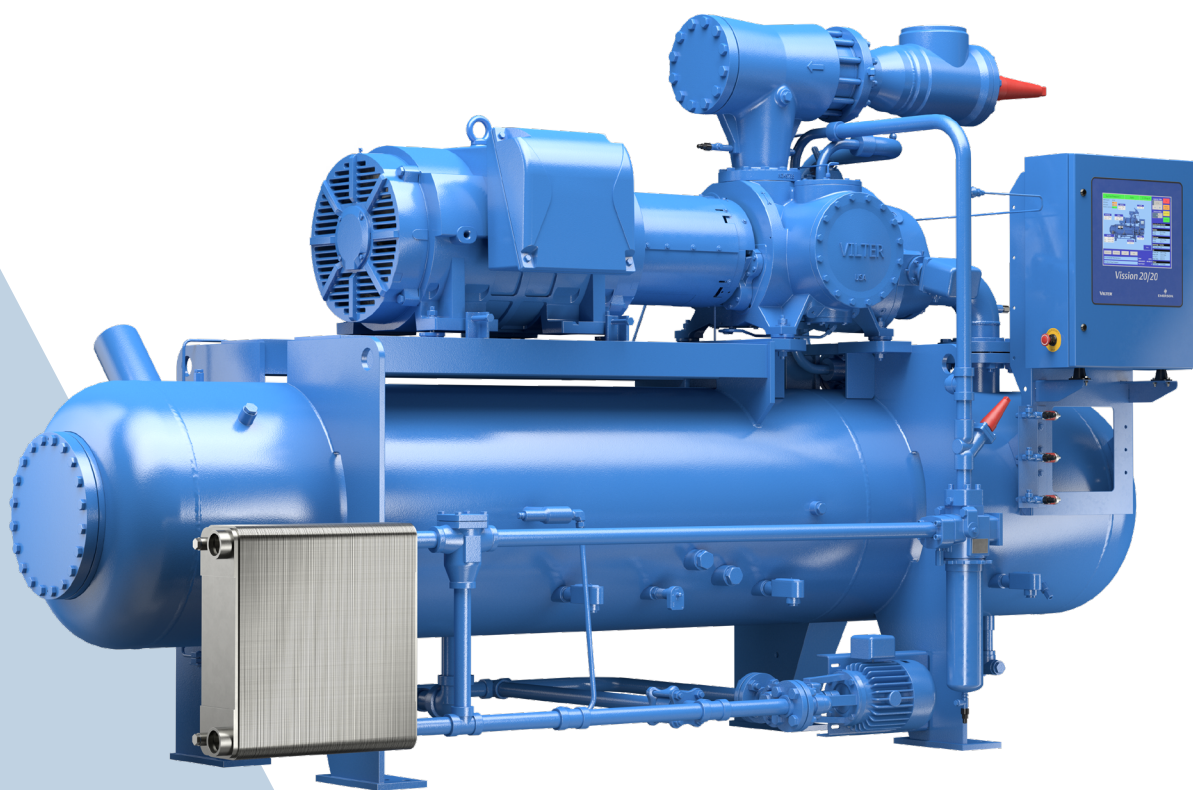


VSS/VSSC/VSM/VSMC Single Screw Compressor Unit

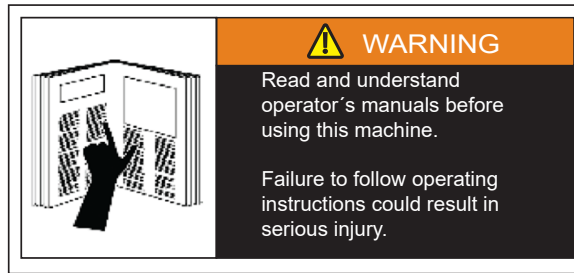
Installation, Operation & Maintenance Manual

FOR UNITS BUILT AFTER JANUARY 1, 2015



VILTER
by **COPELAND**

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 inquiries 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: _____

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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Section 1 • General Information

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

Appendix D: Liquid Injection Valve Setup Instructions and ICM/ICAD Motorized Valve Quick Start Guide

Appendix E: Liquid Injection Valve Station ICF 20-40 Installation Guide


Appendix F: Hand-Held Slide Valve Calibration Tool


Appendix G: Pre Start Up for Remote Oil Coolers

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.

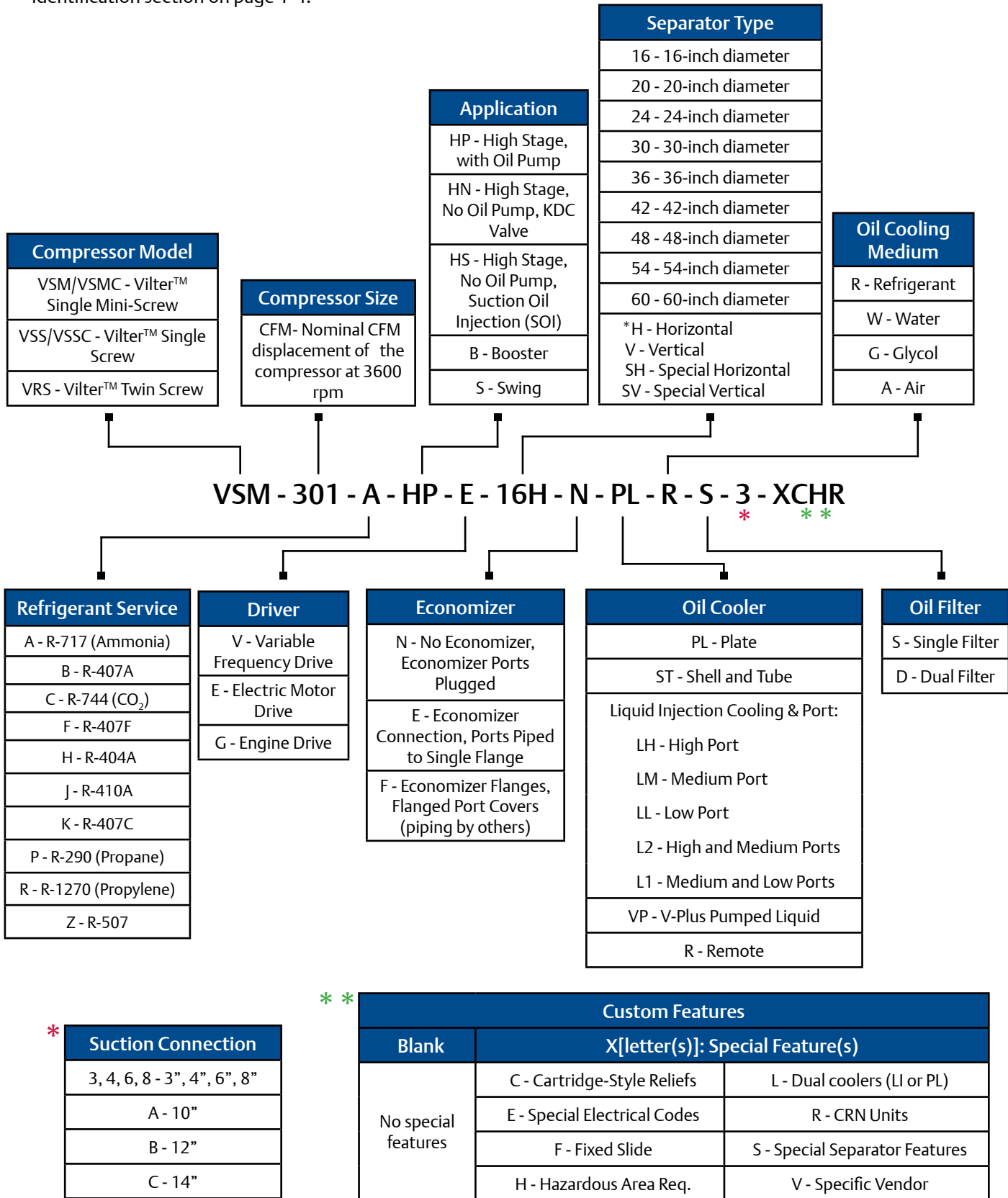
Additional Important Notes

- Additional installation, operation and maintenance instructions can be found in the Vission 20/20 manual (35391SC) or Compact Logix PLC Software Manual (35391CM).
- Due to continuing changes and unit updates, always refer to the website Vilter.com or Copeland.com/Vilter 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.

Section 1 • General Information

Refrigeration Compressor Unit Model Designations

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



Section 1 • General Information

System Unit Identification

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

- Bare Shaft Compressor
- Compressor Unit
- Package Unit

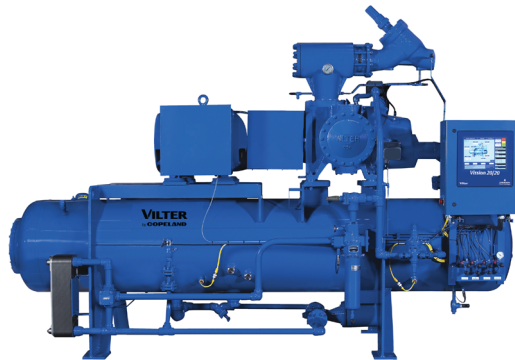
Bare Shaft Compressor

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.



Section 1 • General Information

Compressor Unit Component Identification

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

- | | | |
|--------------------------------|-------------------------------------|---|
| 1 - Motor | 13 - Oil Drain/Fill Valve | 23 - Oil Temperature Control Valve (Oil Mixing Valve) |
| 2 - Motor Conduit Box | 14 - Oil Pressure Regulator | 24 - Oil Cooler (Plate Heat Exchanger) |
| 3 - Coupling and Guard | 15 - Oil Heater | 25 - Oil Separator |
| 4 - Suction Oil Charging Valve | 16 - Frame | 26 - Discharge Connection |
| 5 - Thermometer | 17a - Oil Filter, Single (Vertical) | 27 - Coalescing Oil Return Line |
| 6 - Suction Strainer | 17b - Oil Filter, Dual (Horizontal) | 28 - Heater Wiring Panel |
| 7 - Suction Check Valve | 18 - Oil Pump Motor | 29 - Economizer Connection Flange |
| 8 - Suction Stop Valve | 19 - Oil Pump | 30 - Nameplate |
| 9 - Compressor | 20 - Oil Sight Glass | 31 - Suction Equalizing Line |
| 10 - Discharge Pipe | 21 - Oil Pump Strainer | 32 - Oil Separator Certification Plate |
| 11 - Vision 20/20 HMI | 22 - Oil Pressure Relief Valve | |
| 12 - Block & Bleed Assembly | | |

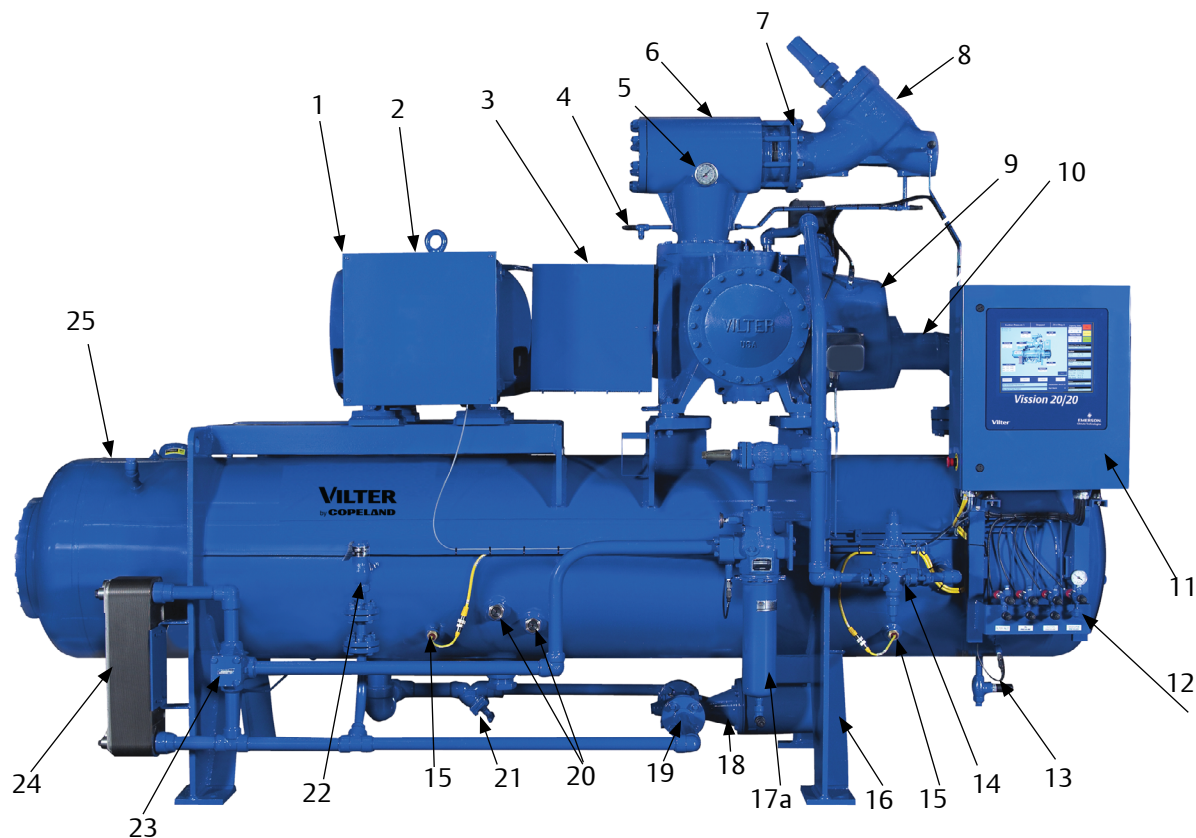


Figure 1-1. Refrigeration Compressor Unit Components (1 of 3)

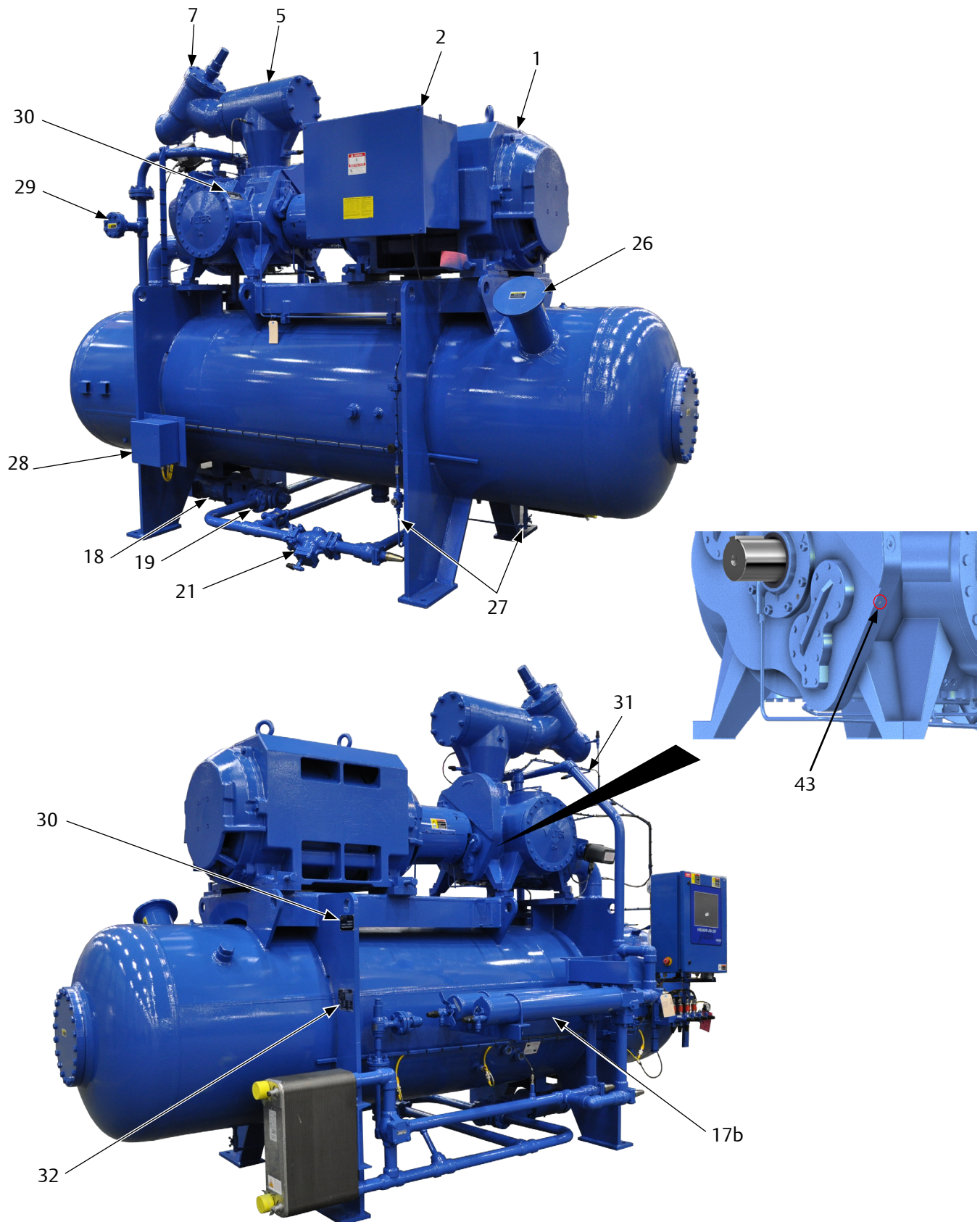


Figure 1-1. Refrigeration Compressor Unit Components (2 of 3)

Section 1 • General Information

Compressor Unit Component Identification (Continued)

33 - Temperature Element (Suction)

34 - Pressure Transducer (Filter Inlet)

35 - Pressure Transducer (Oil Pressure)

36 - Pressure Transducer (Suction Pressure)

37 - Pressure Transducer (Discharge Pressure)

38 - Temperature Element (Oil Separator)

39 - Temperature Element (Oil Injection)

40 - Capacity Slide Valve Actuator

41 - Volume Slide Valve Actuator

42 - Temperature Element (Discharge)

43 - Ground Wiring Hole for Compressor Housing, for 350mm Models Only

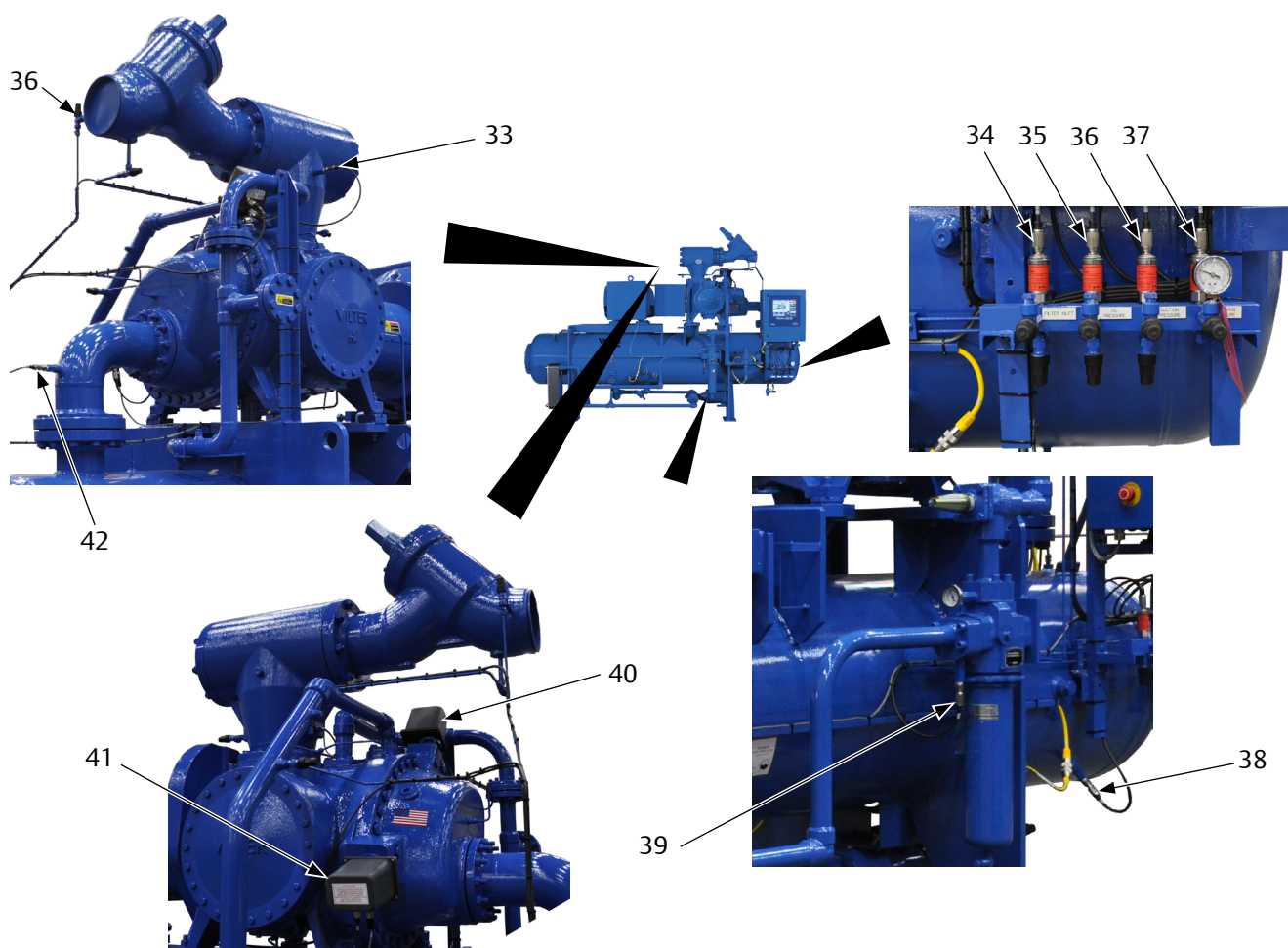


Figure 1-1. Refrigeration Compressor Unit Components (3 of 3)

Section 1 • General Information

Configured Compressor Unit Component Identification - VSSC

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

- | | | |
|--------------------------------|---------------------------------------|--------------------------------------|
| 1 - Motor | 11 - Vission 20/20 HMI | 20 - Oil Pump |
| 2 - Lift Point (Motor ONLY) | 12 - HMI Mounting Bracket | 21 - Oil Sight Glasses |
| 3 - Motor Conduit Box | 13 - Emergency Stop Button | 22 - Oil Level Switch |
| 4 - Suction Oil Charging Valve | 14 - Block & Bleed Assembly | 23 - Motor Mounting Area |
| 5 - Suction Strainer & Cover | 15 - Oil Filter Out Shut-off Valve | 24 - Heaters |
| 6 - Thermometer Connection | 16 - Oil Drain/Fill Valve | 25 - Oil Cooler |
| 7 - Suction Check Valve | 17 - Oil Filter Assembly | 26 - Oil Separator and Cover |
| 8 - Suction Connection Port | 18 - Oil Drain Valve for Oil Filter | 27 - KDC Mounting (plugged) |
| 9 - Suction Stop Valve | 19 - Temperature Element (Oil Filter) | 28 - Lifting Point (Compressor Unit) |
| 10 - Single Screw Compressor | | |

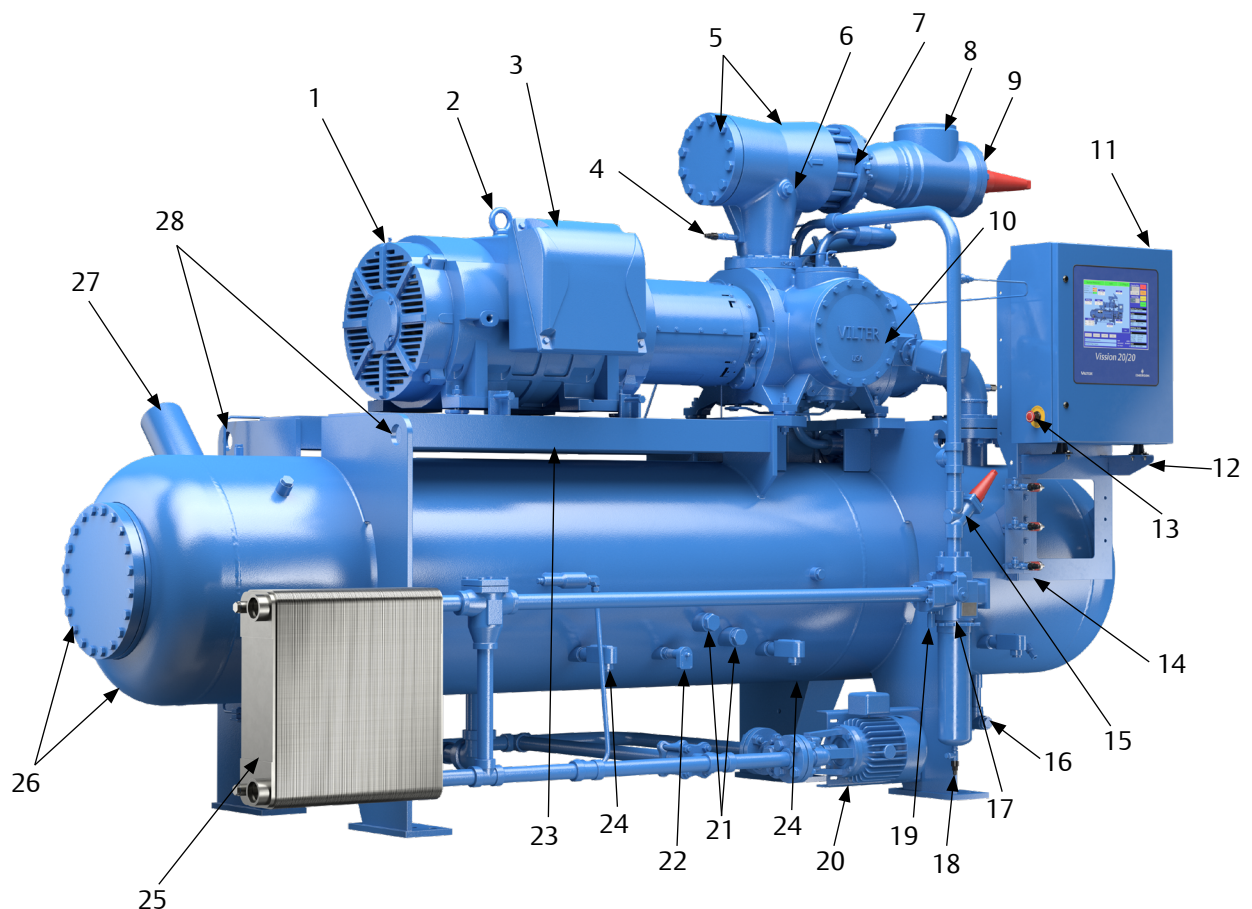


Figure 1-2. VSSC Compressor Unit Components

Section 1 • General Information

Configured Compressor Unit Component Identification - VSMC

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

- | | | |
|--------------------------------|---|--|
| 1 - Motor | 15 - Emergency Stop Button | 27 - Oil Filter Out Shut-off Valve |
| 2 - Motor Conduit Box | 16 - Block & Bleed Assembly Option
(Not Shown) | 28 - Oil Sight Glass |
| 3 - Lift Point (Motor ONLY) | 17 - HMI Mounting Bracket | 29 - Oil Level Switch |
| 4 - G-Flange (Compressor) | 18 - Pressure Transducer (Oil Filter) | 30 - Shaft Seal Oil Drip Tube |
| 5 - G-Flange Cover | 19 - Temperature Element
(Oil Separator) | 31 - Lift Point (Compressor Unit) |
| 6 - Suction Oil Charging Valve | 20 - Oil Drain/Fill Valve | 32 - Oil Separator and Cover |
| 7 - Single Screw Compressor | 21 - Oil Filter Out Shut-off Valve | 33 - Motor Mounting Area |
| 8 - Suction Strainer & Cover | 22 - Oil Filter Assembly | 34 - Discharge Stop Valve |
| 9 - Thermometer Connection | 23 - Oil Drain Valve for Oil Filter | 35 - Discharge Connection Port |
| 10 - Suction Check Valve | 24 - Temperature Element
(Oil Filter) | 36 - Volume Slide Valve Actuator |
| 11 - Suction Pressure Sensor | 25 - Oil Pressure Regulator | 37 - Temperature Element (Suction) |
| 12 - Suction Connection Port | 26 - Oil Heater | 38 - Capacity Slide Valve Actuator |
| 13 - Suction Stop Valve | | 39 - Liquid Injection Diverter Valve
Actuator |
| 14 - Vission 20/20 HMI | | |

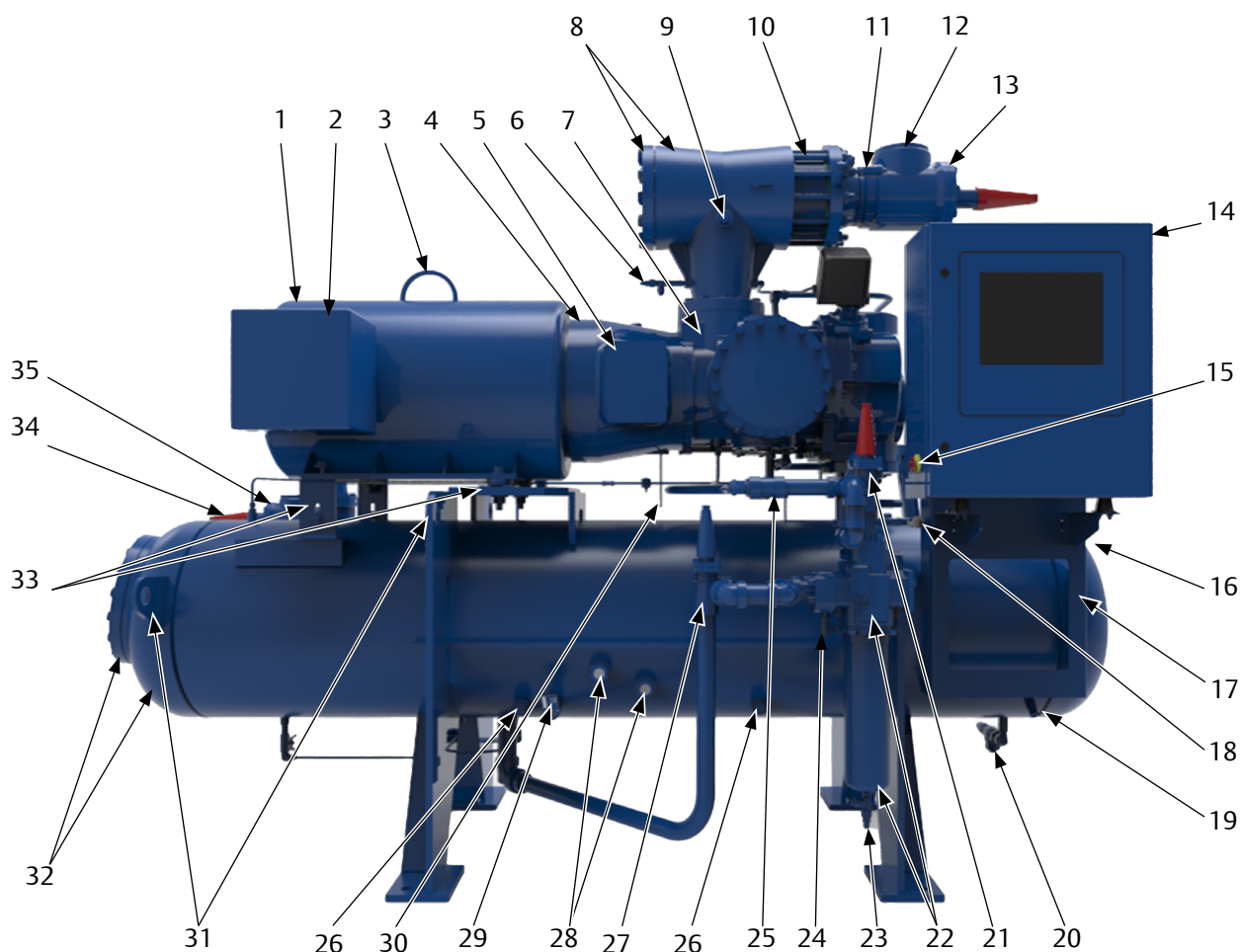
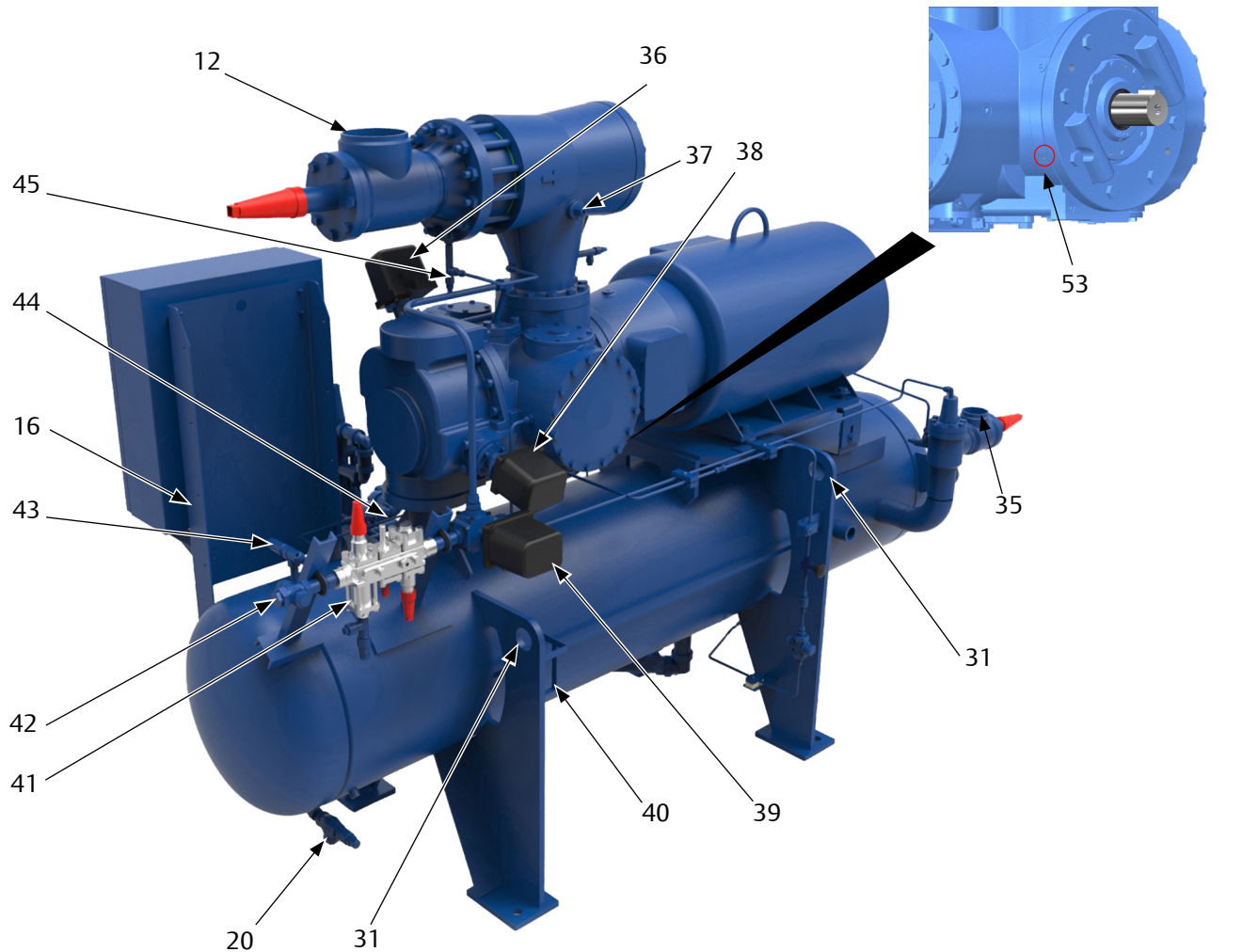


Figure 1-3. VSMC Compressor Unit Components (1 of 2)



- 40 - Shaft Seal Oil Drip Container Holder
- 41 - Liquid Injection Valve Station
- 42 - Refrigerant Supply to Liquid Injection Port
- 43 - Discharge Pressure Sensor
- 44 - Temperature Element (Discharge)
- 45 - Suction Equalizing Line
- 46 - Pressure Relief Connection Port
- 47 - Coalescing Oil Return Control Valve
- 48 - Coalescing Oil Return Shut-off Valve
- 49 - Coalescing Oil Return Sight-glass
- 50 - Coalescing Oil Return Check Valve
- 51 - Oil Drain Valve & Plug (Lowest Point)
- 52 - KDC Discharge Valve
- 53 - Ground Wiring Hole for Compressor Housing, for 240mm VSM Only

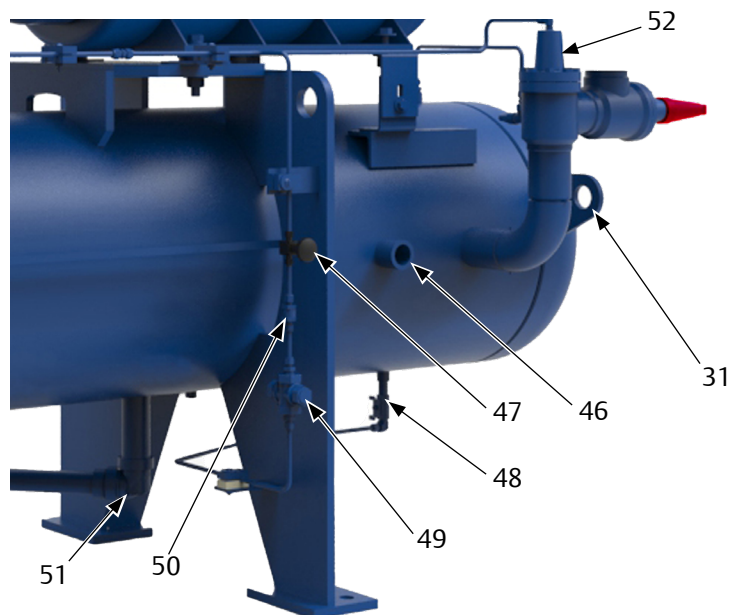


Figure 1-3. VSMC Compressor Unit Components (2 of 2)

Grounding Wire Location

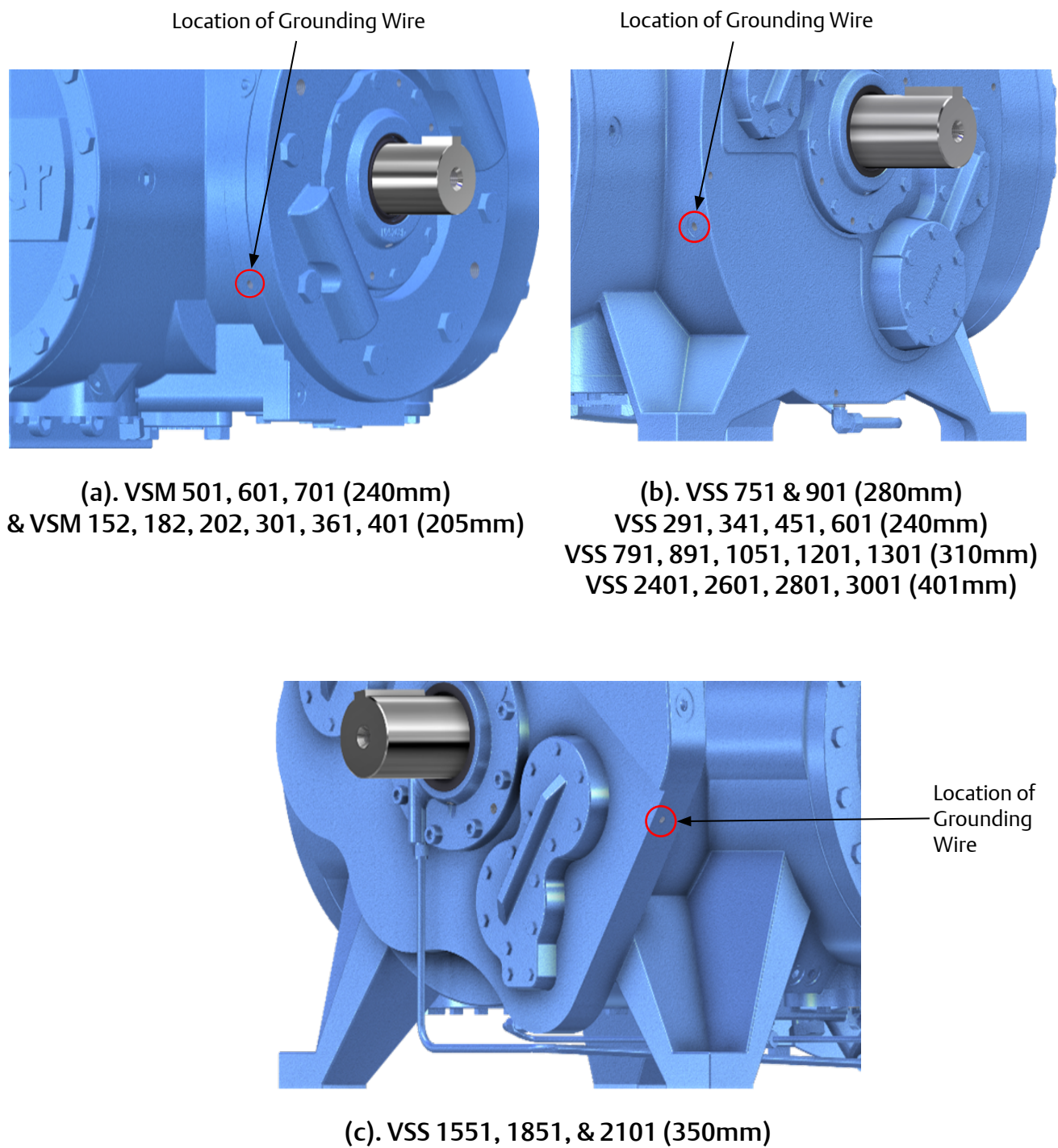


Figure 1-4. The Grounding-Wire Hole Location on Housing for Various Screw Compressor Models

Section 1 • General Information

Instrument Identification Letters

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

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














































Section 1 • General Information

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

Section 1 • General Information

Symbol Identification

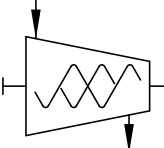

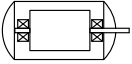

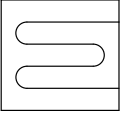
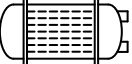
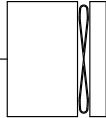

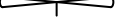

Use this list to identify symbols shown in the Piping & Identification Diagram.

	3-Way Valve		Gate Valve		Regulating Valve Inlet Pressure
	3-Way Solenoid Valve		Globe Valve		Regulating Valve Outlet Pressure
	Angle Valve		Hand Expansion Valve		Rotary Valve
	Ball Valve		Heater		Rupture Disc
	Basket Strainer		Heat Trace		Schroder Valve
	Block/Bleed Gauge Valve		Insulation		Solenoid Valve
	Butterfly Valve		Man-Way Cover		Spring-Closing Drain Valve
	Check Valve		Manifold Gauge Valve		Stop/Check Valve
	Diaphragm Actuator		Motorized Ball Valve		Strainer
	Diaphragm Spring-Opposed		Needle Valve		Thermostatic Valve 3-Way
	Diaphragm Pressure-Balanced		Orifice Plate		Thermowell (SW or NPT)
	Differential Pressure Regulating Valve		Pilot Light		Thermowell (SW or NPT)
	Drive Coupling		Pipe Plug		Venturi Injector Nozzle
	Flange Set		Pipe Reducer		Vibration Absorber
	Flow/Sight Glass		Pneumatic Actuator Control Valve		
			Relief Valve		

BY FILTER BY OTHERS Scope of Supply

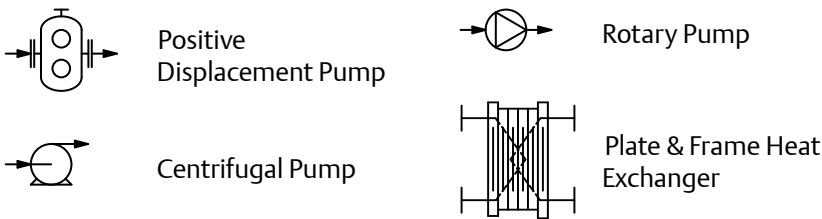
Major Component Identification

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

	Compressor		Filter		Motor
	Damper or Louver		Finned Tube Heat Exchanger		Shell and Tube Heat Exchanger
	Engine Drive		Heat Exchanger		Fan
					Tank/Drum Vessel

Section 1 • General Information

Major Component Identification (Continued)



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

Section 1 • General Information

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

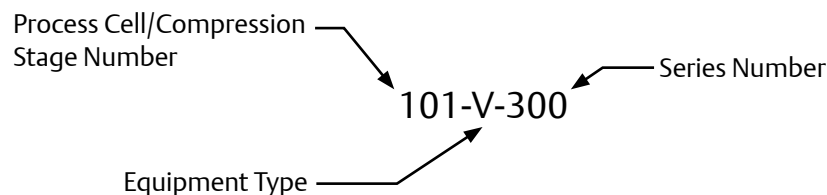
3 - Loop number or sequential number

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

Section 1 • General Information

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

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

Section 2 • Theory of Operation

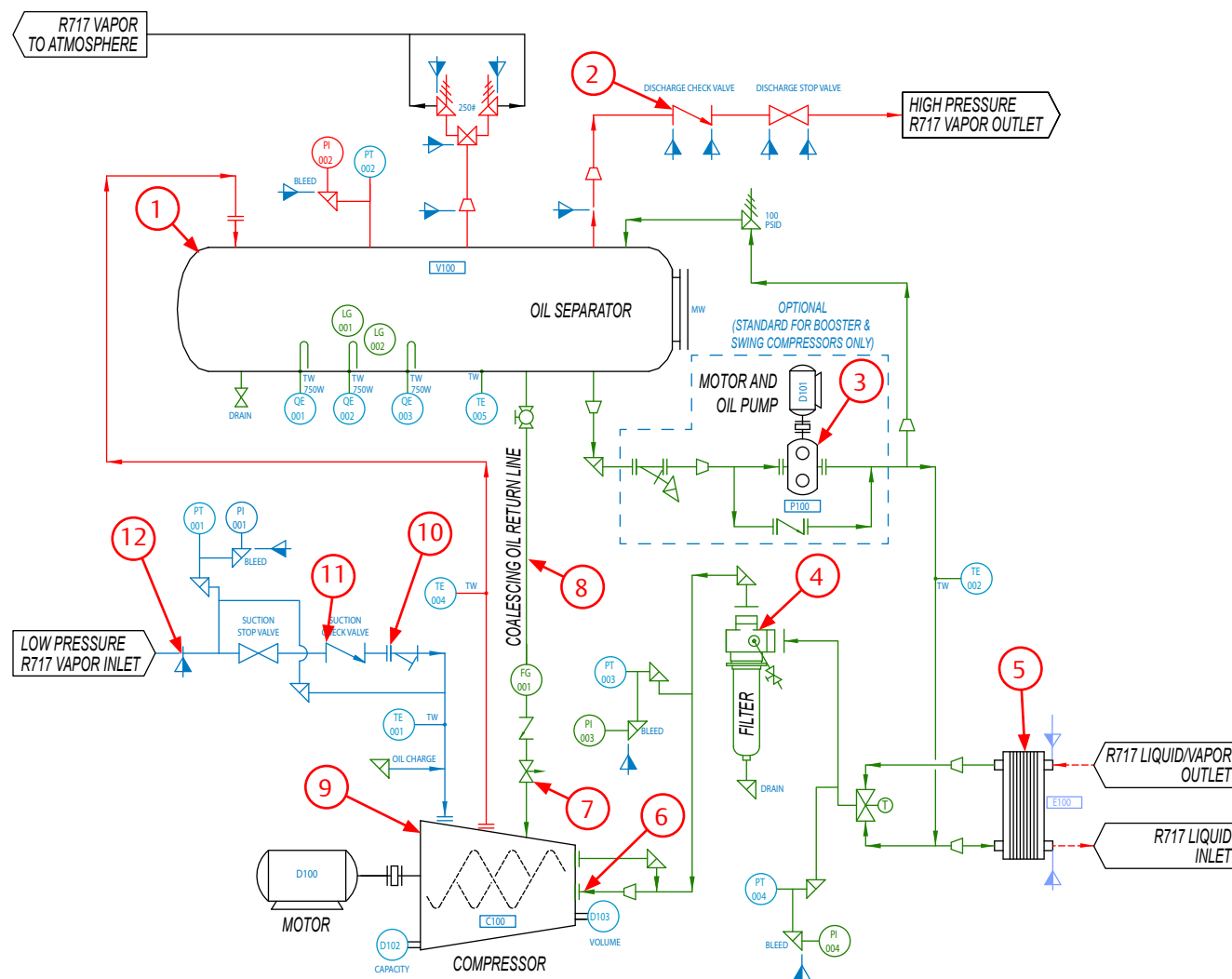


Figure 2-1. Refrigeration Compressor Unit P&ID (Thermosyphon Oil Cooling with Single Oil Filter Shown)

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 refrigeration system with thermosyphon oil cooling.

Moreover, suction stop/check valve (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.

Refrigerant Flow

The refrigeration compression process begins as refrigerant vapor enters the suction inlet (12). The refrigerant vapor flows through a suction stop/check valve (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 siphoned back to the compressor.

Oil Life and Oil Flow

NOTE

An oil pump is not the standard offering for VSMC/VSSC compressor units. See KDC Discharge Valve operation for units without an oil pump.

Oil in the refrigeration system serves three primary purposes. They are compressor lubrication, sealing clearances between moving parts, and heat removal resulting from heat of compression and friction. Initially, oil flow is driven by a mechanical gear pump (3). Once the system reaches design conditions, the oil pump is shut off and oil flow is maintained by differential pressure.

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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 thermosyphon oil cooling, refer to Oil Cooling - Thermosyphon Oil Cooling.

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.

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 water regulating valve and solenoid valve combination to control the water supply to the oil cooler. The water inlet connection should be made on the bottom and the outlet connection on the top. The water supply is controlled by the water regulating valve to maintain the oil temperature at approximately 120°F. The solenoid valve provides positive 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. Unless otherwise specified, the oil cooler is sized for an 85°F water inlet temperature and 10°F temperature rise.

Liquid Injection Oil Cooling

- This type of oil cooling system is designed to maintain compressor discharge gas temperature within acceptable limits. Cooling is accomplished via injection of the liquid refrigerant into the compressor. For this purpose, a liquid injection control valve station is supplied and installed on the compressor unit. On this valve station is an electronically controlled motorized actuator valve assembly that controls the flow of liquid refrigerant being injected into the compressor.
- For additional information, refer to Section 5.
- Liquid injection cooling on booster compressors is

handled in the following manner. Using high pressure liquid, the point of injection can be the discharge line and no horsepower penalty is paid by injecting liquid into the compressor discharge line. The high pressure gas source normally used for the pressure regulator would be compressor discharge pressure. Since, on a booster unit, this intermediate pressure is very rarely as high as the nominal setting of 70 psig, high stage discharge gas is used. On high stage compressors, the liquid is injected directly into the compressor. However, there is a horsepower penalty when the liquid is injected into the compressor. This will vary with refrigerant and operating condition. The liquid is injected into the compressor at a point in the compressor cycle that minimizes the brake horsepower penalty.

V-Plus Oil Cooling

- This system consists of a liquid pump, shut-off valves, motor, solid state variable speed controller and solid state temperature controller. This method of oil cooling is not available on the VSM compressor units. The pump and solenoid valve cycle on and off in parallel with the compressor drive motor. The temperature controller receives a temperature signal from the sensor located in the discharge and oil lines and in turn, sends a signal to the motor speed controller.
- As the oil and de-superheating load varies, the temperature controller adjusts the speed of the pump/motor combination to maintain a constant oil temperature.
 - For additional V-Plus information, refer to V-Plus AC Drive manual (35391XA).

