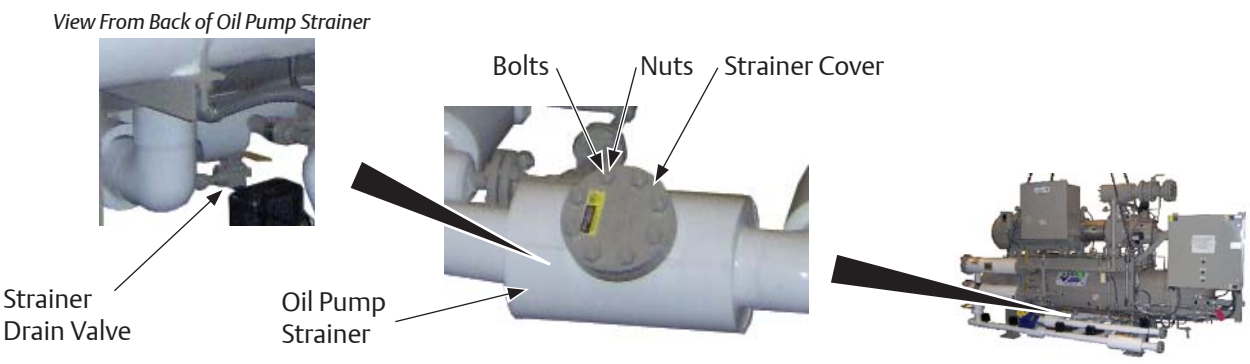


Figure 5-7. Oil Pump Strainer and Drain Valve

Drive Coupling (Form-Flex BPU) Hub Installation

On all single screw units, the coupling assembly is shipped loose and will have to be installed and aligned on site. This is to allow a check of proper electrical phasing and direction of motor rotation. The motor and compressor have been aligned from the factory with the coupling hubs already installed. Using a dial indicator for aligning is recommended.

NOTE

Drive coupling type and size can be determined by the information on the compressor nameplate when ordering; Order Number and Compressor Model Number.

To install the coupling, proceed with the following steps:

WARNING

Follow local lockout/tagout procedure. Failure to comply may result in serious injury, death and/or damage to equipment.

1. Ensure disconnect switches are in the OFF position for the compressor unit and oil pump motor starter, if equipped.
2. If hubs are already installed on motor shaft and compressor shaft, proceed to Drive Center Member Installation and Alignment procedure.
3. If coupling assembly is already assembled, the lock nuts are not torqued. Remove lock nuts and bolts securing hubs to disc packs. Remove both hubs. Leave the disc packs attached to center member.
4. Clean hub bores and shafts. Remove any nicks or burrs. If bore is tapered, check for good contact pattern. If bore is straight, measure bore and shaft diameters to ensure proper fitment. The keys should have a snug side-to-side fit in the keyway with a small clearance over the top.

NOTE

If hub position on shaft does not allow enough room to install bolts, install bolts and disc pack before mounting hub on shaft.

Hubs come in two different types, straight bore and tapered bore. Tapered bore hubs have additional hardware. Typically, a compressor will have a tapered shaft and therefore use a tapered bore hub.

STRAIGHT BORE HUBS

5. For straight bore hubs, install key in keyway of shaft.
6. Install hub on shaft. If installing straight bore hubs on motor and compressor shafts, allow 1/16” gap between the outer face of the hub to the outer face of the shaft for both hub installation. This will allow some play when installing the spacer. If installing a straight bore hub and a taper bore hub, allow a 1/8” gap between the outer face of the straight bore hub to the outer face of the straight shaft, see Table 5-3.
7. Install clamping bolts in hub.
8. Tighten clamping bolts, see Table 5-4.
9. Install set screw in hub to secure key.
10. Tighten set screw, see Table 5-4. Repeat steps for second straight bore hub.

TAPERED BORE HUBS

11. For taper bore hubs, install key in keyway of shaft.
12. Install hub on shaft.
13. If lock washers are being used, install hub cap, lock washers and bolt on shaft.
14. If locking tab is being used, install hub cap, locking tab and bolt on shaft.
15. Tighten bolt and draw hub up shaft to a stop.

Table 5-3. Shaft and Hub Distances

Coupling Size	Shaft Gap for Tapered Compressor & Straight Motor Shaft Combination	Shaft Gap for Straight Compressor & Straight Motor Shaft Combination	Distance Between Hub Faces
BP38U	6.25” (158.75 mm)	5.125” (130.18 mm)	5.00” (127 mm)
BP41U			
BP47U			
BP54U			
BP54U			
BP56U			

16. If locking tab is being used, bend locking tabs in gap towards shaft and around bolt.
17. Install set screw in hub cap to secure key in keyway of shaft.
18. Tighten set screw, see Table 5-4.

Drive Center Member Installation and Alignment

NOTE

Always adjust motor to the compressor. The compressor is aligned to the frame.

19. Adjust motor position as needed to obtain a distance of 5" between both hub faces.
20. Soft Foot. The motor must sit flat on its base (+/- 0.002"). Any soft foot must be corrected prior to center member installation.

NOTE

If the driver or driven equipment alignment specification is tighter than these recommendations, the specification should be used. Also, be sure to compensate for thermal movement in the equipment. The coupling is capable of approximately four time the above shaft alignment tolerances. However, close alignment at installation will provide longer service with smoother operation.

The flex disc pack is designed to an optimal thickness and is not to be used for axial adjustments.

21. *Axial Spacing*. The axial spacing of the shafts should be positioned so that the flex disc packs are flat when the equipment is running under normal operating conditions. This means there is a minimal amount of waviness in the flex disc pack when viewed from the side. This will result in a flex disc pack that is centered and parallel to its mating flange faces. Move the motor to obtain the correct axial spacing, see Table 5-3 and Figure 5-8.
22. *Angular Alignment*. Rigidly mount a dial indicator on one hub or shaft, reading the face of the other hub flange. Rotate both shafts together, making sure the shaft axial spacing remains constant. Adjust the motor by shimming and/or moving so that the indicator reading is within 0.002" per inch of coupling flange, see Figure 5-9.
23. *Parallel Offset*. Rigidly mount a dial indicator on one hub or shaft, reading the other hub flange outside diameter. Indicator set-up sag must be compensated for. Rotate both shafts together. Adjust the equipment by shimming and/or moving so that the indicator reading is within 0.002" per inch of the axial length between flex disc packs, see Figure 5-9.

With the coupling in good alignment the bolts will fit through the holes in the flanges and the disc packs more easily.

NOTE

All bolt threads should be lubricated. A clean motor oil is recommended. On size 226 and larger, a link must be put on bolt first. Remove the disc pack alignment bolt. Proceed to mount the second disc pack to the other hub in the same way.

Ensure that the beveled part of the washer is against

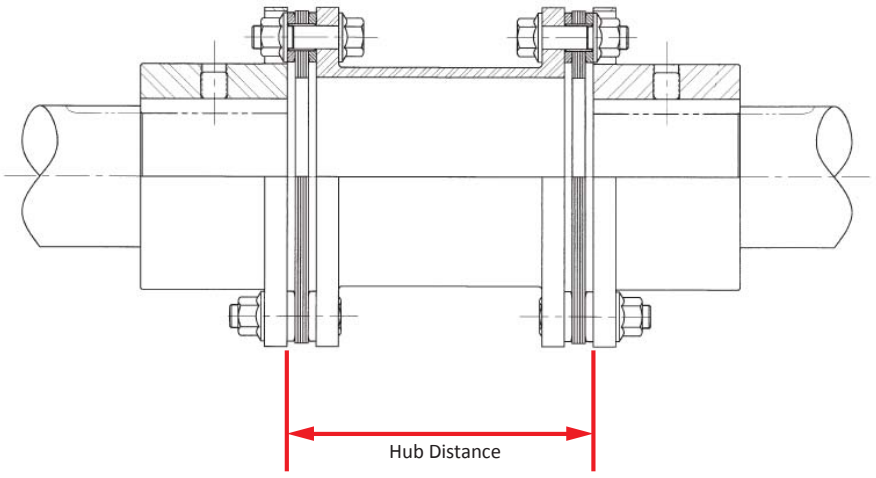
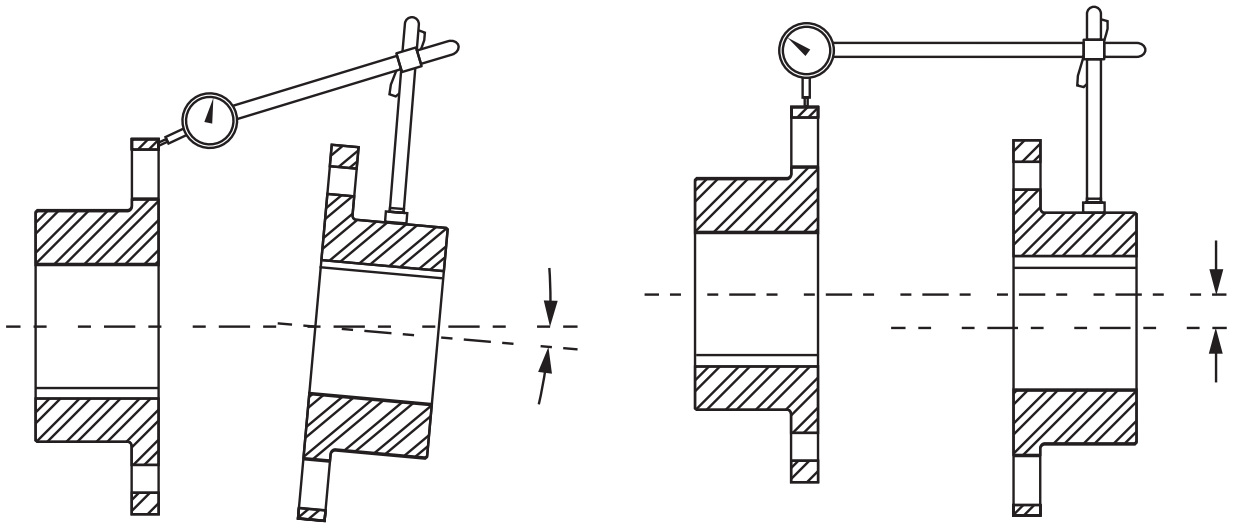


Figure 5-8. Hub Distance (Axial Spacing)



Angular Alignment *Parallel Offset*

Figure 5-9. Angular Alignment and Parallel Offset

the disc pack.

24. Install bolts and locking nuts to secure both disc packs to center member.
25. Tighten locking nuts.
26. If room is required to install center member, adjust hub position accordingly. If both the motor and compressor hubs are straight bores, adjust either hubs. If one hub is tapered and the other a straight, adjust the straight bore hub.
27. Using additional supports supporting center member. Install bolts and locking nuts to secure center member to compressor hub.
28. Tighten locking nuts.
29. Position hubs, ensure distance between face of both hubs is 5".

NOTE

If there is waviness with the disc pack installed, adjust distance accordingly until disc pack is straight.

30. Install bolts and locking nuts to secure disc pack to motor hub.
31. Tighten locking nuts, see Table 5-4.

Table 5-5. Disc Pack Installation Torque Specifications

Coupling Size	Lock Nut Size	Tightening Torque ft-lbs (Nm)
BP38U	5/16-24	22 (30)
BP41U	7/16-20	55 (75)
BP47U	9/16-18	120 (163)
BP54U	9/16-18	120 (163)
BP56U	9/16-18	120 (163)

Table 5-4. Hub Clamp Bolt and Set Screw Torque Specifications

Coupling Series/Size	Clamping Bolt			Set Screw	
	# Bolts	Size-Pitch	Torque ft-lbs (Nm)	Size	Torque ft-lbs (Nm)
BH38U	4	1/4-28	12 (16)	3/8	10 (13)
BH41U	4	5/16-24	23 (31)	3/8	10 (13)
BH47U	4	3/8-24	49 (66)	1/2	20 (27)
BH54U	4	7/16-20	78 (106)	1/2	20 (27)
BH56U	4	1/2-20	120 (163)	5/8	40 (54)
DP42	4	1/2-20	120 (163)	1/2	20 (27)

32. Perform hot alignment. Run compressor unit and allow to warm up completely.
33. Power down compressor unit and re-check alignments. Loosen motor mounting nuts to add shims or to adjust alignments as required.
34. Install coupling guard.

Drive Coupling (Form-Flex BPU) Center Member and Hub Removal

To remove coupling assembly, proceed with the following steps:

WARNING

At shutdown, open any other valves that may trap liquids to prevent serious injury and/or damage to equipment.

WARNING

Follow local lockout/tagout procedure. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE

Drive coupling type and size can be determined by the information on the compressor nameplate when ordering; Order Number and Compressor Model Number.

1. Shut down the compressor unit, refer to Stopping/Restarting procedure in Section 4.
2. Turn disconnect switches to the OFF position for the compressor unit and oil pump motor starter, if equipped.
3. Allow compressor, motor and surrounding components to cool prior to servicing.
4. Remove coupling guard.
5. Remove lock nuts and bolts securing disc pack to hub on compressor shaft.
6. If additional room is required to remove the center member, loosen clamping bolts on straight bore hub(s).
7. Move straight bore hub on shaft as required to allow center member removal.
8. Remove lock nuts and bolts securing disc pack to hub on motor shaft. Remove center member.
9. For straight bore hubs, remove clamping bolts and hub from shaft.
10. For tapered bore hubs, remove bolt, lock washers, large washer and hub from shaft.

Drive Coupling (Type C Sure-Flex) Replacement

Drive couplings that are the Type C Sure-Flex type, are always installed with a C-flange between the compressor and motor. The coupling assembly alignments are built into the design and therefore, should not require alignment.

NOTE

Drive coupling type and size can be determined by the information on the compressor nameplate when ordering; Order Number and Compressor Model Number.

REMOVAL

To remove Type C Sure-Flex coupling, proceed with the following steps:

WARNING

At shutdown, open any other valves that may trap liquids to prevent serious injury and/or damage to equipment.

WARNING

Follow local lockout/tagout procedure. Failure to comply may result in serious injury, death and/or damage to equipment.

1. Shut down the compressor unit, refer to Stopping/Restarting procedure in Section 4.
2. Turn disconnect switches to the OFF position for the compressor unit and oil pump motor starter, if equipped.
3. Allow compressor, motor and surrounding components to cool prior to servicing.
4. Remove C-flange access cover.

