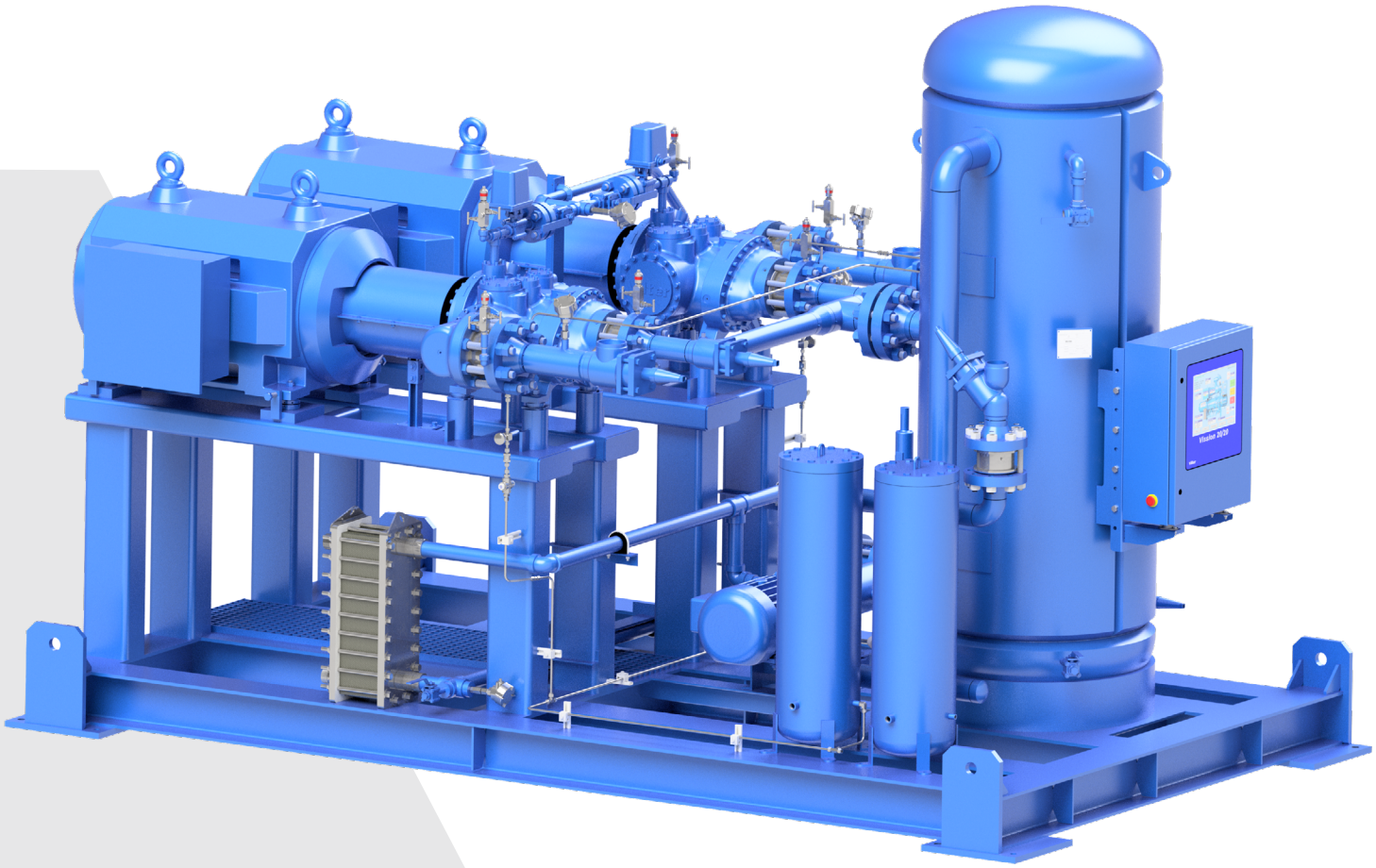
VSTC Single Screw Compressor Transcritical CO_2 Unit

Installation, Operation & Maintenance Manual



VILTER
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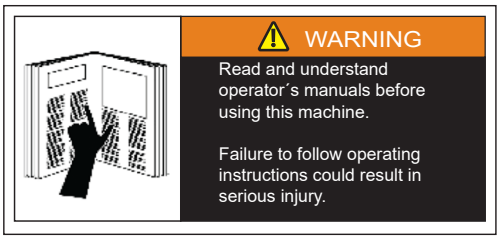
Important Message



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.

Only qualified personnel shall operate, install and maintain the equipment.

Qualified personnel shall be accredited by a local regulatory agency, which requires that they are continually scrutinized by an organization whose sole mission is to establish, maintain and assure that the highest industry standards are set and met in a continuous and ongoing basis. The credentials shall address topics ranging from plant safety, operating concepts and principles and operations through the basics of refrigeration compliance and PSM (Process Safety Management) requirements.

Follow local workplace occupational safety and health regulations.

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:

Copeland Industrial LP (Vilter)
Customer Service Department
5555 South Packard Ave
Cudahy, WI 53110 USA
Telephone: 1-414-373-7615; Fax:1-414-744-3483
E-mail: info.vilter@copeland.com; Web: Copeland.com/Vilter

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: _____

Standard VILTER™ Warranty Statement

It is now on the web site. You can access it here:
Go to www.Copeland.com/Vilter ,then scroll down to find Lifecycle Services -> Warranty Information
Or click directly:
Warranty Information | Copeland US

The EC Declaration of Incorporation

It is now on the web site. You can access it here:
Go to www.Copeland.com/Vilter ,then scroll down to find Lifecycle Services -> Compliance -> Legal & Compliance
Or click below directly:
EC Declaration of Incorporation - Single Screw Compressor

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How To Use This Manual

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

Section 1: General Information

Section 2: Theory of Operation

Section 3: Installation

Section 4: Operation

Section 5: Maintenance and Service

Section 6: Troubleshooting

Section 7: Warranty and Parts

Section 8: Spare Parts List

Appendices

Appendix A: Torque Specifications

Appendix B: Vilter Oil

Appendix C: Vibration Measurements - Single Screw Compressor

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

Figures and tables are included to illustrate key concepts.

NOTE:

The symbol ⟨ at the bottom of every page:

Click the symbol ⟨ . It will take you back to your previous page.

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.

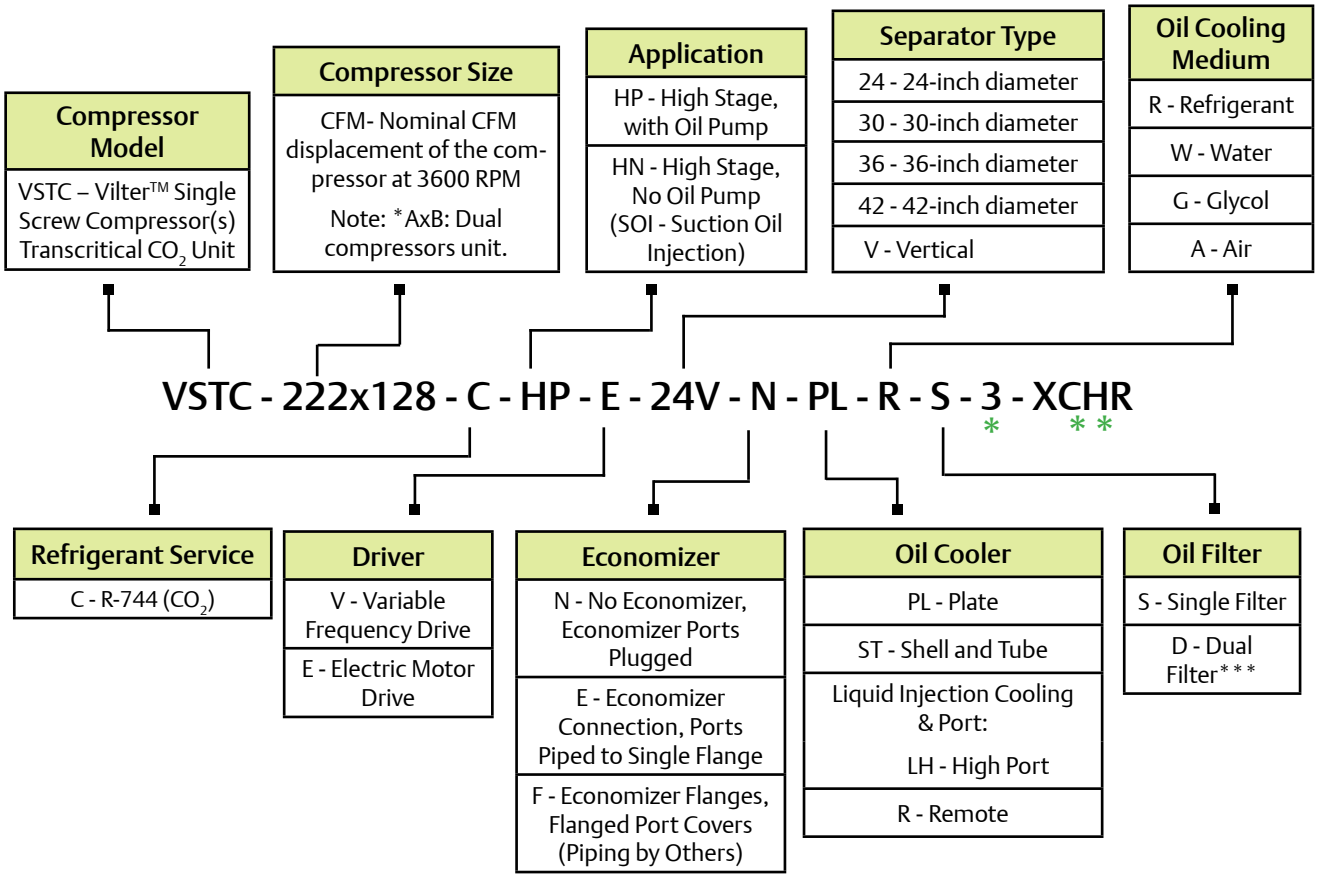
NOTE - Notes are shown when there are additional information pertaining to the instructions explained.

Additional Important Notes

- Additional installation, operation and maintenance instructions can be found in the Vission 20/20 Manual (35391SC).
- Due to continuing changes and unit updates, always refer to the website www.Vilter.com to make sure you have the latest manual.
- Any suggestions of manual improvements can be made to Vilter™ Manufacturing at the contact information on Page iii.

Refrigeration Compressor Unit Model Designations

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



* **Suction Connection**

3, 4 - 3", 4"

* * **Custom Features**

Blank	X[letter(s)]: Special Feature(s)	
No special features	C - Cartridge-Style Reliefs	L - Dual coolers (LI or PL)
	E - Special Electrical Codes	R - CRN Units
	F - Fixed Slide	S - Special Separator Features
	H - Hazardous Area Req.	V - Specific Vendor

Note: ***: Dual filters is standard for dual compressor unit, but only available on configured unit for single compressor unit.

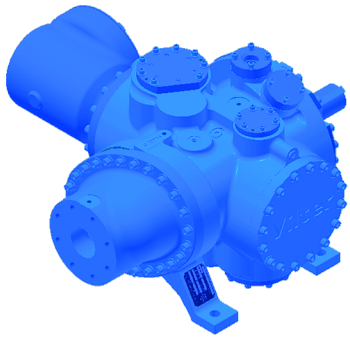
System Unit Identification

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.

Configured Compressor Unit Component Identification - HPLD

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

1 - Motor
4 - Single Screw Compressor
5 - Vission 20/20 HMI
6 - HMI Mounting Bracket
7 - Thermometer Connection
10 - Suction Stop Valve
11 - Suction Connection Port
12 - Suction Check Valve
13 - Suction Strainer & Cover
14 - Oil Filter Out Shut-off Valve
15 - Heaters
16 - Oil Drain Valve for Oil Filter
17 - Oil Pump
18 - Oil Level Switch
19 - Temperature Element (Oil Separator)
21 - Discharge Connection
22 - Oil Separator & Cover

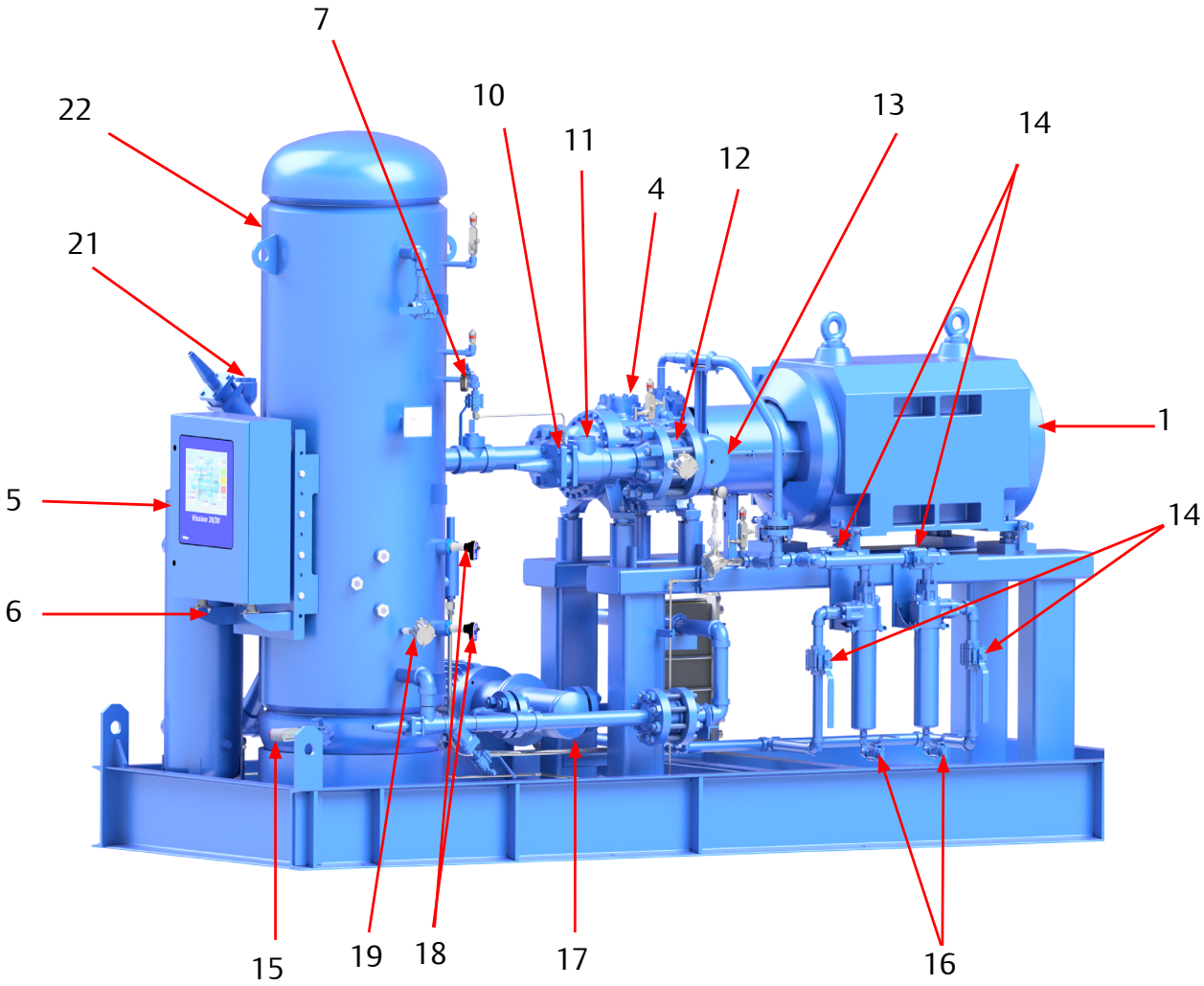


Figure 1-1. CO_2 Compressor Unit Components for Models VSTC 128 to 243 (1 of 4)

2 - Lift Point (Motor ONLY)
8 - Suction Equalizing Valve
9 - Suction Equalizing Line
20 - Lift Point (Compressor Unit)
23 - Motor Mounting Area
29 - Discharge Bleed Valve
30 - Coalescing Oil Return Line
31 - Coupling Guard
32 - Oil Drain Valve for Oil Filter
33 - Oil Drain/ Fill Valve
34 - Charging Valve During Shut-down or Initial Setup
35 - Oil Cooler (Plate Heat Exchange)

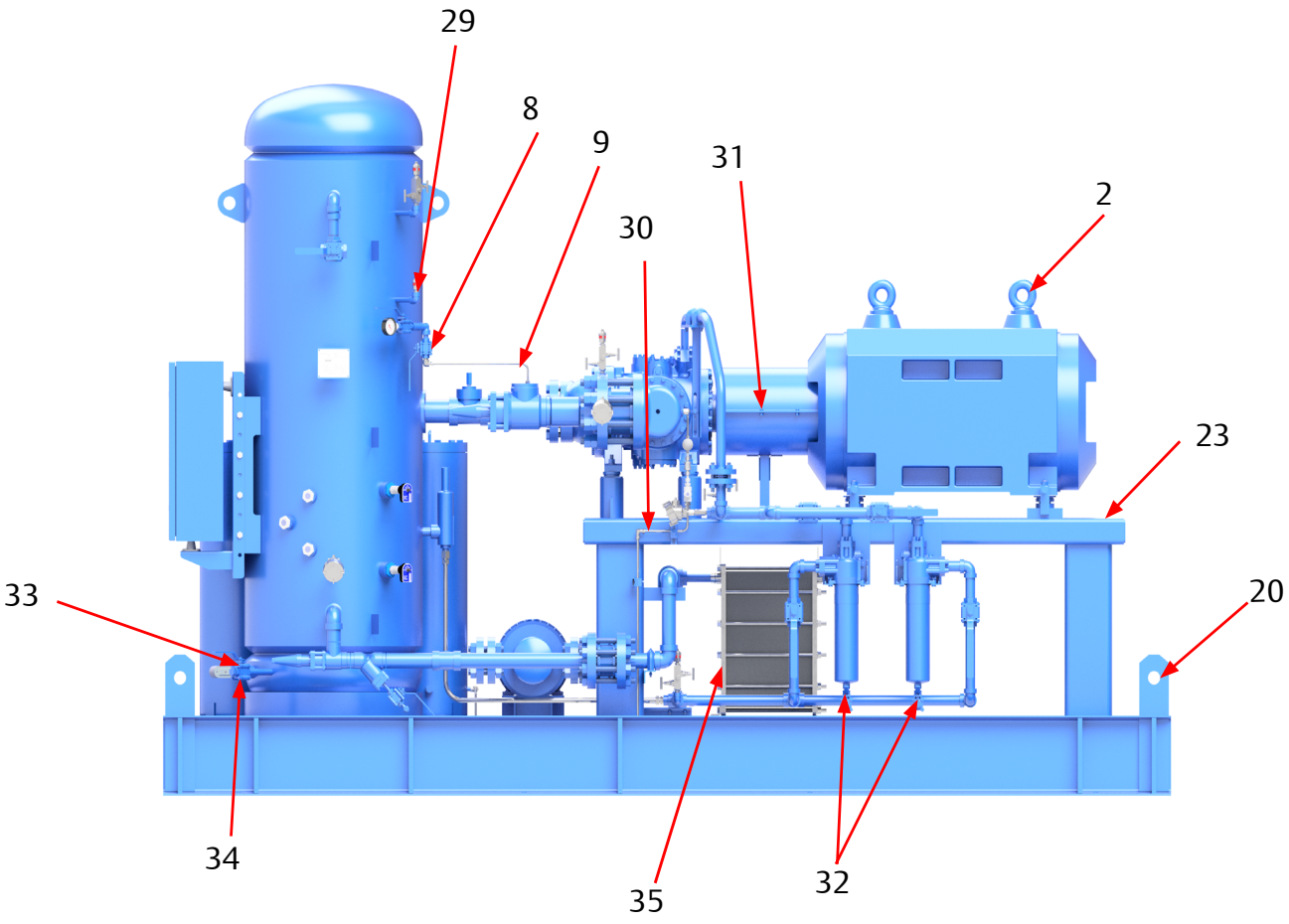


Figure 1-1. CO_2 Compressor Unit Components for Models VSTC 128 to 243 (2 of 4)

3 - Motor Conduit Box
36 - Temprites (Discharge)
37 - Block and Bleed
38 - Pressure Transducer (Discharge Pressure)
39 - Temperature Element (Discharge)
40 - Pressure Transducer (Suction Pressure)
41 - Block & Bleed
42 - Temperature Element (Suction)
43 - Temperature Element (Oil Separator)
44 - Temperature Element (Oil Injection)
45 - Pressure Transducer (Filter outlet)
46 - Pressure Transducer (Filter Inlet)

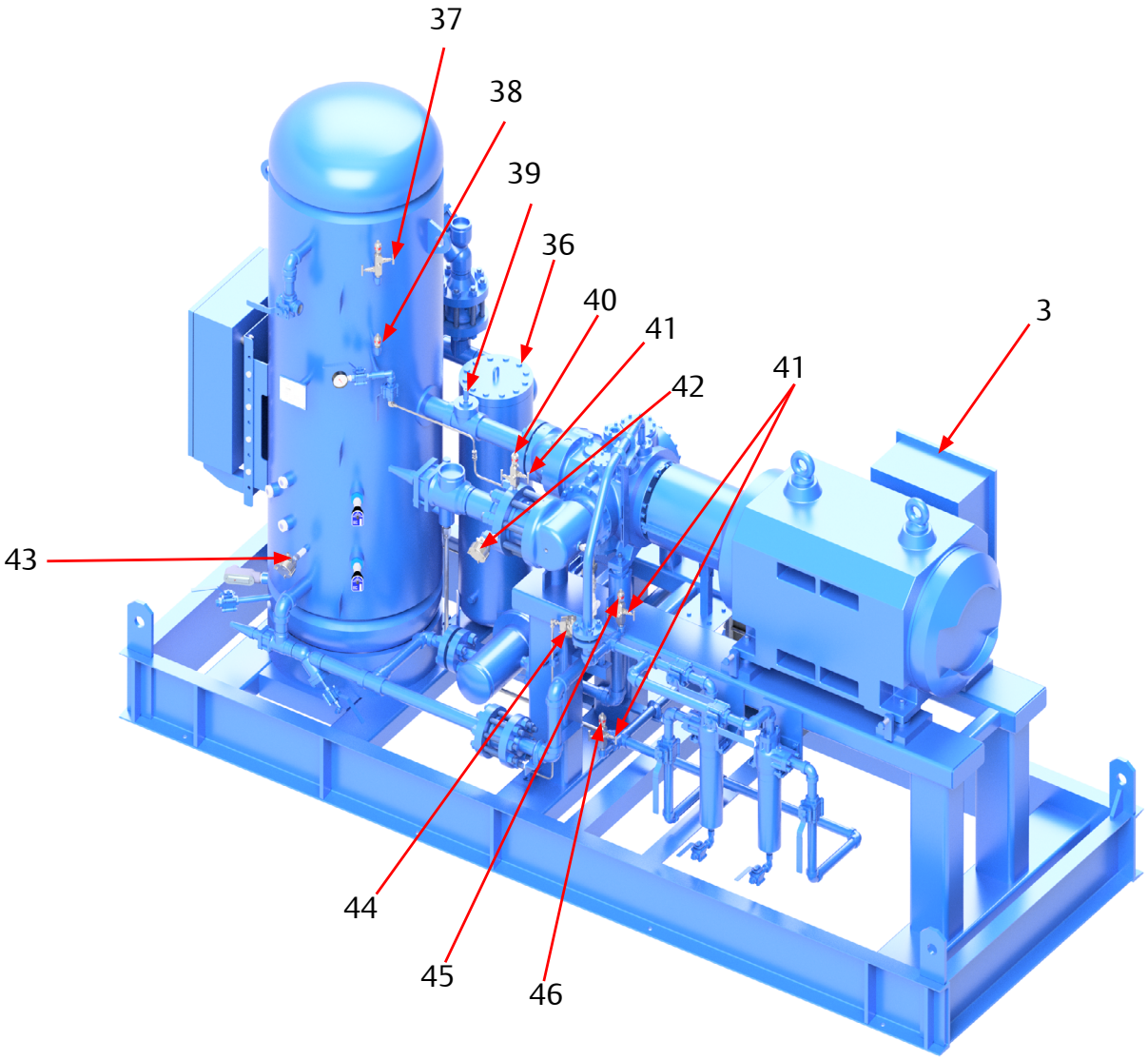


Figure 1-1. CO_2 Compressor Unit Components for Models VSTC 128 to 243 (4 of 4)

Grounding Wire Location

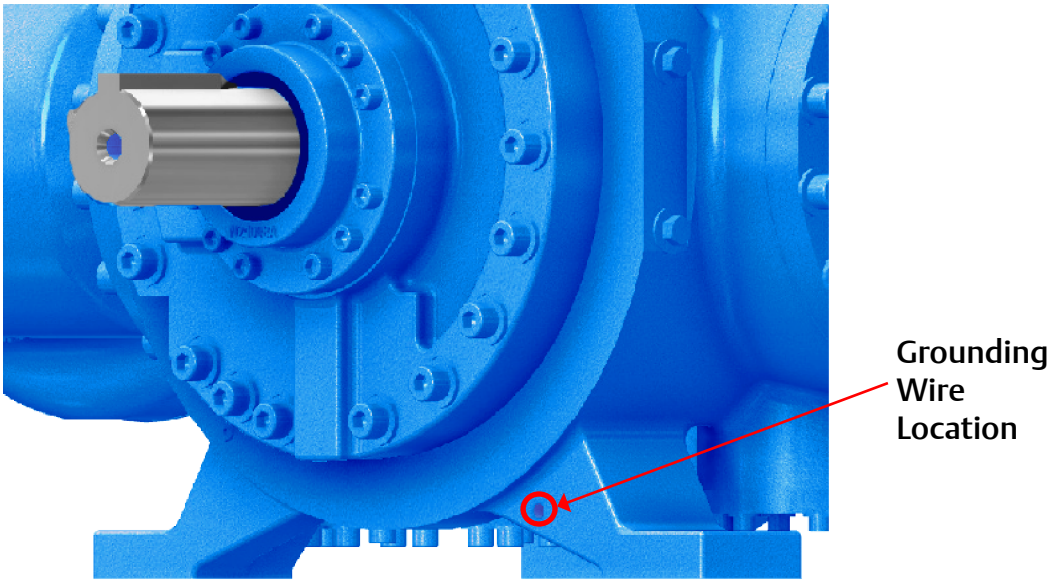


Figure 1-2. The Grounding-wire Hole Location on Housing for Various Single Screw Compressor Models VSTC 128 - 243

Instrument Identification Letters

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

A	Analysis
AAH	Concentration High
AAHH	Concentration/Detection High High
AI	Analysis/Moisture Indicator
AIT	Analysis/Detection Indicating Transmitter
AT	Analysis/Detection (Blind)
AU	Analysis/Detection Monitor
BFV	Butterfly Valve
CV	Check Valve
E	Voltage
EAH	Voltage High
EAHH	Voltage High High (Shutdown)
EI	Voltage Indication
F	Flow
FAH	Flow High
FAHH	Flow High High (Shutdown)
FAL	Flow Low
FALL	Flow Low Low
FC	Flow Controller/Fail Close
FG	Flow Gauge
FI	Flow Indication (Soft)/ Flow Sight Indicator (Glass)
FIC	Flow Indicating Controller
FIT	Flow Indicating Transmitter
FOP	Orifice Plate
FT	Flow Transmitter (Blind)
FV	Flow Control Valve
FY	Flow/Relay/Convertor
G	Gas
GIT	Gas Detecting Indicating Transmitter
GAH	Gas Detected Concentration Level High
GAHH	Gas Detected Concentration Level High High (Shutdown)
H	Hand
HH	Hand Hole
HO	Held Open (Solenoid Valve Only)
HV	Hand Valve
I	Current
IAH	Amperage High
IAHH	Amperage High High (Shutdown)
II	Current Indication
IT	Current Transmitter (Blind)
J	Power
JB	Junction Box (Wire Termination)
JI	Power Indication
JIT	Power Indicating Transmitter
JT	Power Transmitter (Blind)
K	Time Schedule
KC	Time Controller (Blind)
KI	Time Indication
KIC	Time Indication Controller
KR	Time Recorder
KY	Time/Relay/Convertor
L	Level
LAH	Liquid Level High
LAHH	Liquid Level High High (Shutdown)
LAL	Liquid Level Low
LALL	Liquid Level Low Low (Shutdown)
LC	Level Controller
LE	Level Probe (Element)
LG	Level Gauge
LI	Indication (Soft)/Level Sight Indicator (Glass)
LIT	Level Indicating Transmitter
LO	Lock Open
LSH	Level Switch High
LSHH	Level Switch High High (Shutdown)
LSL	Level Switch Low
LSLL	Level Switch Low Low (Shutdown)
LT	Level Transmitter (Blind)
LV	Level Control Valve
LY	Level/Relay/Convertor
MCC	Motor Control Center
MGV	Manifold Gauge Valve
NC	Normally Closed
NO	Normally Open
NV	Needle Valve
P	Pressure
PAH	Pressure High
PAHH	Pressure High High (Shutdown)
PAL	Pressure Low
PALL	Pressure Low Low
PC	Pressure Control
PDAH	Pressure Differential High
PDAHH	Pressure Differential High High (Shutdown)
PDAL	Pressure Differential Low
PDALL	Pressure Differential Low Low (Shutdown)
PDC	Pressure Differential Control
PDI	Differential Pressure Indication
PDIC	Pressure Differential Indicating Controller

PDIT	Pressure Differential Indicating Transmitter
PDSH	Pressure Differential Switch High
PDSHH	Pressure Differential Switch High High (Shutdown)
PDSL	Pressure Differential Switch Low
PDSLL	Pressure Differential Switch Low Low (Shutdown)
PDT	Differential Pressure Transmitter (Blind)
PDV	Pressure Differential Control Valve (Pneumatic Actuator)
PFY	Pressure Ratio Convertor/ Relay
PFC	Pressure Ratio Controller
PG	Pressure Gauge
PI	Pressure Indication (Soft)
PIC	Pressure Indicating Controller
PIT	Pressure Indicating Transmitter
PSE	Pressure Rupture Disk
PSH	Pressure Switch High
PSHH	Pressure Switch High High (Shutdown)
PSL	Pressure Switch Low
PSLL	Pressure Switch Low Low (Shutdown)
PSV	Pressure Safety Relief Valve
PT	Pressure Transmitter (Blind)
PV	Pressure Control Valve
Q	Quantity and Heat
QE	Heater Element, Immersion, Tracing
R	Radiation
S	Speed, Frequency
SC	Speed Control
SD	Shutdown
SIC	Speed Indicating Controller
T	Temperature
TC	Temperature Controller
TAH	Temperature High
TAHH	Temperature High High (Shutdown)
TAL	Temperature Low
TALL	Temperature Low Low (Shutdown)
TE	Temperature Element (RTD, Thermocouple, etc.)
TG	Temperature Gauge
TI	Temperature Indication (Soft)
TIC	Temperature Indicating Controller
TIT	Temperature Indicating Transmitter
TRV	Transfer Valve 3-Way
TSH	Temperature Switch High
TSHH	Temperature Switch High High (Shutdown)
TTSL	Temperature Switch Low
TSLL	Temperature Switch Low Low (Shutdown)
TT	Temperature Transmitter (Blind)
TV	Temperature Control Valve
TW	Temperature Thermowell
TY	Temperature/Relay/ Convertor
U	Multi Variable
V	Vibration, Mechanical Analysis
VE	Vibration Probe
VFD	Variable Frequency Drive
VG	Block/Bleed, Gauge Valve
VSH	Vibration Switch High
VSHH	Vibration Switch High High (Shutdown)
VT	Vibration Transmitter (Blind)
VU	Vibration Monitoring System
W	Weight
XA	Status (Stopping/Not Running) Alarm/Common Alarm
XC	State Controller
XI	Running Indication
XV	Solenoid Valve
XY	State Relay/Convertor
Y	Event, State, Presence
YAH	Fire Alarm
YE	Fire Detecting Sensor
YIT	Fire Indicate and Transmit
YK	Fire Control Station
Z	Position, Dimension
ZC	Position Controller
ZE	Position Element
ZI	Position Indicator
ZIT	Position Indicating Transmitter
ZT	Position Transmitter (Blind)
ZY	Position Transmitter (Blind)
ZZ	Position Actuator (Capacity or Volume)

Symbol Identification

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


3-Way Valve


3-Way Solenoid Valve


Angle Valve


Ball Valve


Basket Strainer


Block/Bleed Gauge Valve


Butterfly Valve


Check Valve


Diaphragm Actuator

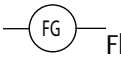

Diaphragm
Spring-Opposed


Diaphragm
Pressure-Balanced


Differential Pressure
Regulating Valve


Drive Coupling


Flange Set



Flow/Sight Glass


Gate Valve


Globe Valve


Hand Expansion Valve

Heater


Heat Trace


Insulation

Man-Way Cover


Manifold Gauge Valve

Motorized Ball Valve


Needle Valve


Orifice Plate

Pilot Light


Pipe Plug


Pipe Reducer


Pneumatic Actuator
Control Valve


Relief Valve


Regulating Valve Inlet
Pressure


Regulating Valve Outlet
Pressure


Rotary Valve


Rupture Disc


Schroder Valve


Solenoid Valve


Spring-Closing Drain
Valve


Stop/Check Valve


Strainer

Thermostatic Valve 3-Way

Thermowell (SW or NPT)

Thermowell (SW or NPT)

Venturi Injector Nozzle

Vibration Absorber

Scope of Supply

Major Component Identification

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

Compressor

Damper or
Louver

Engine Drive

Filter

Finned Tube
Heat Exchanger

Heat Exchanger

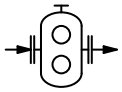
Motor

Shell and Tube
Heat Exchanger

Fan

Tank/Drum Vessel

Major Component Identification (Continued)


Positive Displacement Pump


Rotary Pump


Centrifugal Pump

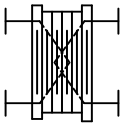


Plate & Frame Heat Exchanger

Control and Instrument Identification


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

Safety Instrumented System, Field Mounted


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

Safety Instrumented System Main Control Panel or DCS


Programmable Logic Control, Auxiliary (Local) Control Panel, Normally Accessible to Operator

Safety Instrumented System Auxiliary (Local) Control Panel


Computer Function, Field Mounted

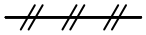

Computer Function, DCS or Remote Control Panel, Normally Accessible to Operator

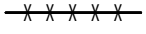

Computer Function, Local Operator Panel, Normally Accessible to Operator

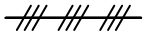
Interlock

Permissive

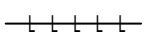
Line Type Designations


Pneumatic Signal

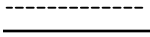

Capillary Tube

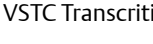

Electrical Signal

Internal System Link (Software or Data Link)


Mechanical Link

Hydraulic Signal


Customer Field Piping


Insulation

Valve and Instrument Tagging

a-bc-yz = ABC-DEFGH-IJKL

a = ABC, b = DE, c = FGH, y = IJK, z = L

A - Process cell or stage of compressor

B - Unit number in process cell or stage of compression

C - Service in process cell or stage of compression

- 1 - Gas lines
- 2 - Coolant lines
- 3 - Oil lube lines
- 4 - Refrigerant lines
- 5 - Condensate lines
- 6 - Air lines

D - Measured variable

E - Variable Modifiers

F - Readout or passive function

G - Output or active function

H - Function modifier

I - Loop number or sequential number

J - Loop number or sequential number

K - Loop number or sequential number

L - Suffix

Sample Tag

105-LSH-300-A

1 - First process cell or stage of compression

0 - First unit number in process cell or stage of compression

5 - Condensate service

L - Level

S - Switch

H - High

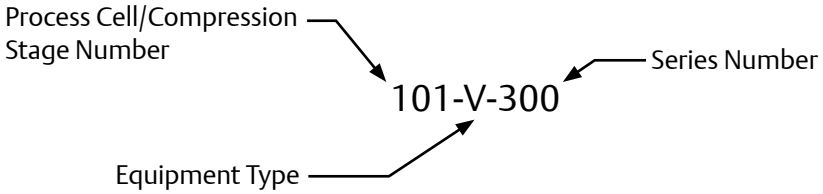
3 - Loop number or sequential number

0 - Loop number or sequential number

0 - Loop number or sequential number

A - Another exactly the same device in the same loop as 105-LSH-300

Equipment Number Identification



Equipment Type

A - Agitator, Mechanical Mixers, Aerators

B - Blowers

C - Compressors

D - Drivers

E - Heat Exchangers

F - Fans

P - Pumps

R - Reactors

U - Filters, Strainers

V - Vessels, Tanks, Separators, Scrubbers

Pipe Line Data Identification

AB - C - D - E - F / X - Y - Z 20-LFG-001-10-STD / PS-1-ET

A - Process cell or stage of compression
- 1 - Process cell first stage of compression
- 2 - Process cell first stage of compression
- 3 - Process cell first stage of compression
- 4 - Process cell first stage of compression
- 5 - Process cell low pressure refrigeration (booster)
- 6 - Process cell high pressure refrigeration (high stage)
- 7 - Open
- 8 - Open
- 9 - Open

B - Unit number in process cell or stage of compression

C - Service
- AR - Process Air
- BD - Blowdown
- BRR - Brine
- CHWS - Chilled Water Supply
- CHWR - Chilled Water Return
- CWR - Cooling Water Return
- CWS - Cooling Water Supply
- DR - Drain
- ER - Ethylene Refrigerant
- GLR - Glycol Return
- GLS - Glycol Supply
- H - Hydrogen
- HR - Hydrocarbon Refrigerant
- IAS - Instrument Air Supply
- LFG - Land Fill Gas
- LO - Lube Oil
- N - Nitrogen
- NG - Natural Gas
- NH - Ammonia
- PC - Process Condensate
- PG - Process Gas
- PR - Propylene Refrigerant/Propane
- SV - Safety Relief
- SO - Seal Oil
- VC - Vacuum Condensate

D - Numerical Sequence Number

E - Size
- #" - Nominal Pipe Size (Inches)

F - Standard/Other Standard
- STD -Vilter™
- 0 - Other Standard (Not Vilter™)

X - Insulation
- AC -Acoustic Control
- CC - Cold Service
- CP - Condensation Control
- N - Not Required
- PP - Personnel Protection
- PS - Process Stability
- TR - Traced (See Tracing Type)

Y - Insulation Thickness
- BO - By Others
- #" - Nominal Thickness (Inches)
- 0 - Insulation Not Required

Z - Heat Tracing
- ET - Electrical Heat Trace
- N - None

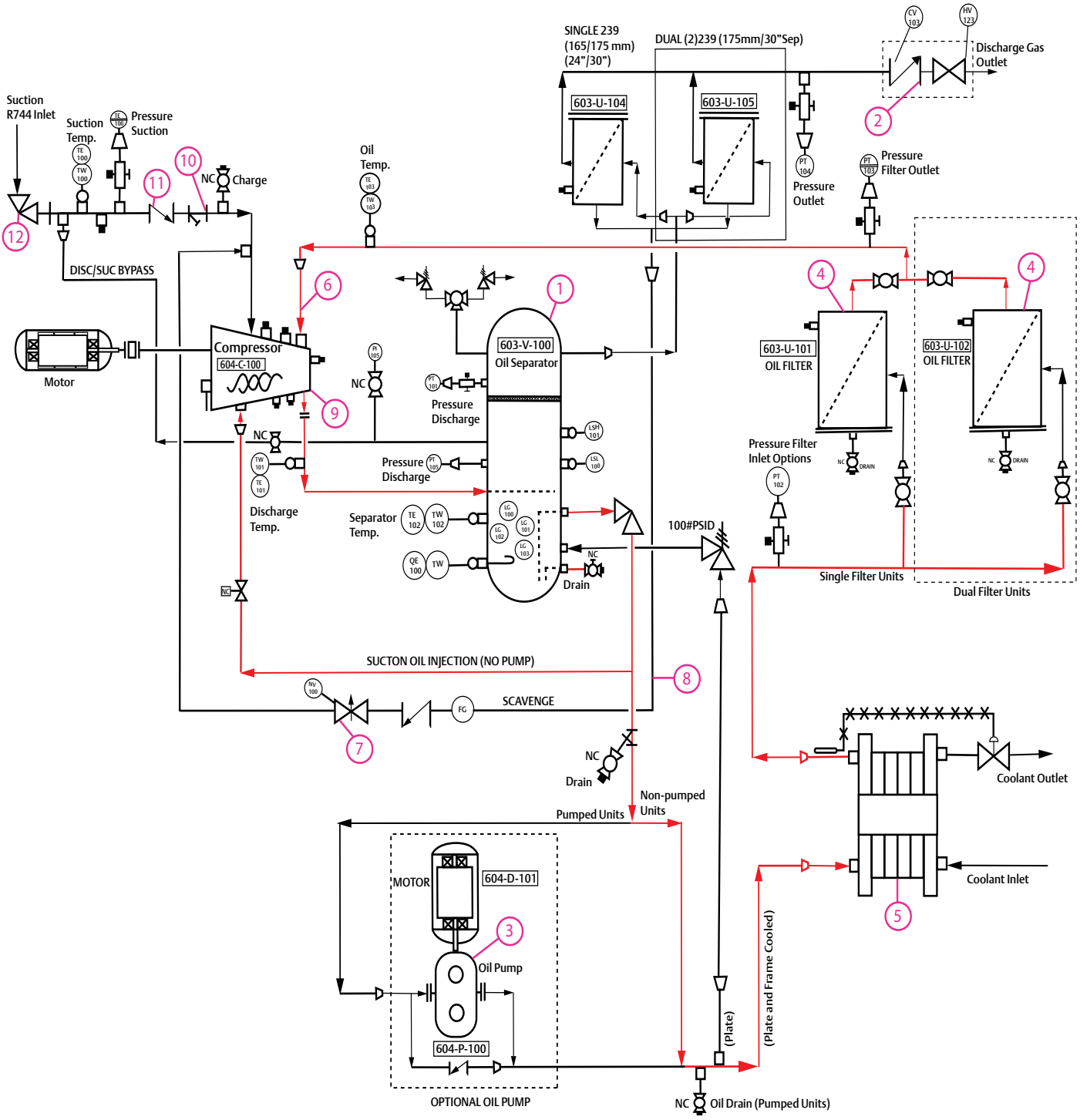


Figure 2-1. CO_2 Transcritical Refrigeration

The refrigeration and oil systems work in unison, but each one will be explained separately. Reference Figure 2-1 for refrigerant and oil flow descriptions.

This is a typical CO_2 Transcritical refrigeration system with liquid injection and heat exchanger oil cooling options.

Refrigerant Flow

The refrigerant compression process begins as refrigerant vapor enters the suction inlet (12). The refrigerant vapor flows through suction stop and check valves (11), then through a strainer (10) to the compressor (9). The refrigerant is then pressurized through the compressor and discharged as high pressure refrigerant vapor into the oil separator (1). In the oil separator, the oil is then separated from the discharged refrigerant by impingement separation. The high pressure refrigerant flows out to the condenser for cooling while the oil is pumped or flowing back to the compressor.