Thermosyphon Oil Cooling

- Using a brazed plate or one pass shell and tube type vessel, similar to the water cooled oil cooler, oil is circulated on the shell side and liquid refrigerant from the receiver is circulated through the tubes. Thermosyphon systems use a 3-way temperature sensing control valve to regulate oil at 120°F. Oil is bypassed around the thermosyphon oil cooler. When oil is higher than 120°F, the oil is passed through the thermosyphon oil cooler. A 1/4" tubing line with valve adds high pressure gas to the oil to quiet the sound of injection. Open this valve in small amounts, until noise subsides. The closed type cooling circuit is free from the fouling problems associated with open circuit water cooling. Since the oil cooling load is rejected in the condenser, this type of cooling is practical. The temperature limits here are the same as those regarding the water cooled oil coolers.

Control System

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The compressor unit is controlled by the micro-processor, i.e. MicroVision 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 Vision 20/20 Operating Manual or 35391CM for Compact Logix PLC Software 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.

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 2-2. 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.

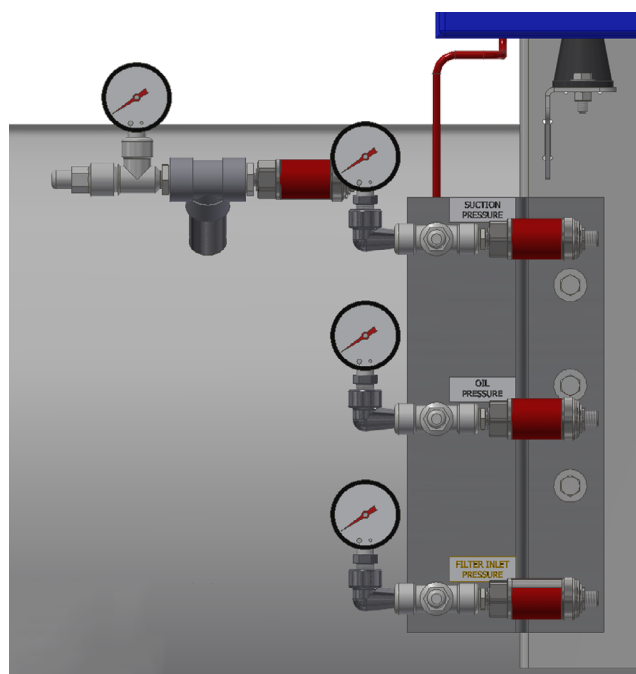


Figure 2-2. Block and Bleed Panel Arrangement

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KDC Discharge Valve

A KDC discharge valve is typically installed on units without an oil pump.

KDCs are pressure valves, which control the discharge pressure of the compressor to ensure a fast build-up of discharge and lubrication pressure. This way, the pressure in the oil separator during start-up will rise quickly.

When pressure in the oil separator is 2 bar (29 psi) higher than the suction pressure, the spring is compressed and the valve opens. In low pressure units (boosters), the spring requires a differential pressure of 0.5 bar (7 psi) for the valve to open.

Function¹

The KDC valve opens in a 3 Step sequence. The sequence of Steps depends on the start-up situation (refer to Figures 2-3 and 2-4).

- **Step 1**

The valve is always closed by a minimum differential pressure of 1.5 to 2.0 bar (0.3 to 0.5 bar in a booster system).

Step 1 will occur when the compressor is stopped and the discharge pressure has equalized to the top of the valve through the suction side of the compressor.

$$p_c - p_1 < 2 \text{ bar (0.5 bar for booster) and } p_c > p_2$$

(See Figure 2-4)

- **Step 2**

Step 2 will occur as soon as the condensing pressure becomes higher than the pressure in the oil separator, and when the differential pressure between suction side and condensing pressure is bigger than the spring force.

$$p_c - p_1 > 2 \text{ bar (0.5 bar for booster) and } p_c > p_2$$

(See Figure 2-4)

When the compressor starts the valve will either be in Step 1 or Step 2 position, depending on the pressure difference between the oil separator and the condensing pressure.

When oil separator pressure comes close to the condensing pressure the valve will start opening and the small spring will open the valve completely. The valve will then be in Step 3 position.

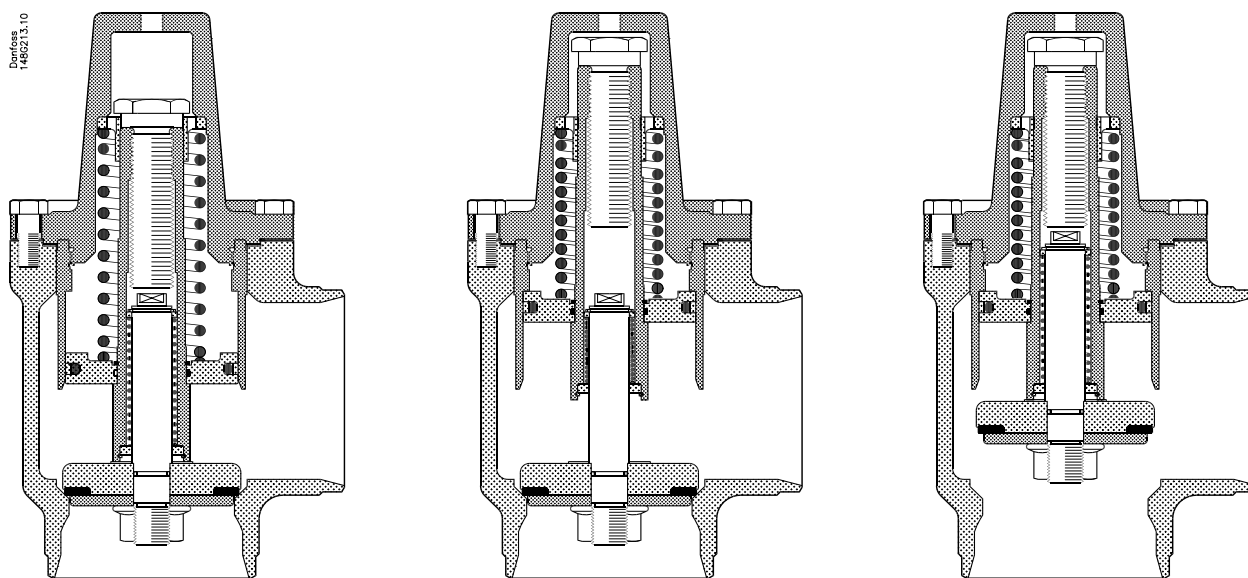


Figure 2-3. Three-Step Opening Sequence of the KDC Valve

¹ From Pressure control valve KDC 65-200 guide by Danfoss.

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When the compressor stops, the valve will be in Step 3 position and as soon as the condensing pressure has equalized to the suction side the spring force will close the valve. The valve will be in Step 1 position until enough differential pressure between condensing pressure and oil separator/suction side pressure occurs for the valve to enter into Step 2 position.

See Table 2-1 for start-up processes based on condensing pressure versus oil separator pressure.

For location of KDC discharge valve, refer to Figure 1-3. VSMC Compressor Unit Components (2 of 2) in Section 1.

Table 2-1. Start-up Situations

	Start-up Situation 1	Start-up Situation 2	Start-up Situation 3
Condensing Pressure vs Oil Separator Pressure	Condensing pressure < oil separator pressure	Condensing pressure is higher than oil separator pressure but the differential pressure is lower than the spring force.	Condensing pressure > oil separator pressure + spring force pressure
Start up process	Start up will occur from Step 1 position and go to Step 3 as soon as a differential pressure between suction side and oil separator that can overcome the spring force is present.	Start up will occur from Step 1 and go to Step 2 when differential pressure between suction side and condensing pressure is bigger than the spring force. When oil separator pressure comes close to the condensing pressure the valve will start opening and the small spring will open the valve completely. The valve will then be in Step 3 position.	Start up will occur from Step 2 position

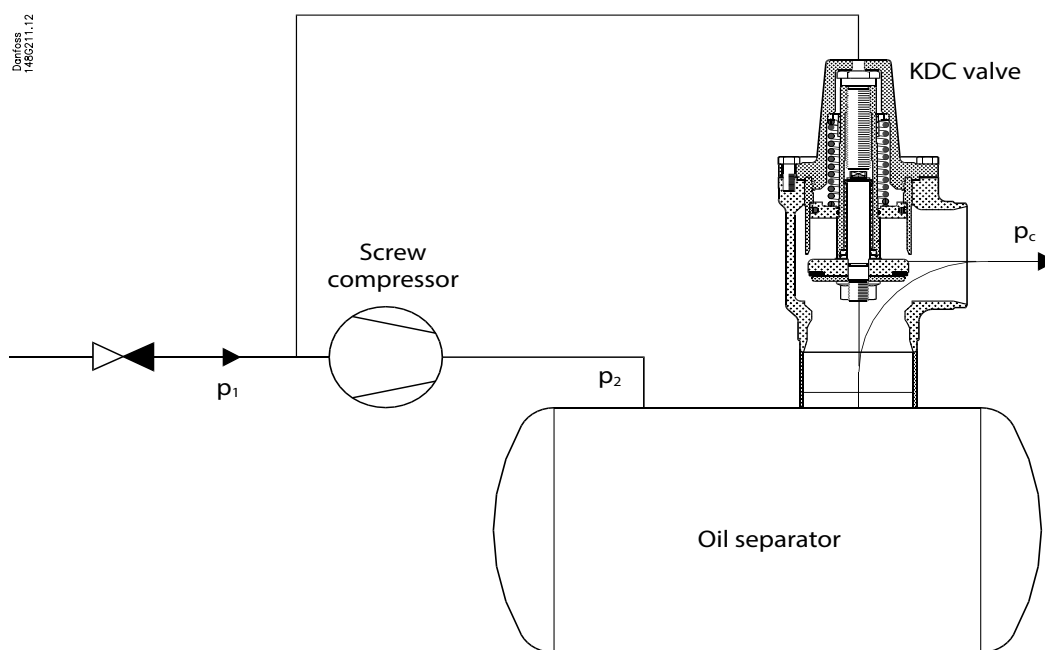


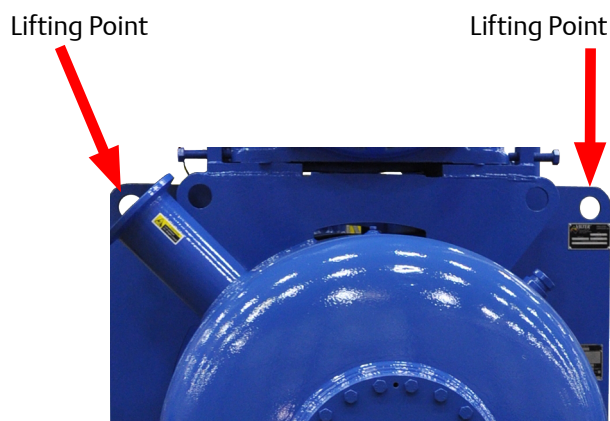
Figure 2-4. Compressor Discharge Line After Oil Separator

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 B31.5 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.



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.

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

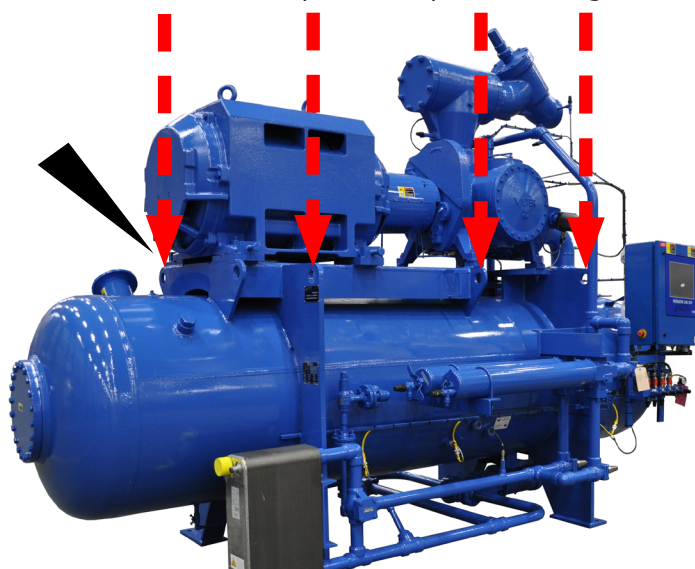


Figure 3-1. Rigging and Lifting Points (VSS-2101 Compressor Unit Shown)

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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, inspections and compressor unit operation. Besides general mechanic tools, these tools are recommended:

- Oil Pump (maximum of 2-3 GPM with motor approved for Division 1 or Division 2 and with ability to overcome suction pressure) (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 are to be closed to isolate the compressor from the remainder of the system. All other valves, except those venting to atmosphere, are to be open. The unit is shipped with dry nitrogen holding charge of 5 psig (5 psi above atmospheric pressure). It is essential that the nitrogen holding charge be maintained.
- The nitrogen or clean dry gas holding charge in the system and compressor are to be monitored on a regular basis for leakage. If not already installed, it is required that a gauge is to be added to help monitor the nitrogen holding charge pressure. If a drop in pressure occurs, the source of leakage must be found and corrected. The system must be evacuated and recharged with dry nitrogen to maintain the package integrity.
- Cover all bare metal surfaces (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 is to be placed in the control panel. If the

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panel is equipped with a space heater, it is to be energized. Use an approved electrical spray-on corrosion inhibitor for panel components (relays, switches, etc.).

- All pneumatic controllers and valves (Fisher, Taylor, etc.) are to be covered with plastic bags and sealed with desiccant bags inside.
- 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.
- Long Term storage log sheet to be kept with documenting dates to show 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 records.

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 of 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, it should not tightly wrap the motor. 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 can be moved, it is suggested that the entire motor be encased in a strong, transparent plastic bag. Before sealing this bag, a moisture indicator should be attached to the side of the motor and several bags of silica-gel desiccant be placed inside the bag around the motor. When the moisture indicator shows that the desiccant has lost its effectiveness, replace desiccants.

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 out, 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. Re-coat 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

Upon Warranty a Claim, 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: _____

Foundation

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

Considerations Prior To Starting

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

Site Characteristics

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

Site Layout

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

Safety

NOTE

Always check with a safety engineer before proceeding.

- Arranging equipment with adequate access space for safe operation and maintenance
- Wherever possible, arrange equipment to be served by crane. If not feasible, consider other handling methods
- 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
- Lightning 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 will have the necessary dimensions required to determine the overall foundation size and where to locate the compressor unit on the foundation. It will also show the dimensions required to form up the housekeeping piers that the compressor unit rests on. The Vilter™ foundation drawing lists the necessary information to construct a suitable foundation. It includes the rebar requirements and locations. It also shows anchor bolt locations, grouting and the concrete specifications. Using the Vilter™ GA drawing, Vilter foundation drawing and the information from site characteristics, site layout and safety studies will provide enough data to allow building the foundation to proceed.

The foundation is to be cast and permanently exposed against the earth. Therefore, if constructing on an existing floor, typically indoors, the floor will need to be broken up to get to the earth. If starting from undisturbed

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

Once the site has been excavated and prepared, place four inches of sand down on the bed where the foundation will rest. The sand must be compacted before placing the forms and rebar. After the sand is compacted, use the Vilter™ GA drawing to construct the forms for the foundation. With forms in place, install expansion

boards on the inside of the forms, for example, see Figure 3-4. Next, place your rebar in the forms as per the Vilter™ foundation drawing. When all rebars are in place the concrete can be poured. The concrete must then be trolled level and a surface texture etched in place. Leave the concrete to cure for at least 28 days.

Compressor Unit Installation

Once the foundation has cured, the compressor unit can be placed on the foundation, see Figure 3-5 and Figure 3-6. With the appropriate material handling equipment, lift the compressor unit by locations shown on the Vilter™ GA drawing and slowly place it on the foundation housekeeping piers. As per the Vilter™ GA drawing, ensure the compressor unit is correctly placed on the foundation. Once placed, use the spherical washers directly under the compressor as the surface to level the compressor unit, see Figure 3-7. Place shims under the feet of the compressor unit, as needed, until it is leveled, see Figure 3-8. Select the correct drill bit and drill thru the anchor bolt hole in the mounting feet of the compressor unit to the depth called for on the Vilter™ foundation drawing. Finally using the HILTI instructions, put your anchor bolts in place and wait for them to cure. Then place the nuts on the anchor bolts to finger tight and prepare to grout.

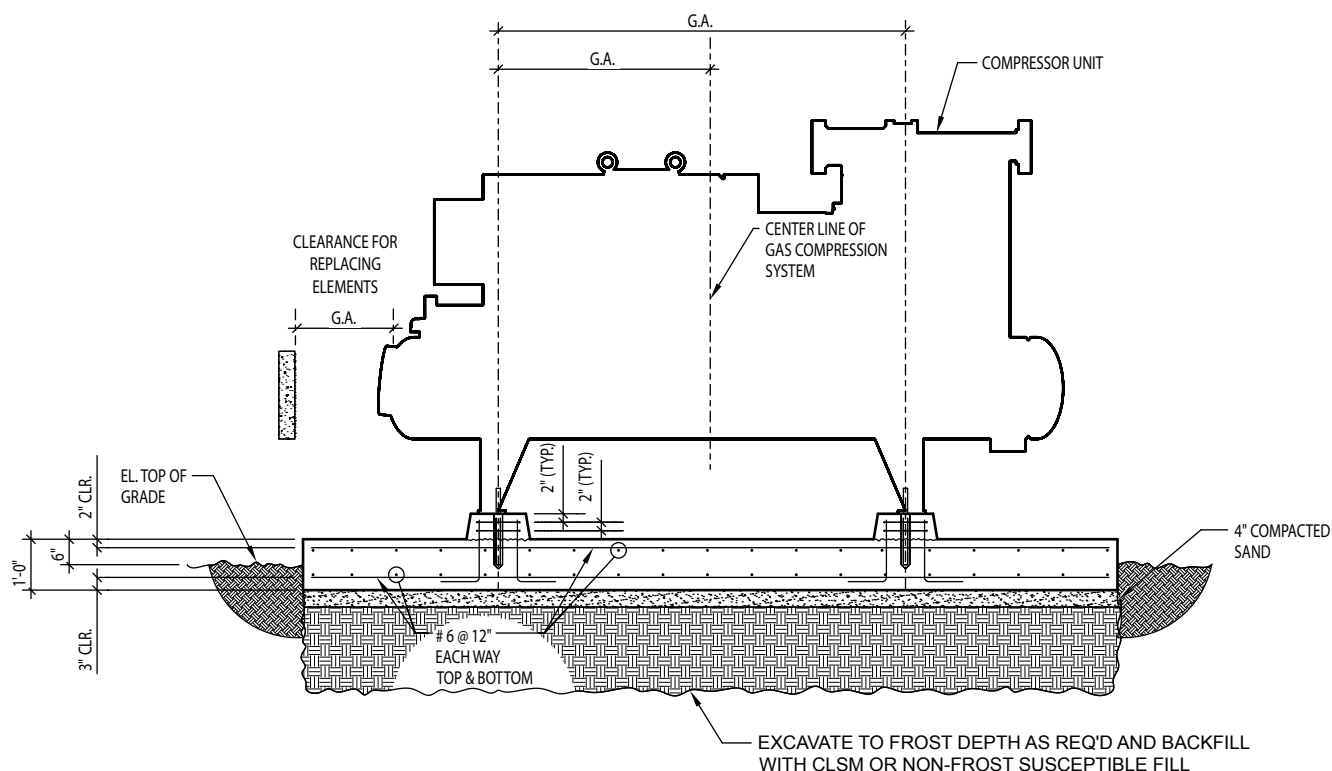


Figure 3-2. Concrete Pad with Compressor Unit Dimensions - Side View

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Leveling and Grouting

The unit should be level in all directions. Wet the concrete pad according to the grout manufacturer's directions. Mix a sufficient amount of grout. The grout must be an expanding grout rather than shrinking to provide

a tighter bond. Follow the manufacturer's recommendations for setting, precautions, mixing, and grout placement, finishing and curing. The grout must be worked under all areas of the feet with no bubbles or voids. If the grout is settled with a slight outside slope, oil and water can run off of the base. Once the grout has cured, torque the anchor bolts as per HILTI instructions.

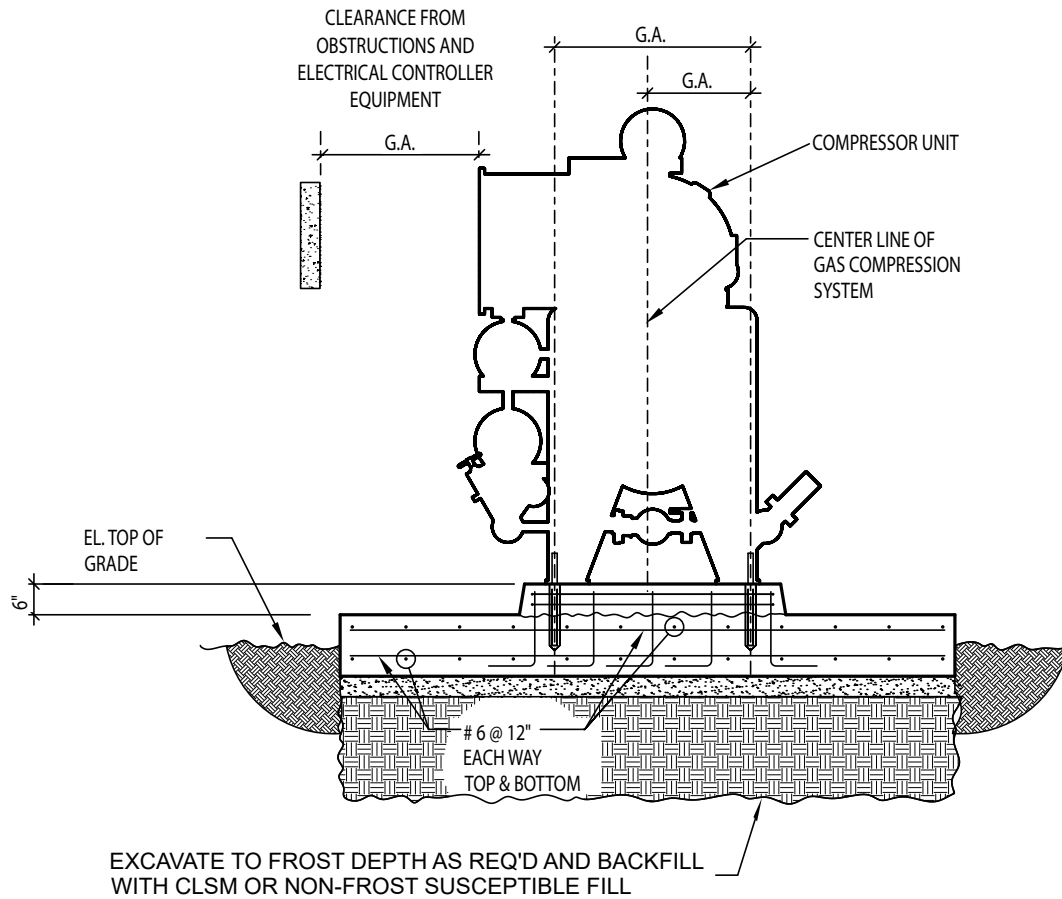


Figure 3-3. Concrete Pad with Compressor Unit Dimensions - Front View

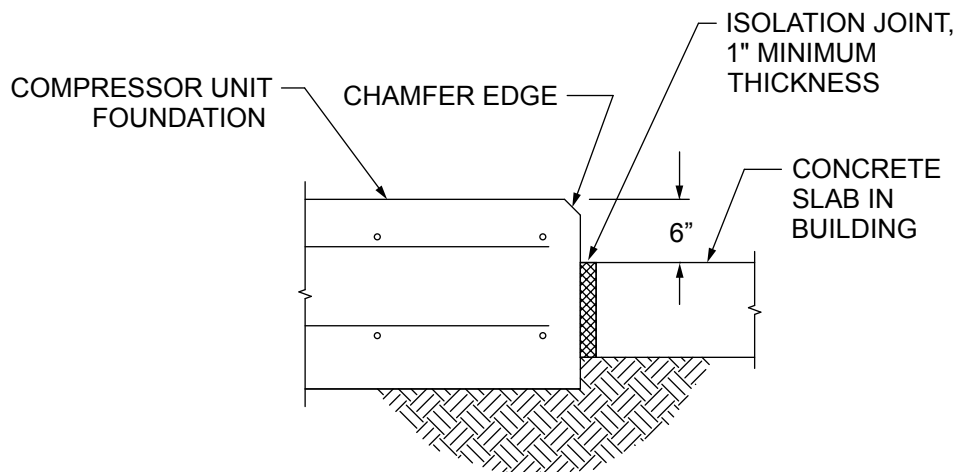


Figure 3-4. Interior Foundation Isolation

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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 3600
- Soil bearing capacity 1,500 lbs/sq.ft.
- Wind speed 120 MPH
- Exposure factor D
- Wind importance factor 1.15
- Concrete poured on and permanently cast against the earth

General Design Requirements

The compressor foundation is designed to:

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

NOTE

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

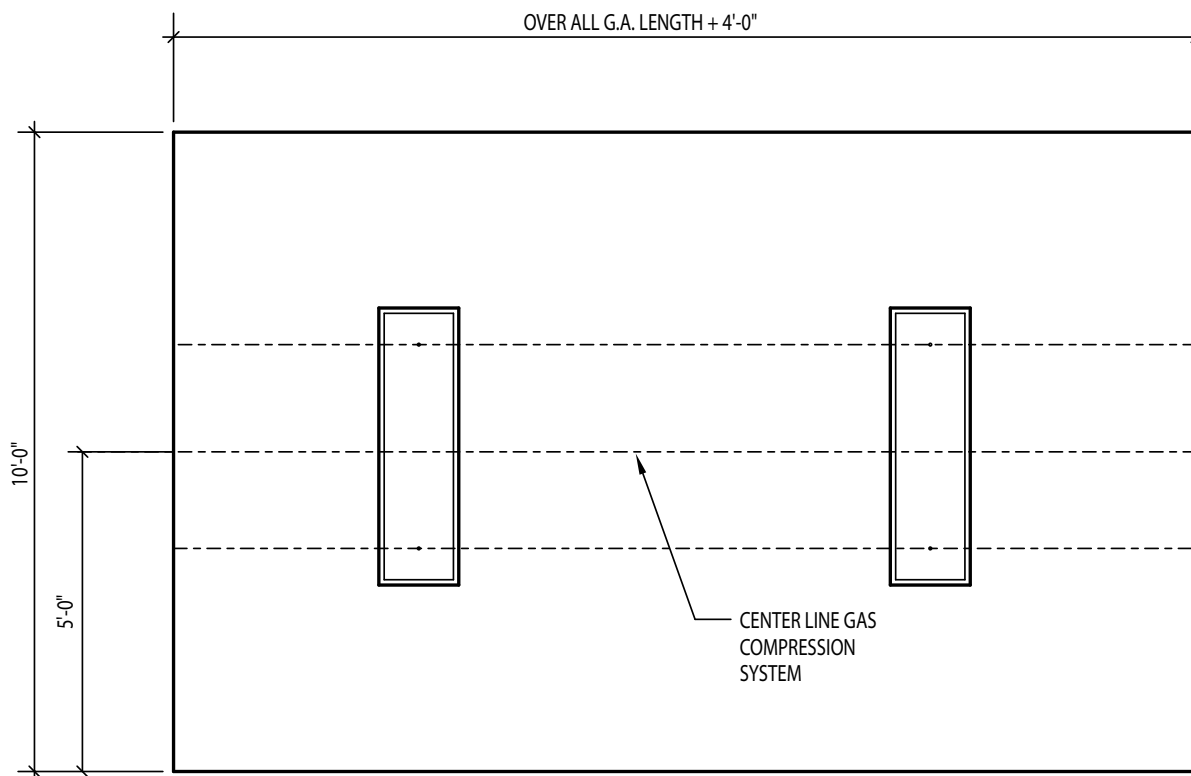


Figure 3-5. Foundation with Housekeeping Pads Dimensions - Top View

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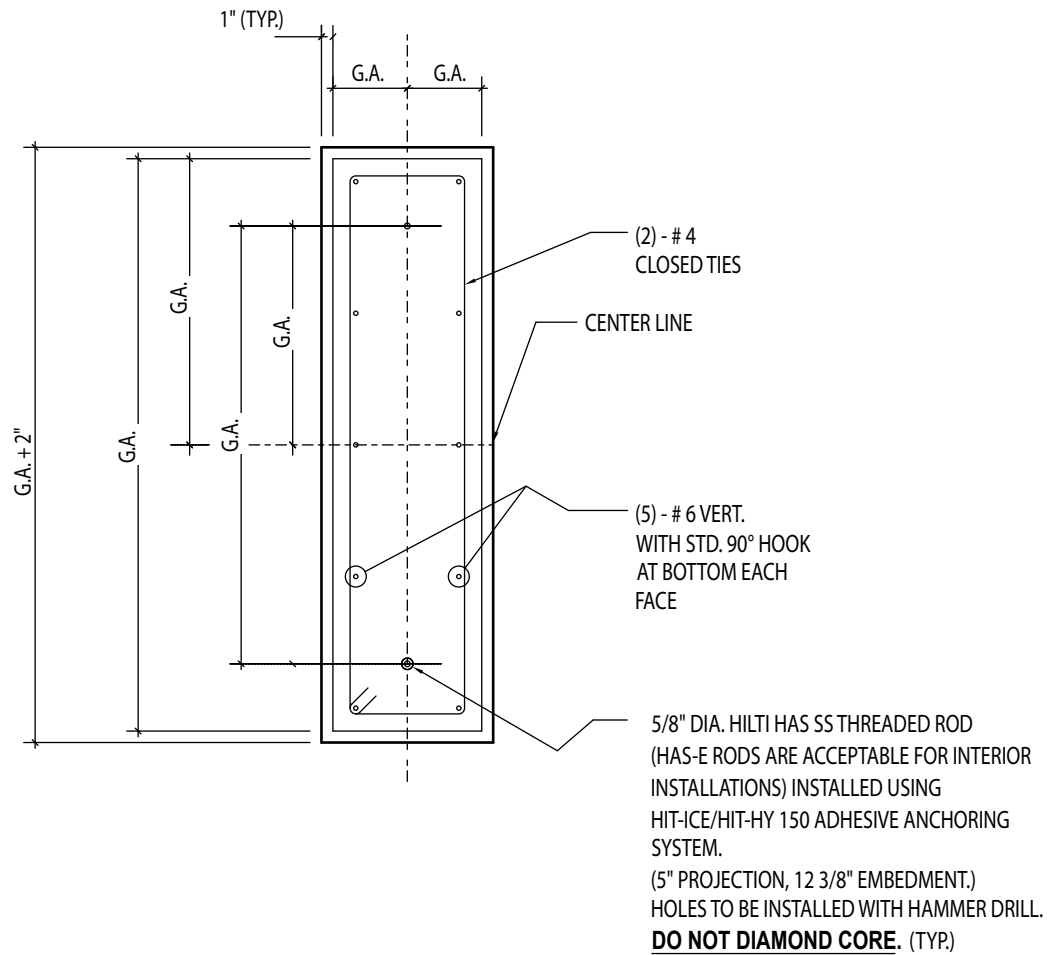


Figure 3-6. Housekeeping Pad Dimension Detail - Top View

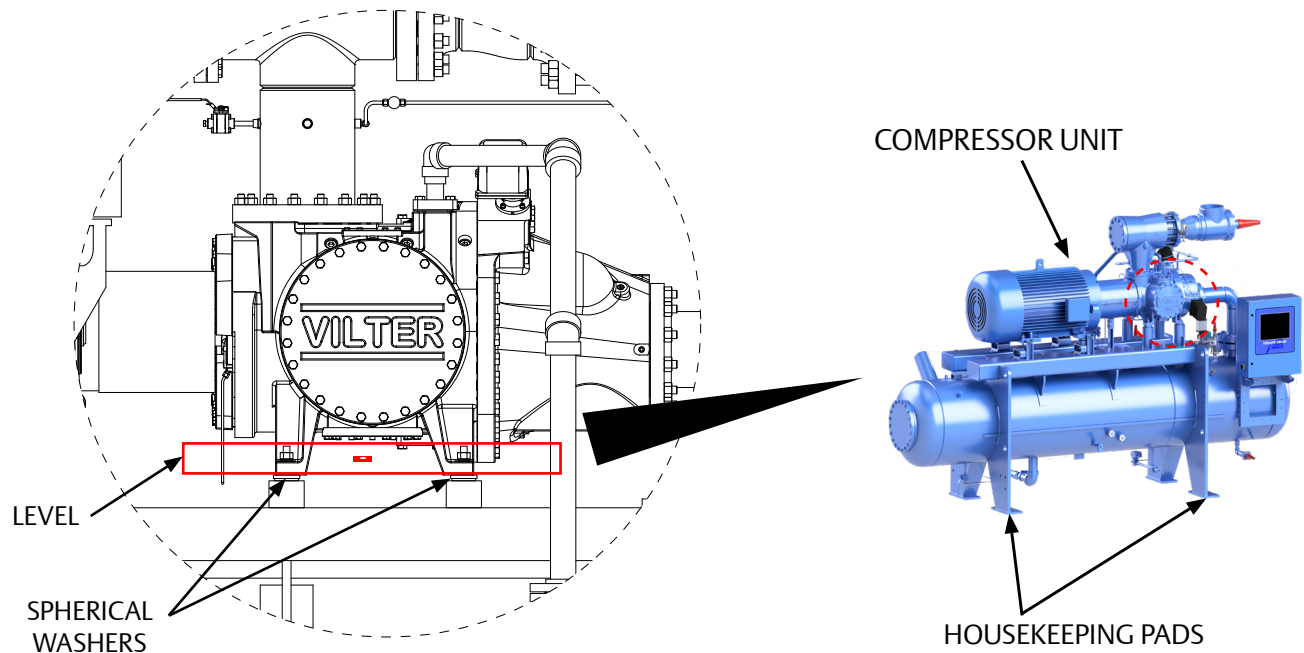


Figure 3-7. Level Compressor Unit Using Top Surface of Spherical Washers

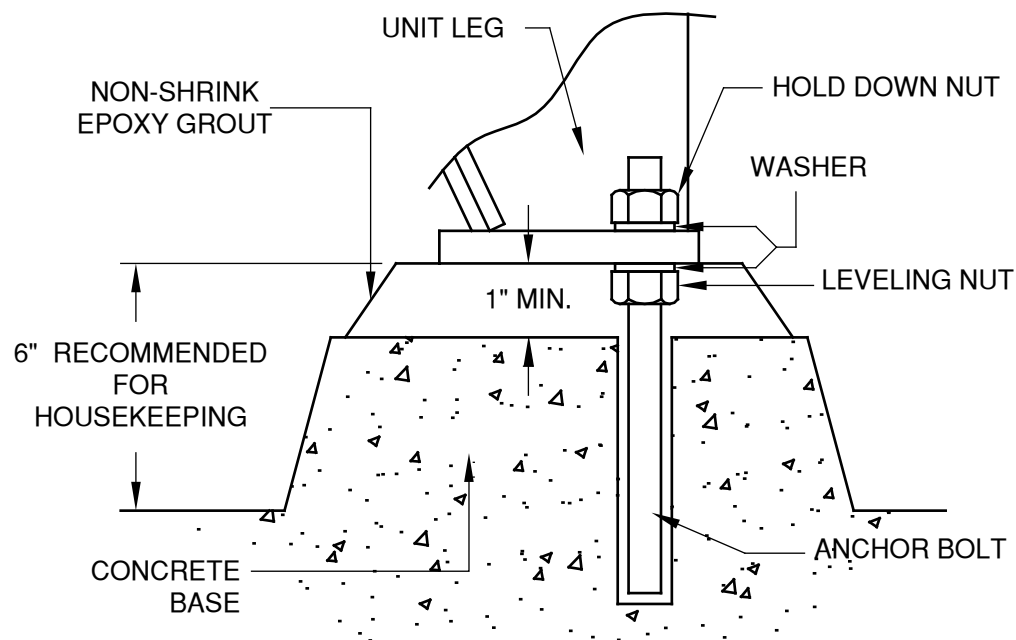


Figure 3-8. Concrete Pad Housekeeping Detail

Piping

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 run 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 coil. The hangers must have ample strength and be securely anchored to withstand the vibration from the compressor and adequately support the pipe lines.
- For CO₂ piping, the pipes can have smaller diameters and they will require a greater thickness to withstand the higher pressures.
- Smaller Halocarbon and Hydrofluorocarbon installations use copper pipes with solder type fittings where possible. The use of screw type fittings in Halocarbon systems should be held to an absolute minimum, as these refrigerants, due to their physical properties, will leak through screw type joints.
- When drawn copper tubing is used for Halocarbon lines, type “K” or “L” conforming to ASTM B88 should be used. Soft annealed copper tubing conforming to ASTM B280 can also be used for tube sizes not larger than 1-3/8” in outside diameter. These requirements are in accordance with the mechanical code for refrigeration ANSI B9.1-1971. The type of copper tubing to be used for a given pressure is dependent on the strength of the copper at the design temperature. Some local codes forbid the use of Type “L”. Therefore, before installation, be sure to check local requirements. Never use type “M” as it does not have adequate wall thickness to withstand the operating pressures.
- For halocarbon piping, only wrought copper fittings should be used. Cast fittings as used for water service are porous and will allow the refrigerant to escape. Note this exception: In larger pipe sizes, wrought fittings are not available. However, specially tested cast fittings are available and these may be used with complete safety.
- When soldering copper tubing joints, only silver solder should be used. Soft solder such as “50-50” should never be used, as its melting point is too low, lacks mechanical strength, and tends to break down chemically in the presence of moisture.
- Water supply and drain connections, and equipment using water, should be installed so all the water may be drained from the system after the plant has

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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 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.

Unit-Mounted KDC Valve and Stop Valve

For applications using the KDC valve, both the KDC and stop valves are supplied factory-installed on the separator discharge so that no other field connections are required.

Compressor Unit Discharge Piping

Vilter typically provides discharge components in one of two configurations:

Check Valve and Stop Valve Shipped Loose For Field Installation

For field-installed check valves, the ideal location and orientation is mounted on a horizontal pipe run near the condenser. Locating the check valve near the condenser minimizes potential for liquid build-up on top of the check valve. If this occurs, there's the possibility that liquid will flow back to the coalescing section of the separator on start-up. Locating the valve in horizontal piping minimizes the potential of valve chatter.

While the above recommendation most consistently minimizes operational issues, it is fairly common for the check valve and stop valve to be mounted immediately at the separator discharge. For this reason, Vilter sizes the check valve so that valve chatter is less likely—it is typically one or more pipe sizes smaller than the separator connection. If liquid return to the condenser is evident (seen as frost on the separator shell), it is important for the user/operator to take Steps to minimize the impact by providing heat and insulation on the discharge piping. If left unresolved, damage to the coalescing elements could occur.

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
10	1200	1200	1200	1200	1200	1200
12	1500	1500	1500	1500	1500	1500
14	2000	2000	2000	2000	2000	2000

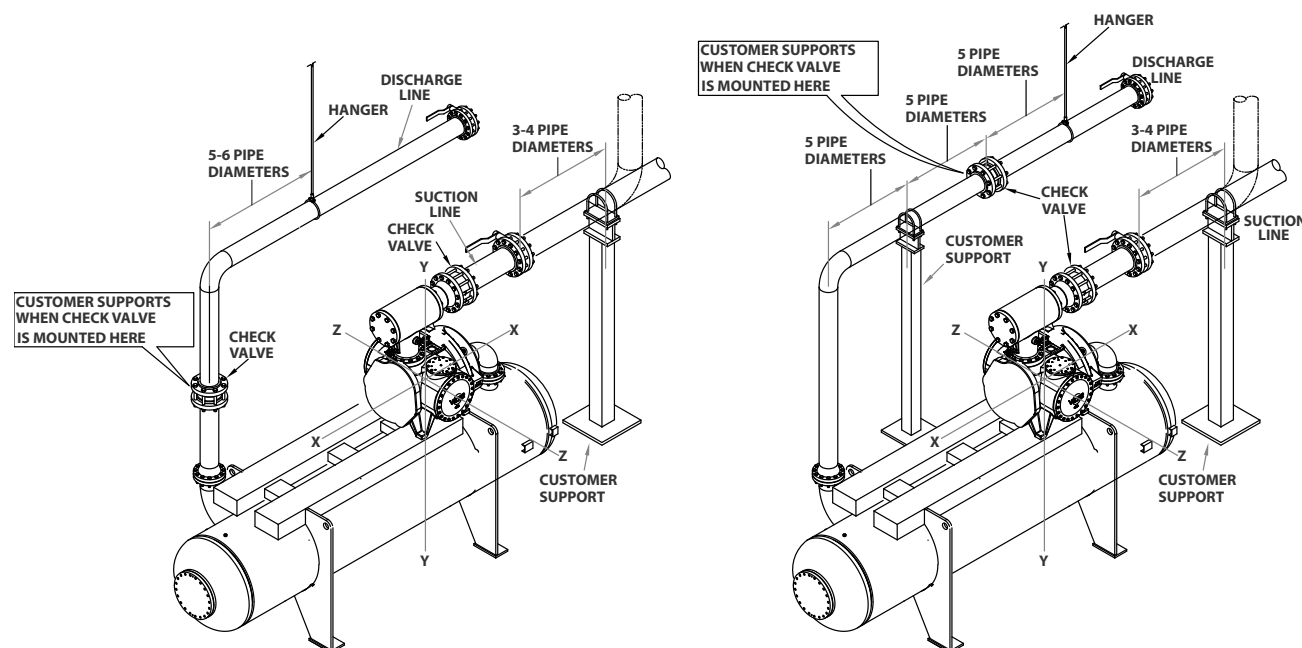


Figure 3-9. Maximum Allowable Flange Loads

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Remote Air-Cooled Oil Cooler Piping

If equipped with a remote air cooled oil cooler, it is important that the piping be installed correctly to and from the compressor unit and remote air cooled oil cooler:

- Outlet must be on top, inlet on bottom.
- Vertical drops should be no higher than 8 to 10 feet.
- If there is no choice and the vertical drops need to be higher, then an electronic service valve needs to be installed in the return line at the compressor. Consult Factory.
- If ambient temperatures get below 50° F, heat trace and insulation on oil lines and air cooler headers needs to be used.
- Maximum pressure drop on oil lines to and from air cooler and compressor should not exceed anymore than 5 to 10 psi.

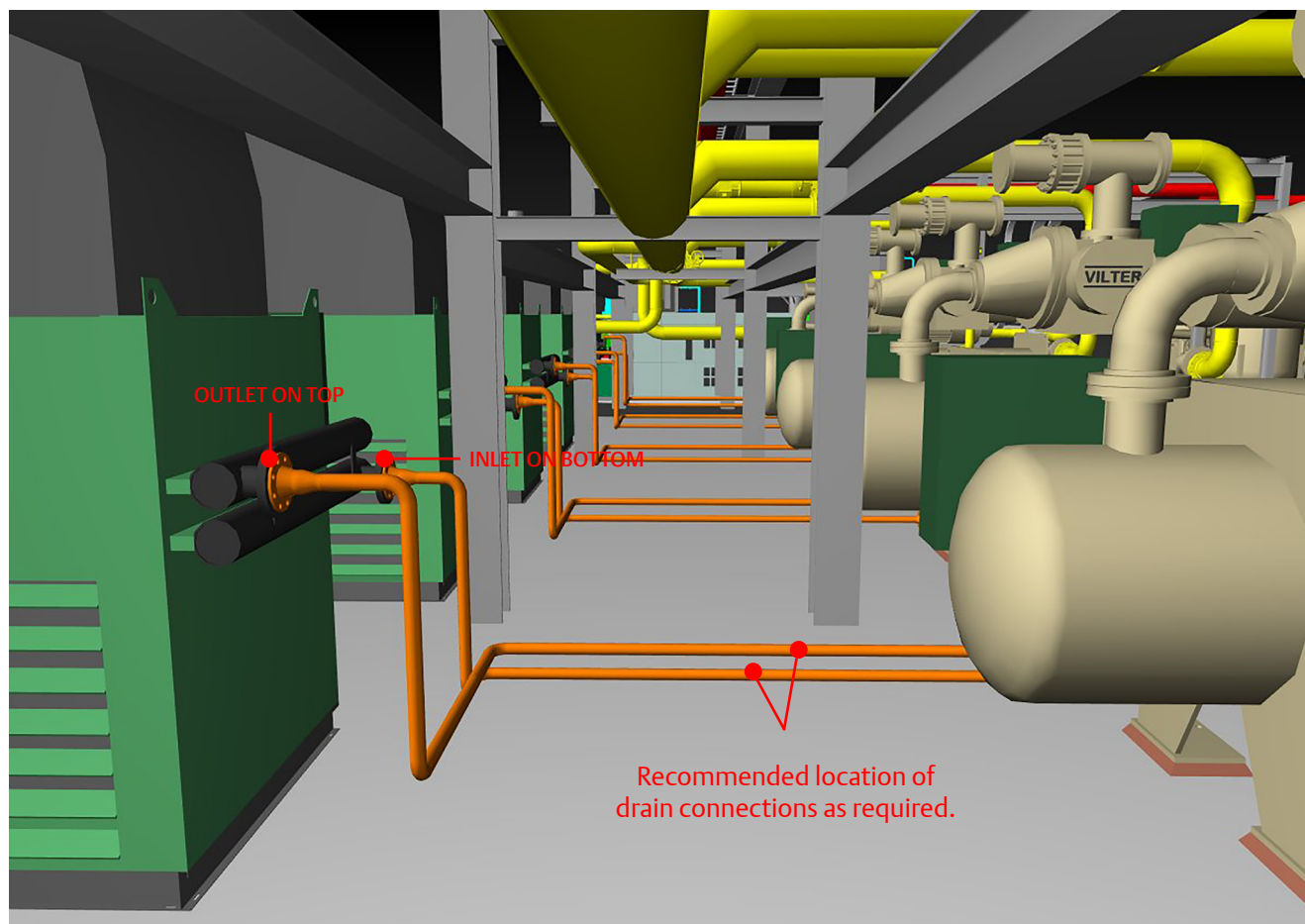


Figure 3-10. Recommended Remote Air Cooled Oil Cooler Piping

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 3-11.
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 3-12.
8. Units with V-PLUS™ oil cooling, L1 must connected to a fuse in V-PLUS panel, and L2 must be connected to a neutral terminal block, see Figure 3-13.

NOTE

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

9. 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.

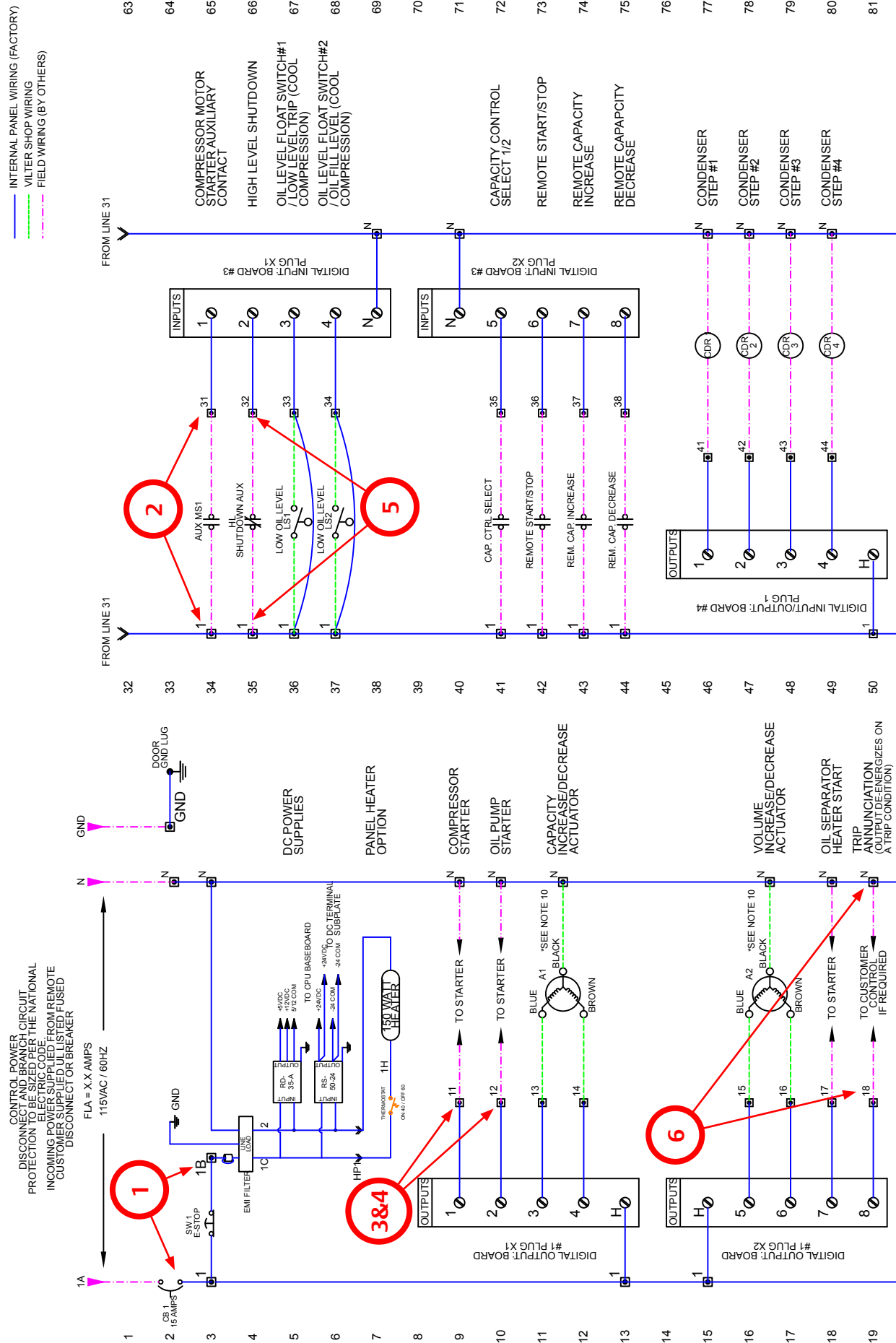
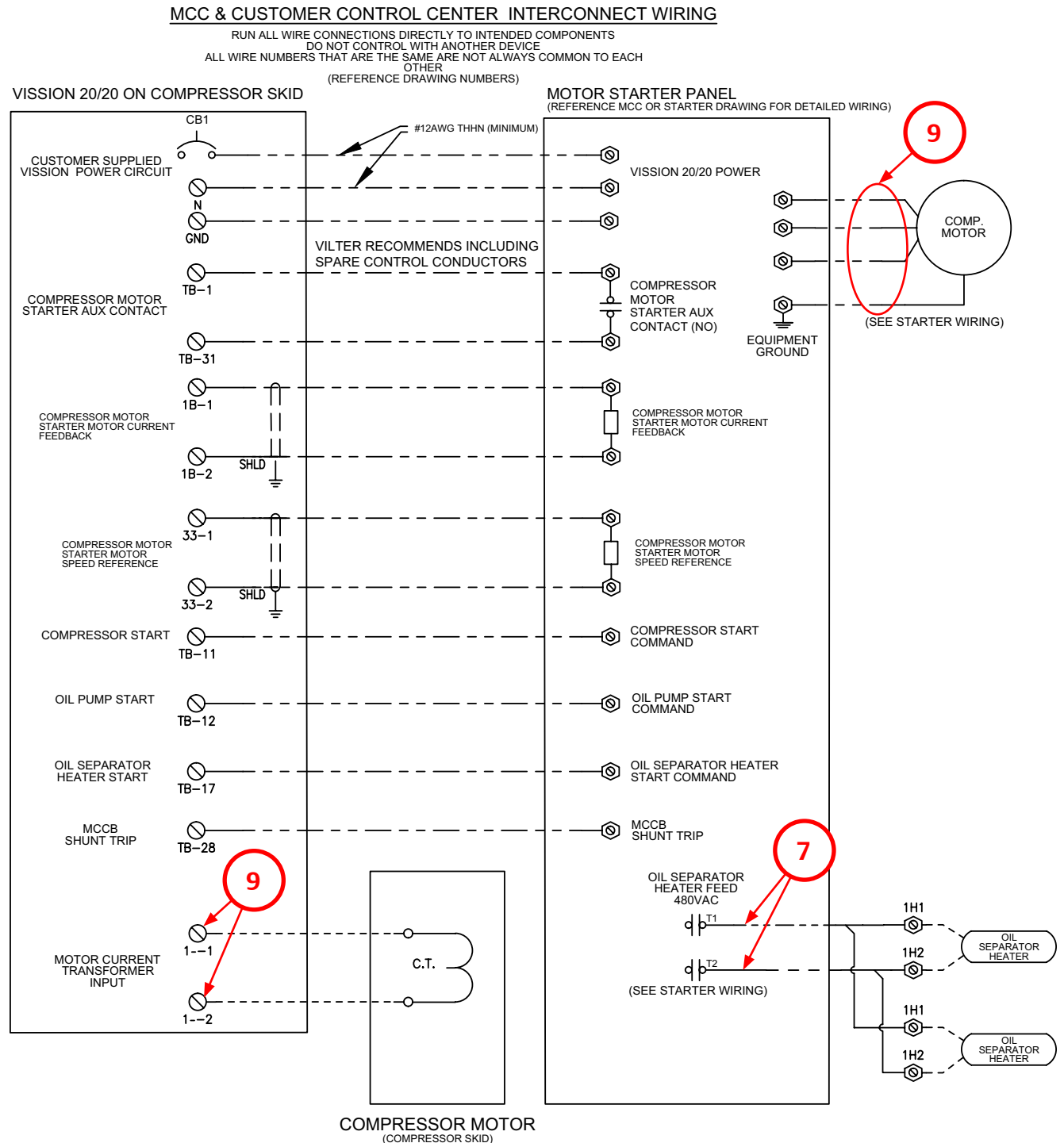


Figure 3-11. Example - Vision 20/20 Wiring Diagram



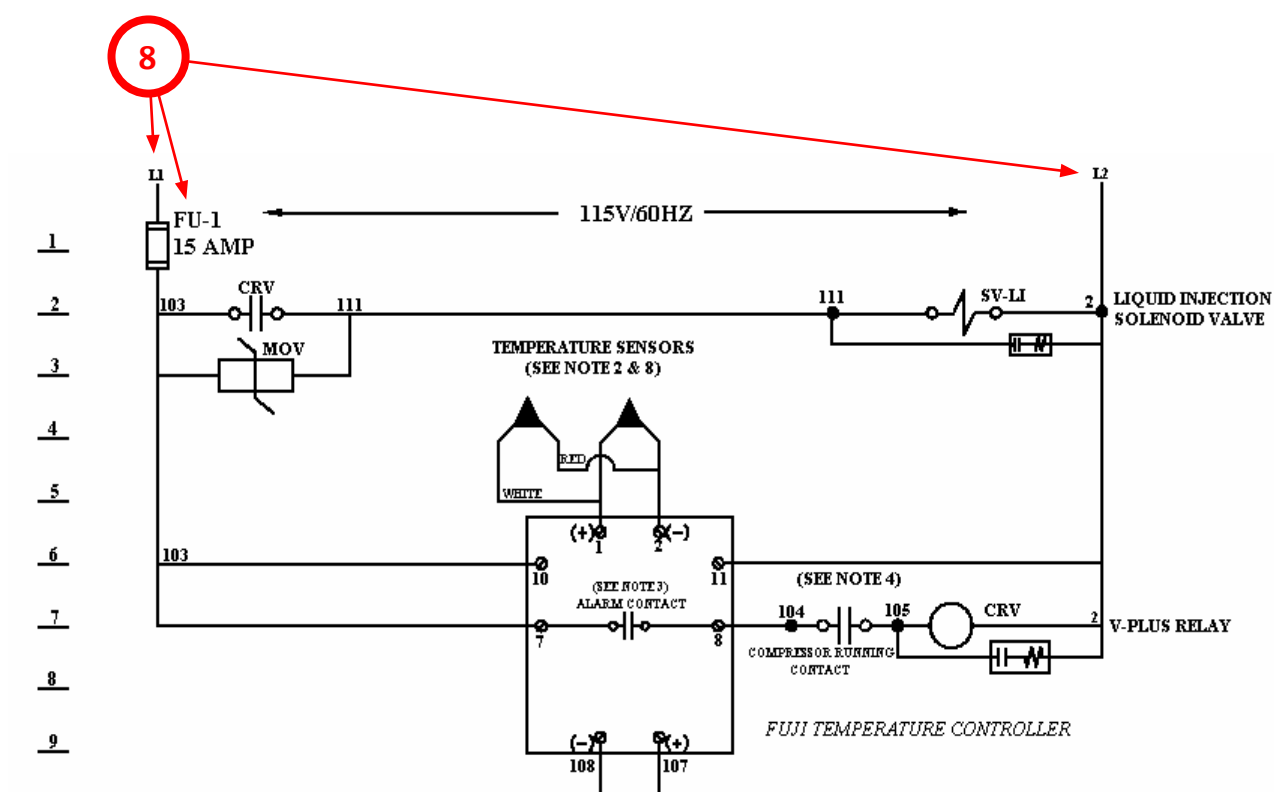


Figure 3-13. Example - V-PLUS Wiring Diagram

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 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 must be determined in accordance with the piping code or ASHRAE 15. These pressures will usually suffice, however, it is advisable to check local codes as they may differ. Before testing may proceed, several things must be done.