NOTE

Mark locations of hubs prior to removal.

5. Loosen set screw in motor hub securing key in keyway.
6. Loosen clamping bolts securing hub to motor shaft.
7. Pry hub up motor shaft for space to remove coupling sleeve.
8. Remove coupling sleeve from hub.
9. Remove hub and key from motor shaft.
10. Loosen set screw in compressor hub securing key in keyway.
11. Loosen clamping bolts securing hub from

compressor shaft.

12. Remove hub and key from compressor shaft.

INSTALLATION

13. Install key and hub on compressor shaft as noted during removal.
14. Install set screw in compressor hub to secure key in keyway, see Table 5-6,
15. Install clamping bolts to secure hub on compressor shaft. Tighten clamping bolts, see Table 5-6,
16. Install key and hub on motor shaft as noted during removal. Allow gap to install coupling sleeve.
17. Install coupling sleeve on hubs. Position hub on motor shaft on coupling sleeve as noted during removal.
18. Install set screw in compressor hub to secure key in keyway. Tighten set screw, see Table 5-6,
19. Install clamping bolts to secure hub to motor shaft. Tighten clamping bolts, see Table 5-6.

Table 5-6. Clamping Bolts and Set Screw Torque Specifications

Coupling Size	Type C ft-lbs (Nm)	
	Clamping Bolts	Key Set Screw
6	13 (18)	13 (18)
7	13 (18)	
8	23 (31)	
9	23 (31)	
10	50 (68)	
11	50 (68)	

Compressor Replacement

Notify Vilter prior to performing a compressor replacement. See Warranty instructions in Section 7.

REMOVAL

To replace a compressor on a unit, proceed with the following steps:

NOTICE

Dispose of the oil in a appropriate manner following all Local, State and Federal ordinances regarding the disposal of used oil.

1. Shut down and isolate the compressor unit, see Compressor Unit Isolation for Maintenance and Service procedure.

   NOTE

   Note location of cables to aid in installation.

2. Disconnect all cables from sensors on compressor and actuators.
3. Remove drive coupling, see appropriate Drive Coupling Replacement procedure.
4. If equipped with C-flange, remove bolts securing C-flange to compressor.
5. Remove center member, see Drive Coupling Removal procedure.
6. Using appropriate drain pan, drain oil by removing drain plugs from under compressor housing and discharge manifold. Allow oil to completely drain.
7. Remove all oil lines from the compressor.
8. Support suction line with appropriate supporting equipment.
9. Remove nuts and bolts securing suction strainer/check valve assembly to suction stop valve and compressor.
10. Using appropriate lifting device, remove suction strainer/check valve assembly from compressor.
11. Remove nuts and bolts securing discharge pipe to compressor and oil separator, see Figure 5-10.
12. Remove discharge pipe and gaskets from compressor and oil separator.
13. Remove nuts, flat washers, lock washers and studs securing compressor to frame.
14. Remove any additional lines and/or components to allow removal of compressor as required.
15. Install appropriate lifting eyes on top of compressor.
16. Using appropriate lifting device and additional

personnel, remove compressor from frame.

17. Remove shims and spherical washers from compressor mounting locations.
18. Inspect shims and spherical washers for damage, replace as required.

INSTALLATION

19. Install shims and spherical washers on compressor mounting locations, see Figure 5-10.
20. Install appropriate lifting eyes on top of compressor.
21. Using appropriate lifting device, position compressor on compressor mounting locations on frame.
22. Loosely install studs, lock washers, flat washers and nuts to secure compressor to frame until alignment is correct.
23. Check compressor for soft foot. Add or remove shims as required until measurements are within +/- 0.002".
24. Tighten nuts to secure compressor to frame, refer to Appendix A.
25. If equipped with C-flange, install bolts to secure C-flange to compressor. Tighten bolts, see Appendix A.
26. If equipped with C-flange, install C-flange coupling, refer to C-flange Coupling Replacement procedure.
27. Install coupling, see Drive Coupling Installation and Alignment procedure .
28. Install coupling guard.
29. Install nuts and bolts to secure discharge pipe to oil separator and compressor.
30. Tighten nuts on 'discharge pipe-to-compressor flange' first, then tighten nuts on 'discharge pipe-to-oil separator flange', see Appendix A.
31. Install nuts to secure suction strainer/check valve assembly to compressor and suction stop valve.
32. Tighten nuts on 'suction strainer/check valve assembly-to-compressor' first, then tighten nuts on 'suction strainer/check valve assembly-to-suction stop valve', refer to Appendix A.
33. Install all lines to compressor.
34. Install all cables to sensors on compressor and actuator.
35. Perform leak check, see Compressor Unit Leak Check procedure.

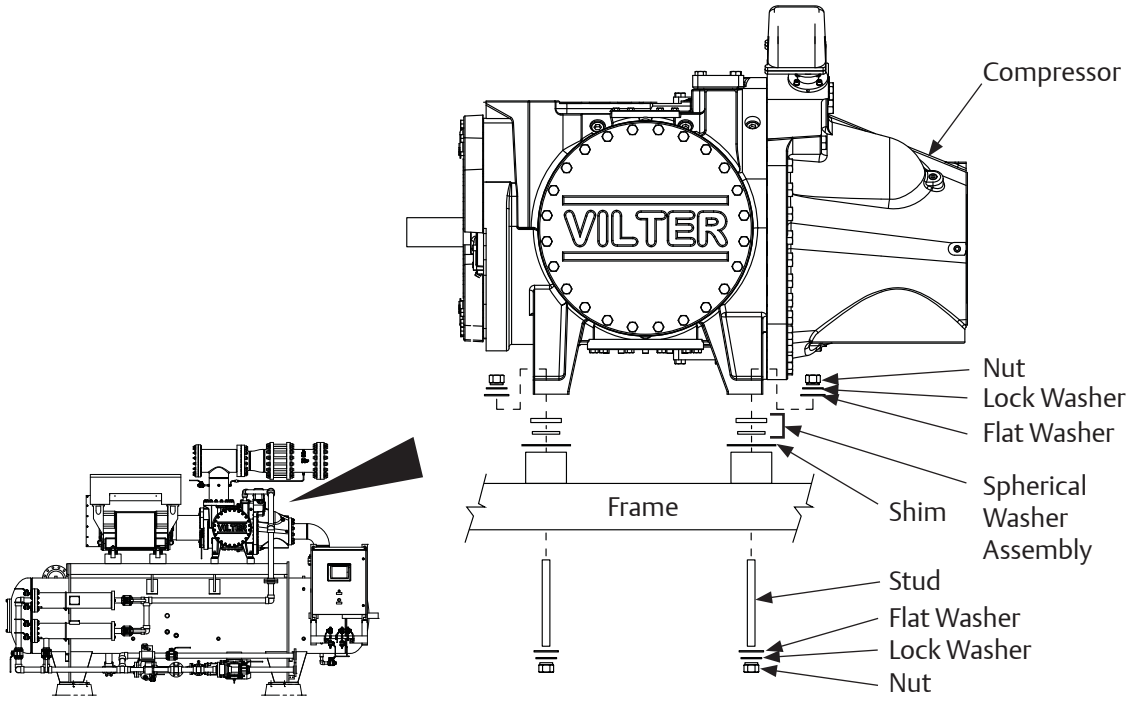


Figure 5-10. Compressor Replacement and Hardware Assembly (Models 2401-3001 Shown)

Compressor Shaft Bearing Float Inspections

If float measurements are out of tolerance, contact Vilter Customer Service for further assistance.

BEARING AXIAL FLOAT INSPECTION

CAUTION

When taking the measurements, do not exceed 300 lbs of force at point of contact or damage may result to the bearings.

DETERMINE MAXIMUM APPLIED FORCE

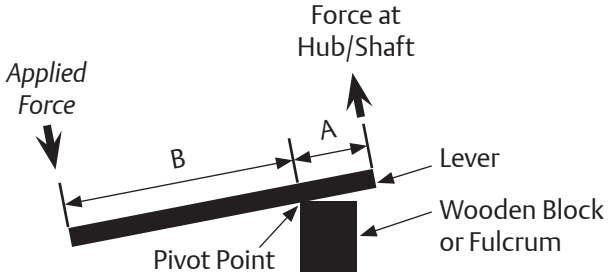
To determine maximum applied force, take maximum applied force at hub/shaft multiplied by length of A and divide by length B. This is the maximum force that should be applied on the lever.

(Applied Force x A)/B = Applied Force (Maximum)

So, using a 36" (or 1 m) lever with pivot space of 6" (or 15 cm) would make the maximum applied force to be 60 lbf (or 235 N). Calculation is as follows:

(300 lbf x 6")/30" = 60 lbf (Max. *Applied Force*)

(1335 N x 15 cm)/85 cm = 235 N (Max. *Applied Force*)



As a quick reference, Table 5-7 shows maximum applied forces for 36" lever with 6" pivot for all compressor models.

MEASURE

To inspect bearing axial float, proceed with the following steps:

1. Remove center member, see appropriate Drive Coupling Replacement procedure.
2. Install dial indicator to the compressor frame and zero indicator, see Figure 5-11.
3. Place lever arm and fulcrum behind compressor coupling half and push the coupling towards the motor. Record measurement.
4. Re-zero indicator, now position the fulcrum on the motor and use the lever arm to push the input shaft towards the compressor. Record measurement
5. Add both measurements. If measurement is out of allowable tolerance shown in Table 5-7, the bearing may need to be replaced. Contact Vilter Customer Service.

BEARING RADIAL FLOAT INSPECTION

6. Install dial indicator to the compressor frame and zero indicator, see Figure 5-12.

NOTE

Do not exceed maximum applied force. For maximum applied forces of all compressor models, see Table 5-7.

7. Place lever arm and fulcrum underneath hub and push hub upwards. Record measurement.
8. If measurement is out of allowable tolerance shown in Table 5-7, the bearing may need to be replaced. Contact Vilter Customer Service.

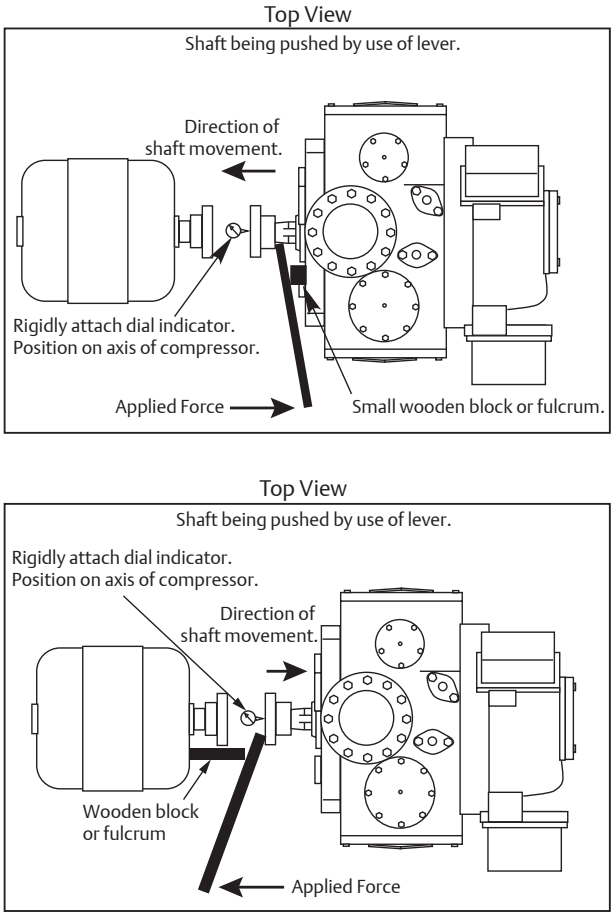


Figure 5-11. Bearing Axial Float Inspection

Table 5-7. Maximum Bearing Float

Compressor Model	Max. Axial Float in. (mm)	Max. Radial Float in. (mm)	Max. Force at Hub/ Shaft lbf (N)	Max. Applied Force (36" Lever, 6" Pivot) lbf (N)
All	0.002 (0.051)	-	300 (1335)	60 (267)
151, 181, 201, 152, 182, 202, 301, 361, 401	-	0.006 (0.152)	100 (444)	20 (89)
501, 601, 701		0.007 (0.178)	150 (667)	30 (133)
291, 341, 451, 601		0.007 (0.178)	150 (667)	30 (133)
751, 901		0.006 (0.152)	200 (890)	40 (178)
791, 891, 1051, 1201, 1301		0.006 (0.152)	300 (1335)	60 (267)
1501, 1551, 1801, 1851, 2101		0.007 (0.178)	400 (1780)	80 (356)
2401, 2601, 2801, 3001		0.006 (0.152)	600 (2670)	120 (534)

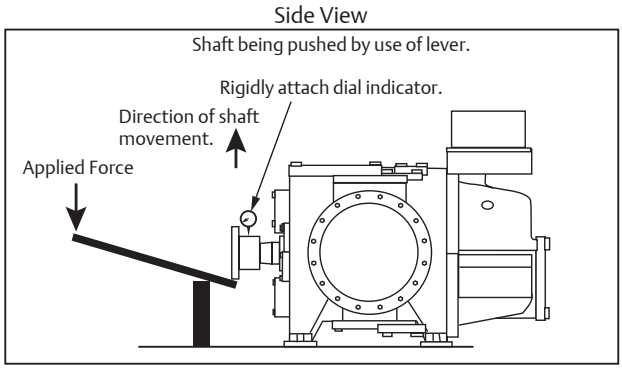


Figure 5-12. Bearing Radial Float Inspection

Gate Rotor Float and Gate Rotor Bearing Float Inspection

GATE ROTOR FLOAT INSPECTION

To inspect gate rotor float and bearing float, proceed with the following steps:

1. Remove center member, see appropriate Drive Coupling Replacement procedure.
2. Remove the side covers from compressor.
3. Position gate rotor blade and damper pin at 90° to the main rotor, see Figure 5-13.