Moreover, suction stop and check valves (11) and discharge check valve (2) are provided between the oil separator to prevent refrigerant vapor or liquid from flowing back to the compressor during shutdown periods.

Oil Flow

NOTE

An oil pump is not the standard offering for VSTC compressor units. See SOI Valve operation for units without an oil pump.

Oil in the refrigeration system serves three primary purposes. It provides lubrication to the compressor, 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 (3). Once the system reaches design conditions, the oil pump is shut off and oil flow is maintained by differential pressure.

As the oil is separated from the refrigerant in the oil separator (1), it is pumped or siphoned through an oil cooler (5), then through an oil filter (4) and back to the injection port (6) of the compressor (9). For additional information on oil cooling options, refer to Oil Cooling section below.

Furthermore, to collect oil from the coalescing side of the oil separator (1), an oil return line (8) is installed between the oil separator and the compressor (9). By opening the needle valve (7), this will allow oil dripping off the coalescing filters to be fed back to the compressor.

This is a continuous cycle.

Oil Cooling

There are different methods of oil cooling for Vilter™ refrigeration compressor units. Oil cooling will depend on the type of application. Below is an explanation of each method.

Glycol/Water Cooled Oil Cooling

- In lieu of the three-way oil temperature valve to control the temperature of the oil used for lubrication and cooling of the compressor, it is required to install a liquid regulating valve and solenoid valve combination to control the glycol/water supply to the oil cooler. The glycol/water inlet connection should be made on the bottom and the outlet connection on the top. The glycol/water supply is controlled by the liquid regulating valve to maintain the oil temperature at approximately 120°F. The solenoid valve provides positive glycol/water shutoff when the compressor is not in operation. A temperature of 150°F is considered high in most circumstances and the compressor is protected by a safety control to prevent operation of the compressor above this temperature.

Suction Oil Injection (SOI) for Single Screw Compressors

Suction Oil Injection (SOI) is Vilter's patented technology. It is used to provide immediate lubrication to the single screw compressor during the start-up.

The SOI can comprise a suction oil line and control valves, see Figure 2-2. When the power source is actuated, CO_2 gas is introduced into a suction cavity within the compressor and drawn into a compression chamber within the compressor and compressed. The compressed gas is discharged into the oil separator thereby elevating the separator vessel pressure. The elevated vessel pressure causes the oil within the separator to be transported through the suction oil line. Transportation of the oil through the suction oil line permits immediate lubrication of the compressor to occur following start-up of the compressor, immediate being a few seconds.

When the oil separator pressure reaches a pre-determined pressure, the valve in the suction oil line is closed. The closed valve results in the oil being prohibited from flowing through the suction oil line and permitted to flow through the conventional oil line. As such, the compressor remains continuously lubricated. Further, immediate lubrication can be accomplished without the need for a back-pressure valve or pump.

Control System

The compressor unit is controlled by the micro-processor, i.e. MicroVission 20/20 panel or PLC panel. This panel's main function is to control the refrigeration system from the data that it receives from the sensors around the unit. For additional information, refer to micro-processor manual (35391SC for Vission 20/20 Operating Manual).

WARNING

Software programming credentials shall only be made available by the supplier. The user will only have access to operational features established by the supplier. Failure to comply may result in serious injury or death.

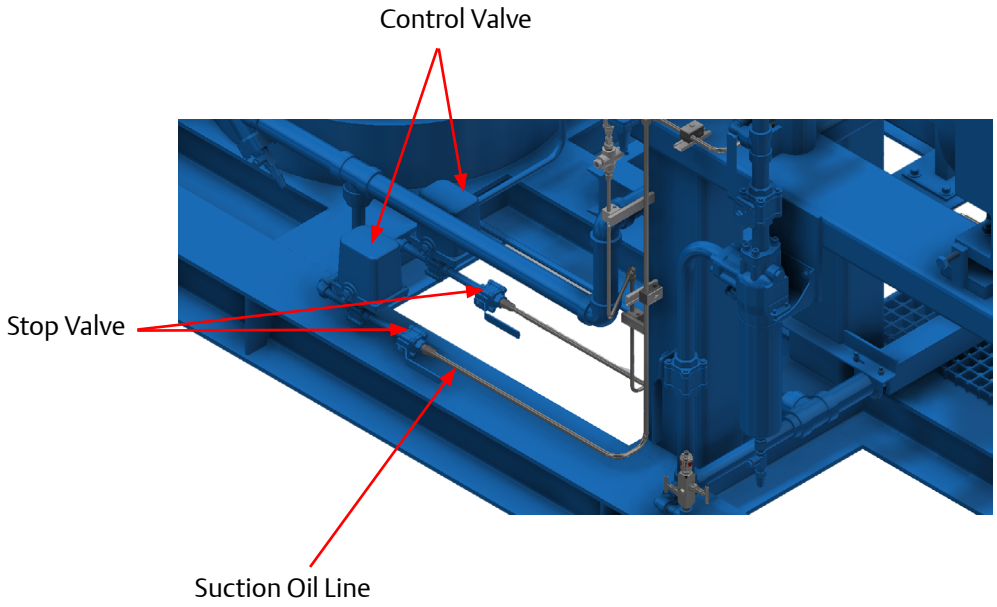


Figure 2-2. Suction Oil Injection

Procedure For System Pressurization

If the differential between the suction pressure before the suction shutoff valve, and the discharge pressure is above 60 PSID, all HPLD single screw compressor units must be brought up to pressure via the oil separator/discharge side of the unit.

A tubing line connected before the suction shutoff valve and the top of the separator is provided with the units to pressurize the unit bypassing the compressor (see Figure 2-3).

If a pressurizing line is not present on the unit, a tubing line (3/8" to 1/2") can be added before the suction shut off valve and the top of the separator (see #2 on Figure 2-3) with a shut off valve for the operator/technician to use to bring up system pressure (see #1 on Figure 2-3).

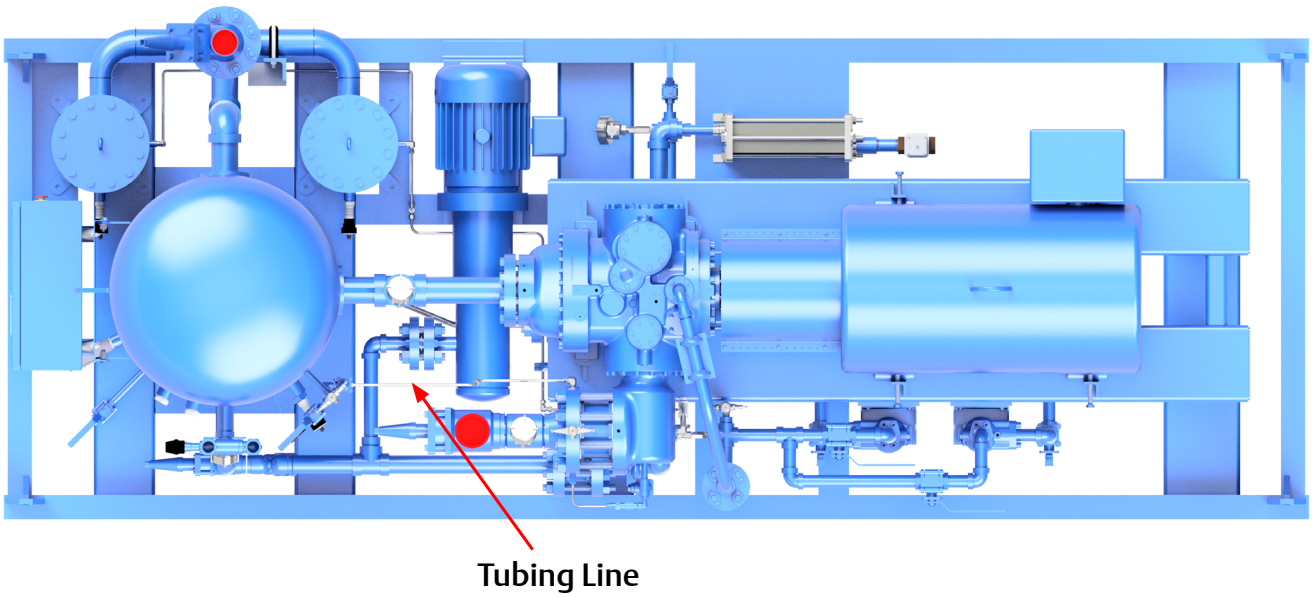


Figure 2-3. Tubing Line To Pressurize The Unit (Bypassing The Compressor)

Temperature Elements, Pressure Transmitters and Indicators

Temperature elements (TE), pressure transmitters (PT) and pressure indicators (PI) are instruments used to measure temperatures and pressures at specific locations on the compressor unit.

Temperature elements are typically mounted on the compressor, suction pipe, discharge pipe, oil separator, oil filter inlet and outlet pipe.

Pressure transmitters are typically mounted on the block and bleed assembly, see Figure 2-4. The pressure transmitters measure suction pressure, inlet and outlet oil pressure, and discharge pressure in the oil separator.

Typically, pressure indicators are not mounted from the factory, except for a pressure indicator to show the nitrogen holding charge for shipping and storage purposes. If required, end users have the ability to mount pressure indicators at the block and bleed assembly.

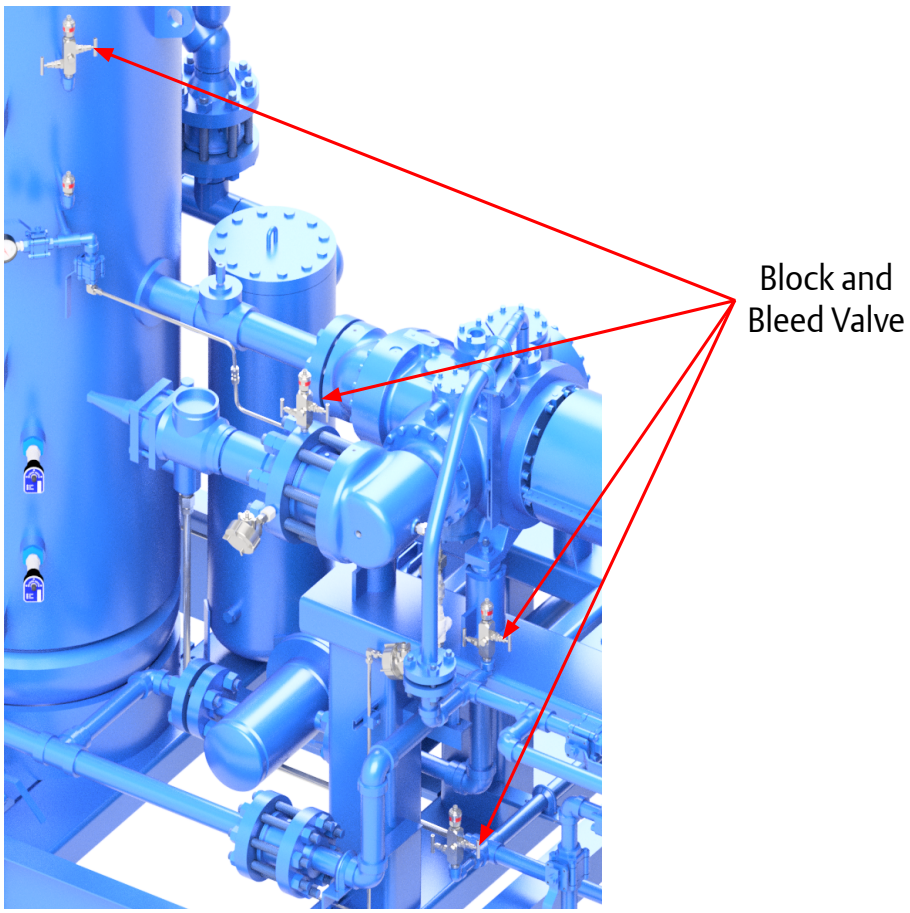


Figure 2-4. Block and Bleed Arrangement

NOTICE

Vilter compressors are to be installed and connected to the customer-provided piping. Vilter expects this piping to be designed and built following ASME B31.3 or ASME B31.5 Process Piping Guide, plus any other local applicable codes, and that the installation will be performed by qualified personnel only.

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 Compressor Unit Inspections Prior To Installation and Storage for additional recommendations.

Use lifting chains/straps and spreader bar. Evenly distribute weight. Keep lifting chains and spreader bar clear of components to prevent damage.

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 On Compressor Unit Frame

Compressor Unit Inspections Prior To Installation and Storage

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.
- Look into the suction and discharge connections and inspect for any signs of corrosion on parts.
- Prelube the compressor with the main oil pump and rotate by hand several revolutions prior to start.
- Notify Vilter™ Service and Warranty Department when the compressor is started.

NOTE

For Pre Start-Up and Start-Up checklists, please contact Vilter Service and Warranty Department.

CAUTION

Before installation, follow the proper procedures to depressurize the compressor.

Recommended On-site Tools

The tools recommended to have on site are important for troubleshooting, inspection 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) (VPN A40849A)
- 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 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 Page 3-4.

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

NOTE

The compressor must be inspected prior to long term storage since components could have come loose and/or damaged during shipment or moving. Refer to Compressor Unit Inspections Prior To Installation and Storage section for inspection details.

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 shall be closed to isolate the compressor from the remainder of the system. All other valves, except those venting to atmosphere, shall be open. The unit is shipped with dry nitrogen holding charge of 5 psig (5 psi above atmospheric pressure). It is essential to maintain the nitrogen holding charge.
- The holding charge of the nitrogen or clean dry gas in the system and compressor shall be monitored on a regular basis for leakage. If not already installed, it is required that a gauge shall 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 (Main rotor shaft, coupling, flange faces, etc.) with rust inhibitor.
- The volume and capacity slide valve motor enclosures should have corrosion inhibitors installed in them and the enclosures should be sealed. On a six month basis (depending on relative humidity), check and replace inhibitors as necessary, and check for signs of corrosion.

- Desiccant shall be placed in the control panel. If the panel is equipped with a space heater, it shall 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.
- Manually rotate the compressor shaft 6 ½ revolutions every month to prevent flat spots on the bearing surfaces. 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 cool compression, there is no pre-lube pump, so the driveshaft must be turned by hand.
- Document all the dates in the Long Term Storage Log sheet to show that all the procedures have been completed.
- Notify Vilter Service and Warranty Department when the compressor is started.

NOTE

The Long Term Storage Log (on Page 3-4) is an interactive form. You can fill it electronically and print the page as your record.

Compressor Motor

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

- Where possible, motors should be stored indoors in a clean, dry area. The preferred condition shall be uniform temperature between 40°F (4.5°C) and 140°F (60°C) throughout the room maintained at least 10°F (5.5°C) above the dew point. Relative humidity should be at 50% or less.
- 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.

- If the motors are stored outside, they should be covered completely to exclude dirt, dust, moisture, and other foreign materials and animals. However, do not wrap the motor tightly. This will allow the captive air space to breathe, minimizing formation of condensation. The motor should also be protected from flooding or harmful chemical vapors.
- If the motor is movable, it is suggested that the entire motor be encased in a strong, transparent plastic bag. Before sealing this bag, attach a moisture indicator to the side of the motor and place several bags of silica-gel desiccant around the motor inside the bag. Replace the desiccants when the moisture indicator shows that the desiccant has lost its effectiveness.

NOTE

Make sure that none of the desiccants is in contact with the heater elements.

- Whenever the motor cannot be sealed, space heaters must be installed to keep the motor at least 10°F above the ambient temperature.
- Whether indoors or outdoors, the area of storage should be free from excessive ambient vibration which can cause bearing damage.
- Inspect the rust preventative coating on all external machined surfaces, including shaft extensions. Recoat the surfaces with a rust preventative material if needed.
- 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.
- For info regarding bearing lubricating and insulation testing, please refer to motor manufacturer's instructions.

NOTE

To claim a warranty, a full record of the above requirements will need to be submitted to Vilter. This will include Log Records and Supporting Pictures.

Long Term Storage Log

Company: _____

Sales Order Number: _____

Serial Number: _____

Name (Please Print): _____ Initial: _____

Date (MM/DD/YYYY): _____

☐ PSIG Nitrogen Pressure - Current

☐ PSIG Nitrogen Pressure - Recharged (If pressure is low, identify and fix leak prior to recharging, see Compressor Unit Leak Check procedure in Section 5 of the compressor manual)

Nitrogen Leak Location (Briefly explain nature of leak):

☐ Compressor Shaft (Rotate shafts at least 6 revolutions)

☐ Motor Shaft (Rotate shafts at least 6 revolutions)

☐ Motor Bearings Greased

☐ Air Cooled Oil Cooler Fan Rotated (If equipped)

☐ Bare Metal Surfaces (Check all bare metal surfaces for rust and ensure they are covered with rust inhibitor)

☐ Desiccants (Are desiccants still effective? If not, replace. Check control panel, motor, pneumatic controllers and valves)

☐ Cover Bags/Tarp (Ensure bags and tarps are not torn and are sealed over components correctly, replace if damaged)

☐ Valves (Stop valves are in closed position so the compressor unit is isolated. All other valves, except those venting and draining to atmosphere are to be open)

☐ Space Heater & Panel Components (Ensure space heater is energized and panel components are rust-free)

If the compressor/unit is stored in a building: then is it heated and insulated to prevent condensation of moisture and freezing of Equipment?

☐ YES ☐ NO

If the compressor/unit is stored outside, please check Cover Bags/Tarp (Ensure bags and tarps are not torn and are sealed over components correctly, replace if damaged)

☐ YES ☐ NO

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

Clear Form

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.

- Arrange 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
- Follow the local building codes to establish proper ventilation
- Make all valves and devices safely accessible
- Use special bright primary color schemes to differentiate service lines
- Provide 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 3-2 - 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-shrink 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 has the necessary dimensions required to determine the overall foundation size and where to locate the compressor unit on the foundation. It also shows 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 casted 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.

NOTE

In Figure 3-3, 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 3-5. 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 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 3-6 and Figure 3-7. With the appropriate material handling equipment, lift the compressor unit by locations shown on the Vilter™ GA drawing and slowly place it on the 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 3-8. 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.

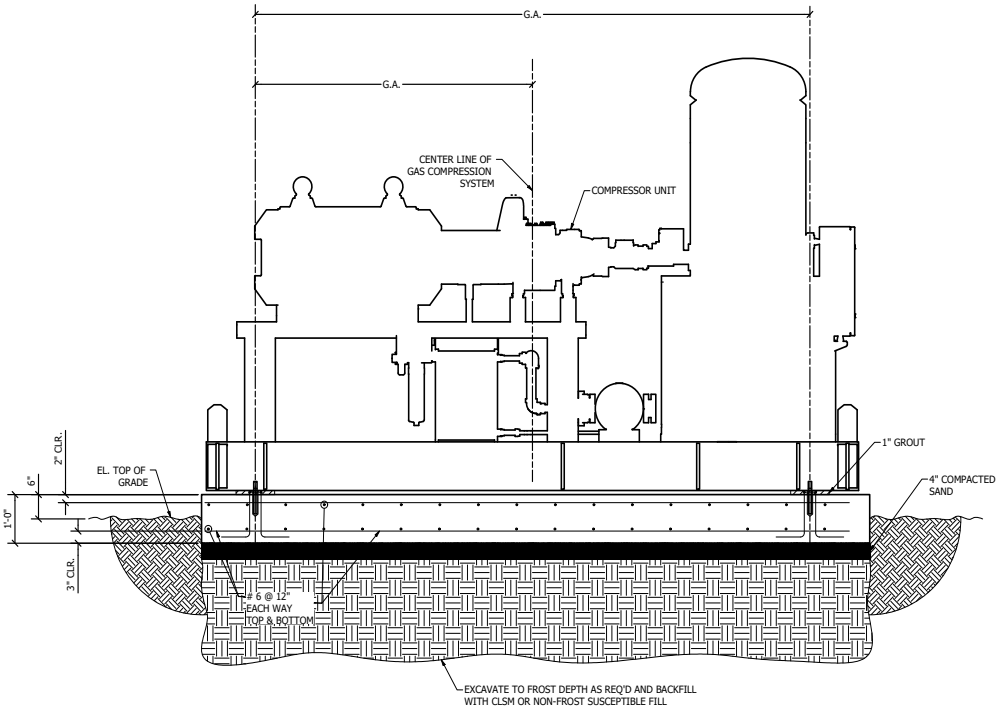


Figure 3-2. Concrete Pad with Compressor Unit Dimensions - Side View

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.

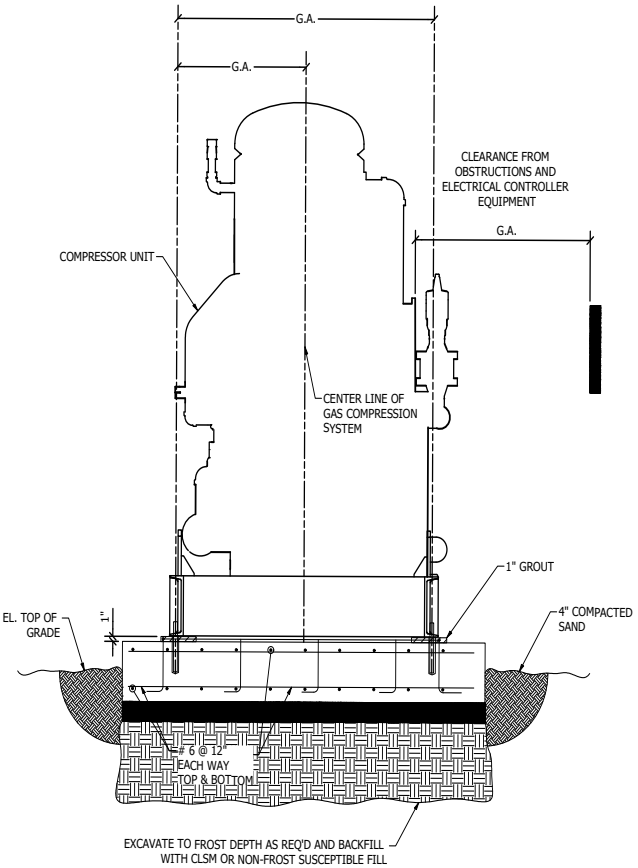


Figure 3-3. Concrete Pad with Compressor Unit Dimensions - Front View

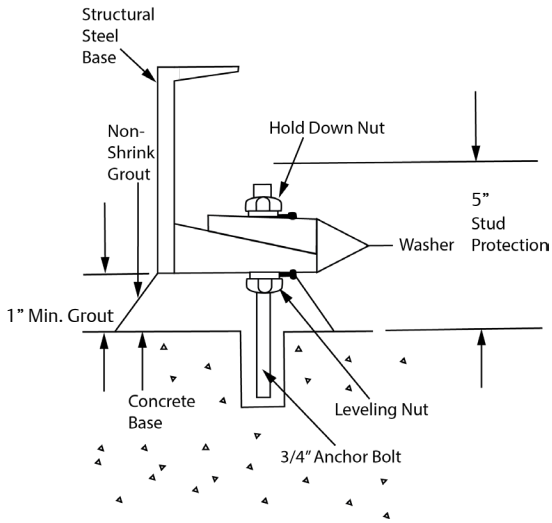


Figure 3-4. Concrete Pad with Compressor Unit Dimensions - Front View

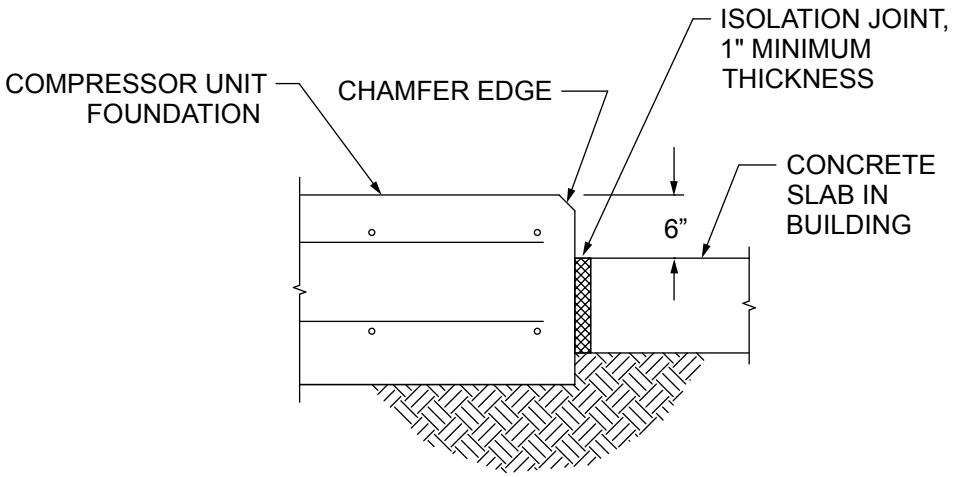


Figure 3-5. Interior Foundation Isolation

Additional Information

Codes and Standards

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

- ACI
- ASTM
- ASCE 7
- IBC

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 4200
- 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 prevent its transmission to other structures
- Provide a permanently rigid support
- Provide sufficient depth to dampen vibrations.

NOTE

Vilter does not recommend utilizing any type of vibration absorption material under the feet of the compressor unit.

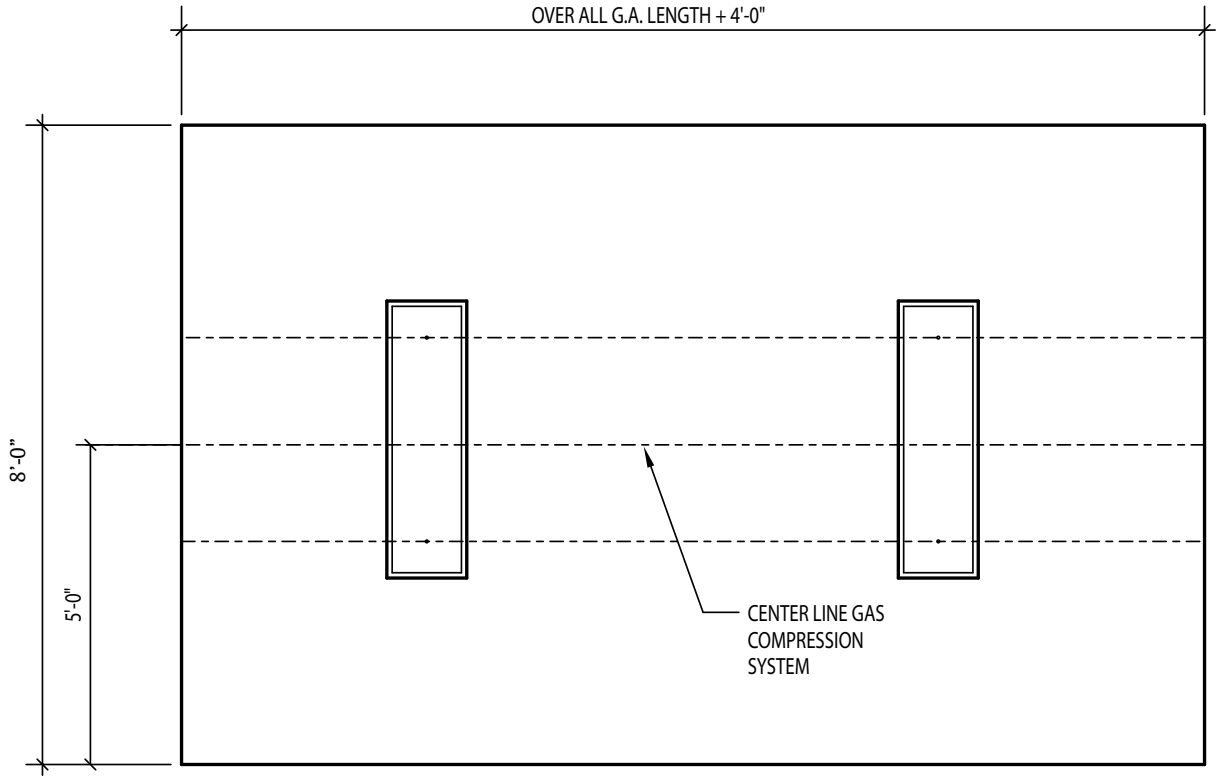


Figure 3-6. Foundation with Housekeeping Pads Dimensions - Top View

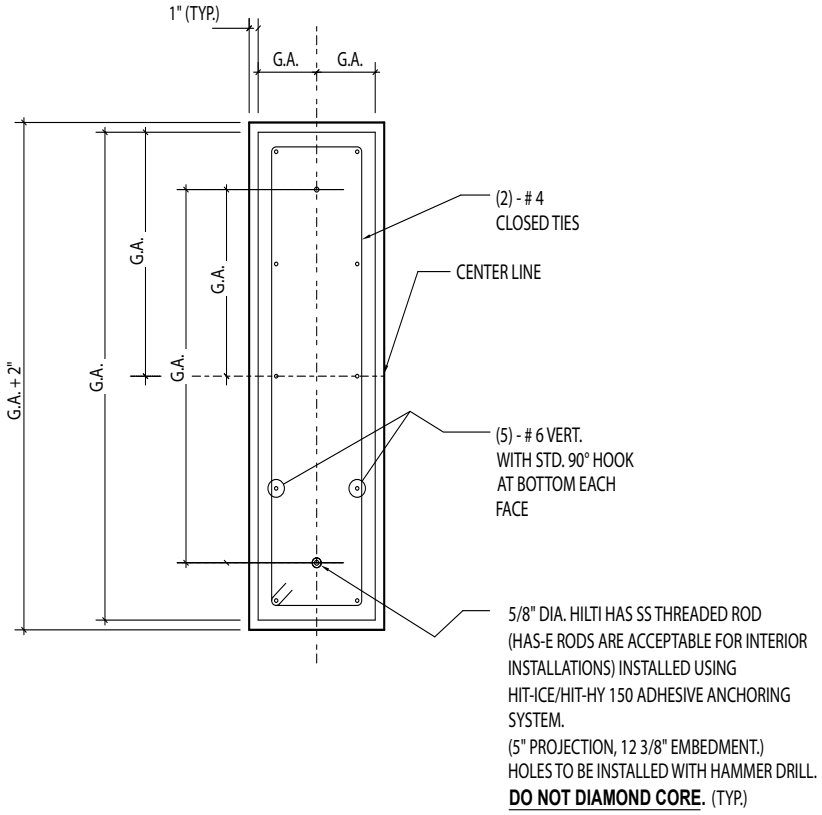


Figure 3-7. Housekeeping Pad Dimension Detail - Top View

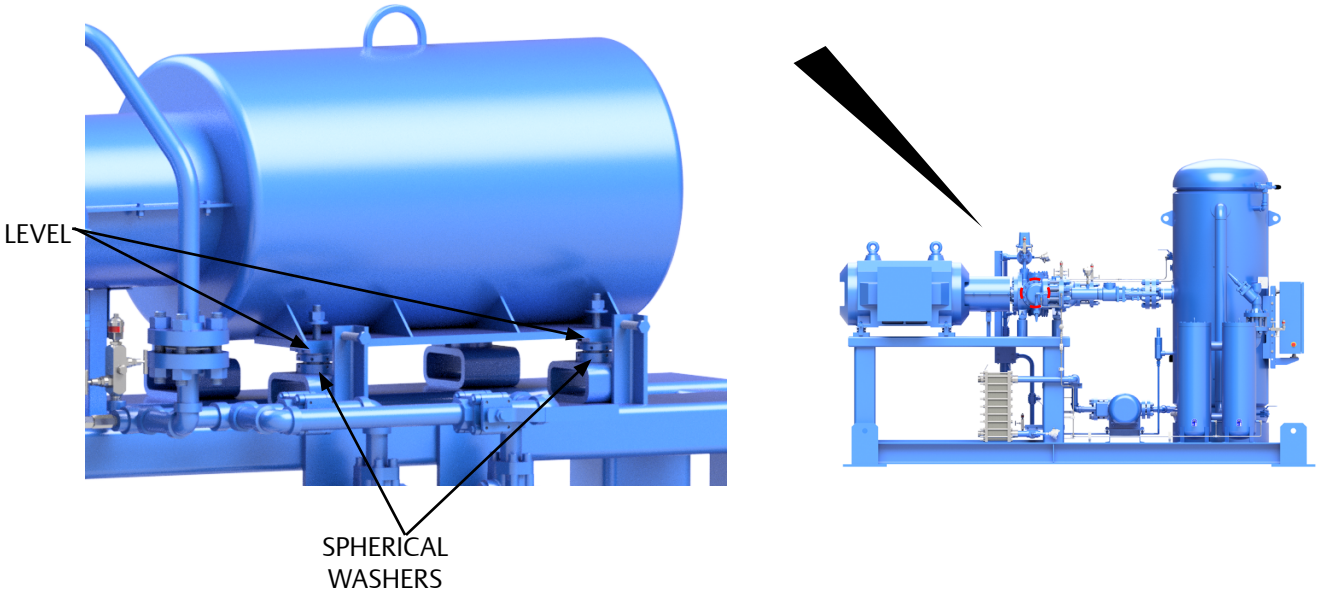


Figure 3-8. Level Compressor Unit Using Top Surface of Spherical Washers

Piping

CAUTION

The piping system should be designed to avoid CO_2 soild or liquid traps and reduce the risk of hydraulic pressure caused by thermal expansion due to the high expansion ratio of CO_2.

Refer to the ANSI/ASME B31.5 Code for Refrigeration Piping. All compressor oil supply and oil return piping has been completed at the factory. The necessary connections to be made to the screw compressor unit will vary depending on the type of oil cooling method purchased. Main line refrigerant suction and discharge connections are always necessary.

- Before installing piping, the compressor inlet and outlet ports should be inspected to ensure no dirt is present.
- Piping should be supported so that no piping loads are transmitted to the compressor casings.
- All piping should be inspected for cleanliness before installation. As each pipe is connected to the compressor, the coupling alignment should be checked to ensure that no alteration has taken place.
- If alignment has altered, the compressor is being strained and the piping supports must be adjusted.
- It is not sufficient merely to re-align the drive coupling, as this will not correct the cause of the strain.
- Care must be taken to avoid trapping the lines except for specific purposes. When traps are used, the horizontal dimensions should be as short as possible to avoid excessive oil trapping.
- Lines for ammonia systems must be of steel pipe with specially designed ammonia service fittings. Common pipe fittings must NEVER be used as they will not provide the same service. Steel pipe is generally used in large installations when joints are welded.

In making up joints for steel pipe, the following procedures should be followed:

- For threaded connections, all threads on the pipe and fitting should be carefully cleaned to remove all traces of grease or oil. Threads should then be wiped dry with a lintless cloth. Only thread filling compounds suitable for service should be used for making steel pipe joints. These compounds should be used sparingly, and on the pipe only. Do not put any on the first two threads to prevent any of the thread sealing compound from entering the piping system. Acetylene or arc welding is frequently used in making steel pipe joints, however, only a skilled welder should attempt this kind of work. Take care to see no foreign materials are left in the pipes and remove all burrs formed when cutting pipe.
- It is important to avoid short, rigid pipe lines that do not allow any degree of flexibility. This must be done to prevent vibration being transmitted through the pipe lines to the buildings. One method of providing the needed flexibility to absorb the vibration is to provide long lines that are broken by 90° Ells in three directions.
- A second method would be to install flexible pipe couplings as close to the compressor unit as possible with connections running in two different directions, 90° apart. These flexible connections should be installed on both the high and low side lines of the compressor unit.
- Hangers and supports for coils and pipe lines should receive careful attention. During prolonged operation of the coils, they may become coated with ice and frost, adding extra weight to the coils. The hangers must have ample strength and be securely anchored to withstand the vibration from the compressor and adequately support the pipe lines.
- For CO_2 piping, the pipes can have smaller diameters and they will require a greater thickness to withstand the higher pressures.
- Glycol supply and drain connections, and equipment using glycol, should be installed so all the glycol may be drained from the system after the plant has been shut down in cold weather. These precautions will avoid costly damage to the equipment due to freezing.

This information is taken from ASHRAE 15-2022 and ANSI/ASME B31.5. The installing contractor should be thoroughly familiar with these codes, as well as any local codes.

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.

Flange Loads

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 3-1, 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 or other local codes as applicable. See guidelines below, particularly with concern to minimize loads on check valves.

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.

Table 3-1. 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

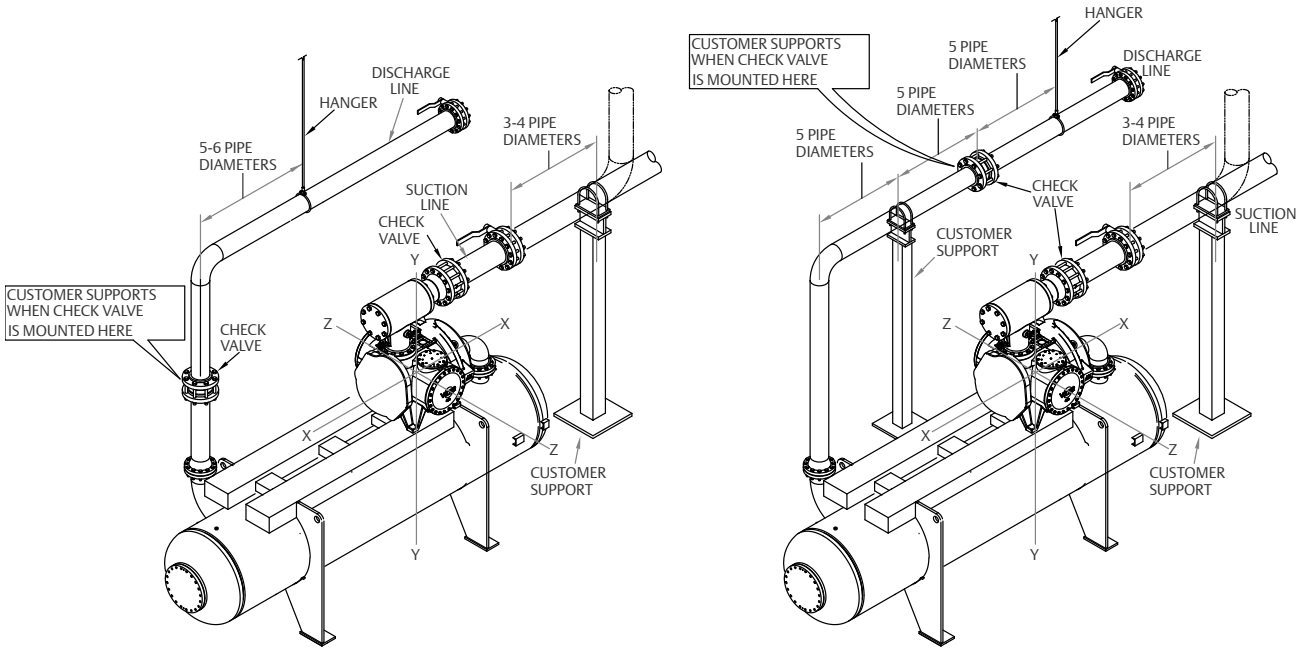


Figure 3-9. Maximum Allowable Flange Loads

Electrical Connections

Single screw compressor units are shipped with all package mounted controls wired. The standard control power is 115 volts 60 Hertz, single phase. If a 115 volt supply is not available, a control transformer may be required. The power source must be connected to the control panel according to the electrical diagrams.

The units are shipped without the compressor motor starter. Field wiring is required between the field mounted starters and package mounted motors, see Field Wiring Instructions.

Additional control wiring in the field is also required. Dry contacts are provided in the control panel for starting the screw compressor motor. These contacts are to be wired in series with the starter coils. A current transformer is supplied along with the compressor unit, and is located in the motor junction box. This transformer is to be installed around one phase of the compressor motor starter. A normally open auxiliary contact from the compressor motor starter is also required.

Terminal locations for this wiring can be found on the wiring diagram supplied with this unit. Additional aspects of the electrical operation of the single screw units are covered in the start up and operation Section of this manual.

Field Wiring Instructions

NOTE

This procedure defines steps required to wire Vission 20/20 micro-controller for the following items: Compressor Motor Starter Auxiliary Contact, High Level Shutdown, Oil Separator Heater(s), Oil Pump Start and Compressor Starter.

Follow supplied wiring diagram for detailed wiring.

Refer to Figure 3-11

1. Control power of 115 VAC 50/60 HZ must be wired to left side of terminal blocks inside the Vission 20/20 cabinet. Line power (1B) shall be connected to 15-amp circuit breaker, CB1. Neutral (1N) is connected to any N terminal blocks. Number of line power feeds required to panel is dependent upon number supplied on compressor, see Figure 3-10.
2. An auxiliary contact from compressor motor starter is required. Connect isolated contact to terminal blocks 1 and 31.
3. A dry contact from control relay CR11 must be wired to compressor motor starter coil. This dry contact is wired to terminal blocks according to supplied drawing. Control power for this coil should come from a source, which will be de-energized with compressor disconnect.
4. A dry contact from control relay CR12 must be wired to oil pump motor starter coil. This dry contact is wired to two terminal blocks according to supplied drawing. Control power for this coil should come from a source, which will be de-energized with compressor disconnect.
5. An auxiliary safety cutout is available to shut down compressor package. A dry contact must be supplied and wired to terminal blocks 1 and 32. The jumper installed on terminal blocks must be removed to use this cutout. If contact is closed, it will allow compressor to run. If contact opens at any time, compressor will shut down.
6. Indication of compressor shutdown status is also available. There is an output on terminal blocks 18 and N where a relay coil can be wired. For output, an energized state represents a “safe” condition. A de-energized state indicates a loss of voltage to relay coil or a “failure” has occurred.
7. Line power for oil separator heaters are required to be wired from the starter panel, see Figure 3-11.

NOTE

There is a dot on one side of the current transformer. This dot must face away from the motor.

8. Current transformer supplied in compressor motor conduit box should be checked to ensure that motor leads of one leg are pulled through the transformer. Typically, a wye delta started motor should have leads 1 and 6 pulled through this transformer for a 6 lead motor. However, this should always be checked as different motors and starting methods will require different leads to be used.

NOTE

For Compressor unit using PLC micro-controller, please refer to the Single Screw Compressor PLC Operation Manual (35391CM) for details.