First, if test pressures exceed the settings of the system, relief valves or safety devices, they must be removed and the connection plugged 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. Because of differences in characteristics of the various refrigerants, two different testing methods are necessary.

Ammonia Systems

Dry nitrogen may be used to raise the pressure in an ammonia 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.

Carbon Dioxide should NOT be used as a testing gas in a system where ammonia is already dissolved in any moisture remaining. This will cause ammonium carbonate to precipitate when the CO₂ is added. If heavy enough, this precipitate may cause the machine to freeze and clog the strainer.

Use a leak test fluid at all flanges, threaded joints, and welds. Repair all visible leaks. If possible, leave the

pressure on over night. A small pressure drop of 5 lbs. Over this period indicates a very tight system.

Remember to note the ambient temperature, as a change in temperature will cause a change in pressure.

After the system is thoroughly tested, open all valves on the lowest part of the system so the gas will float away from the compressor. This prevents any dirt or foreign particles from entering the compressor and contaminating the working parts. The oil should then be charged into the compressor.

Charge a small amount of ammonia into the system and pressurize the system to its respective design pressure. Pass a lit sulfur stick around all joints and connections. Any leaks will be indicated by a heavy cloud of smoke. 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.

Halocarbon Refrigerant Systems

“Oil pumped” dry nitrogen, or anhydrous CO₂ in this order of preference may be used to raise the pressure to the proper level for testing.

When the proper pressure is attained, test for leaks. After all leaks are found and marked, relieve the system pressure and repair the leaks. Never attempt to repair soldered or welded joints while the system is under pressure. Soldered joints should be opened and re soldered.

Do not simply add more solder to the leaking joint. After all the joints have been repaired and the system is considered “tight” the system may be tested with refrigerant.

Attach a drum of the refrigerant to be used in the system and allow the gas to enter until a pressure of 5 psig is reached.

Remove the refrigerant drum and bring the pressure to the recommended test level with oil pumped dry nitrogen or CO₂. Then check the entire system again for leaks, using a halide torch or electronic leak detector. Be sure to check all flanged, welded, screwed and soldered joints, all gasketed joints, and all parting lines on castings. If any leaks are found, they must be repaired and rechecked before the system can be considered tight again, remembering that no repair should be made to welded or soldered joints while the system is under pressure.

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CO₂ Systems

A CO₂ 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 CO₂ leak, but there are also leak detection sprays available in the market (such as Weicon's or Bulleye's), infrared hand held leak detectors (such as D-TEK CO₂), and ultrasonic leak detectors of several brands¹.

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 an 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.

¹ Information taken from Commercial CO₂ Refrigeration Systems Guide for Subcritical and Transcritical CO₂ Applications, by Copeland.

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 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 3-14. 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).

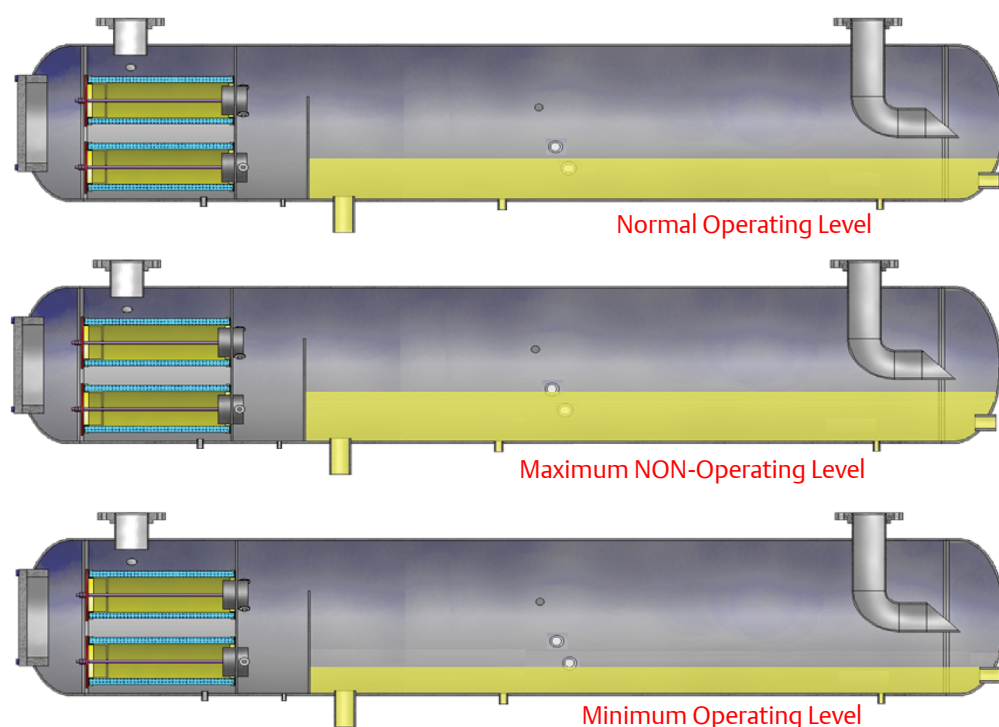


Figure 3-14. Oil Operating Levels

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Unit Initial Oil Charging

(Reference Figure 3-16)

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 3-16).
3. Open oil separator drain valve (10) and fill oil separator (1) to Maximum NON-Operating Level. (See Figure 3-14).
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. Vision 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.

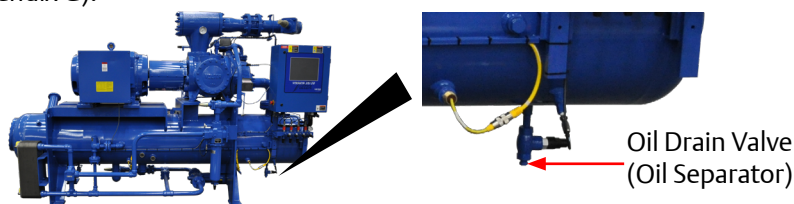


Figure 3-15. Oil Drain Valve

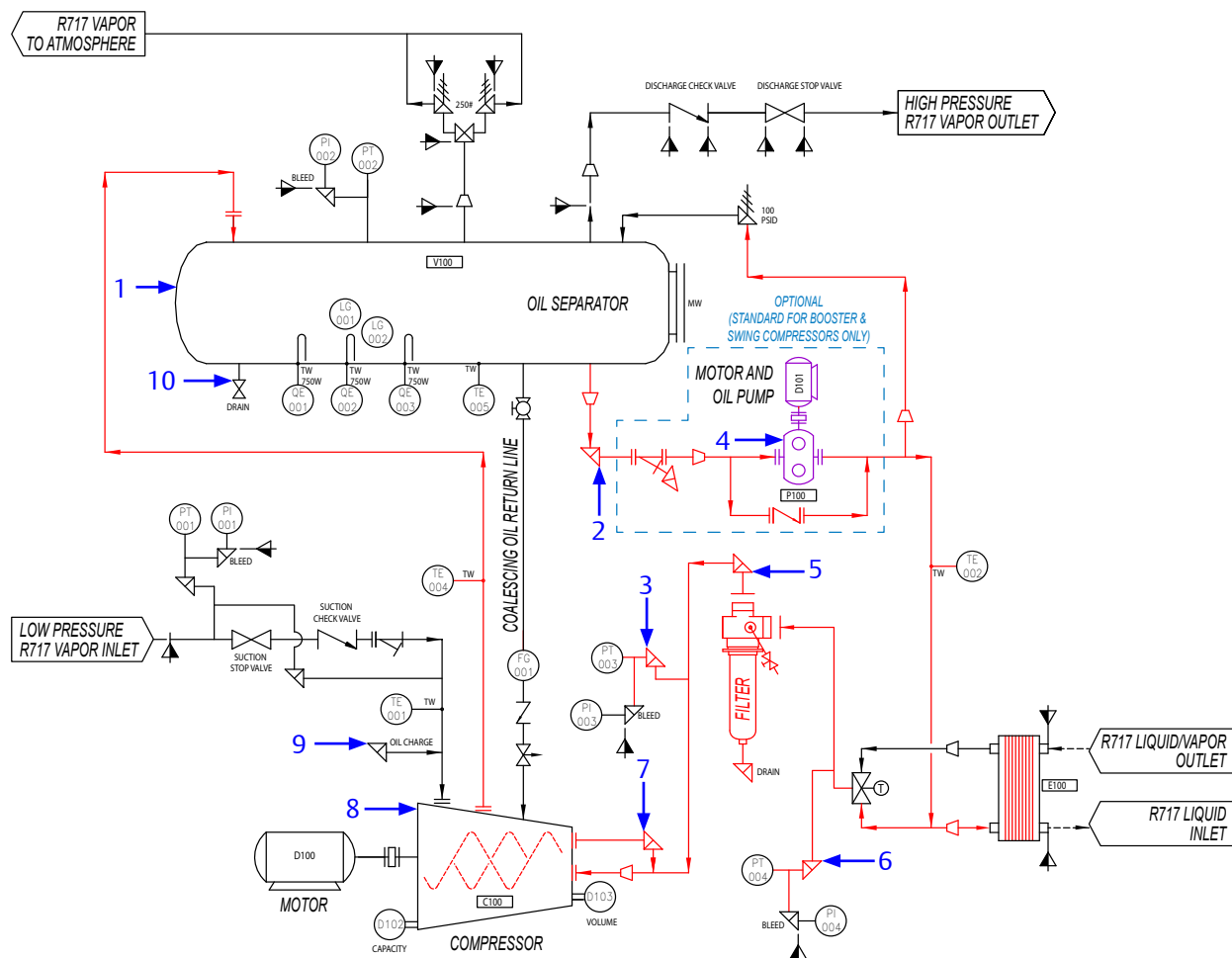


Figure 3-16. Priming Oil Lines and Compressor (With Oil Pump)

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Priming Oil Lines and Compressor (Unit Without Oil Pump)

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

(Reference Figure 3-17)

6. Close the following valves: 3, 4, 5, 6 and 7.
7. Open valve 8 and start charging oil through valve 9 on oil filter (10) and through compressor (11). This Step should be long enough to only prime the line from filter to compressor and to introduce some oil to the compressor (a couple of minutes based on a 2-3 GPM priming pump).
8. During the previous Step the compressor should be rotated manually to ensure that oil injection passages are not blocked and to ensure that any oil entering compressor starts to move towards discharge rather than stacking up into suction tee assembly and suction line.
9. Close valve 8 and open valve 5. Start charging oil via valve 9 through oil cooler (12) until the oil level starts raising in sight glass on oil separator (1). At this point, the oil solenoid valve (15) should be closed to ensure that oil does not drain from oil cooler during stand still conditions.
10. Charge 4 liters of oil via valve 13 into drop leg on evaporator (14).

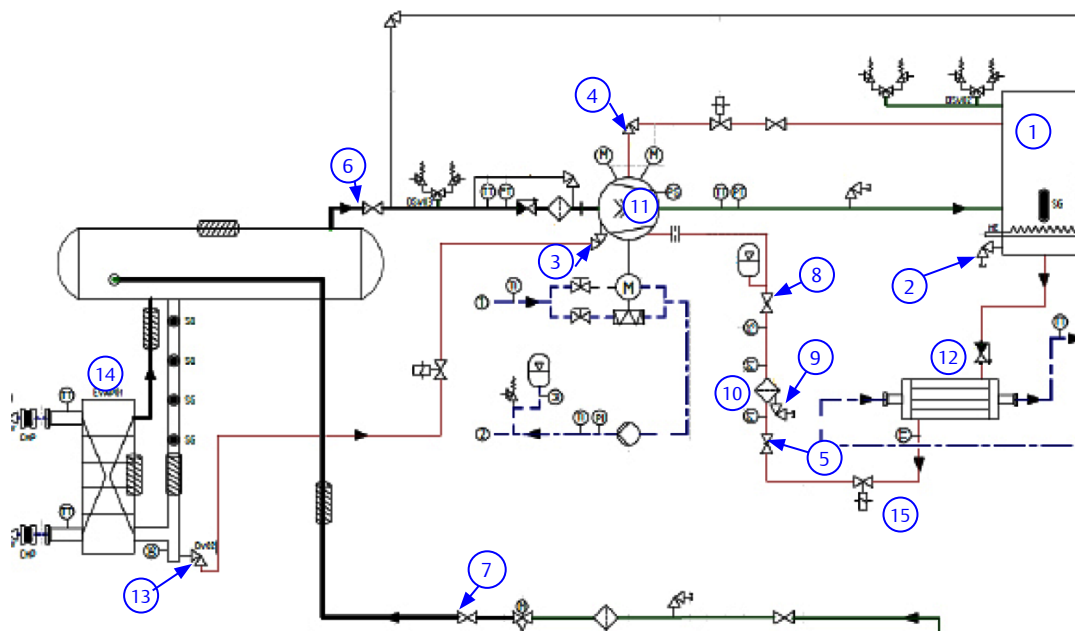


Figure 3-17. Priming Oil Lines and Compressor (Without Oil Pump)

Section 3 • Installation

System Refrigerant Charging

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 drum, as this can produce dangerously high pressures inside drum. Failure to comply may result in damage to equipment.

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 drum of refrigerant to the liquid charging valve. This valve is generally located in the liquid line immediately after the king or liquid line valve. Purge the air from the charging line.
2. Close the liquid line or king valve, if it is not already closed. Open the “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.

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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 drum valves. Then remove the drum from the system.
7. During the charging period, observe the gauge carefully to insure no operating difficulties. Watch head pressures closely to make sure the condensers are functioning properly.
8. Since it is usually necessary to use several drums when charging a system, follow the procedures in Steps 1 and 2 when attaching a new drum. After charging, the refrigerant drums 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 Vision 20/20 Operating Manual or 35391CM for Compact Logix PLC Software 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.

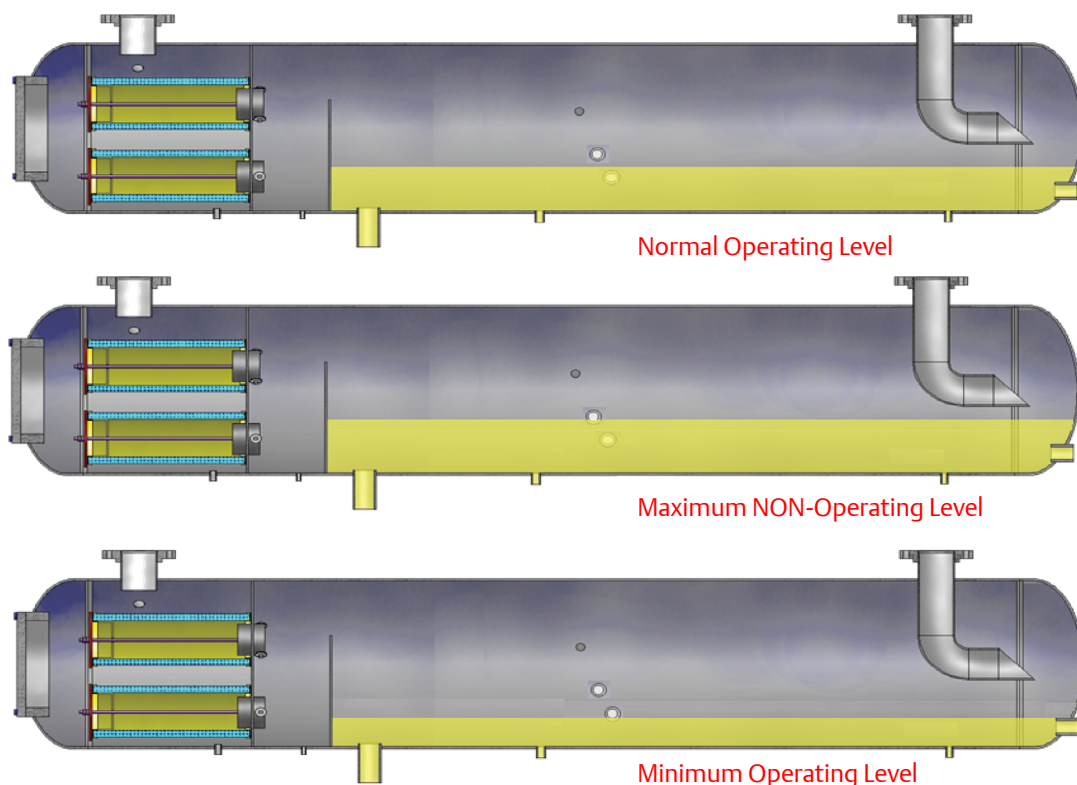


Figure 4-1. Oil Operating Levels

Section 4 • Operation

Dual Oil Filters

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

NOTE

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

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

Control System

Calibration

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

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

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

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

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

Starting, Stopping and Restarting The Compressor

For additional control information, refer to microprocessor manual (35391SC for Vision20/20 Operating Manual or 35391CM for Compact Logix PLC Software 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 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,

Section 4 • Operation

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 set-point, 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.

Slide Valve Actuator Operation

The slide valve actuator is a gear-motor with a position sensor. The motor is powered in the forward and reverse directions from the main computer in the control panel. The position sensor tells the main computer the position of the slide valve. The main computer uses the position and process information to decide where to move the slide valve next.

The position sensors works by optically counting motor turns. On the shaft of the motor is a small aluminum “photochopper”. It has a 180 degree fence that passes through the slots of two slotted optocouplers. The optocouplers have an infrared light emitting diode (LED) on one side of the slot and a phototransistor on the other. The phototransistor behaves as a light controlled switch. When the photochopper fence is blocking the slot, light from the LED is prevented from reaching the phototransistor and the switch is open. When photochopper fence is not blocking the slot, the switch is closed.

As the motor turns, the photochopper fence alternately blocks and opens the optocoupler slots, generating a sequence that the position sensor microcontroller can

use to determine motor position by counting. Because the motor is connected to the slide valve by gears, knowing the motor position means knowing the slide valve position.

During calibration, the position sensor records the high and low count of motor turns. The operator tells the position sensor when the actuator is at the high or low position with the push button. Refer to the calibration instructions for the detailed calibration procedure.

The position sensor can get “lost” if the motor is moved while the position sensor is not powered. To prevent this, the motor can only be moved electrically while the position sensor is powered. When the position sensor loses power, power is cut to the motor. A capacitor stores enough energy to keep the position sensor circuitry alive long enough for the motor to come to a complete stop and then save the motor position to non-volatile EEPROM memory. When power is restored, the saved motor position is read from EEPROM memory and the actuators resumes normal function.

This scheme is not foolproof. If the motor is moved manually while the power is off or the motor brake has failed, allowing the motor to free wheel for too long after the position sensor loses power, the actuator will become lost.

A brake failure can sometimes be detected by the position sensor. If the motor never stops turning after a power loss, the position sensor detects this, knows it will be lost, and goes immediately into calibrate mode when power is restored.

Section 4 • Operation

Calibrate Slide Valve Actuators (For Units Using Vission 20/20™)¹

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

WARNING

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

CAUTION

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

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

- Compressor unit starting up for the first time.
- A new actuator motor has been installed.
- There is an error code flashing on the actuator's circuit board - an attempt to recalibrate should be made.

- The range of travel is not correct and the command shaft travel is physically correct.
- The compressor is pulling high amperage, the calibration of the volume slide should be checked.
- An actuator does not unload below 5%, or an actuator that doesn't move.
- Something is not working properly such as the actuators, RTDs or transducers.

To calibrate optical actuators, continue with the following steps:

NOTE

If the compressor unit is starting up for the first time or a new actuator motor has been installed, leave the power cable and position transmitter cable disconnected until Step 6.

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

CAUTION

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

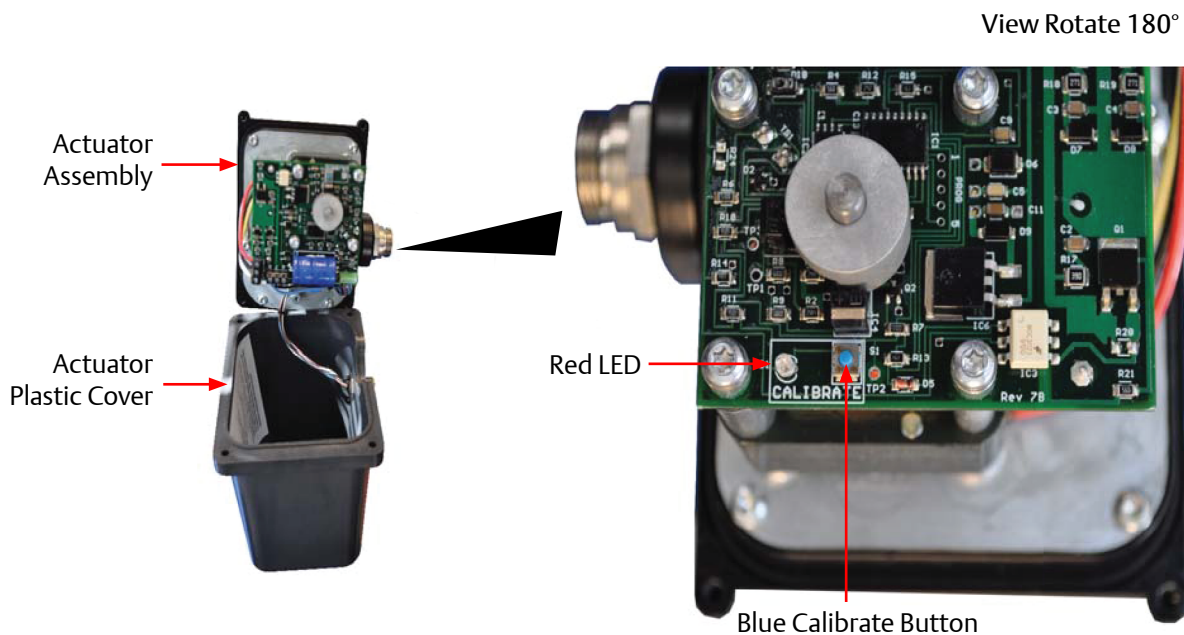


Figure 4-2. Actuator Assembly

¹ Does not apply to compressors that operate without slides (VSM-97, VSM-113, VSM-127).

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- Carefully lift actuator cover from actuator assembly and tilt towards connectors. Raise cover high enough to be able to press the blue calibration button and be able to see the red LED on the top of assembly.
- Logging on into the Vission20/20™ with high-level access will prompt the Calibration buttons to appear, see Figure 4-3.

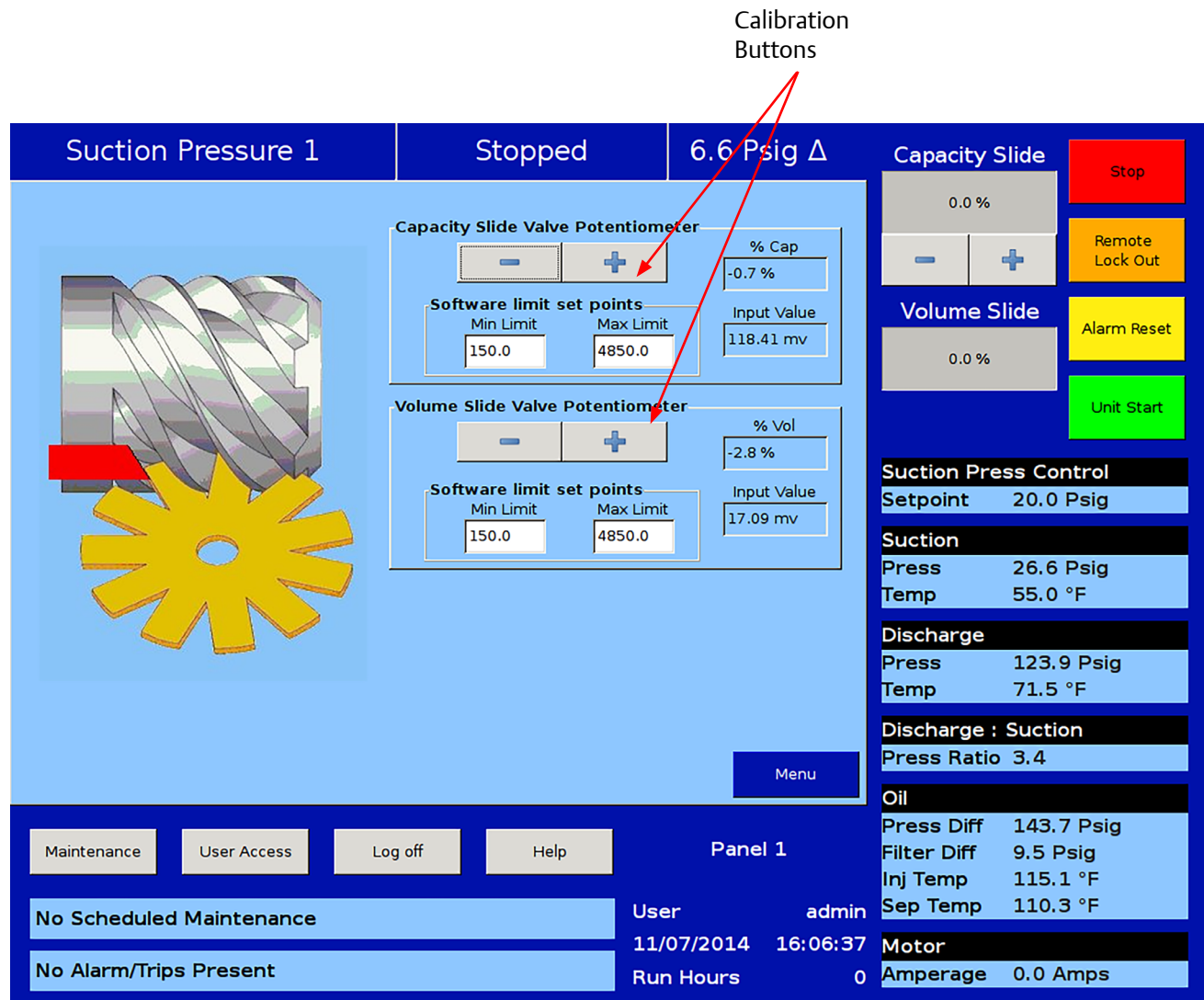


Figure 4-3. Slide Valve Calibration Screen (Vission20/20)

Section 4 • Operation

5. On the main screen, press “Menu” then press the “Slide Calibration” button to enter the slide calibration screen, see Figure 4-4.
6. If the compressor unit is starting for the first time or a new actuator was installed, connect connectors of power cable and position transmitter cable to new actuator.

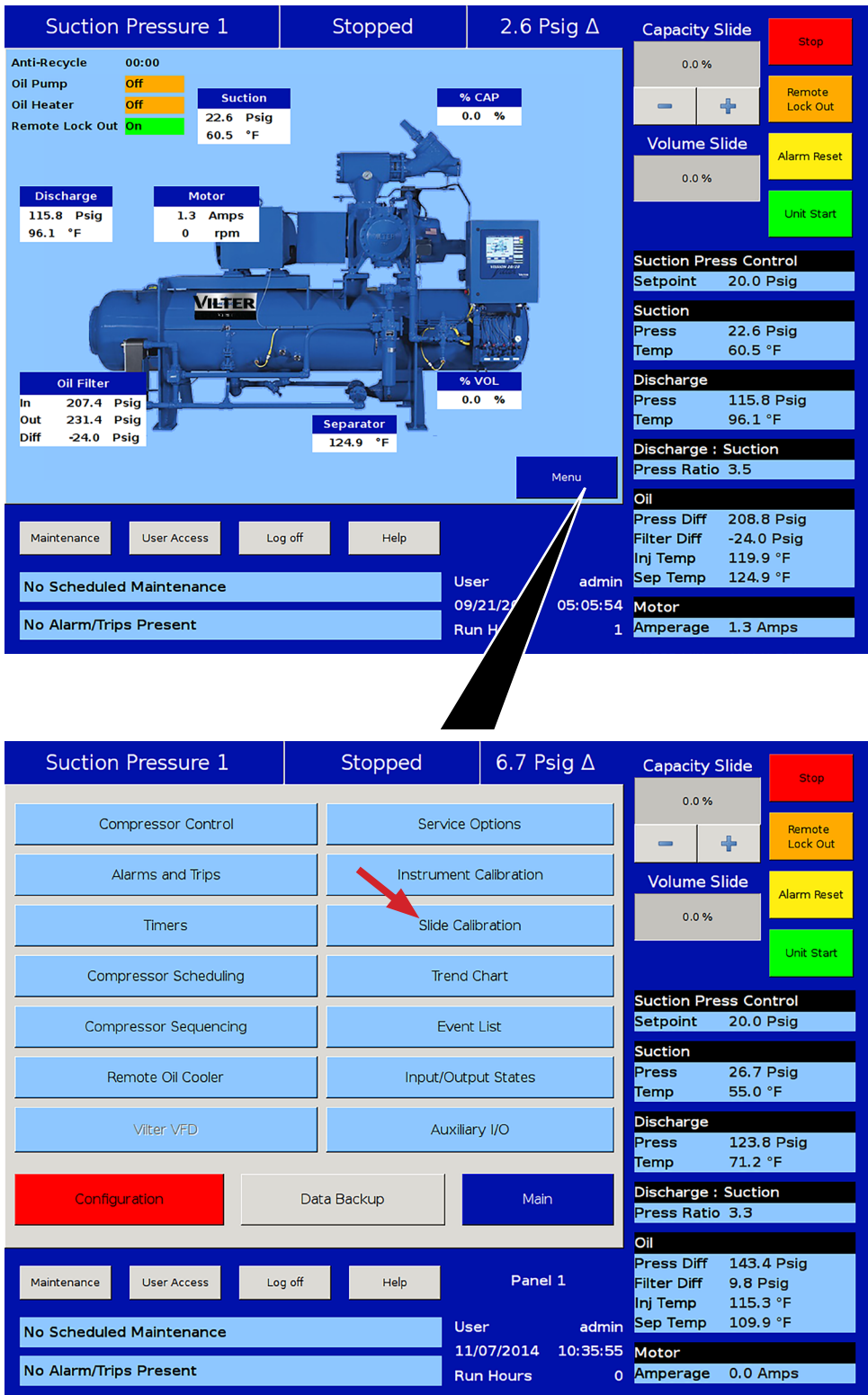


Figure 4-4. Menu Screen and Slide Calibration Button (Vission20/20)

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NOTE

If the “+” (increase) and “-” (decrease) buttons do not correspond to increase or decrease shaft rotation, swap the blue and brown wires of the “power cable” in the control panel. This will reverse the rotation of the actuator/command shaft, see Figure 4-5.

Capacity actuator wires are connected on terminals 13 & 14. Volume actuator wires are connected on terminals 15 & 16.

7. Press “+” or “-” to move the slide valve and check for the correct rotation, see Table 4-1.

NOTE

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

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

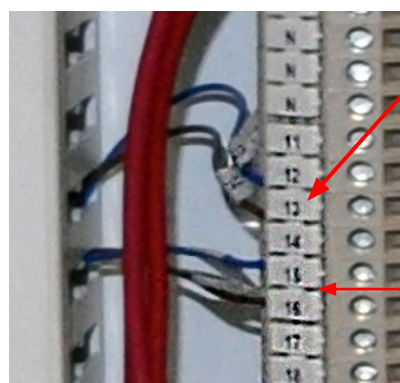
CAUTION

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

NOTE

The “Slide Calibration” screen on the Control Panel has a “Current” window, which displays the actuator output voltage. These values, (the % volume and the % capacity) displayed in the window are meaningless until calibration has been completed.

9. Use the “-” button on the Control panel to drive the slide valve to its minimum “mechanical stop” position. Release the “-” button when the slowing of the motor rotation and a winding sound from the actuator motor is noted.



Capacity Actuator
Wire connections
(13, 14)

Volume Actuator
Wire connections
(15, 16)



Figure 4-5. Wire Connections for Capacity and Volume Actuators

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Table 4-1. Command Shaft Rotation Specifications*

Compressor Model	Command Shaft Rotation				No. of Turns/Rotation			Angle/Slide Travel		
	Capacity		Volume		Capacity			Volume		
	INC	DEC	INC	DEC	Turns	Degrees	Travel	Turns	Degrees	Travel
VSM 71 VSM 91 VSM 101 VSM 151 VSM 181 VSM 201 VSM 301 VSM 361 VSM 401	CW	CCW	CW	CCW	0.80	288	3.141"	0.45	162	1.767"
VSM 501 VSM 601 VSM 701	CCW	CW	CCW	CW	0.91	328	3.568"	0.52	187	2.045"
VSS 451 VSS 601	CW	CCW	CW	CCW	0.91	328	3.568"	0.52	187	2.045"
VSS 751 VSS 901	CCW	CW	CCW	CW	1.09	392	4.283"	0.63	227	2.473"
VSS 1051 VSS 1201 VSS 1301	CCW	CW	CCW	CW	1.22	439	4.777"	0.74	266	2.889"
VSSC 1501	CCW	CW	CCW	CW	1.36	490	5.325"	0.82	295	3.200"
VSS 1551	CCW	CW	CCW	CW	1.48	533	5.823"	0.87	313	3.433"
VSS 1801	CCW	CW	CCW	CW	1.36	490	5.325"	0.82	295	3.200"
VSS 1851 VSS 2101	CCW	CW	CCW	CW	1.48	533	5.823"	0.87	313	3.433"
VSS 2401 VSS 2601 VSS 2801 VSS 3001	CCW	CW	CCW	CW	1.80	648	7.072"	1.36	490	5.341"

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

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

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

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10. Press and hold down on the photo-chopper shaft to disengage the brake slowly, releasing tension from the motor mount, see Figure 4-6. Use the “+” button to pulse the actuator to where the slide is just off of the mechanical stop and there is no tension on the motor shaft.
11. Quickly press and release the blue button on the actuator again. The red LED will now flash at a slower rate, indication that the minimum slide valve position (zero position) has been set.
12. Use the “+” button on the Control panel to drive the slide to its maximum “mechanical stop” position. Release the “+” button when the slowing of the motor rotation and a winding sound from the actuator motor is noted.

NOTE

If the photo-chopper spins faster than 4800 rpm, the actuator will go into an over speed fault and recalibration will be required.

13. Press and hold down on the photo-chopper shaft to disengage the brake slowly, releasing tension from the motor mount. Use the “-” button to pulse the actuator to where the slide is just off of its mechanical stop and there is no tension on the motor shaft.

NOTE

After the blue button is pressed for the third time, an mV reading will be displayed in the Current field. Make sure the mV value is at least 150 to 200 mV higher than the max setpoint on the screen.

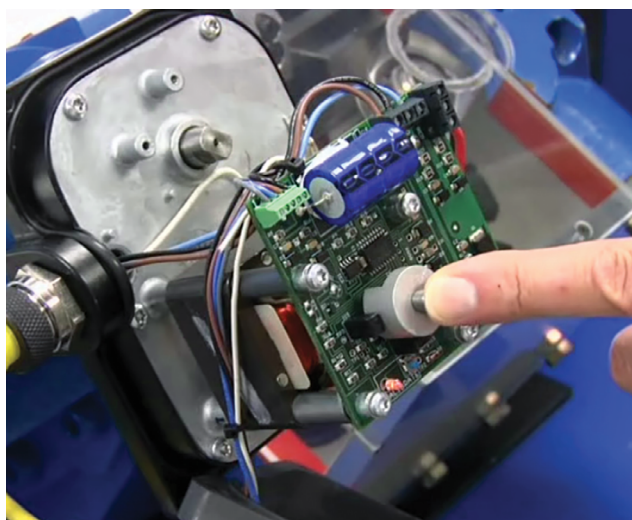
14. Quickly press and release the blue button on the actuator one more time. The red LED will stop flashing. The actuator is now calibrated and knows the minimum and maximum positions of the slide valve it controls.

Now the Capacity Channel is automatically calibrated based on the calibration settings made to the actuator.

CAUTION

Do not over tighten screws. Failure to comply may result in damage to equipment.

15. Gently lower the plastic cover over the top of the actuator to where it contacts the base and O-ring seal. After making sure the cover is seated properly, gently tighten the four #10 screws.
16. Repeat procedure to calibrate other slide valve actuator.



Press down on Photo-chopper to release tension from motor mount.

Figure 4-6. Photo-chopper

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Calibrate Slide Valve Actuators (For Units Using Compact Logix PLC)

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

WARNING

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

CAUTION

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

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

- Compressor unit starting up for the first time.
- A new actuator motor has been installed.
- There is an error code flashing on the actuator's circuit board - an attempt to recalibrate should be made.

- The range of travel is not correct and the command shaft travel is physically correct.
- The compressor is pulling high amperage, the calibration of the volume slide should be checked.
- An actuator does not unload below 5%, or an actuator that doesn't move.
- Something is not working properly such as the actuators, RTDs or transducers.

To calibrate optical actuators, continue with the following steps:

NOTE

If the compressor unit is starting up for the first time or a new actuator motor has been installed, leave the power cable and position transmitter cable disconnected until Step 7.

1. Stop compressor unit and allow to cool.
2. Remove screws securing actuator cover to actuator assembly. As a reference see Figure 4-7.

CAUTION

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

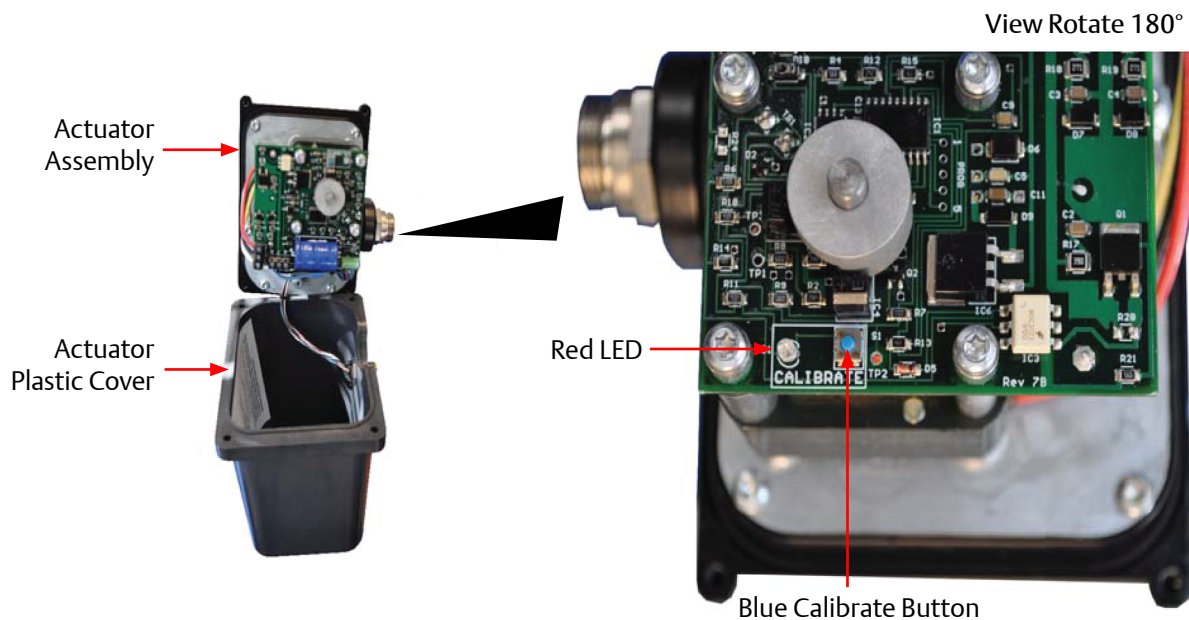


Figure 4-7. Actuator Assembly

Section 4 • Operation

- Carefully lift actuator cover from actuator assembly and tilt towards Turck connectors. Raise cover high enough to be able to press the blue calibration button and be able to see the red LED on the top of assembly.
- On the main screen of the PLC, press “Menu”, then “Instrument Calibration” button to enter the instrument calibration overview screen, then press “Calibrate Slides” button to enter the slide calibration screen, see Figure 4-8.
- Logging on with high-level access will prompt the “Enter Slide Calibration Mode” button to appear.
- Press “Enter Slide Calibration Mode” button to initiate calibration mode. The Slide Calibration button turns green and Set Max and Set Min buttons appear, see Figure 4-9.
- If the compressor unit is starting for the first time or a new actuator was installed, connect connectors of power cable and position transmitter cable to new actuator.

NOTE

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

- Press UP or DOWN to move the slide valve and check for the correct rotation, see Table 4-1.

NOTE

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

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

CAUTION

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

NOTE

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

- Use the DOWN button on the Control panel to drive the slide valve to its minimum “mechanical stop” position. Release the DOWN button when the slowing of the motor rotation and a winding sound from the actuator motor is noted.
- Press down on the photo-chopper shaft to disengage the brake, releasing tension from the motor mount, see Figure 4-10. Use the UP button to pulse the actuator to where the slide is just off of the mechanical stop and there is no tension on the motor shaft.
- Quickly press and release the blue button on the actuator again. The red LED will now flash at a slower rate, indication that the minimum slide valve position (zero position) has been set.
- Use the UP button on the Control panel to drive the slide to its maximum “mechanical stop” position. Release the UP button when the slowing of the motor rotation and a winding sound from the actuator motor is noted.
- Press down on the photo-chopper shaft to disengage the brake, releasing tension from the motor mount. Use the DOWN button to pulse the actuator to where the slide is just off of its mechanical stop and there is no tension on the motor shaft.
- Quickly press and release the blue button on the actuator one more time. The red LED will stop flashing. The actuator is now calibrated and knows the minimum and maximum positions of the slide valve it controls. Now the capacity or volume channel of the PLC can be calibrated.
- Use the DOWN button to move the actuator towards its minimum position while watching the mV readout on the Control Panel screen. Discontinue pressing the DOWN button when the mV reading the “Current” window above the “Set Min” button is approximately 500 mV.
- Now use the DOWN or UP buttons to position the slide valve until a value close to 300 mV is on the screen. Then, press the “Set Min” button in the capacity or volume slide valve window to tell the controller that this is the minimum mV position. Note: The value in the “Current Cap” or “Current Vol” window has no meaning right now.