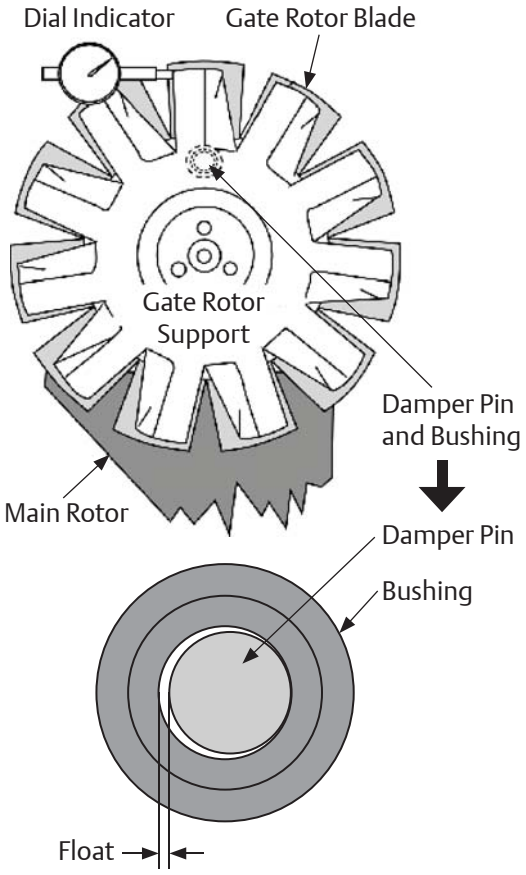


Figure 5-13. Gate Rotor Float

NOTE

Measurements can be an additional 0.020" higher than float dimensions on Table 5-8. If measurement is an additional 0.030" greater than float dimensions, contact Vilter for further assistance.

Total movement of damper pin in bushing is the gate rotor float.

4. Using dial indicator, take measurement of gate rotor float. Measurement should not exceed values as noted above.

Table 5-8. Gate Rotor Float

Model	Float in. (mm)
VSSG 291-601	0.045 (1.143)
VSG 301-401	0.045 (1.143)
VSG 501-701	0.045 (1.143)
VSG 751-901	0.055 (1.397)
VSG 1051-1301	0.060 (1.524)
VSG 1551-2101	0.060 (1.524)
VSG 2401-3001	0.060 (1.524)

NOTE

Some movement between blade and support is necessary to prevent damage to the compressor blade; however at no time should the blade uncover the support.

5. Inspect main rotor and gate rotor for abnormal wear due to dirt or other contaminants. If damaged, replace gate rotor and/or main rotor.

GATE ROTOR BEARING FLOAT INSPECTION

6. Using dial indicator, position a dial indicator on the gate rotor, see Figure 5-14.

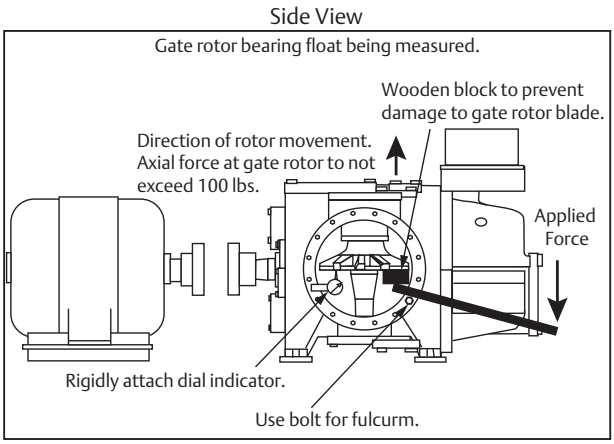


Figure 5-14. Gate Rotor Bearing Float

7. Use a lever arm pivoting on a bolt with a small block of wood against the gate rotor blade to protect the blade.
8. Gently apply pressure to lever and take measurement. Maximum amount of gate rotor bearing float should not exceed 0.002" (0.051 mm).
9. Install gate rotor cover.
10. Install center member, see Drive Coupling Replacement procedure.
11. Perform compressor unit leak check, see Compressor Unit Leak Check procedure.

Gate Rotor and Support Clearance

When measuring, push the gate rotor against the pin to remove float.

1. Place a straight edge along the side of the gate rotor, see Figure 5-16.
2. Measure the gap from the straight edge to the peak of the gate rotor support. For minimum distance, see Figure 5-15.
3. Repeat steps 1 to 2 to check gap along entire gate rotor edge on both sides.

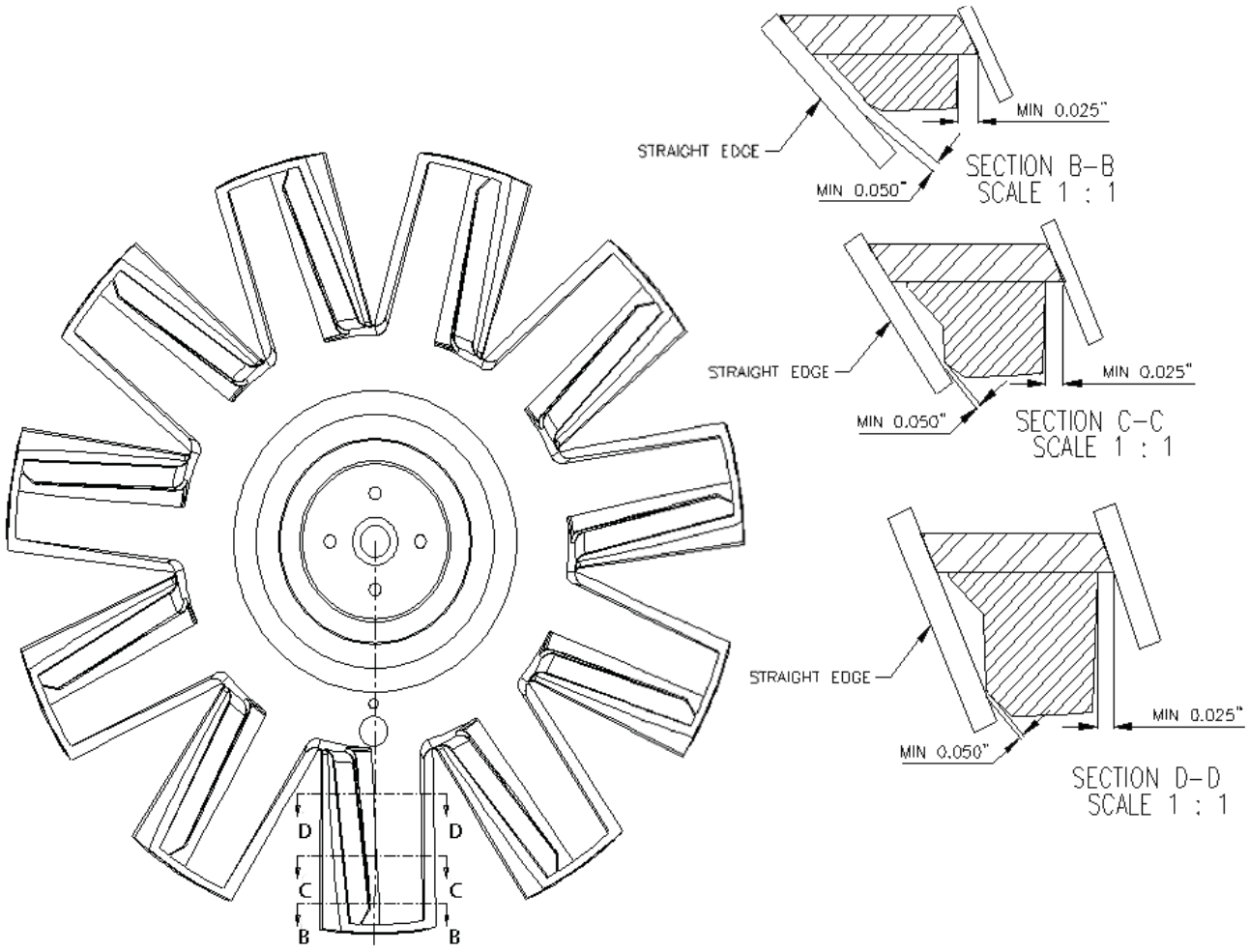


Figure 5-15. Gate Rotor and Support Clearance - Minimum Clearances

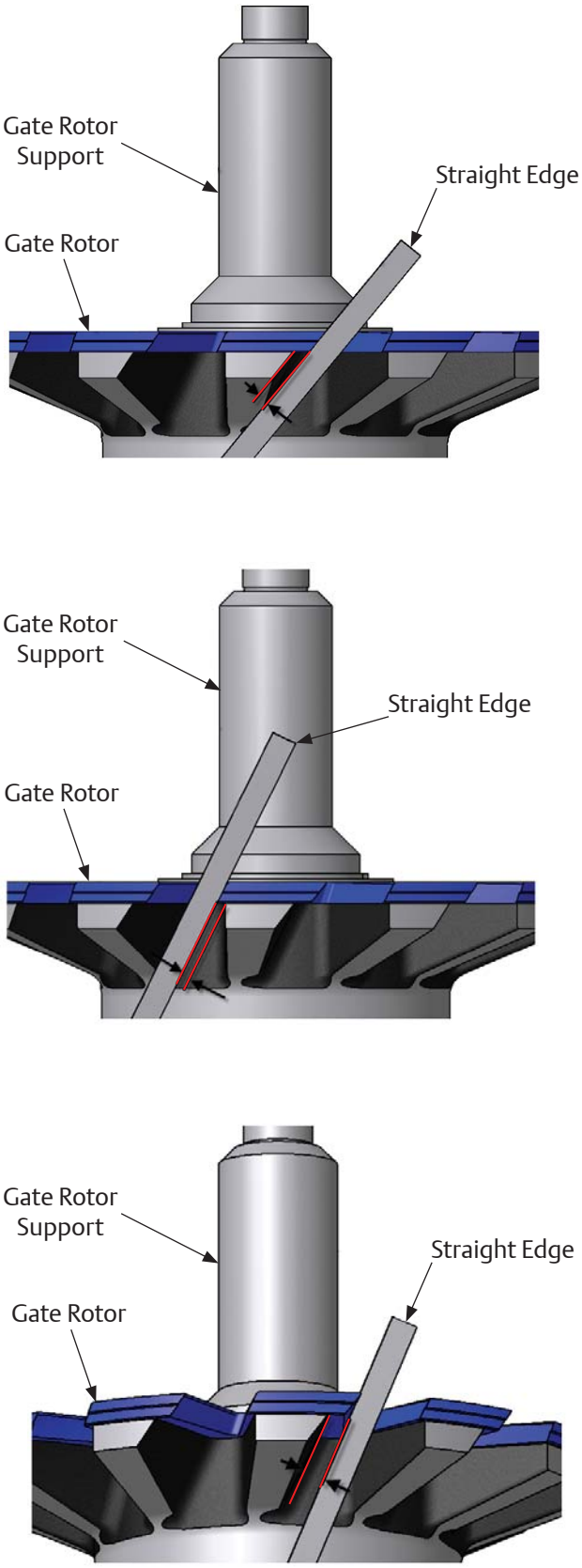


Figure 5-16. Gate Rotor and Support Clearance - Measuring

Gate Rotor Assembly Replacement (All VSG & VSSG Compressors Except VSG 301-701 Compressors)

The following table lists the gate rotor tool sets needed to remove and install gate rotor assemblies.

Table 5-9. Gate Rotor Tool Sets

Model	Tool Set VPN
VSSG 291-601	A25205B
VSG 301-401	N/A
VSG 501-701	A25205B
VSG 751-1301	A2520 5C
VSG 1551-2101	A25205E
VSG 2401-3001	A25205F

REMOVAL

1. Remove center member, see appropriate Drive Coupling Replacement procedure.

NOTE

All parts must be kept with their appropriate side and not mixed when the compressor is reassembled.

2. Remove two upper bolts from side cover
3. Install guide studs in holes.

NOTE

There will be some oil drainage when the cover is removed.

4. Remove remaining bolts and side cover.
5. Turn main rotor so a driving edge of any one of the main rotor grooves is even with the back of the gate rotor support.

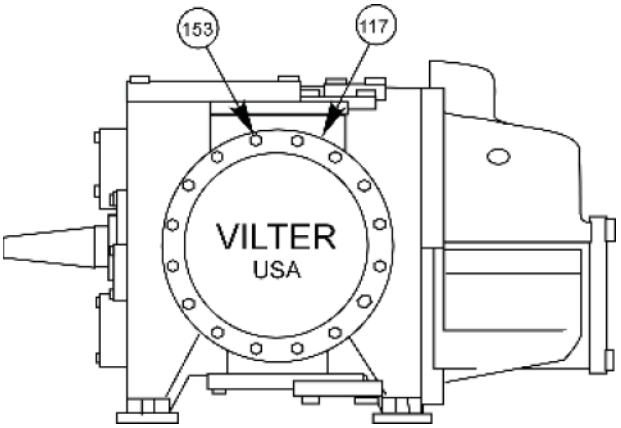
NOTE

The gate rotor stabilizer is designed to hold the gate rotor support in place and prevent damage to the gate rotor blade as the thrust bearings and housing is being removed.

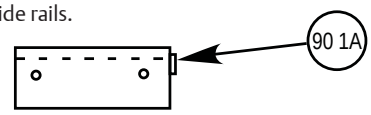
6. Insert gate rotor stabilizer. The side rails are not required on VSSG 291 thru 601. For the VSG 751 thru 901 and VSG 1051 thru 1301 compressors, use the side rails and assemble to the gate rotor stabilizer as stamped. For the VSG 1551 thru 2101, use the side rails and assemble to the gate rotor stabilizer.
7. Remove hex head bolts and socket head bolts from thrust bearing cover.
8. Re-install two bolts into the threaded jacking holes to assist in removing thrust bearing cover. Retain the shim pack.
9. Hold gate rotor support with a suitable wrench on the flats provided near the roller bearing housing.
10. Remove the inner retainer bolts and retainer.
11. To remove the thrust bearing housing, install thrust bearing removal and installation tool with smaller puller shoe. Turn the jacking screw clockwise. The thrust bearings and housing assembly will be pulled off the shaft and out of the frame.
12. Remove bolts from roller bearing housing.
13. Re-install two bolts into jack bolt holes provided in housing to aid in removal.
14. To remove the gate rotor support, carefully move support in the opposite direction of rotation and tilt roller bearing end towards the suction end of the compressor. The compressor input shaft may have to be turned to facilitate the removal of the gate rotor support. On dual gate compressor units, repeat the procedure for the remaining gate rotor support assembly.