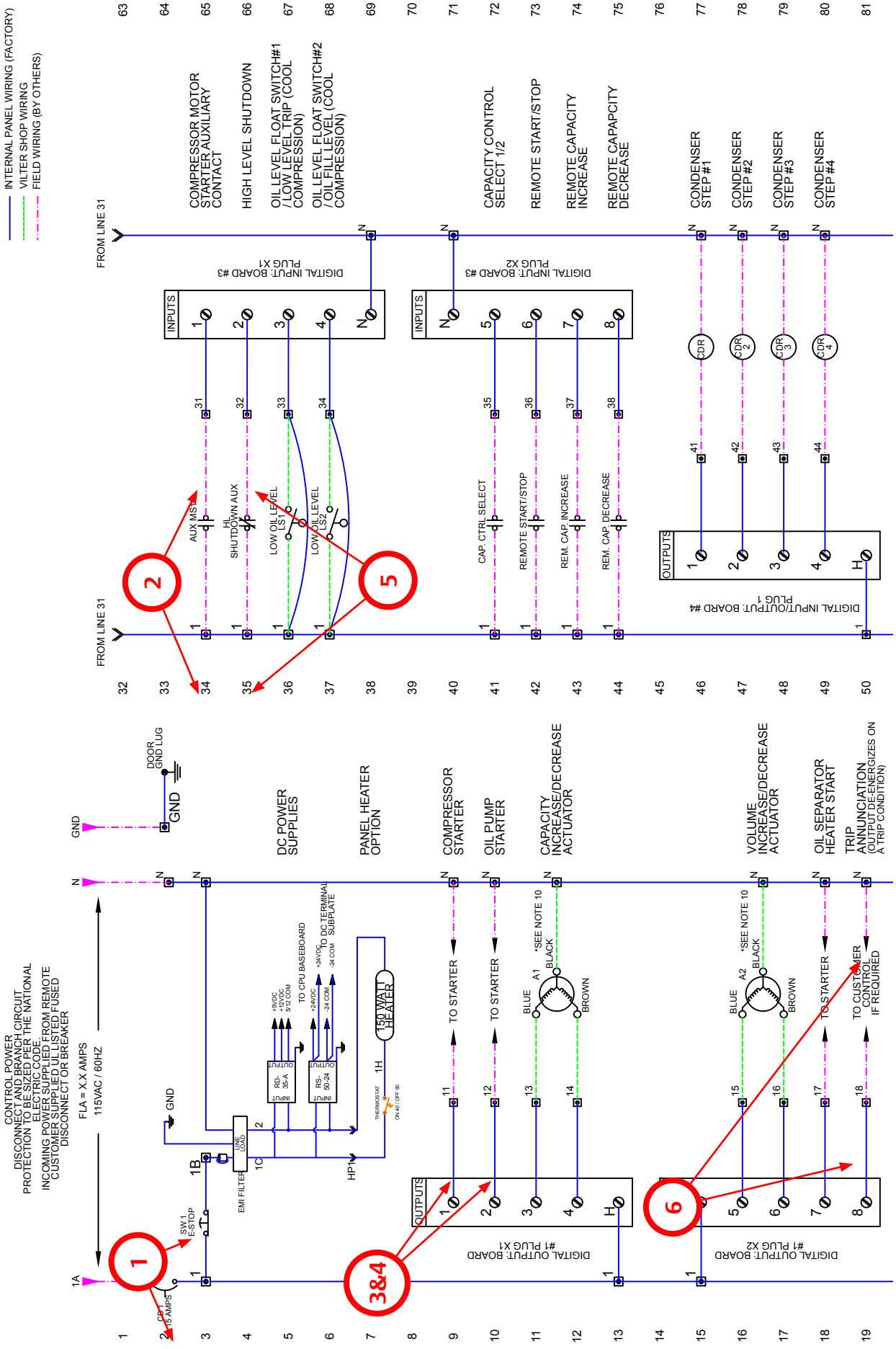


Figure 3-10. Example - Vission 20/20 Wiring Diagram

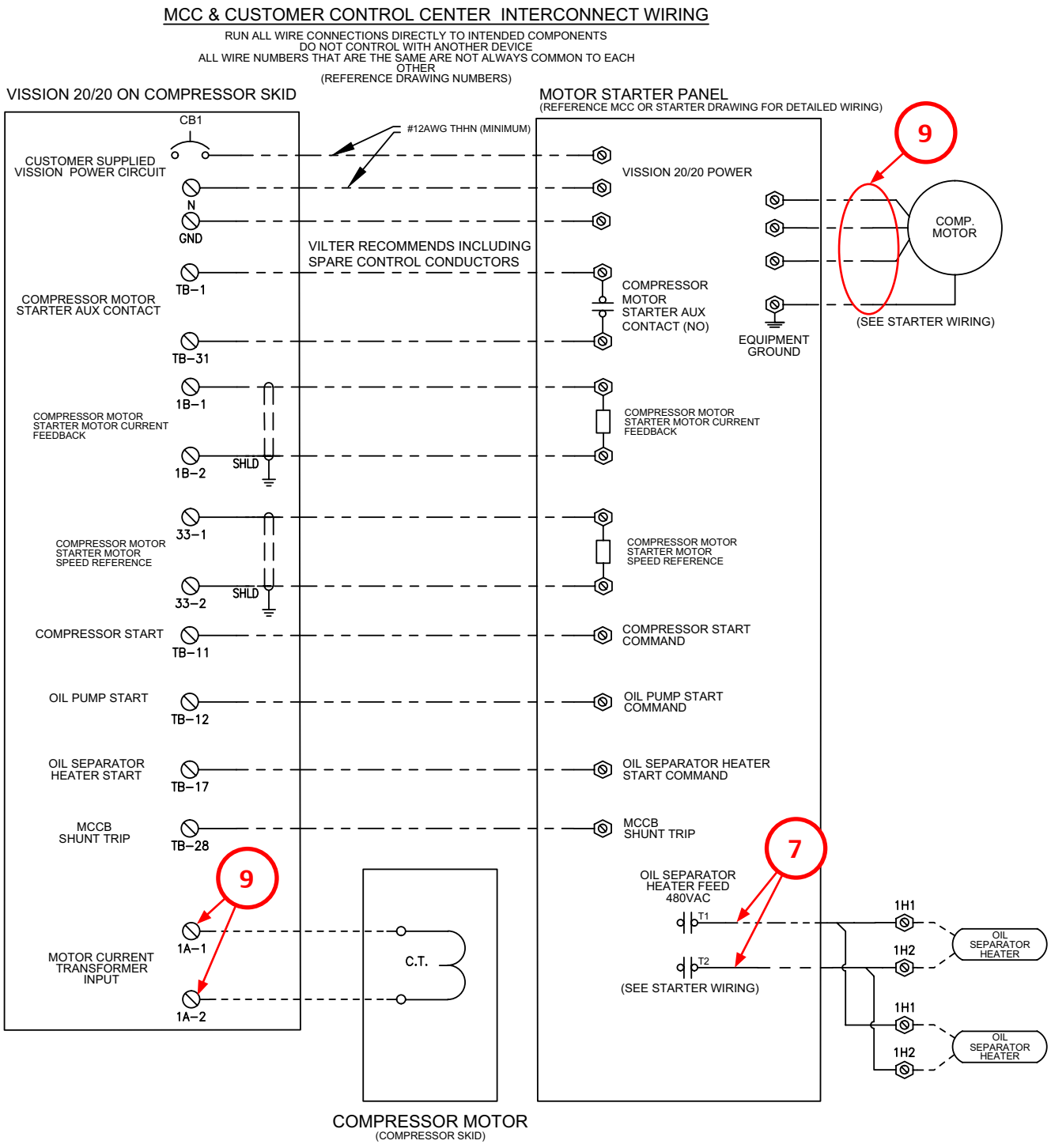


Figure 3-11. Example - Interconnect Wiring Diagram

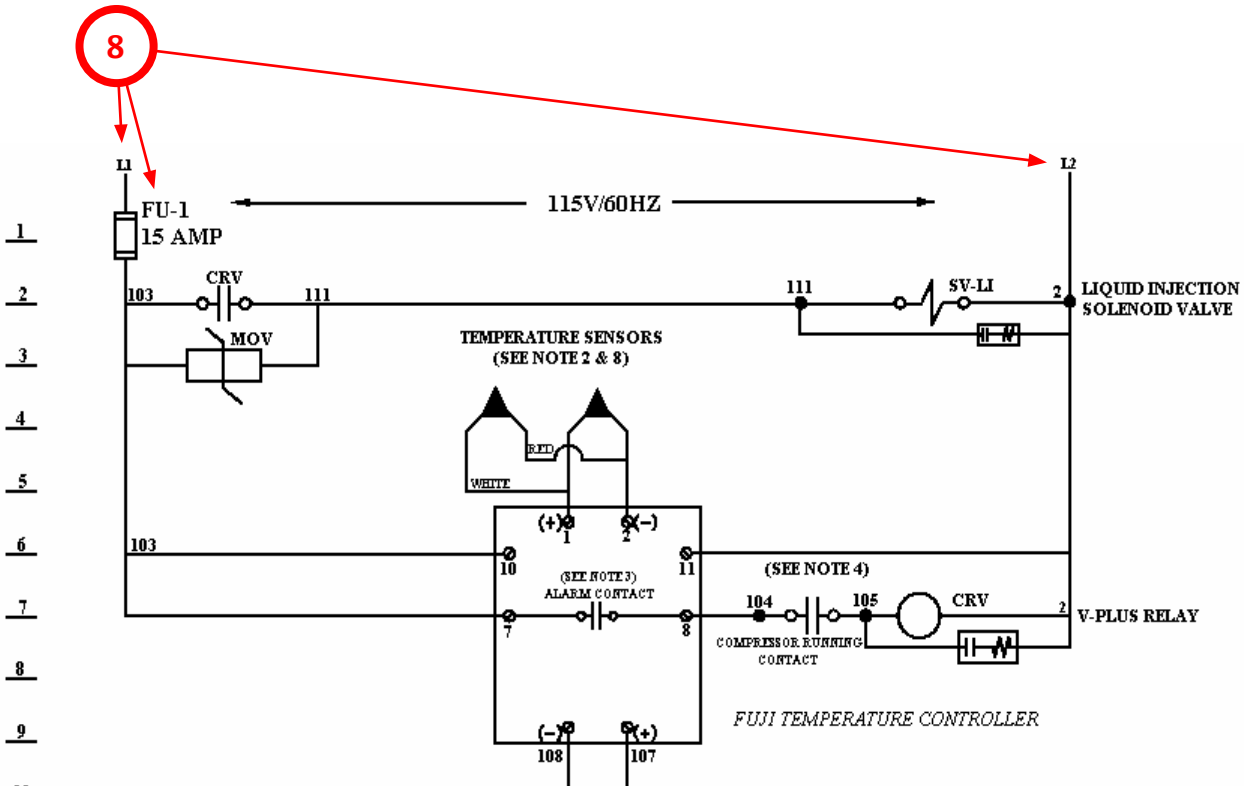


Figure 3-12. Example - V-PLUS Wiring Diagram

Testing Refrigeration System For Leaks

CAUTION

Do not hydro test compressor 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 pressure setting, all system components must be evaluated for acceptability.

Vilter equipment is tested for leaks at the factory. One of the most important steps in putting a refrigeration system into operation is field testing for leaks. This must be done to assure a tight system that will operate without any appreciable loss of refrigerant. To test for leaks, the system pressure must be built up. Test pressures for CO_2 are listed in the IIAR CO_2 Industrial Refrigeration Handbook (ANSI/IIAR Standard CO_2-2021).

Before testing may proceed, several things must be done.

First, if test pressures exceed the settings of the system, relief valves or safety devices, remove those and plug the connection during the test.

Secondly, all valves should be opened except those leading to the atmosphere. Then, open all solenoids and pressure regulators by the manual lifting stems. All bypass arrangements must also be opened.

CO_2 Systems

A CO_2 system will tend to be more prone to leaks due to the higher working pressures and the smaller molecule size, and therefore its leak detection should become a regular maintenance procedure. For a charge size of above 661 lbs, for example, the recommendation would be to perform the leak detection procedure about 4 times a year.

An oil stain will be a visual indicator of a CO_2 leak, but there are also leak detection sprays available in the market (such as Weicon´s or Bulleye´s), infrared handheld leak detectors (such as D-TEK CO_2), and ultrasonic leak detectors of several brands.

Step 1: Test The System At A Test Pressure

Only dry nitrogen or anhydrous CO_2 may be used to raise the pressure in the CO_2 system to the proper level for the test. The gas may be put into the system through the charging valve or any other suitable opening.

Adjust the pressure regulator on the bottle to prevent over-pressurization. Do not exceed the pressure rating on the vessel with the lowest pressure rating.

When the proper pressure, 30 psig for CO_2 system, is attained, test for leaks with a soap mixture described as below.

Take a mixture of four parts water to one part liquid soap, and add a few drops of glycerin to it. This makes a good solution. Apply this mixture with a one-inch round brush at all flanges, threaded joints, and welds.

After all leaks are found and marked, relieve the system pressure and repair the leaks. The pressure should be bled off in 10 – 15 psig increments from the lowest part of the system to help expel any residual water in the system.

Never attempt to repair welded joints while the system is under pressure.

Repair all visible leaks and recheck the system.

Step 2: Test The System At The Design Pressure

Charge a small amount CO_2 into the system and pressurize the system to its respective design pressure. Use a leak detection spray or leak detector around all joints and connections.

If any leaks are observed during this test, they must be repaired and rechecked before the system can be considered tight and ready for evacuation.

Evacuating The System

CAUTION

Ensure compressor unit has been charged, and the compressor primed, with the correct amount of oil prior to initial refrigerant charging. Failure to comply may result in damage to equipment.

A refrigeration system operates best when only refrigerant is present. Steps must be taken to remove all air, water, vapor, and all other non-condensables from the system before charging it with refrigerant. A combination of moisture and refrigerant, along with any oxygen in the system, can form acids or other corrosive compounds that corrode internal parts of the system.

To properly evacuate the system, and to remove all non-condensables, air and water vapor, use a high vacuum pump capable of attaining a blanked off pressure of 50 microns or less. Attach this pump to the system and allow it to operate until system pressure is reduced somewhere below 1000 microns. Evacuation should not be done unless the room temperature is 60°F or higher.

Attach vacuum gauge(s), reading in the 20 to 20,000 micron gauge range, to the refrigerant system. These gauge(s) should be used in conjunction with the high vacuum pump. The reading from the gauge(s) indicates when the system has reached the low absolute pressure required for complete system evacuation.

Connect the high vacuum pump into the refrigeration system by using the manufacturer's instructions. Connect the pump both to the high side and low side of the system, to insure system evacuation. Attach the vacuum gauge to the system in accordance with the manufacturer's instructions.

A single evacuation of the system does not satisfactorily remove all of the non-condensable, air and water vapor. To do a complete job, a triple evacuation is recommended.

When the pump is first turned on, bring system pressure to as low a vacuum level as possible, and continue operation for 5 to 6 hours.

Stop the pump and isolate the system. Allow the unit to stand at this vacuum for another 5 to 6 hours. After this time, break the vacuum and bring the system pressure up to 0 psig with dry nitrogen.

To begin the second evacuation, allow the pump to operate and reduce the pressure again to within 50 to 1000 microns. After this reading is reached, allow the pump to operate 2 or 3 hours. Stop the pump and let the system stand with this vacuum. Again using dry nitrogen, raise the system pressure to zero.

For the third evacuation, follow the previous procedure with the pump operating until system pressure is reduced below the 1000 micron level. Run the pump for additional 6 hours and hold the system for approximately 12 hours at low pressure. After this, again break the vacuum with dry nitrogen and allow the pressure in the system to rise slightly above zero pounds (psig). Install new drier cartridges and moisture indicators. Charge the system once more below the 1000 micron level and use the refrigerant designed for the system.

When properly evacuating the system as outlined above, the system is dry, oxygen-free and free of non-condensables. The piping should not be insulated before the evacuation process is started. If moisture is in the system before evacuating, it condenses in low places and freezes. If this happens, it can be removed by gently heating the trap farthest away from the vacuum pump. This causes the ice to melt and water to boil. Water vapor collects in the next trap towards the vacuum pump. This process should be repeated until all pockets of water have been boiled off, and the vacuum pump has had a chance to remove all the water vapor from the system.

Notice on 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. 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 Initial 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.

NOTICE

Do not put oil when unit is under vacuum. Use an oil pump to charge oil.

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 3-13. 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 (VPN A40849A).

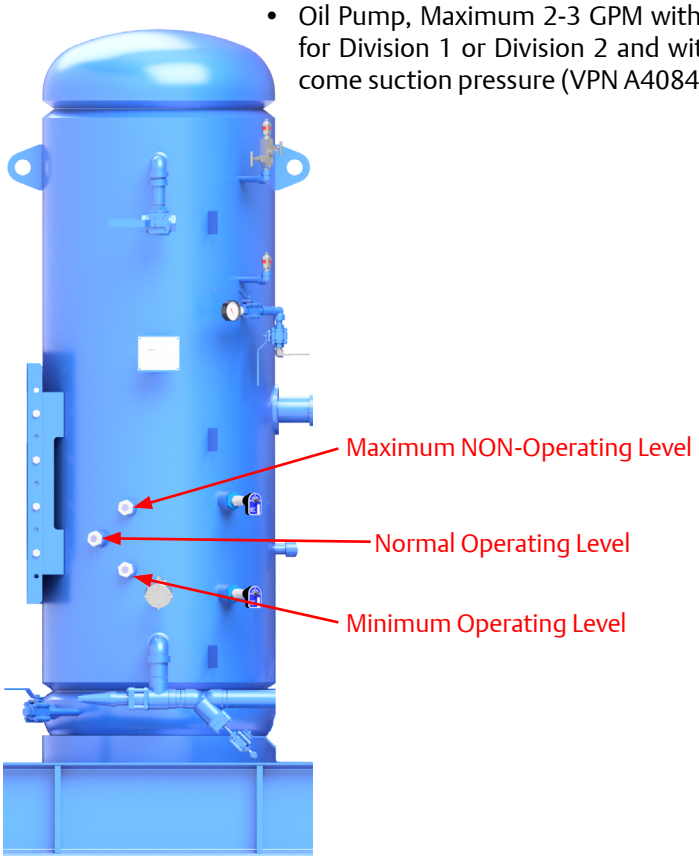


Figure 3-13. Oil Operating Levels

Unit Initial Oil Charging

(Reference Figure 3-15)

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 (10) (for oil separator drain valve location, see Figure 3-14).
3. Open oil separator drain valve (10) and fill oil separator (1) to Maximum NON-Operating Level. (See Figure 3-13).
4. Once Maximum NON-Operating Level has been reached, shut off oil pump, close oil separator drain valve (10) and remove oil pump.
5. If equipped with remote oil cooler, refer to Priming Compressor Units Equipped with Remote Oil Cooler procedure (see Appendix G).

Priming Oil Lines and Compressor (Unit With Oil Pump)

Continue with the following steps to prime the oil lines and compressor:

6. Make sure valves on oil circuit are in the open position. In this case, make sure valves (2), (3), (5), (6) and (7) are in the open position.
7. Energize compressor unit. Vission 20/20 will energize oil heaters.
8. Run oil pump (4) for 15 seconds only.
9. Wait minimum of 30 minutes to allow oil to drain from compressor (8).
10. If compressor unit is not being started right away, repeat steps 6 to 9 prior to starting.

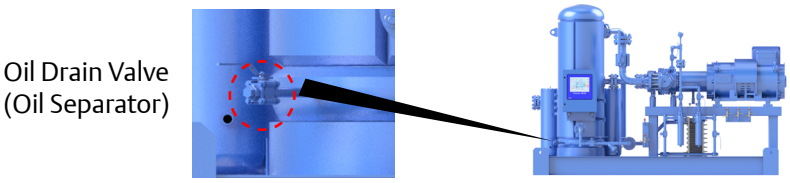


Figure 3-14. Oil Drain Valve

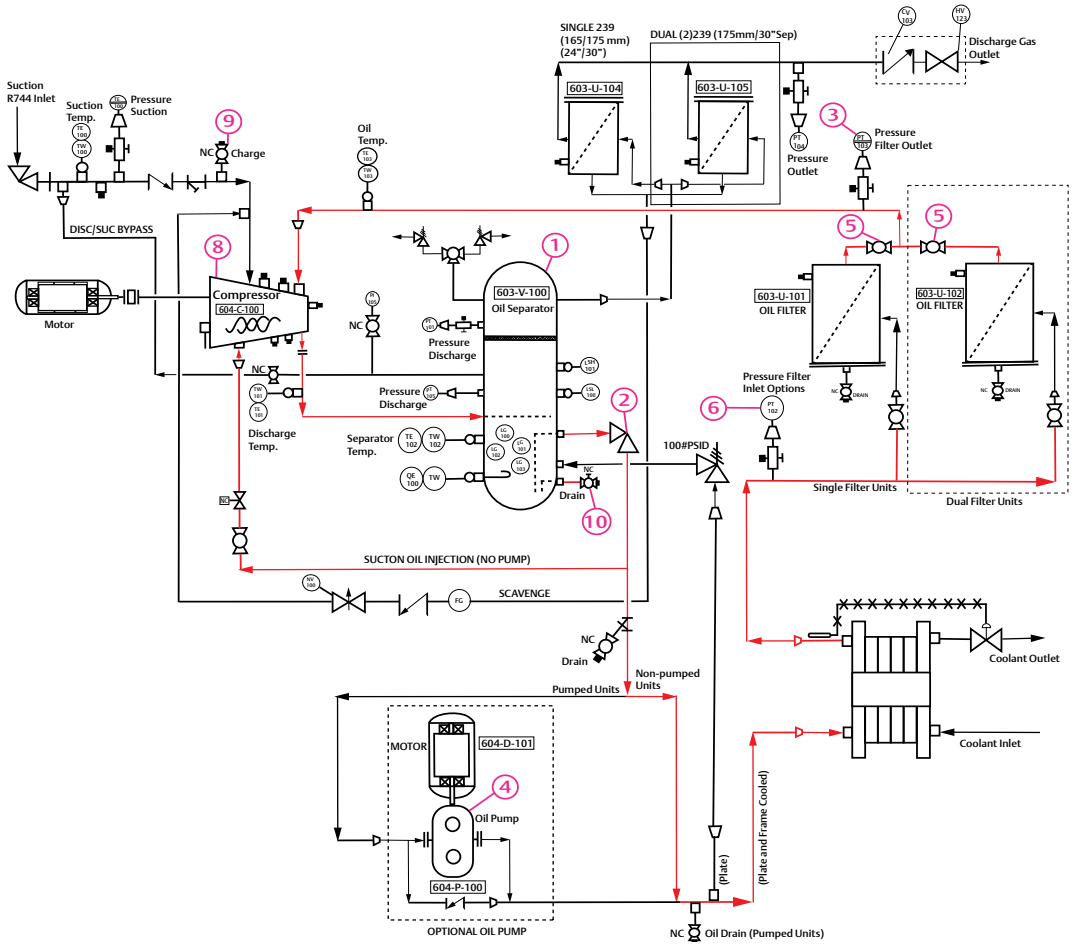


Figure 3-15. Priming Oil Lines and Compressor (With Oil Pump)

Unit Initial Oil Charging (without Compressor Oil Pump) - For Single Compressor Units Only

(Reference Figure 3-16)

1. Compressor unit must be off and fully depressurized prior to the initial oil charging. (Follow proper Lockout/Tagout procedure.
2. Open Valves (6), (9) and (6a if Dual Oil Filters).
3. Close valve (7), (7a if Dual Oil Filters) and all other valves (4), (11), (10), (8) and (5a if Dual Oil Filters).
4. Using a properly selected oil pump, connect oil pump hose to oil filter drain valve (5). As a reference Vilter oil pump is # A40849A (2 to 3 gpm).
5. Open oil filter drain valve (5) and pump around 5 gallons of oil into compressor (1).
6. Shut off oil pump.
7. Close valve (6) and (6a if Dual Oil Filters)
8. Open valves (7), (8) and (7a if Dual Oil Filters)
9. Pump oil through oil cooler to separator (2)
10. When Maximum NON-Operating Level has been reached (Separator (2) Sight Glass, see Figure 3-13 for location), shut off oil pump, close oil filter drain valve (5) and disconnect oil pump hose.
11. Unit is now ready for plant Pre-Start up Safety Review (PSSR) before initial start.

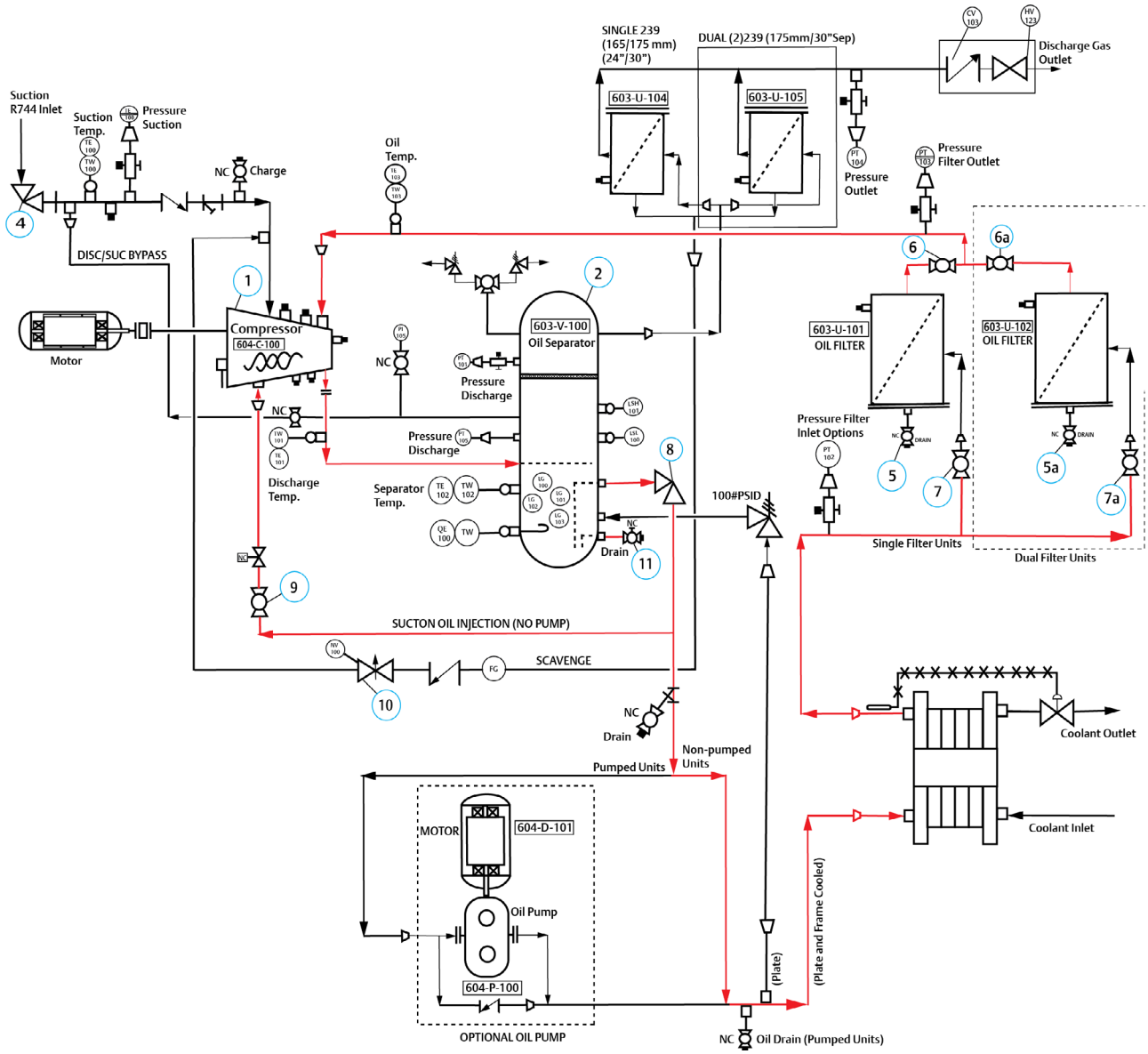


Figure 3-16. Transcritical CO_2 Unit Initial Oil Charging (without Compressor Oil Pump) - Single Compressor

Unit Initial Oil Charging (without Compressor Oil Pump) - For CO_2 Transcritical Dual Compressor Units Only

(Reference Figure 3-18)

1. Compressor unit must be off and fully depressurized prior to the initial oil charging. (Follow proper Lockout/Tagout procedure).
2. Open valves (6), (6a if dual oil filters), (9), and (12).
3. Close valves (7), (7a if dual oil filters) and all other valves (4), (4a) (11), (10), (8) and (5a if Dual Oil Filters).
4. Using a properly selected oil pump, connect oil pump hose to oil filter drain valve (5). As a reference Vilter oil pump is # A40849A (2 to 3 gpm).
5. Open oil filter drain valve (5) and pump around 5 gallons of oil into compressor (1).
6. Shut off oil pump.
7. Close Valves (12) and (9).
8. Open Valves (12a) and (9a).
9. Pump around 5 gallons of oil into compressor (1a).
10. Shut oil pump off.
11. Close valves (12a) and (9a).
12. Open valves (6), (7), (8) and (6a/7a if Dual Oil Filters).
13. Pump oil through oil cooler to separator (2).
14. When Maximum NON-Operating Level has been reached (Separator (2) Sight Glass, see Figure 3-14 for location), shut off oil pump, close oil filter drain valve (5) and disconnect oil pump hose.
15. Unit is now ready for plant Pre-Start up Safety Review (PSSR) before initial start.

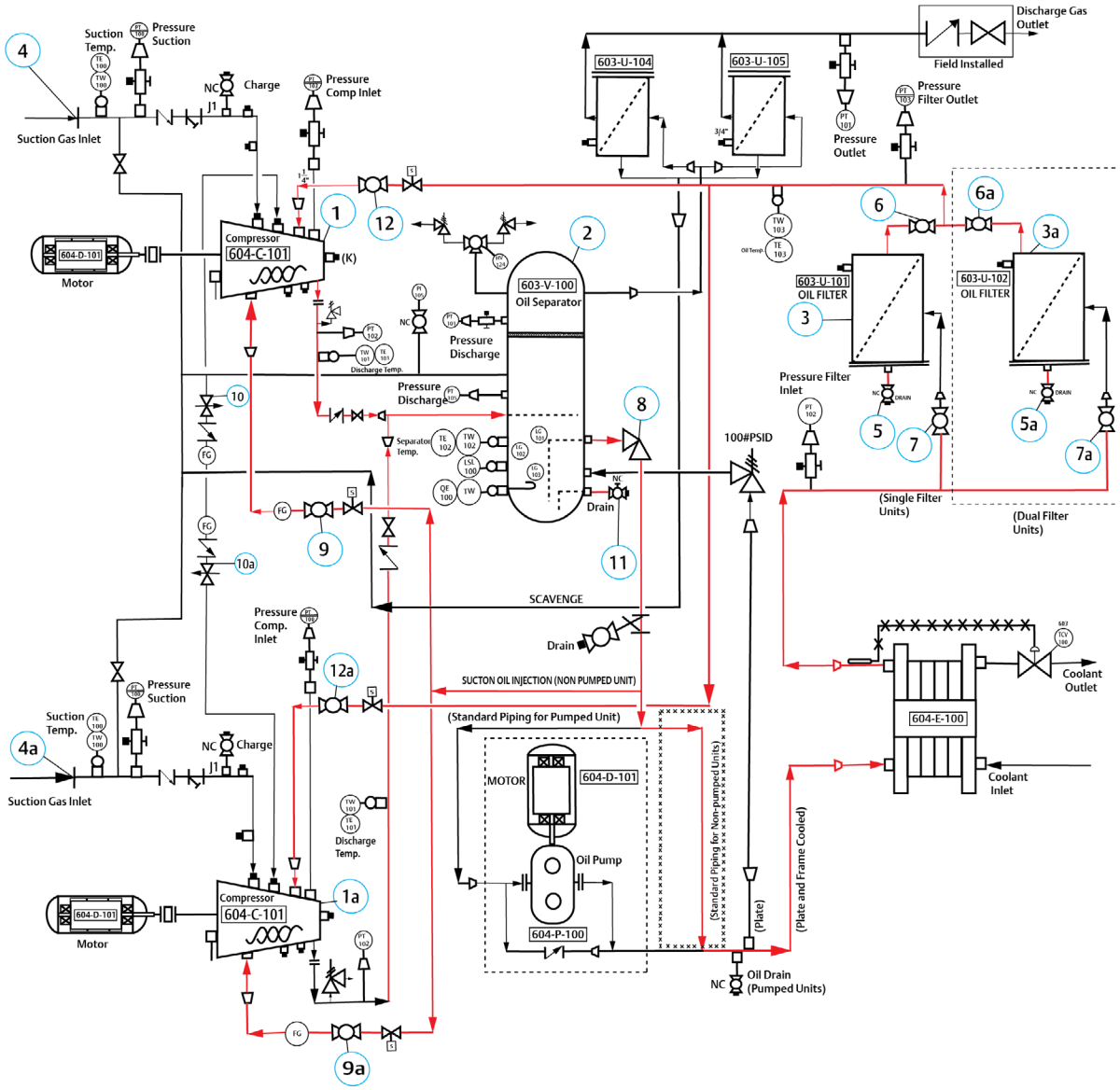


Figure 3-17. Transcritical CO_2 Unit Initial Oil Charging (without Compressor Oil Pump) - Dual Compressors

System Refrigerant Charging Before Commissioning

After the system is leak-free and evacuation has been completed, the entire operation of the refrigeration system should be inspected before charging.

A. Low Side Equipment

1. Fans on air handling equipment running.
2. Pumps on water cooling equipment running.
3. Proper location and attachment of thermostatic expansion valve bulb to suction line.
4. Correct fan and pump rotation.
5. Evaporator pressure regulators and solenoid valves open.
6. Water pumps and motors correctly aligned.
7. Belt drives correctly aligned and tensioned.
8. Proper voltage to motors.

B. Compressors

1. Proper oil level.
2. Voltage agrees with motor characteristics.
3. Properly sized motor fuses and heaters.
4. Direct drivers aligned and couplings tight.
5. All suction and discharge valves open.
6. All transducers and RTDs calibrated and reading correctly.

C. Condensers

1. Water available at water cooled condensers and supply line valve open.
2. Water in receiver of evaporative condenser and makeup water available.
3. Correct rotation of pump and fan motors.
4. Belt drives aligned and tensioned correctly.
5. Pump, fans and motors lubricated.

D. Controls

Controls should be at the initial set points. See microprocessor manual for further information.

Initial High Side Charging

WARNING

When working with refrigerants, ensure there is adequate ventilation and refrigerant vapor detectors as per ASHRAE standards. Failure to comply may result in serious injury or death.

WARNING

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

CAUTION

Ensure compressor unit has been charged with the correct amount of oil prior to initial refrigerant charging. Failure to comply may result in damage to equipment.

CAUTION

Do not apply flame or steam directly to bottle, as this can produce dangerously high pressures inside bottle. Failure to comply may result in damage to equipment.

WARNING

Ensure charge of 60 PSIG minimum pressure gas into the system before adding liquid CO_2 into the system to avoid dry-ice formation

There are two methods of charging refrigerant into the system, through the “high side” or through the “low side”. High side charging is usually used for initial charging as filling of the system is much faster. Low side charging is usually reserved for adding only small amounts of refrigerant after the system is in operation.

High side charging of refrigerant into the system is accomplished as follows:

1. Connect a full bottle of non-syphon tube of refrigerant to the gas/liquid charging valve. This valve is generally located in the gas/liquid line immediately after the king or gas/liquid line valve. Purge the air from the charging line.
2. Close the gas/liquid line or king valve, if it is not already closed. Open the “Gas/Liquid” charging valve slowly to allow refrigerant to enter the system. The vacuum in the system will draw in the refrigerant.
3. It is important that during this operation air handling units be running and water is circulating through the chillers. The low pressures on the system can cause the refrigerant to boil at low temperature and possibly freeze the water if it is not kept circulating.

Water freezing in a chiller can rupture the tubes and cause extensive damage to the system. It would be desirable to charge the initial amount of refrigerant without water in the shell and tube equipment to eliminate the possibility of freeze up.

4. After some refrigerant has entered the system, the compressor unit starting procedure may be followed, see Starting procedure in Section 4.
5. Continue charging refrigerant into the system until the proper operating requirements are satisfied. Then, close the liquid charging connection and open the liquid line valve allowing the system to operate normally. To check that enough refrigerant has been added, the liquid sight glass should show no bubbles, and there will be a liquid seal in the receiver. If these two conditions are not satisfied, additional refrigerant must be added.
6. When sufficient refrigerant has been charged into the system, close the charging and bottle valves. Then remove the bottle from the system.
7. During the charging period, observe the gauge carefully to ensure no operating difficulties. Watch head pressures closely to make sure the condensers are functioning properly.
8. Since it is usually necessary to use several bottles when charging a system, follow the procedures in steps 1 and 2 when attaching a new bottle. After charging, the refrigerant bottles should be kept nearby for several days as it is sometimes necessary to add more refrigerant as the system settles down.

Notice on 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. 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.

Operation

All operation (set-point adjustments, calibrations, monitoring) of the compressor unit is done through the micro-processor. For additional procedural information, refer to micro-processor manual (35391SC for Vission 20/20 Operating Manual).

WARNING

Software programming credentials shall only be made available by the supplier. The user will only have access to operational features established by the supplier. Failure to comply may result in serious injury or death.

Oil Inspection

WARNING

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

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.

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.

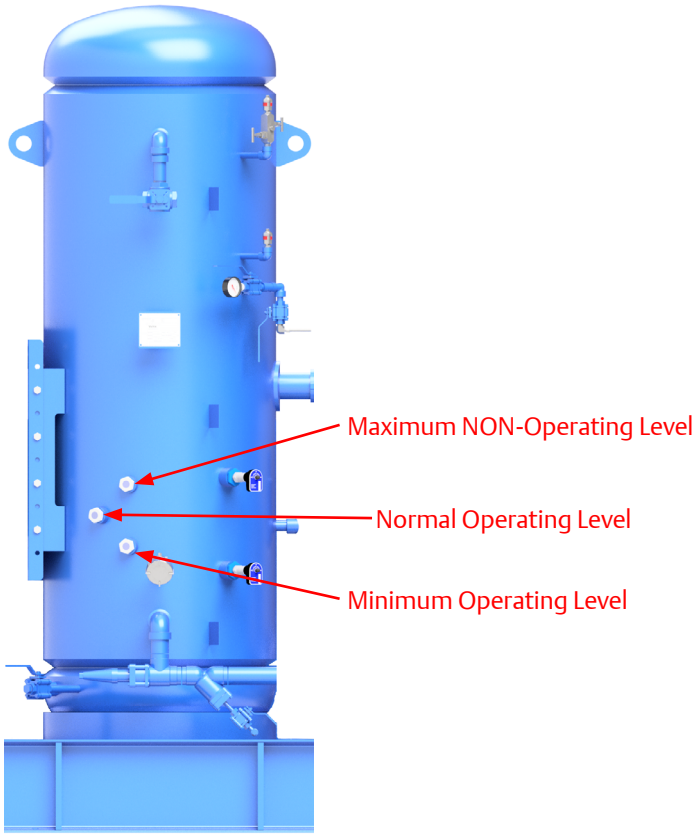


Figure 4-1. Oil Operating Levels

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 Section5 for further details.

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, and 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. Hence 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 Schedule Table in Section 5.

Starting, Stopping and Restarting The Compressor

For additional control information, refer to microprocessor manual (35391SC for Vission20/20 Operating Manual).

WARNING

Software programming credentials shall only be made available by the supplier. The user will only have access to operational features established by the supplier. Failure to comply may result in serious injury or death.

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 in 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, restarting from this condition is accomplished by pushing the reset button to ensure positive operator control. If the auto start on power failure option is selected, 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.

Emergency Shutdown

Emergency shutdown is initiated by the following:

1. A shutdown or trip condition of a process variable while the system is in operation. If a process variable reaches a high-high or low-low shutdown setpoint, the compressor unit will automatically stop. A shutdown alarm is also generated on the control panel HMI screen annunciating the specific process variable trip condition.
2. The Local Emergency Shutdown push button located on the side of the control panel enclosure. When the Local Emergency Shutdown push button is activated, the entire unit powers down. Also, the compressor capacity and volume slide valve will stay in their last position until the unit is powered up. Once recovery has been accomplished and the unit is to be re-powered, the Local Emergency Shutdown push button must be pulled out to power up the unit and controls.

Compressor Control with Vission 20/20™ Micro-controller

The Vission 20/20™ panel can provide control for a single screw compressor without slides as long as Analog Output Board #10 is present and selected in the Configuration screen, see Figure 4-2.

The “No Slide” operation will become active once the correct type of compressor and model has been chosen, see Figure 4-3.

The user must select either VSG/VSH or VSTC from the Compressor combo box in Screen 2 of the Configuration Menu, and then the Model from the next box.

The choice of this type of compressor will cause the refrigerant combo box to be grayed out.

Once the compressor has been selected, the Vission 20/20™ panel touchscreen will show an indicator of VFD speed percentage, and buttons to increase and decrease it.

For more information on VFD capacity control, please check the Vission 20/20™ Manual (35391SC).

WARNING

Software programming credentials shall only be made available by the supplier. The user will only have access to operational features established by the supplier. Failure to comply may result in serious injury or death.

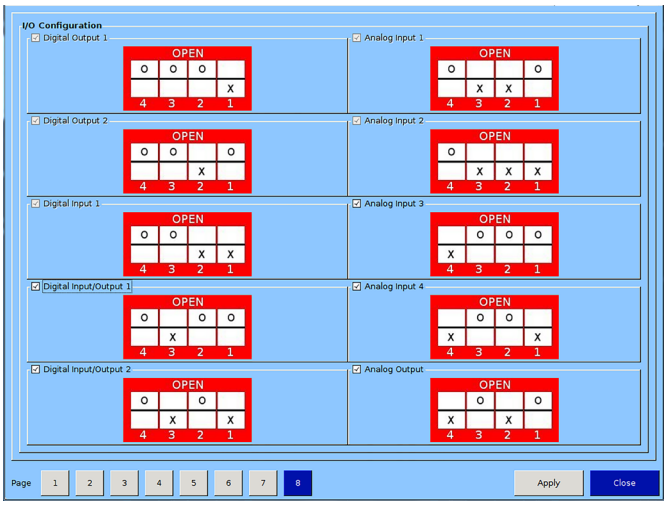


Figure 4-2. Vission 20/20 Configuration Screen - I/O Configuration (Screen 8)

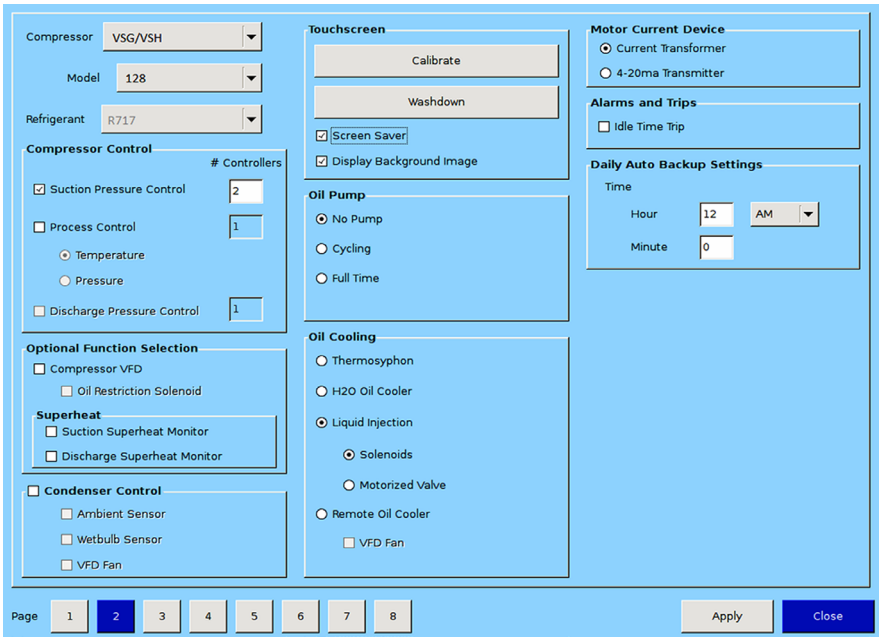


Figure 4-3. Compressor and Model Setup with Vission 20/20

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 following procedure:

NOTE

Do not fully open the needle valve unless directed by Vilter™ Technical Support. 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 4-4.
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.