Section 4 • Operation

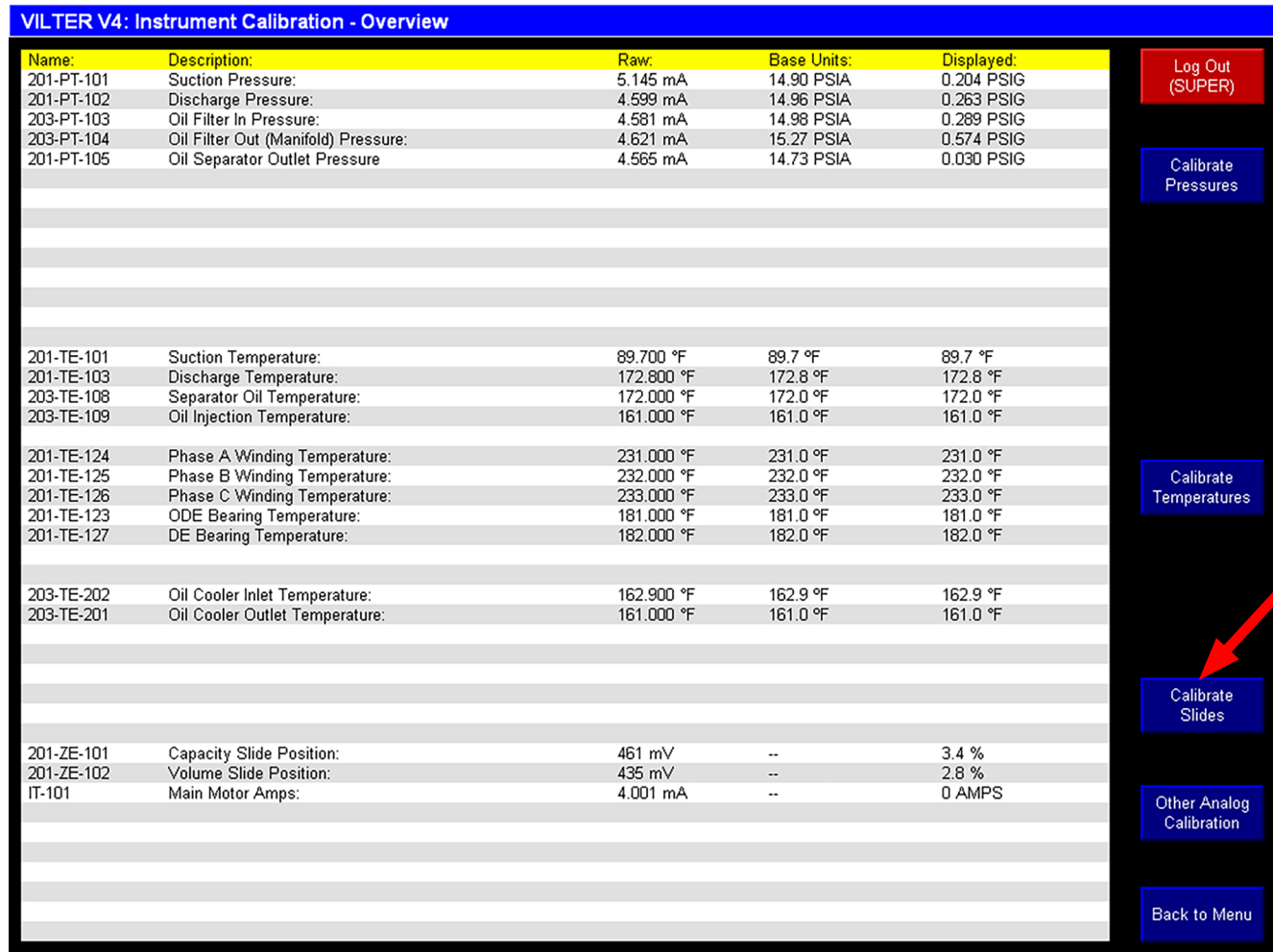
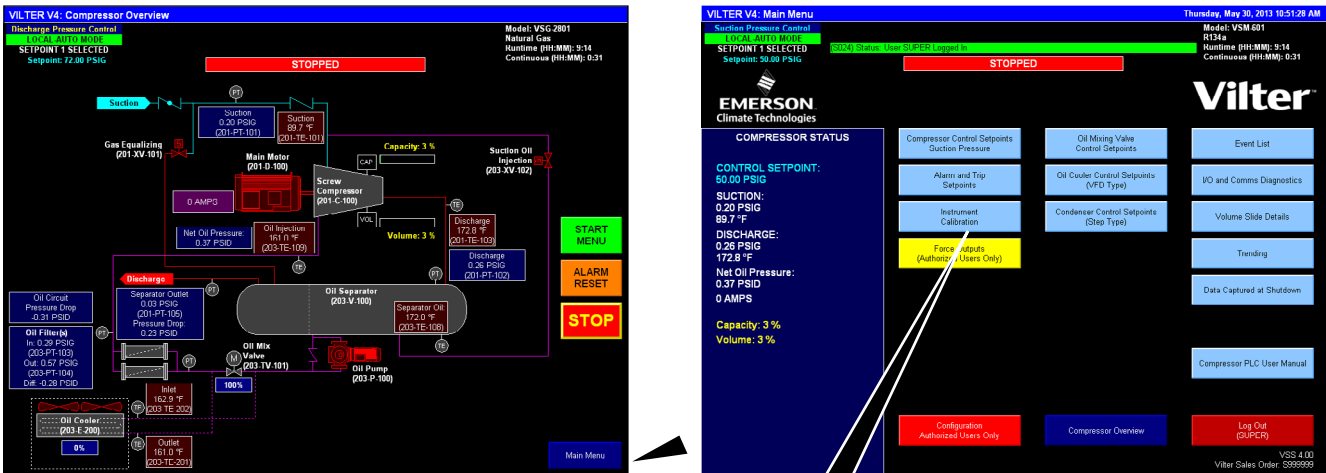
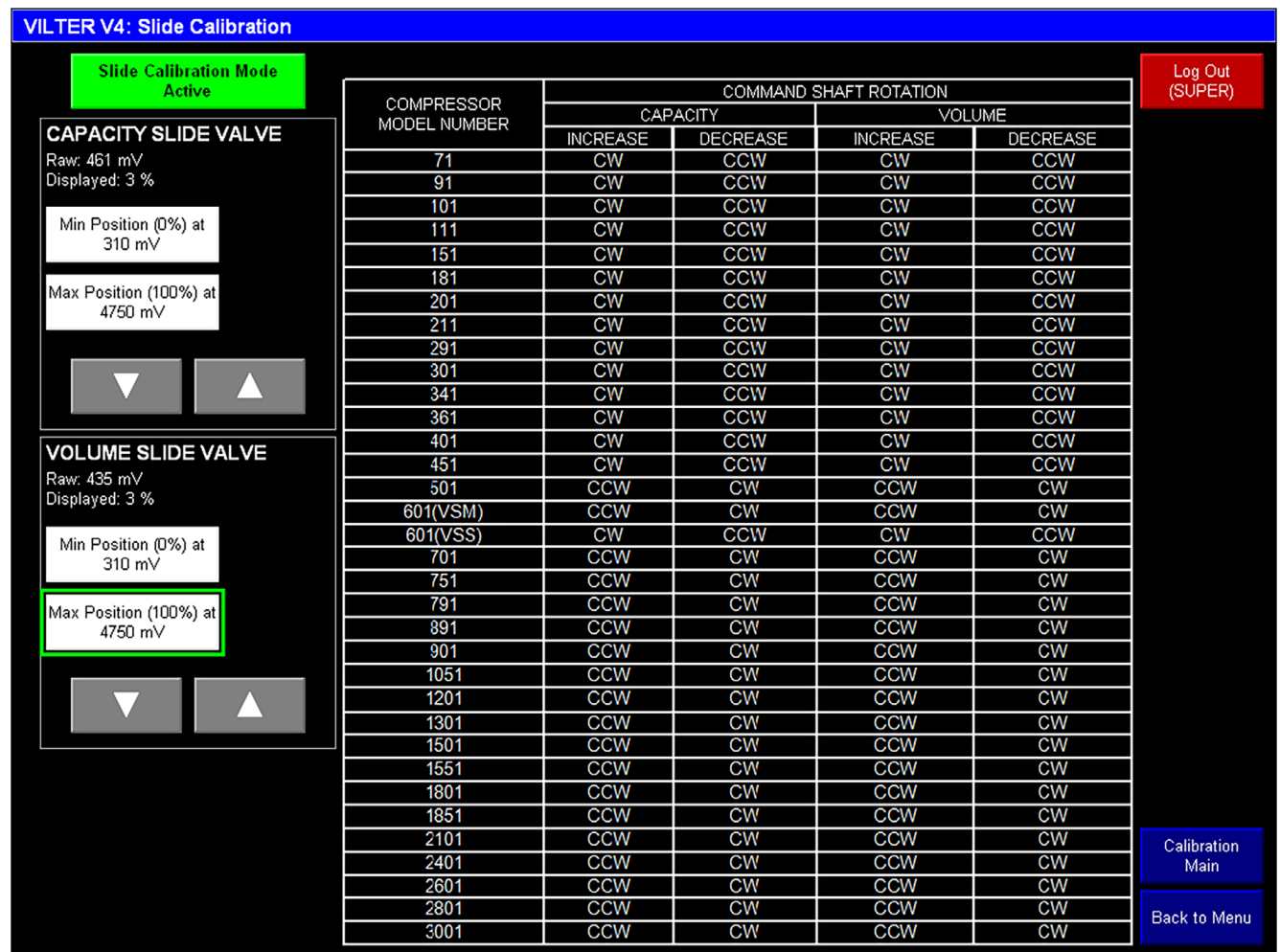
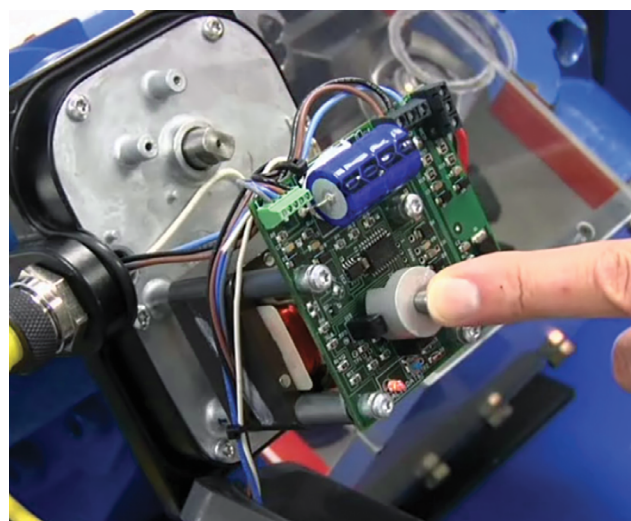


Figure 4-8. Overview, Main Menu and Instrument Calibration Screens (Compact Logix PLC)



Screen colors inverted for ease of reading.

Figure 4-9. Slide Calibration Screen (Compact Logix PLC)



Press down on Photo-chopper to release tension from motor shaft.

Figure 4-10. Photo-chopper

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18. Use the UP button to rotate the actuator towards its maximum position while watching the mV readout on the controller screen. Discontinue pressing the UP button when the mV reading in the “Current” window is approximately 4800 mV. You are nearing the mechanical stop position.
19. Pulse the UP button to carefully move the slide valve until the mV readout “saturates”, or stops increasing. This is around 4800 mV Record mV maximum reading.
20. Pulse the DOWN button until the mV just start to decrease. (This is the point where the channel drops out of saturation). Adjust mV value to 300 mV below recorded maximum mV.
21. Press the “Set Max” button.
22. Press the “Main” button to complete calibration and exit the “Slide Calibration” screen. The controller will automatically energize the actuator and drive it back to its minimum position (below 5%) for pre-start-up.

NOTE

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

23. Gently lower the plastic cover over the top of the actuator to where it contacts the base and O-ring seal.

CAUTION

Do not over tighten screws. Failure to comply may result in damage to equipment.

24. Check and make sure the cover is seated properly, then gently tighten the four #10 screws.
25. Enable the “Slide Non-Movement Alarm” by going to the “Setup” menu and choosing “Alarm Enable” for the “Slide Non-Movement Option”.
26. Repeat procedure to calibrate other slide valve actuator.

Compressor Control with Vission 20/20™ Micro-controller (No Slide Operation)

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 4-11.

The “No Slide” operation will become active once the correct type of compressor and model has been chosen, see Figure 4-12.

The user must select either VSG or VSM from the Compressor combo box in Page 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 4-11. Vission 20/20 Configuration Screen - I/O Configuration (Page 8)

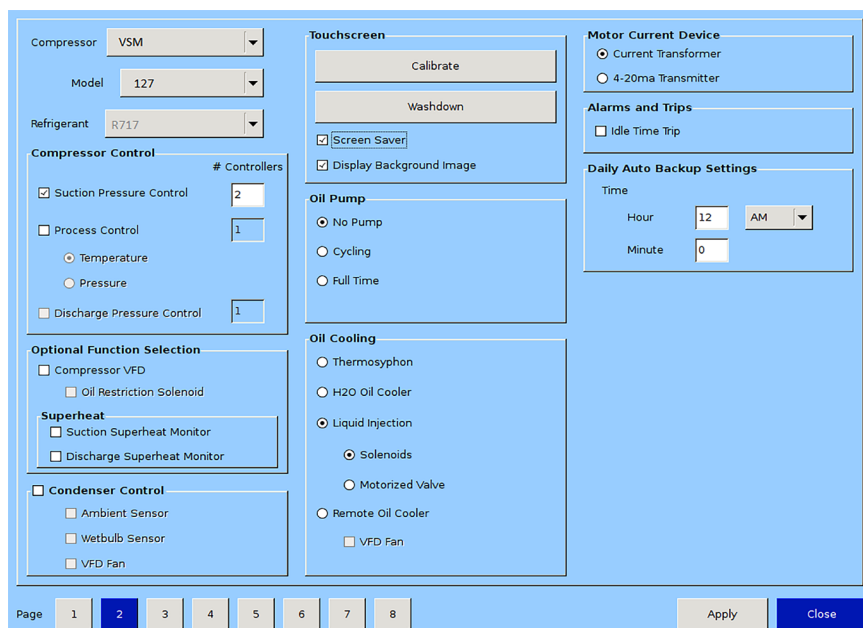
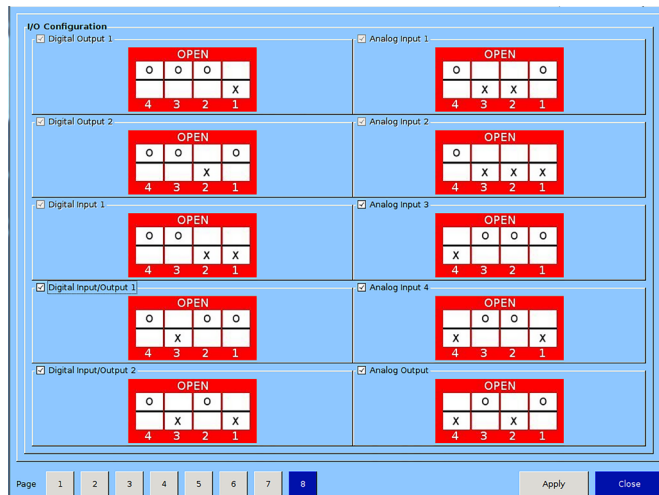


Figure 4-12. Compressor and Model Setup with Vission 20/20

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Coalescing Oil Return Line Setup

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

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

NOTE

Do not fully open the needle valve unless directed by Vilter™ 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 4-13.

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.

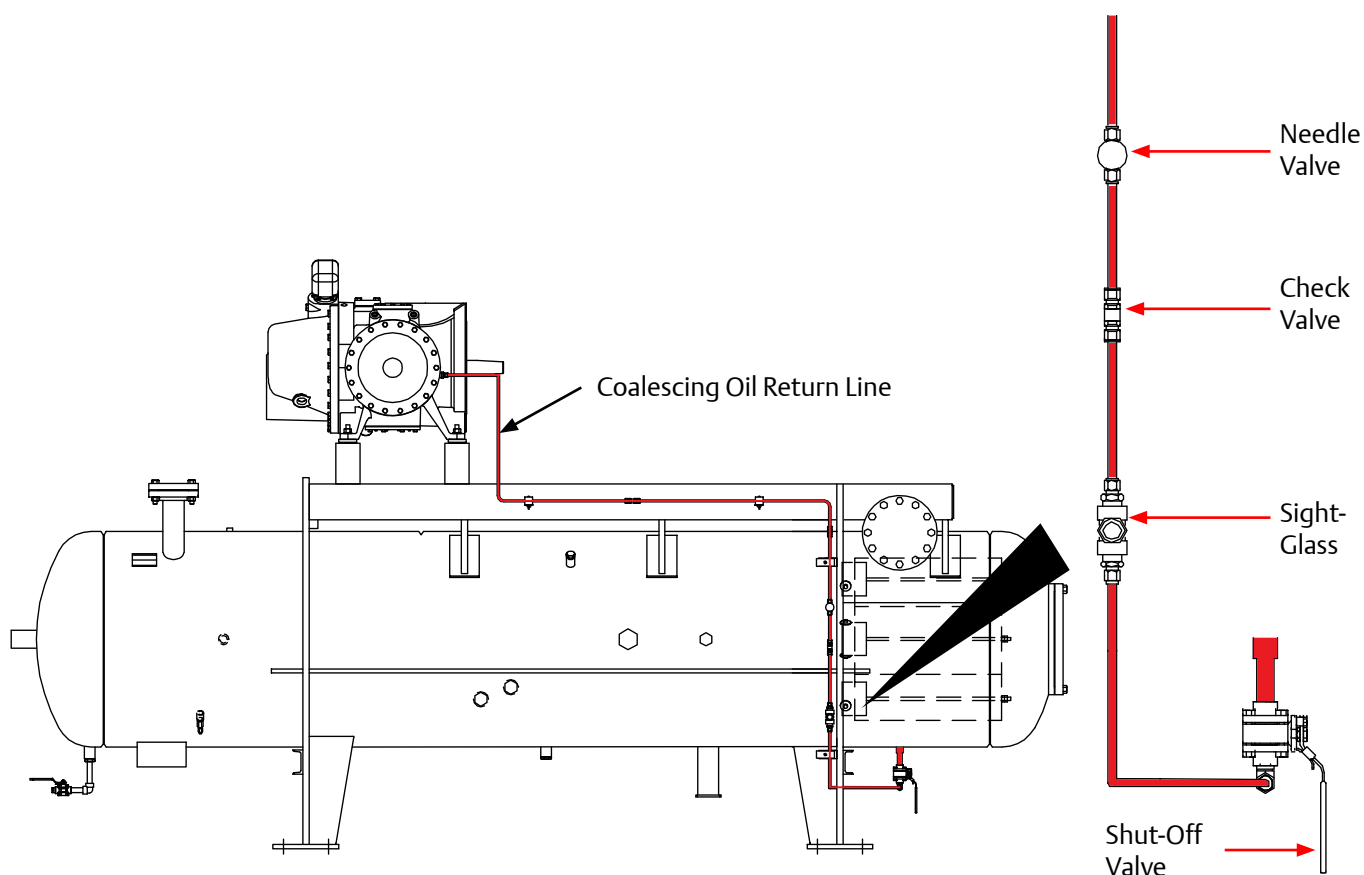


Figure 4-13. Coalescing Oil Return Line

Suction Equalizing Line Setup - For VSS/VSSC Compressors

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 4-14.

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.

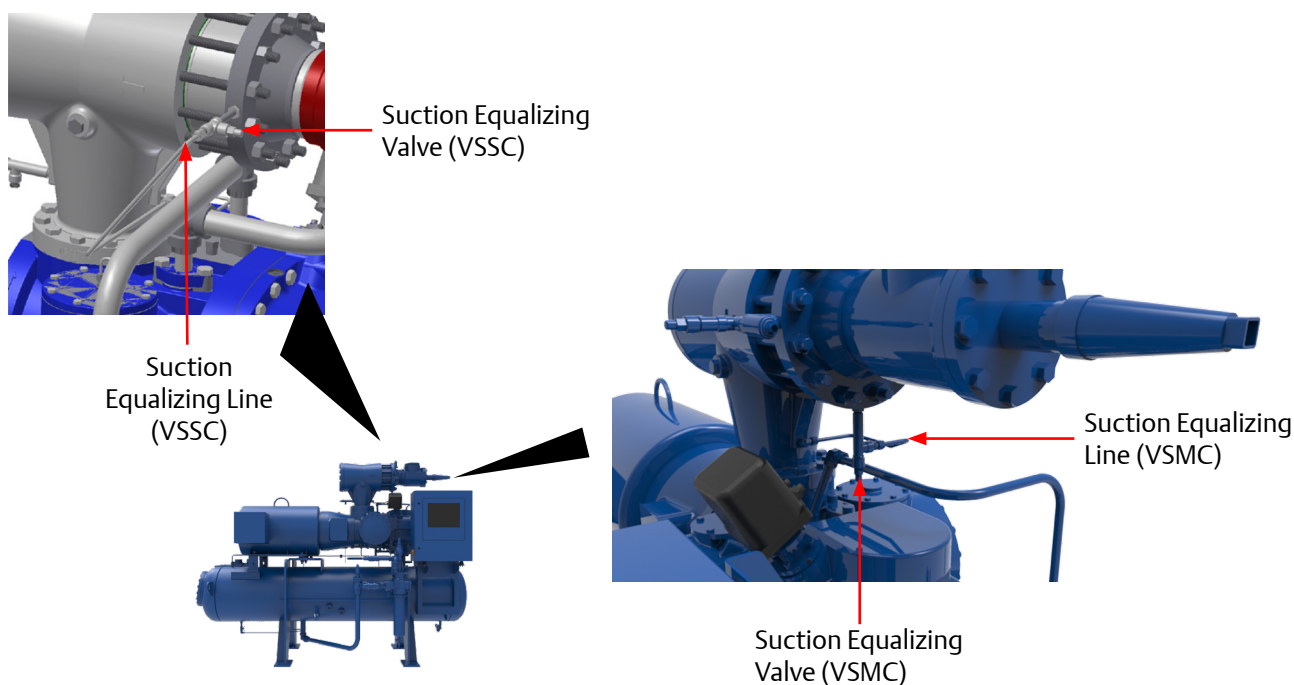


Figure 4-14. Suction Equalizing Line and Valve

NOTE

For some compressors, suction equalizing is automatically controlled.

Oil Cooling

Vilter™ single screw compressors have several options when it comes to oil cooling, such as plate-type cooler (using refrigerant, glycol or water) and liquid injection, (single or dual) controlled by Vision 20/20's settings.

For liquid injection, low, medium and high ports are available, as are dual ports: high/medium or medium/low. See Table 4-2 for the panel's toggle switch's position depending on compressor size and tubing positions, and Figure 4-15 for possible variations of the liquid injection configuration.

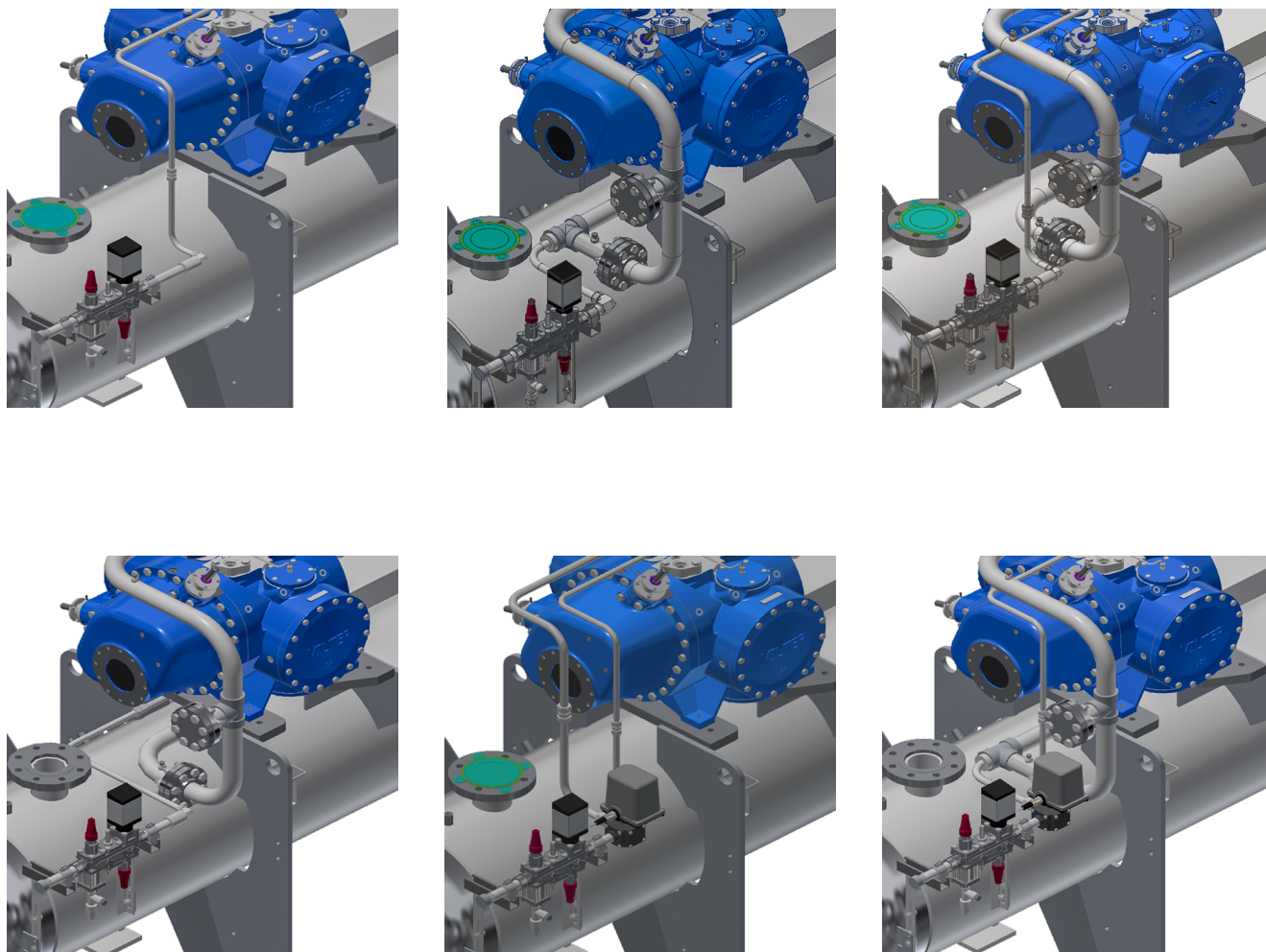


Figure 4-15. Liquid injection variations

Liquid Injection Outlet Port Direction

In the “SIG CCW” position, the actuator moves CCW when the signal is energized during operation (based on the switch pressure), until it reaches the limit - this makes the 3 o'clock port the outlet port (Figure 4-16, right image). Therefore, the other switch position, “SIG CW,” makes the 12 o'clock port the outlet when the signal is energized during operation (Figure 4-16, left image).

Each rotor diameter has a different port configuration on the compressor housing.

For 205mm: there are only medium and low-ratio ports, both of which are located on both top and bottom of the housing.

For 240mm-350mm: low ports are located on the top and bottom of the compressor, the medium port is on the top, and the high port is on the bottom.

For 401mm: all three ports are located on both the top and bottom of the housing.

Table 4-2. Compressor Size and Liquid Injection Outlet Port Direction

Compressor Size	Tubing Lines	Toggle Switch	Outlet Port (de-energized)
VSMC 152 - 401 (205mm)	Low-Medium	SIG CW	3 o'clock
	Low-High	N/A	N/A
	Medium-High	N/A	N/A
VSMC 501 - 701 (240mm) VSSC 751 - 901 (280mm)	Low-Medium	SIG CW	3 o'clock
VSSC 1051 - 1301 (310mm)	Low-High	SIG CCW	12 o'clock
VSSC 1551 - 2101 (350mm)	Medium-High	SIG CCW	12 o'clock
VSSC 2401 - 3001 (401mm)	Low-Medium	SIG CW	3 o'clock
	Low-High	SIG CCW	12 o'clock

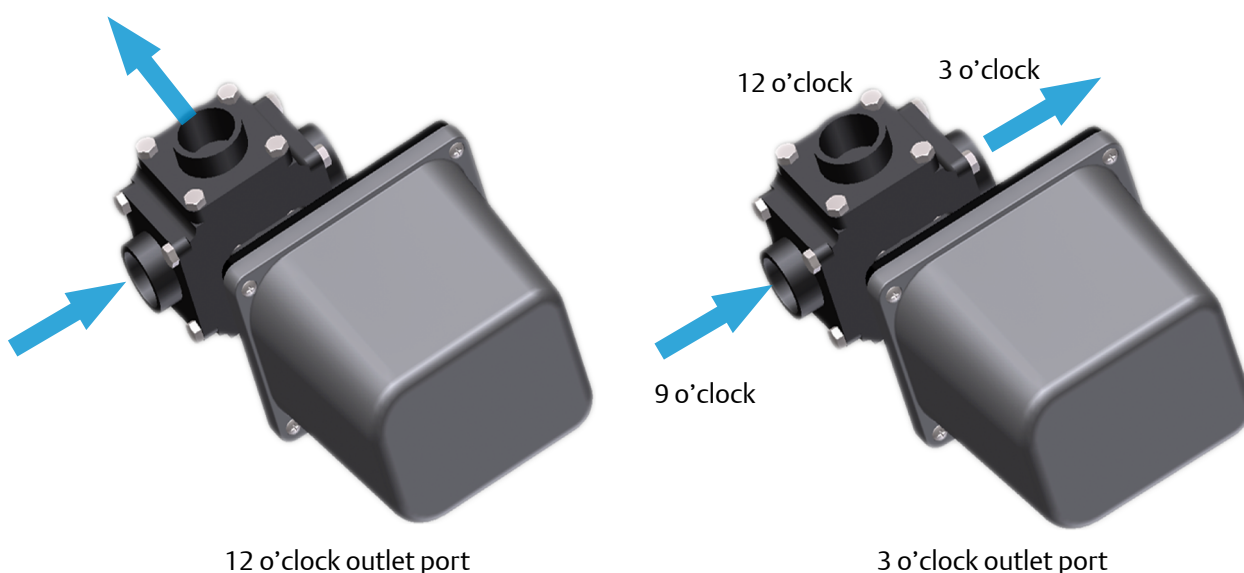


Figure 4-16. Port Inlet and Outlet Flow Directions

Section 4 • Operation

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 show 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.

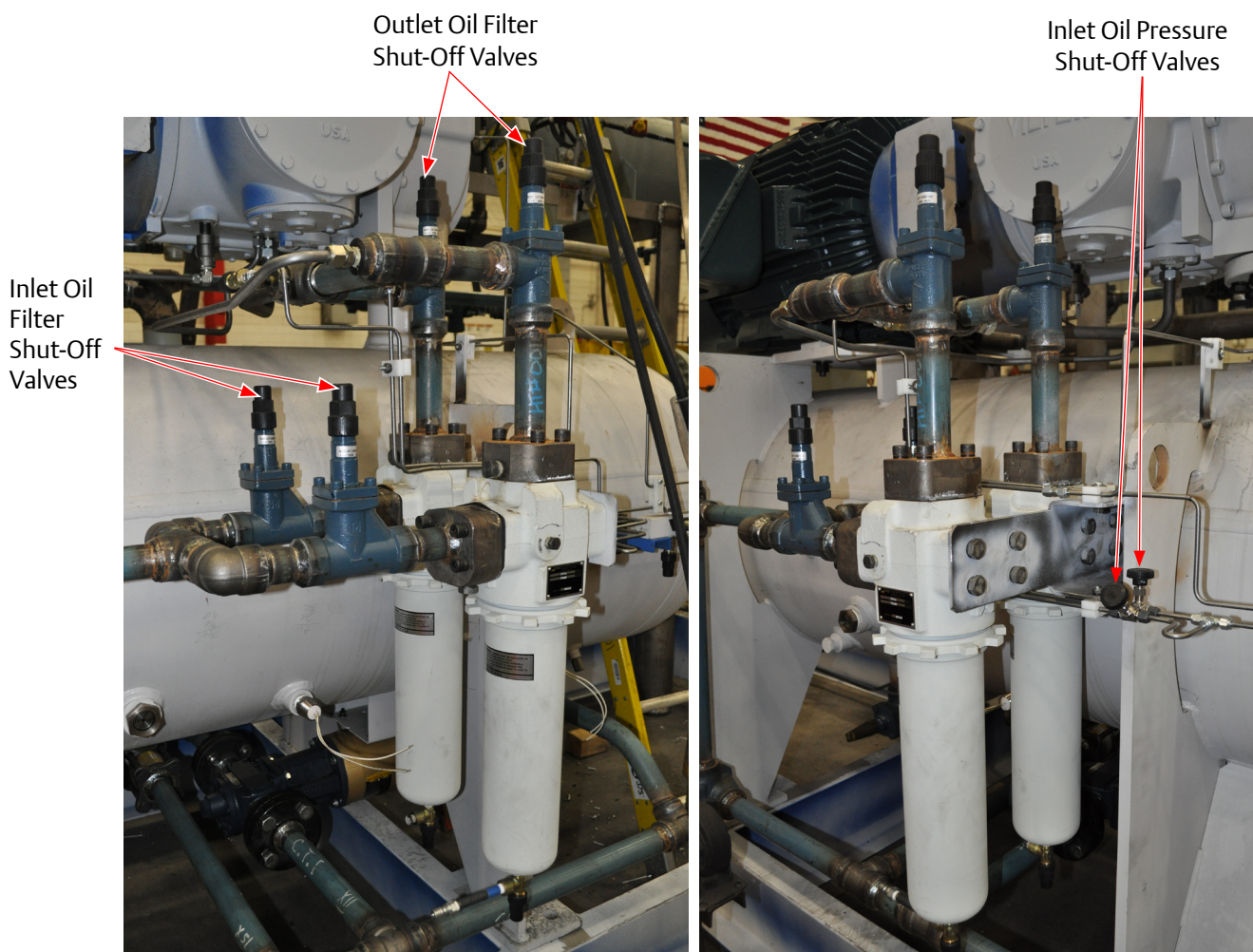


Figure 4-17. Dual Oil Filter Setup for Oil Filters with Manifold Heads

Section 5 • Maintenance/Service

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)													
		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.

Notes continued..

Section 5 • Maintenance/Service

Notes (continued)

(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 a desired trouble-free operation, however, a systematic maintenance program is a prerequisite. The following PMCS is suggested in addition 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 is 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 suitable 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 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.

Compressor Unit Isolation For Maintenance/Service (Compressors with Slide Valves)

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

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.

NOTICE

Recover or transfer all refrigerant vapor in accordance with local ordinances before opening any part of the package unit to atmosphere.

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

1. Shut down the compressor unit, refer to Stopping/Restarting procedure in Section 4.
2. Turn motor and oil pump starter disconnect switches into the OFF position. Lock-out/tag-out disconnect switches.
3. If suction equalizing valve is not open, open it to allow oil separator pressure to vent to low-side system pressure, see Figure 5-1. Close valve when complete.
4. Isolate the compressor unit by closing all valves to the house system. Lock-out/tag-out valves.

CAUTION

When servicing the KDC valve, always drain out refrigerant before disassembling the valve. This must be done via the access port on the side of the valve.

NOTE

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

5. Open any other valves that may trap gas or liquid. Lock-out/tag-out valves.
6. Recover and/or transfer all vapors per local/state codes and policies.
7. Servicing the compressor unit can proceed at this point. After servicing, ensure to perform a leak check, see Compressor Unit Leak Check procedure.

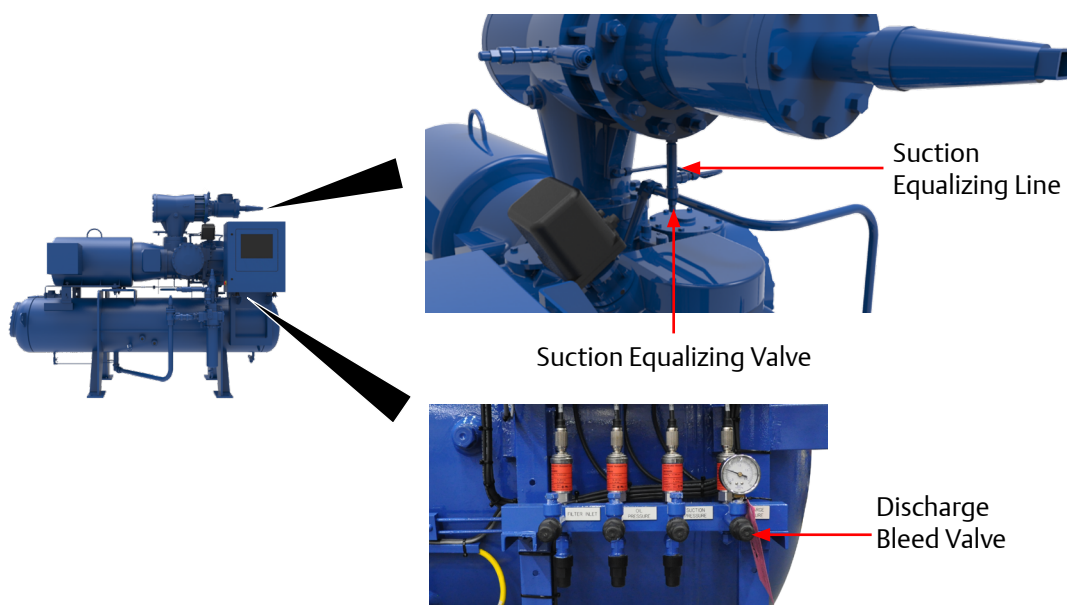


Figure 5-1. Discharge Bleed Valve, Suction Equalizing Line and Valve

Recommendations when Servicing (Compressors Without Slide Valves)

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 CO₂ piping. CO₂ has a very steep pressure curve, and as sections containing CO₂ 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.

Section 5 • Maintenance/Service

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.

Pre-Sampling

Use the Vilter Oil Analysis Kit (VPN 3097A) to collect an oil sample for analysis, see Figure 5-2.

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 5-2. Oil Analysis Kit (VPN 3097A)

Sampling Procedure

THE SAMPLING PRESSURE RANGE IS LIMITED BETWEEN 5 TO 750 PSI (0.03 – 5.17 MPa). IF THE OPERATING PRESSURE IS ABOVE 750 PSI (5.17 MPa), THE OIL SAMPLING MUST BE DONE WHEN THE COMPRESSOR IS NOT RUNNING AND ENSURE THE SYSTEM PRESSURE IS WITHIN THE 5 TO 750 PSI (0.03 – 5.17 MPa) SAMPLING RANGE.

A 1/4" NPT oil sampling valve is provided either in the oil filter canister cover or in the piping after the filter (See Figure 5-3 or 5-4 (a) according to application).

1. Unthread the oil sampling valve cap. For valve #3709A, you also need to turn the knurled locknut clockwise, see Figure 5-4 (b).

NOTE

DO NOT remove the valve from the piping or filter housing.

2. Remove the cap of the oil analysis bottle and position it carefully under the valve spout. (Make sure the valve spout is rotated to the downward position) **SLOWLY AND VERY CAREFULLY** press the "PUSH BUTTON" with your finger to open the valve, and release the button to close it, see Figure 5-5.

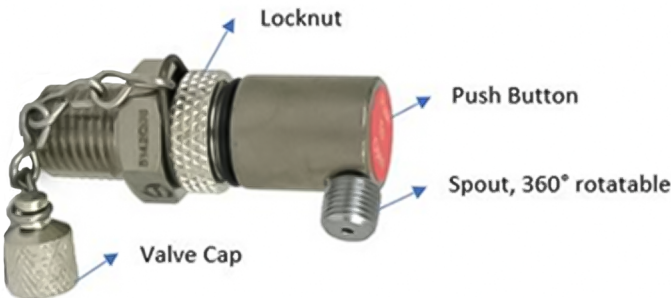
WARNING

If the valve is opened too rapidly, a foamy pressurized jet of oil will gush out and splash outside the container.

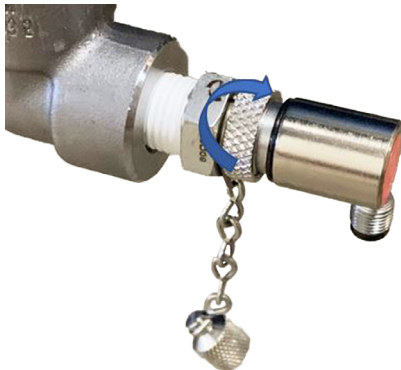


Figure 5-3. Oil Sampler Valve (VPN #3708A) For Gas Compression Applications

(a) Oil Sampler Valve for Ammonia and Other Refrigerants Applications



(b) Valve shown ready for oil sampling



(c) Valve shown in lockout position



Figure 5-4. Oil Sampling Valve (VPN #3709A) For Ammonia and Refrigerant Compressors

Button being pressed, valve open



Button released, valve closed



Figure 5-5. Operating the Oil Sampling Valve

3. In most cases there will be foam in the oil, so you must fill the bottle up to the top and then wait for the foam to dissipate. Repeat this step as many times as necessary (around 4 to 6 times) until the clear oil level reaches $\frac{3}{4}$ full, see sequence in Figure 5-6.
4. After all the foam dissipates, tighten the sample bottle cap.
5. Tighten the oil sampling valve cap.
6. For valve #3709A only: back seat the knurled lock-nut by turning it counter-clockwise. This is to prevent any accidental release, see Figure 5-4 (c).
7. Attach the filled sampling information label to the bottle and mail the sample out to the oil analysis lab immediately.

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 metals



Figure 5-6. Stages of the Oil Sample Taking Process

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 5-7.

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.

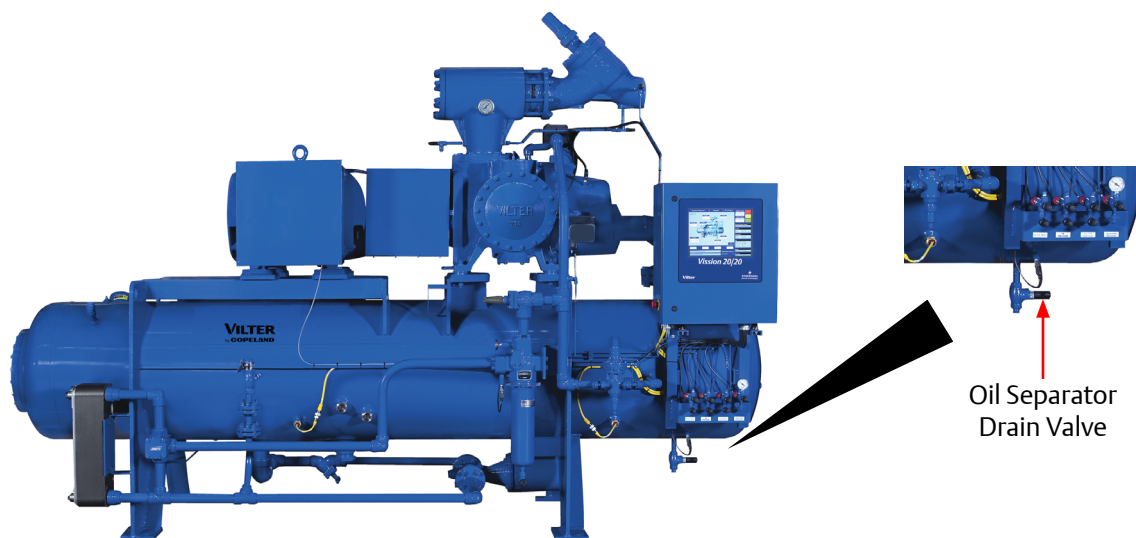


Figure 5-7. Oil Strainer Drain Valve and Oil Separator Drain Valve

Oil Charging

WARNING

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

CAUTION

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

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

Tool Required

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

Charging During Operation

During operation, if the oil level is low, add oil to the operating compressor through the suction oil charging valve, see Figure 5-8. 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 5-7. 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.

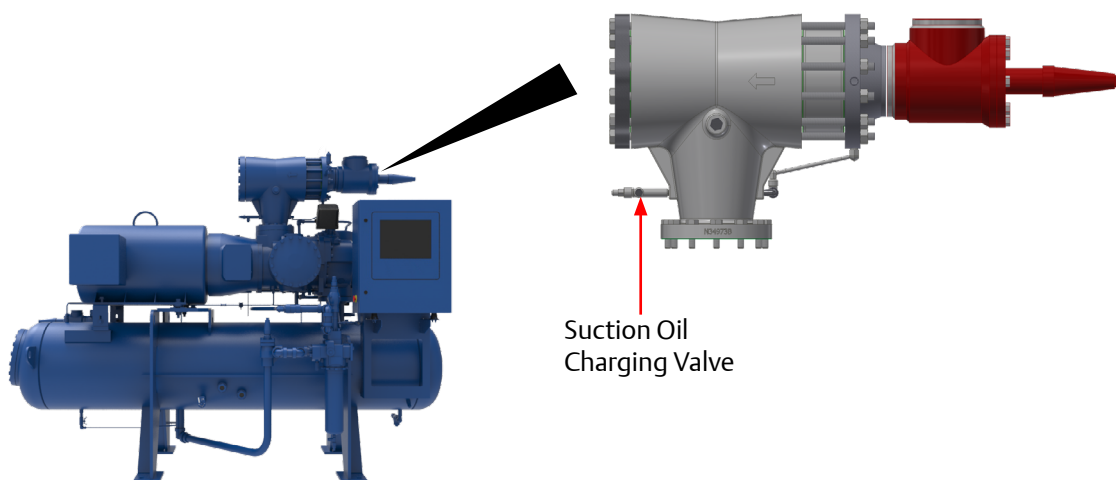


Figure 5-8. Suction Oil Charging Valve

Section 5 • Maintenance/Service

Filter Element Replacement (Single Oil Filter Assembly)

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

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

NOTE

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

This procedure is for a compressor unit equipped with a single oil filter assembly only, but can be used for units equipped with dual oil filters. The compressor unit must be shut down prior to servicing, see Stopping/Restarting procedure in Section 4.

Parts Required for VSMC

- Oil Filter Element (VPN KT 773)
- Supplied on all VSMC compressor units since 4-1-2000
- O-ring, Drain Plug (VPN 3111AB)
- For Filter Housings with Drain Plugs ONLY

For other compressors, see Table 5-2 for the parts required for an oil filter replacement, with their part numbers.

NOTE

For filter housings with drain plugs only, replace with O-ring (VPN 3111AB) after removing drain plug. Drain plug and O-ring are not shown in this procedure.

Drain Oil From Isolated Oil Line

1. Isolate the compressor unit, see Compressor Unit Isolation procedure.
2. Close oil supply valve and oil filter outlet valve to isolate oil filter assembly and oil pump strainer for servicing.
3. Remove plug from drain valve on oil pump strainer.
4. If needed, attach a hose with 1/4" male adapter to drain valve to aid in controlling discharged oil.
5. Using a drain pan, slowly open drain valve to reduce pressure and allow oil to completely drain from oil lines and oil pump strainer.
6. Remove plug from bleed valve on oil filter housing.
7. If needed, attach a hose with 1/4" male adapter to bleed port to aid in controlling discharged oil.
8. Using a drain pan, slowly open bleed valve and allow oil to completely drain from filter housing. Remove plug from oil filter head assembly to aid in oil removal.

Table 5-2. Oil Filter Replacement Parts Required, with their numbers

KIT	Oil Filter	Oil Filter Element	O-Ring and Drain Plug	Filter Type
KT773B	3111A	3109B	2176BZ	Single
KT773A	3109A	3109B	2176BY	Dual*
KT774**	3112A	3110B	2176BY	Single
KT721	3007A	3007B	2176BU	Single
KT722	3039A	3039B	2176AJ	Single

* 2 Kits required

** Supplied on VSS 1501-1801 Single Screw compressor units

Section 5 • Maintenance/Service

Oil Filter Element Removal (For 3111A Oil Filter Housing)

(Reference Figure 5-9)

NOTICE

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

9. Remove locking ring and filter housing from head assembly.
10. Remove filter element from internal port of head assembly.
11. Clean filter element connection area of head assembly and interior of filter housing.
12. Remove (head-to-housing) O-ring from inside of filter head. Discard O-ring.

Oil Filter Element Removal (For 3110A OR 3112A Oil Filter Housing)

(Reference Figure 5-10)

13. Remove oil filter housing cover and O-ring from oil filter housing. Discard O-ring.
14. Remove filter element from internal port of head assembly.
15. Clean filter element connection area of head assembly and interior of filter housing and cover.

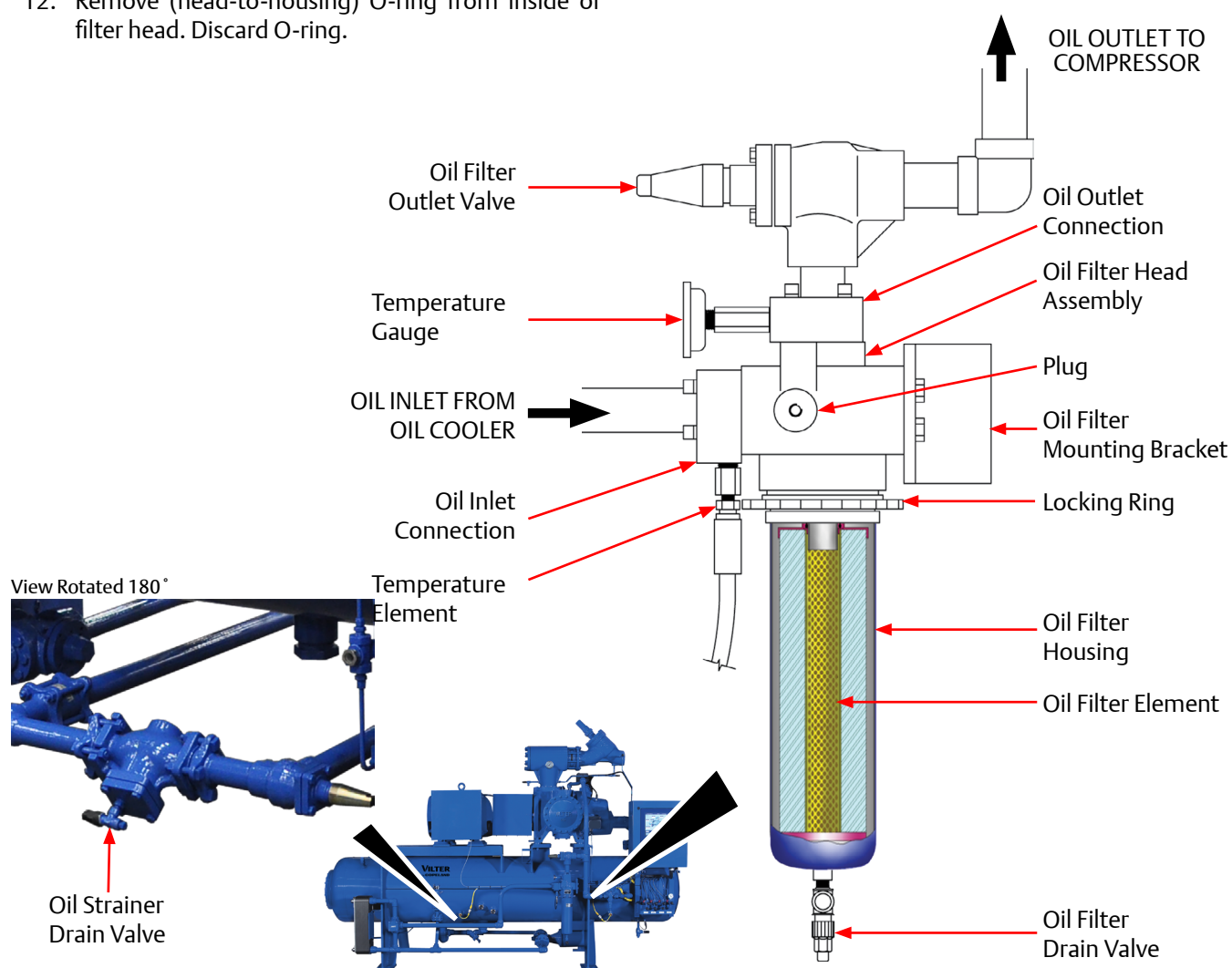


Figure 5-9. Filter Assembly and Oil Strainer Drain Valve (VPN 3111A Oil Filter Housing Shown)

Section 5 • Maintenance/Service

Oil Filter Element Installation (For 3111A Oil Filter Housing)

(Reference Figure 5-9)

16. Lubricate new O-ring with clean system oil.
17. Install O-ring on inside of filter head.
18. Install new filter element on internal port of head assembly. Make sure filter element is fully seated.
19. Lubricate threads of locking ring with clean system oil.
20. Hand tighten locking ring only. Install locking ring and filter housing on head assembly until filter housing bottoms. Do not overtighten locking ring.
21. Using dry nitrogen gas, pressurize isolated oil line through bleed valve of filter housing. Check for leaks on replaced components.
22. Evacuate isolated oil line to 29.88" Hg (1000 microns) and close bleed valve.
23. Install plug on bleed valve of filter housing.
24. Slowly open oil supply valve and allow oil to fill oil line.
25. Open filter outlet valve.
26. Check oil level and fill oil separator to non-operating level, see Oil Charging procedure.

Oil Filter Element Installation (For 3110A OR 3112A Oil Filter Housing)

(Reference Figure 5-10)

27. Install new filter element on internal port of head assembly. Make sure filter element is fully seated.
28. Lubricate new O-ring with clean system oil.
29. Hand tighten oil filter housing cover only. Install O-ring and oil filter housing cover on oil filter housing.
30. Using dry nitrogen gas, pressurize isolated oil line through bleed valve of filter housing. Check for leaks on replaced components.
31. Evacuate isolated oil line to 29.88" Hg (1000 microns) and close bleed valve.
32. Install plug on bleed valve of filter housing.
33. Slowly open oil supply valve and allow oil to fill oil line.
34. Open filter outlet valve.
35. Check oil level and fill oil separator to non-operating level, see Oil Charging procedure.

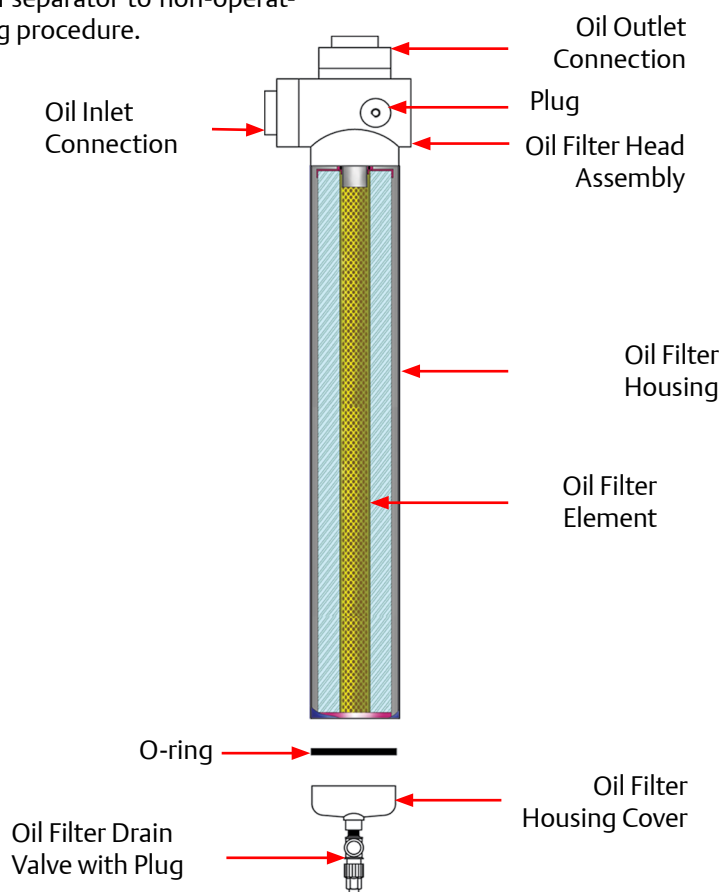


Figure 5-10. Filter Assembly (VPN 3112A Oil Filter Housing Shown)

Filter Element Replacement (Duplex Oil Filter Assembly)

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

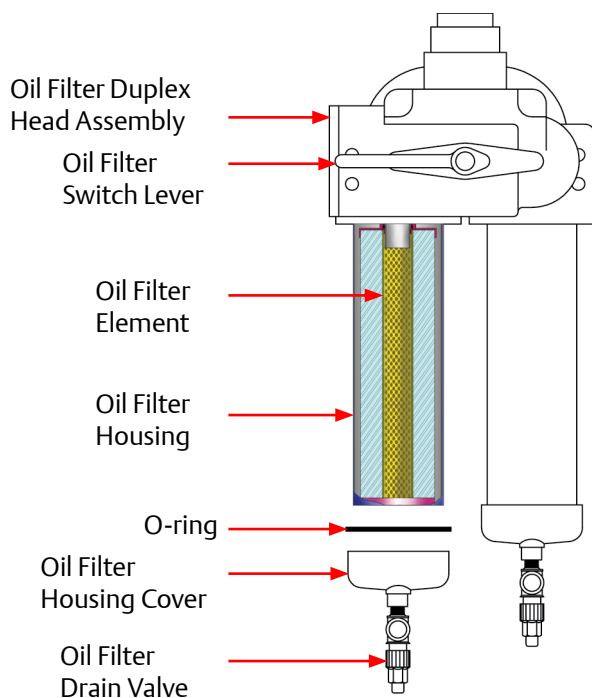
Avoid skin contact with oil. Wear rubber gloves and a face shield when working with oil. Failure to comply may result in serious injury or death.