INSTALLATION

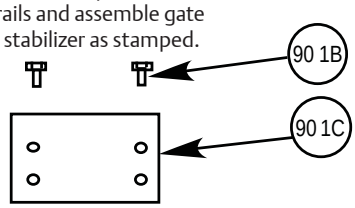
15. Install gate rotor support by carefully tilting the roller bearing end of the gate rotor support towards the suction end of the compressor. The compressor input shaft may have to be rotated to facilitate the installation of the gate rotor support. Install gate rotor stabilizer. The gate rotor stabilizer (901) will hold the gate rotor support in place as the thrust bearing housing is being installed. If the gate rotor support is not restricted from moving, the gate rotor blade may be damaged.
16. Install the roller bearing housing (112) with a new O-ring (141).
17. Tighten bolts (152), see Appendix A.
18. When installing the thrust bearing housing (113), a new O-ring (142) must be used when the housing is installed, see Figure 5-19. Lubricate the outside of the housing and bearings with clean compressor oil to aid in the installation. Due to the fit of the bearings on the gate rotor shaft, the thrust bearing removal and installation tool with the pusher shoe must be used. Turn the jacking screw clockwise. This will push the thrust bearings onto the shaft and push the housing assembly into the frame. Install the inner retainer (115) and bolts (151) using Loctite® 242 thread locker. Tighten bolts, see Appendix A.
19. Set clearance between gate rotor blade and shelf.
20. Place a piece of 0.003”-0.004” shim stock between gate rotor blade and shelf.



For VSSG 291-601 compressors, do not use side rails.



For VSG 751/901 and 1051-1301compressors, use side rails and assemble gate rotor stabilizer as stamped.



Position leading edge of main rotor groove flush with or slightly below back of gate rotor support.

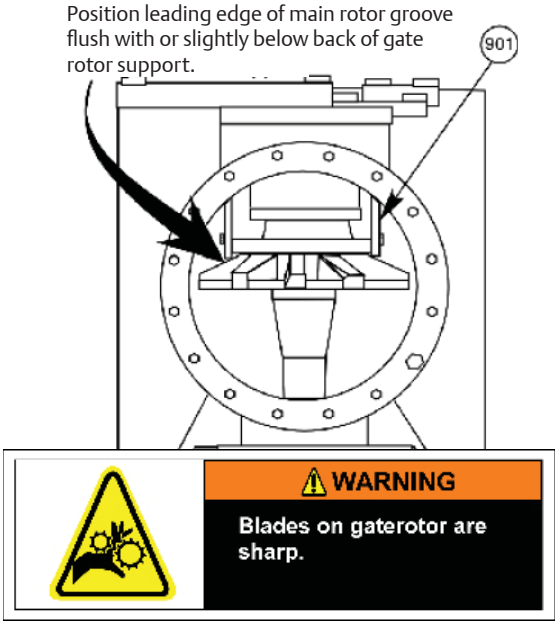


Figure 5-17. Gate Rotor Assembly Removal and Tools

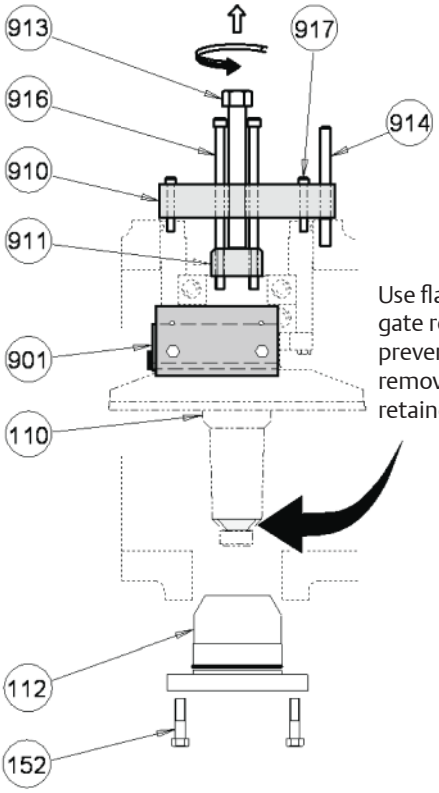
NOTE

This measurement determines the amount of shims needed for the correct clearance.

21. Measure depth from top of compressor case to top of thrust bearing housing.
22. Use factory installed shim pack (106) and bearing housing cover (116) without the O-ring (143).

NOTE

Replacement blades are precisely the same dimensionally as blades installed originally at factory: Therefore, the same amount of shims will be required for replacement blades.



Use flats provided on gate rotor support to prevent rotation when removing bearing retainer.

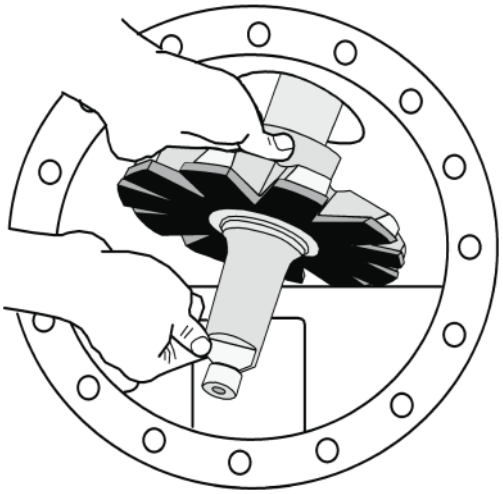


Figure 5-18. Gate Rotor Assembly Removal

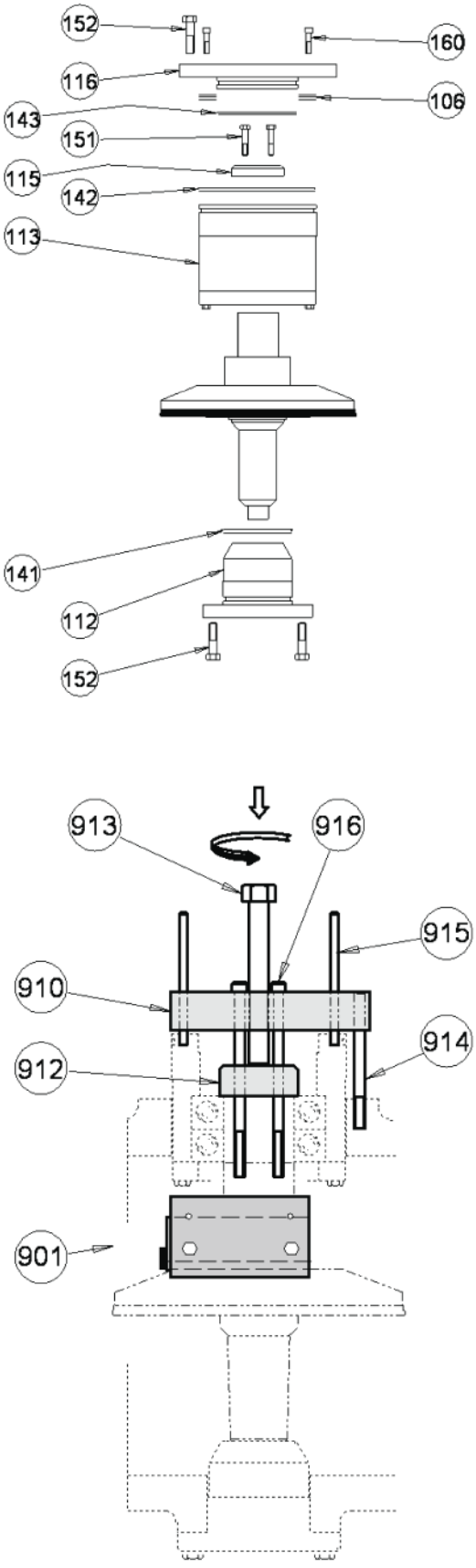


Figure 5-19. Gate Rotor Assembly and Tools

23. Check the clearance between the entire gate rotor blade and the shelf, rotate the gate rotor to find the tightest spot. It should be between 0.003-0.004“ (0.076-0.102 mm). Make adjustments, if necessary. It is preferable to shim the gate rotor blade looser rather than tighter against the shelf, see Figure 5-20.
24. After clearance has been set install a new O-ring (143) on bearing housing cover, install cover and tighten the bolts to the recommended torque value.
25. Install side cover with a new gasket. Tighten the bolts to the recommended torque value. The unit can then be evacuated and leak checked.

Check for 0.003-0.004” (0.076- 0.102 mm) clearance between gate rotor blade and partition.

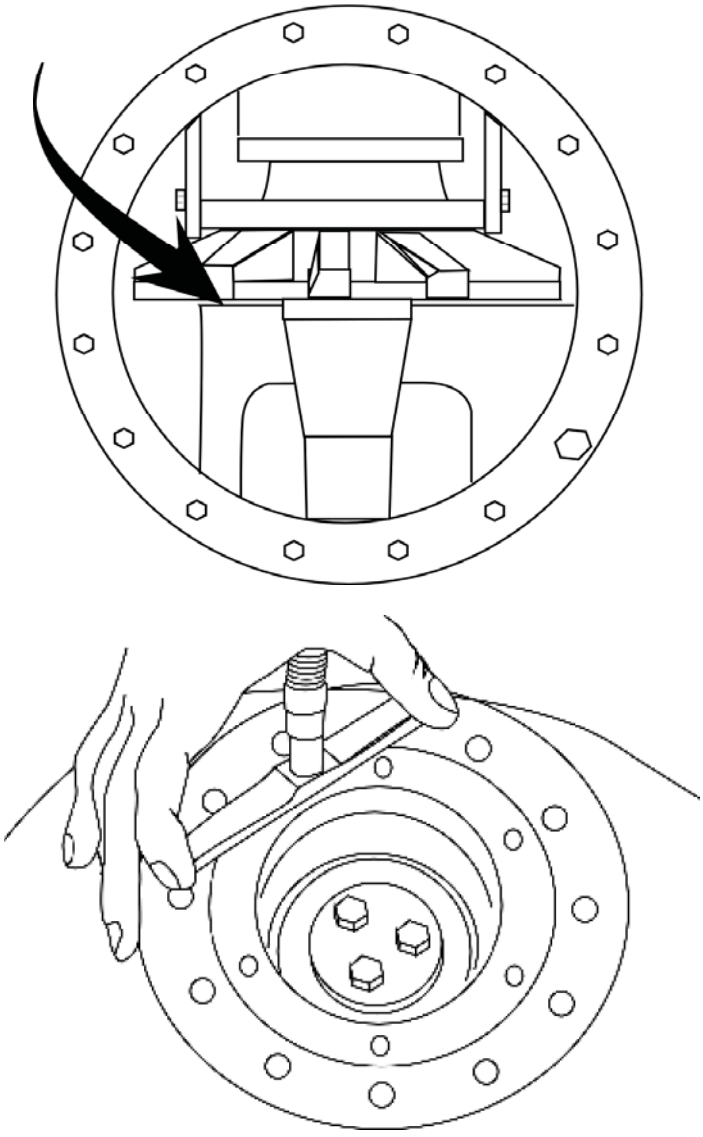


Figure 5-20. Gate Rotor and Shelf Clearance

Gate Rotor Assembly Replacement (VSG 301-701 Compressors ONLY)

REMOVAL

The removal of the gate rotor assembly for the VSG 301-701 compressors is similar for the VSG 901- 2101 compressors except that the inner races are secured to the stationary bearing spindle.

1. Remove center member, see appropriate Drive Coupling Replacement procedure.
2. Remove the upper bolt from the side cover and install a guide stud in the hole.
3. Remove remaining bolts and side cover. There will be some oil drainage when the cover is removed.
4. The side cover that contains the suction strainer should have the suction line properly supported before the bolts securing the line to the cover can be removed. After the line is removed, the cover can be removed per paragraph B.
5. Turn the main rotor so the driving edge of the groove is between the top of the shelf or slightly below the back of the gate rotor support. At this point install the gate rotor stabilizing tool.
6. Remove plug on the thrust bearing housing. Loosen the socket head cap screw that is located underneath the plug. This secures the inner races of the thrust bearings to the spindle.
7. Remove bolts that hold the thrust bearing housing to the compressor. Insert two of the bolts into the threaded jacking holes to assist in removing the bearing housing from the compressor. When the housing is removed, there will be shims between the spindle and thrust bearings. These control the clearance between the shelf and gate rotor blades. These must be kept with their respective parts for that side of the compressor.
8. Remove the bolts from the roller bearing housing. After the bolts have been removed, the housing can be removed from the compressor.
9. To remove the gate rotor support, carefully move the support opposite the direction of rotation and tilt the roller bearing end towards the suction end of the compressor. The compressor input shaft may have to be turned to facilitate the removal of the gate rotor support. On dual gate versions, repeat the procedure for the remaining gate rotor support assembly.