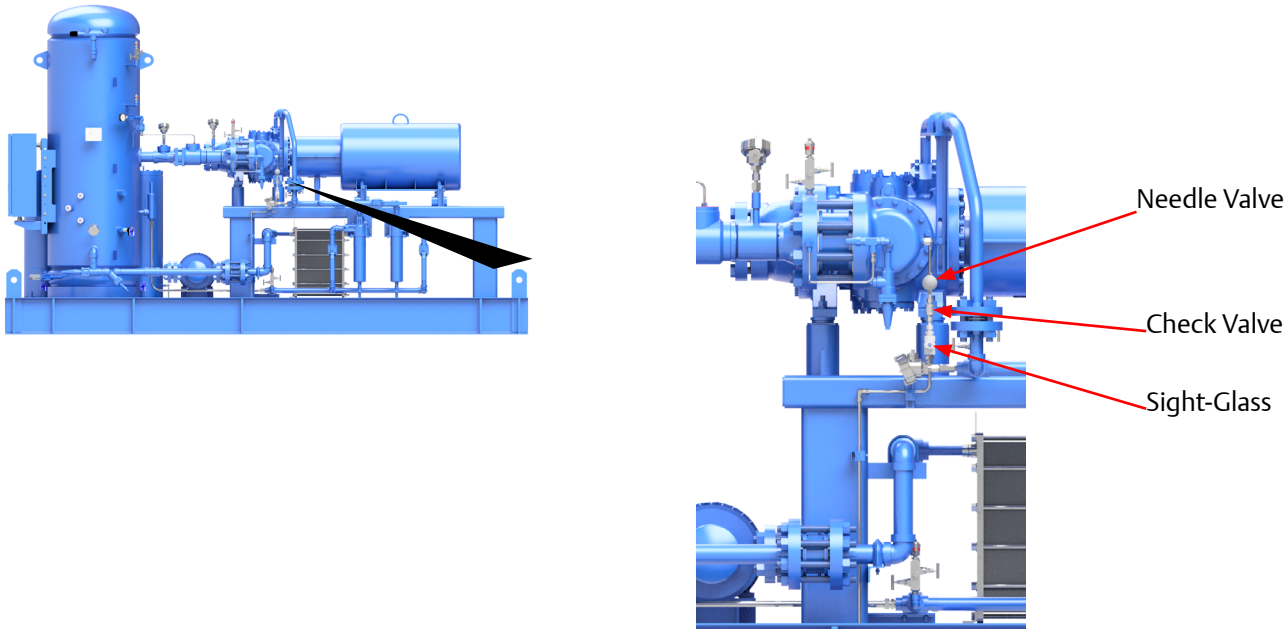


Figure 4-4. Coalescing Oil Return Line

Suction Equalizing Line Setup

The suction equalizing line allows system pressure to equalize to suction pressure during shutdown periods. The line is connected before the suction stop/check valve to after the suction strainer, see Figure 4-5.

NOTE

Valve adjustment depends on size of oil separator and how quickly system pressure should equalize to suction pressure. The larger the oil separator the longer system pressure will take to equalize to suction pressure.

1. To open valve, turn counterclockwise. To close valve, turn clockwise.
2. Fully close valve to a stop.
3. Turn valve to fully open position while counting number of turns to fully open. Note total number of turns.
4. Adjust valve to be half open. Close valve to half of the number of total turns.
5. If suction pressure needs to equalize slower, turn valve towards closed position.
6. If suction pressure needs to equalize faster, turn valve towards open position.

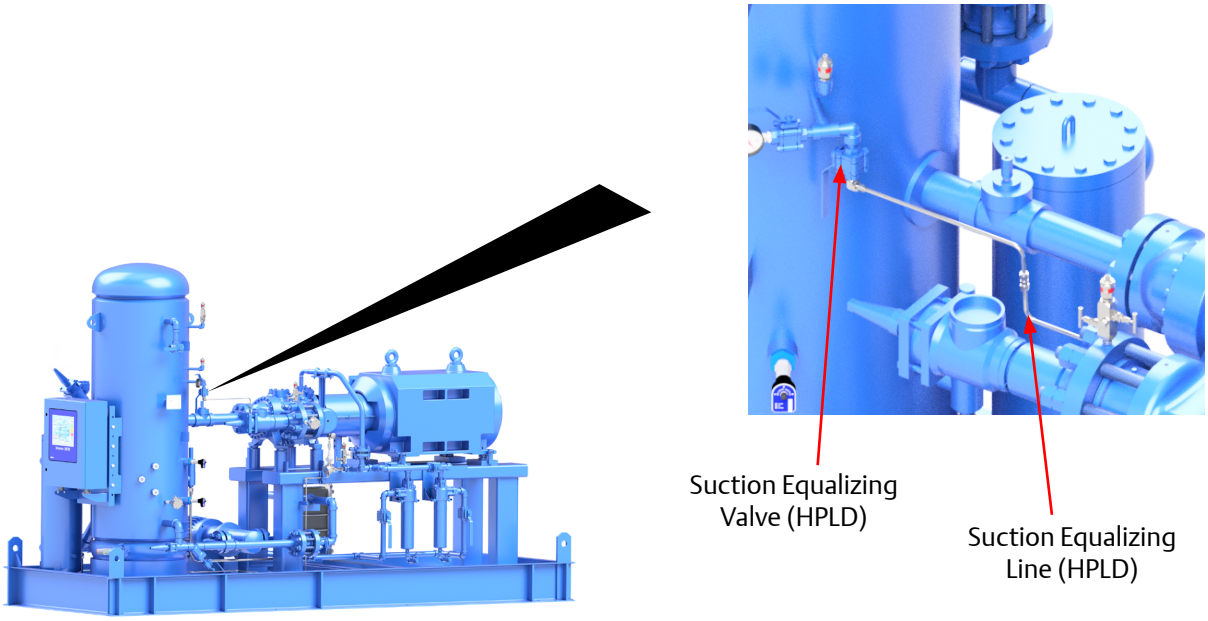


Figure 4-5. Suction Equalizing Line and Valve

Dual Oil Filter Setup For Oil Filters with Filter Head Assemblies

It is very important to correctly setup units equipped with dual oil filters, especially for oil filters that have filter head assemblies. Otherwise, oil pressure readings will be shown incorrectly.

To setup dual oil filters, proceed with the following steps:

NOTE

Inlet Oil Pressure Transducer should only read oil pressure from active oil filter.

1. Decide which oil filter will be active/in use.
2. Open inlet and outlet oil filter shut-off valves to active oil filter.
3. Open inlet oil pressure shut-off valve for active oil filter.
4. Close outlet oil filter shut-off valve to inactive oil filter.
5. Close inlet oil pressure shut-off valve for inactive oil filter.

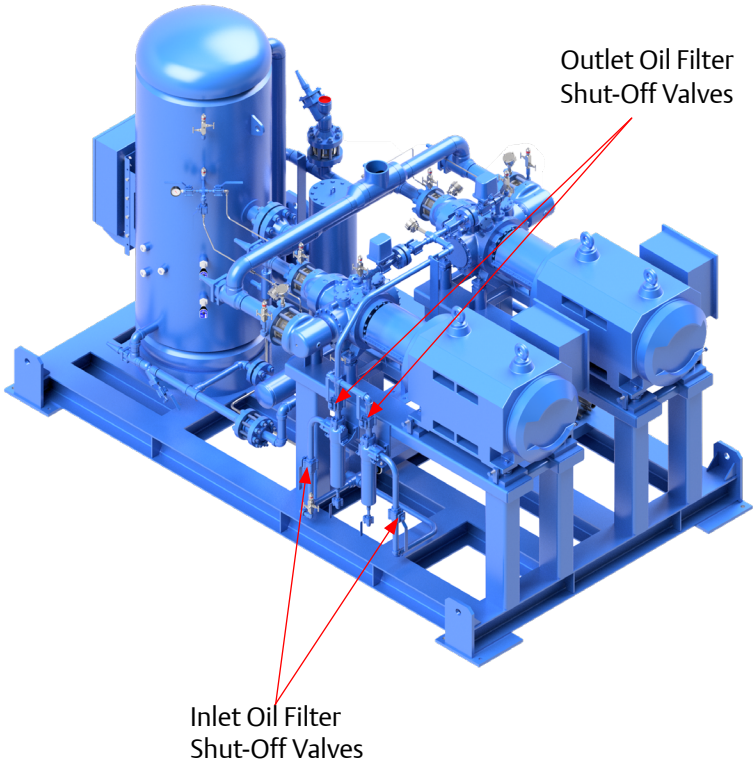


Figure 4-6. Dual Oil Filter Setup for Oil Filters with Manifold Heads

Maintenance and Service Schedule (For All Applications Except Heat Pump and Gas Compression)

Follow this table for maintaining and servicing the single screw compressor at hourly intervals, for applications of Refrigeration, including Subcritical and Transcritical CO2 applications.

Table 5-1. Maintenance/Service Schedule

Group	Inspection / Maintenance	Service Interval (Hours) Based on Dry Clean Gas													
		200	5,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000
Oil Circuit	Oil Change(1)	-	R	-	R	-	R	-	R	-	R	-	R	-	R
	Oil Analysis (2)	-	S	S	S	S	S	S	S	S	S	S	S	S	S
	Oil Filters(3)	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Oil Strainers	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	I	I	I	I	I	I	I
	Liquid Line Strainers	I	I	I	I	I	I	I	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/TTs	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Slide Valve Motors (If Applicable)	Slide valve calibration should be inspected monthly. Inspections can be performed through the control panel. If a Non-Movement Alarm appears, calibrate immediately													
Compressor	Compressor(*)	-	I	-	I	-	I	-	I	-	I	-	I	-	I
	Inspect for Back Spin (4)	Inspect Every 10,000 Hours or As Needed													
	Inspect for Leak	Check Monthly													
	Shaft Seal Replacement	When oil leak over 15 drops per hour													
I – Inspect S – Sampling R – Replace															

Notes: *: Inspections include: gaterotor inspection (backlash measurement, shelf clearance and gaterotor float), end play measurement (main rotor & gaterotor), slide valve inspection (if applicable). Please see "Compressor Inspection" under Section 5 for detailed instructions.

(1) The oil should be changed at these intervals unless oil analysis results exceed the allowable limits. The frequency of changes will depend on the system cleanliness.

(2) Oil analysis should be done at these intervals as a minimum; the frequency of analysis will depend on system cleanliness.

(3) The oil filter(s) on a minimum must be changed at these intervals or annually if not run continuously. However, the oil filter(s) must be changed if the oil filter differential exceeds the given limit or oil analysis requires it.

(4) When shutting off the compressor, normally there is a back spin of the compressor motor shaft in the opposite direction. The backspin of 4 or 5 revolutions are normal to fill the suction cavity with high pressure gas from the Oil Separator. More than this will reflect a faulty suction check valve or fully open bleed line around the suction check valve

Preventive Maintenance, Checks and Services

Careful checking of a refrigeration system for leaks and proper operation of all components upon installation will start the system on its way to a long life of satisfactory service. To ensure the desired trouble-free operation, however, a systematic maintenance program is a prerequisite. The following PMCS is suggested in addi tion to the Maintenance/Service Schedule.

NOTE
After any maintenance work, the workplace should be cleaned and free from any hazards.

Daily

1. Check oil levels.
2. Check all pressure and temperature readings.
3. Check micronic oil filter inlet and outlet pressures for excessive pressure drop. Change filter when pressure drop exceeds 45 psi or every six months, whichever occurs first. For proper procedure for changing micronic oil filter and for charging oil into the system, see Operation Section.
4. Clean strainers each time filter cartridge if replaced.
5. Check compressor sound for abnormal noises.
6. Check shaft seals for excessive oil leakage. A small amount of oil leakage (approximately 6 to 15 drops per hour) is normal. This allows lubrication of the seal faces.

Weekly

(Items 1 thru 6 above plus 7 thru 9)

7. Check the refrigeration system for leaks with a suit able leak detector.
8. Check oil pressures and review microprocessor log and log sheets.
9. Check refrigerant levels in vessels.

Monthly

(Items 1 thru 9 above plus 10 thru 13)

10. Grease all motors and bearings. Follow manufacturer's instructions on lubrication.
11. Check calibration and operation of all controls, particularly safety controls.
12. Check oil cooler for any evidence of corrosion, scaling or other fouling.
13. Operate compressor capacity and volume ratio controls through their range both automatically and manually.

Trimonthly

(Approximately 2000 operating hours)

A. Check movement of compressor rotor at drive coupling end to determine bearing float, see Compressor Shaft Bearing Float Inspections.

Annually

(Items 1 thru 13 and "A" above plus 14 thru 31)

14. Check entire system thoroughly for leaks.
15. Remove all rust from equipment, clean and paint.
16. Grease valve stems and threads for the valve caps.
17. Flush out sediment, etc. from water circuits.
18. Clean all oil strainers.
19. Clean suction strainer – compressors.
20. Check motors and fans for shaft wear and end play.
21. Check operation and general condition of microprocessor and other electrical controls.
    - Check fuses in the Vission 20/20 or PLC panel.
    - Check for loose wiring connections in the Vission 20/20 or PLC panel.
    - Check relay and contact operation for relays in the Vission 20/20 or PLC panel.
    - Verify set points in the Vission 20/20 or PLC.
22. Clean all water strainers.
23. Check drains to make sure water will flow away from equipment.
24. Drain and clean entire oil system at receiver drain. Recharge with new clean moisture free oil. For proper procedure for changing micronic oil filter and charging oil into the system, see Start-Up and Operation Section.
25. Check compressor coupling for integrity and alignment.
26. Check the oil pump coupling for integrity.
27. Check the calibration of the microprocessor pressure transducers and RTD's for accuracy.
28. Check mounting bolts for compressor and motor.
29. Verify the operation of the suction and discharge check valves.
30. Check setup of soft starts and VFDs.
31. Check oil heater operation.

Recommendations when Servicing

When working on the compressor, care must be taken to ensure that contaminants (i.e. water from melting ice, dirt and dust) do not enter the compressor while it is being serviced. It is essential that all dust, oil or ice that has accumulated on the outside of the compressor be removed before servicing the compressor.

After servicing the compressor, all gaskets, O-rings, roll pins and lock washers must be replaced when reassembling the compressor.

Preparation of Unit For Servicing

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

A) Shut down the unit, open the electrical disconnect switch and pull the fuses for the compressor motor to prevent the unit from starting. Put a lock on the disconnect switch and tag the switch to indicate that maintenance is being performed.

WARNING

Be cautious when isolating sections of CO_2 piping. CO_2 has a very steep pressure curve, and as sections containing CO_2 warm up, pressures can rise dramatically & well beyond system design.

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.

B) Isolate the unit by manually closing the discharge Stop valve. Allow the unit to equalize to suction pressure before closing the Suction Bypass. After the unit has equalized to suction pressure and suction valve closed, use an acceptable means to depressurize the unit that complies with all Local, State and Federal Ordinances.

WARNING

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

NOTICE

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

C) Remove drain plugs from the bottom of compressor housing and the discharge manifold. Drain the oil into appropriate containers.

Compressor Unit Leak Check After Servicing

The compressor unit must be checked for leaks after servicing to ensure a tight system. For additional leak testing information, refer to ASME B31.5 Refrigeration Piping and Heat Transfer Components code.

CAUTION

Do not hydro test compressor 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. Open all shut-off valves, check valves, control valves and solenoid valves in the system to be tested.
3. If equipped with a three-way pressure relief valve, make sure the valve stem is in the mid position (but only during testing).
4. Slowly pressurize compressor unit through suction oil charging port with dry nitrogen.
5. Using appropriate soap solution, check for leaks on joints and connections of the serviced component.
6. If leaks are found, depressurize system and fix leaks. Repeat steps 3 and 4 until all leaks are fixed.
7. Evacuate from suction oil charging port.
8. Close all valves previously opened in the system. Remove tags as per the local lock-out/tag-out procedure.
9. Turn the motor and oil pump disconnect switches to the ON position.
10. Return compressor unit to service.

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

Improper selection or application of fluid diagnostic products can cause serious injury or damage. The user is solely responsible for making the final selection of products to ensure that the overall system performance and safety requirements are met. These include reviewing fluid compatibility with materials and seals.

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.

DANGER

Sampling often releases hot fluid under high velocity/pressure.

1. **Hot fluid can cause severe burn injuries.**
2. **Skin penetration from high-pressure fluid can occur, causing severe injury, gangrene and/or death. If this happens, immediately contact an experienced medical practitioner.**
3. **Hot fluid escaping to the atmosphere can ignite if it comes into contact with an ignition source. This can lead to severe property damage.**

Recommendations

1. Make sure you ´re aware of the risks associated with the fluid being sampled or worked with. Check with the manufacturer.
2. If you have not been trained to sample, service, repair, or troubleshoot a pressurized fluid system, especially a hydraulic system, you are at risk of suffering an accident. Seek the proper training before proceeding.

Installation of The Oil Sampler Valve

1. Lubricate the threads (1/4”-18 NPT) with Teflon tape.
2. Tighten to the max. torque 25 ft-lbs (34 N-m). Use 11/16” open wrench. Avoid over tightening.

Sampling

Use the Vilter Oil Analysis Kit (VPN 3097A) to collect an oil sample for analysis, see Figure 5-1.

Once the sample has been taken, the label must be filled out and pasted on the bottle, and both must be placed inside the mailing tube and sealed with the pre-addressed mailing label.

Below are a few points to remember when taking a sample:

- Sample running compressor units, not cold units. Sample after minimum 30 minutes of compressor operating time.
- Sample after the oil filter.
- Sample according to the sampling procedure below.
- 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 to the oil analysis lab immediately after sampling, do not wait 24 hours.

Figure 5-1. Oil Analysis Kit (VPN 3097A)

NOTE

Missing information from the sampling label may result in longer turnaround time as the laboratory will need to request the info before the sample can be tested.

Oil Sample Analysis Report

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
- Contaminating/additive metal

Oil Draining

WARNING

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

WARNING

When working with refrigerants, ensure there is adequate ventilation and refrigerant vapor detectors as per ASHRAE standards. Failure to comply may result in serious injury or death.

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 5-6.

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.

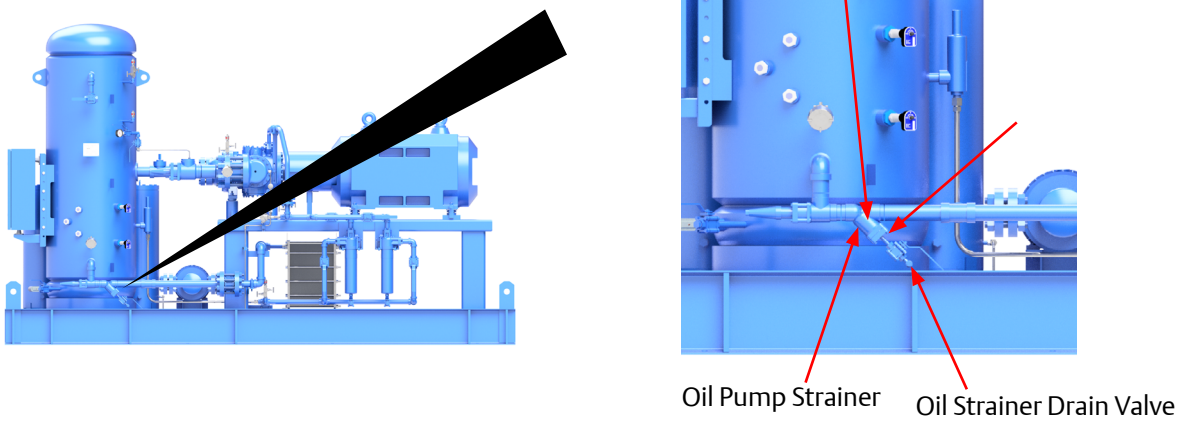


Figure 5-6. Oil Strainer Drain Valve and Oil Separator Drain Valve

Oil Charging

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.

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 5-7. 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.
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 5-6. 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.

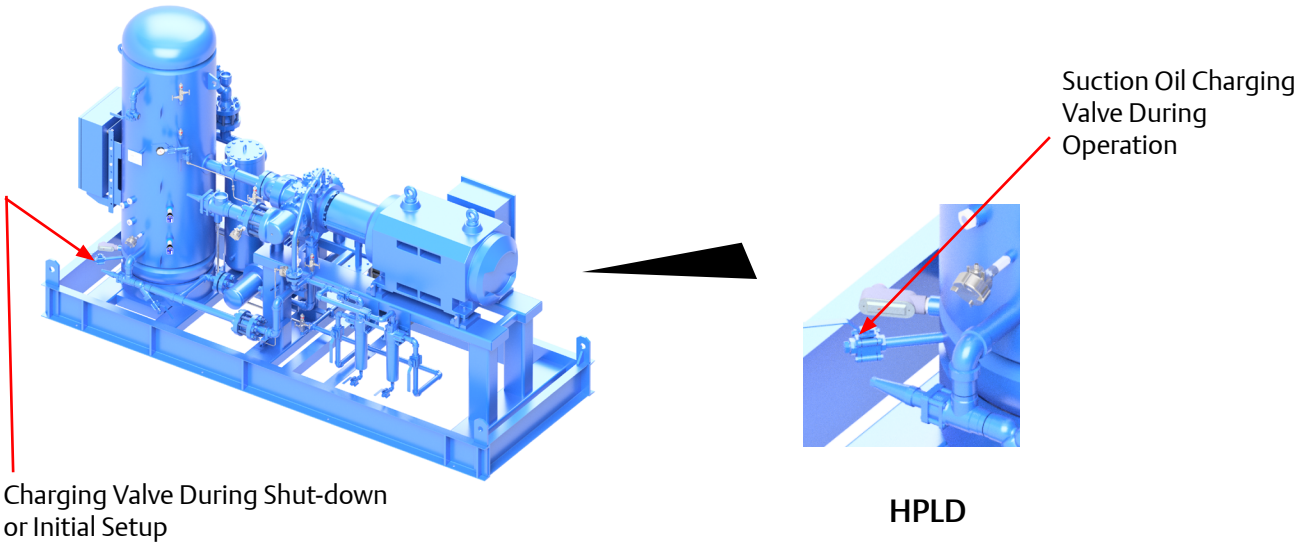


Figure 5-7. Suction Oil Charging Valve

Oil Filter Element Replacement

WARNING

When working with refrigerants, ensure there is adequate ventilation and refrigerant vapor detectors as per ASHRAE standards. Failure to comply may result in serious injury or death.

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.

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.

See Table 5-2 for the parts required for an oil filter replacement, with their part numbers.

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.

If equipped with dual oil filters, open inlet shut-off valve for non-operating oil filter to put it into operation, see Figure 5-8.

1. To isolate oil filter for servicing, close inlet and outlet shut-off valves for that 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.

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

NOTICE

Dispose of used oil in an appropriate manner following all Local, State and Federal laws and ordinances.

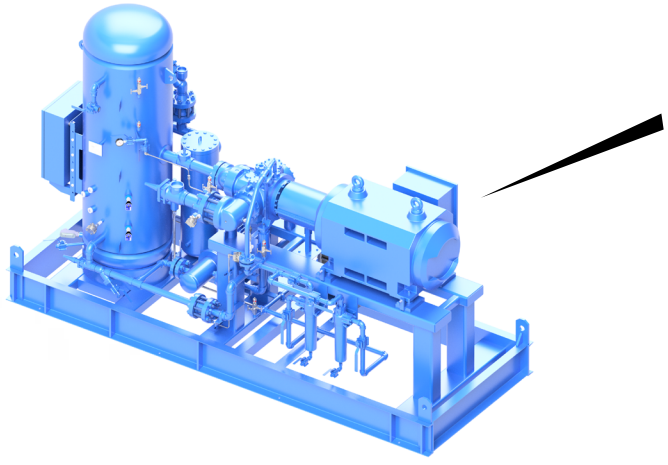
3. Using an drain pan, open drain valve and allow the oil to completely drain from the oil filter canister.

NOTE

Note orientation of components to aid in installation.

Table 5-2. Oil Filter Replacement Parts Required

KIT	Oil Filter	Oil Filter Element	Element Type
KT819A	3677A	3007C	Single/Dual



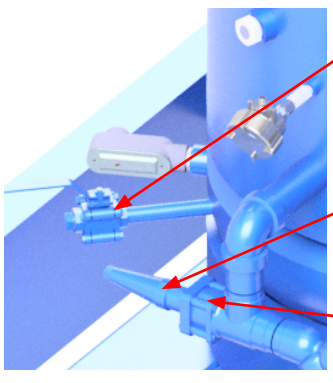


Figure 5-8. Oil Filter Inlet, Drain and Shut-Off Valves

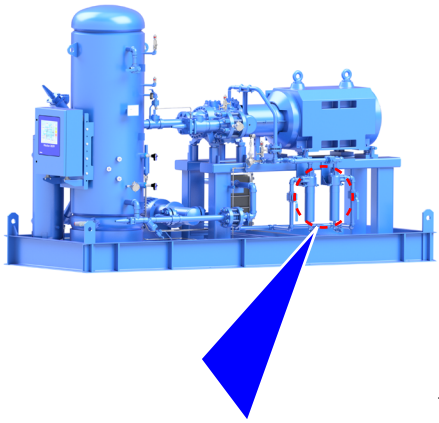
4. Use a proper tool to turn the canister knob (at filter bottom) anti-clockwise to unscrew the canister from the filter head. See Figure 5-9.
5. Remove filter element from oil filter canister.
6. Thoroughly clean the interior of the oil filter canister, and the connection area of head assembly.
7. Remove (Canister-to-head) O-ring from inside of filter head. Discard O-ring.

Installation

NOTE

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

1. Lubricate new O-ring with clean system oil.
2. Install O-ring on inside of filter head.
3. Install oil filter element into head in orientation noted during removal. Make sure filter element is fully seated.
4. Install oil filter canister to the filter head by hand, then tighten canister knob with a wrench.
5. Using dry nitrogen gas, pressurize oil filter canister through vent valve and check for leaks.
6. Close the vent valve and drain valve.
7. Open outlet shut-off valve for the oil filter that is not in operation.
8. Repeat for second oil filter if equipped, as required.



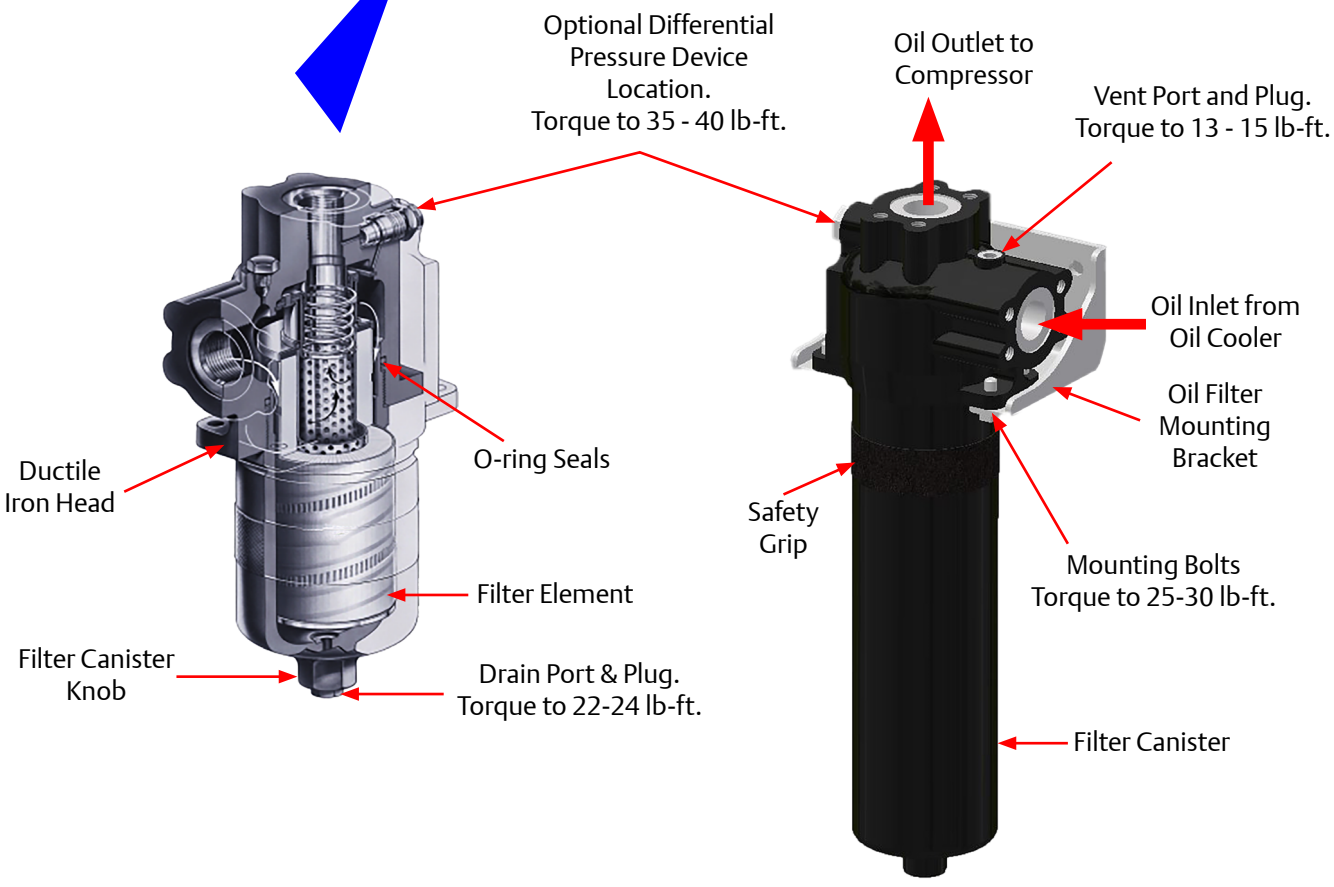


Figure 5-9. Filter Assembly (VPN 3677A Oil Filter Housing Shown)

Switching Oil Filters For Maintenance (Reference Figure 5-10)

When switching oil flow from one filter to the other for maintenance, proceed with the following steps:

1. Slowly open inlet oil filter shut-off valve to oil filter that will be active.
2. Slowly open inlet oil pressure shut-off valve for oil filter to allow oil pressure to be read from oil filter that is now active.
3. Slowly open outlet oil filter shut-off valve to oil filter that is now active.
4. Slowly close inlet and outlet oil filter shut-off valves for oil filter that is to be serviced.
5. Slowly close oil pressure shut-off valve for oil filter that is to be serviced. Remove plug from oil filter head assembly to aid in oil removal.
6. Continue with steps in Removal or Installation of Filter Element Replacement section (see previous pages).

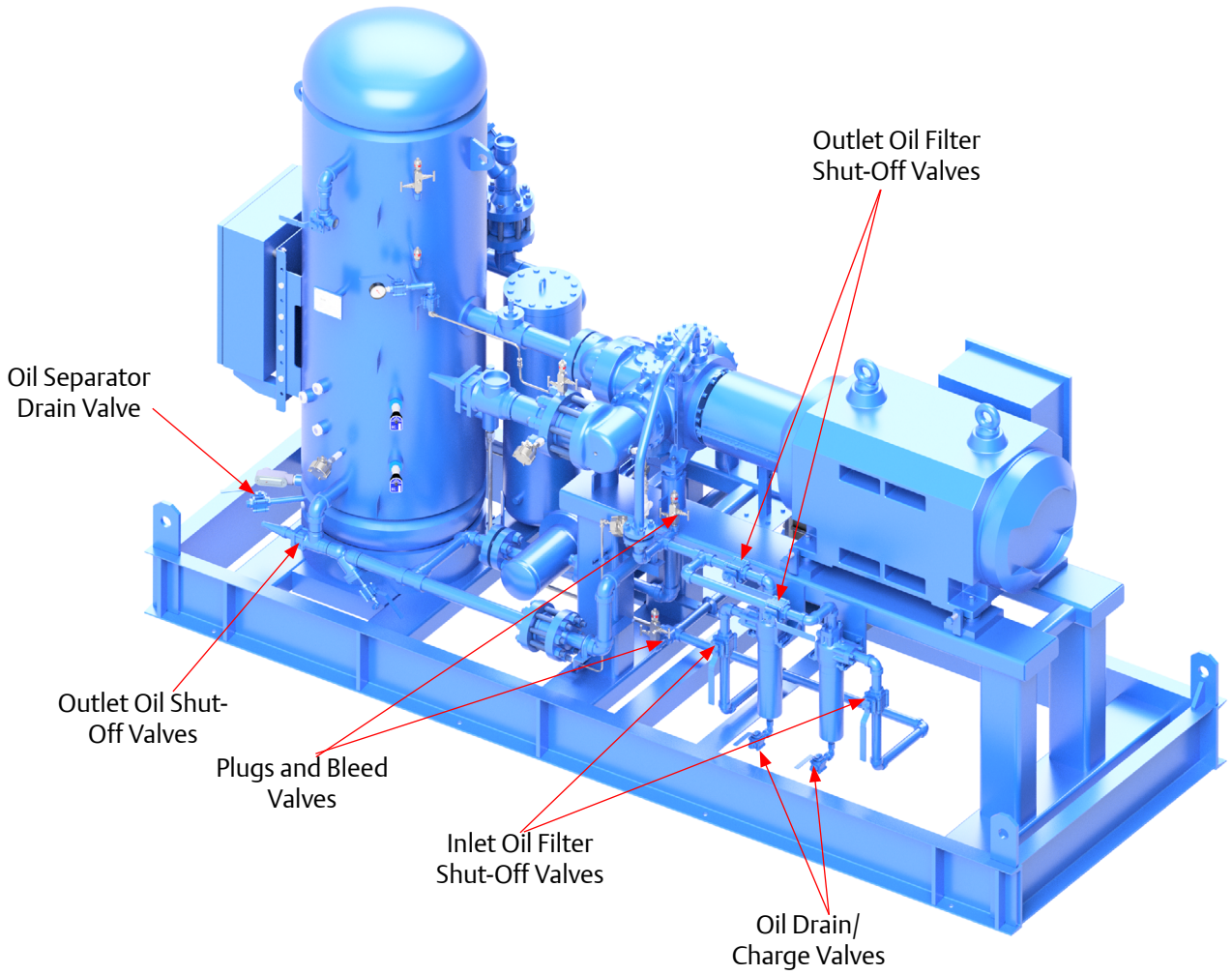


Figure 5-10. Dual Oil Filter (3677A Oil Filter Housings Shown)

Oil Pump Strainer Servicing

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

NOTICE

Dispose of used oil in an appropriate manner following all Local, State and Federal laws and ordinances.

WARNING

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

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. 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, at the oil filter inlet(s), oil cooler inlet and oil cooler outlet.
4. Position drain pan under drain valve.
5. Open strainer drain valve and allow oil to completely drain, see Figure 5-11.
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 Table A-3 in 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.

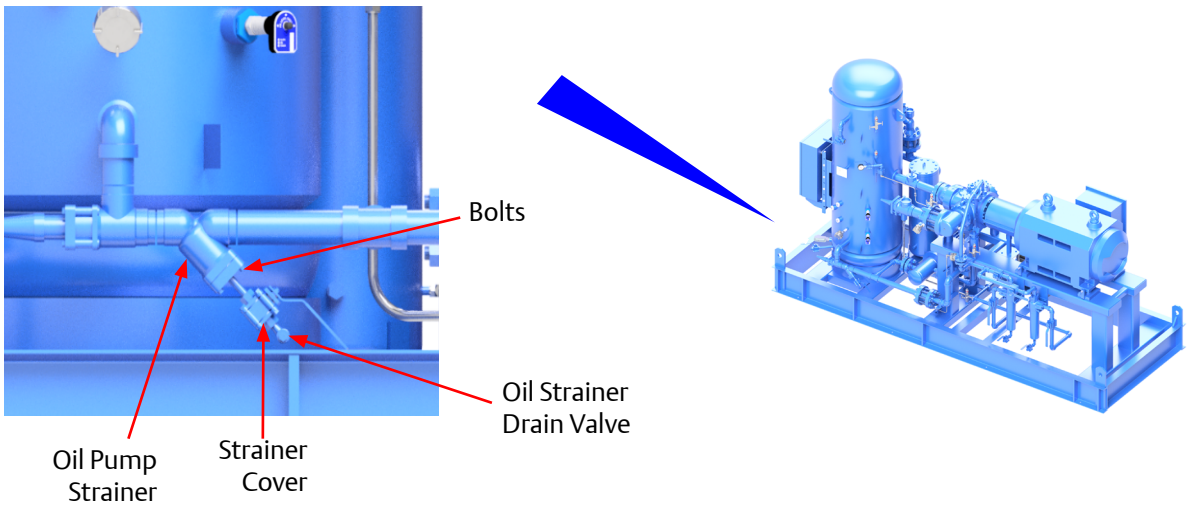


Figure 5-11. Oil Pump Strainer and Drain Valve

Oil Separator Coalescing Filter Replacement

WARNING

When working with refrigerants, ensure there is adequate ventilation and refrigerant vapor detectors as per ASHRAE standards. 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

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.

NOTE

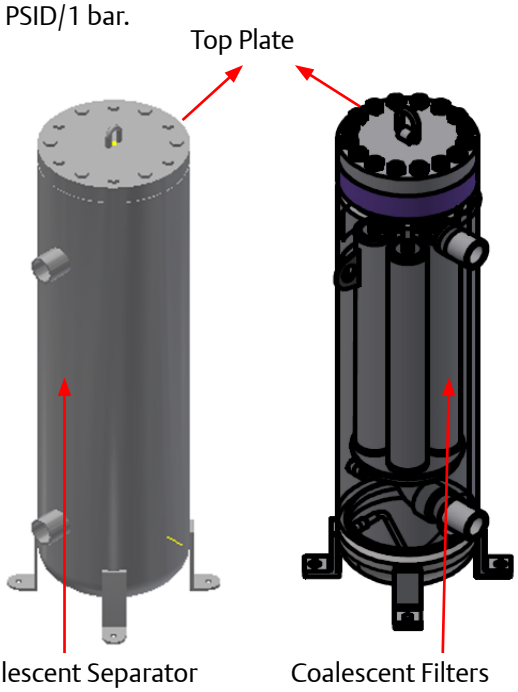
The oil separator coalescing filters pick up all dirt and particulates down to 0.3 microns. Replace filter if dirt loading is above 14.5 PSID/1 bar differential across the separator.

Filter Replacement

1. Isolate the compressor unit from the system, per compressor unit isolation procedure.
2. Recover or recycle refrigerant from primary oil separator.
3. Make sure there is no internal pressure in both separators. Failure to do so may cause injury and/or damage to equipment.
4. Unbolt flange bolts, washers, and nuts. Put aside with washers, to be reused.
5. Use (2) screwdrivers 180° apart to pry the top plate off. Carefully remove top plate.
6. Remove filter retaining nut and sealing washer. Put aside filter nut to be reused.
7. Remove old filter and filter's O-ring.
8. Make sure filter sealing surface inside separator is smooth and clean of dirt.

Filter Installation

9. Install new Genuine Vilter coalescent. The replacement Filter Kit part number.
10. Apply a light film of oil to the O-ring on new filter and insert new filter into the separator so it is centered and the O-ring seats flush on sealing surface.
11. Install new sealing washer and saved filter nut.
12. Tighten filter nut until filter will not turn.
13. Tighten filter nut an additional 1 to 1-1/2 turns.
14. Remove old O-ring from top plate. Clean groove and place new O-ring in groove. Apply oil around the O-ring circumference and inner sealing surface inside separator's flange ring.
15. Place top plate (with O-ring side facing vessel opening) squarely over the vessel's flanged opening and use uniform pressure with both hands to press the plate squarely into the flange ring opening. If done properly, the O-ring should "snap" into the opening. If pressed in unevenly, the O-ring may not be properly sealed and there might be a gap between the top plate and the vessel's flange ring, indicating an improper seal. If so, remove top plate, make sure the O-ring is not damaged, add more oil to the flange ring and O-ring, and reassemble again until the O-ring snaps into place. Re-attach bolts and lock washers.
16. Gradually tighten bolts in an alternating star pattern to 50 foot-lbs torque.
17. Return separator to operating service, slowly opening isolation valve so flow does not rush into oil separator.
18. Verify there are no O-ring leaks.
19. Continue to monitor pressure drop and replace filters until the pressure drop remains below 14.5 PSID/1 bar.