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

NOTE

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

This procedure is for a compressor unit equipped with a duplex oil filter assembly only (VPN 3109A and 3110A oil filter housings). One oil filter can be isolated and serviced one at a time during operation. Note that there is one oil filter head assembly for both oil filters. This is different from dual oil filters, where each oil filter has its own oil filter head assembly.



Parts Required for VSMC

- Oil Filter Element (VPN KT 773)
- Supplied on all VSMC compressor units since 4-1-2000
- O-ring, Drain Plug (VPN 3111AB)
- For Filter Housings with Drain Plugs ONLY

For other compressors, see Table 5-2 for the parts required for an oil filter replacement, with their part numbers.

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

NOTE

For filter housings with drain plugs only, replace with O-ring (VPN 3111AB) after removing drain plug. Drain plug and O-ring are not shown in this procedure.

Removal

(Reference Figure 5-11)

NOTICE

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

1. Pull switch lever and switch over to second filter.
2. Remove plug from bleed valve.

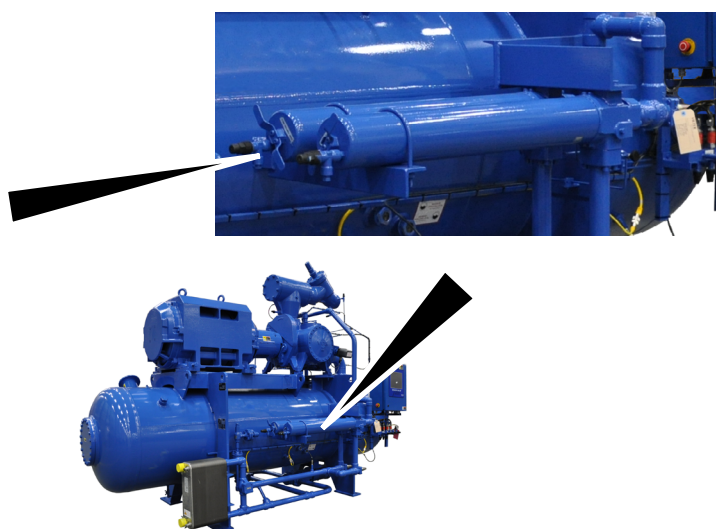


Figure 5-11. Duplex Oil Filter Assembly (VPN 3110A Double Oil Filter Housing Shown)

Section 5 • Maintenance/Service

3. If needed, attach a hose with 1/4" male adapter to bleed port to aid in controlling the flow of discharged oil.
4. Using a drain pan, slowly open bleed valve to reduce pressure and allow oil to completely drain from filter housing.
5. Remove oil filter housing cover and O-ring from oil filter housing. Discard O-ring.
6. Remove filter element from internal port of head assembly.
7. Clean filter element connection area of head assembly and interior of filter housing.

Installation

8. Before reassembling, clean all parts thoroughly.
9. Install new filter element on internal port of head assembly. Make sure filter element is fully seated.
10. Lightly lubricate new O-ring with clean system oil.
11. Install O-ring and replace the oil filter housing (canister) on oil filter Duplex head Assembly. Hand-tighten only the oil filter housing cover.
12. Using dry nitrogen gas, pressurize filter housing through bleed valve and check for leaks.
13. Evacuate filter housing to 29.88" Hg (1000 microns) and close bleed valve.
14. Install plug on bleed valve.
15. Pull switch lever and slowly rotate lever to middle position to allow oil to fill filter housing. Allow a minimum of 5 seconds to fill housing, then rotate lever back to second filter.
16. Repeat for second oil filter, as required.

Filter Element Replacement (Dual Oil Filter Assembly)

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

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

NOTE

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

This procedure is for a compressor unit equipped with a dual oil filter assembly only. One oil filter can be isolated and serviced one at a time during operation. Note that there is one oil filter head assembly for each oil filter. This is different from duplex oil filters, where there is only one oil filter head assembly for both oil filters.

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

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

NOTE

For filter housings with drain plugs only, replace with O-ring (VPN 3111AB) after removing drain plug. Drain plug and O-ring are not shown in this procedure.

Section 5 • Maintenance/Service

Switching Oil Filters For Maintenance

(Reference Figure 5-12)

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.

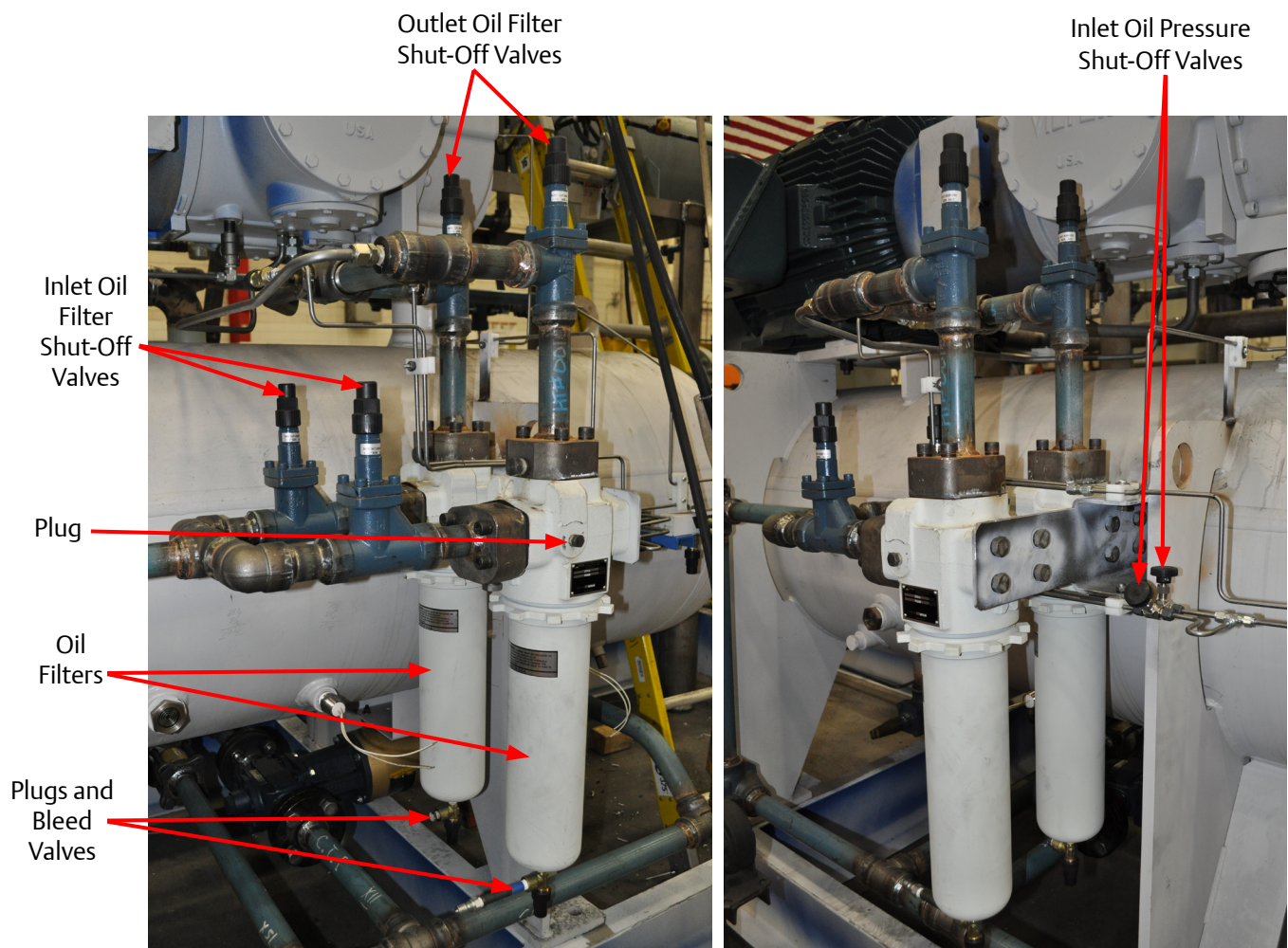


Figure 5-12. Dual Oil Filter (3111A Oil Filter Housings Shown)

Section 5 • Maintenance/Service

Drain Oil From Isolated Oil Filter

(Reference Figure 5-13)

6. Remove plug from bleed valve on oil filter housing.
7. If needed, attach a hose with 1/4" male adapter to bleed port to aid in controlling discharged oil.
8. Using a drain pan, slowly open bleed valve and allow oil to completely drain from filter housing.

Oil Filter Element Removal (For 3111A Oil Filter Housing)

(Reference Figure 5-13)

NOTICE

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

9. Remove locking ring and filter housing from head assembly.
10. Remove filter element from internal port of head assembly.
11. Clean filter element connection area of head assembly and interior of filter housing.
12. Remove (head-to-housing) O-ring from inside of filter head. Discard O-ring.

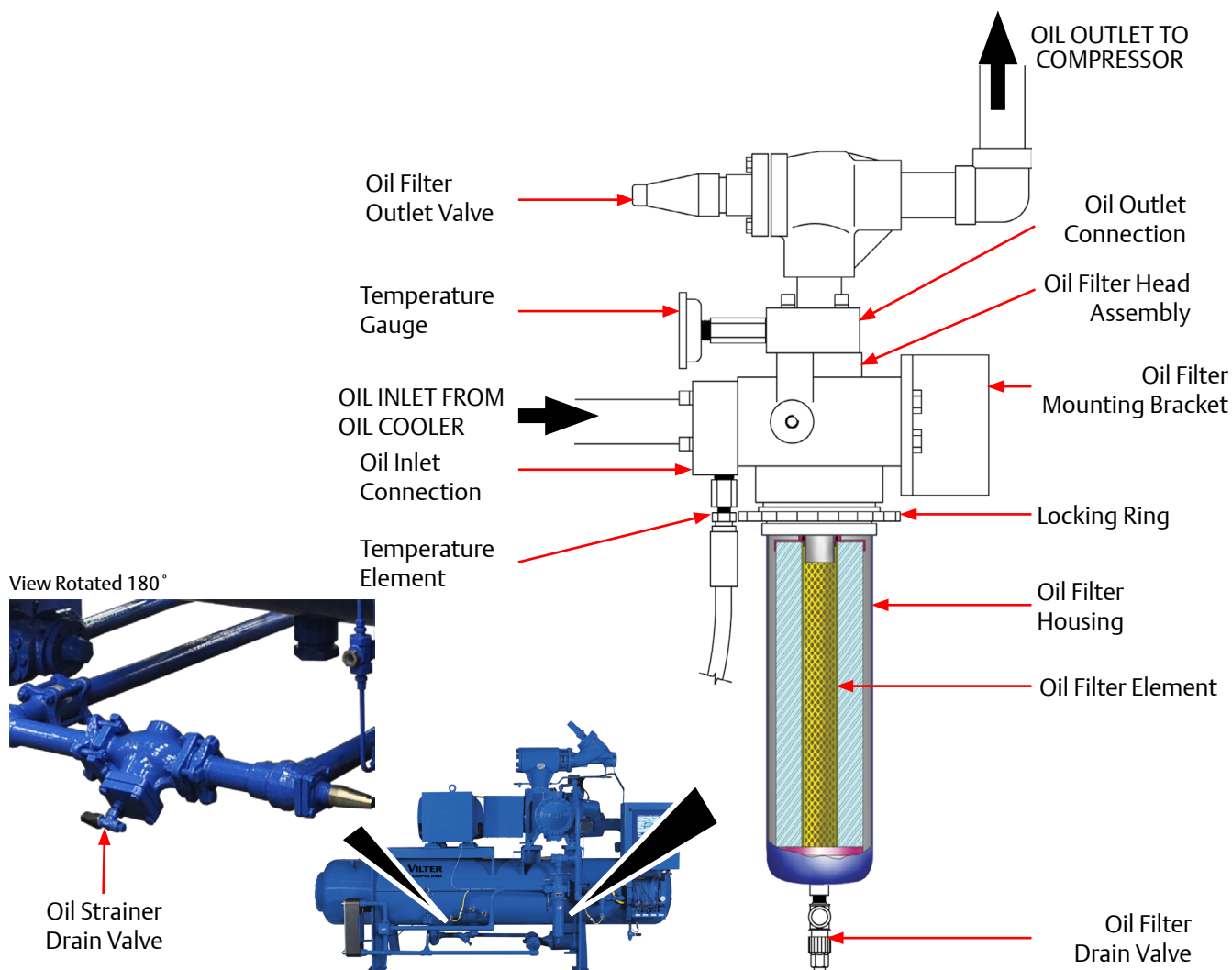


Figure 5-13. Filter Assembly and Oil Strainer Drain Valve (VPN 3111A Oil Filter Housing Shown)

Section 5 • Maintenance/Service

Oil Filter Element Removal (For 3110A OR 3112A Oil Filter Housing)

(Reference Figure 5-14)

13. Remove oil filter housing cover and O-ring from oil filter housing. Discard O-ring.
14. Remove filter element from internal port of head assembly.
15. Clean filter element connection area of head assembly and interior of filter housing and cover.

Oil Filter Element Installation (For 3111A Oil Filter Housing)

(Reference Figure 5-9)

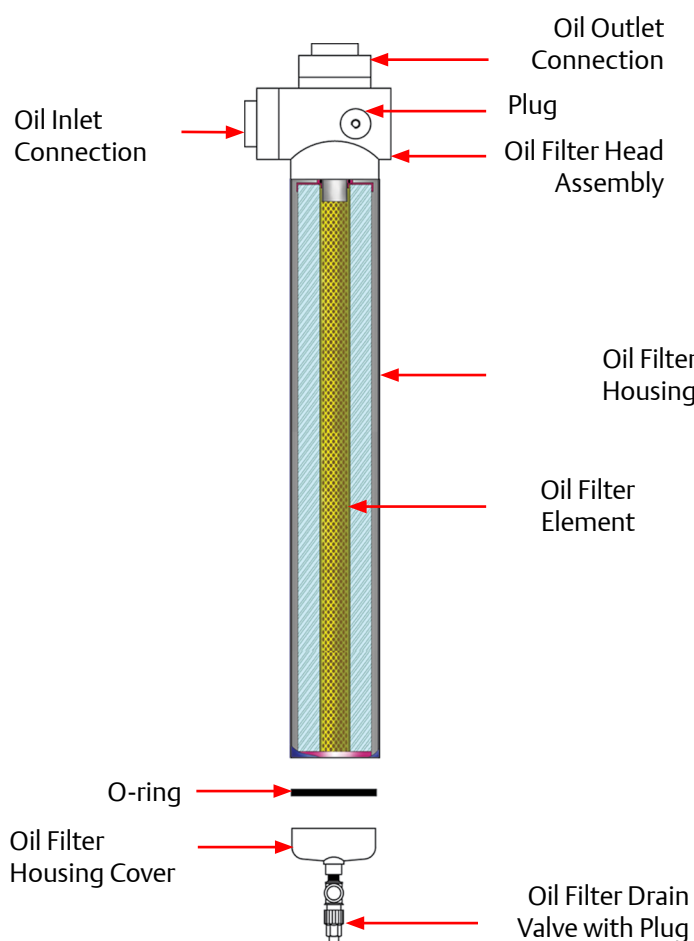
16. Lubricate new O-ring with clean system oil.
17. Install O-ring on inside of filter head.
18. Install new filter element on internal port of head assembly. Make sure filter element is fully seated.

19. Lubricate threads of locking ring with clean system oil.
20. Hand tighten locking ring only. Install locking ring and filter housing on head assembly until filter housing bottoms. Do not overtighten locking ring.
21. Using dry nitrogen gas, pressurize isolated oil line through bleed valve of filter housing. Check for leaks on replaced components.
22. Evacuate isolated oil line to 29.88" Hg (1000 microns) and close bleed valve.
23. Install plug on bleed valve of filter housing.
24. Slowly open oil supply valve and allow oil to fill oil line.
25. Open filter outlet valve.
26. Check oil level and fill oil separator to non-operating level, see Oil Charging procedure.

Oil Filter Element Installation (For 3110A OR 3112A Oil Filter Housing)

(Reference Figure 5-14)

27. Install new filter element on internal port of head assembly. Make sure filter element is fully seated.
28. Lubricate new O-ring with clean system oil.
29. Hand tighten oil filter housing cover only. Install O-ring and oil filter housing cover on oil filter housing.
30. Using dry nitrogen gas, pressurize isolated oil line through bleed valve of filter housing. Check for leaks on replaced components.
31. Evacuate isolated oil line to 29.88" Hg (1000 microns) and close bleed valve.
32. Install plug on bleed valve of filter housing.
33. Slowly open oil supply valve and allow oil to fill oil line.
34. Open filter outlet valve.
35. Check oil level and fill oil separator to non-operating level, see Oil Charging procedure.



**Figure 5-14. Filter Assembly
(VPN 3112A Oil Filter Housing Shown)**

Section 5 • Maintenance/Service

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 5-15.
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.

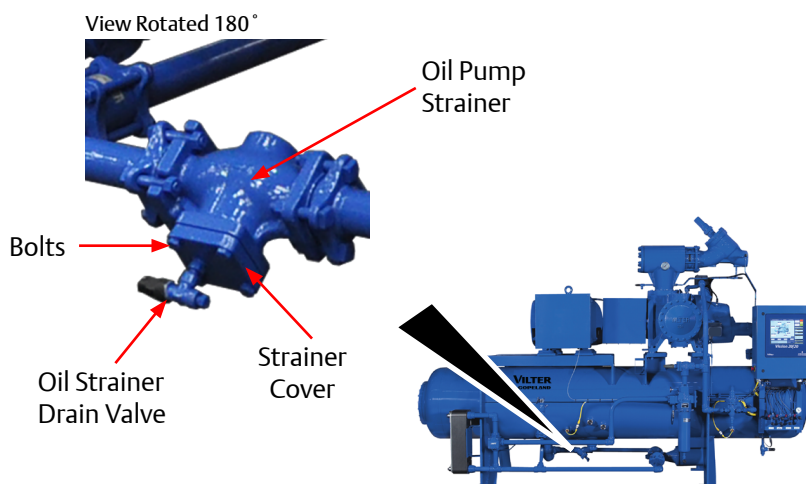


Figure 5-15. Oil Pump Strainer and Drain Valve

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

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

Removal

1. Isolate the compressor unit, see Compressor Unit Isolation procedure.
2. If required, install lifting eyes on oil separator manhole cover, see Figure 5-16.
3. Secure appropriate lifting device to oil separator manhole cover.
4. Remove all bolts except top four bolts securing oil separator manhole cover to oil separator vessel.
5. Adjust lifting device as needed to hold weight of oil separator manhole cover.
6. Remove remaining four bolts and oil separator manhole cover from oil separator vessel.
7. Remove nuts, flat washer and cover plate securing coalescing oil filter to hold-down rod.
8. With assistance of second person, remove coalescing filter from oil separator vessel.
9. Repeat steps 7 and 8 to remove additional coalescing filters, as required.

Installation

10. Install tubing over hold-down rod. Position tubing as far back as possible.
11. With assistance of second person, position coalescing element over tubing and through hole of centering strap.
12. Push coalescing filter into vessel until fully seated on pipe stub.
13. Remove tubing.
14. Position cover plate and flat washer on hold-down rod on end of the coalescing filter.
15. Install nut to secure flat washer and cover plate to coalescing filter. Tighten nut to 25 ft-lbs.
16. Install second nut to prevent first nut from moving.
17. Repeat steps 10 to 16 for installing additional coalescing filters.
18. Position oil separator manhole cover on oil separator vessel.
19. Install bolts to secure oil separator manhole cover to oil separator vessel.
20. Tighten bolts, see Table A-3 in Appendix A.
21. Perform Compressor Unit Leak Check procedure.

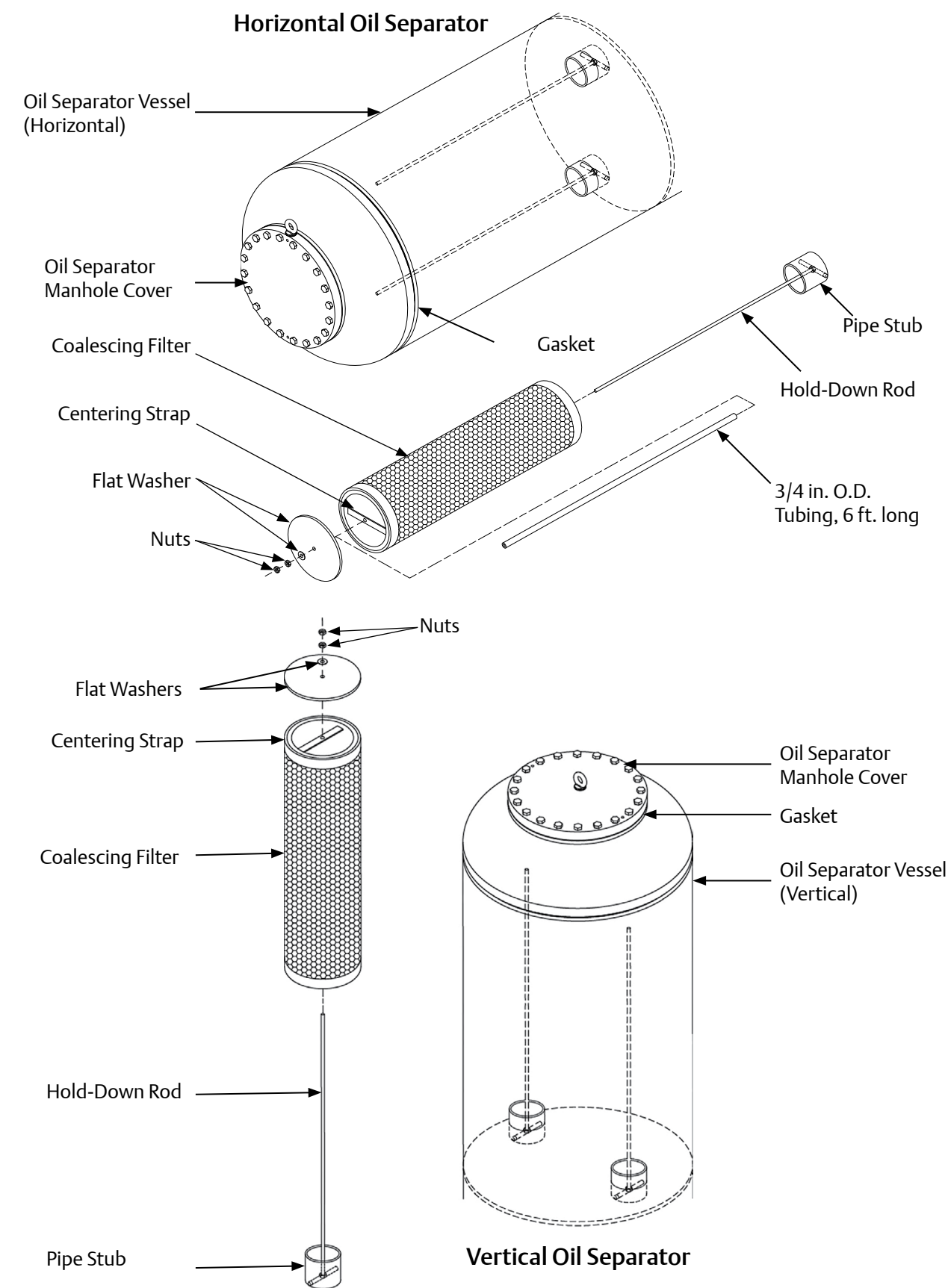


Figure 5-16. Oil Separators, Manhole Covers and Coalescing Filter Assemblies

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)

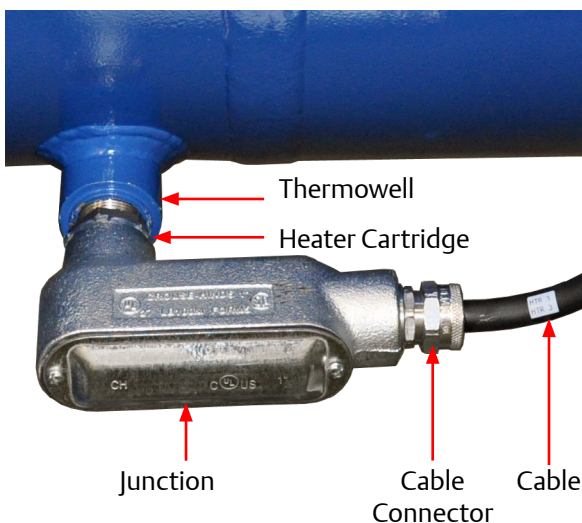
Removal

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 Cartridge WITHOUT 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 WITH Turck Connector

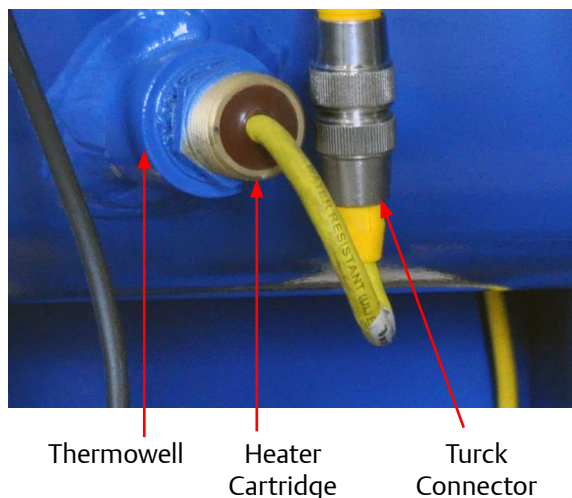


Figure 5-17. Heater Cartridges

KDC Valve Maintenance

CAUTION

Do not remove the bonnet while the KDC valve is still under pressure.

CAUTION

Always pull the valve seat back in open position before assembling the valve.

The refrigerant must be evacuated from the pipe system before any servicing of the valve takes place, and this evacuation must take place from both sides of the valve (inlet and outlet). Use the valve's service port (item #4 in Figure 5-18) to evacuate refrigerant from above the cone.

Follow these steps when performing maintenance on the valve:

Disassembly

1. Mount the dismantling bolt (1), the hexagon flange nut (2) and the nylon ring (3) as shown in Figure 5-18.
2. Tighten the nut (2) a few rounds in order to redraw the valve cone from the seat.
3. Loosen the bonnet bolts (5) by a third of an inch, and make sure the bonnet doesn't feel under pressure from the internal spring. If there's no pressure, the rest of the valve's components can be safely removed. Go to step 5.
4. If the spring is applying pressure to the bonnet,

then there's damage inside the valve, and only two bolts must be removed (for safety), and replaced with studs and nuts, to hold the bonnet in place while the other two bolts are being removed. Once all bolts are out, the nuts on the studs can be loosened, and the bonnet can be eased off gently.

5. Remove the valve top (actuator).
6. Check that the O-ring has not been damaged, and replace if it has.
7. Once the internal parts are out, the spring can be removed by unscrewing the spring bolt (6).
8. Make sure the Teflon seat is free of scratches and impact marks.
9. Remove any dirt from pipes and valve body before assembly.

Assembly

1. Mount the dismantling bolt (1), the hexagon flange nut (2) and the nylon ring (3) as shown on Figure 5-18.
2. Tighten the nut (2) a few rounds in order to redraw the valve cone from the seat.
3. Make sure the bonnet gasket (7) is captured in the bonnet's groove.
4. Mount the bonnet assembly in the valve housing and tighten the bonnet bolts (5).
5. Remove disassembly bolt. The purpose of the bolt is to secure the insert from falling out during disassembly and avoid damage of the Teflon seat when bonnet is mounted.

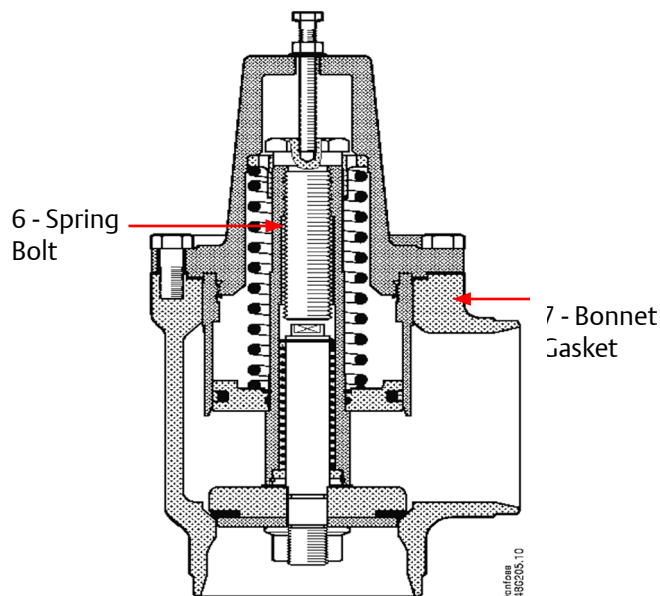
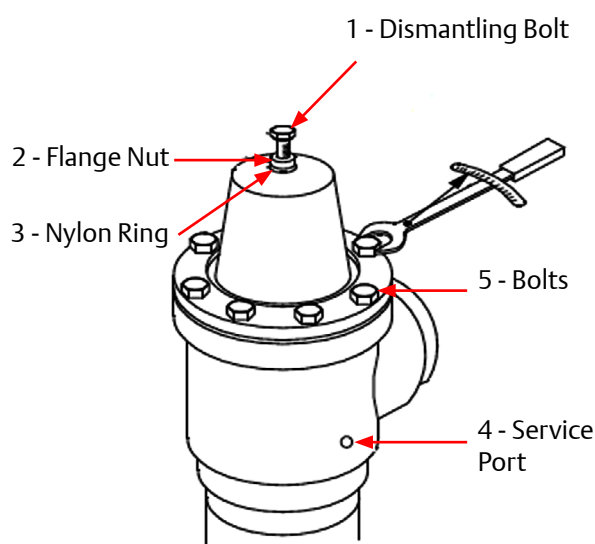


Figure 5-18. KDC Servicing

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 5-19), 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.

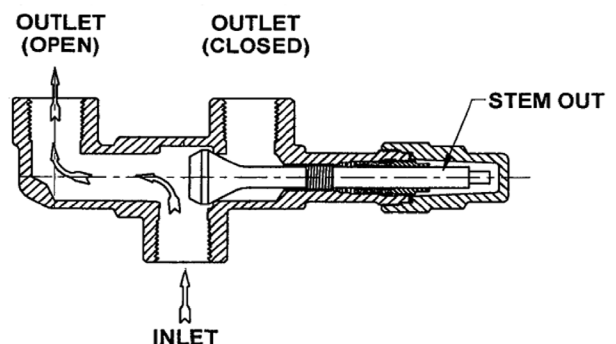


Figure 5-19. Three-way Dual Shut-off Pressure Relief Valve (Back Seated)

Drive Coupling Hub (Form-Flex BPU) Installation

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

NOTE

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

To install the coupling, proceed with the following steps:

WARNING

Follow local 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.

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

NOTE

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

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

Straight Bore Hubs

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

Tapered Bore Hubs

10. For taper bore hubs, do not use Anti-seize because this will allow the hub to slide on farther than without, and you may not be able to get it removed. Install key in keyway of shaft.
11. Install hub on shaft.
12. If lock washers are being used, install hub cap, lock washers and bolt on shaft.
13. If locking tab is being used, install hub cap, locking tab and bolt on shaft.
14. Tighten bolt and draw hub up shaft to a stop.

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

Table 5-3. Shaft and Hub Distances

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

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

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

Drive Center Member Installation and Alignment

NOTE

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

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

NOTE

If the driver or driven equipment alignment specification is tighter than these recommendations, the specification should be used. Also, be sure to compensate for thermal movement in the equipment. The coupling is capable of approximately four times the above shaft alignment tolerances. However, close alignment at installation will provide longer service with smoother operation. The flex disc pack is designed to an optimal thickness and is not to be used for axial adjustments.

20. *Axial Spacing.* The axial spacing of the shafts should be positioned so that the flex disc packs are flat when the equipment is running under normal operating conditions. This means there is a minimal amount of waviness in the flex disc pack when viewed from the side. This will result in a flex disc pack that is centered and parallel to its mating flange faces. Move the motor to obtain the correct axial spacing, see Table 5-5 and Figure 5-20.

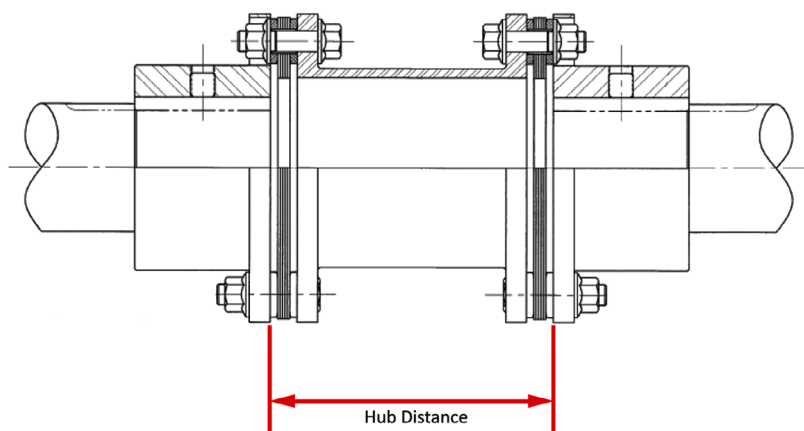


Figure 5-20. Hub Distance (Axial Spacing)

Table 5-5. Disc Pack Installation Torque Specifications

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

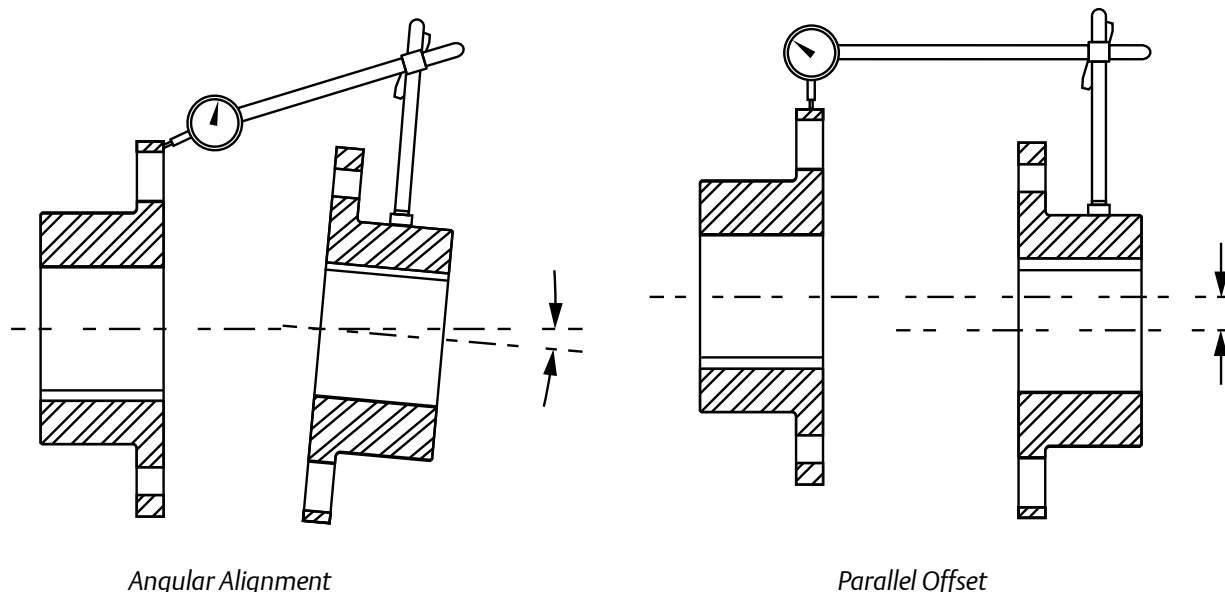


Figure 5-21. Angular Alignment and Parallel Offset

21. *Angular Alignment.* Rigidly mount a dial indicator on one hub or shaft, reading the face of the other hub flange. Rotate both shafts together, making sure the shaft axial spacing remains constant. Adjust the motor by shimming and/or moving so that the indicator reading is within 0.002" overall, see Figure 5-21.
22. *Parallel Offset.* Rigidly mount a dial indicator on one hub or shaft, reading the other hub flange outside diameter. Indicator set-up sag must be compensated for. Rotate both shafts together. Adjust the equipment by shimming and/or moving so that the indicator reading is within 0.002" overall, see Figure 5-21.

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

NOTE

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

23. Install bolts and locking nuts to secure both disc packs to center member.
24. Tighten locking nuts.

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

NOTE

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

29. Install bolts and locking nuts to secure disc pack to motor hub.
30. Tighten locking nuts, see Table 5-5.
31. Perform hot alignment. Run compressor unit and allow to warm up completely.
32. Power down compressor unit and re-check alignments. Loosen motor mounting nuts to add shims or to adjust alignments as required.
33. Install coupling guard.

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

To remove coupling assembly, proceed with the following steps:

WARNING

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

WARNING

Follow local 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

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

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

Drive Coupling (Type C Sure-Flex) Replacement

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

NOTE

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

Removal

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

WARNING

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

WARNING

Follow local 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.

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

NOTE

Mark locations of hubs prior to removal.

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

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11. Loosen clamping bolts securing hub from compressor shaft.
12. Remove hub and key from compressor shaft.

Installation

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

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

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

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.

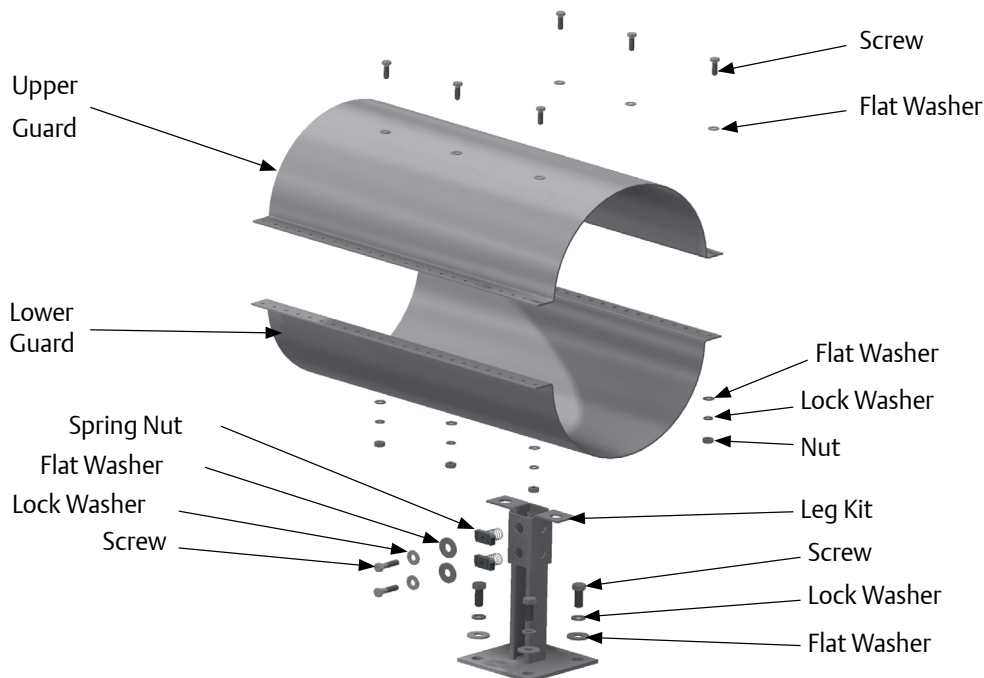


Figure 5-22. Coupling Guard Assembly (VPN A27435C shown)

Compressor Replacement - Except VSMC Compressors

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.

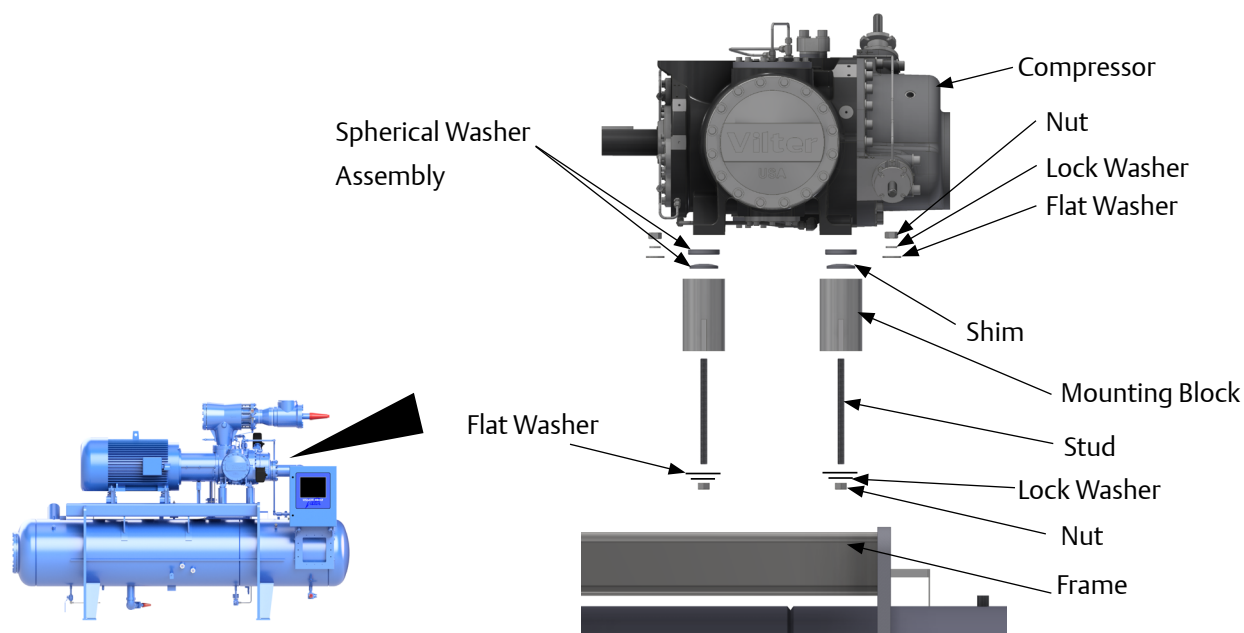


Figure 5-23. Compressor Replacement and Hardware Assembly (VSS 2401-3001 Shown)

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.

VSMC 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 motor.
4. Remove drive coupling, see appropriate Drive Coupling Replacement procedure.

NOTE

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

5. Remove drip tube from compressor.
6. Remove C-flange.
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. Install appropriate lifting eyes on top of compressor.

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13. Remove any additional lines and/or components to allow removal of compressor as required.
14. Remove nuts and bolts securing discharge pipe to compressor, see Figure 5-24.
15. Using appropriate lifting device and additional personnel, remove compressor from oil separator.
16. Remove shims and spherical washers from compressor mounting locations.
17. Inspect shims and spherical washers for damage, replace as required.
22. Tighten nuts to secure compressor to frame, refer to Appendix A.
23. Install bolts to secure C-flange to compressor. Tighten bolts, see Appendix A.
24. Install motor to C-flange making sure the motor is aligned to compressor.
25. Install nuts to secure suction strainer/check valve assembly to compressor and suction stop valve.
26. Tighten nuts on 'suction strainer/check valve assembly-to-compressor' first, then tighten nuts on 'suction strainer/check valve assembly-to-suction stop valve', refer to Appendix A.

Installation

18. Install shims and spherical washers on compressor mounting locations, see Figure 5-24.
19. Install appropriate lifting eyes on top of compressor.
20. Using appropriate lifting device, position compressor on compressor discharge flange on oil separator.
21. Loosely install studs, lock washers, flat washers and nuts to secure compressor to frame until alignment is correct.
27. Install drip tube to compressor.
28. Install all lines to compressor.
29. Install all cables to sensors on compressor and actuator.
30. Perform leak check, see Compressor Unit Leak Check procedure.

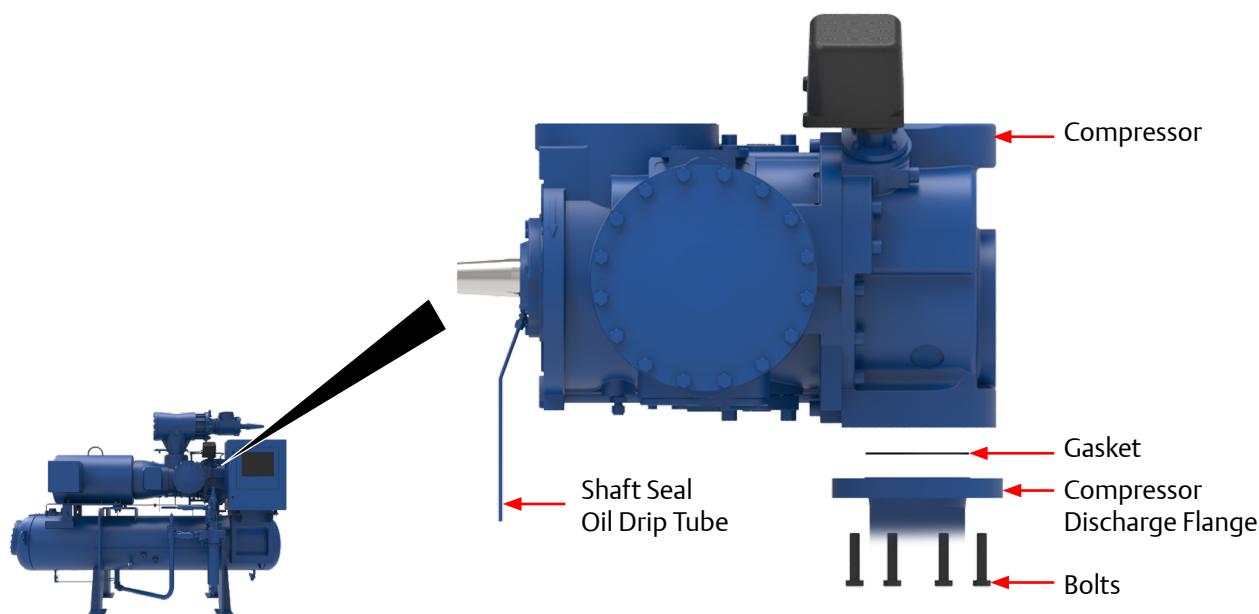


Figure 5-24. Compressor Replacement and Hardware Assembly

Bareshaft Compressor Lifting Points and Weights

Table 5-7. Bareshaft Compressor Component Weights

Models	Component Weights				
	Gaterotor Bearing Housing	Gaterotor Bearing Housing Cover	Discharge Manifold	Main Compressor Assembly ONLY	Gaterotor Cover
97-127	3.3 lbs (1.6 kg)	8 lbs (4 kg)	N/A	249 lbs (113 kg)	10 lbs (5 kg)
291-601	19 lbs (9 kg)	11 lbs (5 kg)	125 lbs (57 kg)	1105 lbs (502 kg)	46 lbs (21 kg)
751-901	28 lbs (13 kg)	11 lbs (5 kg)	177 lbs (80 kg)	1450 lbs (658 kg)	33 lbs (15 kg)
1051-1301	37 lbs (17 kg)	13 lbs (6 kg)	274 lbs (125 kg)	2006 lbs (910 kg)	42 lbs (19 kg)
1551-2101	54 lbs (24 kg)	19 lbs (9 kg)	349 lbs (158 kg)	3151 lbs (1429 kg)	70 lbs (32 kg)
2401-3001	58 lbs (27 kg)	32 lbs (15 kg)	788 lbs (358 kg)	4152 lbs (1883 kg)	150 lbs (68 kg)

Table 5-8. 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
97-127	A & B Lifting Points: 1/2 - 13 UNC -2B		-	-	-
291-601	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	3/8-16 UNC-2B
751-901	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	-
1051-1301	5/8-11 UNC-2B	5/8-11 UNC -2B	3/4-10 UNC -2B	5/8-11 UNC -2B	3/8-16 UNC -2B
1551-2101	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	3/8-16 UNC -2B
2401-3001	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	3/4-10 UNC -2B	5/8-11 UNC -2B

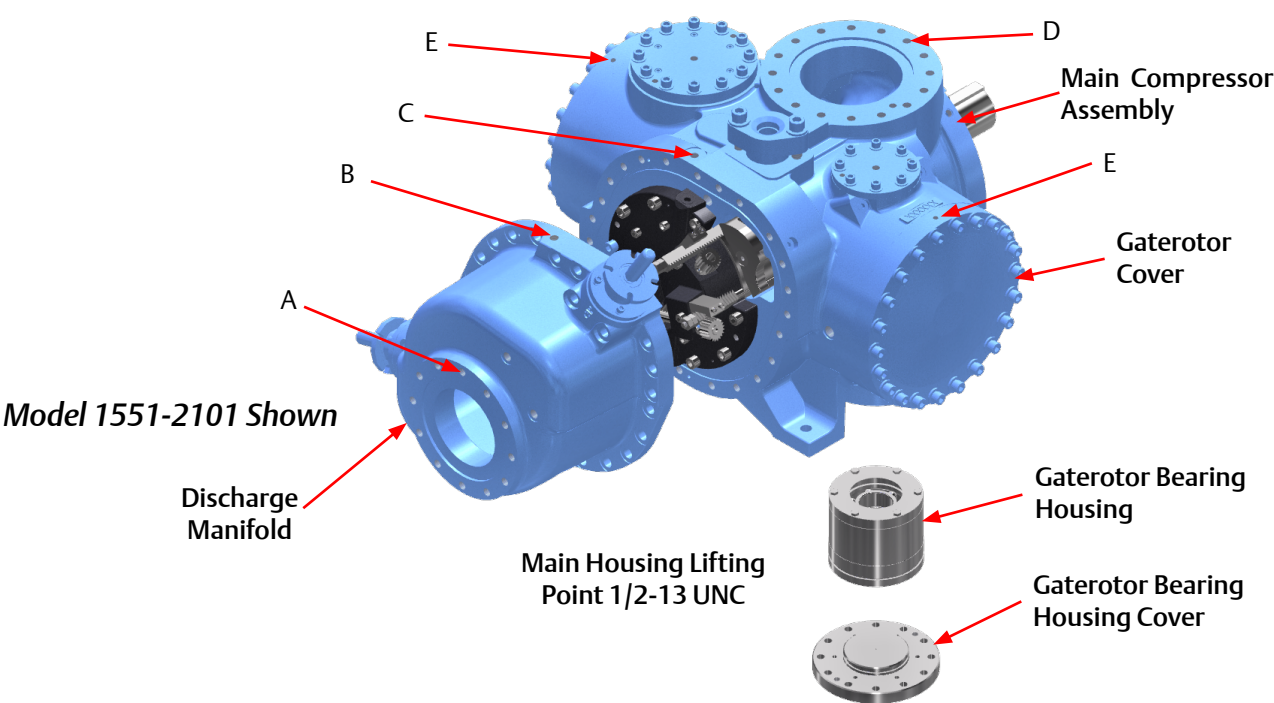


Figure 5-25. Bareshaft Compressor Lifting Points and Component Weights

Bareshaft Compressor Center of Gravity (Models 291-2101)

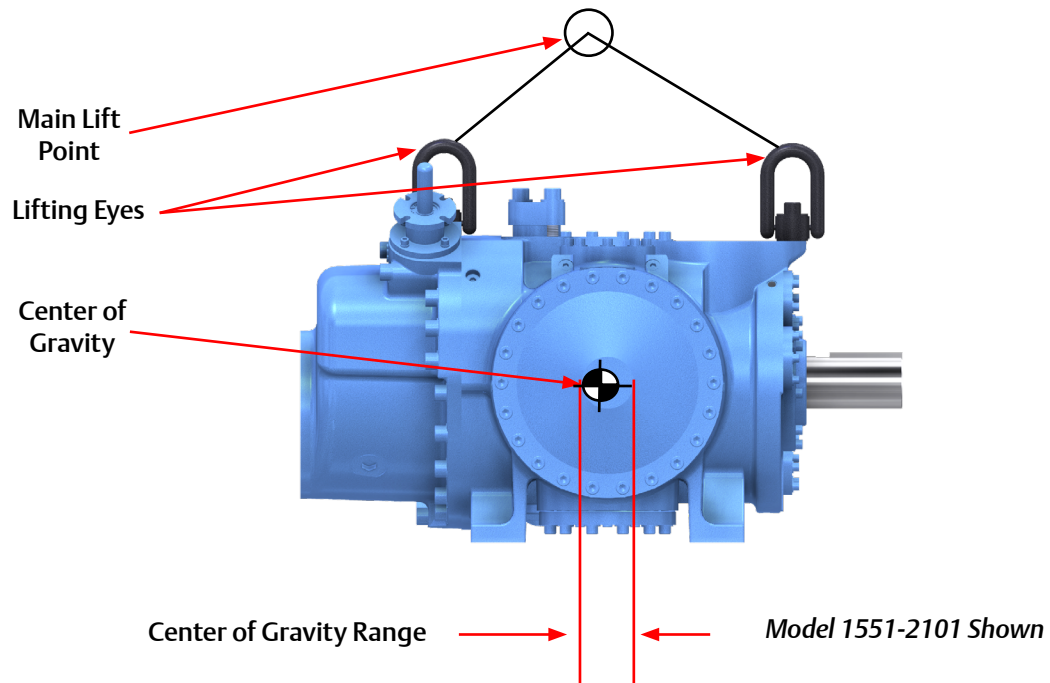


Figure 5-26. Bareshaft Compressor Assembly Center of Gravity (Models 291-2101)

Center of gravity may differ slightly between models 291-2101. Adjust main lift point within the range to keep bareshaft compressor as leveled as possible when lifting.