INSTALLATION

10. Install the gate rotor support. Carefully tilt the roller bearing end of the gate rotor support towards the suction end of the compressor. The compressor input shaft may have to be rotated to facilitate the installation of the gate rotor support.
11. Install the roller bearing housing with a new O-ring. Tighten the bolts to the recommended torque value.
12. Install the spindle with shims and O-ring, tighten bolts, see Appendix A. Measure the clearance between the shelf and blade.
13. Check the clearance between the entire gate rotor blade and the shelf, rotate the gate rotor to find the tightest spot. It should be between 0.003-0.004“ (0.076-0.102 mm). Make adjustments, if

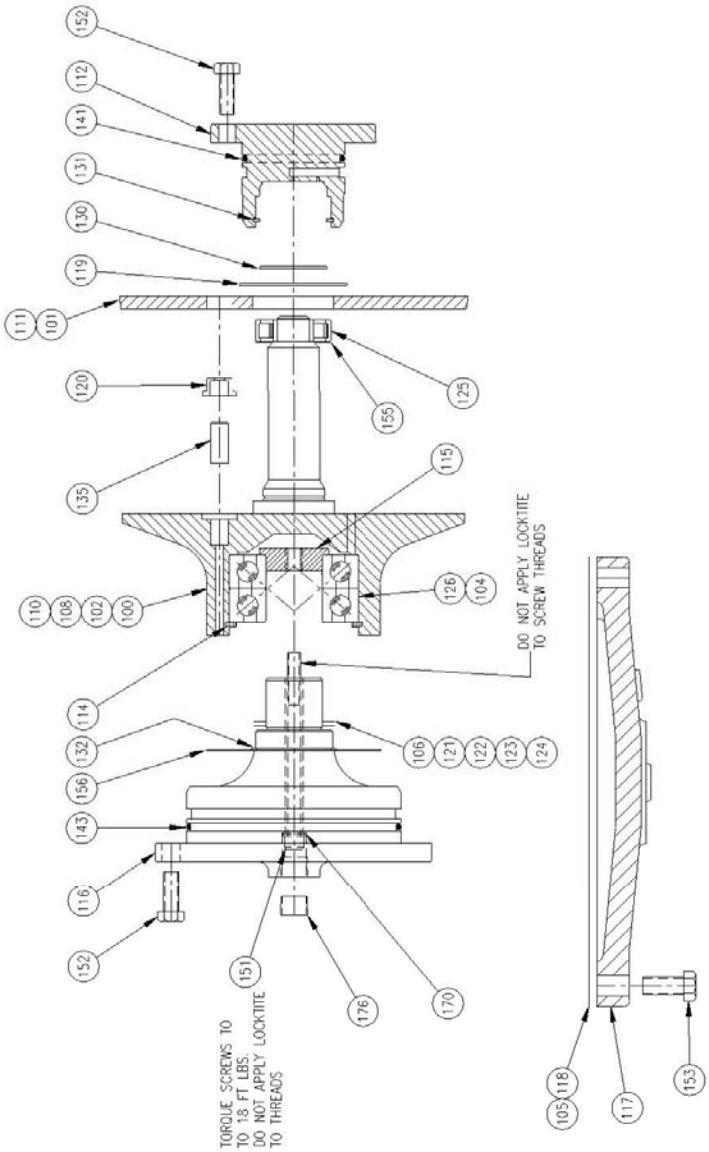


Figure 5-21. Gate Rotor Assembly Breakdown

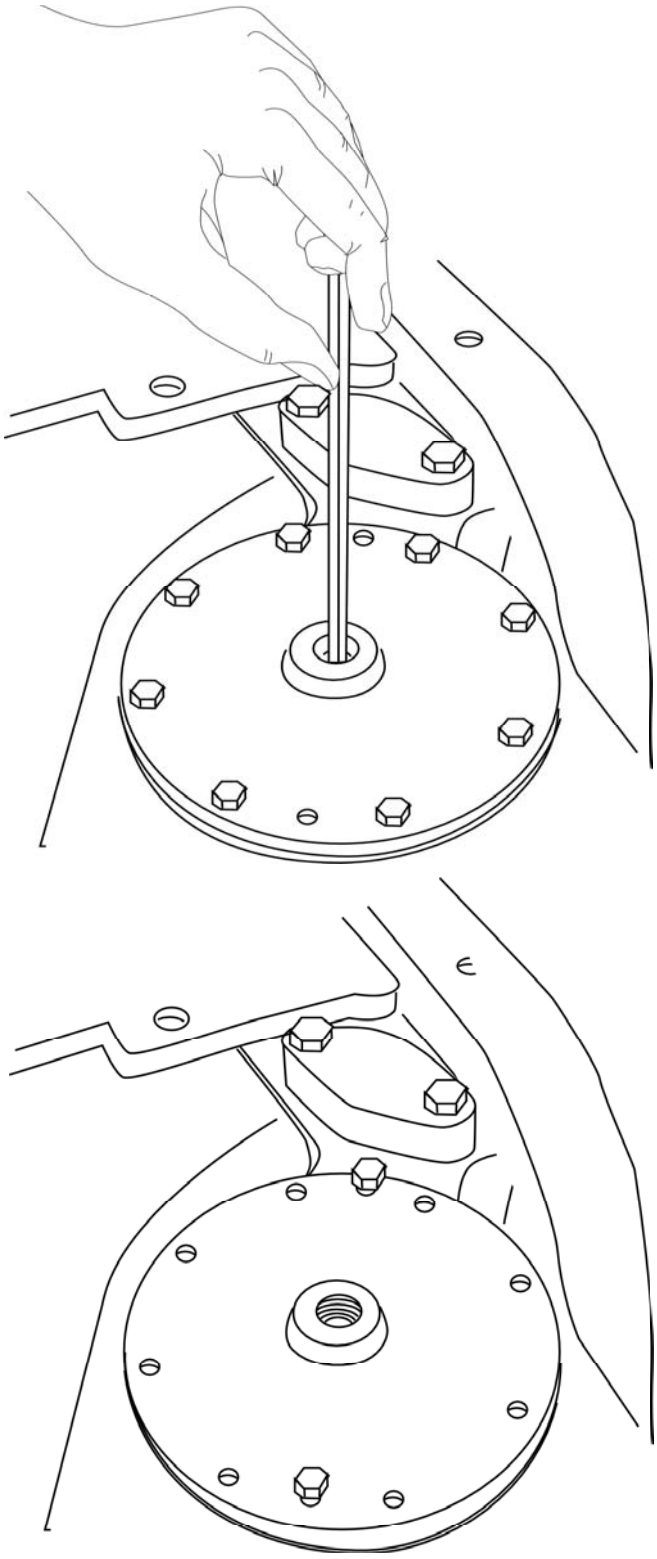
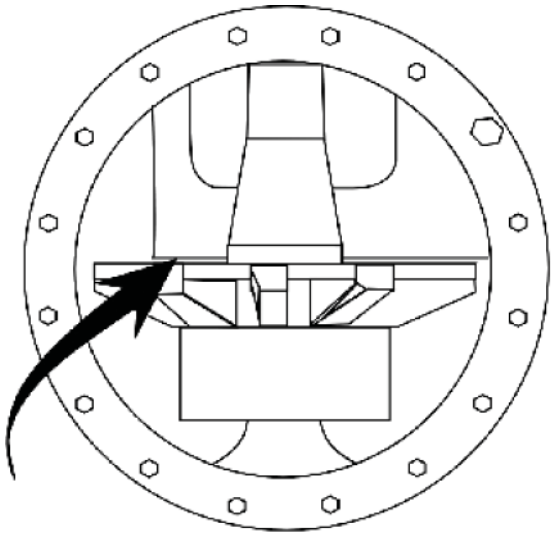


Figure 5-22. Gate Rotor Thrust Bearing

necessary. It is preferable to shim the gate rotor blade looser rather than tighter against the shelf.

14. Once the clearance is set remove the spindle. Install new O-ring, apply Loctite 242 thread locker to the socket head cap screw clamping the thrust bearings to the spindle. Torque all bolts, see Appendix A.
15. Install side covers with new gaskets. Tighten bolts, see Appendix A. The unit can now be evacuated and leak checked.

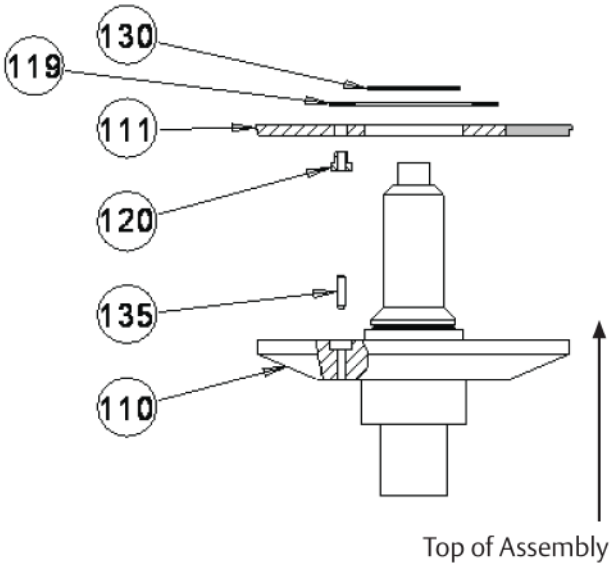


Check for 0.003-0.004" (0.076- 0.102 mm) clearance between gate rotor blade and partition.

Figure 5-23. Gate Rotor and Shelf Clearance

Gate Rotor Disassembly

1. To perform gate rotor disassembly, remove gate rotor from compressor, see Gate Rotor Assembly Replacement procedure (All VSG-VSSG Compressors Except VSG 301-701 Compressors) or Gate Rotor Assembly procedure (VSG 301-701 Compressors ONLY).



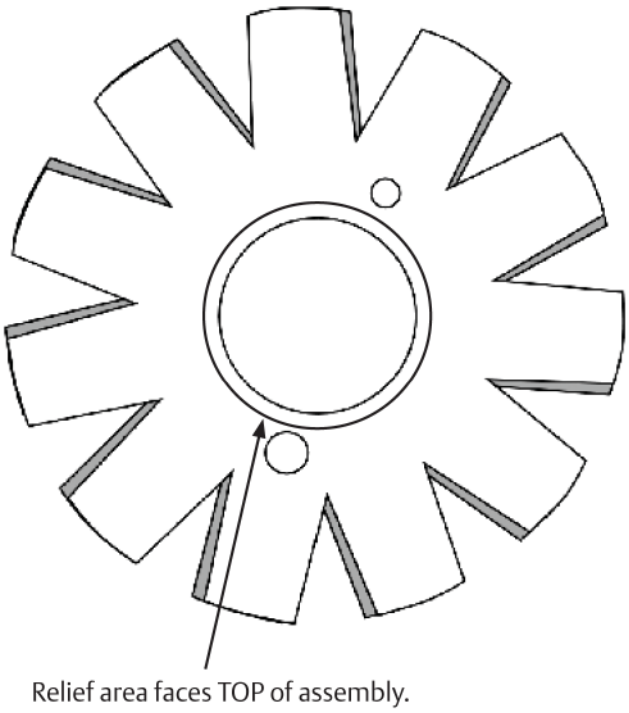


Figure 5-24. Gate Rotor Blade Assembly

GATE ROTOR BLADE REMOVAL

2. Remove the snap ring and washer from the gate rotor assembly. Lift gate rotor blade assembly off the gate rotor support, see Figure 5-24.
3. Check damper pin and bushing for excessive wear. Replace if required.

GATE ROTOR BLADE INSTALLATION

4. Install damper pin bushing (120) in gate rotor blade (111) from the back side of the blade. Be sure bushing is fully seated.
5. Place blade assembly on gate rotor support. Locating damper over pin.
6. Install washer (119) and snap ring (130) on gate rotor assembly. The bevel on the snap ring must face away from the gate rotor blade. After the gate rotor blade and support are assembled, there should be a small amount of rotational movement between the gate rotor and support.

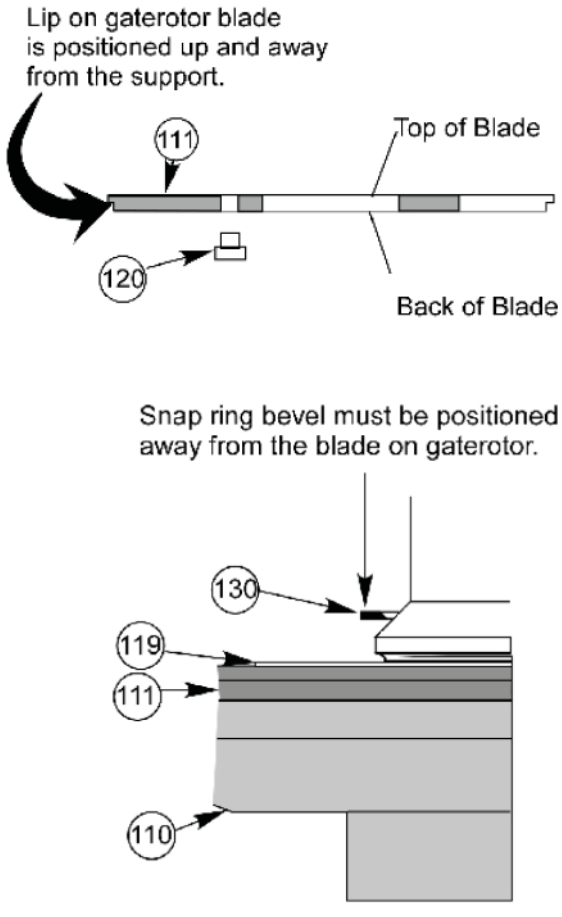


Figure 5-25. Gate Rotor Blade Installation

GATE ROTOR THRUST BEARING REMOVAL

For removal of thrust bearings on VSG units:

7. Remove bolts (150) from the clamping ring (114), see Figure 5-26.
8. Remove thrust bearing clamping ring.
9. Remove thrust bearings (126) from housing (113).

For removal of thrust bearings on VSSG units:

10. Remove retaining ring from gate rotor support.
11. Remove bearings from support.
12. Remove bearing retainer from inner race.

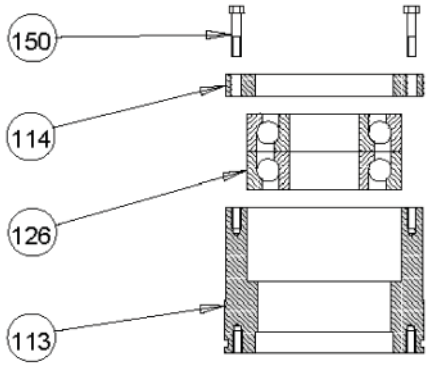


Figure 5-26. Gate Rotor Thrust Bearing

GATE ROTOR THRUST BEARING INSTALLATION

For installation of thrust bearings on VSG and VSSG units:

13. Install thrust bearings (126) in the housing so the bearings are face to face. The larger sides of the inner races are placed together. A light application of clean compressor lubricating oil should be used to ease the installation of the bearings into the housing.
14. Center the bearing retainer ring on housing, use Loctite® 242-thread locker and evenly tighten the bolts to the recommended torque value, see Figure 5-27.

For installation of thrust bearings on VSG 301- 701 units:

15. Install retainer in the back of the inner race of one of the thrust bearings. The back of the inner race is the narrower of the two sides.
16. The bearing with the retainer should be placed in the housing first, retainer towards the support. Install the second bearing. The bearings should be positioned face to face. This means that the larger sides of the inner races are placed together. A light application of clean compressor lubricating oil should be used to ease the installation of the bearings into the gate rotor support.
17. Install the bearing retaining snap ring.