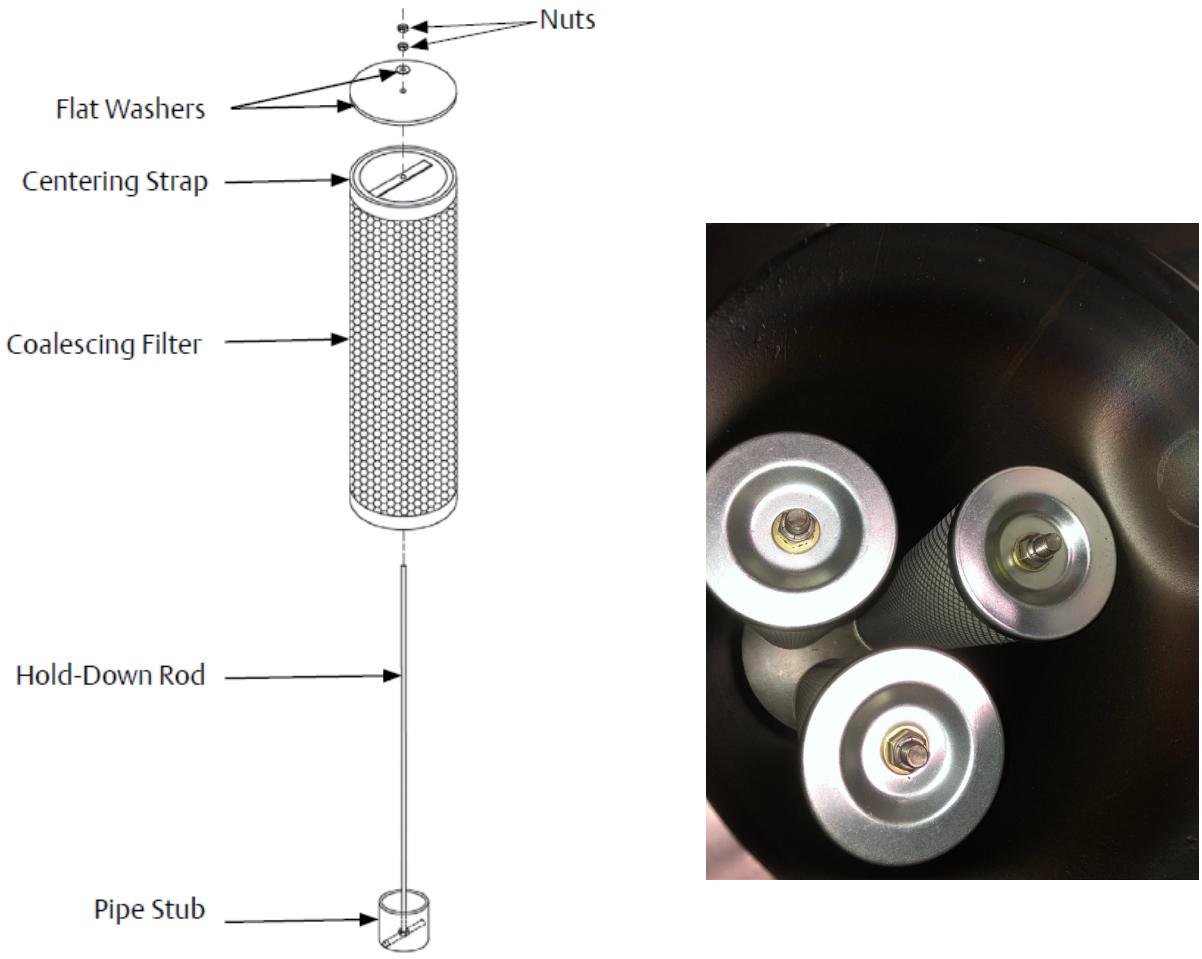


Figure 5-12. Coalescent Filter Assembly

Oil Separator Heater Cartridge Replacement

Parts Required

- **Heater Cartridges with loose wires**
  - Heater Cartridge, 1000W, 480V (VPN 3555A)
  - Heater Cartridge, 500W, 120V (VPN 3116A)
  - Heater Cartridge, 1000W, 120V (VPN 3116B)
  - Heater Cartridge, 750W, 120V (VPN 3116E)
  - Heater Cartridge, 1250W, 120V (VPN 3116J)
  - Heater Cartridge, 1000W, 220V (VPN 3116K)
- **Heater Cartridges with Turck connectors**
  - Heater Cartridge, 750W, 120V (VPN 3116C)
  - Heater Cartridge, 500W, 120V (VPN 3116D)
  - Heater Cartridge, 1250W, 120V (VPN 3116F)
- Anti-Seize, High Temperature (-65˚F to 2400˚F)

Removal

1. Isolate the compressor unit, see Compressor Unit Isolation procedure.
2. Drain oil from oil separator, see Oil Draining procedure.
3. For heater cartridges with Turck connectors, see Step 4. For heater cartridges with loose wires, see steps 5 to 9.

Heater Cartridges with Turck Connectors:

4. Disconnect Turck connector.

Heater Cartridges with Loose Wires:

5. Remove junction cover to gain access to heater cartridge wires.

NOTE
Note location of wires to aid in installation.

6. Disconnect wires.
7. Remove cable connector.
8. Remove cable and wires from junction.
9. Remove junction from heater cartridge.
10. Remove heater cartridge from thermowell.

Installation

11. Apply anti-seize to threads of heater cartridge.
12. Install heater cartridge in thermowell.
13. For heater cartridges with Turck connectors, see Step 14. For heater cartridges without Turck connectors, see steps 15 to 19.

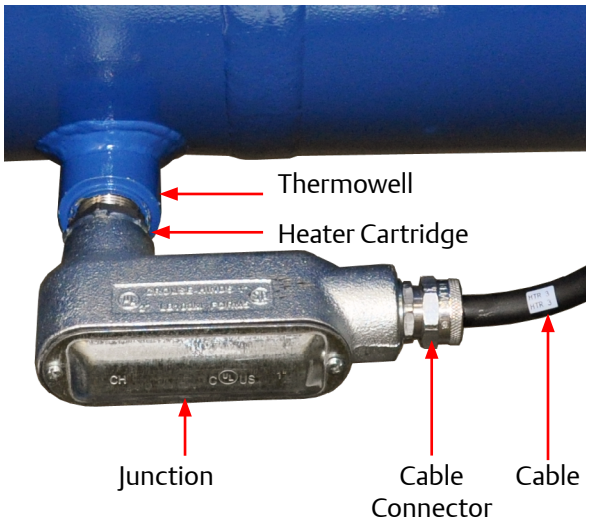
Heater Cartridges with Turck connectors:

14. Connect Turck connector.

Heater Cartridges with loose wires:

15. Install junction on heater cartridge.
16. Route cable and wires through junction.
17. Connect wires as noted during removal.
18. Install cable connector.
19. Install junction cover.

Heater Cartridge WITHOUT Turck Connector



Heater Cartridge WITH Turck Connector

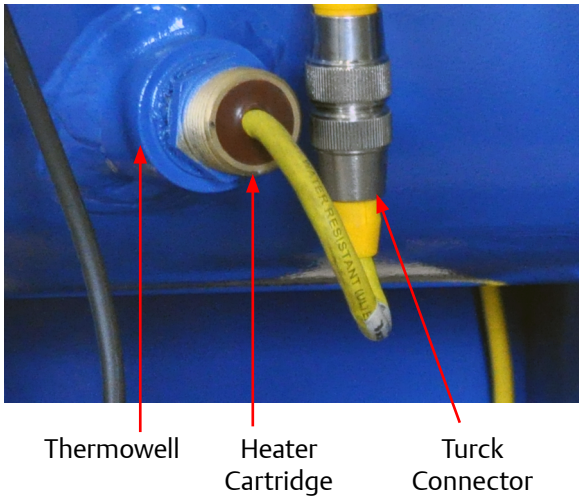


Figure 5-13. Heater Cartridges

Pressure Relief Valve

The purpose of a pressure-relief valve is to vent to the atmosphere any temporary excessive overpressure that could be present inside a vessel. As such, it is intended for a one-time over-pressure operation.

Once the valve has discharged, it attempts to re-seat itself to minimize the refrigerant loss, but it still must be replaced as soon as possible since debris may have settled on the seat during discharge, and because setting or seat tightness may have been altered during the occurrence. A relief valve must be replaced after 5 years of service in application, even if it has never discharged.

Service and Maintenance

The tamper-resistant pressure-relief valves are accurately set from factory and don´t require any field adjustments. However, a few maintenance tips must be kept in mind:

- An effort should be made to protect the valve from dirt and moisture.
- Avoid trapped ice build-up between valves and other equipment.
- Visually inspect the relief valve once a year, to detect corrosion or accumulation of scale and for leaks.

Replacement

Even when simply replacing an existing valve, a review of requirements per current local and national code is advisable.

WARNING

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

WARNING

When working with refrigerants, ensure there is adequate ventilation and refrigerant vapor detectors as per ASHRAE standards. Failure to comply may result in serious injury or death.

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious

Do not install valves in a refrigerated space unless precautions are taken to prevent moisture migration into the valve body or the relief vent line.

- Ensure that both the valve and related piping have been isolated from the refrigeration system before attempting the replacement. Pump out pressure to zero.
- Vent the relief valve to a safe outdoor location in an approved manner, away from people and building openings.
- When putting into service a dual pressure-relief system, the new three-way valve stem should be positioned so that only one valve is exposed to pressure.
- Apply thread sealing compound only to external pipe threads and use a small amount to avoid getting compound inside the valve.
- Use brackets or hangers to support the pipe and prevent the valve from being overly stressed, and don´t put undue stress on it by using it to stretch or align pipe.
- Do not discharge valves prior to installation or when pressure testing. Never attempt to reset or change the valve setting.

While the valve can be either front seated (front port is closed) or back seated (back port is closed, see Figure 5-14), the back seated position is recommended because it takes pressure off the packing and reduces the possibility of packing leaks.

When leak testing a dual pressure-relief system, the three-way valve stem of the pressure relief valve should be in the mid position. Refer to Compressor Unit Leak Check procedure.

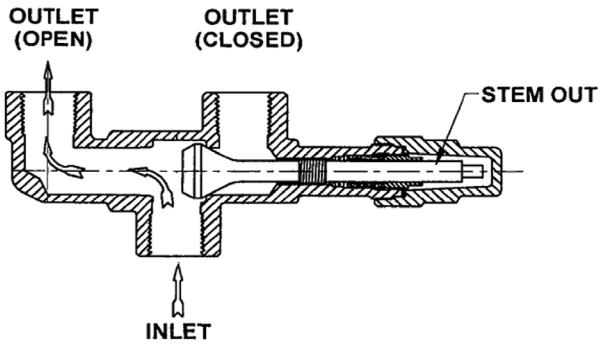


Figure 5-14. Three-way Dual Shut-off Pressure Relief Valve (Back Seated)

Lovejoy Quick Flex Standard Coupling Installation

Please complete the following steps to install QUICK FLEX couplings (See Figure 5-15 and Figure 5-16).

You should have the following pieces before starting the job:

- Two hubs (See Figure 5-15 and Table 5-4 for dimensions)
- One insert (See Figure 5-21 and Table 5-5 for dimensions)
- One cover with included hardware (See Figure 5-25 and Table 5-5 for dimensions).

Figure 5-15. Standard Coupling with High-Speed Cover

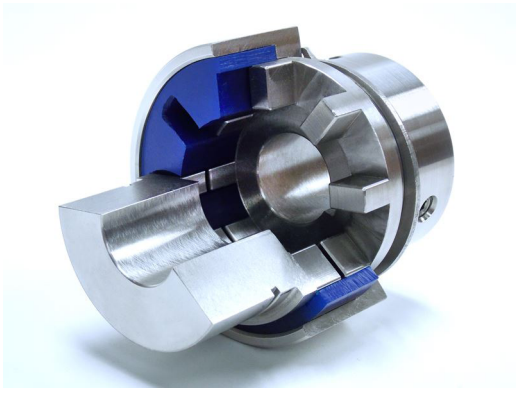


Figure 5-16. Standard Coupling Cutaway - with Blue Insert

Installation

WARNING

Failure to observe the following warnings could cause serious injury or death.

Contact with moving parts and/or rotating shafts poses a risk of serious injury. Proper guards in accordance with OSHA and American Society of Mechanical Engineers standards must be installed on all power transmission equipment. Power transmission equipment should not be started if proper guarding is not in place. Observe all required lock out/tag out procedures when servicing power transmission equipment.

1. Check the bore size of the coupling halves and the shafts. Ensure that they are the correct bore size to fit the application.
2. If the coupling does not fit easily, clean and deburr the shafts.
3. Slide on the high-speed cover:

   It should be placed on the driven shaft. If space does not permit, then it can be mounted on the drive shaft. If cover uses a snap ring, slide the snap ring down the shaft, then slide the cover onto shaft with the larger opening facing the shaft separation.
4. Install the first hub. It should be mounted so the end of the shaft is flush with surface “A” as shown in Figure 5-17. It is acceptable for the shaft to extend past “A” as long as it is not past the teeth shown as “B.”

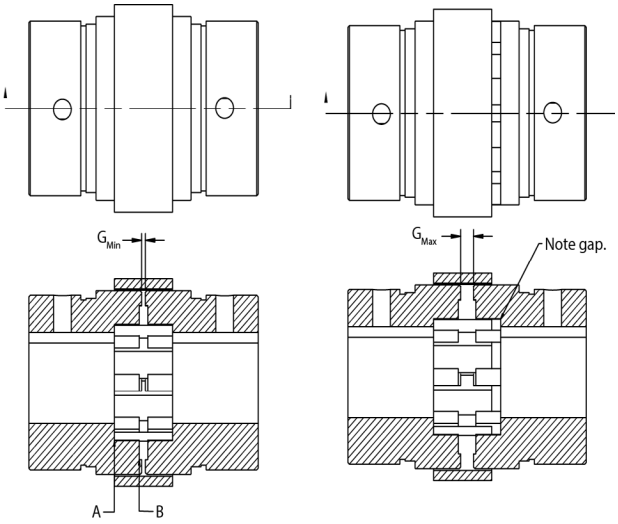


Figure 5-17. Proper Shaft-to-Hub Engagement

5. Install the second hub with the insert in place. This will set the hubs at the minimum hub gap (GMin) dimension, ensuring proper clearance. For specific GMin and GMax dimensions see Table 5-4.

NOTE

Shaft should penetrate to base of teeth and hubs should be set at GMin. Otherwise, the coupling may not deliver maximum torque.

6. Tighten both hubs securely to the shafts.
7. Check coupling for misalignment (See Figure 5-18 and Table 5-3) and align as necessary.
8. Install the High-speed Cover:
   Slide the cover over the hub and insert until fully rested against the shoulder of the hub. QF100 use standard snap rings to hold the cover in place (See Figure. 5-26). Use the included hardware to secure the cover

Table 5-3. QUICK FLEX Standard Coupling Misalignment Tolerances

Coupling Series	Radial Misalignment Tolerance	Axial Misalignment Tolerance	Angular Misalignment Tolerance
	mm in	mm in	
QF100	0.0508	0.0508	2°
	0.002	0.002	

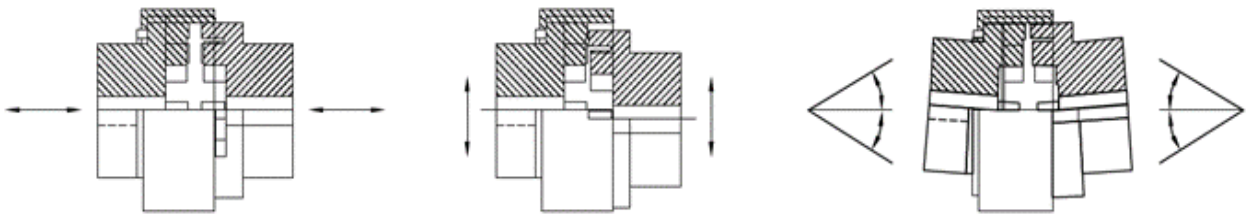


Figure 5-18. Types of Misalignment

Standard Coupling with High-Speed Cover

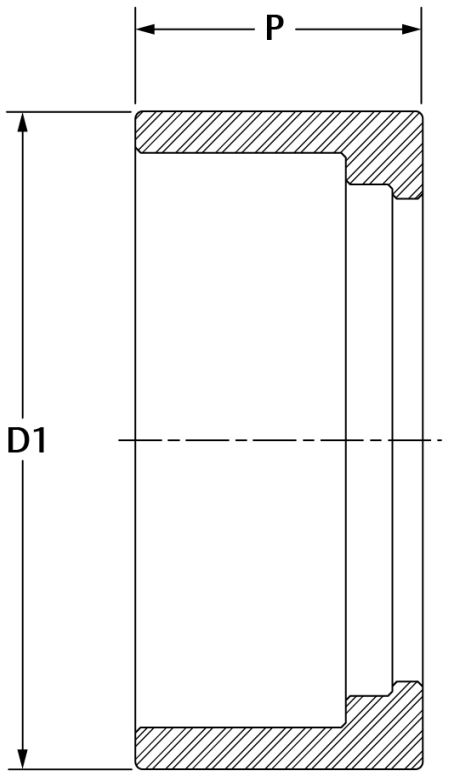


Figure 5-19. High Speed Cover

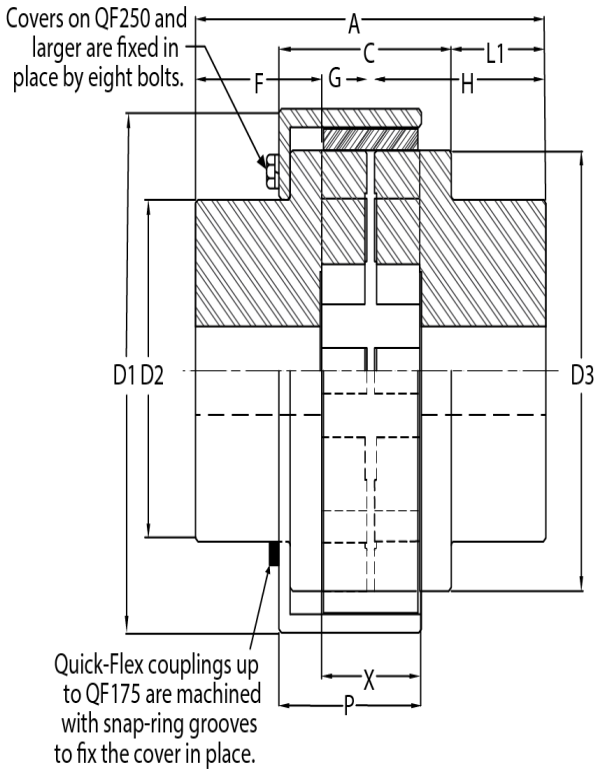


Figure 5-20. Standard Coupling with High-Speed Cover

Table 5-4. QUICK FLEX Standard Coupling with High Speed Cover Dimensions

Coupling Series	Max. Bore Size	Max. RPM	Cont. Torque[1]	A	C	D1	D2	D3	F	G_{Min}	G_{Max}	H	L1	P	X
	mm in		Nm in-lbs	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in	mm in
QF100	75	4800	3177	179	90	177	108	150	62	4	5	86	44	75	55
	3		**28115**	**7.07**	**3.55**	**7.00**	**4.25**	**5.92**	**2.46**	**0.18**	**0.21**	**3.40**	**1.76**	**2.96**	**2.19**

Notes-

1 indicates: When used with blue insert.

2 indicates: Weights shown are approximate weights of complete coupling assemblies including two pilot-bore hubs, cover and insert.

QUICK FLEX Insert

Table 5-5. QUICK FLEX Insert Dimensions

Coupling Series	L	M	N	Wt.
	mm in	mm in	mm in	kg lbs
QF100	77.5	163.6	51.3	0.7
	3.05	6.44	2.02	1.5

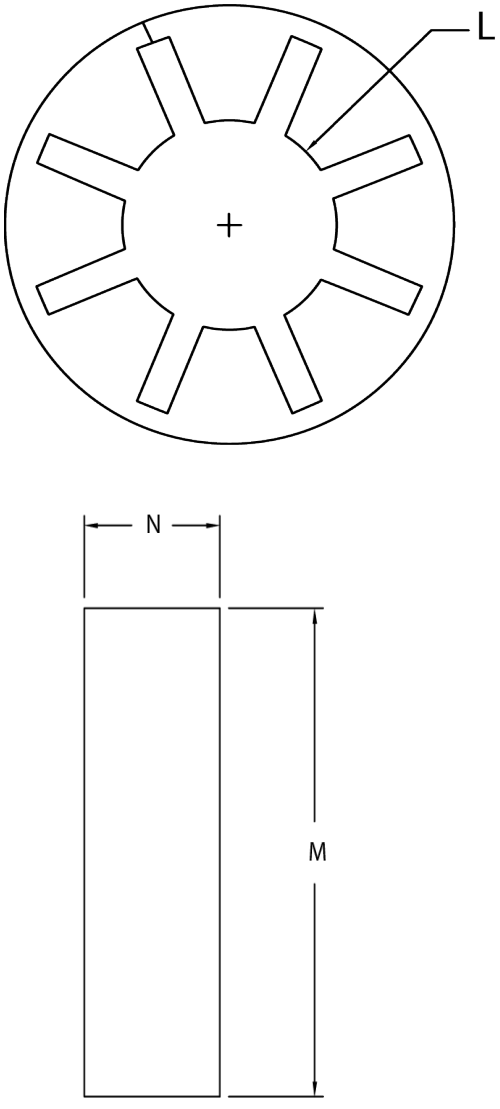


Figure 5-21. High Speed Cover

Storage of Components

Lovejoy suggests the following storage guidelines for its coupling components

(Hereinafter referred to as “products”):

- Unless directed otherwise by Lovejoy, products should be kept in their original packaging until they are ready to be placed into service.
- Do not remove or alter any labels or stencil markings on the packaging.
- Products should be stored in such a way that the packaging is not pierced, crushed, or otherwise damaged.
- After a product is removed from its packaging, it should be placed into service as soon as possible.
- When removing a product that is not individually packaged from a bulk pack container, the container should be resealed immediately after the product is removed.
- The relative humidity should be maintained below 60 percent and the surfaces should be dry.
- The storage area should be kept free from airborne contaminants such as, but not limited to, dust, dirt, harmful vapors, etc.
- Extreme conditions of any kind should be avoided. In as much as Lovejoy is not familiar with a customer’s particular storage conditions, these guidelines are strongly suggested. However, the customer may very well be required by circumstance or applicable government requirements to adhere to stricter storage requirements. Upon receipt of a product shipment, ensure that the product is not removed from its packaging until it is ready for mounting so that it does not become corroded or contaminated. Product should be stored in an appropriate atmosphere in order that it remains protected for the intended period. Any questions concerning storage should be directed to your local sales office.

Coupling Guard Replacement

NOTE

Coupling guards may differ slightly but this replacement procedure can be used to remove and install them. The coupling guard assembly described in this procedure is VPN A27435C.

WARNING

The design, construction, mounting and opening of coupling guards should be performed following proper local codes. Failure to comply may result in serious injury or death.

Removal

Reference Figure 5-22.

1. Shut down compressor unit, see Compressor Unit Isolation for Maintenance/Service procedure.
2. Remove eight screws (1) and flat washers (2) securing upper guard (7) to lower guard (8).
3. Remove three screws (1) and flat washers (2) securing upper guard (7) to ring mounting guard (5). Remove upper guard.
4. Remove two screws (1) and flat washers (2) securing lower guard (8) to ring mounting guard (5). Remove lower guard.
5. Remove eight fasteners (6) from lower guard (8).
6. Remove four nuts (4), screws (1) and flat washers (2) securing ring mounting guard (5) to four support brackets (3). Remove ring mounting guard.
7. Remove five fasteners (6) from ring mounting guard (5).
8. Remove four screws (9), lock washers (10) and flat washers (11) securing support brackets (3) from compressor. Remove support brackets. Discard lock washers.

Installation

9. Install four flat washers (11), new lock washers (10) and screws (9) to secure support brackets (3) to compressor. Do not fully tighten.
10. Install five fasteners (6) to ring mounting guard (5).
11. Install four screws (1), flat washers (2) and nuts (4) to secure ring mounting guard (5) to four support brackets (3).
12. Tighten nuts (4) and screws (9).
13. Install eight fasteners (6) to lower guard (8).
14. Install two flat washers (2) and screws (1) to secure lower guard (8) to ring mounting guard (5).
15. Install three flat washers (2) and screws (1) to secure upper guard (7) to ring mounting guard (5).
16. Install eight flat washers (2) and screws (1) to secure upper guard (7) to lower guard (8).
17. Return compressor unit to service.

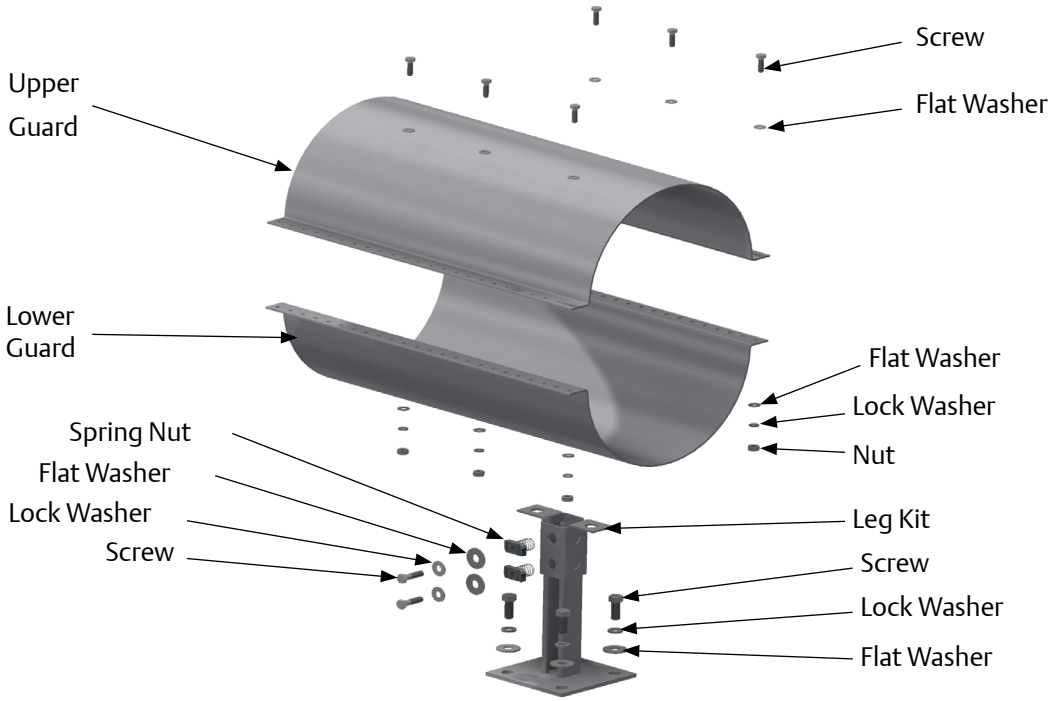


Figure 5-22. Coupling Guard Assembly (VPN A27435C shown)

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 used oil in an appropriate manner following all Local, State and Federal laws and ordinances.

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 coupling guard, see Coupling Guard Replacement procedure.
4. Remove drive coupling, see appropriate Drive Coupling Replacement procedure.
5. Remove center member, see Drive Coupling Removal procedure.

NOTE

Use appropriate supporting equipment to support and keep motor, C-flange and compressor leveled.

6. If equipped with C-flange, remove bolts securing C-flange to compressor.
7. Using appropriate drain pan, drain oil by removing drain plugs from under compressor housing and discharge manifold. Allow oil to completely drain.
8. Remove all oil lines from the compressor.
9. Support suction line with appropriate supporting equipment.
10. Remove nuts and bolts securing suction strainer/check valve assembly to suction stop valve and compressor.
11. Using appropriate lifting device, remove suction strainer/check valve assembly from compressor.
12. Remove nuts and bolts securing discharge pipe to compressor and oil separator, see Figure 5-23.
13. Remove discharge pipe and gaskets from compressor and oil separator.
14. Remove nuts, flat washers, lock washers and studs securing compressor to frame.
15. Remove any additional lines and/or components to allow removal of compressor as required.

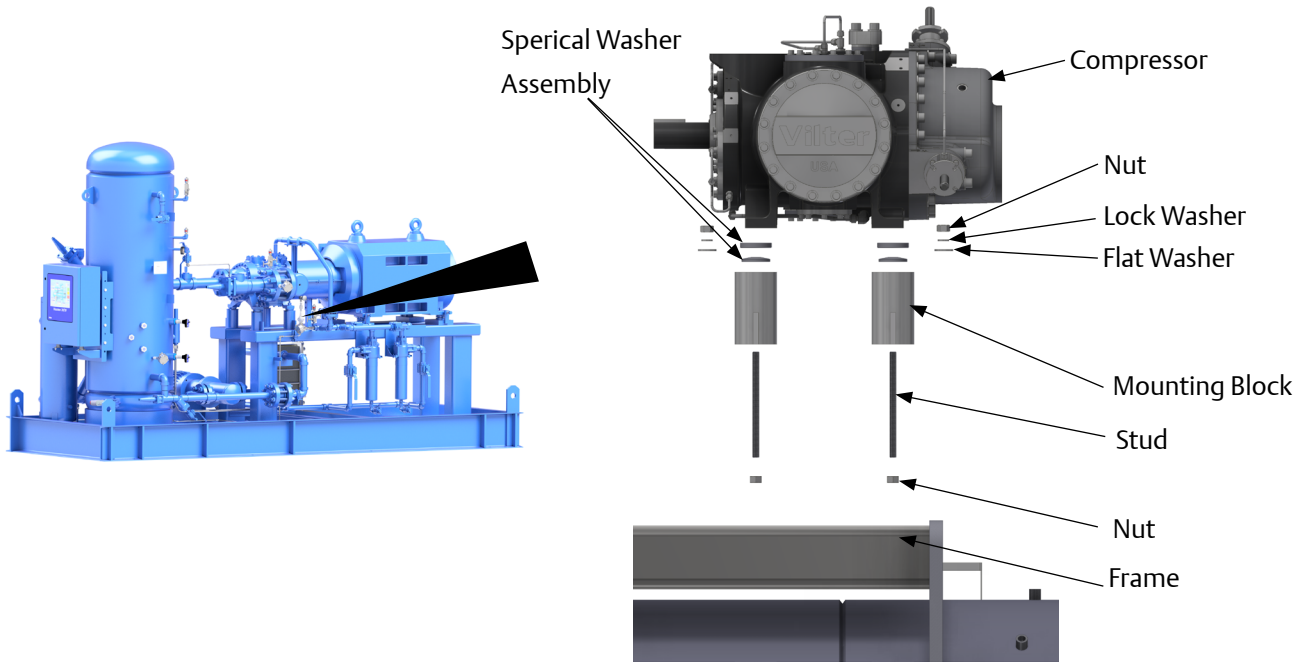


Figure 5-23. Compressor Replacement and Hardware Assembly

NOTE

Refer to Bareshaft Compressor Lifting Points and Weights Section for appropriate lifting hole sizes, weights and lifting points.

16. Install appropriate lifting eyes on top of compressor.
17. Using appropriate lifting device and additional personnel, remove compressor from frame.
18. Remove shims and spherical washers from compressor mounting locations.
19. Inspect shims and spherical washers for damage, replace as required.

Installation

20. Install shims and spherical washers on compressor mounting locations, see Figure 5-23.
21. Install appropriate lifting eyes on top of compressor.
22. Using appropriate lifting device, position compressor on compressor mounting locations on frame.
23. Loosely install studs, lock washers, flat washers and nuts to secure compressor to frame until alignment is correct.
24. Check compressor for soft foot. Add or remove shims as required until measurements are within +/- 0.002".
25. Tighten nuts to secure compressor to frame, refer to Table A-1 or Table A-2 in Appendix A.
26. If equipped with C-flange, install bolts to secure C-flange to compressor. Tighten bolts, refer to Table A-1 or Table A-2 in Appendix A.
27. Install drive coupling, see appropriate Drive Coupling Replacement procedure.
28. Install center member, see Drive Center Member Installation and Alignment procedure.
29. Install coupling guard, see Coupling Guard Replacement procedure.
30. Install nuts and bolts to secure discharge pipe to oil separator and compressor.
31. Tighten nuts on 'discharge pipe-to-compressor flange' first, then tighten nuts on 'discharge pipe-to-oil separator flange', refer to Table A-1 or Table A-2 in Appendix A.
32. Install nuts to secure suction strainer/check valve assembly to compressor and suction stop valve.
33. 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 Table A-1 or Table A-2 in Appendix A.
34. Install all lines to compressor.
35. Install all cables to sensors on compressor and actuator.
36. Perform leak check, see Compressor Unit Leak Check procedure.

Bareshaft Compressor Lifting Points and Weights

Table 5-6. Bareshaft Compressor Component Weights

Models	Component Weights				
	Gaterotor Bearing Housing	Gaterotor Bearing Housing Cover	Discharge Manifold	Main Compressor Assembly ONLY	Gaterotor Cover
128-243	14 lbs (6.35 kg)	9 lbs (4.08 kg)	160 lbs (72.57 kg)	1095 lbs (498 kg)	26 lbs (11.79 kg)

Table 5-7. Bareshaft Compressor Component Lifting Hole Sizes

Models	Component Lifting Hole Sizes				
	A	B	C	D	E
	Discharge Manifold (Side)	Discharge Manifold (Top)	Main Compressor Assembly ONLY (Discharge)	Main Compressor Assembly ONLY (Suction)	Gaterotor Cover
128-243	1/2 - 13 UNC -2B		1/2 - 13 UNC -2B	1/2 - 13 UNC -2B	-

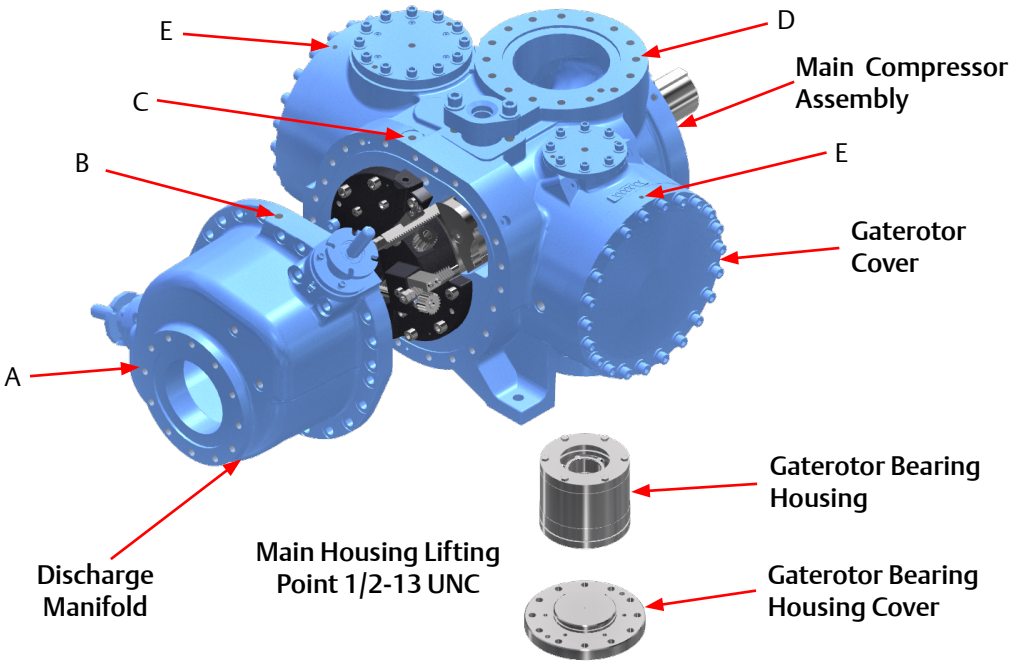


Figure 5-24. Bareshaft Compressor Lifting Points and Component Weights

Suction Tee Strainer Replacement (For Compressors VSTC 128 - 243)

The below procedure references tool A24061A which is shown in Figure 5-25 on the next page.

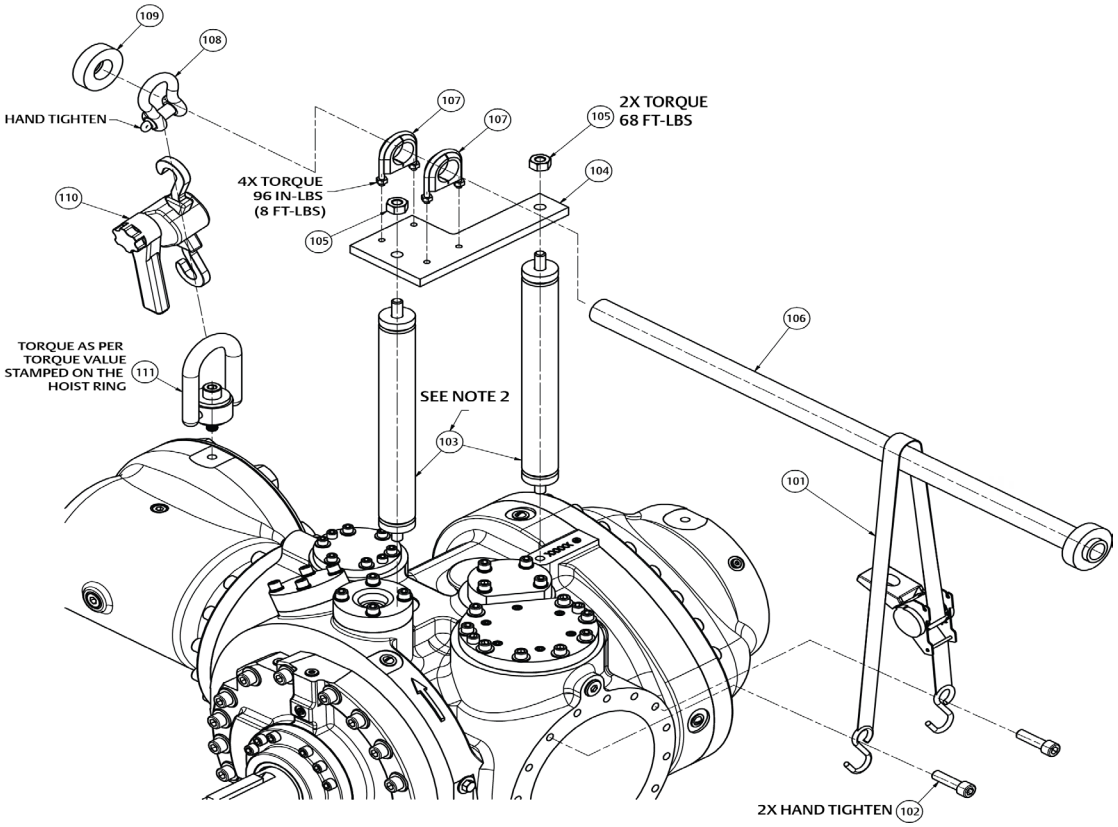
NOTE

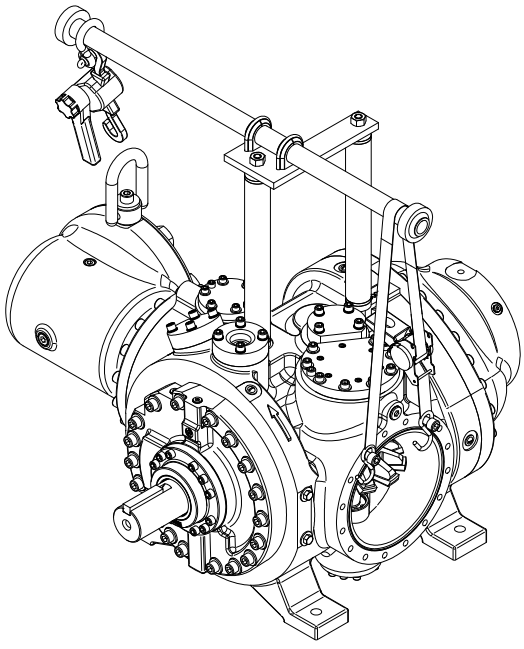
Always ensure compressor unit is locked out/ tagged out and depressurized before working on the compressor.

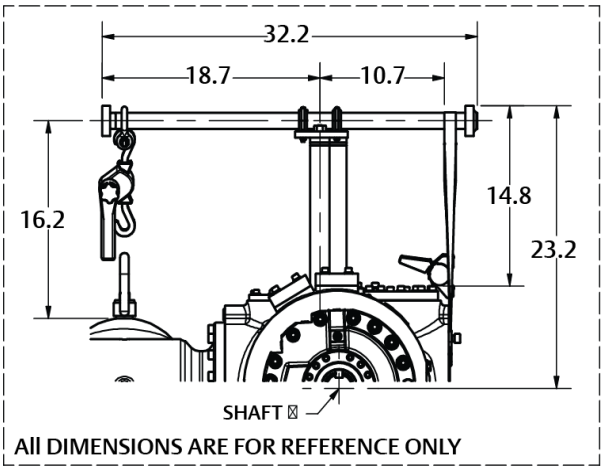
1. With gaterotor side cover removed re-install two bolts (item 102).
2. Install both support pillars (items 103) into the lifting holes of the main compressor frame.
3. Install support plate (item 104) using two nuts (item 105). Torque to 68ft-lbs
4. Install two u-bolts (item 107) into the support plate (item 104) but do not tighten nuts.
5. Slide cantilever beam (item 106) through u-bolts such that the un-capped end sticks approximately 18" from the support pillar toward the suction tee (see dimensional view on drawing). Tighten the nuts on the u-bolts to 8ft-lbs.
6. Slide the lifting eye (item 108) over the uncapped end of the beam and tighten the end cap (item 109).
7. Attach the ratchet strap (item 101) to the opposite end of the beam and bolts. Tighten the ratchet until there is tension on the strap.
8. Install hoist ring (item 111) into the lifting hole of the suction tee. Torque per value specified on the hoist ring.
9. Attach chain hoist (item 110) to the lifting eye on the cantilever beam.
10. Hook the other end of the chain hoist to the hoist ring on the suction tee.
11. Tighten the chain hoist until there is a small amount of tension on the hoist.
12. Remove socket head cap screws that attach the suction tee to the compressor and bolts/studs that connect the suction tee to the suction line/check valve.
13. Once all bolts/studs are removed, the suction tee can be lowered to the ground (take care of any oil that may be present in the suction tee).
14. Use a snap ring plier to remove the snap ring, then remove the old strainer.
15. Put in the new strainer and put back the snap ring.
16. Once ready to re-assemble, the chain hoist can then lift the suction tee back into place before being bolted down.

WARNING

Do not use this tooling to lift objects weighing more than 140 LBS







Notes-

1. Tooling assembly approx. Weight 37 lbs.
2. Install by hand tightening each item #103 on two lifting holes on compressor housing. Make sure item #103 does not wobble after installation.

Figure 5-25. Tool (A24061A) To Handle Suction Tee Assembly

Compressor Inspection

Compressor Shaft Bearing Clearance Inspections

If clearance measurements are out of tolerance, contact Vilter Technical Support for further assistance.

CAUTION

When taking the measurements, do not exceed 300 to 500 lbs of force at point of contact or damage may result to the bearings.

Determine Maximum Applied Force

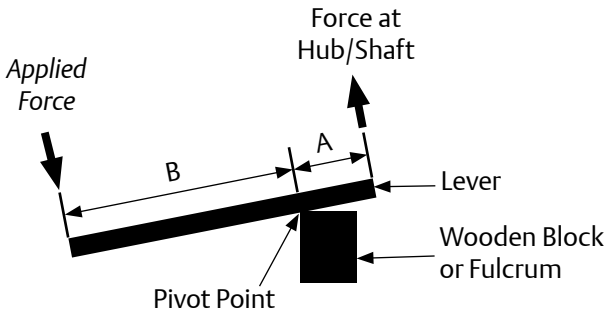
To determine maximum applied force, take maximum applied force at hub/shaft multiplied by length of A and divide by length B. This is the maximum force that should be applied on the lever.

(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 5-8 shows maximum applied forces for 36" lever with 6" pivot for all compressor models.

Main Rotor Bearing Axial Clearance Inspection

To inspect bearing axial clearance, 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 5-26.
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 5-8, the bearing may need to be replaced. Contact Vilter™ Technical Support.