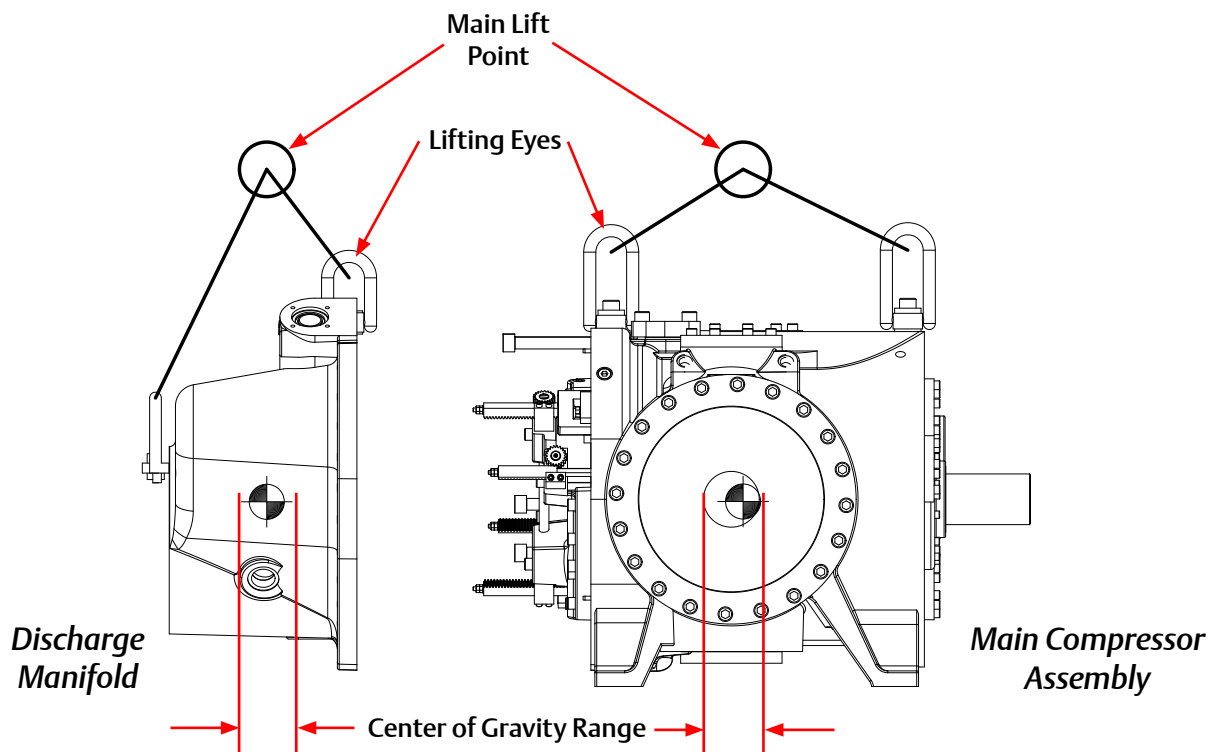


Figure 5-27. Bareshaft Compressor Center of Gravity - Discharge Manifold and Main Compressor Assembly (Models 291-2101)

Bareshaft Compressor Center of Gravity (Models 2401-3001)

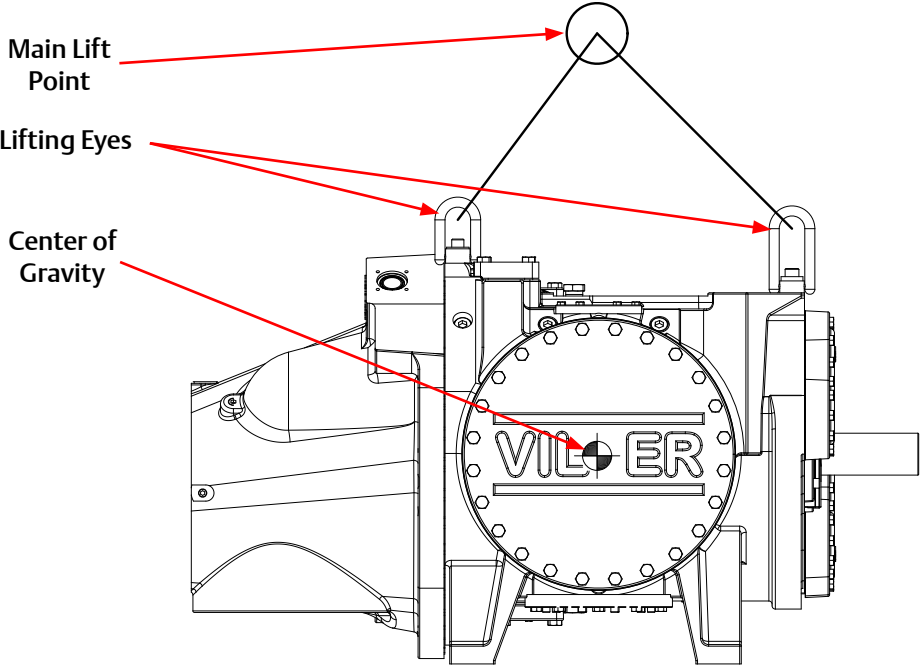


Figure 5-28. Bareshaft Compressor Assembly Center of Gravity (Models 2401-3001)

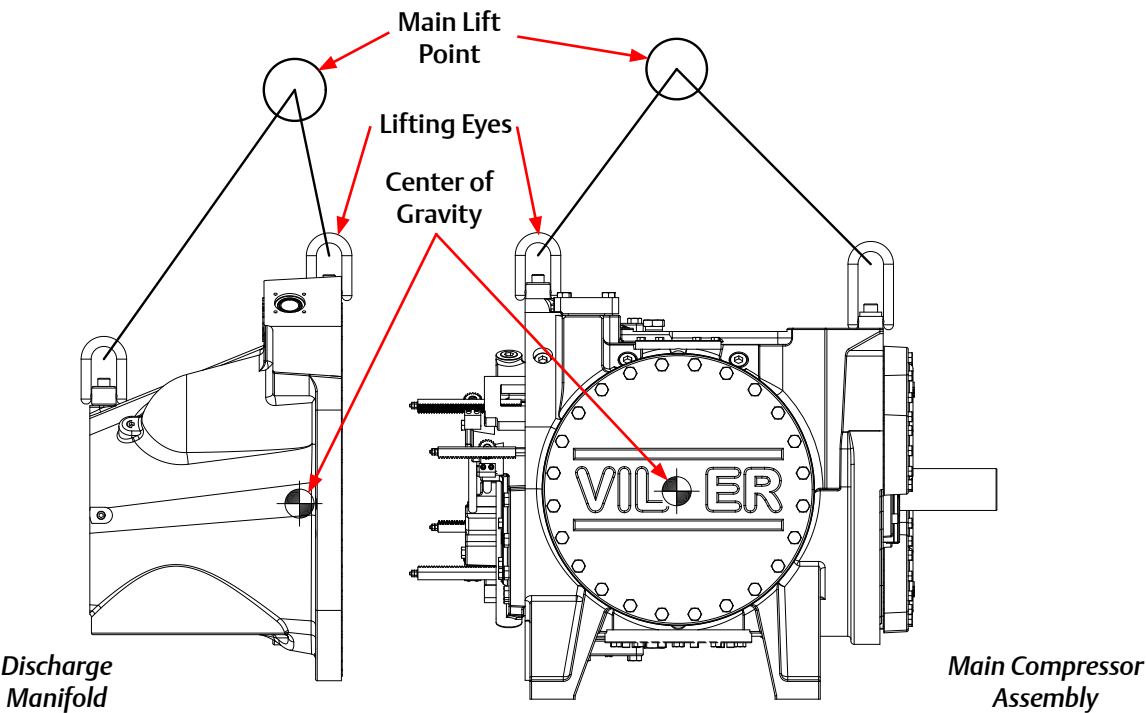


Figure 5-29. Bareshaft Compressor Center of Gravity - Discharge Manifold and Main Compressor Assembly (Models 2401-3001)

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

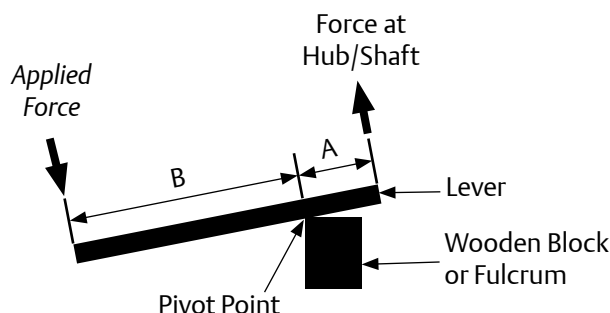
To determine maximum applied force, take maximum applied force at hub/shaft multiplied by length of A and divide by length B. This is the maximum force that should be applied on the lever.

$$(\text{Applied Force} \times A) / B = \text{Applied Force (Maximum)}$$

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:

$$(300 \text{ lbf} \times 6") / 30" = 60 \text{ lbf (Max. Applied Force)}$$

$$(1335 \text{ N} \times 15 \text{ cm}) / 85 \text{ cm} = 235 \text{ N (Max. Applied Force)}$$



As a quick reference, Table 5-9 shows maximum applied forces for 36" lever with 6" pivot for all compressor models.

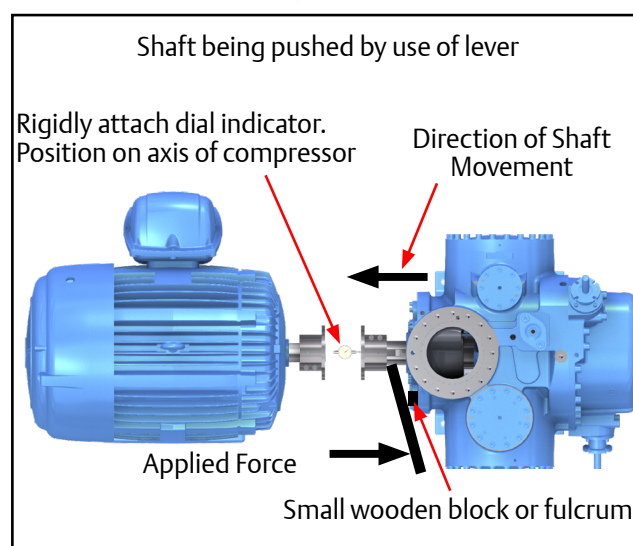
Main Rotor Bearing Axial Clearance Inspection

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 5-30.
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 5-9, the bearing may need to be replaced. Contact Vilter™ Technical Support.

Top View



Top View

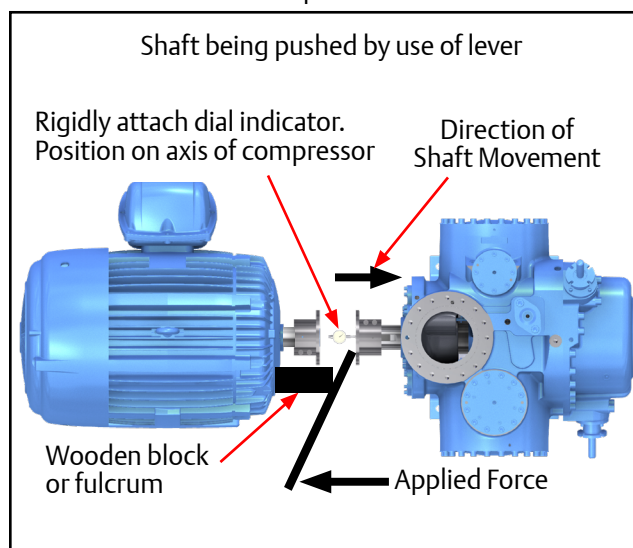


Figure 5-30. Bearing Axial Clearance Inspection

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Main Rotor Bearing Radial Clearance Inspection

6. Install dial indicator to the compressor frame and zero indicator, see Figure 5-31.

NOTE

Do not exceed maximum applied force. For maximum applied forces of all compressor models, see Table 5-9.

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 5-9, the bearing may need to be replaced. Contact Vilter™ Technical Support.

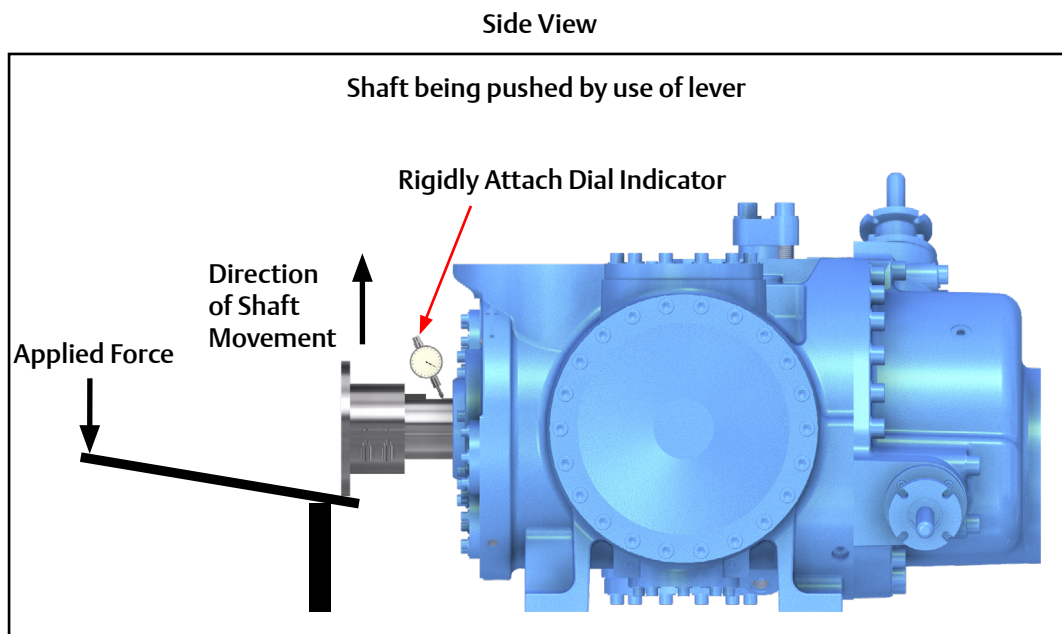


Figure 5-31. Bearing Radial Clearance Inspection

Table 5-9. 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)
151, 181, 201, 152, 182, 202, 301, 361, 401	0.002 (0.051)	0.006 (0.152)	100 (444)	20 (89)
501, 601, 701		0.007 (0.178)	150 (667)	30 (133)
291, 341, 451, 601		0.007 (0.178)	150 (667)	30 (133)
751, 901		0.006 (0.152)	200 (890)	40 (178)
791, 891, 1051, 1201, 1301		0.006 (0.152)	300 (1335)	60 (267)
1501, 1551, 1801, 1851, 2101		0.007 (0.178)	400 (1780)	80 (356)
2401, 2601, 2801, 3001		0.006 (0.152)	600 (2670)	120 (534)

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 5-32 (a) and zero the indicator. Put a hand as shown and firmly move the shaft in the direction shown in Figure 5-32 (a). Record the measurement. See Table 5-10 for the maximum radial clearance value.
3. To measure the gaterotor axial bearing clearance,

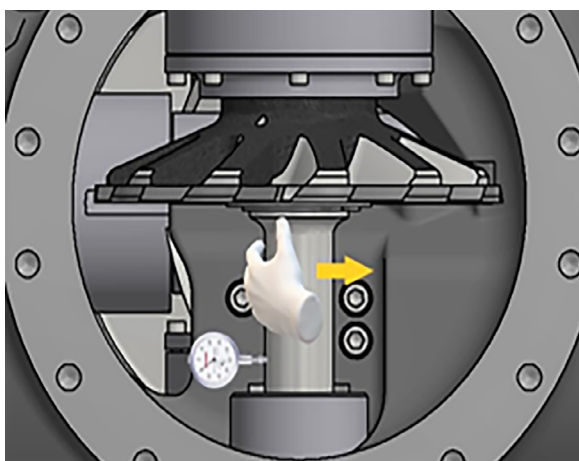
position a dial indicator on the gaterotor, as shown in Figure 5-32 (b).

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 5-32 (b). Record the measurement. See Table 5-10 for the maximum axial clearance value.

Table 5-10. 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)

(a): Radial



(b): Axial

Side View

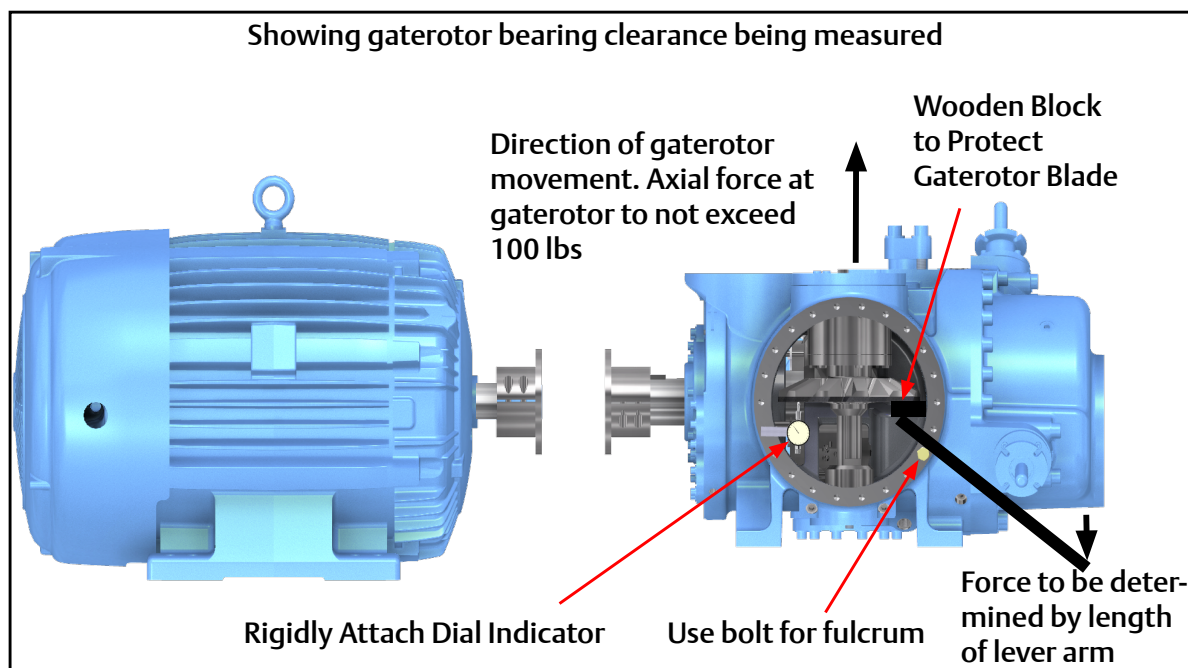


Figure 5-32. Gaterotor Bearing Clearance

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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 5-33.

1. Place a 0.003" feeler gauge between the gaterotor teeth, as shown in Figure 5-34 (a) and (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 5-34 (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 5-34 (d).

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

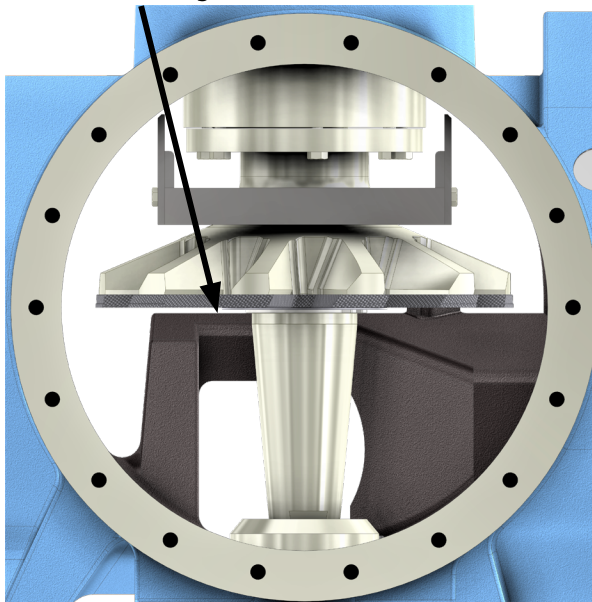
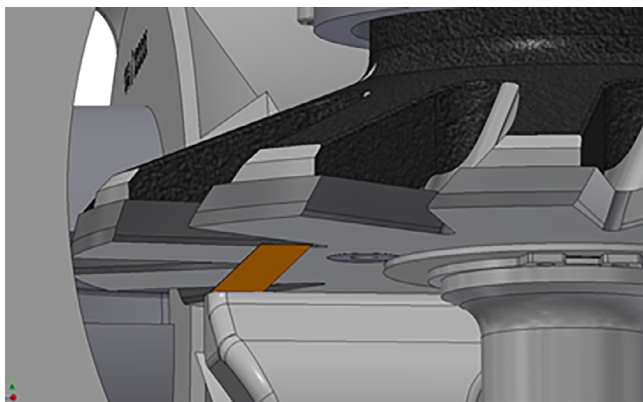
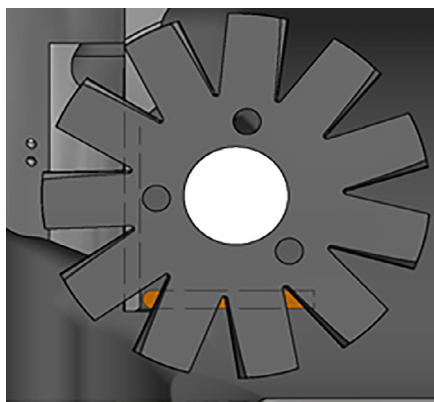


Figure 5-33. Gaterotor and Shelf Clearance

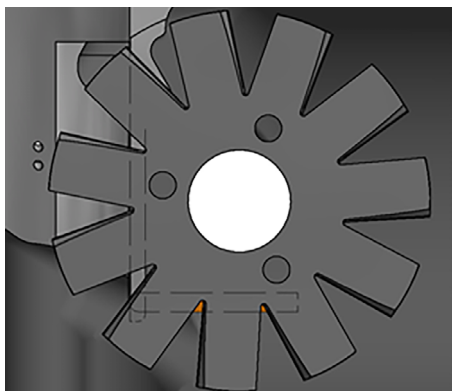
(a) Feeler Gauge Placement (Side View)



(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

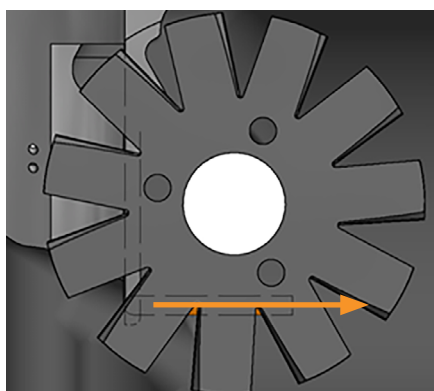


Figure 5-34. Gaterotor and Shelf Clearance Measurement Steps

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- 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 (106 in Figure 5-44 & 5-46) to achieve 0.003" – 0.004"	Perfect!	Add shims (106 in Figure 5-44 & 5-46) to achieve 0.003" – 0.004"

B) Gaterotor Float Measurement

- 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 5-35. 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.

- To measure the float between the gaterotor bushing and the support damper pin (see Figure 5-37), position a dial indicator at the tip of the support as shown in Figure 5-36. Hold the gaterotor in place, then gently move the support teeth back and forth with two fingers (and record measurement). Refer to Table 5-11 to find the maximum float value.

NOTICE

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

Table 5-11. Gaterotor Float

Model	Float in. (mm)
VSM 71 - VSM 401	0.045 (1.143)
VSM 501 - 701	0.045 (1.143)
VSS 291 - 601	0.045 (1.143)
VSS 751 - 901	0.055 (1.397)
VSS 791 - 1301	0.060 (1.524)
VSS 1501 - 2101	0.060 (1.524)
VSS 2401-3001	0.060 (1.524)

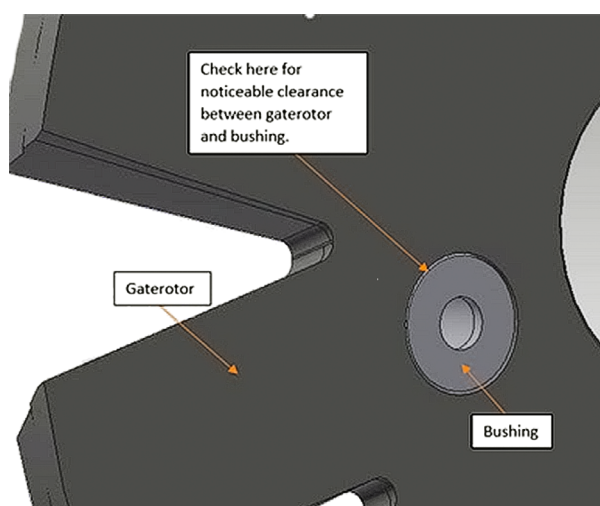


Figure 5-35. Visual Inspection Between Gaterotor and Bushing

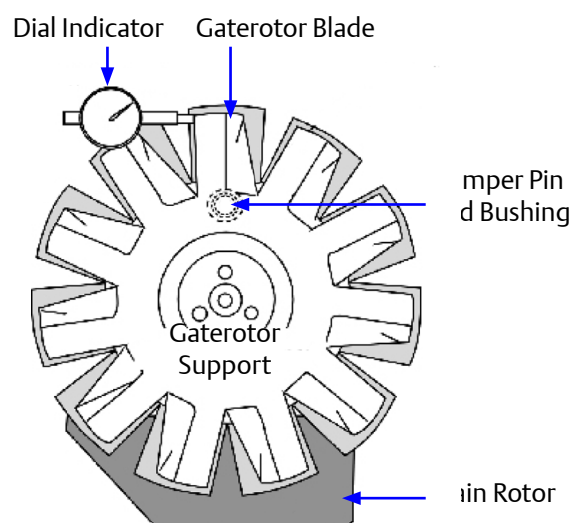


Figure 5-36. Gaterotor Float Dial Location

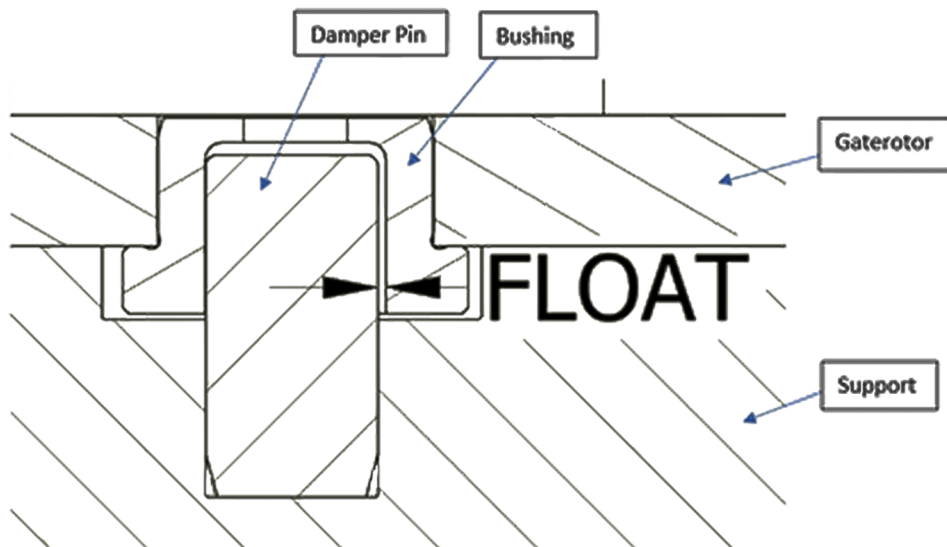


Figure 5-37. Gaterotor Float

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 5-38. 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 5-39 for location.

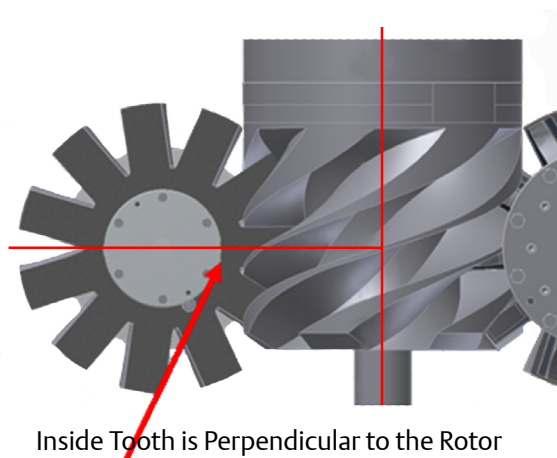


Figure 5-38. Alignment of Gaterotor

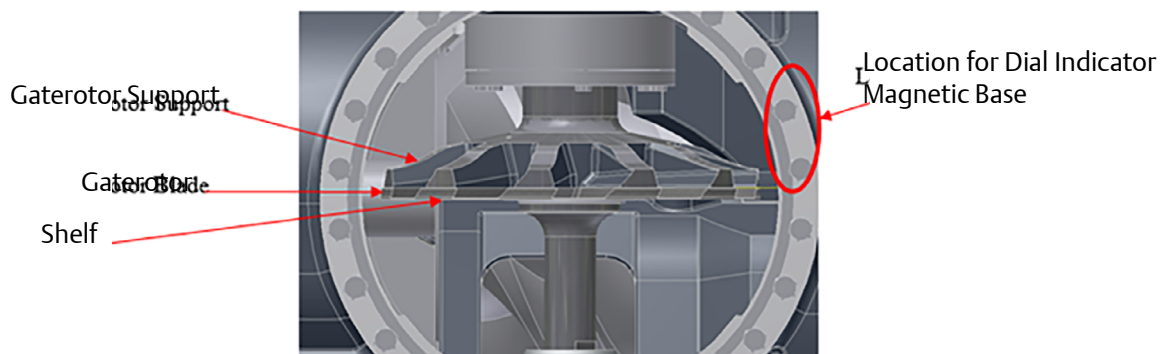


Figure 5-39. Location of Dial Indicator Magnetic Base

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- Place the Dial Indicator as square as possible on the Gaterotor tooth as shown on Figure 5-40.

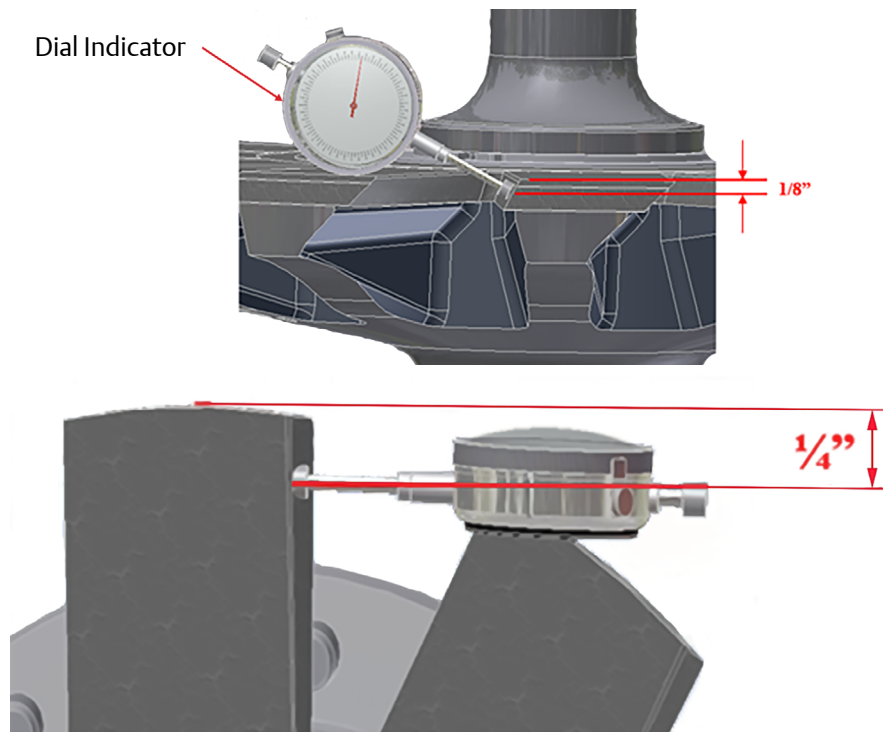


Figure 5-40. Placement of Dial Indicator

- To measure the backlash (see Figure 5-41), 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 5-12.

Table 5-12. Backlash Range

Compressor Model	Normal backlash
VSM-71 thru VSS-1301	0.008" to 0.012"
VSS-1501 thru VSS-3001	0.008" to 0.015"

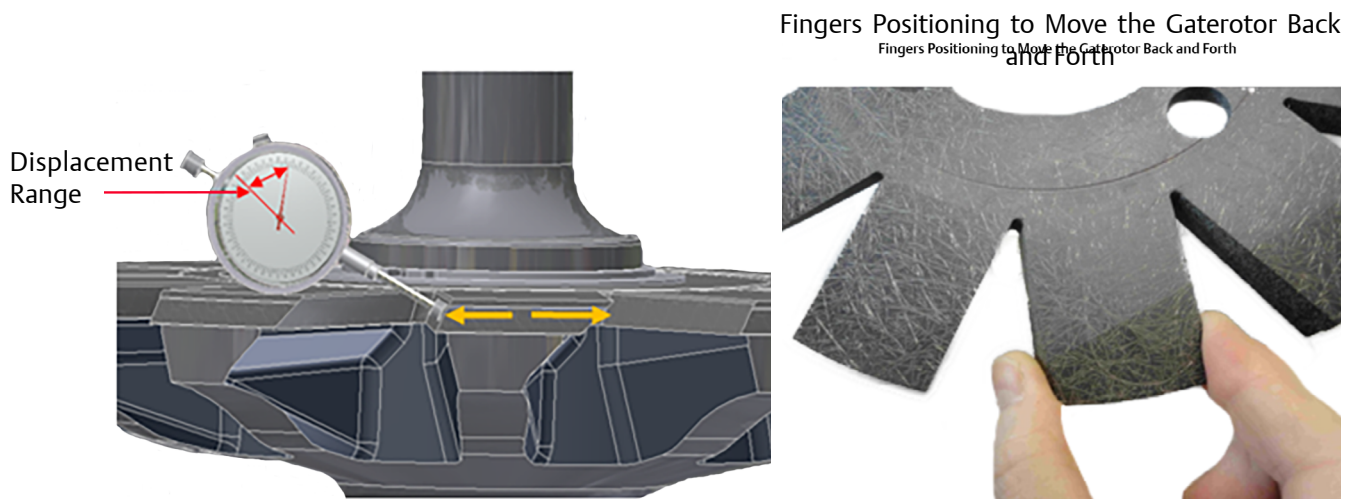


Figure 5-41. Measuring Backlash

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 5-42, 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.

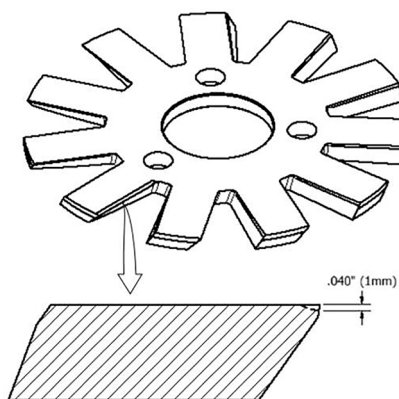


Figure 5-42. Chipped Edge of Gaterotor

Gaterotor Assembly Replacement (All Compressors Except VSM 301-701 Compressors)

Table 5-13 lists the gaterotor tool sets needed to remove and install gaterotor assemblies.

Table 5-13. Gaterotor Tool Kits

Model	Tool Set VPN
VSM 71 - VSM 401	N/A
VSM 501-701	A25205B
VSS 291-601	A25205B
VSS 751-1301	A25205C
VSS 1551-2101	A25205E
VSS 2401-3001	A25205F

Removal

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

NOTE

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

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

NOTE

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

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

NOTE

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

6. Insert gaterotor stabilizer. The side rails are not required on VSS 451 thru 601. For the VSS 751 thru 901 and VSS 1051 thru 1301 compressors, use the

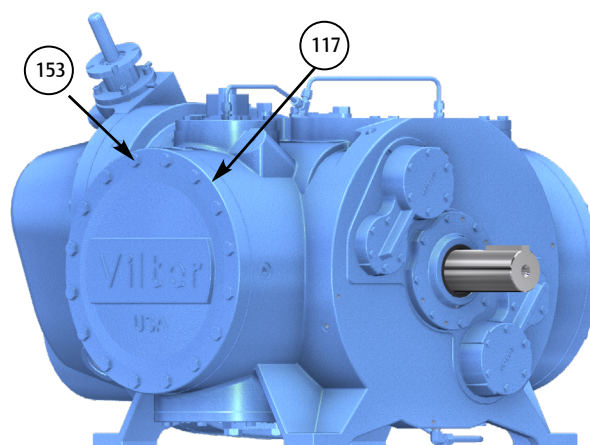
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side rails and assemble to the gaterotor stabilizer as stamped. For the VSS 1551 thru 2101, use the side rails and assemble to the gaterotor stabilizer. Refer to Figure 5-43.

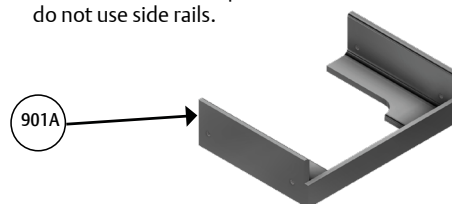
7. Remove hex head bolts and socket head bolts from thrust bearing cover.
8. Re-install two bolts into the threaded jacking holes to assist in removing thrust bearing cover. Retain the shim pack.
9. Hold gaterotor support with a suitable wrench on the flats provided near the roller bearing housing.
10. Remove the inner retainer bolts and retainer.
11. To remove the thrust bearing housing, install thrust bearing removal and installation tool with smaller puller shoe. Turn the jacking screw clockwise. The thrust bearings and housing assembly will be pulled off the shaft and out of the frame.
12. Remove bolts from roller bearing housing.
13. Re-install two bolts into jack bolt holes provided in housing to aid in removal.
14. To remove the gaterotor support, carefully move support in the opposite direction of rotation and tilt roller bearing end towards the suction end of the compressor. The compressor input shaft may have to be turned to facilitate the removal of the gaterotor support. On dual gate compressor units, repeat the procedure for the remaining gaterotor support assembly.

Installation

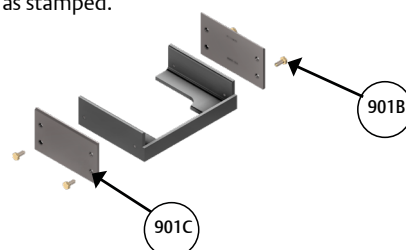
15. Install gaterotor support by carefully tilting the roller bearing end of the gaterotor support towards the suction end of the compressor. The compressor input shaft may have to be rotated to facilitate the installation of the gaterotor support. Install gaterotor stabilizer. The gaterotor stabilizer (901) will hold the gaterotor support in place as the thrust bearing housing is being installed. If the gaterotor support is not restricted from moving, the gaterotor blade may be damaged. See Figure 5-44.
16. Install the roller bearing housing (112) with a new O-ring (141). See Figure 5-45.
17. Tighten bolts (152), see Table A-1 or Table A-2 in Appendix A.
18. When installing the thrust bearing housing (113), a new O-ring (142) must be used when the housing is installed, see Figure 5-44. Lubricate the outside of the housing and bearings with clean compressor oil to aid in the installation. Due to the fit of the bearings on the gaterotor shaft, the thrust bearing



For VSS 451-601 compressors, do not use side rails.



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



Position leading edge of main groove flush with or slightly below back of gaterotor support

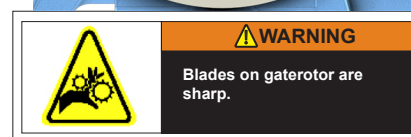
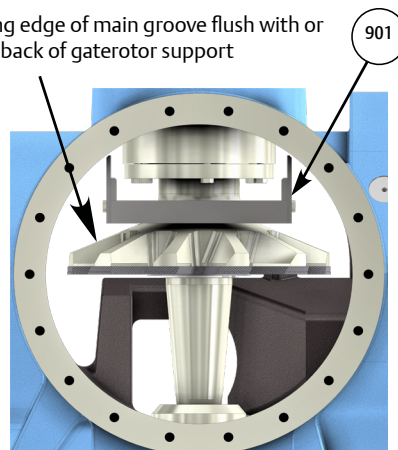


Figure 5-43. Gaterotor Assembly Removal and Tools

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removal and installation tool with the pusher shoe must be used. Turn the jacking screw clockwise. This will push the thrust bearings onto the shaft and push the housing assembly into the frame. Install the inner retainer (115) and bolts (151) using Loctite® 242 thread locker. Tighten bolts, see Table A-1 or Table A-2 in Appendix A.

19. Set clearance between gaterotor blade and shelf.
20. Place a piece of 0.003"-0.004" shim stock between gaterotor blade and shelf.

NOTE

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

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

NOTE

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

23. 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"

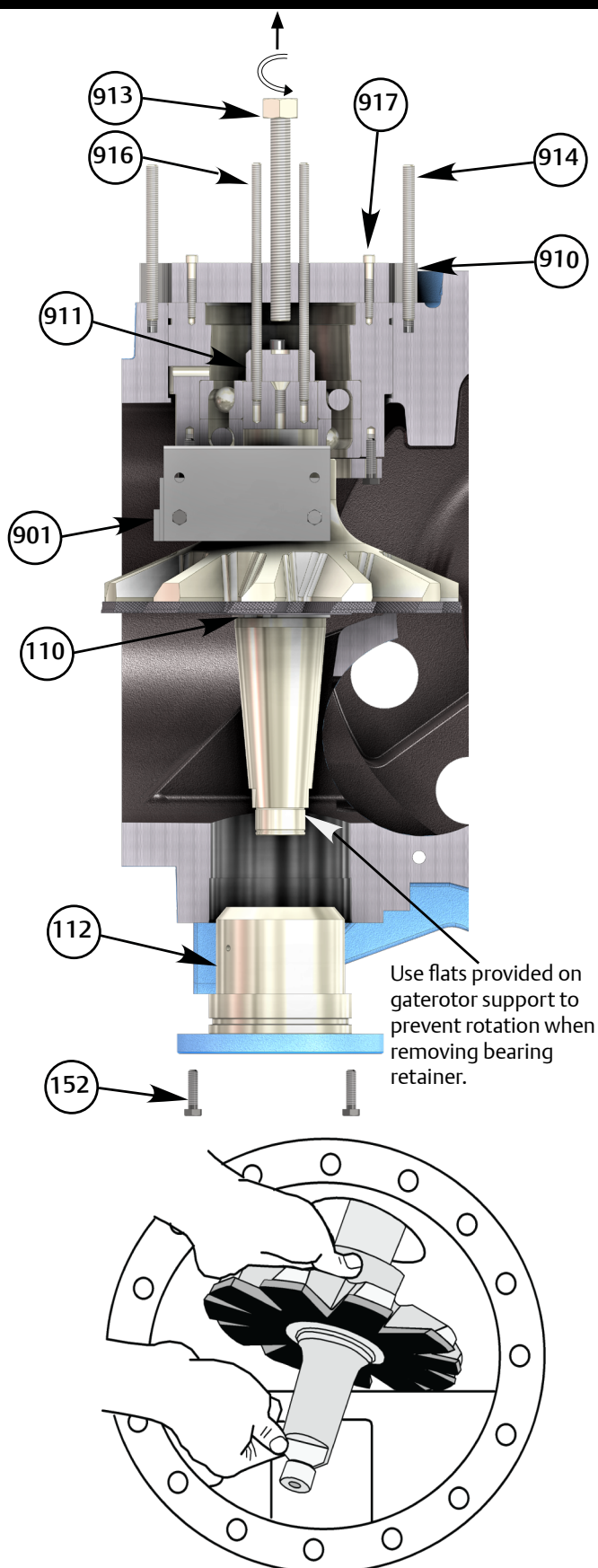


Figure 5-44. Gaterotor Assembly Removal

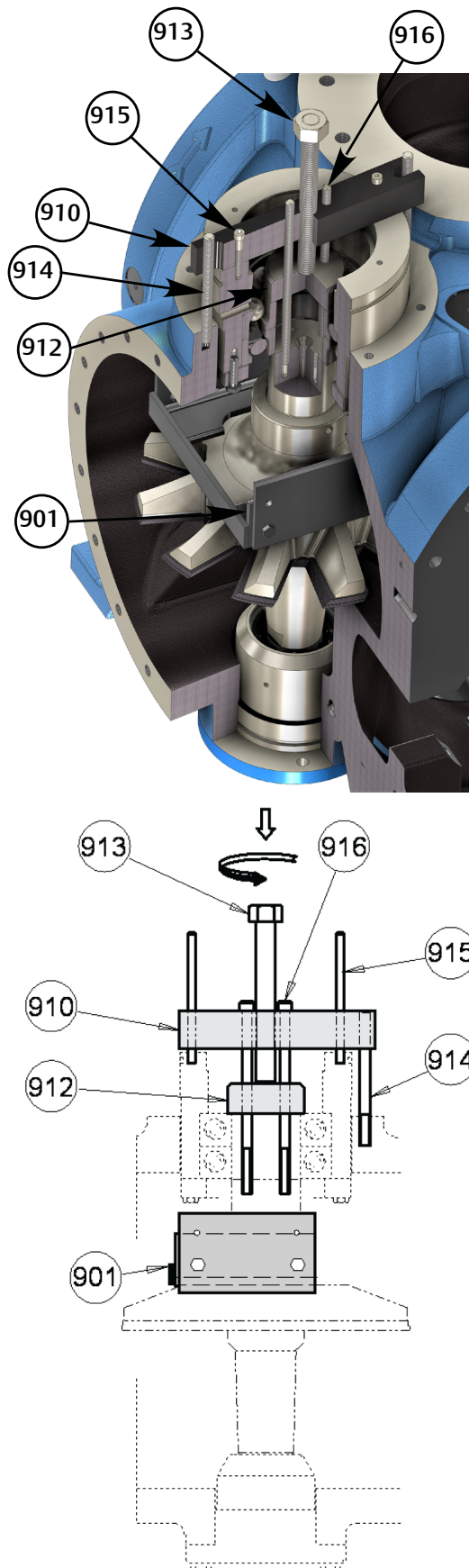


Figure 5-45. Gaterotor Assembly and Tools

(0.076-0.102 mm). Make adjustments, if necessary. It is preferable to shim the gaterotor blade looser rather than tighter against the shelf, see Figure 5-46.

24. After clearance has been set install a new O-ring (143) on bearing housing cover, install cover and tighten the bolts to the recommended torque value.
25. Install side cover with a new gasket. Tighten the bolts to the recommended torque value. The unit can then be evacuated and leak checked.

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

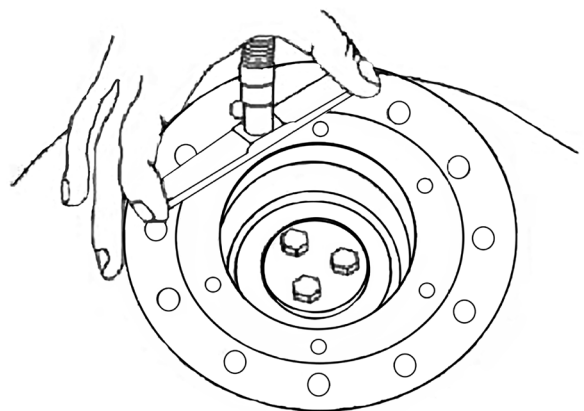
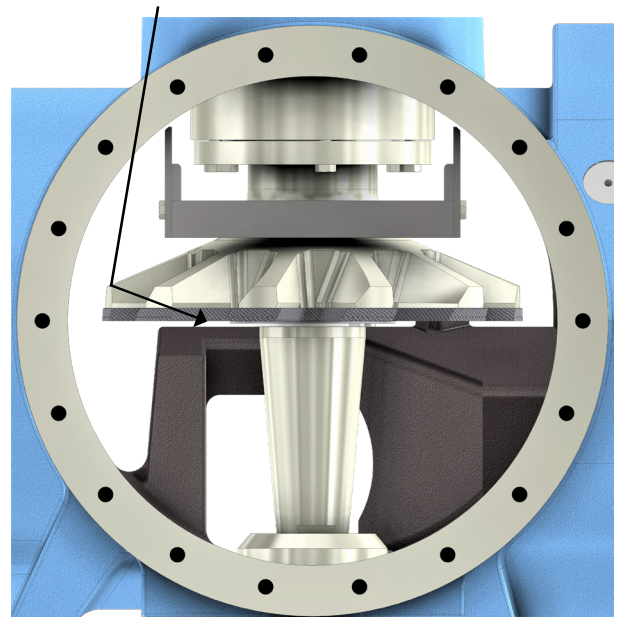


Figure 5-46. Gaterotor and Shelf Clearance

Gaterotor Assembly Replacement (VSM 301-701 Compressors ONLY)

Removal

The removal of the gaterotor assembly for the VSM 301-701 compressors is similar for the VSS 751-3001 compressors except that the inner races are secured to the stationary bearing spindle.

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

Installation

10. Install the gaterotor support. Carefully tilt the roller bearing end of the gaterotor support towards the suction end of the compressor. The compressor input shaft may have to be rotated to facilitate the installation of the gaterotor support.
11. Install the roller bearing housing with a new O-ring. Tighten the bolts to the recommended torque value.
12. Install the spindle with shims and O-ring, tighten bolts, see Table A-1 or Table A-2 in Appendix A. Measure the clearance between the shelf and blade.