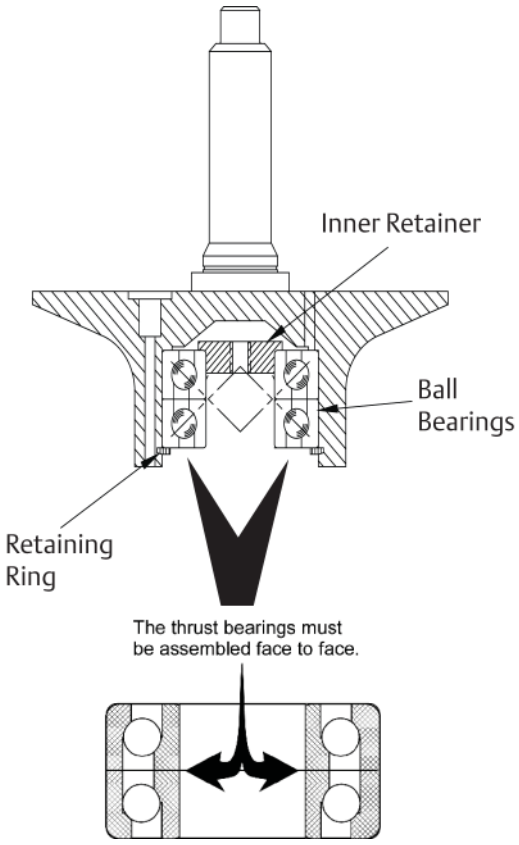


Figure 5-27. Thrust Bearing Installation

GATE ROTOR ROLLER BEARING REMOVAL

18. Remove the snap ring (131), which retains the roller bearing in the bearing housing, see Figure 5-28.
19. Remove the roller bearing (125) from the bearing housing (112).
20. Use a bearing puller to remove the roller bearing race (125) from the gate rotor support (110).

GATE ROTOR ROLLER BEARING INSTALLATION

21. Match up the part numbers on the inner race to the part numbers outer race. Press the bearing race (numbers visible) onto the gate rotor support.
22. Install the outer bearing into the bearing housing so the numbers match the numbers on the inner race. Install the snap ring retainer in the housing.

The bevel on the snap ring must face away from the roller bearing.

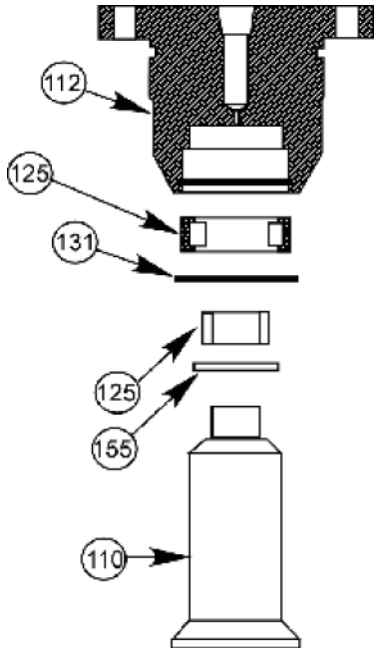


Figure 5-28. Roller Bearing Assembly

Slide Valve Actuator Assembly Replacement

To replace slide valve actuator assembly, proceed with the following steps:

REMOVAL

WARNING

At shutdown, open any other valves that may trap liquids to prevent serious injury and/or damage to equipment.

WARNING

Follow local lockout/tagout procedure. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE

This procedure is applicable to both capacity and volume slide valve actuator assemblies.

1. Shut down the compressor unit, refer to Stopping/Restarting procedure in Section 4.
2. Turn disconnect switches to the OFF position for the compressor unit and oil pump motor starter, if equipped.
3. Allow compressor, motor and surrounding components to cool prior to servicing.
4. Disconnect connectors from actuator.

NOTE

Note orientation of components to aid in installation.

5. Remove screws and lock washers securing actuator assembly to actuator mount.
6. Remove actuator assembly from actuator mount.

INSTALLATION

CAUTION

When installing the slide valve actuator assembly, loosen locking collar down the shaft. Do not use a screwdriver to pry locking collar into position.

7. Position actuator assembly on mount as noted in removal.
8. Install lock washers and screws to secure actuator assembly to actuator mount.
9. Tighten screws, see Appendix A.
10. Connect connectors to actuator assembly.
11. Calibrate actuator assembly, see Slide Valve Calibration procedure in Section 4.

Command Shaft Assembly Replacement

REMOVAL

NOTE

The following steps can be used to remove or install either the capacity or volume command shaft assemblies.

1. Shut down and isolate compressor unit, see Compressor Unit Shutdown and Isolation procedure.
2. Remove actuator, see Actuator Assembly Replacement procedure.
3. Remove four socket head cap screws (457) and Nord-Lock washers (477) securing mounting plate (415) to manifold.
4. The command shaft and mounting plate may now be removed from the compressor.

INSTALLATION

5. Install the command shaft assembly with a new O-ring (446) on the manifold. Make sure that the command shaft tongue is engaged in the cross shaft slot. Rotate the bearing housing so the vent holes point down, this will prevent water and dust from entering the vents.
6. Install the actuator mounting plate with the four socket head cap screws and Nord-Lock washers securing it with proper torque.
7. Perform leak check, see Compressor Unit Leak Check procedure.

Command Shaft Seal Replacement

REMOVAL

1. Remove bolts (281) holding the shaft seal cover (218). Insert two of the bolts into the threaded jacking holes to assist in removing the cover. There will be a small amount of oil drainage as the cover is removed.
2. Remove the rotating portion of the shaft seal (219C).
3. Remove oil seal (230) from cover.
4. Remove the stationary portion of the shaft seal (219B) from the seal cover using a brass drift and hammer to tap it out from the back side of the seal cover.
5. Seal with stationary carbon face (219B) and rotating mirror face (219C).

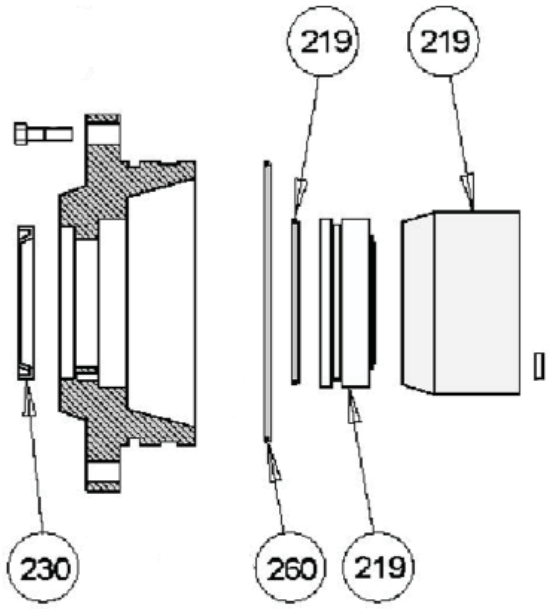


Figure 5-29. Command Shaft Seal

INSTALLATION

CAUTION

Care must be taken when handling the shaft seal and mirror face so it is not damaged. Do not touch the carbon or mirror face as body oil and sweat will cause the mirror face to corrode.

NOTE

When replacing the stationary members of the seal on the VSSG 291 thru VSSG 601 the roll pin in the cover is used only with the seal assembly having a stationary mirror face. If a seal assembly with a stationary carbon face is installed, the roll pin must be removed.

6. To install the carbon cartridge part of the seal in the seal cover; clean the seal cover, remove protective plastic from the carbon cartridge, do not wipe or touch the carbon face. Lubricate the sealing O-ring with clean compressor lubricating oil. If applicable, align the hole on the back of the carbon cartridge with the dowel pin in the seal cover. Install cartridge using seal installation tool or similar (see tool lists).
7. Wipe clean, the compressor input shaft and the

shaft seal cavity in the compressor housing. Apply clean compressor oil to the shaft seal seating area on input shaft.

8. Lubricate the inside area of the rotating seal with clean compressor lubricating oil, do not wipe or touch the face of the rotating portion of the seal. Align the slot in the rotating seal with the drive pin on the compressor input shaft, see Figure 5-30. Carefully push the seal on, holding onto the outside area of the seal until the seal seats against the shoulder on the input shaft. Make sure the seal is seated against the shoulder. If the seal is not fully seated against the shoulder, the shaft seal carbon will be damaged when the seal cover is installed.

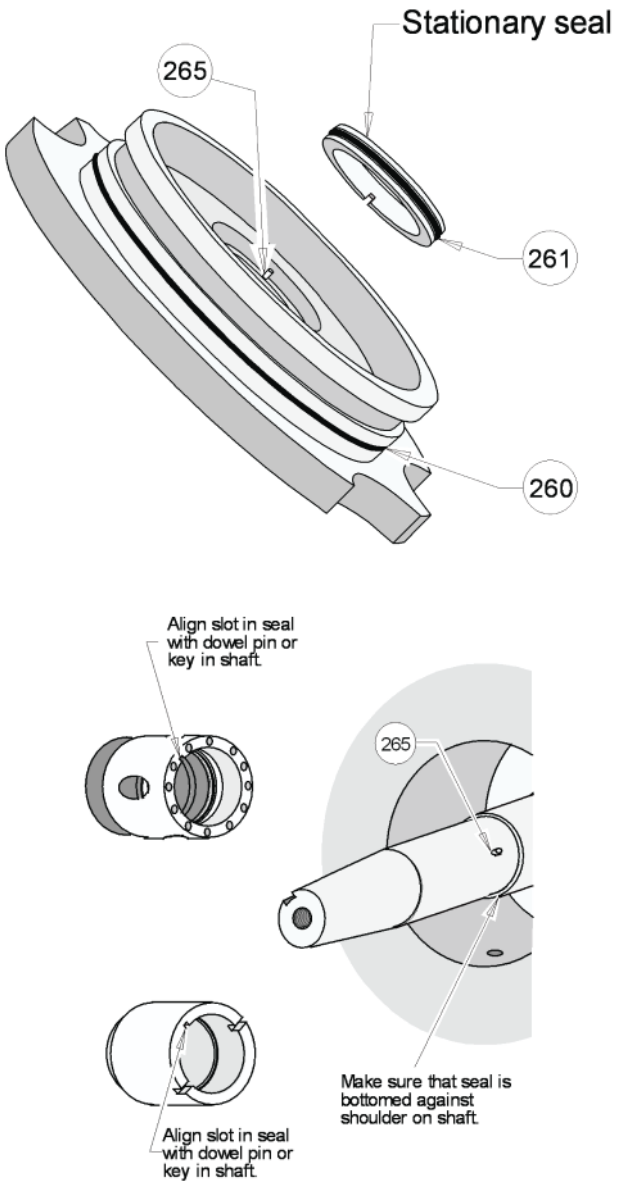


Figure 5-30. Command Shaft Seal Installation

Table 6-1. Slide Valve Actuator Troubleshooting Guide (1 of 2)

Problem	Reason	Solution
The actuator cannot be calibrated or exit calibration mode	Dirt or debris is blocking one or both optocoupler slots	Clean the optocoupler slots with a Q-Tip and rubbing alcohol.
	The photochopper fence extends less than about half way into the optocoupler slots	Adjust the photochopper so that the fence extends further into the optocoupler slots. Make sure the motor brake operates freely and the photochopper will not contact the optocouplers when the shaft is pressed down.
	The white calibrate wire in the grey Turck cable is grounded	Tape the end of the white wire in the panel and make sure that it cannot touch metal
	Dirt and/or condensation on the position sensor boards are causing it to malfunction	Clean the boards with an electronics cleaner or compressed air.
	The calibrate button is stuck down	Try to free the stuck button.
	The position sensor has failed	Replace the actuator.
	Push button is being held down for more that ¾ second when going through the calibration procedure	Depress the button quickly and then let go. Each ¾ second the button is held down counts as another press.
The actuator goes into calibration mode spontaneously	The white calibrate wire in the grey Turck cable is grounding intermittently	Tape the end of the white wire in the panel and make sure that it cannot touch metal.
	A very strong source of electromagnetic interference (EMI), such as a contactor, is in the vicinity of the actuator or grey cable	Tape the end of the white wire in the panel and make sure that it cannot touch metal. Install additional metal shielding material between the EMI source and the actuator or cable.
	There is an intermittent failure of the position sensor	Replace the actuator.
The actuator goes into calibration mode every time power is restored after a power loss	The motor brake is not working properly (see theory section above.)	Get the motor brake to where it operates freely and recalibrate.
The actuator does not transmit the correct position after a power loss	The motor was manually moved while the position sensor was not powered.	Recalibrate.
	The motor brake is not working properly	Get the motor brake to where it operates freely and then recalibrate.
	The position sensor's EEPROM memory has failed	Replace the actuator.

Table 6-1. Slide Valve Actuator Troubleshooting Guide (2 of 2)

Problem	Reason	Solution
The actuator does not transmit the correct position after a power loss	The motor was manually moved while the position sensor was not powered.	Recalibrate.
	The motor brake is not working properly	Get the motor brake to where it operates freely and then recalibrate.
	The position sensor's EEPROM memory has failed	Replace the actuator.
There is a rapid clicking noise when the motor is operating	The photochopper is misaligned with the slotted optocouplers	Try to realign or replace the actuator.
	The photochopper is positioned too low on the motor shaft.	Adjust the photochopper so that the fence extends further into the optocoupler slots.
	A motor bearing has failed	Replace the actuator.
The motor operates in one direction only	There is a loose connection in the screw terminal blocks	Tighten.
	There is a loose or dirty connection in the yellow Turck cable	Clean and tighten.
	The position sensor has failed	Replace the actuator.
	There is a broken motor lead or winding	Replace the actuator.
The motor will not move in either direction	The thermal switch has tripped because the motor is overheated	The motor will resume operation when it cools. This could be caused by a malfunctioning control panel. Consult the factory.
	Any of the reasons listed in "The motor operates in one direction only"	See above.
	The command shaft is jammed	Free the command shaft.
	Broken gears in the gearmotor	Replace the actuator.
	Blown relay or fuse.	Check and replace blown relay and/or fuse.
The motor runs intermittently, several minutes on, several minutes off	Motor is overheating and the thermal switch is tripping	This could be caused by a malfunctioning control panel. Consult the factory.
The motor runs sporadically	Bad thermal switch	Replace the actuator.
	Any of the reasons listed in "The motor will not move in either direction"	See above.
The motor runs but output shaft will not turn	Stripped gears inside the gear motor or the armature has come unpressed from the armature shaft	Replace the actuator.

Slide Valve Actuators communicate problems discovered by internal diagnostics via LED blink codes. Only one blink code is displayed, even though it is possible that more than one problem has been detected.