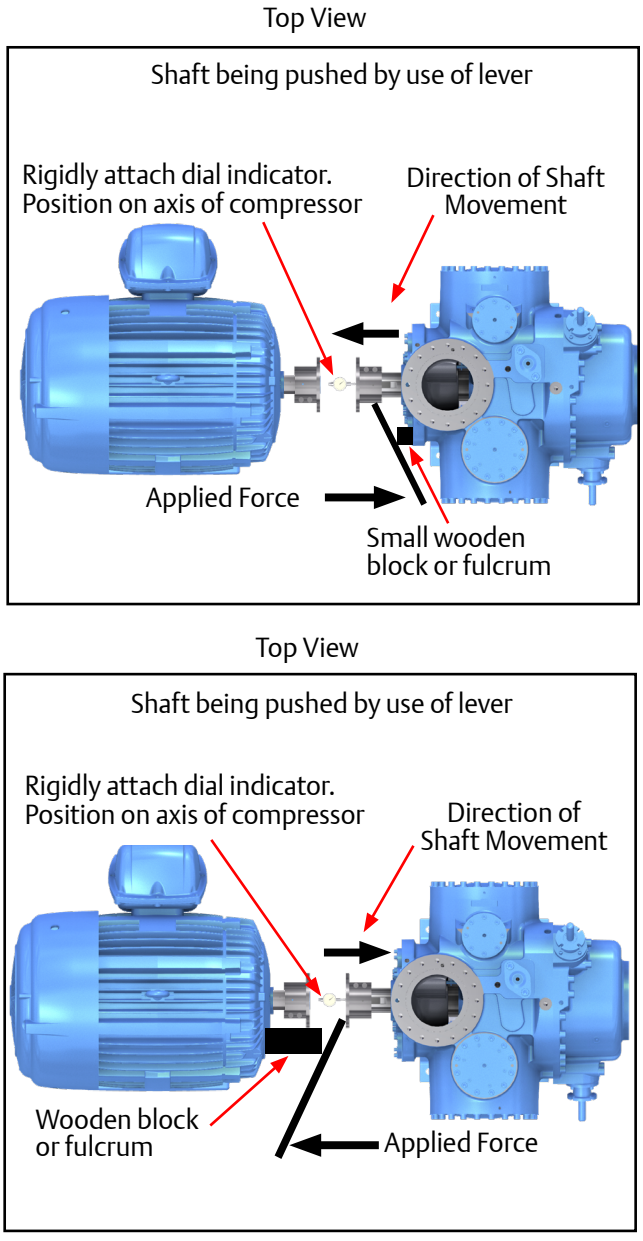


Figure 5-26. Bearing Axial Clearance Inspection

Main Rotor Bearing Radial Clearance Inspection

6. Install dial indicator to the compressor frame and zero indicator, see Figure 5-27.

NOTE

Do not exceed maximum applied force. For maximum applied forces of all compressor models, see Table 5-8.

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 5-8, the bearing may need to be replaced. Contact Vilter™ Technical Support.

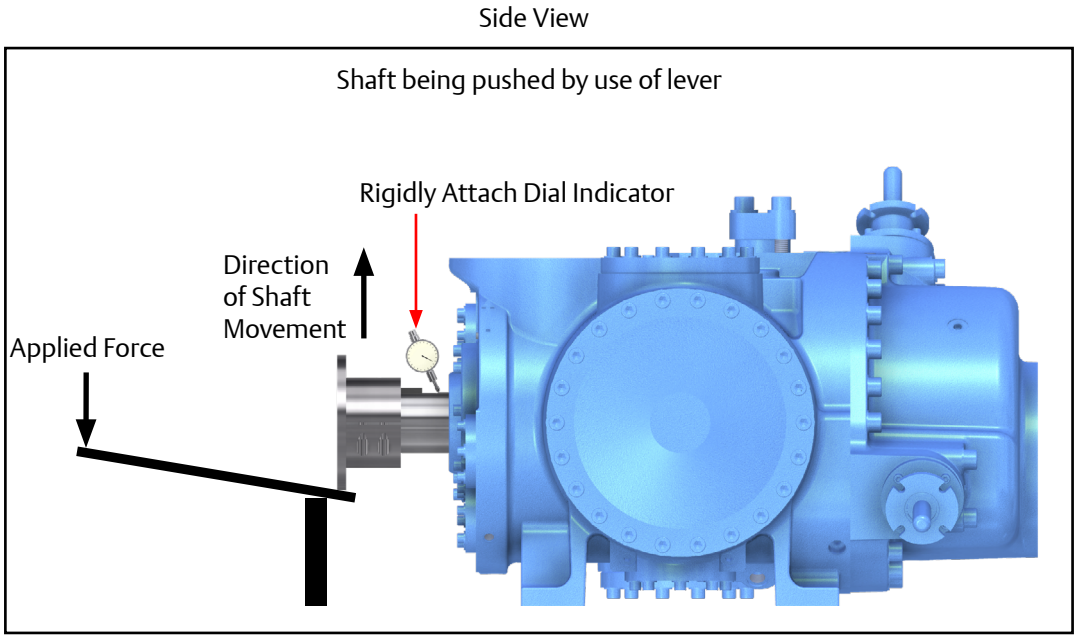


Figure 5-27. Bearing Radial Clearance Inspection

Table 5-8. Maximum Main Rotor Bearing Clearance

Compressor Model	Max. Axial Clearance in. (mm)	Max. Radial Clearance in. (mm)	Max. Force at Hub/Shaft lbf (N)	Max. Applied Force (36" Lever, 6" Pivot) lbf (N)
128, 145, 160, 180, 204, 222, 243	0.002 (0.051)	0.006 (0.152)	100 (444)	20 (89)

Gaterotor Bearing Inspection

1. Position a one gallon (at least) plastic oil collection bin beneath the side cover. Carefully pry open the side cover to allow the oil to drain before finally removing the side cover.
2. To measure the gaterotor radial bearing clearance, position a dial indicator to the gaterotor shaft as shown in Figure 5-28 (a) and zero the indicator. Put a hand as shown and firmly move the shaft in the direction shown in Figure 5-28 (a). Record the measurement. See Table 5-9 for the maximum radial clearance value.
3. To measure the gaterotor axial bearing clearance, position a dial indicator on the gaterotor, as shown in Figure 5-28 (b).
4. To check axial bearing clearance use a lever arm pivoting on a bolt with a small block of wood against the gaterotor to protect it, as shown in Figure 5-28 (b). Record the measurement. See Table 5-9 for the maximum axial clearance value.

Table 5-9. Maximum Gaterotor Bearing Clearance

Compressor Models	Max. Axial Clearance in (mm)	Max. Radial Clearance in (mm)
All Sizes	0.002” (0.051 mm)	0.004” (0.102 mm)

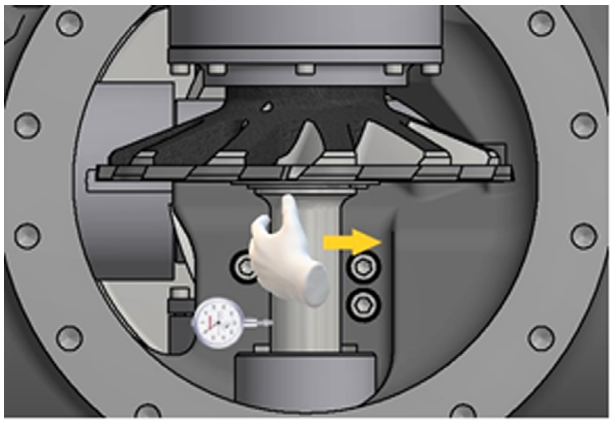


Figure 5-28 (a): Radial

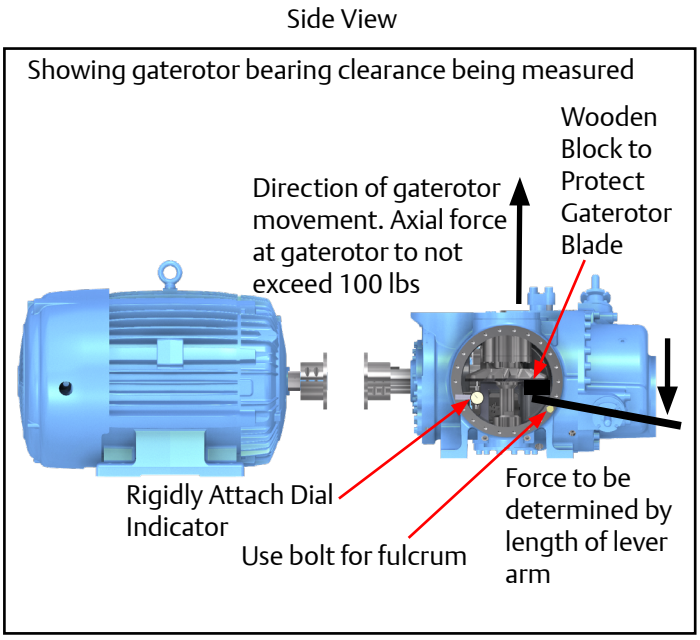


Figure 5-28 (b): Axial

Figure 5-28. Gaterotor Bearing Clearance

Gaterotor Inspection

A) Gaterotor - Main Housing Shelf Clearance

Follow these steps to check the clearance between the gaterotor and the shelf, which should be between 0.003" – 0.004", see Figure 5-29.

1. Place a 0.003" feeler gauge between the gaterotor teeth, as shown in Figure 5-30 (a) and 5-30 (b).

NOTE

Make sure the feeler gauge stays in the opening between the two teeth until it is on top of the shelf.

2. Without moving the feeler gauge, slowly rotate the gaterotor so that the feeler gauge tip stays between the gaterotor and the shelf. See Figure 5-30 (c).

CAUTION

Do not over rotate. If the rotor catches the feeler gauge, a piece can break and fall into the rotor groove.

3. Gently pull the feeler gauge out in the direction shown in Figure 5-30 (d).

Check for 0.003-0.004" (0.076- 0.102 mm) clearance between gaterotor blade and shelf.

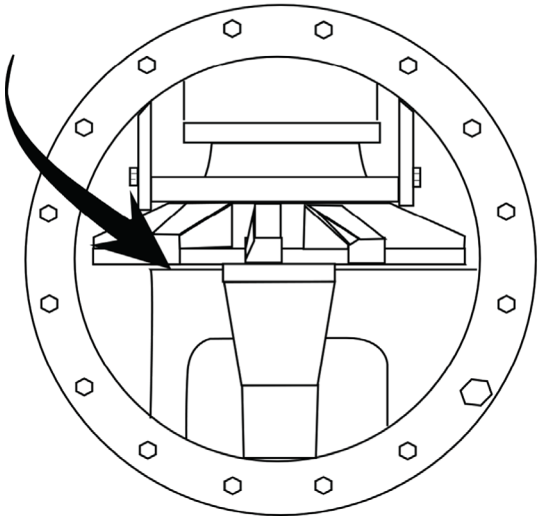
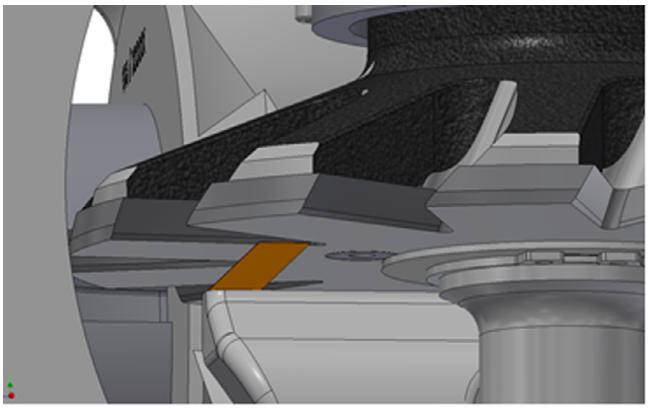
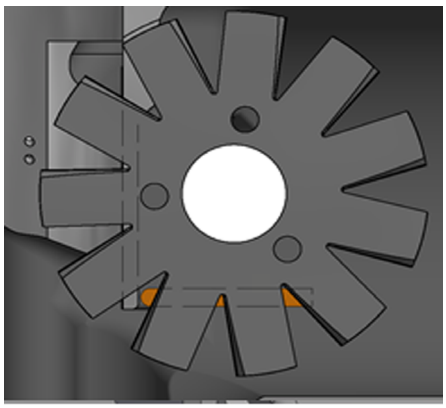


Figure 5-29. Gaterotor and Shelf Clearance

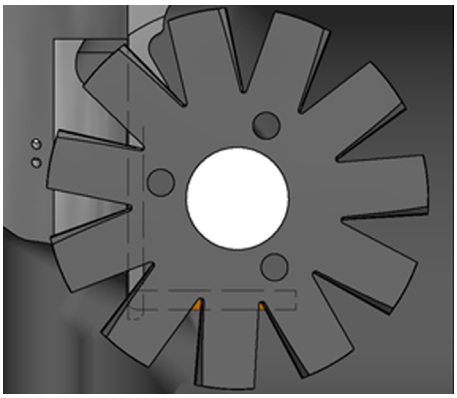
(a) Feeler Gauge Placement (Side View)

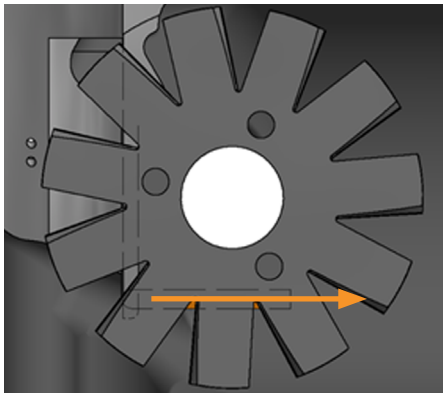




(b) Feeler Gauge Placement (Top View)

(c) Tip Of The Feeler Gauge Stays Between Gaterotor and Shelf While Rotating





(d) Feeler Gauge Must Be Pulled Out In This Direction

Figure 5-30. Gaterotor and Shelf Clearance Measurement Steps

4. If it is easy to pull out the feeler gauge, then increase the feeler gauge thickness by 0.001" and repeat above steps 1-3. If it is slightly tight to pull it out, then the clearance corresponds to the feeler gauge thickness.

NOTE

Replacement gaterotors are the same dimensionally as the gaterotors installed at the factory. Therefore, the same shims can be reused when replacement is needed to preserve the 0.003" – 0.004" clearance.

Clearance and Shims

Under 0.003"	0.003" – 0.004"	Over 0.004"
Remove shims (103 in Figure 5-45) to achieve 0.003" – 0.004"	Perfect!	Add shims (103 in Figure 5-45) to achieve 0.003" – 0.004"

B) Gaterotor Float Measurement

1. Before doing any measurements, first conduct a visual check to see if there is any noticeable clearance between the gaterotor and its bushing, see Figure 5-31. If there is noticeable clearance, please contact Vilter Service Department.

NOTE

The number of bushings on a gaterotor can be anywhere from one to three.

2. To measure the float between the gaterotor bushing and the support damper pin (see Figure 5-33), position a dial indicator at the tip of the support as shown in Figure 5-32. Hold the gaterotor in place, then gently move the support teeth back and forth with two fingers (and record measurement). Refer to Table 5-10 to find the maximum float value.

NOTICE

If clearance measurements are out of tolerance, contact Vilter Service Department for further assistance.

Table 5-10. Gaterotor Float

VSTC Model	Float in. (mm)
128, 145, 160, 180, 204, 222, 243	0.065 (1.651)

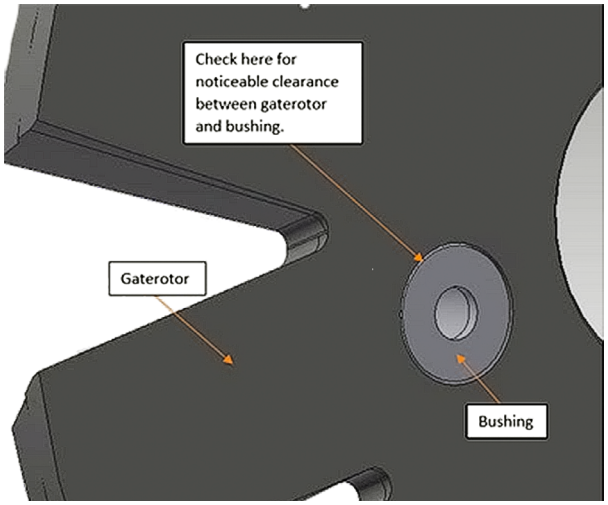


Figure 5-31. Visual Inspection Between Gaterotor and Bushing

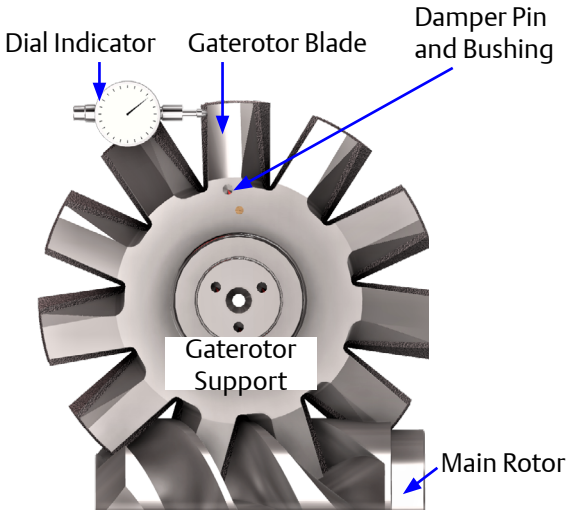


Figure 5-32. Gaterotor Float Dial Location

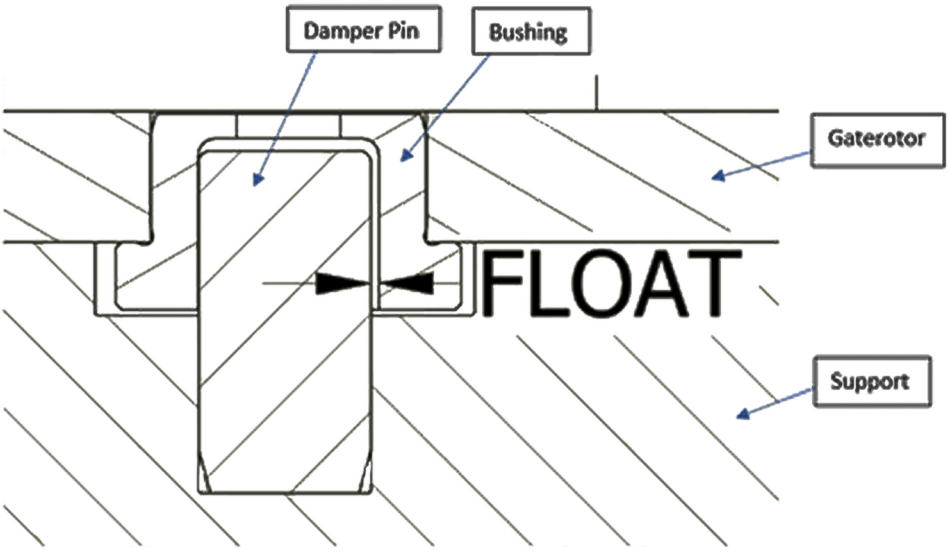


Figure 5-33. Gaterotor Float

C) Gaterotor Backlash Inspection

Gaterotor Backlash is the clearance between the gaterotor teeth width and the main rotor groove.

Follow these steps to perform the gaterotor backlash inspection:

1. The Gaterotor should be aligned so that a tooth in the rotor is perpendicular to the Main Axis as shown in Figure 5-35. The tooth should be in the center axis of the housing.
2. A dial indicator with magnetic base can be used (Vilter part numbers 9994ARE or 9994ARJ for the dial indicator, and 9994ARD for the magnetic base). See Figure 5-34 for location.

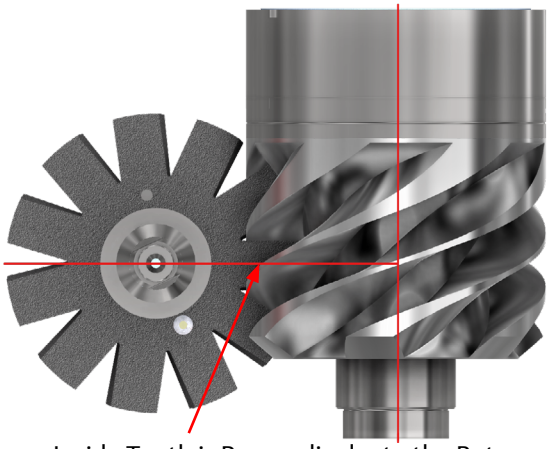


Figure 5-35. Alignment of Gaterotor

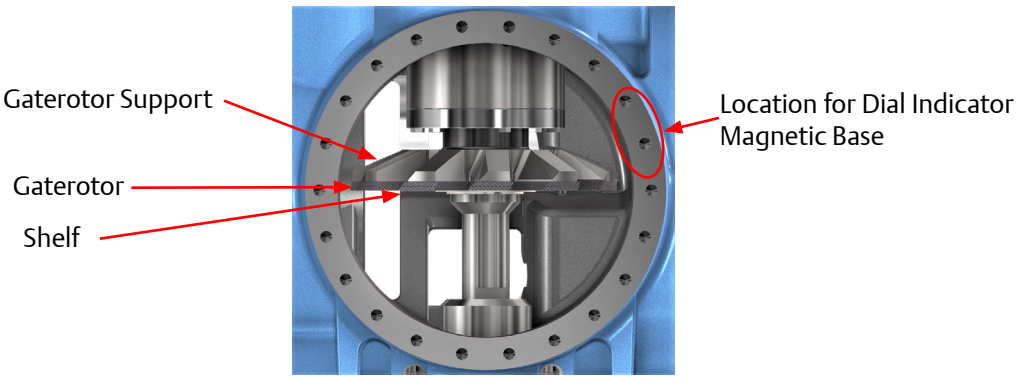


Figure 5-34. Location of Dial Indicator Magnetic Base

3. Place the Dial Indicator as square as possible on the Gaterotor tooth as shown on Figure 5-35.

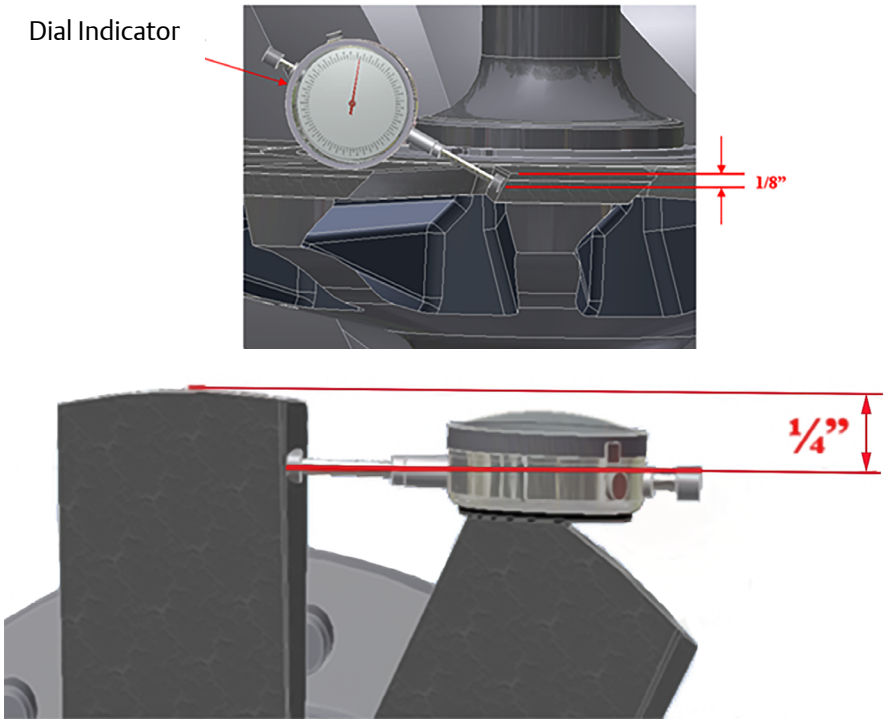


Figure 5-36. Placement of Dial Indicator

4. To measure the backlash (see Figure 5-37), move the gaterotor with two fingers back and forth rapidly several times while reading the dial indicator to see what the displacement range is. This displacement range will be the total backlash.

Contact Vilter Service Department if the measurement is above the ranges shown on Table 5-11.

Table 5-11. Backlash Range

Compressor Model	Normal Backlash
VSTC 128 thru 243	Up to 0.012" (Up to 0.305 mm)

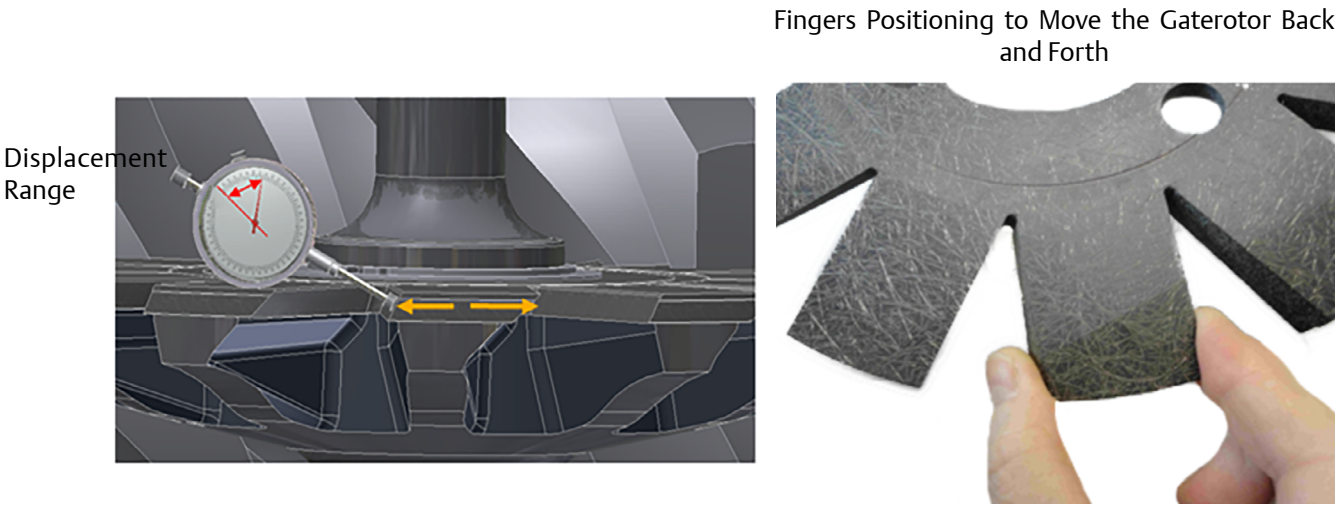


Figure 5-37. Measuring Backlash

Important Notes

1. Backlash cannot be checked if:

- The gaterotor is damaged in any way.
- The clearance between the gaterotor and the shelf is too tight.

2. Make sure you check the backlash, not the float:

- The backlash is the clearance between the gaterotor teeth width and the rotor groove.
- The float is the amount of play between the gaterotor bushing and the damper pins.

Additional Inspections

In addition, visually inspect the main rotor and gaterotors for signs of abnormal wear due to dirt or other contaminants.

If some chipping is present on the edges of the gaterotor, this will not influence the compressor performance. If chipping is more than what´s shown on Figure 5-38, take pictures and contact Vilter Service Department.

Post Inspection

After all the inspections are complete, the gaterotor cover, suction tee, coupling center member and coupling guard can be reinstalled and the unit can be evacuated and leak checked before starting.

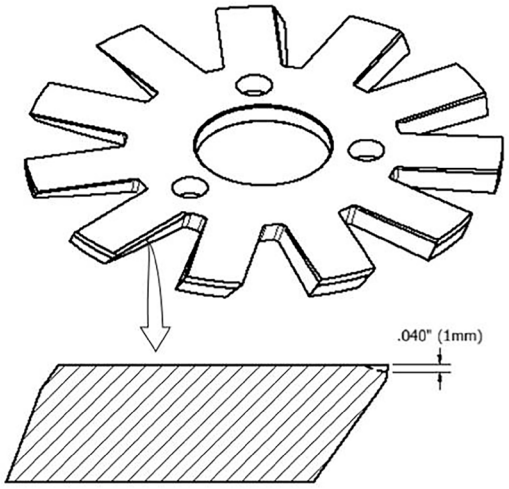


Figure 5-38. Chipped Edge of Gaterotor

Gaterotor Removal and Installation

Table 5-12 lists the gaterotor tool sets needed to remove and install gaterotor assemblies.

Table 5-12. Gaterotor Tool Kits

Model	Tool Set VPN
VSTC 128-243	A25205G & A24061A

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

Removal

1. Prepare the compressor for servicing (please see Preparation of Unit for Servicing on Page 5-3 for procedure details). Use Tool Kit A24061A to remove suction tee. See Figure 5-25 for details.

NOTE

Each gaterotor assembly must be reassembled on the same side that it is disassembled from.

2. Position at least a one gallon plastic oil collection bin beneath the side cover. Carefully pry open the side cover to allow the oil to drain before finally removing the side cover.
3. Rotate the main rotor to the position indicated in Figure 5-39.

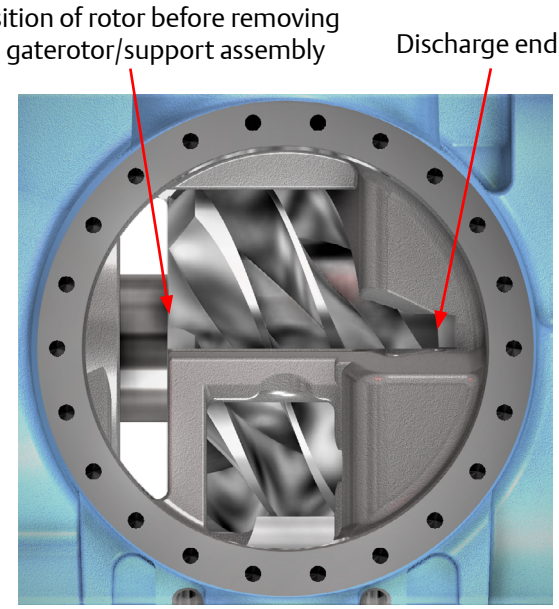


Figure 5-39. Rotor Position for Gaterotor/ Support Assembly Removal

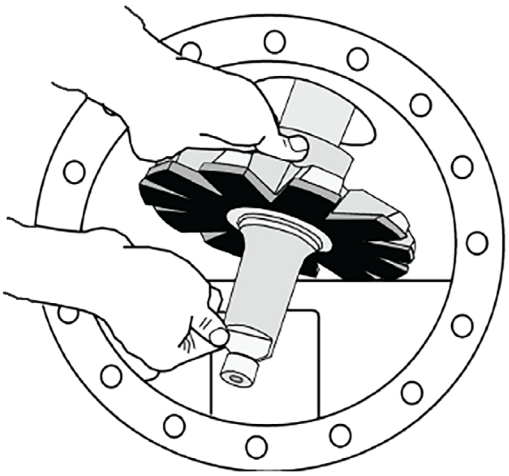


Figure 5-40. Gaterotor/Support Assembly Removal

1. Using Figure 5-41 as a guide, remove the screws (110), and the washers (115).
2. Remove ball bearing housing cover screws (112 & 113), washers (116) and cover (106).
3. Remove ball bearing retainer screws (111), washer (114), and retainer (109).
4. Remove shim pack (103) and O-ring (104-2).
5. Remove roller bearing housing (105).
6. Remove O-ring (104-3).
7. Use the tool set A25205G (shown in Figure 5-25) to remove ball bearing housing (102 in Figure 5-41):

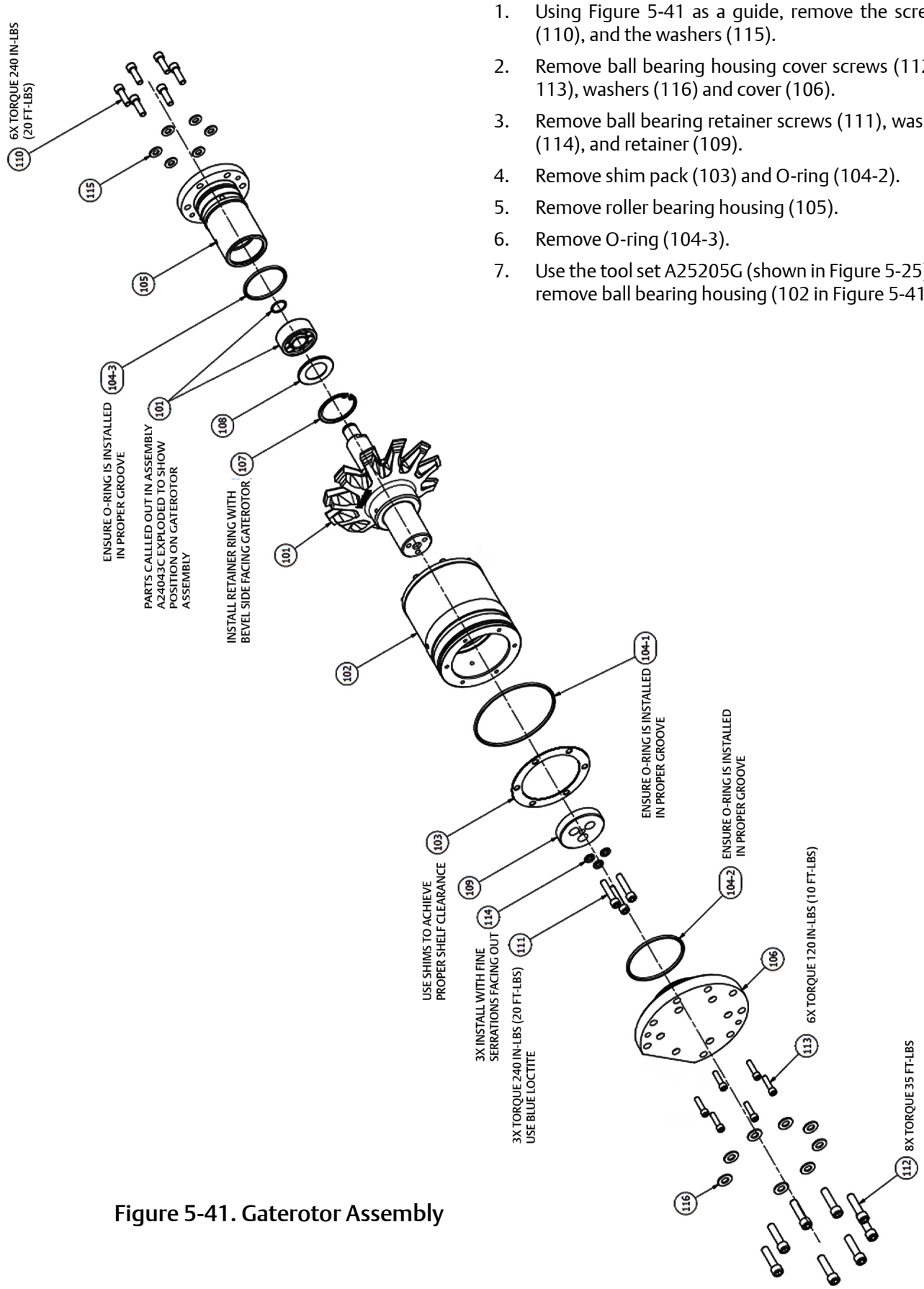
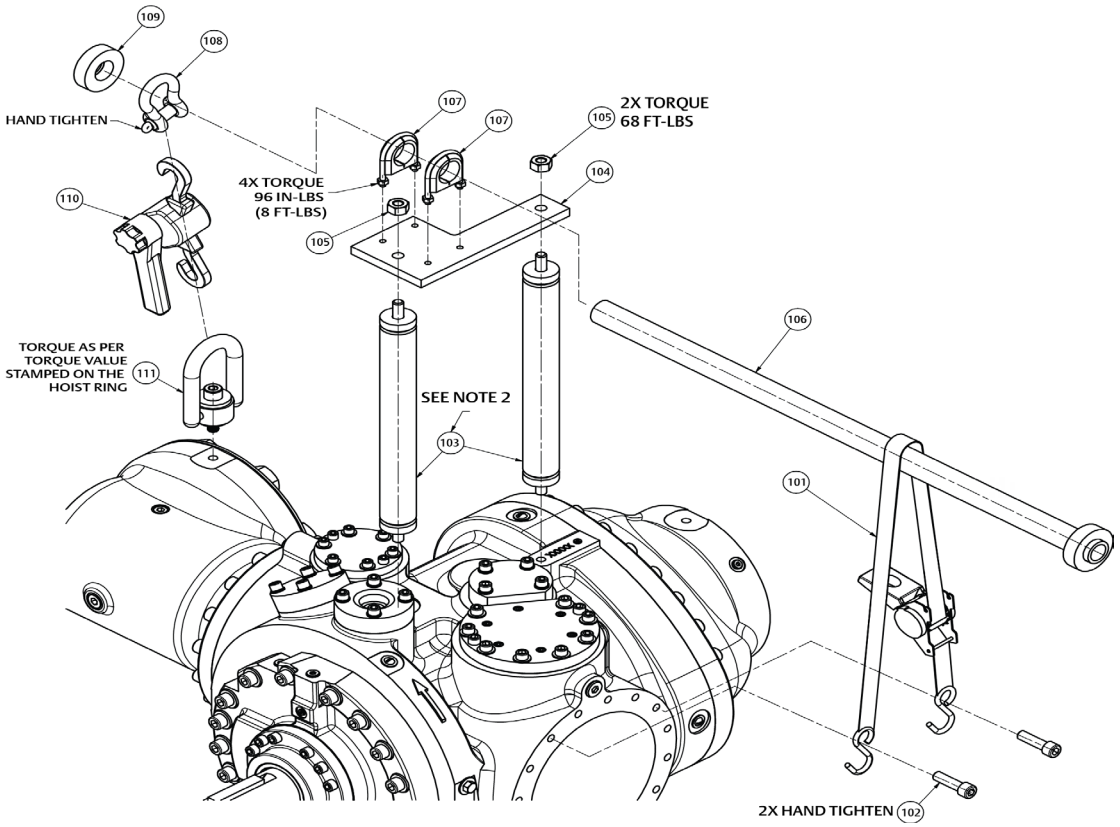
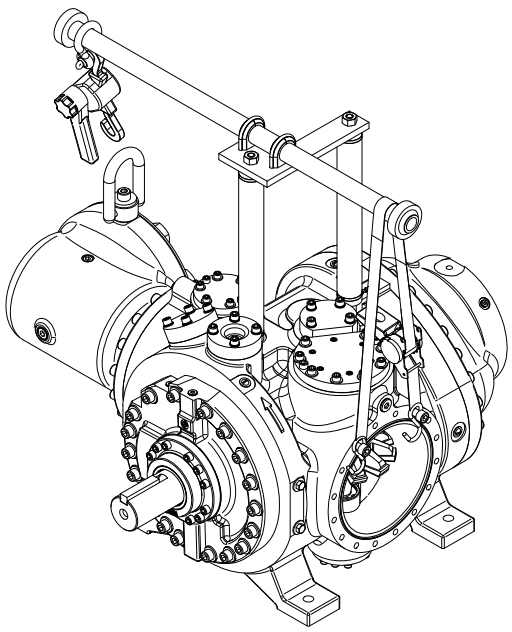


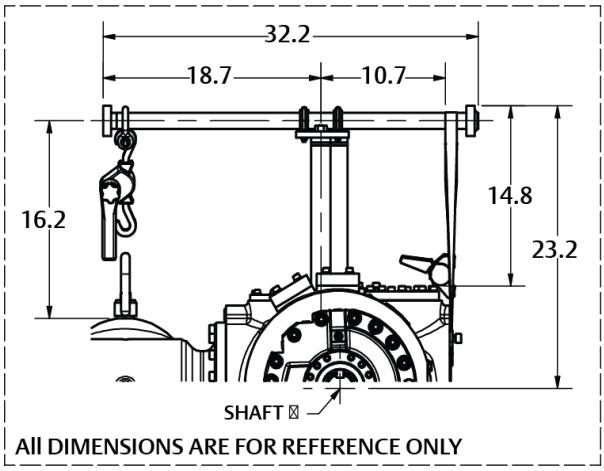
Figure 5-41. Gaterotor Assembly

WARNING

Do not use this tooling to lift objects weighing more than 140 LBS







Notes-

1. Tooling assembly approx. Weight 37 lbs.
2. Install by hand tightening each item #103 on two lifting holes on compressor housing. Make sure item #103 does not wobble after installation.

Figure 5-25. Tool (A24061A) To Handle Suction Tee Assembly

Install the tool set as shown in Figure 5-25 by hand tightening the bolt (109) - this will hold the gaterotor support in place. Turn the jacking screw (105 in Figure 5-25) clockwise. The ball bearing housing assembly will be pulled off the gaterotor support. Remove entire tool set.

8. Remove O-ring (104-1 in Figure 5-41).
9. Make sure the rotor is in position as shown in Figure 5-39. Remove support assembly (101 in Figure 5-41) as shown in Figure 5-40.

NOTE
O-rings and Nord-Lock washers (114 in Figure 5-41) will need to be replaced each time.

Note on Tool
Make sure that gaterotor is not in contact with the housing shelf while installing and removing the bearing housing assembly.

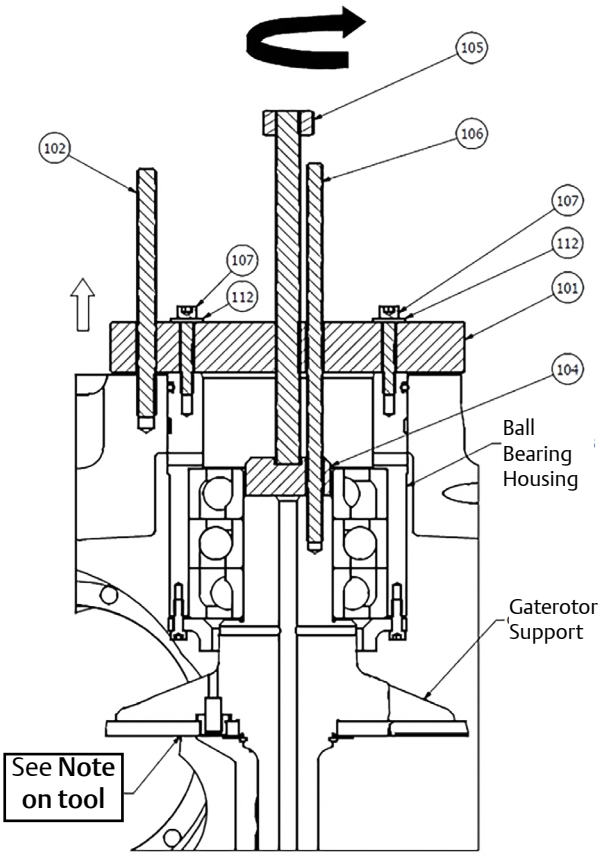


Figure 5-42. Tool To Remove Bearing Housing Assembly

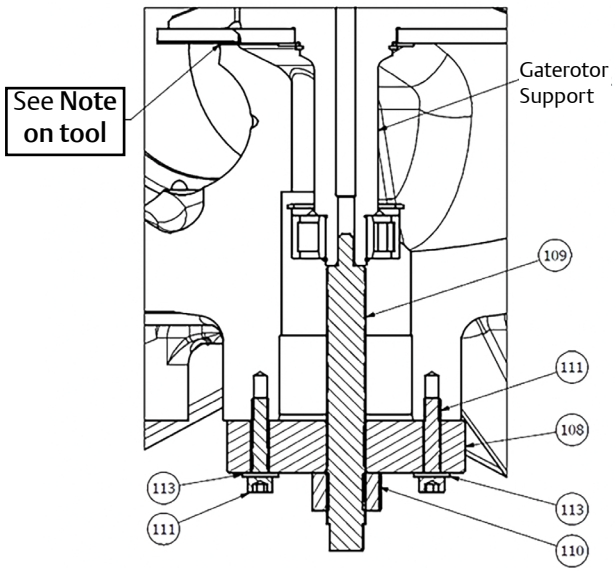


Figure 5-43. Tool To Install and Remove Bearing Housing Assembly

Installation (Refer to Figure 5-39)

Torque values for screws:
- 110: 20 ft-lbs
- 112: 35 ft-lbs
- 113: 10 ft-lbs
- 111: 20 ft-lbs (use blue Loctite)

- The beveled side of the retaining ring (101.14) must face away from gaterotor, see Figure 5-46.
- Make sure O-rings are placed in the proper grooves, see Figure 5-41.
- Washer 114 has fine and coarse serrations, and those fine serrations must be facing out. See "NORD-LOCK Washers" on Page 5-51 for more details.