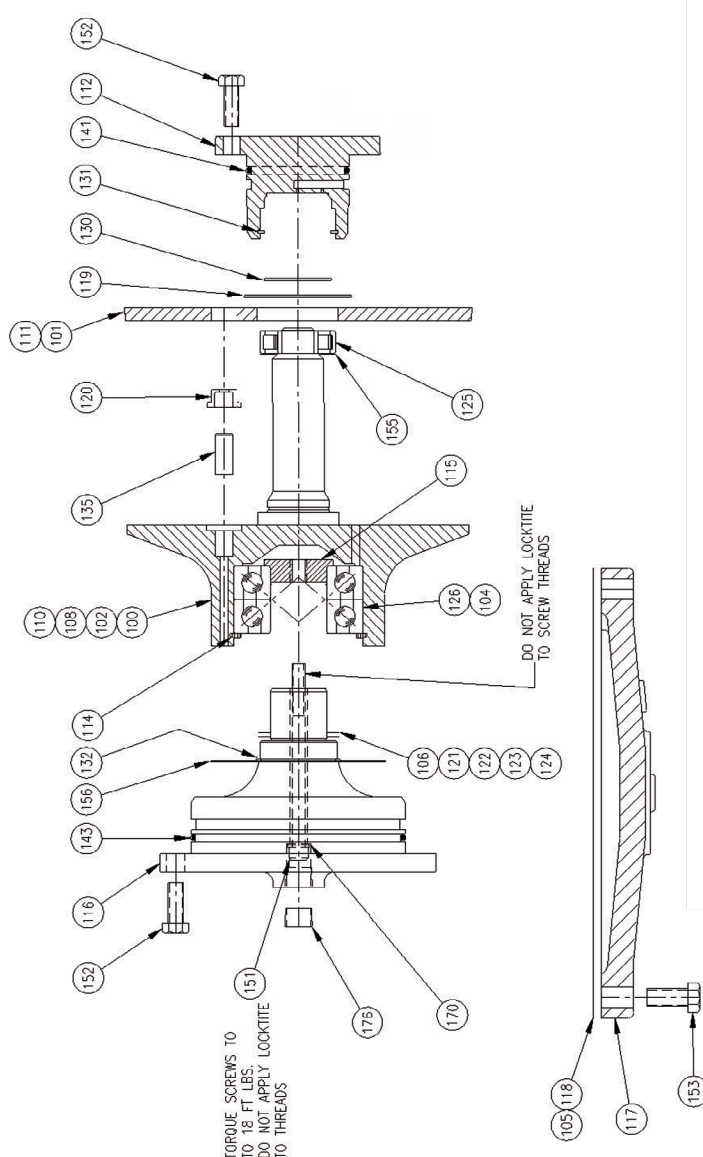


Figure 5-47. Gaterotor Assembly Breakdown

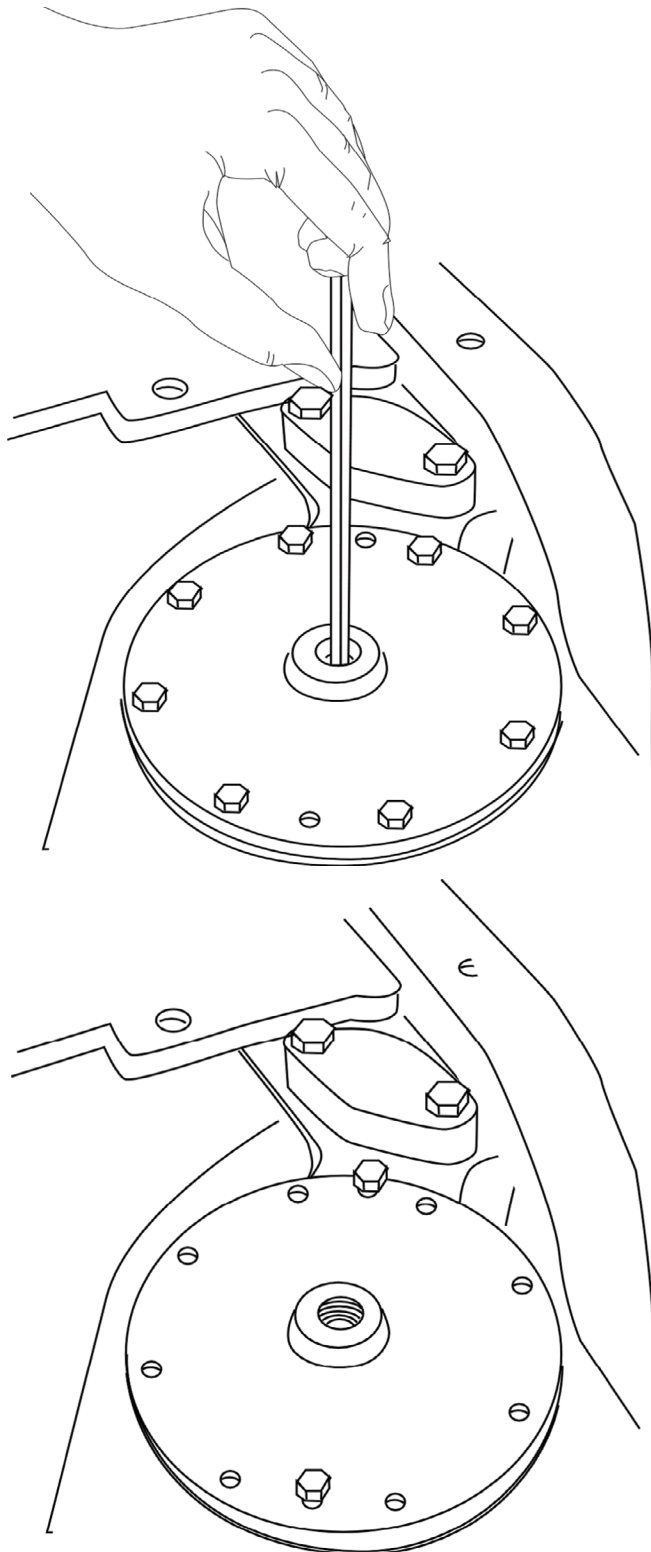
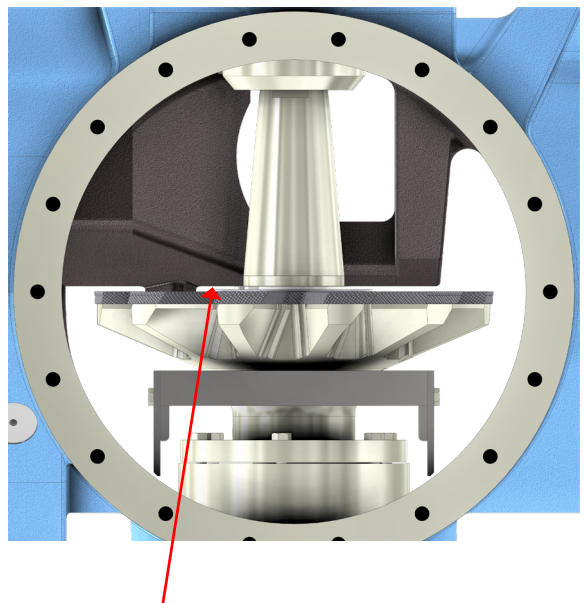


Figure 5-48. Gaterotor Thrust Bearing

13. 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" (0.076-0.102 mm). Make adjustments, if necessary. It is preferable to shim the gaterotor blade looser rather than tighter against the shelf.
14. Once the clearance is set remove the spindle. Install new O-ring, apply Loctite 242 thread locker to the socket head cap screw clamping the thrust bearings to the spindle. Torque all bolts, see Table A-1 or Table A-2 in Appendix A.
15. Install side covers with new gaskets. Tighten bolts, see Table A-1 or Table A-2 in Appendix A. The unit can now be evacuated and leak checked.



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

Figure 5-49. Gaterotor and Shelf Clearance

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.

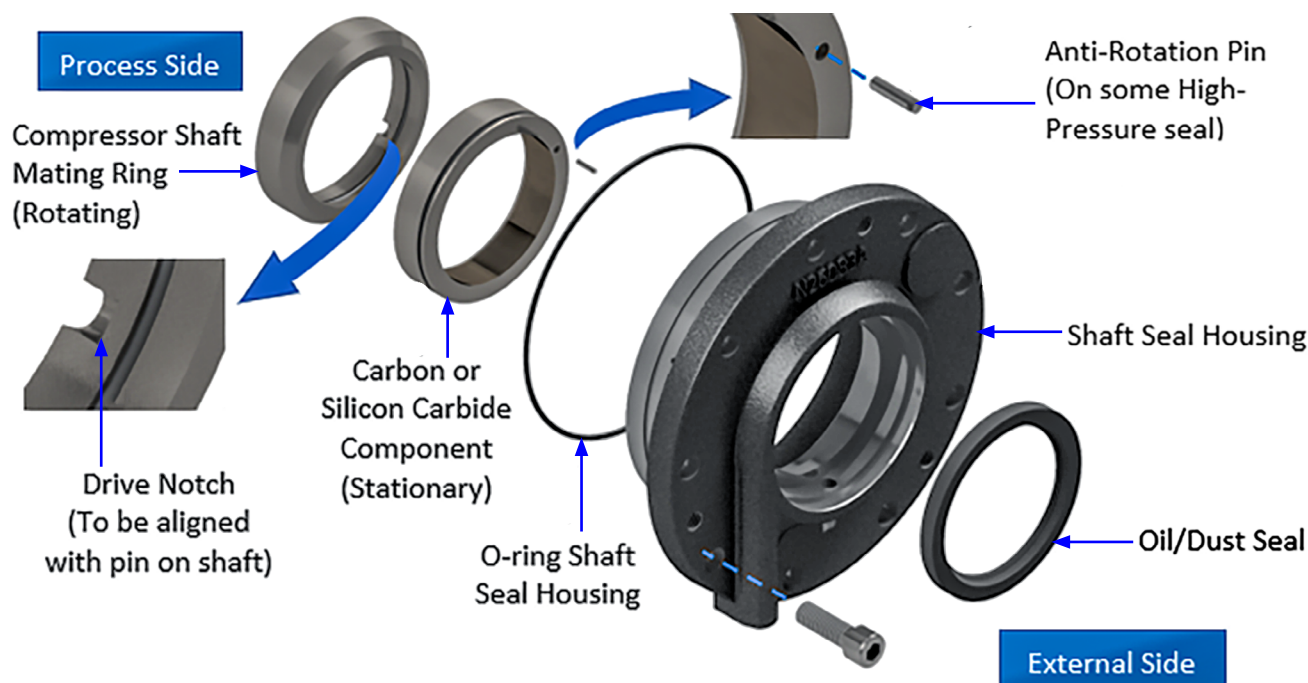


Figure 5-50. Shaft Seal Assembly

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 – For VSS/VSM Units

Tools

Table 5-14. Shaft Seal Tool Kits

Model	(VPN) for the Shaft Seal Tool Kits
VSM 152 - VSM 401	25455A
VSM 501 - 701	25455B
VSS 291 - 601	25455B
VSS 751 - 1301	25455C
VSS 1551 - 2101	25455D

Removal

1. Remove bolts (281) securing shaft seal housing (218) to compressor.

NOTE

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

2. Insert two of bolts (281) into threaded jacking holes to assist in removing shaft seal housing (218).
3. Remove mating ring (219C) from compressor shaft.
4. Remove oil seal (230) from shaft seal housing (218).
5. Using a brass drift and hammer, tap out cup assembly (219B) from the back side of shaft seal housing (218).
6. Remove O-ring (260).

Installation

CAUTION

Care must be taken when handling the cup assembly and mating ring when installing. See Figure 5-50 for handling seal faces with care. Do not touch the carbon component of the cup assembly or mirror face on the mating ring as body oil and sweat will cause corrosion.

NOTE

On VSS 291 - 601 compressors equipped with an Anti-rotation pin in the shaft seal housing, when replacing the cup assembly (219B) the Anti-rotation pin in the housing must be removed. See Figure 5-53.

Suggestion

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

7. Install a new oil seal (230) in seal housing (218).
8. To install the carbon cartridge part of the seal in the seal housing: clean inside shaft seal housing (218) where cup assembly (219B) meets inside shaft seal housing.
9. If applicable, remove protective plastic from cup assembly (219B). **DO NOT** wipe or touch carbon component of cup assembly.
10. If carbon component of cup assembly (219B) needs cleaning, use alcohol and a lint-free cloth to clean.
11. Apply clean compressor lubricating oil to O-ring on cup assembly (219B).
12. Using shaft seal tool or similar, install cup assembly (219B) in shaft seal housing (218). If applicable, align the hole on the back of the carbon cartridge with the Anti-rotation pin in the seal housing. See Figure 5-53.
13. Clean compressor shaft and shaft seal cavity in compressor housing.
14. Apply clean compressor lubricating oil to mating ring (219C) seating area on compressor shaft. See Figure 5-53.
15. Apply clean compressor lubricating oil to inside area of mating ring (219C).

IMPORTANT

DO NOT wipe or touch the face of the mating ring (219C) where face meets the carbon component of the cup assembly (219B).

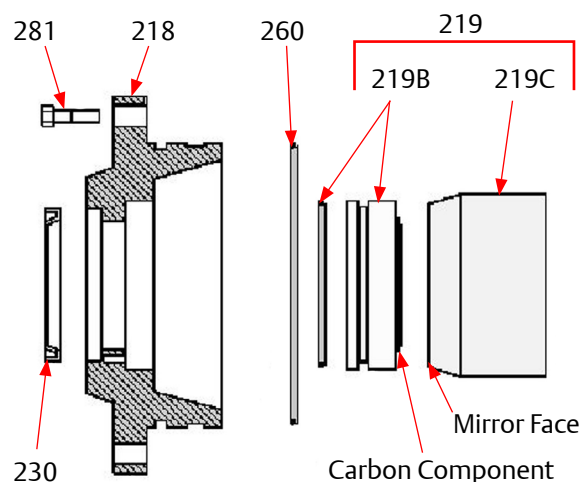


Figure 5-52. Compressor Shaft Seal Assembly

CAUTION

Ensure the mating ring (219C) is fully seated against the shoulder of the compressor shaft. If the mating ring is not fully seated against the shoulder, the carbon component of the cup assembly (219B) will be damaged when the shaft seal housing (218) is installed. See Figure 5-53.

16. Align slot in mating ring (219C) with drive pin on compressor shaft. Carefully push mating ring on while holding onto outside area of mating ring until mating ring is fully seated against shoulder on compressor shaft. See Figure 5-53.

17. 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. See Figure 5-53.
18. Lubricate both seal faces with clean compressor lubricating oil.
19. Carefully install the seal housing (218) on the compressor shaft, evenly tightening the bolts (281) to the recommended torque values (36 ft-lbs).
20. Install the coupling and coupling guard. The unit can then be evacuated and leak checked.

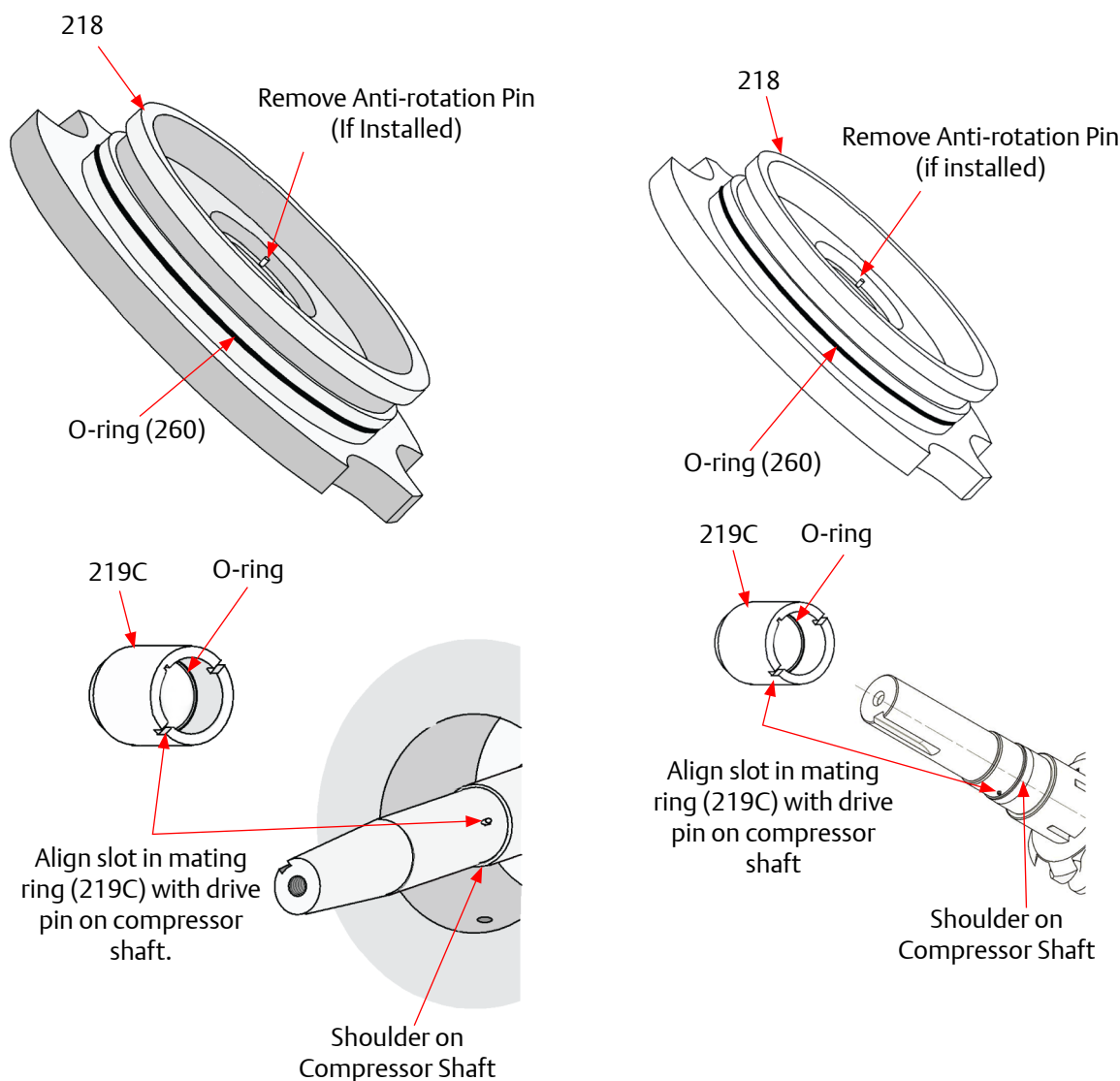


Figure 5-53. Compressor Shaft Seal Installation: Tapered and Straight Shafts

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Shaft Seal Removal – For Part# 25985Y and 25985YA

(See Table 5-15 and Figure 5-54)

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

VSS/VSM compressors are designed using some of the following shaft seals, see Table 5-15 for their VPN and pressure ranges.

Table 5-15. Some of the Shaft Seals

Shaft Seal	Pressure (PSI)		O-ring Material
	Static	Dynamic	
25985Y	1800	1350	Fluoroelastomer
25985YA	1800	1350	EPDM
25985W	1800	1350	Fluoroelastomer
25985WA	1800	1350	EPDM
25985T	1200	600	Viton
25985R	1200	600	Aflas
25043G	600	300	Neoprene

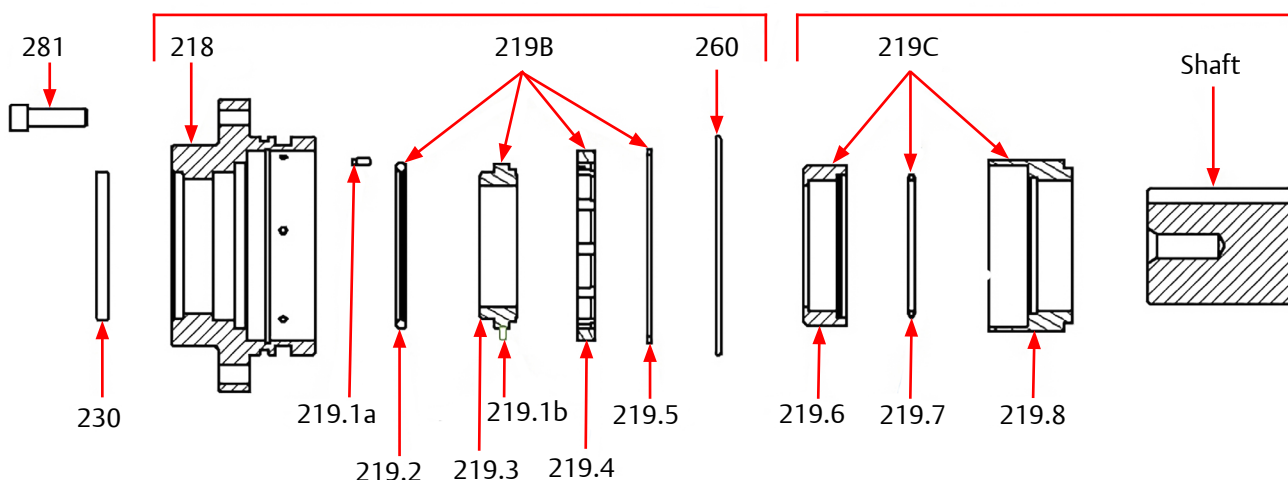


Figure 5-54. Shaft Seal Breakdown (25985Y and 25985YA)

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Shaft Seal Removal – For Part# 25985W and 25985WA

(See Table 5-15 and Figure 5-55)

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. Prepare compressor for disassembly (standard nomenclature from other area of manual).
2. Loosen and remove screws (281) mounting shaft seal housing (218) to main compressor housing.
3. Carefully thread three screws (281) into the jacking holes in the shaft seal housing (218) to push it out of the main compressor housing. Do not go more than one-half turn on any screw at a time.
4. Once the shaft seal housing (218) has been removed from the compressor housing, loosen the 4 small socket cap screws (303) holding the shaft seal retainer (304) to the shaft seal housing (218).
5. Using a hammer and punch, carefully tap the seal cartridge (305) out of the shaft seal housing (218).
6. Remove oil seal (230) from shaft seal housing (218).
7. Remove the O-ring (260) from the shaft seal housing (218).
8. The rotating assembly (219C) can be firmly pulled off the compressor shaft as one assembly. Be sure to note the location of the drive pin in the main compressor shaft for re-assembly. See Figure 5-53.

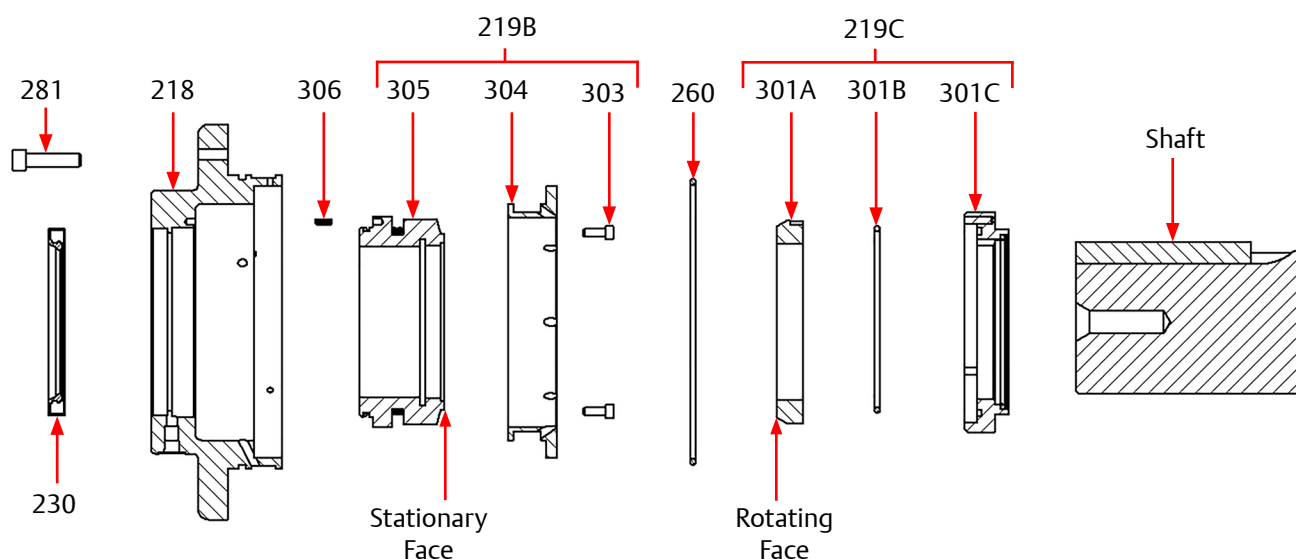


Figure 5-55. Shaft Seal Breakdown (25985W and 25985WA Only)

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Shaft Seal Removal – For Part# 25985T, 25985R and 25043G

(See Table 5-15 and Figure 5-56)

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 mating ring (219C) from compressor shaft.
4. Remove oil seal (230) from shaft seal housing (218).
5. Using a brass drift and hammer, tap out the stationary assembly (219B) from the back side of shaft seal housing (218).
6. Remove O-rings (260).

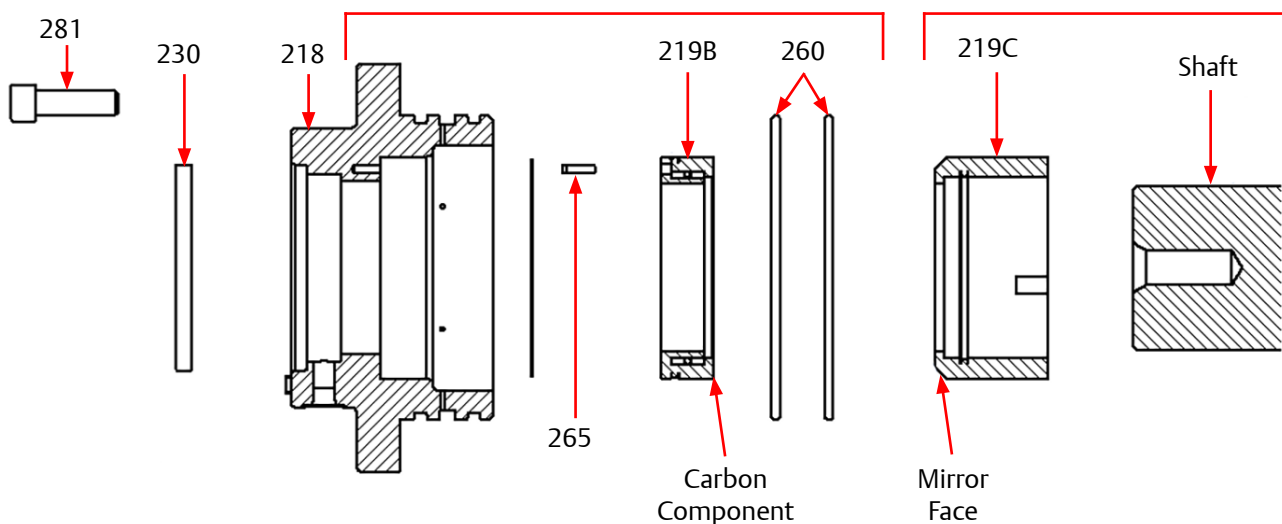


Figure 5-56. Shaft Seal Breakdown (25985T, 25985R and 25043G)

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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 5-57.
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 5-58.
3. For shaft seals 25985R and 25985T, shim 24022A needs to be assembled in shaft seal housing before shaft seal. To assemble the shim, align the slot on it with the anti-rotation pin during installation. Visually verify that the back of the shim is abutted against the shaft seal housing, see Figure 5-58.
4. Clean compressor shaft and shaft seal cavity in compressor housing.
5. Apply clean compressor lubricating oil to the compressor shaft in mating ring seating area, see Figure 5-59.

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.

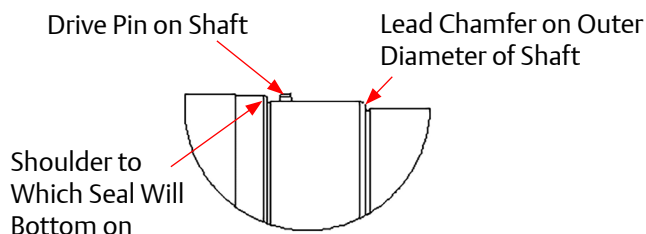


Figure 5-57. Shaft with Pin

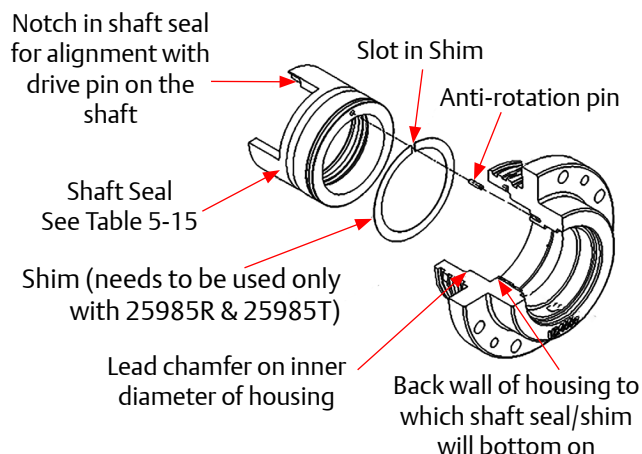


Figure 5-58. Shaft Seal Housing

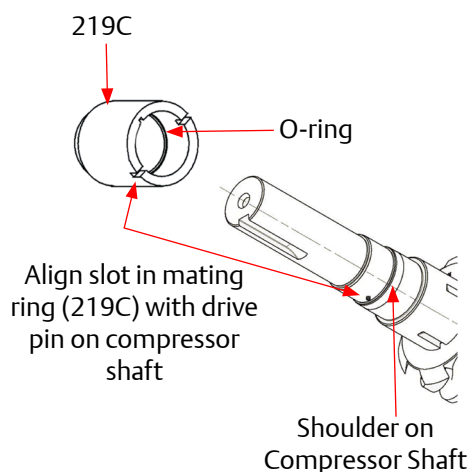


Figure 5-59. The Alignment of Compressor Shaft and Mating Ring

Section 5 • Maintenance/Service

Shaft Seal Installation - For Part# 25985Y and 25985YA

(See Table 5-15 and Figure 5-54)

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 5-59.

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.

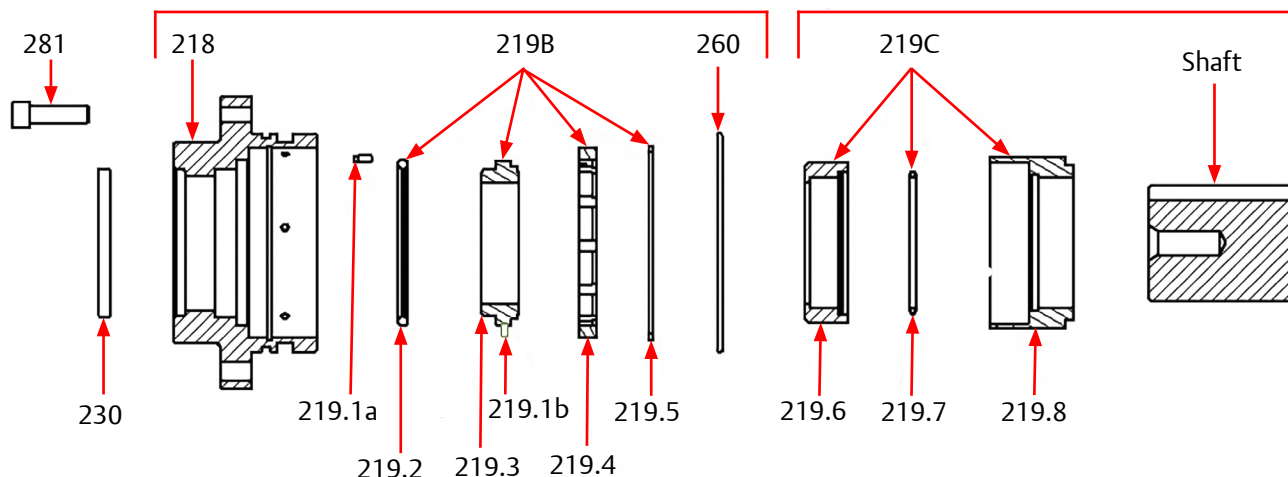


Figure 5-54. Shaft Seal Breakdown (25985Y and 25985YA)

Section 5 • Maintenance/Service

Shaft Seal Installation – For Part# 25985W and 25985WA

(See Table 5-15 and Figure 5-55)

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. Install a new oil seal (230) in seal housing (218).
2. Ensure compressor shaft is clean and free from marks and scratches.
3. Remove seal rotating face (301A) and O-ring (301B) from rotating assembly portion of the seal (assembly 219C).

4. Apply clean compressor lubricating oil to seal seating area on the compressor shaft and inside area of rotating face support (301C).
5. Gently assemble the rotating face support (301C) onto main compressor shaft, taking care to align the drive pin in the main shaft with the keyway on the rotating face support (301C).
6. Using a small amount of Flowserve supplied grease, carefully re-assemble O-ring (301B) and rotating face (301A) over the compressor shaft, onto the rotating face support (301C).
7. Moving onto the stationary portion of the seal (219B), gently press the stationary face (305), into the seal housing (218) ensuring it is fully seated. Make sure to align the hole on the back of the stationary face (305) with the Anti-rotation pin (306) in the seal housing (218). See Figure 5-58.
8. Assemble retaining ring (304) over the seal into the shaft seal housing (218), aligning the mounting holes with the threaded holes in the shaft seal housing.
9. Apply blue Loctite 242 to the bolts (303) and tighten them down evenly in a star pattern until snug, then torquing each to 48 in-lbs (6 N-m).
10. Apply clean compressor lubricating oil to both seal faces (305 and 219C).
11. Ensure a new O-ring (260) is installed in proper groove of shaft seal housing (218).
12. Carefully assemble shaft seal housing (218) onto main compressor shaft into main compressor housing, evenly tightening the bolts (281) and torquing to their appropriate value as specified by compressor specific drawing.
13. Install the coupling and coupling guard. The unit can then be evacuated and leak checked.

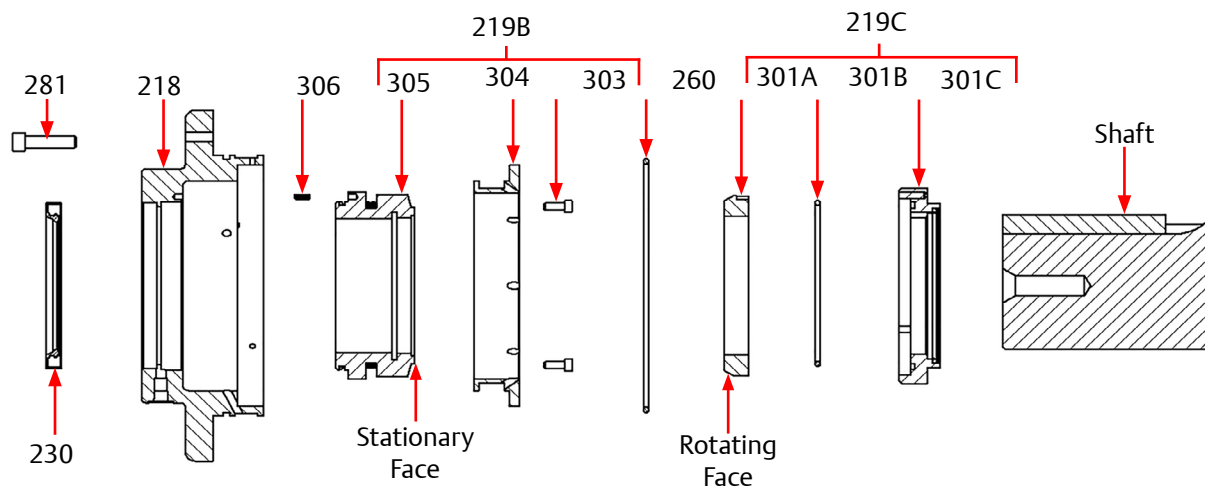


Figure 5-55. Shaft Seal Breakdown (25985W and 25985WA Only)

Shaft Seal Installation – For Part# 25985T, 25985R and 25043G

(See Table 5-15 and Figure 5-56)

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 mating ring (219).
2. Align slot in mating ring (219) with drive pin on compressor shaft. Carefully push mating ring on while holding onto its outside area until it is fully seated against shoulder on compressor shaft. See Figure 5-59.

CAUTION

Ensure the mating ring (219C) is fully seated against the shoulder of the compressor shaft. If the mating ring is not fully seated against the shoulder, the carbon component of the cup assembly (219B) will be damaged when the shaft seal housing (218) is installed. See Figure 5-53.

3. Install new oil seal (230) in housing.
4. To install the carbon cartridge part of the seal in the seal housing: clean inside shaft seal housing (218) where stationary assembly (219B) seats.
5. If applicable, remove protective plastic from stationary assembly (219B). Do not wipe or touch carbon component of stationary assembly.
6. If carbon component of stationary assembly (219B) needs cleaning, use alcohol and a lint-free cloth to clean.
7. Apply clean compressor lubricating oil to O-ring on stationary assembly (219B).
8. If applicable, align the hole on the back of the carbon component with the dowel pin (265) in the seal housing. Using a shaft seal tool or similar, install stationary assembly (219B) in shaft seal housing (218).
9. Install new O-rings (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.
10. Carefully install the seal housing (218) on the compressor shaft, evenly tightening the bolts (281) to the recommended torque values (36 ft-lbs.).
11. Install the coupling and coupling guard. The unit can then be evacuated and leak checked.

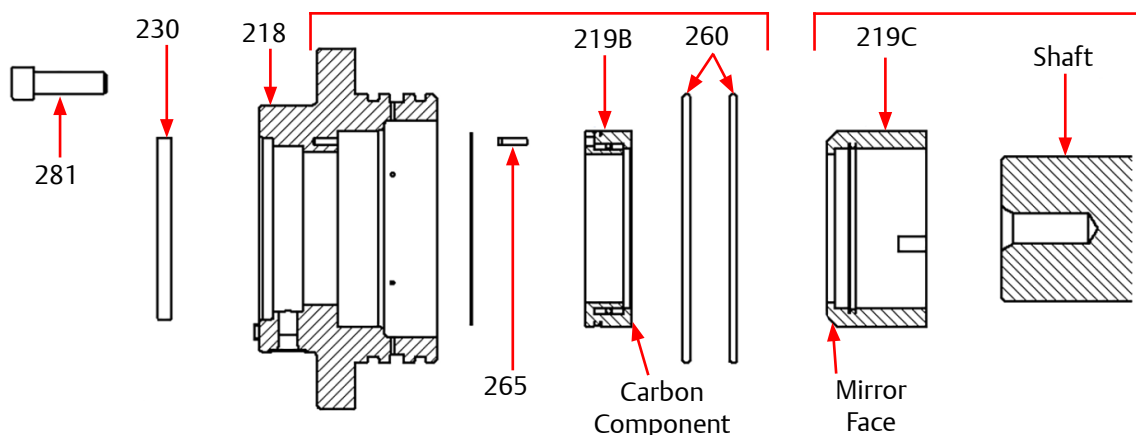


Figure 5-56. Shaft Seal Breakdown (25985T, 25985R and 25043G)

Slide Valve Actuator Assembly Re- placement

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

Removal

WARNING

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

WARNING

Follow local 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

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

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

NOTE

Note orientation of components to aid in installation.

5. First remove E-clips, then remove Locking Retainers, next loosen and remove Grooved Bolts and Washes that securing actuator assembly to actuator mount. See Figure 5-60 for parts details.
6. Remove actuator assembly from actuator mount.

Installation

CAUTION

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

7. Position actuator assembly on mount as noted in removal.
8. Install washers and grooved bolts to secure actuator assembly to actuator mount, torque them to 6 lb-ft. Then install locking retainers. Last push E-clips into grooved bolt heads. Refer to Actuator Installation Using Anti-Rotation Bolts (see next page) for details.
9. Tighten screws, see Table A-1 or Table A-2 in Appendix A.

CAUTION

If installing new actuator, do not connect connectors of power cable or position transmitter cable to new actuator once installed. Connecting connectors to new actuator will occur during calibration procedure. Failure to comply may result in damage to equipment.

10. Leave connectors disconnected to actuator assembly.
11. Calibrate actuator assembly, see Slide Valve Calibration procedure in Section 4 or Appendix F.

Section 5 • Maintenance/Service

Actuator Installation Using Anti-Rotation Bolts

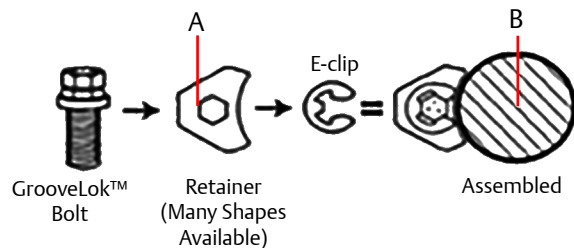
Tools Needed: A 7/16" open wrench or torque wrench with 7/16" crowfoot wrench adapter.

Part #: The parts come with the actuator. Retrofit kit # is 25972R (Includes 4 sets of bolts, washers, retainers & E-clips).

1. Install the Grooved Bolt and Washer and torque them to 6 lb-ft. See Figure 5-60 (a).

NOTE

It may be necessary to adjust the bolt position so that one of the bolt edges is parallel to line A and B, then the retainer will drop-on easily. If required, tighten bolt further for this alignment.



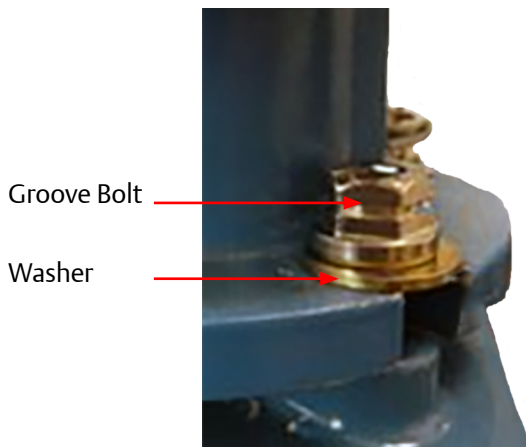
2. Position Locking Retainer over Grooved Bolt, with the shallow curved edge toward the center of the command shaft housing. See Figure 5-60 (b).

NOTE

The locking retainer hex hole is offset 3° so flipping it over gives it new positioning.



3. Push E-Clip into Grooved Bolt Head. Once E-clip is on make sure it rotates back and forth freely. This will ensure E-Clip is completely seated. See Figure 5-60 (c).



(a) Groove bolt and washer



(b) Locking Retainer



(c) E-clip

Figure 5-60. Actuator Installation Using Anti-Rotation Bolts

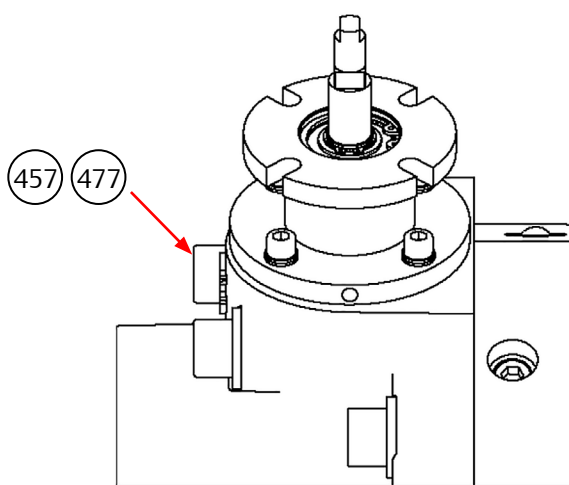
Slide Valve Command Shaft Assembly Replacement

Removal

NOTE

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

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



Installation

5. Install a new O-ring (446) into the groove on the compressor discharge manifold. You may use clean compressor lubricating oil on the O-ring.
6. Install the command shaft onto the compressor discharge manifold. Ensure that the command shaft tongue is engaged in the cross-shaft slot inside the compressor discharge manifold. Rotate the command shaft assembly so that the vent holes point downward. This will prevent water and dust from entering the vent.
7. Secure the command shaft assembly to the discharge manifold using the four socket head cap screws and Nord-Lock washers and apply the proper torque.
8. Perform leak check, see Compressor Unit Leak Check Procedure.

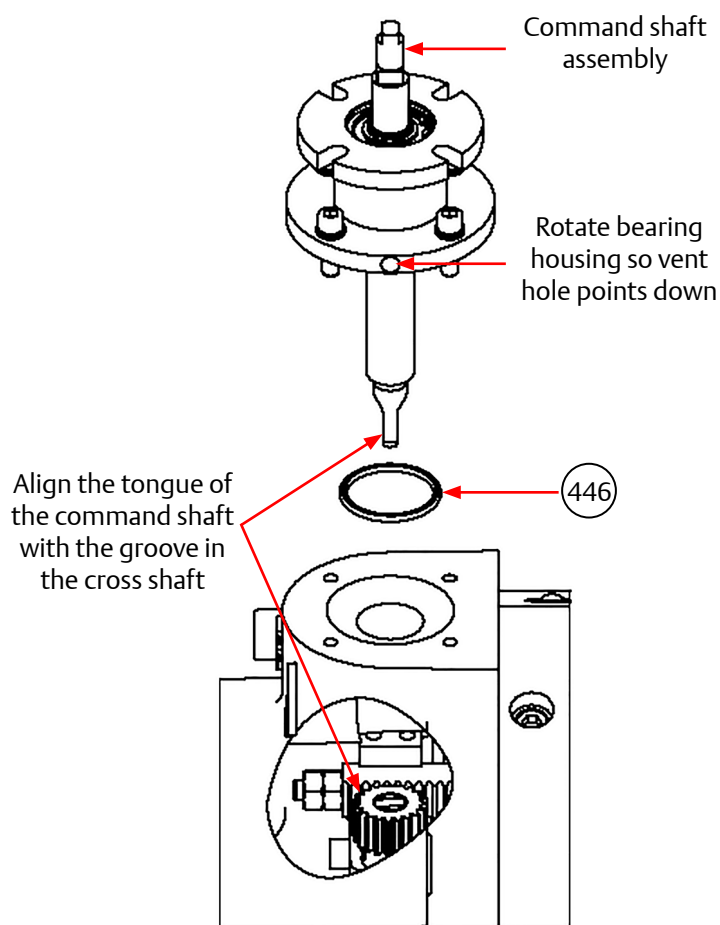


Figure 5-61. Command Shaft Assembly Replacement

Liquid Injection Control Valve Station (Danfoss ICF 20-25 Valve Station)

For liquid injection control operation, refer to Section 2. For additional information regarding setup, installation, programming and troubleshooting, refer to Appendices.

The liquid injection control valve station (ICF) consists of these parts (Danfoss part acronyms are shown in parentheses):

- Shut-off Valves (ICFS), Inlet and Outlet
- Solenoid Valve (ICFE) with Manual Stem (ICFO)
- Motorized Valve Assembly (ICM valve assembly with ICAD motor actuator)
- Strainer (ICFF) with Drain Valve

For parts and service kits, refer to Tables 5-16 and 5-17.

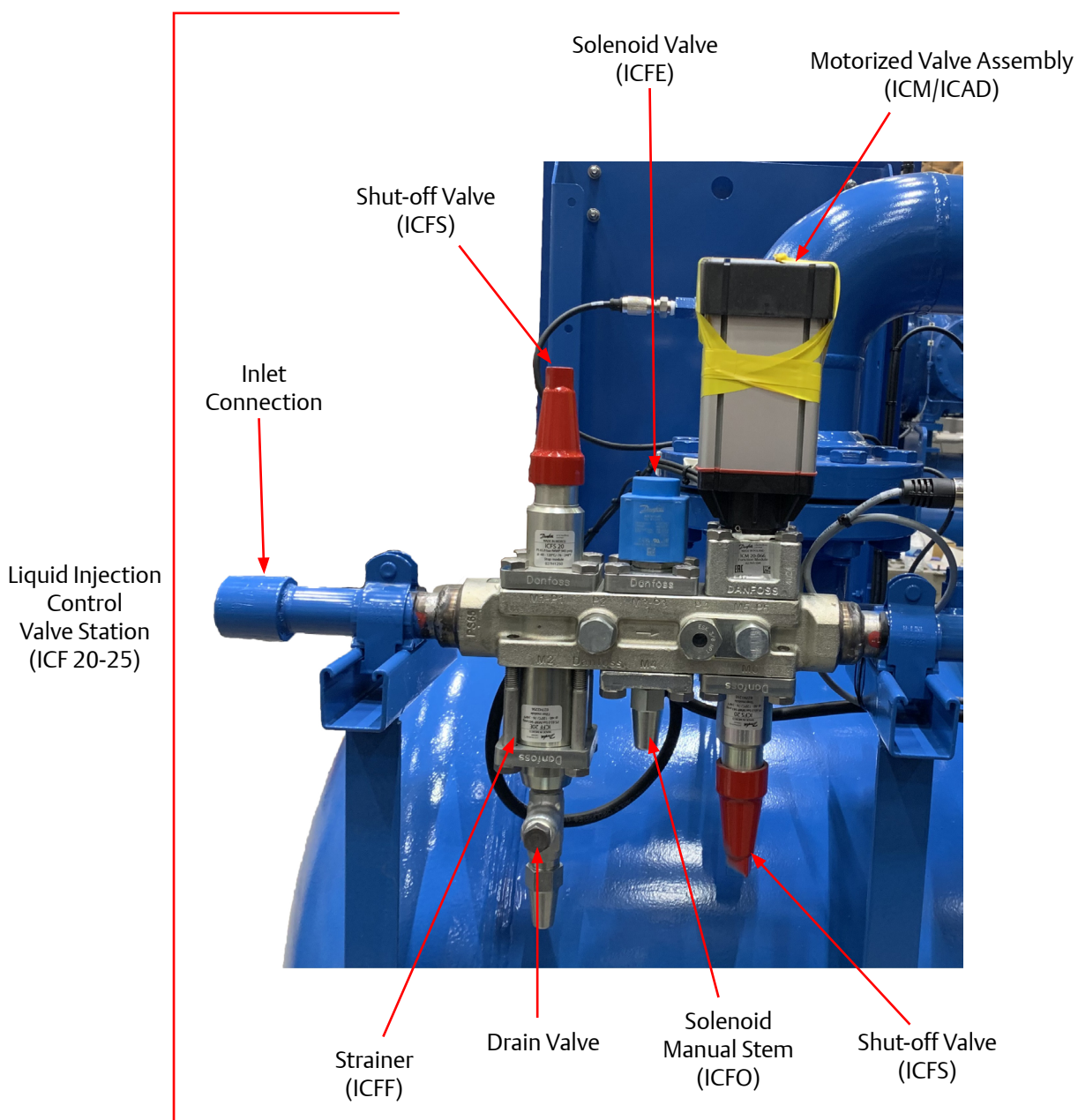


Figure 5-62. Danfoss ICF 20-25 Valve Station (Liquid Injection Control)

Table 5-16. Coils for Solenoid Valves (ICFE)

VILTER™ PART NO	VOLTAGE	Hz	HOLDING	CONNECTION	PILOT LIGHT
3389DA	110-120VAC	60	14W	DIN	
3389DB	110-120VAC	60	14W	DIN	GREEN
3389DC	110VAC	60	12W	TERMINAL BOX	GREEN
3389DD	220VAC	60	12W	TERMINAL BOX	GREEN
3389DD1	220VAC W/110VAC LED BOX	60	12W	-	LED

Table 5-17. Parts for Motorized Valve Station (ICF)

VILTER™ PART NO	DESCRIPTION
3389EA	ICAD 600 MOTOR ACTUATOR W/10M CABLES
3389EE	ICAD 900 MOTOR ACTUATOR W/10M CABLES
3389AE1	CABLES, 10M FOR ICAD ACTUATOR
3389AE2	TOP COVER FOR ICAD ACTUATOR
3389EB	CONTROLLER EKC 347, LIQUID LEVEL
3389FD	MODULE B66 FUNCTION (FOR ICF VALVE STATION)
3389FA	MAGNETIC TOOL FOR ICM VALVE MANUAL OPERATION 20,25, AND 32
3389FC	MAGNETIC TOOL FOR ICM VALVE MANUAL OPERATION 40, 50, AND 65
3389FB	ICM 20 SERVICE KIT (VALVE SEAT)
3389FE	ICM 25 SERVICE KIT (VALVE SEAT)
3389FF	ICM 32 SERVICE KIT (VALVE SEAT)

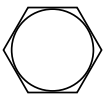

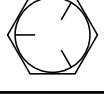
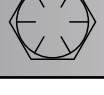
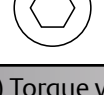
Main Rotor Assembly

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 5-18. 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 5 COARSE (UNC)			8	16	28	44	68	98	135	240	387
SAE GRADE 5 FINE (UNF)				16							
SAE GRADE 8 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 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 5-19. 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.