Table 6-2. Slide Valve Actuator LED Blink Codes* (1 of 2)

Flash Pattern	Meaning
*=ON _=OFF	
* _ * _ * _ * _ * _ * _ * _ * _ * _ * _	Calibration step 1
* ___ * ___ * ___ * ___ * ___	Calibration step 2
* __ * _____	This indicates a zero span. This error can only occur during calibration. The typical cause is forgetting to move the actuator when setting the upper limit of the span. If this is the case, press the blue button to restart the calibration procedure. This error can also occur if either or both of the slotted optocouplers are not working. If this is the case, the slide valve actuator will have to be replaced. The operation of the slotted optocouplers is tested as follows: 1. Manually rotate the motor shaft until the aluminum photochopper fence is not blocking either of the optocoupler slots. 2. Using a digital multi-meter, measure the DC voltage between terminal 3 of the small terminal block and TP1 on the circuit board (see Note 1). You should measure between 0.1 and 0.2 Volts. 3. Next, measure the DC voltage between terminal 3 and TP2 on the circuit board. You should measure between 0.1 and 0.2 Volts.
* _____	This indicates a skipped state in the patterns generated by the optocouplers as the motor moves. This error means that the slide valve actuator is no longer transmitting accurate position information. The actuator should be recalibrated as soon as possible. This code will not clear until the actuator is recalibrated. This code can be caused by: 1. The motor speed exceeding the position sensors ability to measure it at some time during operation. A non-functioning motor brake is usually to blame. 2. The actuator is being operated where strong infrared light can falsely trigger the slotted optocouplers, such as direct sunlight. Shade the actuator when the cover is off for service and calibration. Do not operate the actuator with the cover off.

Table 6-2. Slide Valve Actuator LED Blink Codes (2 of 2)

Flash Pattern	Meaning
*__*__*_____	The motor has overheated. The actuator motor will not run until it cools. Once the motor cools, the actuator will resume normal operation. Motor overheating is sometimes a problem in hot and humid environments when process conditions demand that the slide valve reposition often. Solutions are available; consult your Vilter authorized distributor for details. Another possible cause for this error is a stuck motor thermal switch. The thermal switch can be tested by measuring the DC voltage with a digital multi-meter between the two TS1 wire pads (see Note 2). If the switch is closed (normal operation) you will measure 0 Volts.
**********	The 24V supply is voltage is low. This will occur momentarily when the actuator is powered up and on power down. If the problem persists, measure the voltage using a digital multi-meter between terminals 3 and 4 of the small terminal block. If the voltage is >= 24V, replace the actuator.
_**********	The EEPROM data is bad. This is usually caused by loss of 24V power before the calibration procedure was completed. The actuator will not move while this error code is displayed. To clear the error, calibrate the actuator. If this error has occurred and the cause was not the loss of 24V power during calibration, possible causes are: 1. The EEPROM memory in the micro-controller is bad. 2. The large blue capacitor is bad or has a cracked lead.
*****____*_____	Micro-controller program failure. Replace the actuator.

*There are two versions of slide valve actuators, version A and B. Only version B is able to display LED blink codes. Slide valve actuator version B can be distinguished by only having a single circuit board as supposed to two circuit boards in version A.

Note 1: TP1 and TP2 are plated-thru holes located close to the slotted optocouplers on the board. They are clearly marked on the board silkscreen legend.

Note 2: The TS1 wire pads are where the motor thermal switch leads solder into the circuit board. They are clearly marked on the board silkscreen legend and are oriented at a 45 degree angle.

Table 6-3. Troubleshooting Guide - General Problems & Solutions (1 of 3)

Problem	Solution
Low Oil Pressure at Start	• After failing to start compressor with "Prelube Oil Pump Inhibit", first allow Discharge pressure, Oil Filter In pressure and Out pressure to equalize. Then restart compressor. If compressor fails to start due to low oil pressure, continue troubleshooting with items below. • Reset Prelube Oil Pressure Setpoint in Alarms and Trip Setpoints screen to lowest recommended setpoints. • Check calibration of oil manifold transducer, discharge pressure transducer, and suction transducer. • Check for correct oil pump motor rotation and operation. • Ensure transducer isolation valves are open. • Verify that the correct transducer ranges are selected. • Check to see all oil line valves are open except the oil dump valve used to fill the lines and oil cooler. • Check oil strainer for dirt. • Check oil filter pressure drop. • Check "Prelube Oil Pump Time Limit" setpoint is sufficient in Compressor Timer Setpoints screen. • Prelube pressure is manifold pressure minus discharge pressure.
Low Run Oil Pressure	• Check solutions in "Low Oil Pressure at Start". • Check that there is proper discharge pressure ratio to create differential pressure, otherwise oil pressure can't be maintained. Oil pressure is manifold oil pressure minus the suction pressure. It is a net pressure. • If the oil pump is selected to be a part time oil pump in the "Setup" menu, then ensure that it only shuts off at an appropriate pressure ration that takes into account pressure drops through the oil cooler. This is a set point in the "Compressor Control Setpoints" menu called "Oil Pump Restart." It is a pressure ratio. (discharge pressure in psia/suction pressure in psia) Default ratio is a pressure ratio of 3.00:1 that stops the pump and 2.80:1 that restarts the pump. This ratio can be increased. Do not decrease without consulting Vilter.
Oil flow or oil pressure problems	• Clean oil strainer screen. • Change oil filter, maybe plugged or collapsed. • Oil pump gears worn internally, excessive end-clearance. • Oil priming valve used on air-cooled cooler units is open. • Relief in-line check valve stuck open. • Pressure ratio too low, oil pump should be on.
Faulty pressure or temperature readings	• Check that the correct pressure or temperature range is selected in the Instrument Calibration menu. • Check cable connections at device, terminal strips, and PLC input card for correct wiring and shielding (RF noise). • Check calibration of RTDs and transducers.

Table 6-3. Troubleshooting Guide - General Problems & Solutions (2 of 3)

Problem	Solution
Oil Loss Issues	• Oil return line from coalescing side of oil separator to suction is closed, not open enough (.75 turns should be sufficient), or plugged with debris • The check valve in the oil return line could be stuck closed or the flow is in the wrong direction • There may be water in the oil affecting the coalescing elements • Coalescent elements in need of replacement due to age or damage (water contamination) • The operating conditions are not correct (too high of suction and/or too low discharge pressure) This creates increased gas flow which could make the oil separator too small • The suction or discharge check valve is not working correctly causing oil to escape when the unit stops • Viscosity of oil incorrect; send sample for testing • There is an oil leak somewhere in the system
High oil temperature (liquid injection)	• Check for correct setting of all manual values. • Check for correct operation of 2-way automatic oil mixing valve. • In the “Vilter Only” menu, ensure that you select “Yes this unit has the oil mixing valve” to enable it. • If your are controlling a step type oil cooler or a VFD oil cooler, verify the correct one is selected in the “Vilter Only” menu and the amount of steps are entered in the menu screen “Oil Cooler Step Control” menu. • Check the oil cooler and associated piping to make sure it is full of oil before starting. • Check the oil strainer for debris and clean if necessary. • Verify that the volume slide actuator is functioning correctly and that the correct compressor size (type) is selected in the “Vilter Only” menu. • Check that all fans are working. • Check for correct fan rotation on the oil cooler. • Check that your operating conditions are within the “As Sold” design conditions.
Capacity/Volume Slide Actuator Alarms/Trips/ Symptoms:	• Calibration method not correct • Actuator or Gear motor not working, or off on overload • Slide valve carriage assembly out of position, slides binding • Cross-shaft gears, broken pins • Command shaft broken • Slide valve rack or rack shaft damaged • Check balance piston movement • Reference Slide Valve Actuator Troubleshooting Guide • Check I/O fusing

Table 6-3. Troubleshooting Guide - General Problems & Solutions (3 of 3)

Problem	Solution
High Amp Draw	• Check Main Motor Amps scaling and PLC.
Vibration	• Check that unit is leveled and secured to mounting pad or floor. • Check supported pipes (i.e. suction and discharge pipe) and make sure they are adequately supported. • Check for loose bolts and nuts. • Check condition of compressor and motor (i.e. alignments)
Excessive Motor Backspin	• If there is more than normal motor backspin at shutdown, check suction check valve for proper operation.

Warranty Claim Processing

This section explains how the warranty claim is processed and to help clear any questions that may arise prior to contacting customer service. For additional warranty information, refer to the VSG/VSSG Standard Vilter Warranty Statement on page i. Vilter contact information can be found on page ii.

1. The warranty process starts with contacting a Vilter Service and Warranty (S&W) department representative. *Ensure to have the original Vilter sales order number for the equipment available to better assist you.*
2. Our Vilter S&W representative will confirm if the equipment is within the warranty time frame as described in the warranty statement.

If the equipment (Part/Compressor/Compressor Motor) is within the warranty time frame, proceed to the following section regarding the type of equipment:

PART

1. Submit a Purchase Order (PO) to procure the replacement part:
    - The correct Vilter part number and the quantity.
    - The original Vilter sales order for the equipment.
2. Request a Return Material Authorization (RMA) number:
    - Please provide as much information describing the mode of failure to be recorded on the RMA document. This will assist us with providing a quicker review once we have received the warranty part (ex. Part does not calibrate, part does not read correct temperature, etc.).
    - Any additional parts returned on the RMA that is not listed, will be returned freight collect or scrapped. The RMA is valid for 60 days from the RMA request date.
3. After replacing the warranty part:
    - Ship the part to Vilter per the instructions on the RMA document.
    - Please include a copy of the RMA document in the box for identification purposes when the part is received.
4. Part to be evaluated.
5. Warranty Consideration:
    - Acceptance – A credit will be provided for the customer part sales order.
    - Denial – Notification of denial will be provided to the customer.

COMPRESSOR

- Due to the site specific nature of compressor warranty, all warranty responses must be mitigated through a Vilter S&W department representative.

COMPRESSOR MOTOR

The warrany is a pass through warranty as stated in the equipment warranty and as such will be determined by the manufacturer. *All extraneous expenses (i.e. shipping, removal/installation, alignment) are not covered by Vilter's nor the manufacturer's warranty.*

1. The motor will need to be taken to the nearest Electrical Apparatus Service Association (EASA) repair facility or motor manufacturer approved repair facility.
2. The motor shop will provide the motor manufacturer with the failure analysis.
3. The motor manufacturer will make the warranty disposition.

On Site Service Support

If on site support is required, contact a Vilter S&W department representative to start this process.

Warranty does not cover labor and extraneous expenses.

1. A quote, a service rate sheet, and the service terms and conditions will be provided.
2. Submit a PO.
3. Schedule the service visit.

Remanufactured Gas Bare Shaft Compressor Process

These instructions are an overview of how the process works when a bare shaft compressor is in need of being remanufactured. This is to help clear any questions that may arise prior to contacting customer service.

The process begins by contacting Vilter's Customer Service Department. Vilter contact information can be found on page ii.

- Request a "VSG Single Screw Compressor Rebuild Form".
- Submit the Rebuild Form and a Purchase Order (PO) for the inspection. A fee is required for the initial inspection and teardown report; contact Vilter Customer Service representative for the latest fee.
- A Return Material Authorization (RMA) number will be provided.
- Send the compressor to Vilter in the condition as stated on the Rebuild Form (i.e. no oil in the compressor). Charges may apply if conditions are not met.
- A report will be sent to you after the inspection has been completed explaining what level of rebuild is necessary along with the cost.

NOTE

Inspection and rebuild times will vary, contact Vilter Customer Service representative for further details.

- Submit a new PO for the amount that will be needed for the rebuild. The inspection cost will be waived upon receipt of the new PO. Make sure to provide your "Ship to Address" and "Billing Address".

EXPLANATION OF REBUILD LEVELS

Level 1

Compressor is in good condition. Replace bearings, gaskets, shaft seal and o-rings. All hardware is intended to be re-used (when possible). Parts are organized in part kit form.

Level 2

Compressor is in good condition, but requires new gate rotor blades. Replace all items in Level 1 plus new gate rotor blades and bushings.

Level 3 - Current Reman Compressor requires complete rebuilding and re-conditioning to "as-new" condition. All the components listed in Level 2 are replaced plus all hardware, slide assemblies, pistons, and a main rotor (if damaged) and/or gate rotor supports.

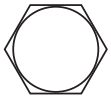
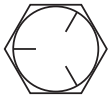
NOTE

A Level 1 and Level 2 rebuild will include washing the housing and repainting over the current paint. A Level 3 rebuild will include blasting all the current paint off before repainting.

BARE SHAFT COMPRESSOR DESCRIPTION

Single Screw Bare Shaft Compressor features include:

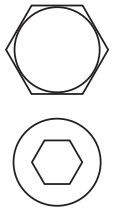
- Cast grey iron frame with cast ductile iron discharge manifold and gate rotor covers with discharge connection horizontal.
- Standard drive shaft is tapered.
- Standard slide assembly.
- Viton shaft seal O-rings.
- Crating with Purge & Gauge.
- Does not include handwheels or slide valve motors.

Torque Specifications (ft-lbs)											
Type Bolt	Head Markings	Nominal Size Numbers or Inches									
		#10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8
SAE Grade 2 Coarse (UNC)		-	5	10	18	29	44	63	87	155	150*
SAE Grade 5 Coarse (UNC)		-	8	16	28	44	68	98	135	240	387
SAE Grade 5 Coarse (UNC)		-	-	18	-	-	-	-	-	-	-
SAE Grade 8 Coarse (UNF)		-	11	22	39	63	96	138	191	338	546
Socket Head Cap Screw (ASTM A574) Coarse (UNC)		5	13	26	46	73	112	115	215	380	614

1) Torque values in this table are not to override other specific torque specifications when supplied.

2) When using loctite, torque values in this table are only accurate if bolts are tightened immediately after loctite is applied.

* The proof strength of Grade 2 bolts is less for sizes 7/8 and above and therefore the torque values are less than smaller sizes of the same grade.

Torque Specifications for 17-4 Stainless Steel Fasteners (ft-lbs)										
Type Bolt/Nut	Head Markings	Nominal Size Numbers or Inches								
		#10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4
Hex & Socket Head Cap Screws		3	8	14	25	40	60	101	137	245
Nut		-	8	-	25	-	-	-	-	-

NOTE: Continue use of red loctite #271 (VPN 2205E) on currently applied locations. Use blue loctite #243 (VPN 2205F or 2205G) on all remaining locations.