1. Install gaterotor support by carefully tilting the roller bearing end of the gaterotor support towards the suction end of the compressor, see Figure 5-40. The compressor input shaft may have to be rotated to facilitate the installation of the gaterotor support, see Figure 5-39.
2. When installing the ball bearing housing (102), a new O-ring (104-1) must be used when the housing is installed, see Figure 5-41. Lubricate the outside of the housing and bearings with clean compressor oil to aid in the installation. Due to the way the bearings fit on the gaterotor support, the gaterotor tool set (A25205G) must be used. Assemble the tool set according to Figure 5-44 and 5-39 by hand tightening the bolt (109) - this will hold the gaterotor support in place. Evenly turn the jacking studs (102) clockwise. This will push the ball bearing housing onto the gaterotor support. Remove entire tool set.
3. Install the inner retainer (109), washers (114) and bolts (111) using Loctite® 242 thread locker. Tighten bolts to 20 ft-lbs.
4. Install the roller bearing housing (105) with a new O-ring (104-3).
5. Tighten bolts (110) to 20 ft-lbs.
6. Set clearance between gaterotor blade and shelf.
7. Place a piece of 0.003"-0.004" shim stock between gaterotor blade and shelf.

NOTE
This measurement determines the number of shims needed for the correct clearance.

8. Measure depth from top of compressor case to top of ball bearing housing.
9. Use factory installed shim pack (103) and ball bearing housing cover (106) without the O-ring (104-2).

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

Note on Tool
Make sure that gaterotor is not in contact with the housing shelf while installing and removing the bearing housing assembly.

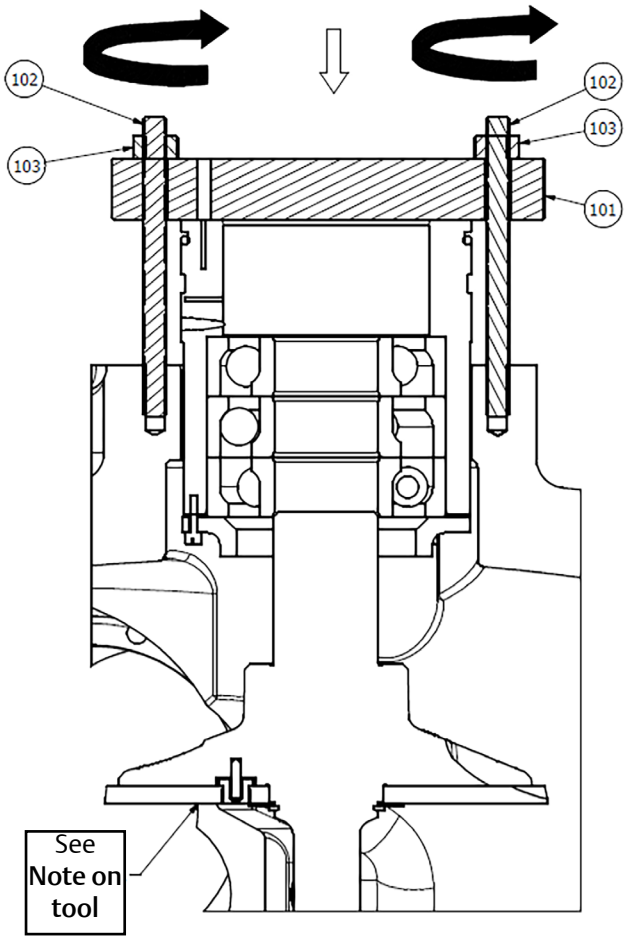


Figure 5-44. Tool To Install Bearing Housing Assembly

10. Check the clearance between the entire gaterotor blade and the shelf, rotate the gaterotor to find the tightest spot. It should be between 0.003-0.004”(0.076-0.102mm). Make adjustments, if necessary. It is preferable to shim the gaterotor blade looser rather than tighter against the shelf, see Figure 5-45.
11. After clearance has been set install a new O-ring (104-2) on ball bearing housing cover, install cover (106), and tighten the bolts (112 and 113) to the recommended torque values.
12. Install side cover with a new gasket. Tighten the bolts to the recommended torque value. The unit can then be evacuated, and leak checked.

Torque values for screws:
- 110: 20 ft-lbs
- 112: 35 ft-lbs
- 113: 10 ft-lbs
- 111: 20 ft-lbs (use blue Loctite)

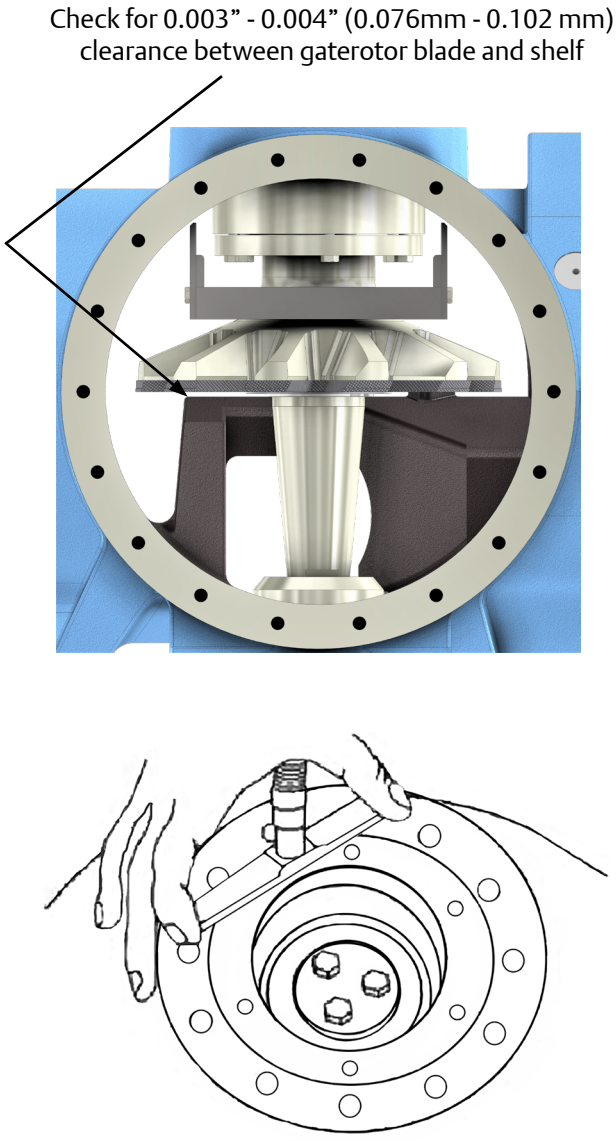


Figure 5-45. Check the Clearance Between the Gaterotor and Shelf

Gaterotor Disassembly

Gaterotor Blade Removal

1. Remove the retaining ring (101.14) and washer (101.13) from the assembly, see Figure 5-46.
2. Lift gaterotor blade assembly (101.12) off the gaterotor support (101.11).
3. Check damper pin and bushing for excessive wear. Replace if required (see Page 5-33 for gaterotor float details).

Gaterotor Blade Installation

1. Install bushings (101.12b) in gaterotor blade (101.12a) from the back side of the blade. Be sure bushing is fully seated and torqued to 5 ft-lbs. using red Loctite (271), see Figure 5-47.
2. Place blade assembly (101.12) on gaterotor support (101.11). Locate bushing over pin, see Figure 5-46.
3. After the gaterotor and support are assembled, there should be a small amount of rotational movement between the gaterotor and support.
4. Install washer (101.13) and retaining ring (101.14).

NOTE

Retaining ring (101.14) must be installed with bevel side facing away from the gaterotor, see Figure 5-46.

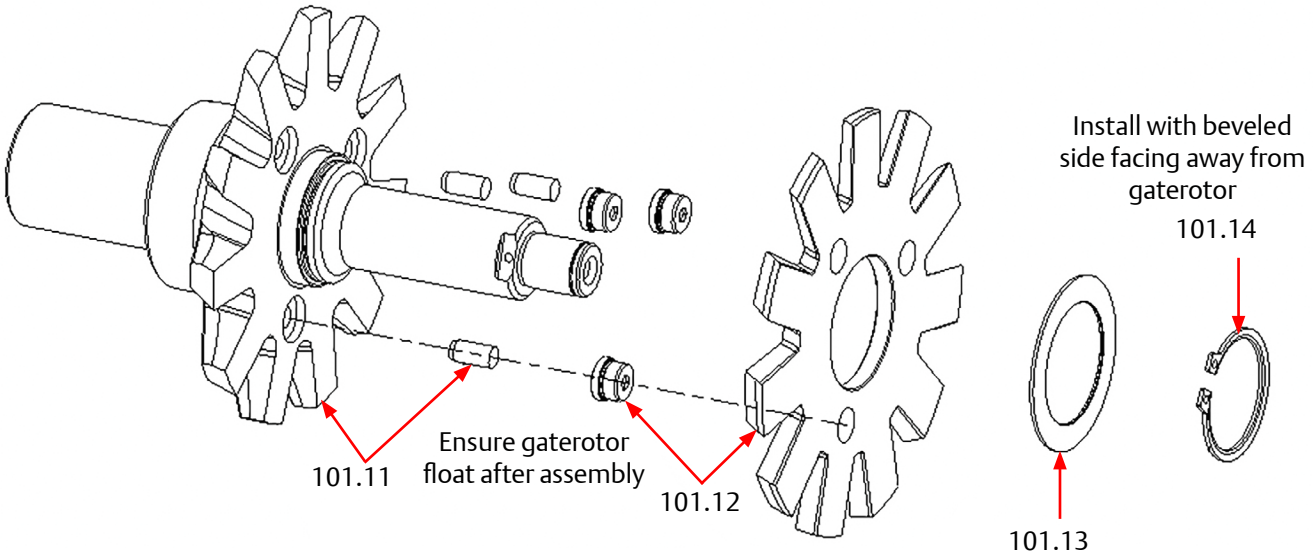


Figure 5-46. Gaterotor and Support Assembly

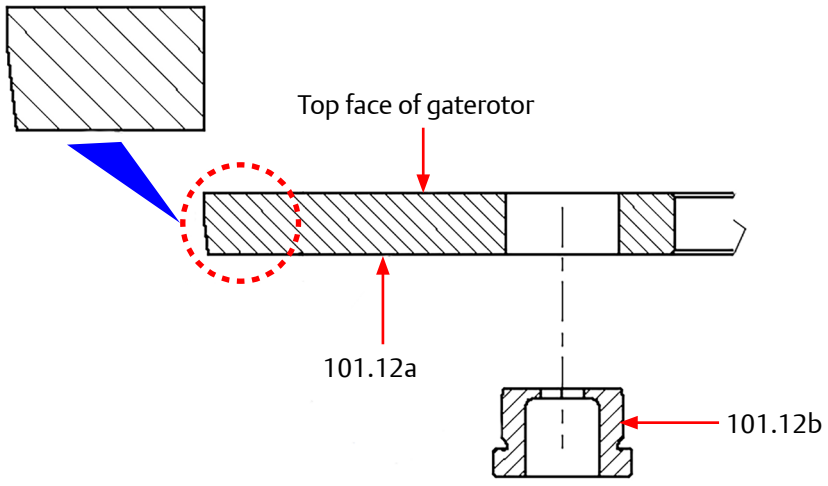


Figure 5-47. Gaterotor Top Face Identification

Gaterotor Ball Bearing Removal

1. Remove bolts (102.4) from the outer retainer (102.3), see Figure 5-48.
2. Remove ball bearing outer retainer (102.3).
3. Using a press, remove ball bearings (102.2) from housing (102.1).

Gaterotor Ball Bearing Installation

1. Install three ball bearings (102.2) in the housing (102.1) so the first two bearings are back to back, and the second and third bearings are face to face (the larger sides of the inner races are placed together, as shown in Figure 5-48. A light application of clean compressor lubricating oil should be used to ease the installation of the bearings into the housing.
2. Center the bearing outer retainer (102.3) on housing (102.1), use Loctite® 242-thread locker and evenly tighten the bolts (102.4) to the recommended torque value (4 lb-ft), see Figure 5-48.

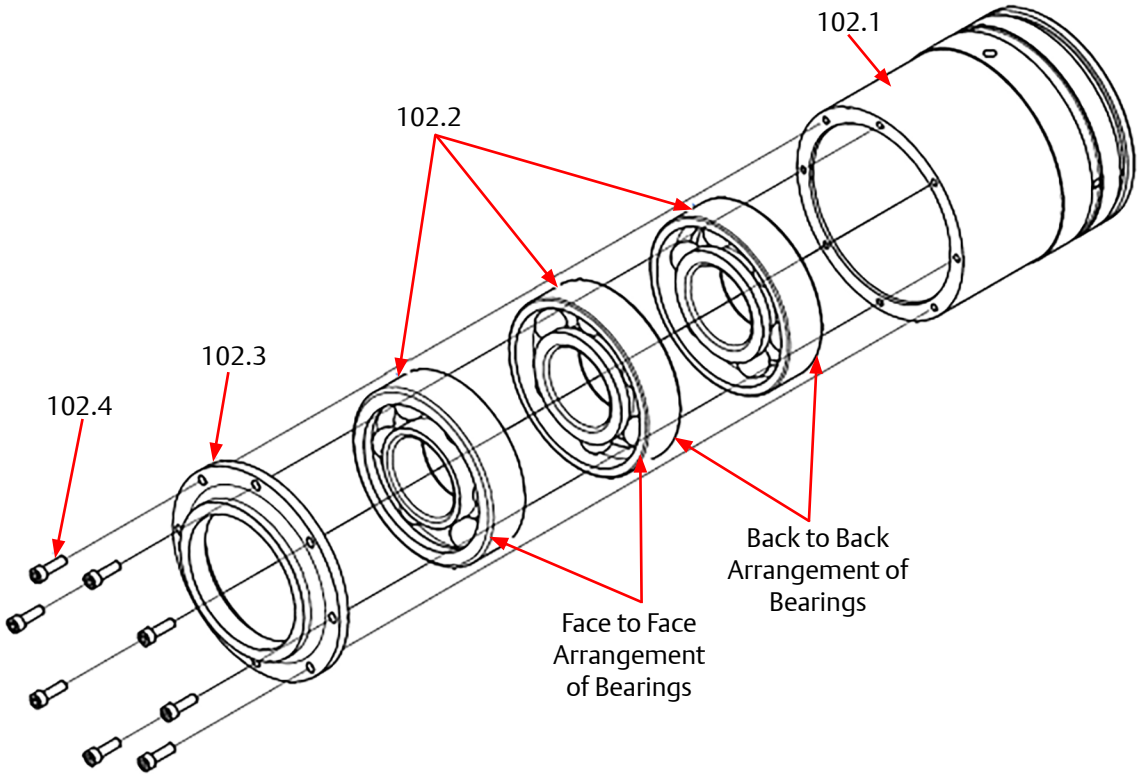


Figure 5-48. Gaterotor Ball Bearing

Gaterotor Roller Bearing Removal

1. Remove the snap ring (107), which retains the roller bearing in the bearing housing, see Figure 5-49.
2. Remove the baffle washer (108) and the roller bearing (101.3b) from the bearing housing (105).
3. Remove the retaining ring (101.2) from the gaterotor support (101.1). Use a bearing puller to remove the roller bearing inner race (101.3a) from the gaterotor support (101.1).

Gaterotor Roller Bearing Installation

1. Match up the part numbers on the inner race and outer race of the bearing (101.3a & 101.3b).
2. Install the outer race (101.3b) into the bearing housing (105). Install baffle washer (108) with inner bevel facing the bearing rollers (101.3b). Install the snap ring retainer (107) in the housing. The bevel on the snap ring must face away from the roller bearing.
3. Heat Roller bearing inner race (101.3a) to 250°F, then quickly install on gaterotor support (101.1). Once cool, install retaining ring (101.2).

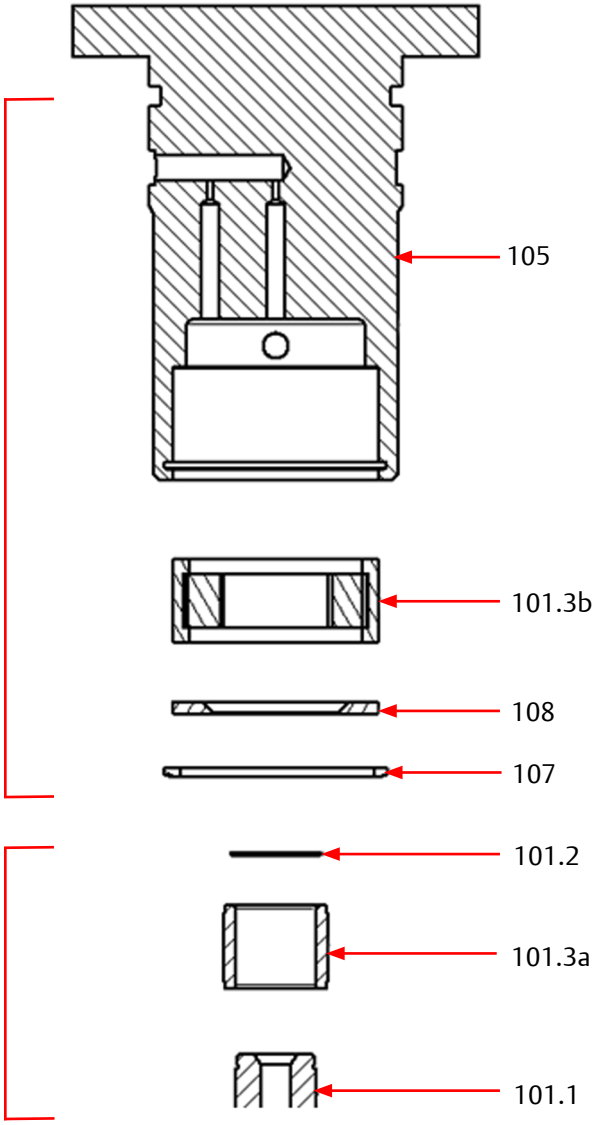


Figure 5-49. Gaterotor Roller Bearing Assembly

Compressor Shaft Seal Replacement

Shaft Seal Assembly

The shaft seal is made up of a mating ring and a carbon or silicon carbide (SC) component.

The mating ring is the rotating part of the seal and is installed against the shaft shoulder. It has a drive notch on one end which aligns with the drive pin inserted in the shaft.

Carbon or SC component is the stationary part of the seal and is installed into the shaft seal housing using an O-ring.

The shaft seal housing with the stationary part is assembled in the compressor main housing using an O-ring, see Figure 5-50.

The shaft seal needs to be carefully handled and installed to function properly. Please see Figure 5-51 for details.

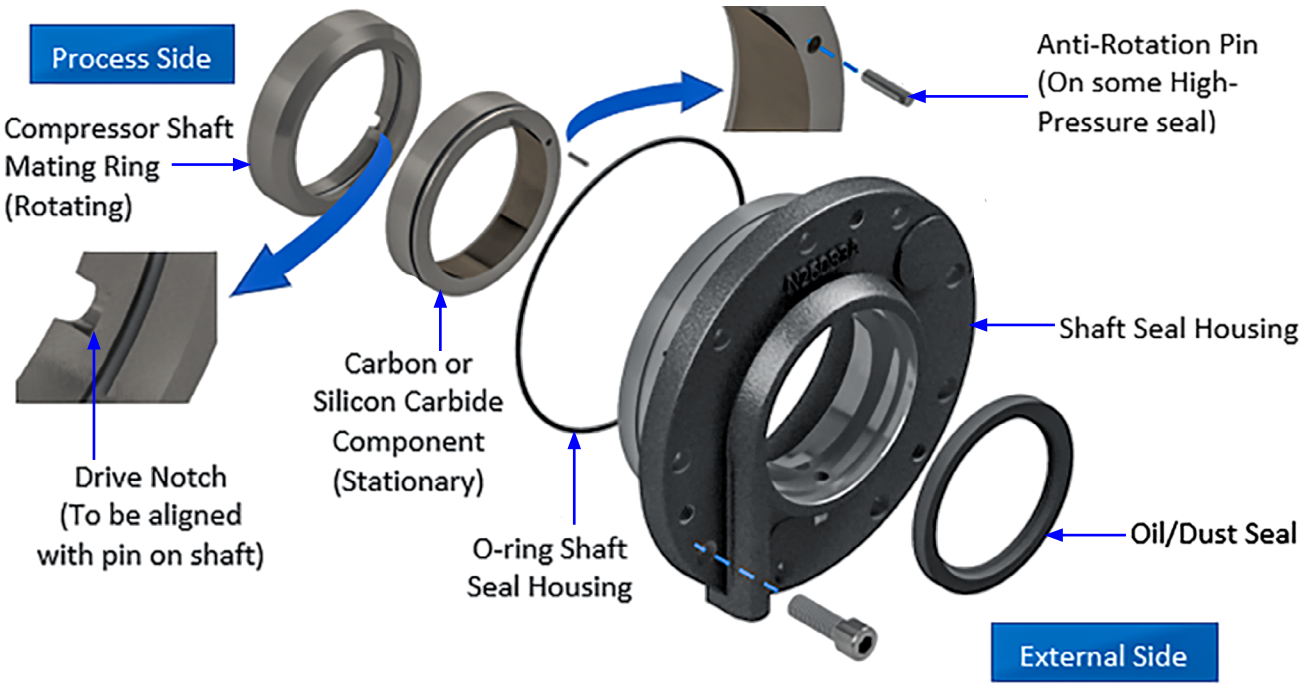


Figure 5-50. Shaft Seal Assembly

Handling Seal Face with Care

- Avoid touching seal faces as much as possible during installation.
- Be sure to always keep seal faces face-up, rather than face-down, see image on the right.

Figure 5-51. Handling Seal Face with Care

Compressor Shaft Seal Replacement

Shaft Seal Removal

(See Table 5-13 and Figure 5-52)

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE

There will be a small amount of oil drainage as the shaft seal housing is removed.

1. Remove bolts (281) securing shaft seal housing (218) to compressor.
2. Insert two bolts (281) into threaded jacking holes to assist in removing shaft seal housing (218).
3. Remove silicon carbide rotating face (219.6) & O-ring (219.7) from shaft.
4. Remove spring holder (219.8) from shaft.
5. Remove oil seal (230) from shaft seal housing (218).
6. Remove retaining ring (219.5) from seal housing.
7. Flip the seal housing over and carefully tap the stationary silicon carbide piece (219.3), retainer (219.4), and O-ring (219.2) out of the seal housing using brass drift and hammer.
8. Remove O-ring (260).

NOTE

VSTC compressors are designed using some of the following shaft seals, see Table 5-13 for their VPN and pressure ranges.

Table 5-13. Some of the Shaft Seals

Shaft Seal	Pressure (PSI)		O-ring Material
	Static	Dynamic	
25985Y	1800	1350	Fluoroelastomer

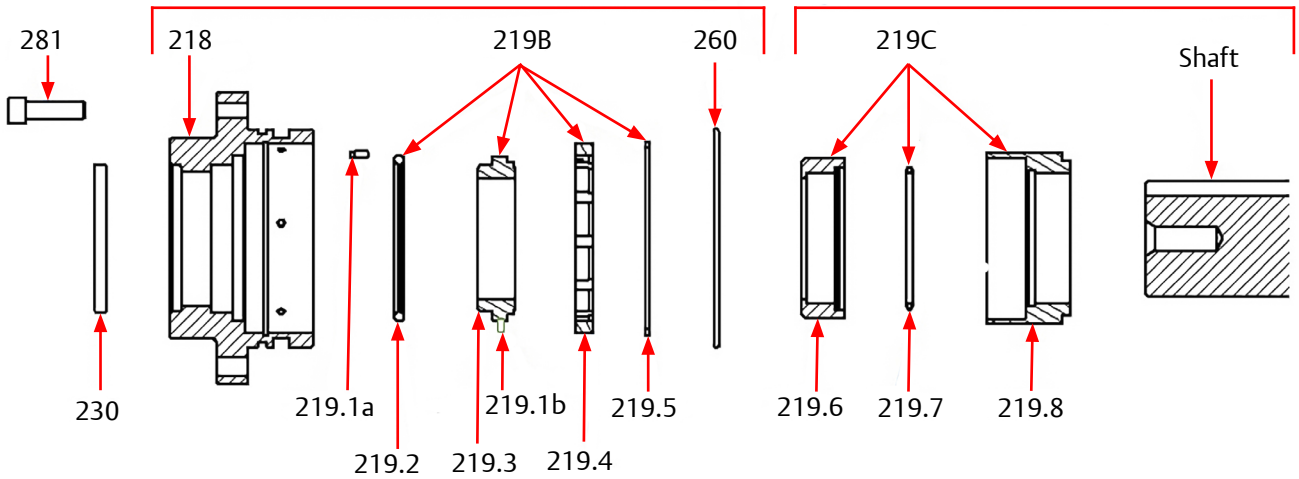


Figure 5-52. Shaft Seal Breakdown (25985Y, 25985YA, and 25985YF)

Prior to Shaft Seal Installation

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE

Care must be taken when handling the cup assembly and mating ring when installing. See Figure 5-51 for Handling Seal Face with Care.

Suggestion

A spray bottle filled with clean compressor oil may be used to lubricate the faces of the seals without touching the seal.

Follow these steps to verify the integrity of a shaft seal:

1. Check lead chamfer and outer diameter of shaft for deep scratches that may potentially damage the O-ring on the inner diameter of the shaft seal, see Figure 5-53.
2. Check lead chamfer and inner diameter of shaft seal housing for burrs and/or deep scratches that may potentially damage the O-ring on the outer diameter of the shaft seal, see Figure 5-54.
3. Clean compressor shaft and shaft seal cavity in compressor housing.
4. Apply clean compressor lubricating oil to the compressor shaft in mating ring seating area, see Figure 5-55.

NOTE

Once these steps have been performed, the installation procedure will depend on the shaft seal model of the compressor, so check the section relevant to yours.

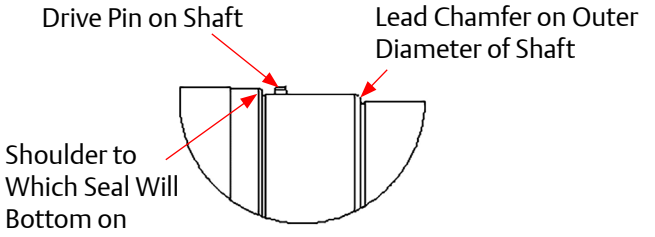


Figure 5-53. Shaft with Pin

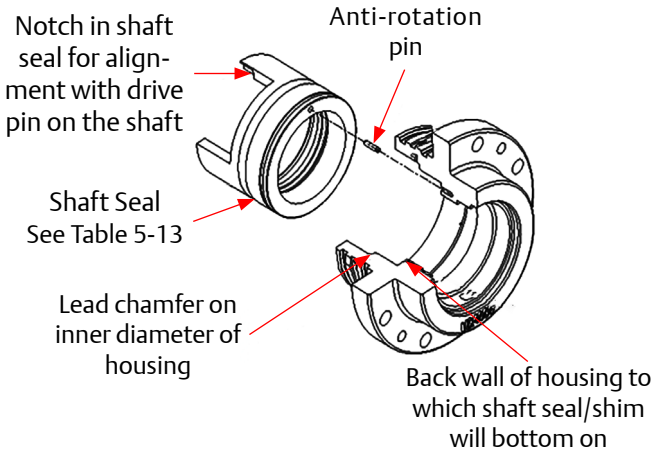


Figure 5-54. Shaft Seal Housing

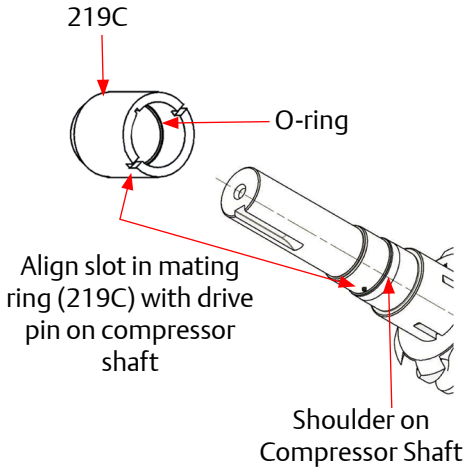


Figure 5-55. The Alignment of Compressor Shaft and Mating Ring

Shaft Seal Installation

(See Table 5-13 and Figure 5-52)

NOTE
Follow the "Prior to Shaft Seal Installation" steps before starting this procedure.

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE
Care must be taken when handling the cup assembly and mating ring when installing. See Figure 5-51 for Handling Seal Face with Care.

Suggestion

A spray bottle filled with clean compressor oil may be used to lubricate the faces of the seals without touching the seal.

CAUTION

Do not wipe or touch the face of the mating ring (219C) where the face meets the carbon component of the stationary assembly (219B).

1. Apply clean compressor lubricating oil to inside area of spring holder (219.8), rotating Silicon carbide piece (219.6) and O-ring (219.7).
2. Carefully fit spring holder (219.8) onto shaft until it is fully seated against shoulder on compressor shaft. Be sure to align slot in spring holder (219.8) with drive pin on compressor shaft, see Figure 5-55.

CAUTION

Ensure the spring holder (219.8) is fully seated against the shoulder of the compressor shaft. If the spring holder (219.8) is not fully seated against the shoulder, the carbon component of the stationary assembly (219B) will be damaged when the shaft seal housing (218) is installed.

3. Place O-ring (219.7) inside rotating silicon carbide piece (219.6) and carefully assemble onto shaft. You should feel some resistance in sliding this onto the shaft shoulder.
4. Install a new oil seal (230) in seal housing (218).
5. If necessary, Install anti-rotation pin (219.1a) in hole in shaft seal housing (218).
6. Install O-ring (219.2) into shaft seal housing.
7. Install stationary silicon carbide piece (219.3) in shaft seal housing with anti-rotation pin (219.1b) aligned 180 degrees away from the pin (219.1a) in Step 4. You should feel some resistance to fit the stationary piece into the O-ring.
8. Fit the retainer (219.4) over the stationary piece while aligning the slots on the anti-rotation pins.
9. Install retaining ring (219.5) into groove in shaft seal housing.
10. Install a new O-ring (260) on the seal housing (218), making sure the O-ring is placed in the O-ring groove and not the oil gallery groove. Lubricate both seal faces with clean compressor lubricating oil.
11. Carefully install the seal housing (218) on the compressor shaft, evenly tightening the bolts (281) to the recommended torque values (36 ft-lbs).
12. Install the coupling and coupling guard. The unit can then be evacuated and leak checked.

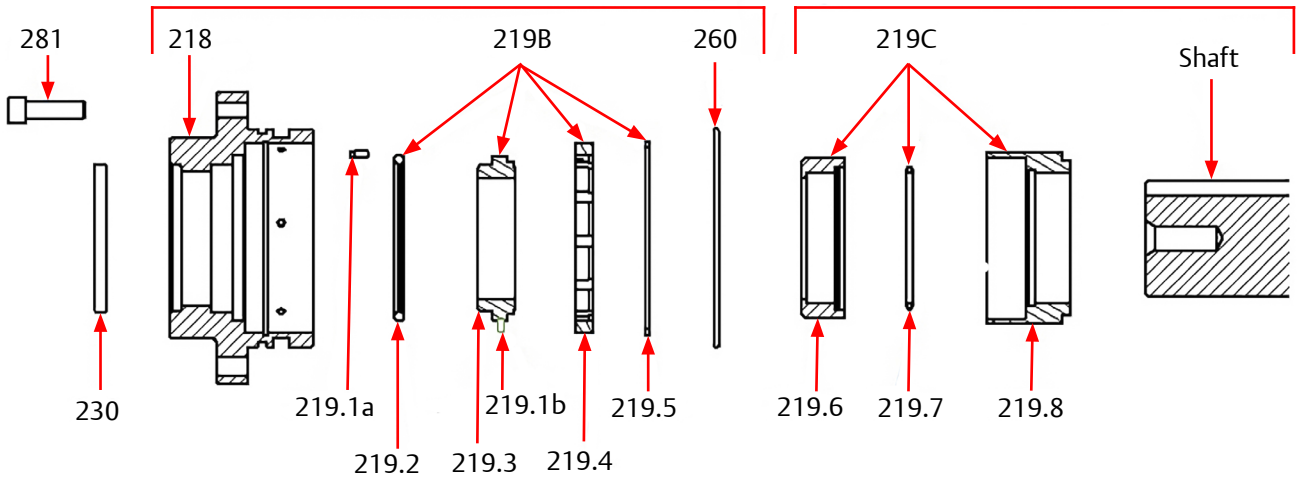


Figure 5-52. Shaft Seal Breakdown (25985Y, 25985YA, and 25985YF)

Main Rotor Assembly

Due to the procedures and tools involved in the disassembly and reassembly, the main rotor assembly must be performed by qualified individuals. Please consult the factory if maintenance is required.

Torque Specifications

Refer to the following table for torque specifications.

Table 5-14. Torque Specifications (ft-lbs) (For Compressors Only)

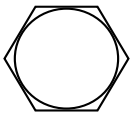
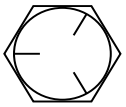
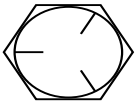
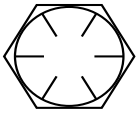
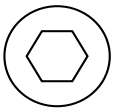
TYPE BOLT	HEAD MARKINGS	NOMINAL SIZE NUMBERS OR INCHES									
		#10	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	3/4"	7/8"
SAE GRADE 2 COARSE (UNC)			5	10	18	29	44	63	87	155	150*
SAE GRADE 2 COARSE (UNC)			8	16	28	44	68	98	135	240	387
SAE GRADE 5 FINE (UNF)				16							
SAE GRADE 2 COARSE (UNC)			11	22	39	63	96	138	191	338	546
SOCKET HEAD CAP SCREW (ASTM A574) COARSE (UNC)		5	13	26	46	73	112	155	215	380	614
Notes:	1) Torque values on this sheet are not to override those given on the individual drawings.										
	2) When using loctite, the torque value on this sheet are only accurate if bolts are tightened immediately after loctite is applied.										
	* The proof of 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.										

Table 5-15. SA193 B7/SA320 L7 Bolts / Studs – Torque Requirements Per ASME Codes: B31.5 and B31.3

Nominal Bolting Diameter	Nominal Torque (ft.lbs.)	Maximum Torque (ft.lbs.)	Torque (ft.lbs) Using Flexitallic Gasket
3/8"	17	20	25
7/16"	19	22	28
1/2"	20	25	30
5/8”	40	50	60
3/4"	65	83	100
7/8”	100	133	160
1”	120	204	245
1-1/4”	150	454	500

Notes:

1. The above torque values apply unless otherwise specified on drawing.
2. Bolting to be tightened incrementally in a diametrically staggered pattern to the nominal torque value.
3. If necessary, torque can be increased in 10% increments; do not exceed the maximum torque values.
4. For other materials please consult Vilter Engineering Department for torque values.

Using A Torque Wrench Correctly

Torque Wrenches

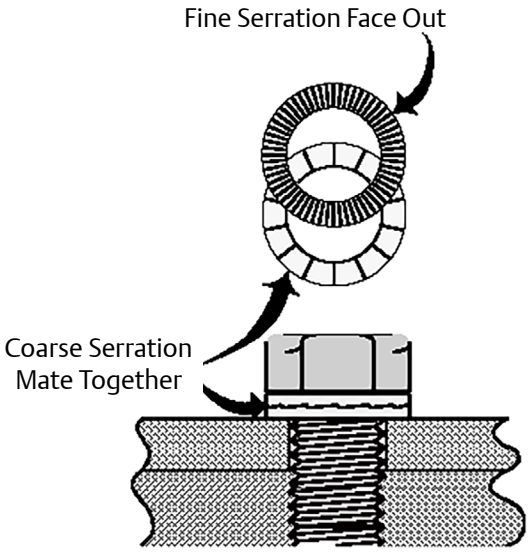
USING A TORQUE WRENCH CORRECTLY INVOLVES FOUR PRIMARY CONCERNS:

A. A smooth even pull to the break point is required. Jerking the wrench can cause the pivot point to break early leaving the bolt at a torque value lower then required. Not stopping when the break point is reached results in an over torque condition.

B. When more than one bolt holds two surfaces together there is normally a sequence that should be used to bring the surfaces together in an even manner. Generally bolting is tightened incrementally in a diametrically staggered pattern. Some maintenance manuals specify a tightening scheme. If so, the manual scheme shall be followed. Just starting on one side and tightening in a circle can cause the part to warp, crack, or leak.

C. In some cases threads are required to be lubricated prior to tightening the bolt/nut. Whether a lubricant is used or not has considerable impact on the amount of torque required to achieve the proper preload in the bolt/stud. Use a lubricant, if required, or not if so specified.

D. Unlike a ratchet wrench a torque wrench is a calibrated instrument that requires care. Recalibration is required periodically to maintain accuracy. If you need to remove a bolt/nut do not use the torque wrench. The clockwise/counterclockwise switch is for tightening right hand or left hand threads not for loosening a fastener. Store the torque wrench in a location where it will not be bumped around.



Nord-Lock® Washers

A. The Nord-Lock® lock washer sets are used in many areas in the single screw compressors that require a vibration proof lock washer.

B. The lock washer set is assembled so the coarse serrations that resemble ramps are mated together.

C. Once the lock washer set is tightened down, it takes more force to loosen the bolt that it did to tighten it. This is caused by the washers riding up the opposing ramps.

Troubleshooting Guide - General Problems and Solutions with Oil Pump

Table 6-1. Troubleshooting Guide - General Problems and Solutions with Oil Pump (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 Pressure Safety Changeover" setpoint is sufficient in Timers Screen. • Prelube Oil 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.
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 6-1. Troubleshooting Guide - General Problems and Solutions with Oil Pump (2 of 3)

Problem	Solution
Oil Loss Issues	• Oil return line from coalescing side of oil separator to suction is closed, not open enough (3/4 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	• Check for correct setting of all manual values. • Check for correct operation of 3-way oil mixing valve. • If you are controlling a step type oil cooler or a VFD oil cooler, verify the correct one is selected in the Configuration Screen and the amount of steps are entered in the Remote Oil Cooler Control Screen. • 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. • 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.
High Amp Draw	• Check calibration at full load. • Check CT ratio entered in Vission20/20.
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).

Table 6-1. Troubleshooting Guide - General Problems and Solutions with Oil Pump (3 of 3)

Problem	Solution
Excessive Motor Backspin	• If there is more than normal motor backspin at shutdown, check suction check valve for proper operation.

Troubleshooting Guide - General Problems and Solutions for Units Without Oil Pump

Refer to the following tables for Troubleshooting Guide - General Problems & Solutions for Units Without Oil Pump.

Table 6-2. Troubleshooting Guide - General Problems and Solutions for Units WITHOUT Oil Pump (1 of 2)

Problem	Solution
Low Oil Pressure at Start	• Check calibration of oil manifold transducer, discharge pressure transducer, and suction transducer. • 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 filter pressure drop.
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.
Oil flow or oil pressure problems	• Change oil filter, maybe plugged or collapsed.
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 controller´s input card for correct wiring and shielding (RF noise). • Check calibration of RTDs and transducers.
Oil Loss Issues	• Oil return line from coalescing side of oil separator to suction is closed, not open enough (3/4 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.

Table 6-2. Troubleshooting Guide - General Problems and Solutions for Units WITHOUT Oil Pump (2 of 2)

Problem	Solution
High oil temperature	• Check for correct setting of all manual values. • Check for correct operation of 3-way oil mixing valve. • If your are controlling a step type oil cooler or a VFD oil cooler, verify the correct one is selected in the Configuration Screen and the amount of steps are entered in the Remote Oil Cooler Control Screen. • Check the oil cooler and associated piping to make sure it is full of oil before starting. • 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.
High Amp Draw	• Check calibration at full load. • Check CT ratio entered in Vission 20/20.
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 Terms and Conditions of your order. Vilter™ contact information can be found on Page iii.

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:

Process For Returning Products Covered By the Warranty

STEP 1. To return a defective Product or part under this warranty, you will need to provide the Vilter™ compressor order number on all submitted documents.

For a parts warranty request, you will also need to provide:

- The Vilter™ serial number of the compressor;
- A detailed and accurate description of the issue;
- A valid purchase order for the new part(s)—you must pay the freight;
- One copy of Return Merchandise Authorization (RMA) sent to you for your records;
- One copy of RMA sent to you to include in the return shipment of parts back to Vilter™ for warranty consideration.

STEP 2. Return the parts (freight prepaid) to:

VILTER MANUFACTURING CORPORATION

5555 South Packard Avenue

Cudahy, WI 53110-8904

STEP 3. Upon receipt of the returned part(s), Vilter™ will complete a timely evaluation of the part(s).

STEP 4. You will be contacted with Vilter's decision once the final report is completed.

STEP 5. If approved, the approved warranty will be credited (excluding freight) to your account. Vilter™ will retain the returned part(s) for final disposition. If a warranty request is not approved, you will be provided with a written response and the parts will be held for 30 days. After such time, Vilter™ will dispose of the parts. If you wish to have the part(s) returned, you will need to contact Vilter™ and the part(s) will be returned freight collect.

Procedure For Parts Not Manufactured By Vilter™

Although Vilter™ does not provide any warranty for parts and products that are not manufactured by Vilter™, Vilter™ does pass through any manufacturer's warranty to you (to the maximum extent permitted by the manufacturer). Vilter™ will work with you in facilitating your warranty claim with the manufacturer.

To facilitate your warranty claim, please follow the following four steps:

STEP 1. Determine if the part or product is within the OEM's warranty.

STEP 2. If the defective part or product is not a motor, send a description containing the specifications of the part/product and the defect to:

Service.Vilter@Copeland.com

If the defective part or product is a motor or starter, please complete the form on the next page and return it to:

Service.Vilter@Copeland.com.

STEP 3. Vilter™ will communicate with you, if necessary, to ascertain additional information and will reasonably assist with the OEM to determine the part/product's warranty status.

VILTER
by COPELAND

Motor Warranty Procedure

To facilitate your warranty claim, please follow the steps outlined below:
1. Determination if motor is within the OEM warranty.
2. Please complete the following and return to Service.Vilter@Copeland.com, along with a picture of the motor's nameplate.
3. Vilter will assist with the motor OEM to determine the motor's warranty status.

Model: _____ Serial Number: _____ Manufacturer: _____

Starter Type: _____
- ☐ Soft Start
- ☐ Across the Line
- ☐ VFD

Run Hours: _____

Start Date: _____

Grease Type: _____

Alignment Data Available:	☐ Yes, please include with Information	☐ No
Lubrication Records Available:	☐ Yes, please include with Information	☐ No
Vibration Report Available:	☐ Yes, please include with Information	☐ No

Describe Motor Symptoms:

4. If the motor falls within the OEM's warranty time frame:
- The motor will need to be taken to a manufacturer approved shop for diagnosis. Vilter can help with locating motor shops that are manufacturer approved in your area. The shop will diagnose the root cause, submit a report to the OEM, and the motor OEM will make the determination of warranty coverage.
- If warranty is approved, the OEM will either have the motor repaired by the motor shop or send a new replacement motor to the site.

Note: Motor warranty is a "pass thru warranty" as stated in Vilter Manufacturing's standard warranty statement which means that the original motor OEM is the provider of the warranty. Vilter does assist with the expediting of the claim but any dispensation of warranty is provided solely by the motor OEM.
Motor manufacturer warranty covers only repair or replacement of the motor. It does not cover removal and installation charges, incidental charges associated with the removal and installation process, loss of product or shipping to and from the manufacturer or approved shop. This is standard motor manufacturer warranty policy regardless of brand or application. If the end user requires additional information regarding warranty coverage, the individual motor manufacturer warranty terms can be found on their associated websites.

Clear Form

STEP 4. For defective motor or starter claims, if the motor or starter falls within the OEM's warranty time frame:

- The motor or starter will need to be taken to a manufacturer approved shop for diagnosis. Vilter™ can help you locate motor shops in your area that are manufacturer approved. The shop will diagnose the root cause, submit a report to the OEM, and the motor OEM will make the determination of warranty coverage.
- If a warranty claim is approved, the OEM will either have the motor or starter repaired by the motor shop or send a new replacement motor to the site.

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 or 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 Bare Shaft Single Screw 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 iii.

- Request a "VSS/VSM 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 tear down 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 hand wheels or slide valve motors.

How to Read a Parts List and Illustration

A parts list consist of the following information:

Item Number

Item number associated with the number shown in the parts illustration.

Description

A description of an item.

Model Number

Compressor type and size.

VPN

VPN stands for Vilter™ Part Number.

Quantity

A quantity used for respective model or series of models.

Assembly and Kit Information

For assembly and kit, included items are added in parenthesis after part description.

Example-

ITEM	DESCRIPTION	MODEL NUMBER	
		VSTC 451	
		QTY	VPN
100	SUPPORT ASSEMBLY (110 and 135B)	2	A25159BB
110	SUPPORT	2	25606A
135B	DOWEL PIN, LG, 0.4375" O.D.	2	25910A

VPN A25159BB - SUPPORT ASSEMBLY includes items (110 and 135B).

Terms and Abbreviation Used

Term	Description
SM	Small
LG	Large
O.D.	Outer Diameter
BRG	Bearing
HSG	Housing
VOL.	Volume
CAP.	Capacity
AR	As Required
QTY	Quantity
W/O	Without
W/	With

Important Notes

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor.

Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Additional note/information of part/item/quantity shown at the bottom of parts table.

Vilter™ Aftermarket Parts Contact Information

Phone: 1-800-862-2677

Fax: 1-800-862-7788

E-mail: Parts.Vilter@Copeland.com

Website: Copeland.com/Vilter or Vilter.com

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

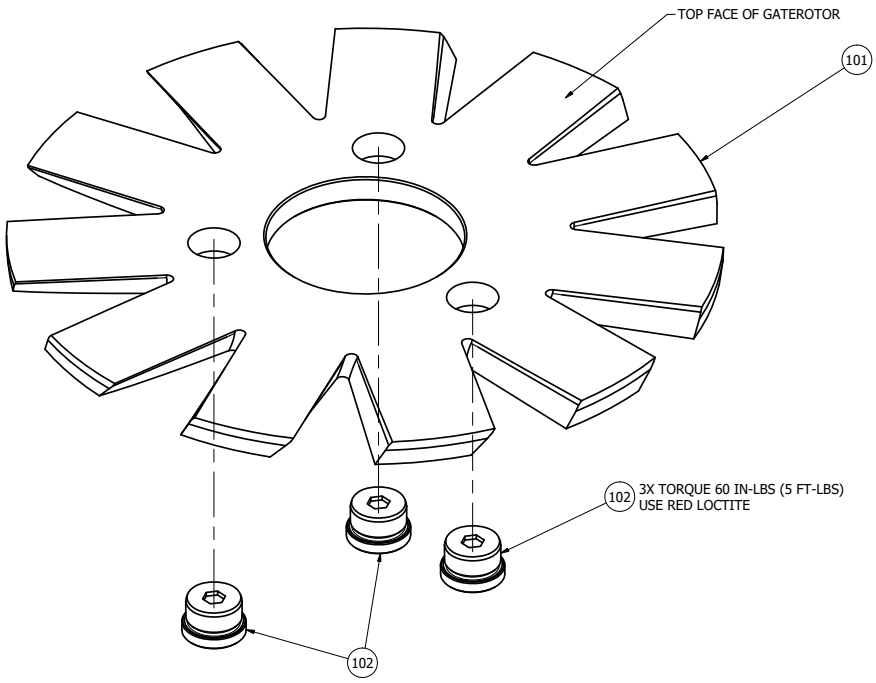
Compressor Models
VSTC 128 - 243 (HPLD)
Recommended
Spare Parts List

Refer to the Custom Manual
Spare Parts Section for Specific Applications

Please have your Model # and Sales Order # available when ordering.
These are found on the compressor's Name Plate.

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

VSTC 128 - 243 Compressor Kits



Gaterotor Kits

Gaterotor Kits		
Compressor Model	With Bearings	Without Bearings
128	KT712ABAAF*	KT713ABAAF*
145	KT712ABBAF*	KT713ABBAF*
160	KT712ABCAF*	KT713ABCAF*
180	KT712ABDAF*	KT713ABDAF*
204	KT712ABEAF*	KT713ABEAF*
222	KT712ABFAF*	KT713ABFAF*
243	KT712ABGAF*	KT713ABGAF*

*Aflas

Shaft Seal Kit

All HPLD Models			
Application	Description	VPN	QTY
Shaft Seal #25985Y	HPLD Shaft Seal Kit	KT709BHPFAF	1
25985YF (FFKM)	HPLD Shaft Seal Kit	KT709NAHPFAAF	1

Compressor Gasket and O-Ring Kit

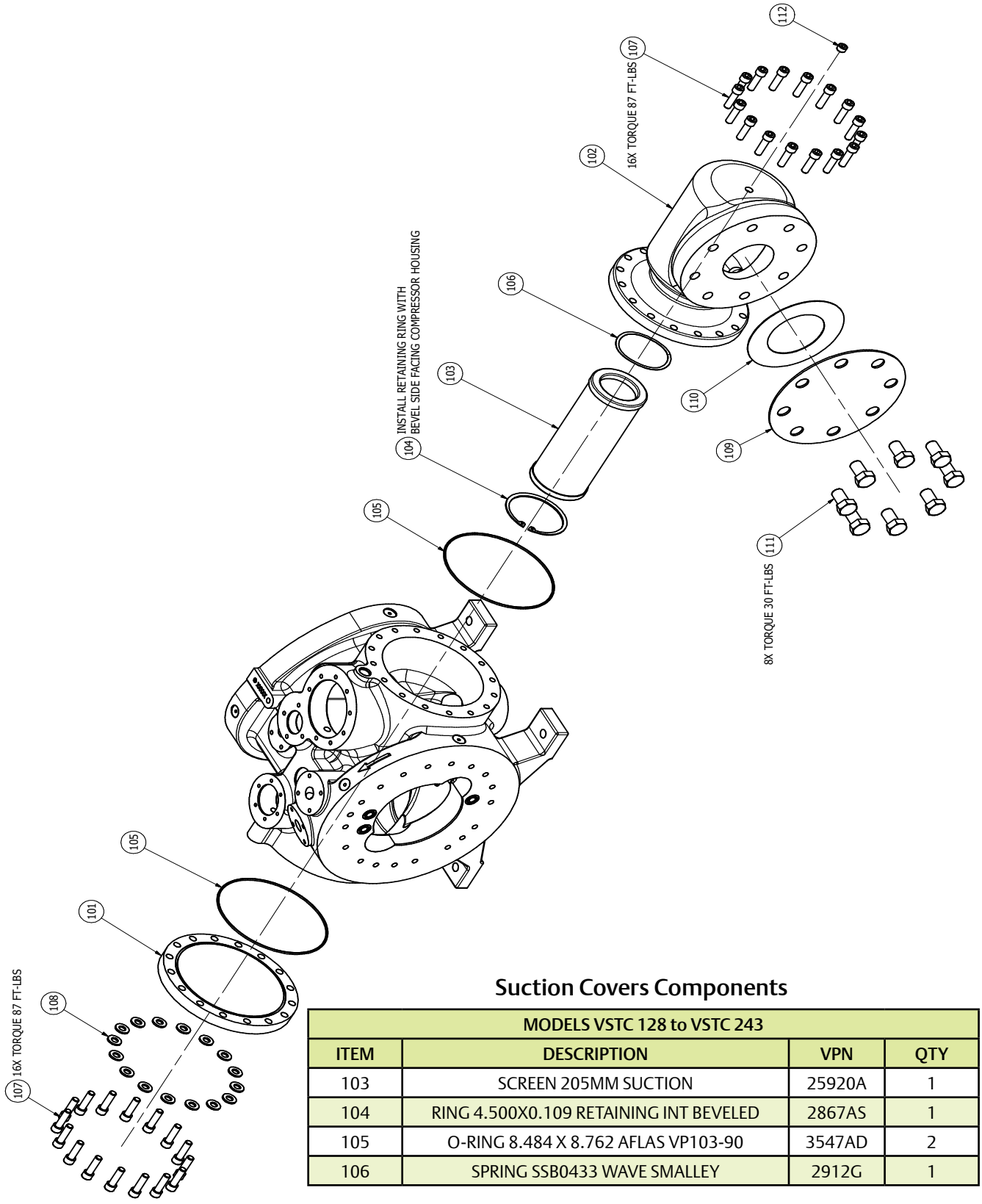
All HPLD Models			
Application	Description	VPN	QTY
All Gaskets and O-Rings	Gasket & O-Ring Kit 600#	KT710MAF	1
	Gasket & O-Ring Kit 900#	KT710MBAF	1

Tool Kit

All HPLD Models			
Application	Description	VPN	Qty
For Gaterotor Removal and Installation	Gaterotor Tool Kit	A25205G	1
	Suction Tee Tool Kit	A24061A	1

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Suction Covers

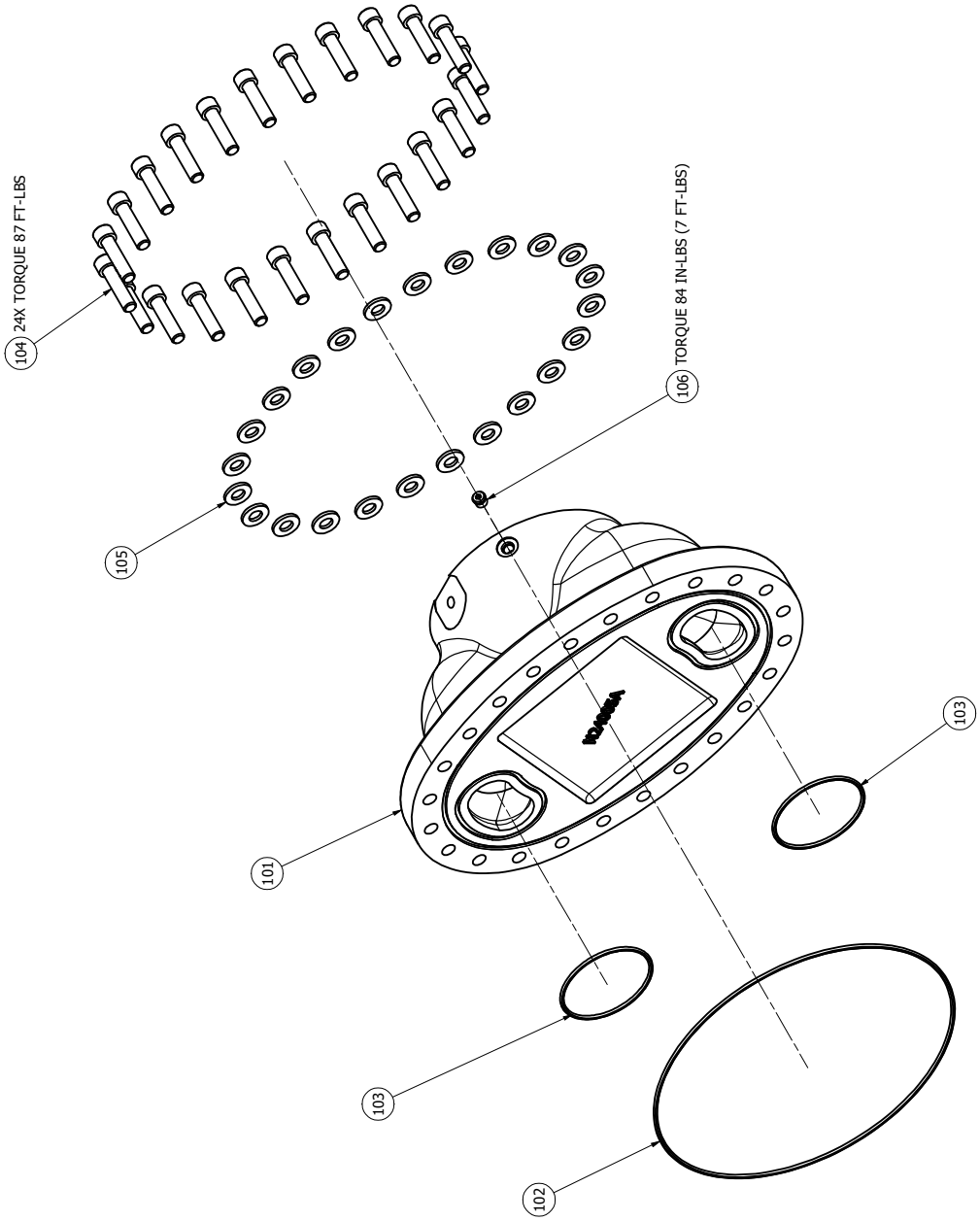


Suction Covers Components

MODELS VSTC 128 to VSTC 243			
ITEM	**DESCRIPTION**	**VPN**	**QTY**
103	SCREEN 205MM SUCTION	25920A	1
104	RING 4.500X0.109 RETAINING INT BEVELED	2867AS	1
105	O-RING 8.484 X 8.762 AFLAS VP103-90	3547AD	2
106	SPRING SSB0433 WAVE SMALLEY	2912G	1

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Discharge Manifold

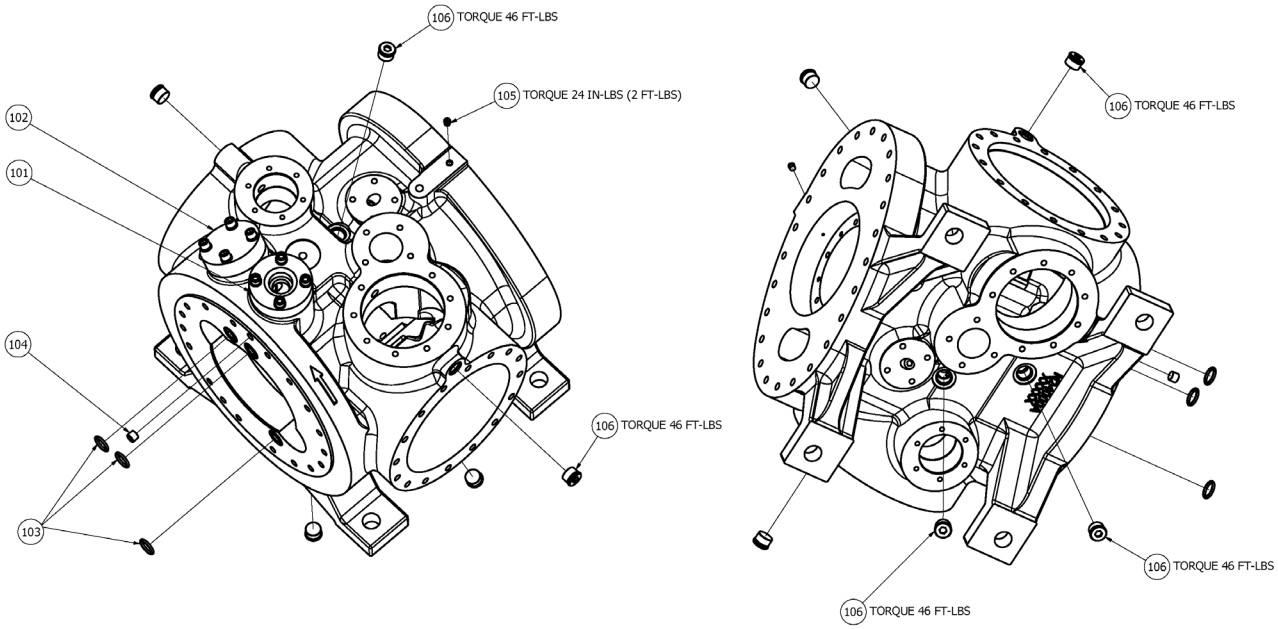


Discharge Manifold Components

MODELS VSTC 128 to VSTC 243			
ITEM	DESCRIPTION	VPN	QTY
102	O-RING 11.984 X 12.262 AFLAS VP103-90	3547AA	1
103	O-RING 3.484 X 3.762 AFLAS VP103-90	3547AB	2

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Housing



Housing Components

MODELS VSTC 128 to VSTC 243			
ITEM	**DESCRIPTION**	**VPN**	**QTY**
103	O-RING .796X1.074 AFLAS VP103-90	3547BN	3
104	PLUG 1/4-18NPTF FLUSH SEAL SOC HD	2606C	1
105	PLUG 5/16 HEX SAE FOR J1926 PORT AFLAS	3647A	1
106	PLUG 9/16 HEX SAE FOR J1926 PORT AFLAS	3647D	5

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Torque Specifications

Refer to the following tables for torque specifications.

Table A-1. Torque Specifications (ft-lbs) (For Compressors Only)

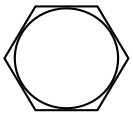
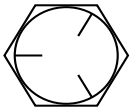
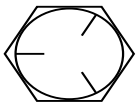
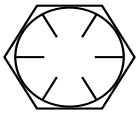
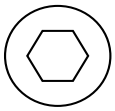
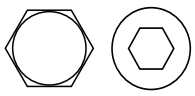
TYPE BOLT	HEAD MARKINGS	NOMINAL SIZE NUMBERS OR INCHES									
		#10	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	3/4"	7/8"
SAE GRADE 2 COARSE (UNC)			5	10	18	29	44	63	87	155	150*
SAE GRADE 2 COARSE (UNC)			8	16	28	44	68	98	135	240	387
SAE GRADE 5 FINE (UNF)				16							
SAE GRADE 2 COARSE (UNC)			11	22	39	63	96	138	191	338	546
SOCKET HEAD CAP SCREW (ASTM A574) COARSE (UNC)		5	13	26	46	73	112	155	215	380	614
Notes:	1) Torque values on this sheet are not to override those given on the individual drawings.										
	2) When using loctite, the torque value on this sheet are only accurate if bolts are tightened immediately after loctite is applied.										
	* The proof of 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.										

Table A-2. Torque Specifications for 17-4 Stainless Steel Fasteners (ft-lbs) (For Compressors Only)

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.

Table A-3. SA193 B7/SA320 L7 Bolts / Studs – Torque Requirements Per ASME Codes: B31.5 and B31.3

Nominal Bolting Diameter	Nominal Torque (ft.lbs.)	Maximum Torque (ft.lbs.)	Torque (ft.lbs) Using Flexitallic Gasket
3/8"	17	20	25
7/16"	19	22	28
1/2"	20	25	30
5/8”	40	50	60
3/4"	65	83	100
7/8”	100	133	160
1”	120	204	245
1-1/4”	150	454	500

Notes:

1. The above torque values apply unless otherwise specified on drawing.
2. Bolting to be tightened incrementally in a diametrically staggered pattern to the nominal torque value.
3. If necessary, torque can be increased in 10% increments; do not exceed the maximum torque values.
4. For other materials please consult Vilter Engineering Department for torque values.

Oil Analysis Report

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

Storage Guidelines For Vilter B and Fl Type Lubricants

Vilter Type B and FL lubricants are ester-based fluids and are hygroscopic by nature. This means that they absorb water moisture from the surrounding environment. Compared to mineral based lubricants which are typically saturated with water at less than 100 PPM, ester based lubricants become saturated with water at approximately 2,500 PPM.

High water moisture levels cannot be tolerated in the refrigeration systems where ester based lubricants are utilized and require specific handling and storage guidelines, in addition to the normal precautions for system dehydration prior to system start-up.

All Vilter lubricants are manufactured to meet strict requirements to ensure minimal water moisture content as shipped. The following guidelines are provided for the end-user of the equipment as a means to minimize the water content of lubricants in storage.

Guidelines

- Use a suitable dehydration process for the complete refrigeration system to ensure that the system as a whole is completely dry and water free. This can be accomplished by the use of vacuum pumps and checked by a vacuum gauge to ensure that a suitable micron value has been reached, and maintained.
- Store all lubricant containers in a dry environment. Do not expose the lubricant to the atmosphere by opening the container until the compressor sump or separator is ready to be charged.
- Keep the lubricant in its original container. Some plastic containers allow water moisture to pass through the container itself.
- If possible, use container sizes appropriate to the compressor charge to avoid leaving partially filled containers open for long period of times. Vilter B Type lubricant is available in 5 and 55 gallon containers.
- Refrigeration systems using ester based lubricants will require suitable high capacity moisture filter/driers to maintain low total moisture content in the refrigerant and lubricant.

Compatibility and Misc.

- Vilter Type B lubricant has been extensively tested with many of the components in a refrigeration system. Elastomers, driers, etc. for use with HFCs have demonstrated no adverse effects when tested for hardness, swelling and brittleness.
- Vilter Type B lubricant cannot be used in conjunction with a mineral based oils are not miscible with HFCs. The performance of a refrigeration system is optimized when the lubricant is allowed to be miscible with the refrigerant to aid in the oil return to the compressor. If the oil used in an HFC refrigeration system does not provide oil return capability, the oil will tend to accumulate in the evaporator reducing the overall system capacity.
- CFC and HCFC refrigerants should not be used with Vilter Type B lubricant since these types of refrigerants greatly reduce the viscosity of ester based lubricants, resulting in inadequate compressor lubrication.

Table B-1 Oil Recommendations for Standard Warranty Coverage Single Screw Compressors Only

Vilter Oil Type	717	HCL-68	F-68	FL-100	B-68	HC-68
ISO Grade	68	68	68	100	68	68
@ 100°F (cSt)	77	75.7	65.67	76.4	71	67.2
Viscosity Index	100	132	79	115	108	168
Spec. Gravity	0.867	0.835	0.876	0.96	0.957	0.989
Density lbm/gal, 60°F	7.4	6.95	7.3	8.26	7.96	8.25
Flash Point - °F	440	525	295	558	505	425
Fire Point - °F	475	570	315	633	560	465
Pour Point - °F	-38.2	-67	-31	Pending	-45	-55
Floc Point - °F	-25	NA	-75	NA	NA	NA
Refrigerant Type	R-717	R-717, R-22, R-1270	R-22	R-22	R-134a, R-507; R-404A, R-407C R-410A	R-290

Table B-2 Cross Reference Index

VPN	Oil Type	Vilter Lube Type	Container Size	Applications
3339A	PAO	CO_2 GAS	5 gallon pail	CO_2, CO
3339B	PAO	CO_2 GAS	55 gallon drum	CO_2, CO
3636A	PAO	CO_2	5 gallon pail	Gas streams containing moisture, CO_2, CO and/or H_2S
3636B	PAO	CO_2	55 gallon drum	Gas streams containing moisture, CO_2, CO and/or H_2S
3724A	PAG	CO_2 PAG	1 gallon	CO_2 lubricant
3724B	PAG	CO_2 PAG	55 gallon	CO_2 lubricant

Vibration Measurements - Single Screw Compressor

Scope

The vibration criteria provided applies to broad-band vibration measurements taken on the bearings and housing of the Single Screw compressors under steady-state operating conditions within the nominal operating speed range in addition to the piping and tubing on the compressor unit. They relate to both acceptance testing and operational monitoring. The evaluation criteria is intended to apply to both continuous and non-continuous monitoring situations. The scope does not address the diagnostic evaluation of the condition of the roller element bearings. The criteria are applicable only for the vibration produced by the machine itself and not for vibration which is transmitted to the machine set from external sources. Information used in this chapter was taken from ISO Standard 10816-3, Mechanical Vibration – Evaluation of Machine Vibration by Measurements on Non-Rotating Parts – Part 3, First Edition, 1998.

Measurement Procedures and Operational Conditions

Measurement Equipment

The measurement equipment shall be capable of measuring broad-band rms vibration with flat response over a frequency range of at least 10 Hz to 1000 Hz. Depending on the vibration criteria, this may require measurements of displacement or velocity or combinations thereof.

Care should be taken to ensure that the measuring system is not influenced by environmental factors such as:

- Temperature variations;
- Magnetic fields;
- Sound fields;
- Power source variations;
- Transducer cable length;
- Transducer orientation.

Particular attention should be given to ensure that the vibration transducers are correctly mounted and that such mountings do not degrade the accuracy of the measurements.

Compressor Measurement locations

Measurements taken on the compressor will usually be taken on exposed parts that are normally accessible. Care shall be taken to ensure that measurements reasonably represent the vibration of the bearing housing and do not include any local resonances or amplification. The locations and directions of vibration measurements shall be such that they provide adequate sensitivity to the machine dynamic forces. Typically, this will require two radial measurement locations on each bearing cover on the gate rotor housing support and back plate (near the compressor shaft). Vertical and horizontal directions are preferred for Single Screw compressors. The specific locations and directions shall be recorded with the measurement.

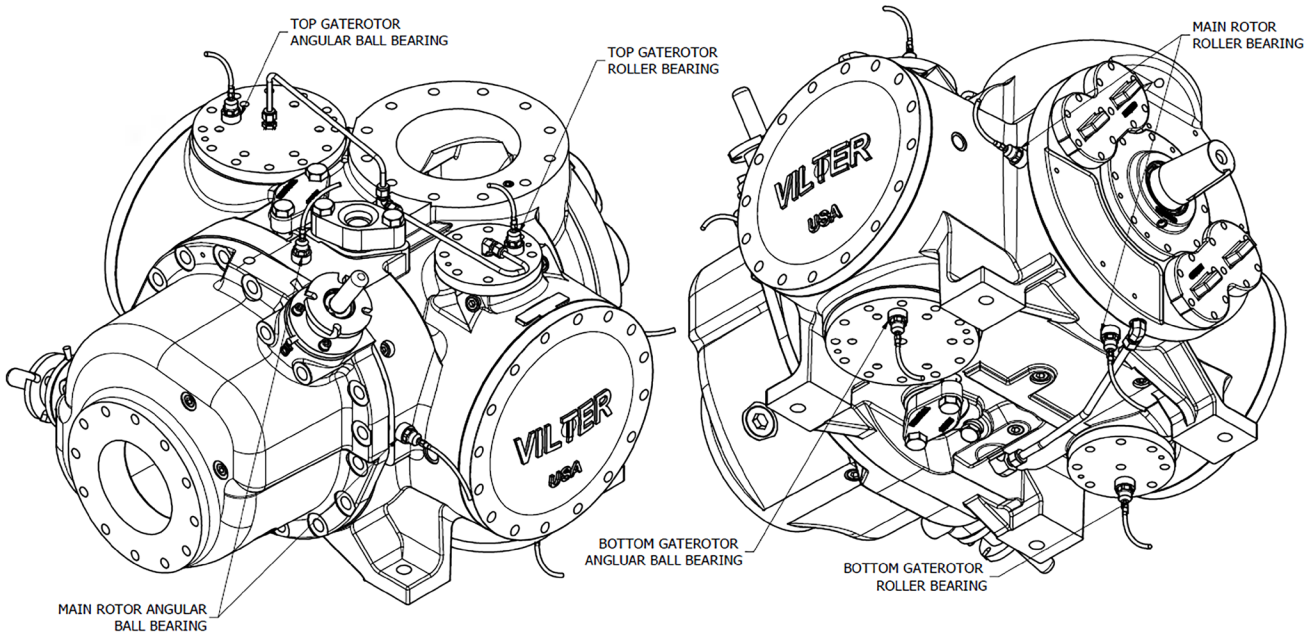


Figure C-1. Compressor Bearing Vibration Measurement Location

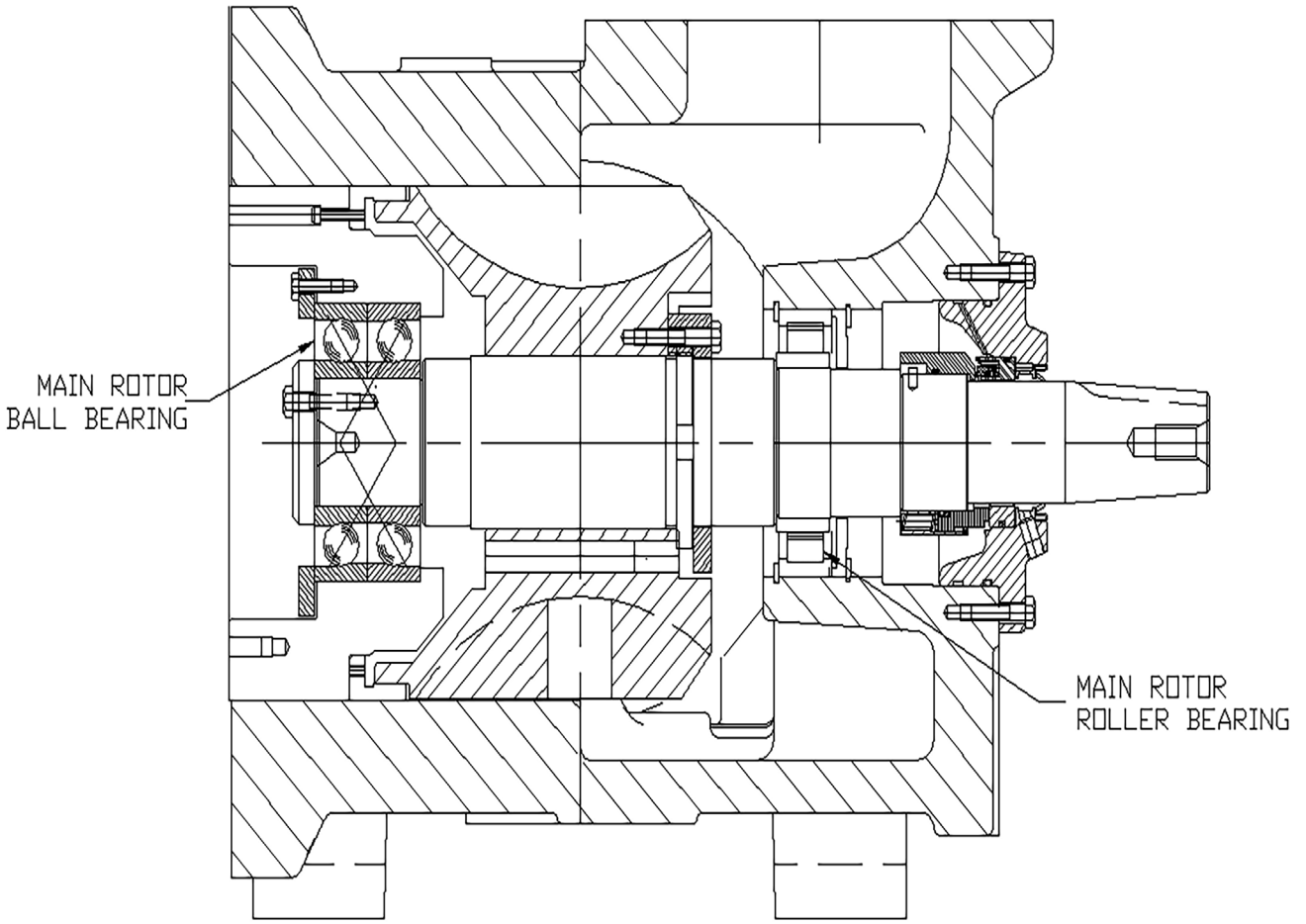


Figure C-2. Main Rotor Cross-Section VSTC Compressors

Continuous and Non-continuous Monitoring

While it is common practice on large or critical machinery to have installed instrumentation for continuous online monitoring of vibration values at key measurement points, this is not necessarily carried out in industrial applications.

Changes in unbalance, bearing performance, alignment, etc. can be detected with sufficient reliability from periodic measurements with permanently installed or handheld instruments. The use of computers for trend analysis and warning against malfunctions is also becoming more common.

Operational Conditions

Measurements shall be carried out when the compressor has reached normal steady-state operating temperatures and with the machine running under specified conditions. If the measured vibration is greater than the acceptance criteria allowed and an excessive background vibration is suspected, measurements should be made with the machine shut down to determine the degree of external influence. If the vibration with the machine stationary exceeds 25% of the value measured when the machine is running, corrective action may be necessary to reduce the effect of the background vibration.

Evaluation

There are two evaluation criteria used to assess vibration severity on various classes of machines. One criteria considers the magnitude of observed broad-band vibration; the second considers changes in magnitude, irrespective of whether they are increases or decreases.

Criterion 1: Vibration Magnitude

This criterion is concerned with defining limits for vibration magnitude consistent with acceptable dynamic loads on the bearings and acceptable vibration transmission into the environment through the support structure and foundation. The maximum vibration magnitude observed at each bearing or pedestal is assessed against the evaluation zones for the support class. The evaluation zones have been established from international experience.

The following evaluation zones are defined to permit a qualitative assessment of the vibration of a given machine and provide guidelines on possible actions.

- Zone A: The vibration of newly commissioned machines would normally fall within this zone.
- Zone B: Machines with vibration within this zone are normally considered acceptable for unrestricted long-term operation.
- Zone C: machines with vibration within this zone are normally considered unsatisfactory for long term continuous operation. Generally, the machine may be operated for a limited period in this condition until a suitable opportunity arises for remedial action.
- Zone D: Vibration values within this zone are normally considered to be of sufficient severity to cause damage to the machine.

Numerical values assigned to the zone boundaries are not intended to serve as acceptance specifications, which shall be subject to agreement between Vilter™ manufacturing and the customer. However, these values provide guidelines for ensuring that gross deficiencies or unrealistic requirements are avoided. In certain cases, there may be specific features associated with a particular machine which would require different zone boundary values (higher or lower) to be used.

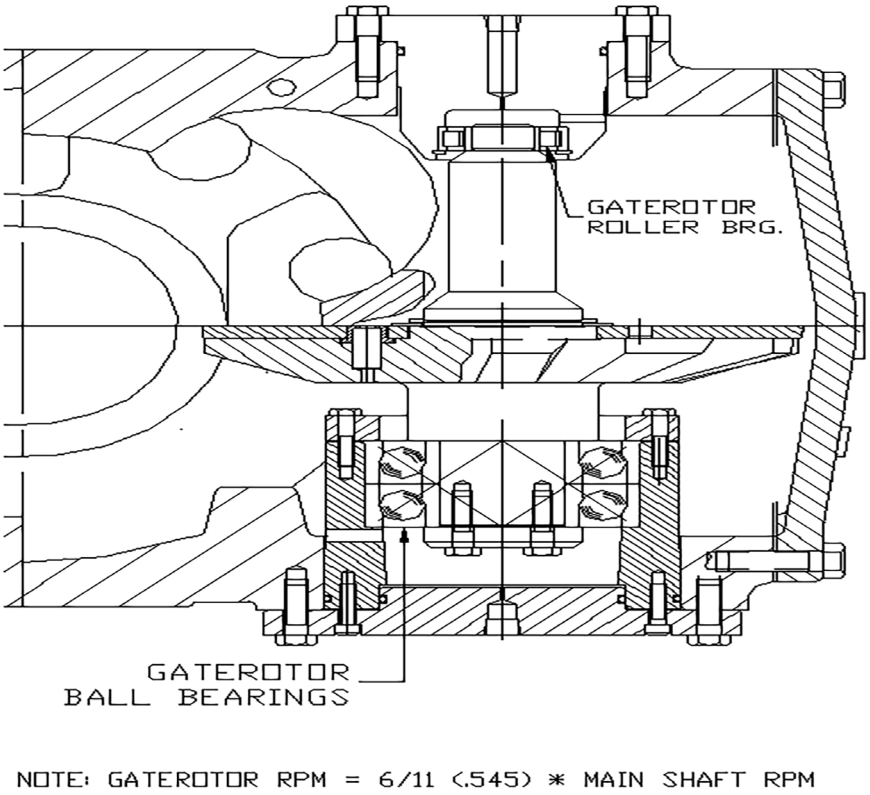


Figure C-3. Gaterotor Cross-Section VSTC Compressors

Evaluation Zone limits

The values for the zone boundaries given below are based on the maximum broad-band values of velocity and displacement when measurements are taken from two orthogonally oriented radial transducers. Therefore when using these tables, the higher of each of the values measured from the two transducers in each measurement plane should be used. When the maximum measured values of velocity and displacement are compared to the corresponding values in the table, the severity zone which is most restrictive shall apply.

Operational limits

For long-term operation, it is common practice to establish operational vibration limits. These limits take the form of ALARM and TRIP set points.

ALARM: To provide a warning that a defined value of vibration has been reached or a significant change has occurred, at which remedial action may be necessary. In general, if an ALARM situation occurs, operation can continue for a period while investigations are carried out to identify the reason for the change in vibration and define any remedial action.

TRIP: To specify the magnitude of vibration beyond which further operation of the machine may cause damage. If the TRIP value is exceeded, immediate action should be taken to reduce the vibration or the machine should be shut down.

Different operational limits, reflecting differences in dynamic loading and support stiffness, may be specified for different measurement positions and directions.

Table C-1. Vibration Zone Values

VIBRATION MEASUREMENTS – SINGLE SCREW COMPRESSOR*					
Support Class	ZONE	RMS Displacement		RMS Velocity	
		µmm	mils	mm/s	In/sec
	A	0-30	0-1.15	0-2.3	0-.09
	B	30-57	1.15-2.25	2.3-4.5	.09-.18
	C	57-90	2.25-3.55	4.5-7.1	.18-.28
	D	Above 90	Above 3.55	Above 7.1	Above .28

*RMS= 0.707 X peak (sine wave only)

Setting of ALARMS

The ALARM values may vary considerably, up or down, for different machines. The values chosen will normally be set relative to a baseline value determined from experience for the measurement position or direction for that particular machine.

It is recommended that the ALARM value should be set higher than the baseline by an amount equal to 25% of the upper limit for zone B. If the baseline is low, the ALARM may be below zone C.

Where there is no established baseline (for example with a new machine) the initial ALARM setting should be based either on experience with other similar machines or relative to agreed acceptance values. After a period of time, the steady-state baseline value will be established and the ALARM setting should be adjusted accordingly.

It is recommended that the ALARM value should not normally exceed 1.25 times the upper limit of zone B.

If the steady-state baseline changes (for example after a machine overhaul), the ALARM setting should be revised accordingly.

Setting of TRIPS

The TRIP values will generally relate to the mechanical integrity of the machine and be dependent on any specific design features which have been introduced to enable the machine to withstand abnormal dynamic forces. The values used will, therefore, generally be the same for all machines of similar design and would not normally be related to the steady-state baseline value used for setting ALARMS.

There may, however, be differences for machines of different designs and it is not possible to have clear guidelines for absolute TRIP values. In general, the TRIP value will be within zone C or D, but it is recommended that the TRIP value should not exceed 1.25 times the upper limit of zone C.

Vibration limits For Piping and Tubing

The piping and tubing on the compressor units must be supported with the appropriate brackets and supports to minimize the vibration levels. These brackets and supports should also be strategically placed to prevent the natural frequency from matching the normal operating speed. The typical goal is to have the natural frequency of an assembly to be at least 10% above or below the operating speed. In the case when a compressor is operated by a VFD (Variable Frequency Drive), there is a high probability that there will be an opportunity to match either the natural frequency of the assembly or it's 2nd or 3rd order since the compressor's speed will vary within a large range of RPM's.

The compressor unit should first be operated at either the normal operating speed or if it utilizes a VFD, through the operating range of speed. Visual observations of the vibration levels of all the piping and tubing should first be observed. After this initial survey, the vibration measurement equipment should be individually mounted or attached to each specific piece of piping or tubing as required in the location of what is perceived as the maximum amplitude or worse vibration.

While there are references which specifically allow higher levels of vibration for piping, the goals for the vibration levels of the piping and tubing on the compressor unit should still utilize the same criteria outlined in this standard. If possible, the vibration levels should be within the zone boundaries of Zone B or better. These values will ensure that the stress levels in the piping and tubing are acceptable for continuous operation. These values provide guidelines for ensuring that gross deficiencies or unrealistic requirements are avoided. In certain cases, there may be specific features associated with a particular compressor unit which would require different zone boundary values.

For compressors that are operated at a fixed speed, brackets and supports may be added or moved to reduce the vibration levels of the specific component. If the compressor is operated utilizing a VFD, a skip frequency should be inputted into the controls to ensure the compressor passes through the harmonic and that it operates either below or above the operating speed that matches the natural frequency of the specific component. It is not unusual to have three or four skip frequencies within the normal operating ranges of a compressor utilizing a VFD.

About Vilter

Vilter is a technology leader in energy-efficient, environmentally conscious solutions in its industry. The 150-year history of the Vilter brand tells a rich story of perseverance and drive to cultivate continuous innovation within the industrial refrigeration and gas compression industries. Vilter offers unprecedented efficiency, productivity and reliability in cooling, recovery, and compression. It combines best-in-class technology with proven engineering and design to create quality products and latest solutions for customers worldwide.

About Copeland

Vilter is a business segment of Copeland, a global leader in providing sustainable climate solutions for customers in industrial, commercial and consumer markets around the world. Copeland combines category-leading brands in compression, controls, software and monitoring for heating, cooling and refrigeration. With best-in-class engineering and design and the broadest portfolio of modulated solutions, we're not just setting the standard for compressor leadership; we're pioneering its evolution. Combining our technology with our smart energy management solutions, we can regulate, track, and optimize conditions to help protect temperature-sensitive goods over land and sea, while delivering comfort in any space. Through energy-efficient products, regulation-ready solutions, and expertise, we're revolutionizing the next generation of climate technology for the better. For more information please visit

Copeland.com

Copeland.com/Vilter

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