Appendix B • Motor (Compressor) - General Storage Instructions

Short Term Storage

If the equipment is not put into immediate use it should be stored in a clean, dry location. For all Weather Protected Type II (WPII) motors, motor heaters should be activated upon arriving at the jobsite to prevent condensation. This is required for warranty considerations.

Care should be taken to keep the equipment covered when moving from a cold location to a warm location, otherwise condensation may occur. If condensation does occur, and the equipment is moist, allow it to dry thoroughly before applying power.

Long Term Storage

1. Cover machined metal parts with weatherproof cover, but leave ventilating area exposed.

2. Make certain unpainted portions are covered and retouch any scratches or flaked areas.

3. If condensate plugs or drain plugs have been used, make sure they are operative.

4. Cover completely with plastic cover and insert silica-gel bags inside the cover for moisture control.

5. If motor is equipped with space heaters make sure space heaters are properly connected and operative. The motor interior temperature should be maintained approximately 10 °F (5.6 °C) above ambient.

6. For all Weather Protected Type II (WPII) motors, motor heaters should be activated upon arriving at the jobsite to prevent condensation. This is required for warranty considerations.

7. A systematic inspection and maintenance schedule should be established. If rotating apparatus is to be stored for 6 months or longer, it should, in addition to the minor precautions above, be given a megger test every 3 to 6 months. A minimum reading of 10 megohoms is recommended. A record of insulation values, temperature, time, humidity and length of voltage application should be recorded to show winding conditions prior to start up.

8. If windings are designed for outdoor operation, they will not be affected by extreme or sudden temperature changes or inclement weather in general. However a weather proof cover with provisions for adequate ventilation should be used to guard against intrusion of salt, dust, or other abrasive or corrosive material.

9. It is recommended that the rotor be turned every month to redistribute the lubricant in the bearings and oil or grease be added every 6 six months.

10. Preferably, storage would be in a warehouse or enclosed building but the same precautions should be followed.

Lubrication

Refer to manufacturer's lubrication instructions.

OIL SERVICES LABORATORIES
www.oil-services-lab.com

PRODUCT ANALYSIS REPORT

No Action Required

Report Date:	3/4/2013
Report Number:	*********
Customer	Customer
Comp. Mfr.	Vilter
Oil Type	VILTER-717
Serial Number	****-***
Model Number	VSM-601
Hrs. on Fluid	6049
Hrs. on Machine	11239
Sample Date	Feb 21, 2013
Receive Date	Mar 01, 2013
I.D. #	*********

Customer Name
Customer Address

Evaluation:

The fluid is in good condition. Sample again in 6 months.

Physical Properties Results *

Sample Date (Lube Hours)	Feb 21, 2013 (6049)	Oct 19, 2012 (4809)	Jul 26, 2010 (5190)
Water by Karl Fischer (ppm)	19.5	147.7	41.4
Viscosity 40 C (cSt)	64.23	64.47	66.00
TAN Total Acid #	0.077	0.106	0.080
ISO Code	21/20/16	21/19/16	21/19/14

Spectrochemical Analysis

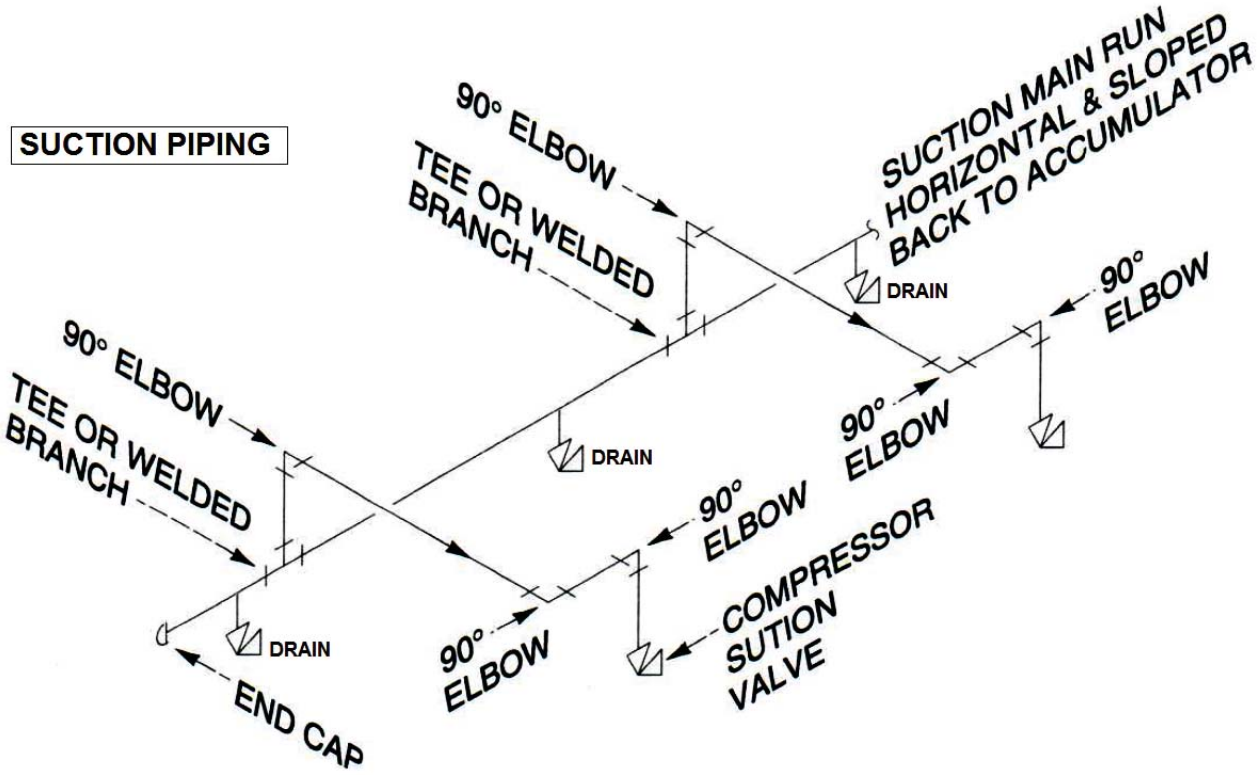
Wear Metals (ppm)			
Silver (Ag)	0	0	0
Aluminum (Al)	0	0	0
Chromium (Cr)	0	0	0
Copper (Cu)	0	0	0
Iron (Fe)	0	0	0
Nickel (Ni)	0	0	0
Lead (Pb)	0	0	0
Tin (Sn)	0	0	0
Titanium (Ti)	0	0	0
Vanadium (V)	0	0	0
Contaminant/Additive Metals (ppm)			
Barium (Ba)	0	0	0
Calcium (Ca)	0	0	0
Magnesium (Mg)	0	0	0
Molybdenum (Mo)	0	0	0
Sodium (Na)	0	0	0
Phosphorus (P)	0	0	0
Silicon (Si)	0	0	0
Zinc (Zn)	0	0	0

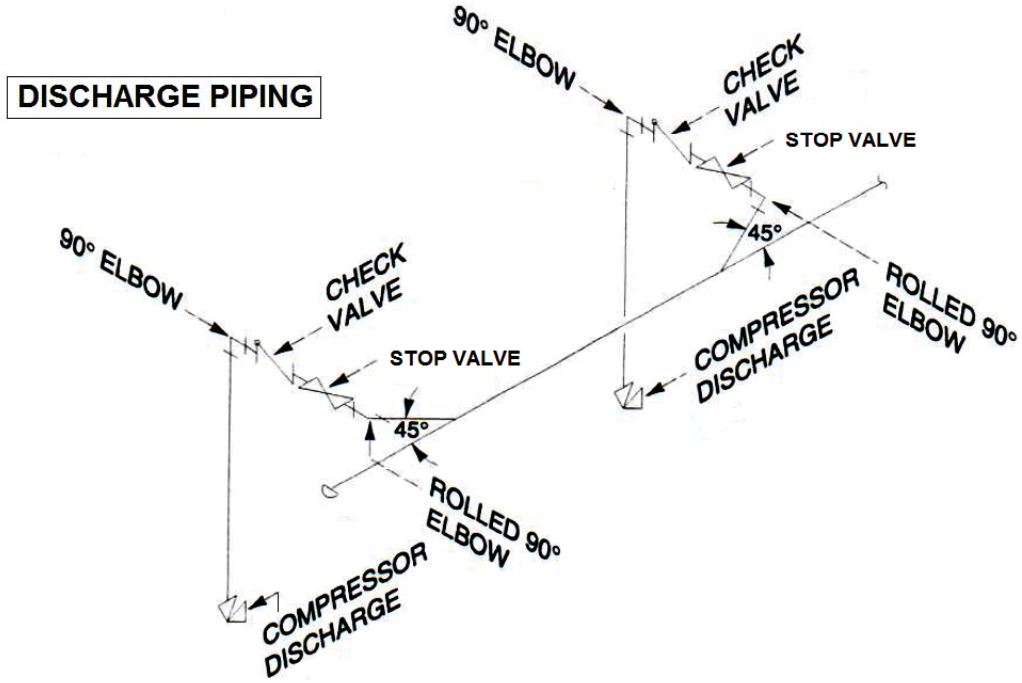
Thank you for this opportunity to provide technical assistance to your company. If you have any questions about this report, please contact us at 1-800-637-8628, or fax 1-989-496-2313 or email us at tslab@oil-services-lab.com

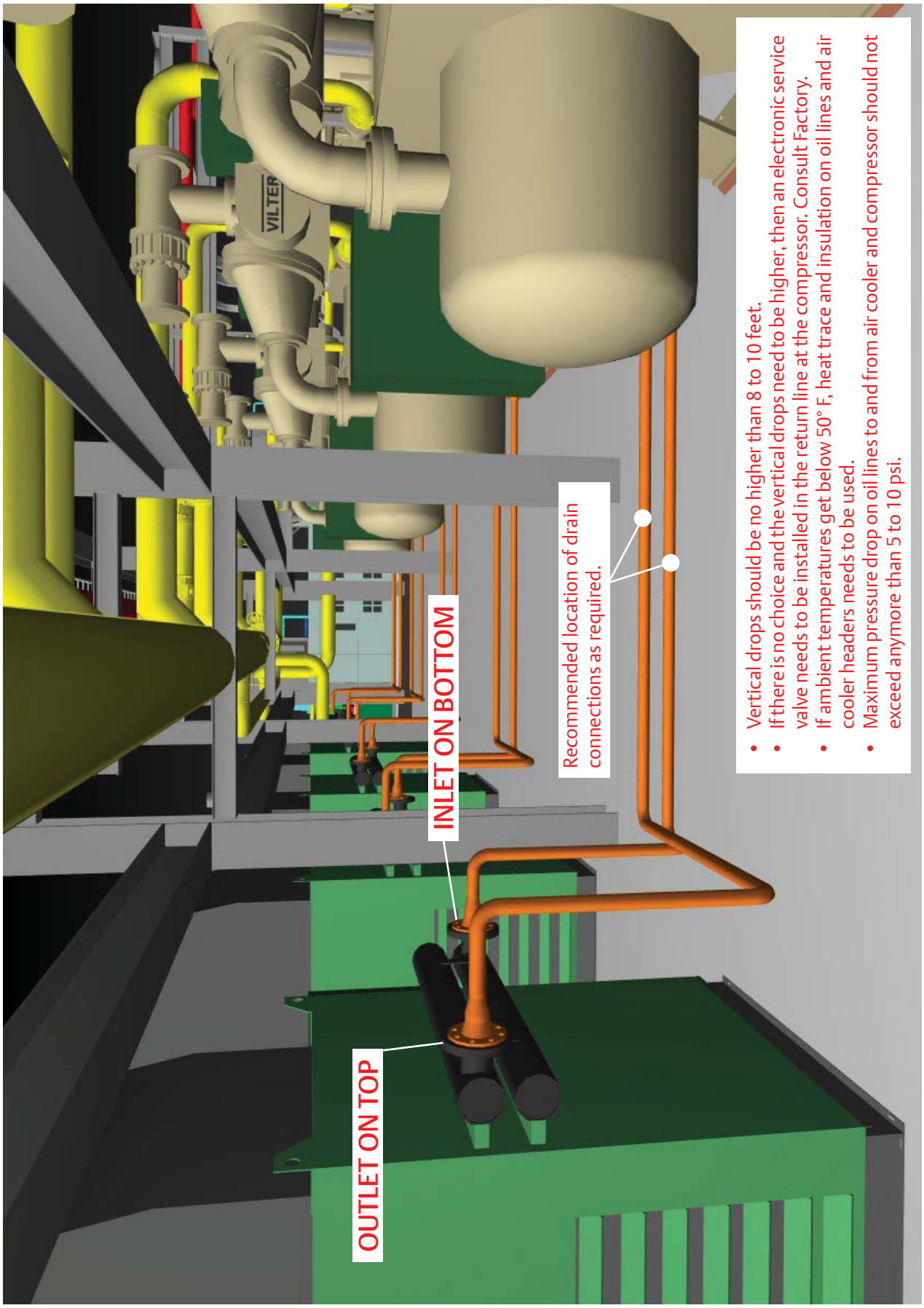
CC List

Accuracy of recommendations is dependent on representative oil samples and complete correct data on both unit and oil

* Property values should not be construed as specifications


SUCTION PIPING
90° ELBOW
TEE OR WELDED BRANCH
SUCTION MAIN RUN HORIZONTAL & SLOPED BACK TO ACCUMULATOR
DRAIN
90° ELBOW
90° ELBOW
TEE OR WELDED BRANCH
DRAIN
90° ELBOW
90° ELBOW
COMPRESSOR SUTION VALVE
DRAIN
END CAP


DISCHARGE PIPING
90° ELBOW
CHECK VALVE
STOP VALVE
45°
ROLLED 90° ELBOW
90° ELBOW
CHECK VALVE
STOP VALVE
45°
COMPRESSOR DISCHARGE
ROLLED 90° ELBOW
COMPRESSOR DISCHARGE


OUTLET ON TOP
INLET ON BOTTOM
Recommended location of drain connections as required.
• Vertical drops should be no higher than 8 to 10 feet.
• If there is no choice and the vertical drops need to be higher, then an electronic service valve needs to be installed in the return line at the compressor. Consult Factory.
• If ambient temperatures get below 50° F, heat trace and insulation on oil lines and air cooler headers needs to be used.
• Maximum pressure drop on oil lines to and from air cooler and compressor should not exceed anymore than 5 to 10 psi.

Blank