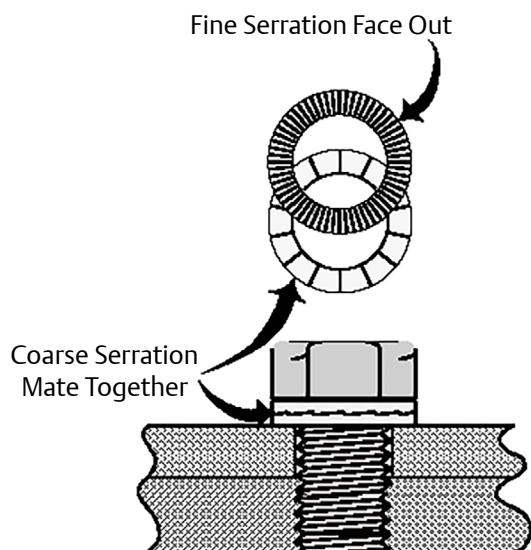
Using A Torque Wrench Correctly



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 than 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 than it did to tighten it. This is caused by the washers riding up the opposing ramps.

Slide Valve Actuator Troubleshooting Guide

Table 6-1. Slide Valve Actuator Troubleshooting Guide (1 of 3)

Problem	Reason	Solution
The actuator cannot be calibrated.	Dirt or debris is blocking one or both optocoupler slots.	Clean the optocoupler slots with a cotton swab and rubbing alcohol.
	The photo-chopper fence extends less than about half way into the optocoupler slots.	Adjust the photo-chopper so that the fence extends further into the optocoupler slots. Make sure the motor brake operates freely and the photo-chopper will not contact the optocouplers when the shaft is pressed down.
	The white calibrate wire in the grey Turck cable is grounded.	Tape the end of the white wire in the panel and make sure that it cannot touch metal.
	Dirt and/or condensation on the position sensor boards are causing it to malfunction.	Clean the boards with an electronics cleaner or compressed air.
	The calibrate button is stuck down.	Try to free the stuck button.
	The position sensor has failed.	Replace the actuator.
	Push button is being held down for more that $\frac{3}{4}$ second when going through the calibration procedure.	Depress the button quickly and then let go. Each $\frac{3}{4}$ second the button is held down counts as another press.
The actuator goes into calibration mode spontaneously.	The white calibrate wire in the grey Turck cable is grounding intermittently.	Tape the end of the white wire in the panel and make sure that it cannot touch metal.
	A very strong source of electromagnetic interference (EMI), such as a contactor, is in the vicinity of the actuator or grey cable.	Increase the distance between the EMI source and the actuator. Install additional metal shielding material between the EMI source and the actuator or cable.
	There is an intermittent failure of the position sensor	Replace the actuator.

Table 6-1. Slide Valve Actuator Troubleshooting Guide (2 of 3)

Problem	Reason	Solution
The actuator goes into calibration mode every time power is restored after a power loss	The motor brake is not working properly.	Get the motor brake to where it operates freely and recalibrate.
	The position sensor's EEPROM memory has failed	Replace the actuator.
The actuator does not transmit the correct position after a power loss.	The motor was manually moved while the position sensor was not powered.	Recalibrate.
	The motor brake is not working properly.	Get the motor brake to where it operates freely and recalibrate.
	The position sensor's EEPROM memory has failed	Replace the actuator.
There is a rapid clicking noise when the motor is operating.	The photo-chopper is misaligned with the slotted optocouplers.	Try to realign or replace the actuator.
	The photo-chopper is positioned too low on the motor shaft.	Adjust the photo-chopper so that the fence extends further into the optocoupler slots.
	A motor bearing has failed	Replace the actuator.
The motor operates in one direction only	There is a loose connection in the screw terminal blocks.	Tighten
	There is a loose or dirty connection in the yellow Turck cable.	Clean and tighten
	The position sensor has failed.	Replace the actuator.
	There is a broken motor lead or winding	Replace the actuator.

Table 6-1. Slide Valve Actuator Troubleshooting Guide (3 of 3)

Problem	Reason	Solution
The motor will not move in either direction	The thermal switch has tripped because the motor is overheated	The motor will resume operation when it cools. This could be caused by a malfunctioning control panel. Consult the factory.
	Any of the reasons listed in “The motor operates in one direction only”	See above.
	The command shaft is jammed.	Free the command shaft.
	Broken gears in the gear-motor.	Replace the actuator.
	Blown relays or fuses.	Check and replace blown relays and/or fuse
The motor operates intermittently, several minutes on, several minutes off.	Motor is overheating and the thermal switch is tripping.	This could be caused by a malfunctioning control panel. Consult the factory.
The motor runs sporadically	Bad thermal switch.	Replace the actuator.
	Any of the reasons listed in “The motor operates in one direction only”	See above.
The motor runs but output shaft will not turn.	Stripped gears inside the gear rotor, or the armature has come unpressed from the armature shaft.	Replace the actuator.

Section 6 • Troubleshooting

Slide Valve Actuator LED Blink Codes

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

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

Flash Pattern * = ON - = OFF	Meaning
* _ * _ * _ * _ * _ * _ * _	Calibration step 1.
* _ _ * _ _ * _ _ * _ _	Calibration step 2.
* _ * _ _ _ _ _ _ _ _ _ _ _	<p>This indicates a zero span. This error can only occur during calibration. The typical cause is forgetting to move the actuator when setting the upper limit of the span. If this is the case, press the blue button to restart the calibration procedure. This error can also occur if either or both of the slotted optocouplers are not working. If this is the case, the slide valve actuator will have to be replaced.</p> <p>The operation of the slotted optocouplers can be tested as follows:</p> <ol style="list-style-type: none"> 1. Manually rotate the motor shaft until the aluminum photo-chopper fence is not blocking either of the optocoupler slots. 2. Using a digital multimeter, measure the DC voltage between terminal 3 of the small terminal block and TP1 on the circuit board.⁽¹⁾ 3. The measurement should be between 0.1 and 0.2 Volts. 4. Next, measure the DC voltage between terminal 3 and TP2 on the circuit board. You should measure between 0.1 and 0.2 Volts.
* _ _ _ _ _ _ _ _ _ _ _ _ _	<p>This error means that the slide valve actuator is no longer transmitting accurate position information. The actuator should be recalibrated as soon as possible, after the cause of the over-speed is identified and corrected. This error will not clear until the actuator is re-calibrated.</p> <p>This code can be caused by:</p> <ol style="list-style-type: none"> 1. The motor speed exceeding the position sensors ability to measure it at some time during operation. A non-functioning motor brake is usually to blame. 2. The actuator is being operated where strong infrared light can falsely trigger the slotted optocouplers, such as direct sunlight. Shade the actuator when the cover is off for service and calibration. Do not operate the actuator with the cover off.

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

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

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

Flash Pattern * = ON - = OFF	Meaning
* _ * _ * _ _ _ _ _ _ _ _ _ _	<p>The motor is overheated. The actuator motor will not run until it cools. Once the motor cools, the actuator will resume normal operation.</p> <p>Motor overheating is sometimes a problem in hot humid environments when process conditions demand that the slide valve actuators reposition often. Solutions are available; consult your Vilter™ authorized distributor for details.</p> <p>Another possible cause for this error is a stuck motor thermal switch. The thermal switch can be tested by measuring the DC voltage with a digital multimeter between the two TS1 wire pads.⁽²⁾ If the switch is closed (normal operation) you will measure 0 Volts.</p>
*****	<p>The 24V supply voltage is low. This will occur momentarily when the actuator is powered up and on power down.</p> <p>If the problem persists, measure the voltage using a digital multimeter between terminals 3 and 4 of the small terminal block. If the voltage is less than 24V, the problem is in the supply to the board. If the voltage is \geq 24V, replace the actuator.</p>
_*****	<p>The EEPROM data is bad. This is usually caused by loss of 24V power before the calibration procedure was completed. The actuator will not move while this error code is being displayed. To clear the error, calibrate the actuator. If this error has occurred and the cause was not loss of 24V power during calibration, possible causes are:</p> <ol style="list-style-type: none"> 1. The EEPROM memory in the micro-controller is bad. 2. The large blue capacitor is bad or has a cracked lead.
***** _ _ _ *	Micro-controller program failure. Please notify your Vilter™ authorized distributor.

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

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

Troubleshooting Guide - General Problems and Solutions with Oil Pump

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

Problem	Solution
Low Oil Pressure at Start	<ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • Prelube Oil Pressure is Manifold Pressure minus Discharge Pressure.
Low Run Oil Pressure	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check that the correct pressure or temperature range is selected in the Instrument Calibration menu. • Check cable connections at device, terminal strips, and PLC input card for correct wiring and shielding (RF noise). • Check calibration of RTDs and transducers.

Table 6-3. Troubleshooting Guide - General Problems and Solutions with Oil Pump (2 of 3)

Problem	Solution
Oil Loss Issues	<ul style="list-style-type: none"> 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 (Liquid injection)	<ul style="list-style-type: none"> 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. Verify that the volume slide actuator is functioning correctly and that the correct compressor size (type) is selected. Check that all fans are working. Check for correct fan rotation on the oil cooler. Check that your operating conditions are within the “As Sold” design conditions.
Capacity/Volume Slide Actuator Alarms/Trips/ Symptoms:	<ul style="list-style-type: none"> Calibration method not correct. Actuator or Gear motor not working, or off on overload. Slide valve carriage assembly out of position, slides binding. Cross-shaft gears, broken pins. Command shaft broken. Slide valve rack or rack shaft damaged. Check balance piston movement. Reference Slide Valve Actuator Troubleshooting Guide. Check I/O fusing.

Section 6 • Troubleshooting

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

Problem	Solution
High Amp Draw	<ul style="list-style-type: none">• Check calibration at full load.• Check CT ratio entered in Vission20/20.• Check slide valve calibration, especially volume slide.
Vibration	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• If there is more than normal motor backspin at shutdown, check suction check valve for proper operation.

Section 6 • Troubleshooting

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 6-4. Troubleshooting Guide - General Problems and Solutions for Units WITHOUT Oil Pump (1 of 2)

Problem	Solution
Low Oil Pressure at Start	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Change oil filter, maybe plugged or collapsed.
Faulty pressure or temperature readings	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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.

Section 6 • Troubleshooting

**Table 6-4. Troubleshooting Guide - General Problems and Solutions for Units
WITHOUT Oil Pump (2 of 2)**

Problem	Solution
High oil temperature (liquid injection)	<ul style="list-style-type: none"> • 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. • Verify that the volume slide actuator is functioning correctly and that the correct compressor size (type) is selected. • Check that all fans are working. • Check for correct fan rotation on the oil cooler. • Check that your operating conditions are within the “As Sold” design conditions.
Capacity/Volume Slide Actuator Alarms/Trips/ Symptoms:	<ul style="list-style-type: none"> • Calibration method not correct. • Actuator or Gear motor not working, or off on overload. • Slide valve carriage assembly out of position, slides binding. • Cross-shaft gears, broken pins. • Command shaft broken. • Slide valve rack or rack shaft damaged. • Check balance piston movement. • Reference Slide Valve Actuator Troubleshooting Guide. • Check I/O fusing.
High Amp Draw	<ul style="list-style-type: none"> • Check calibration at full load. • Check CT ratio entered in Vission 20/20. • Check slide valve calibration, especially volume slide.
Vibration	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 product or part for warranty consideration, you will need to provide the original Copeland Industrial LP sales order number on all submitted documents.

For a parts warranty request, you will also need:

- To provide Copeland Industrial LP a detailed and accurate description of the issue.
- To provide Copeland Industrial LP 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 Copeland Industrial LP for warranty consideration.

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

COPELAND INDUSTRIAL LP
5555 South Packard Avenue
Cudahy, WI 53110-8904

STEP 3. Upon receipt of the returned part(s), Copeland Industrial LP will complete a timely evaluation of the part(s).

STEP 4. You will be contacted with Copeland Industrial LP decision once the final report is completed.

STEP 5. If approved, the warranty will be credited (excluding freight) to your account. Copeland Industrial LP 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 from the date of the response. After such time, Copeland Industrial LP reserves the right to dispose of the parts. If you wish to have the part(s) returned within the 30 days, you will need to contact Vilter™ and the part(s) will be returned freight collect.

Procedure For Parts Not Manufactured By Copeland Industrial LP

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

To facilitate your warranty claim for a third party, please follow the following four steps:

STEP 1. Determine if the part or product is within the original equipment manufacturer's warranty.

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

Service.Vilter@Copeland.com

If the part or product is a motor or starter, please complete the following form and return it to:

Service.Vilter@Copeland.com.

STEP 3. Copeland Industrial LP 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.



Motor Warranty Procedure

Step 1: Determine if the part or product is within the original equipment manufacturer's warranty.

Step 2: If the part or product is not a motor, send a description containing the specifications of the part/product and the alleged defect to Service.Vilter@Copeland.com.

If the part or product is a motor or starter, please complete the following form and return it to Service.Vilter@Copeland.com.

Step 3: Copeland Industrial LP 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.

Step 4: For 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. Copeland Industrial LP 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, depending on the OEM's warranty terms.

Model:	_____	Serial Number:	_____	Manufacturer:	_____
Starter Type	Run Hours	_____	Start Date:	_____	
<input type="checkbox"/> Soft Start	Alignment Data Available:	<input type="checkbox"/> Yes, please include	<input type="checkbox"/> No		
<input type="checkbox"/> Cross the Line	Lubrication Records Available:	<input type="checkbox"/> Yes, please include	<input type="checkbox"/> No		
<input type="checkbox"/> VFD	Vibration Report Available:	<input type="checkbox"/> Yes, please include	<input type="checkbox"/> No		
	Grease Type:	_____			
Describe Motor Symptoms:					

Section 7 • Warranty and Parts

STEP 4. For 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. Copeland Industrial LP 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, depending on the OEM's warranty terms.

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 straight.
- Standard slide assembly.
- Viton shaft seal O-rings.
- Crating with Purge & Gauge.
- Does not include hand wheels or slide valve motors.

Section 8 • Spare Parts List

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	
		VSS 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.

**VSS
Recommended
Spare Parts List**

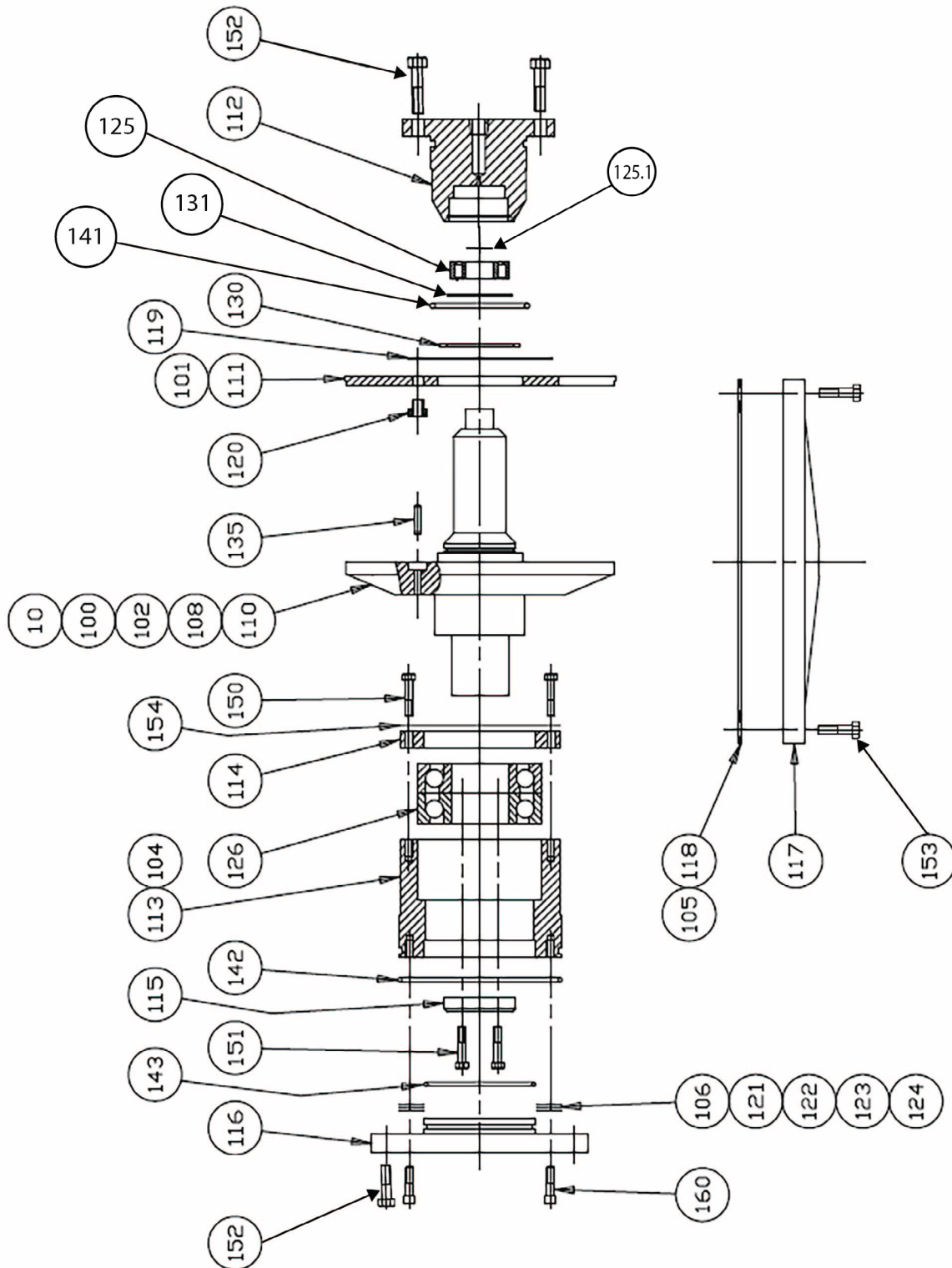
**Refer to the Custom Manual
Spare Parts Section for Specific Applications**

NOTE

**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.

Gaterotor



*For VSS Models from 291 to 2101

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.

Section 8 • Spare Parts List

Gaterotor

ITEM	DESCRIPTION	MODEL NUMBER					
		VSS 451		VSS 601		VSS 751	
		QTY	VPN	QTY	VPN	QTY	VPN
-	GATEROTOR BLADE AND BEARING REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 125, 125.1, 126, 130, 131, 141, 142, 143)	AR	KT712A	AR	KT712B	AR	KT712C
-	GATEROTOR BLADE REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 130, 141, 142, 143)	AR	KT713A	AR	KT713B	AR	KT713C
100	SUPPORT ASSEMBLY (110 & 135B)	2	A25159BB	2	A25159BA	2	A25159CB
102	GATEROTOR SUPPORT ASSEMBLY (100, 111, 120B, 119, 130)	2	A25161BB	2	A25161BA	2	A25161CB
105	GATEROTOR GASKET SET (118, 141, 142, 143)	2	A25164B	2	A25164B	2	A25164C
106	SHIM PACK SET ((2) 121, (2) 122, (1) 123, (1) 124)	2	A25165B	2	A25165B	2	A25165C
110	SUPPORT	2	25606A	2	25520A	2	25612A
111	GATEROTOR	2	25557A	2	25534A	2	25608A
112	SMALL BEARING HOUSING	2	25518D	2	25518D	-	N/A
113	LARGE BEARING HOUSING	2	25517A	2	25517A	-	N/A
114	RETAINER	2	25008A	2	25008A	-	N/A
115	RETAINER	2	25009A	2	25009A	-	N/A
116	BALL BEARING COVER	2	25258A	2	25258A	-	N/A
117	GATEROTOR COVER	2	25519A	2	25519A	-	N/A
118	GATEROTOR COVER GASKET	2	25259A	2	25259A	2	25088A
119	WASHER	2	25007A	2	25007A	2	25086A
120A	BUSHING, SMALL DOWEL PIN	2	25006A	2	25006A	2	25087A
120B	BUSHING, LARGE DOWEL PIN	2	25760A	2	25760A	2	25760B
121	SHIM 0.002"	AR	25010AA	AR	25010AA	AR	25089AA
122	SHIM 0.003"	AR	25010AB	AR	25010AB	AR	25089AB
123	SHIM 0.005"	AR	25010AC	AR	25010AC	AR	25089AC
124	SHIM 0.010"	AR	25010AD	AR	25010AD	AR	25089AD
125	ROLLER BEARING	2	2864B	2	2864B	2	2864C
125.1	RETAINING RING	2	2928W	2	2928W	2	2928AA
126	BALL BEARING	4	2865BP	4	2865BP	4	2865A
130	RETAINING RING	2	2866A	2	2866A	2	2866B
131	RETAINING RING	2	2867A	2	2867A	2	2867E
135A	DOWEL PIN, SM, 0.250" O.D.	2	2868B	2	2868B	2	2868F

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.

Section 8 • Spare Parts List

Gaterotor

ITEM	DESCRIPTION	MODEL NUMBER					
		VSS 451		VSS 601		VSS 751	
		QTY	VPN	QTY	VPN	QTY	VPN
135B	DOWEL PIN, LG, 0.4375" O.D.	2	25910A	2	25910A	2	25910B
141	O-RING ROLLER BEARING HOUSING	2	2176M	2	2176M	2	2176N
142	O-RING BALL BEARING HOUSING	2	2176R	2	2176R	2	2176CQ
143	O-RING BRG HSG COVER	2	2176N	2	2176N	2	2176U
150	HEX HEAD CAP SCREW	12	2796AJ	--	--	-	N/A
151	HEX HEAD CAP SCREW	6	2796B	6	2796N	-	N/A
152	HEX HEAD CAP SCREW	40	2796CJ	40	2796CJ	-	N/A
153	HEX HEAD CAP SCREW	32	2795E	32	2796E	-	N/A
160	SOCKET HEAD CAP SCREW	12	2795E	12	2795H	-	N/A

Note - AR: As Required.

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.

Section 8 • Spare Parts List

Gaterotor

ITEM	DESCRIPTION	MODEL NUMBER							
		VSS 901		VSS 1051		VSS 1201		VSS 1301	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
-	GATEROTOR BLADE AND BEARING REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 125, 126, 130, 131, 141, 142, 143)	AR	KT712D	AR	KT712E	AR	KT712F	AR	KT712Y
-	GATEROTOR BLADE REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 130, 141, 142, 143)	AR	KT713D	AR	KT713E	AR	KT713F	AR	KT713Y
100	SUPPORT ASSEMBLY (110 & 135B)	2	A25159CA	2	A25159DB	2	A25159DA		
102	GATEROTOR SUPPORT ASSEMBLY (100, 111, 120B, 119, 130)	2	A25161CA	2	A25161DB	2	A25161DA	2	A25161DH
105	GATEROTOR GASKET SET (118, 141, 142, 143)	2	A25164C	2	A25164D	2	A25164D	2	A25164D
106	SHIM PACK SET ((2) 121, (2) 122, (1) 123, (1) 124)	2	A25165C	2	A25165C	2	A25165C	2	A25165C
110	SUPPORT	2	25553A	2	25614A	2	25587A	2	25587A
111	GATEROTOR	2	25554A	2	25610A	2	25588A	2	25588F
118	GATEROTOR COVER GASKET	2	25088A	2	25132A	2	25132A	2	25132A
119	WASHER	2	25086A	2	25086A	2	25086A	2	25086A
120A	BUSHING, SMALL DOWEL PIN	2	25087A	2	25104A	2	25104A	2	25104A
120B	BUSHING, LARGE DOWEL PIN	2	25760B	2	25760B	2	25760B	2	25760B
121	SHIM 0.002"	AR	25089AA	AR	25089AA	AR	25089AA	AR	25089AA
122	SHIM 0.003"	AR	25089AB	AR	25089AB	AR	25089AB	AR	25089AB
123	SHIM 0.005"	AR	25089AC	AR	25089AC	AR	25089AC	AR	25089AC
124	SHIM 0.010"	AR	25089AD	AR	25089AD	AR	25089AD	AR	25089AD
125	ROLLER BEARING	2	2864C	2	2864G	2	2864G	2	2864G
126	BALL BEARING	4	2865A	4	2865A	4	2865A	4	2865A
130	RETAINING RING	2	2866B	2	2866B	2	2866B	2	2866B
131	RETAINING RING	2	2867E	2	2867L	2	2867L	2	2867L
135A	DOWEL PIN, SM, 0.250" O.D.	2	2868F	2	2868H	2	2868H	2	2868H
135B	DOWEL PIN, LG, 0.4375" O.D.	2	25910B	2	25910B	2	25910B	2	25910B
141	O-RING ROLLER BEARING HOUSING	2	2176N	2	2176AJ	2	2176AJ	2	2176AJ
142	O-RING BALL BEARING HOUSING	2	2176CQ	2	2176AM	2	2176AM	2	2176AM
143	O-RING BRG HSG COVER	2	2176U	2	2176U	2	2176U	2	2176U

Note - AR: As Required.

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.

Section 8 • Spare Parts List

Gaterotor (VSS 1551 - 1801, 1 of 2)

ITEM	DESCRIPTION	MODEL NUMBER					
		VSS 1551		VSS 1501		VSS 1801	
		QTY	VPN	QTY	VPN	QTY	VPN
-	GATEROTOR BLADE AND BEARING REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 125, 126, 130, 131, 141, 142, 143)	AR	KT712L* KT712LAF* KT712LN** KT712LNAF**	AR	KT712G* KT712GN**	AR	KT712H* KT712HN**
-	GATEROTOR BLADE REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 130, 141, 142, 143)	AR	KT713T* KT713TAF* KT713TN** KT713TNAF**	AR	KT713G* KT713GN**	AR	KT713H* KT713HN**
101	GATEROTOR ASSEMBLY (111, 120)	2	A25160EB	2	A25160EB	2	A25160EA
102	GATEROTOR SUPPORT ASSEMBLY (100, 111, 120B, 119, 130)	2	A25161EB	2	A25161EB	2	A25161EA
104	SHIM 350MM GATEROTOR BALL BRG VSS	2	25977U				
105	GATEROTOR GASKET SET (118, 141, 142, 143)	2	A25164E	2	A25164E	2	A25164E
106	SHIM PACK SET ((2) 121, (2) 122, (1) 123, (1) 124)	2	A25165E	2	A25165E	2	A25165E
110	SUPPORT	2	25665C	2	25087A	2	25665E
111	GATEROTOR	2	25647A	2	25647A	2	25645A
112	SMALL BEARING HOUSING	2	26507A	2	25667A	2	25667A
113	LARGE BEARING HOUSING	2	26506A	2	25669A	2	25669A
114	RETAINER	2	25141A	2	25141A	2	25141A
115	RETAINER	2	25789A	2	25789A	2	25789A
116	BALL BEARING COVER	2	25351A	2	25351A	2	25351A
117	GATEROTOR COVER	2	26508B	2	25354A	2	25354A
118	GATEROTOR COVER GASKET	2	26509A	2	25790A	2	25790A
119	WASHER	2	25788A	2	25788A	2	25788A
120A	BUSHING, SMALL DOWEL PIN	-	N/A	2	25104A	2	25104A
120B	BUSHING, LARGE DOWEL PIN	2	25760C	2	25104A	2	25104A
121	SHIM 0.002"	AR	25791AA	AR	25791AA	AR	25791AA
122	SHIM 0.003"	AR	25791AB	AR	25791AB	AR	25791AB
123	SHIM 0.005"	AR	25791AC	AR	25791AC	AR	25791AC
124	SHIM 0.010"	AR	25791AD	AR	25791AD	AR	25791AD
125	ROLLER BEARING	2	2864K	2	2864K	2	2864K
126	BALL BEARING	4	2865K	4	2865K	4	2865K
130	RETAINING RING	2	2866G	2	2866G	2	2866G
131	RETAINING RING	2	2867R	2	2867R	2	2867R
135A	DOWEL PIN, SM, 0.250" O.D.	-	N/A	2	2868H	2	2868H

Notes - AR: As Required. *: For Serial Numbers Before 5580. **: For Serial Numbers After 5580.

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Section 8 • Spare Parts List

Gaterotor (VSS 1551 - 1801, 2 of 2)

ITEM	DESCRIPTION	MODEL NUMBER					
		VSS 1551		VSS 1501		VSS 1801	
		QTY	VPN	QTY	VPN	QTY	VPN
135B	DOWEL PIN, LG, 0.4375" O.D.	2	25910C	2	2868H	2	2868H
141	O-RING ROLLER BEARING HOUSING	2	2176U	2	2176U	2	2176U
142	O-RING BALL BEARING HOUSING	2	2176BD	2	2176BD	2	2176BD
143	O-RING BRG HSG COVER	2	2176P	2	2176P	2	2176P
150	HEX HEAD CAP SCREW (1/4-20 NC X 1-1/4)	12	2796CJ	12	2796CJ	12	2796CJ
151	HEX HEAD CAP SCREW (5/16-18 NC X 1-1/4)	8	2796N	8	2796N	8	2796N
152	HEX HEAD CAP SCREW (3/8-16 NC X 1-1/4)	32	2796CJ	32	2796CJ	32	2796CJ
153	HEX HEAD CAP SCREW (1/4-20 NC X 1)	44	2796R	44	2796R	44	2796R
160	SOCKET HEAD CAP SCREW	16	2795G	16	2795G	16	2795G

Gaterotor (VSS 1851 & 2101, 1 of 2)

ITEM	DESCRIPTION	MODEL NUMBER			
		VSS 1851		VSS 2101	
		QTY	VPN	QTY	VPN
-	GATEROTOR BLADE AND BEARING REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 125, 126, 130, 131, 141, 142, 143)	AR	KT712M* KT712MAF* KT712MN** KT712MNAF**	AR	KT712K* KT712KN** KT712KNAF**
-	GATEROTOR BLADE REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 130, 141, 142, 143)	AR	KT713U* KT713UAF* KT713UN** KT713UNAF**	AR	KT713L* KT713LN** KT713LNAF**
101	GATEROTOR ASSEMBLY (111, 120)	2	A25160EA	2	A25160EA
102	GATEROTOR SUPPORT ASSEMBLY (100, 111, 120B, 119, 130)	2	A25161EA	2	A25161EC
104	SHIM 350MM GATEROTOR BALL BRG VSS	2	25977U	2	25977U
105	GATEROTOR GASKET SET (118, 141, 142, 143)	2	A25164E	2	A25164E
106	SHIM PACK SET ((2) 121, (2) 122, (1) 123, (1) 124)	2	A25165E	2	A25165E
110	SUPPORT	2	25665E	2	25665D
111	GATEROTOR	2	25645A	2	25744D
112	SMALL BEARING HOUSING	2	26507A	2	26507A
113	LARGE BEARING HOUSING	2	26506A	2	26506A
114	RETAINER	2	25141A	2	25141A
115	RETAINER	2	25789A	2	25789A
116	BALL BEARING COVER	2	25351A	2	25351A
117	GATEROTOR COVER	2	26508B	2	26508B
118	GATEROTOR COVER GASKET	2	26509A	2	26509A

Notes - AR: As Required. *: For Serial Numbers Before 5580. **: For Serial Numbers After 5580.

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Section 8 • Spare Parts List

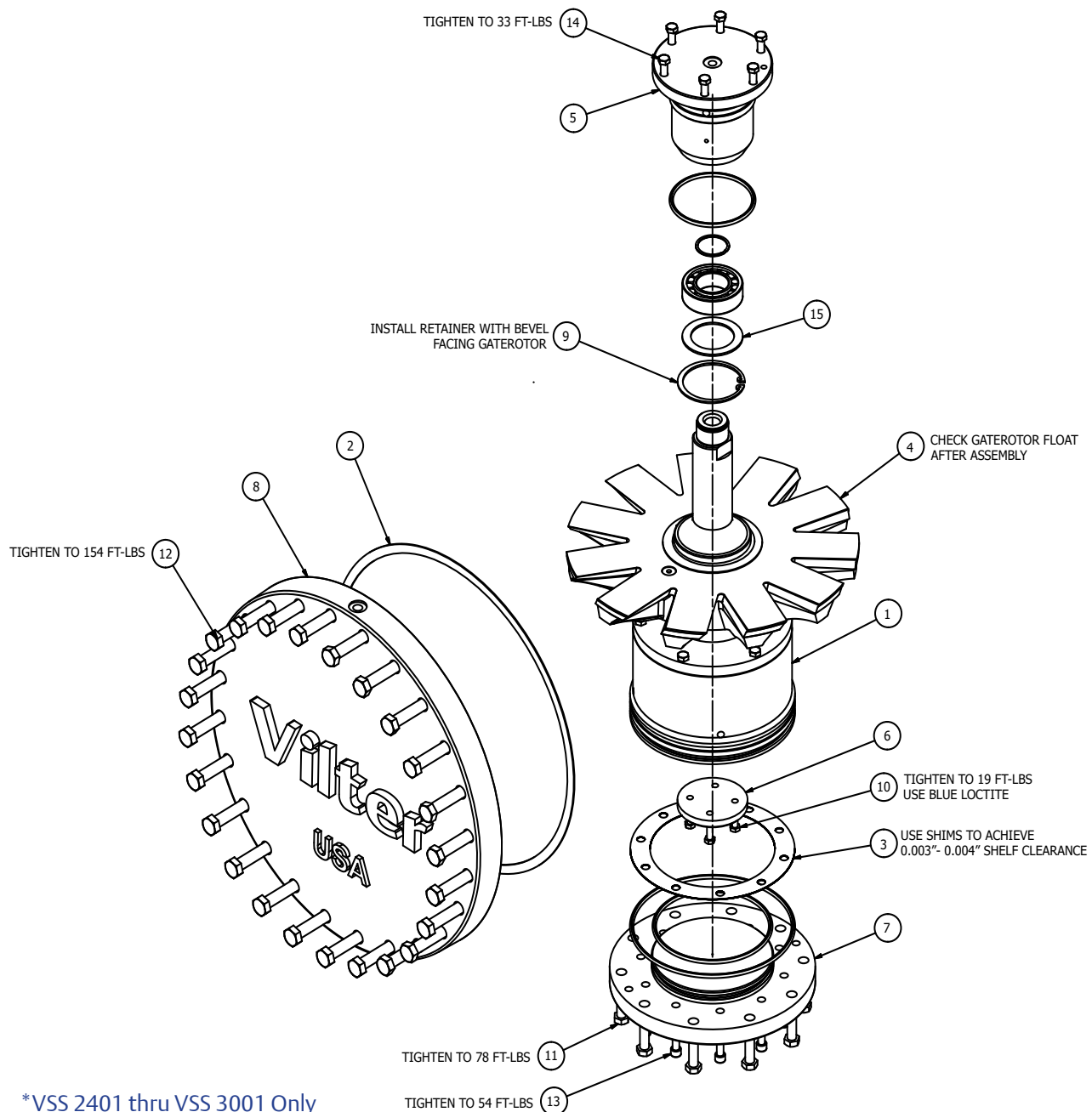
Gaterotor (VSS 1851& 2101, 2 of 2)

ITEM	DESCRIPTION	MODEL NUMBER			
		VSS 1851		VSS 2101	
		QTY	VPN	QTY	VPN
119	WASHER	2	25788A	2	25788A
120A	BUSHING, SMALL DOWEL PIN	-	N/A	-	N/A
120B	BUSHING, LARGE DOWEL PIN	2	25760C	2	25760C
121	SHIM 0.002"	AR	25791AA	AR	25791AA
122	SHIM 0.003"	AR	25791AB	AR	25791AB
123	SHIM 0.005"	AR	25791AC	AR	25791AC
124	SHIM 0.010"	AR	25791AD	AR	25791AD
125	ROLLER BEARING	2	2864K	2	2864K
126	BALL BEARING	4	2865K	4	2865K
130	RETAINING RING	2	2866G	2	2866G
131	RETAINING RING	2	2867R	2	2867R
135A	DOWEL PIN, SM, 0.250" O.D.	-	N/A	-	N/A
135B	DOWEL PIN, LG, 0.4375" O.D.	2	25910C	2	25910C
141	O-RING ROLLER BEARING HOUSING	2	2176U	2	2176U
142	O-RING BALL BEARING HOUSING	2	2176BD	2	2176BD
143	O-RING BRG HSG COVER	2	2176P	2	2176P
150	HEX HEAD CAP SCREW (1/4-20 NC X 1-1/4)	12	2796CJ	12	2796CJ
151	HEX HEAD CAP SCREW (5/16-18 NC X 1-1/4)	8	2796N	8	2796N
152	HEX HEAD CAP SCREW (3/8-16 NC X 1-1/4)	32	2796CJ	32	2796CJ
153	HEX HEAD CAP SCREW (1/4-20 NC X 1)	44	2796R	44	2796R
160	SOCKET HEAD CAP SCREW	16	2795G	16	2795G

Notes - AR: As Required. *: For Serial Numbers Before 5580. **: For Serial Numbers After 5580.

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Gaterotor



*VSS 2401 thru VSS 3001 Only

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Section 8 • Spare Parts List

Gaterotor

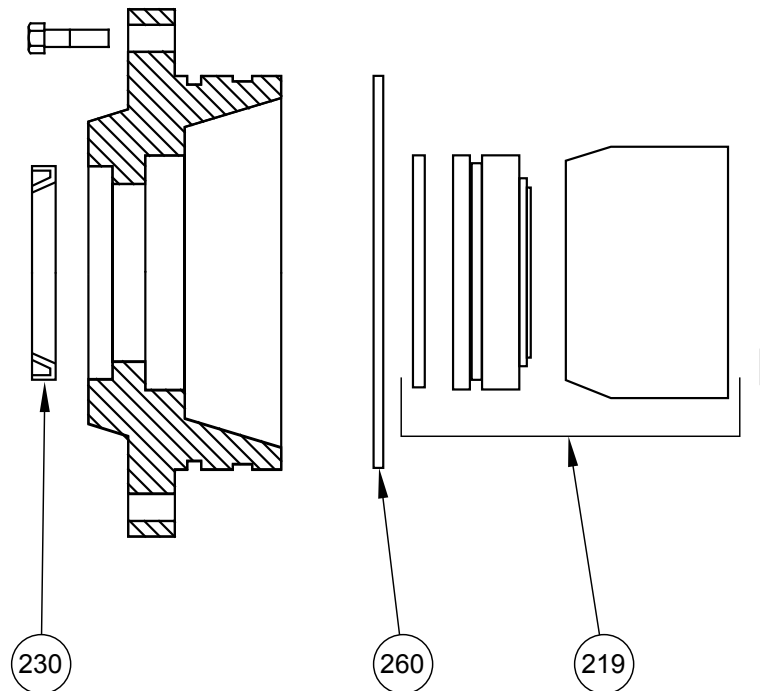
ITEM	DESCRIPTION	MODEL NUMBER				
		QTY	VSS 2401	VSS 2601	VSS 2801	VSS 3001
			VPN	VPN	VPN	VPN
-	GATEROTOR BLADE AND BEARING REPLACEMENT KIT	AR	KT712N	KT712P	KT712Q KT712QAF*	KT712R
-	GATEROTOR BLADE REPLACEMENT KIT	AR	KT713P	KT713Q	KT713R KT713RAF*	KT713S
001	BALL BEARING	1	A25163G	A25163G	A25163G	A25163G
002	SEAL GATEROTOR	1	A25164F	A25164F	A25164F	A25164F
003	SHIM	1	A25165F	A25165F	A25165F	A25165F
004	SUPPORT	1	A25222FH	A25222FG	A25222FF	A25222FE
005	BEARING HOUSING	1	26089B	26089B	26089B	26089B
006	GATEROTOR BEARING HOUSING COVER	1	25789B	25789B	25789B	25789B
007	GATEROTOR COVER	1	26087B	26087B	26087B	26087B
008	RETAINING RING (3.346 X 0.109) BEVELED	1	26132C	26132C	26132C	26132C
009	HEX HEAD CAP SCREW (5/16 -18 NC X 1-1/4)	1	2867R	2867R	2867R	2867R
010	HEX HEAD CAP SCREW (1/2-13 NC X1-3/4)	4	2796B	2796B	2796B	2796B
011	HEX HEAD CAP SCREW (5/8-11 NC X 2-3/4)	10	2796EL	2796EL	2796EL	2796EL
012	HEX HEAD CAP SCREW (3/8-16 NC X 1-3/4)	24	2796GQ	2796GQ	2796GQ	2796GQ
013	HEX HEAD CAP SCREW (3/8-16 NC X 1-1/4)	10	2795AH	2795AH	2795AH	2795AH
014	ROLLER BEARING SHIM	6	2796CJ	2796CJ	2796CJ	2796CJ
015	BEARING RETAINER	1	25977Z	25977Z	25977Z	25977Z

Notes - AR: As Required. *: AFLAS.

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Shaft Seal

Shaft Seal With Stationary Carbon Face

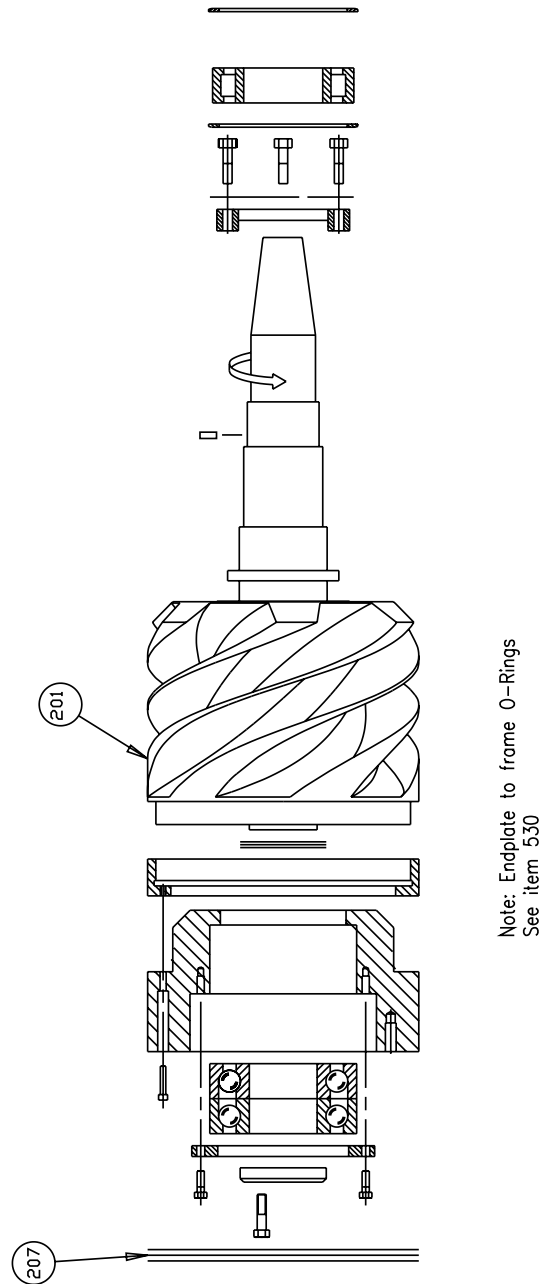


ITEM	DESCRIPTION	QTY	MODEL NUMBER				
			VSS 291 thru VSS 601	VSS 751 thru VSS 1301	VSS 1551 thru VSS 2101		VSS 2401 thru VSS 3001
			VPN	VPN	VPN		VPN
*	SHAFT SEAL AMM KIT (219, 230, & 260)	1	KT709A (Ø2.25")	KT709B (Ø2.5")	KT709C (Ø2.875")	KT709H (Ø3.25")	KT709H (Ø3.25")
*	SHAFT SEAL HALO KIT (219, 230, & 260)	1	KT781A	KT781B	KT781C (Ø2.875")	NA	NA
219	SHAFT SEAL	1	A	A	A	A	A
230	OIL SEAL	1	25040A	2930F	2930J	2930H	2930H
260	O-RING	1	2176F	2176AC	2176BH	2176CQ	2176CQ

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Main Rotor

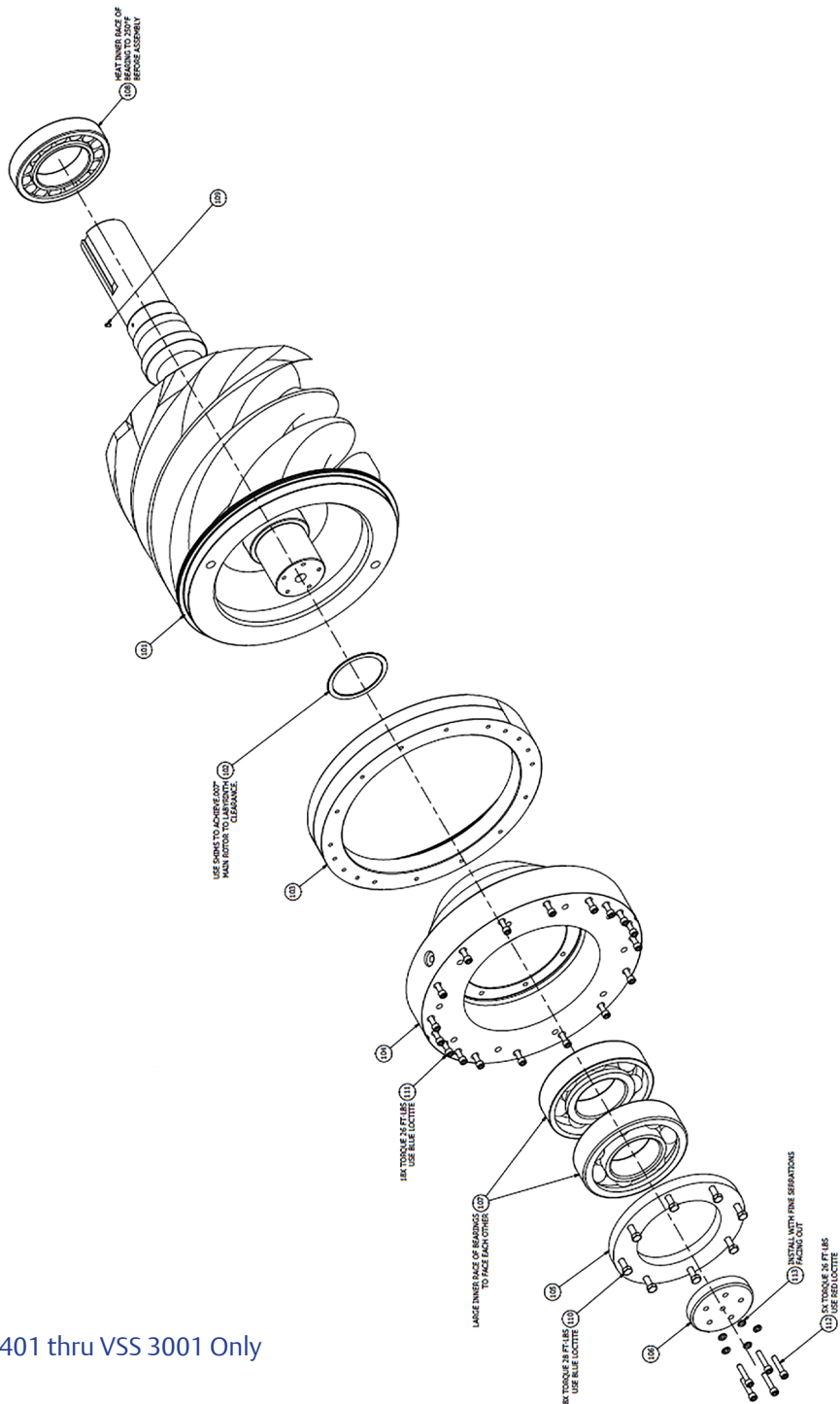
ITEM		207	201
MODEL NUMBER	QTY	DESCRIPTION	
		SHIM PACK	ROTOR ASSEMBLY
VSS 451	1	A25177B	A25226BB
VSS 601	1	A25177B	A25226BA
VSS 751	1	A25177C	A25226CB
VSS 901	1	A25177C	A25226CA
VSS 1051	1	A25177D	A25226DB
VSS 1201	1	A25177D	A25226DA
VSS 1301	1	A25177D	A25752HA
VSS 1501	1	A25177E	A25226EB
VSS 1551	1	A25177E	A25226EC
VSS 1801	1	A25177E	A25226EA
VSS 1851	1	A25177E	A25226ED
VSS 2101	1	A25177E	A25226EE



* For VSS Models from 451 to 2101

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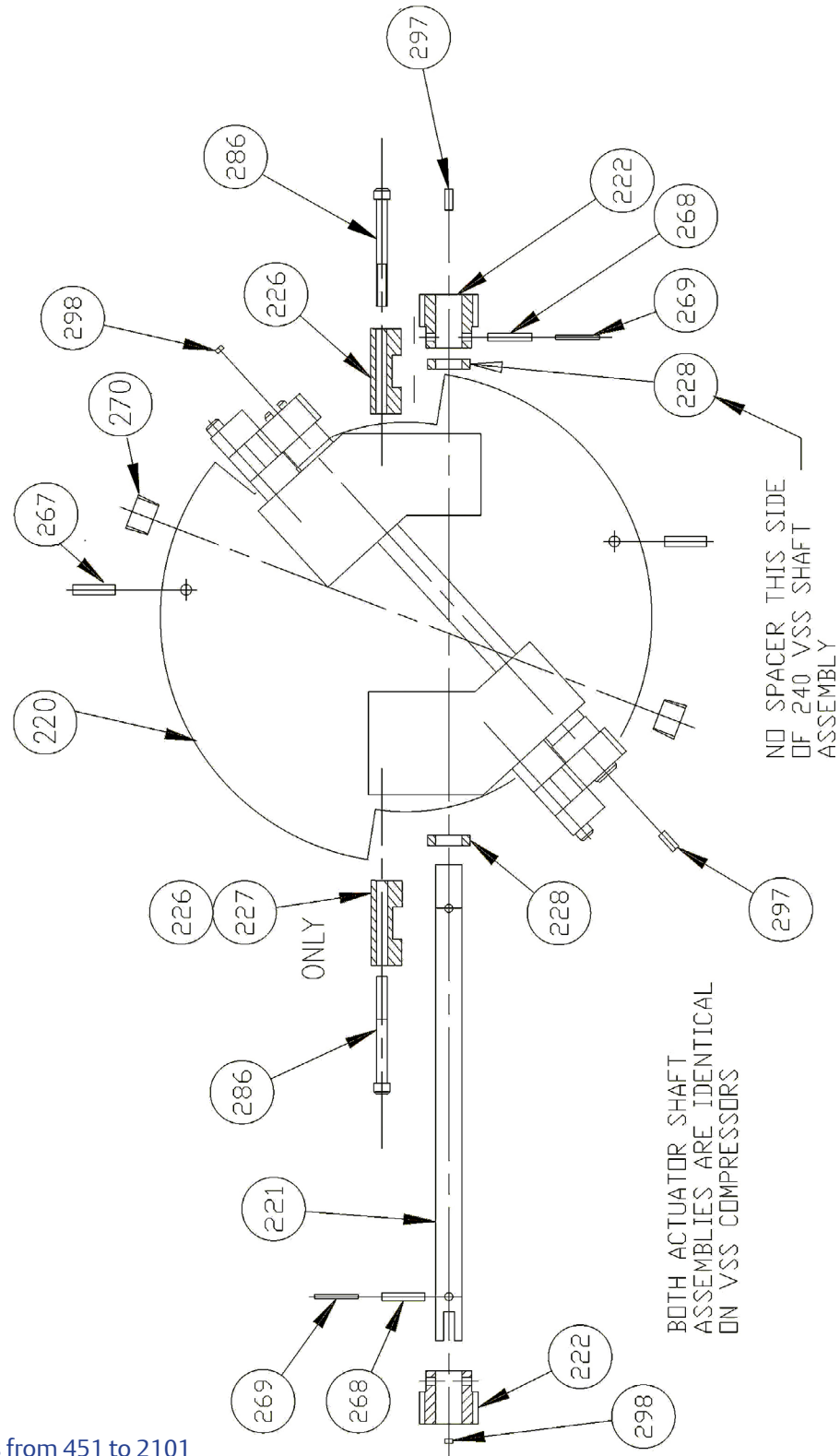
Main Rotor



* VSS 2401 thru VSS 3001 Only

ITEM	DESCRIPTION	MODEL NUMBER				
		QTY	VSS 2401	VSS 2601	VSS 2801	VSS 3001
			VPN	VPN	VPN	VPN
-	ROTOR ASSEMBLY	1	A25226AN	A25226AM	A25226AL	A25226AK
102	SHIM PACK	1	A25177G	A25177G	A25177G	A25177G

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.



*For VSS Models from 451 to 2101

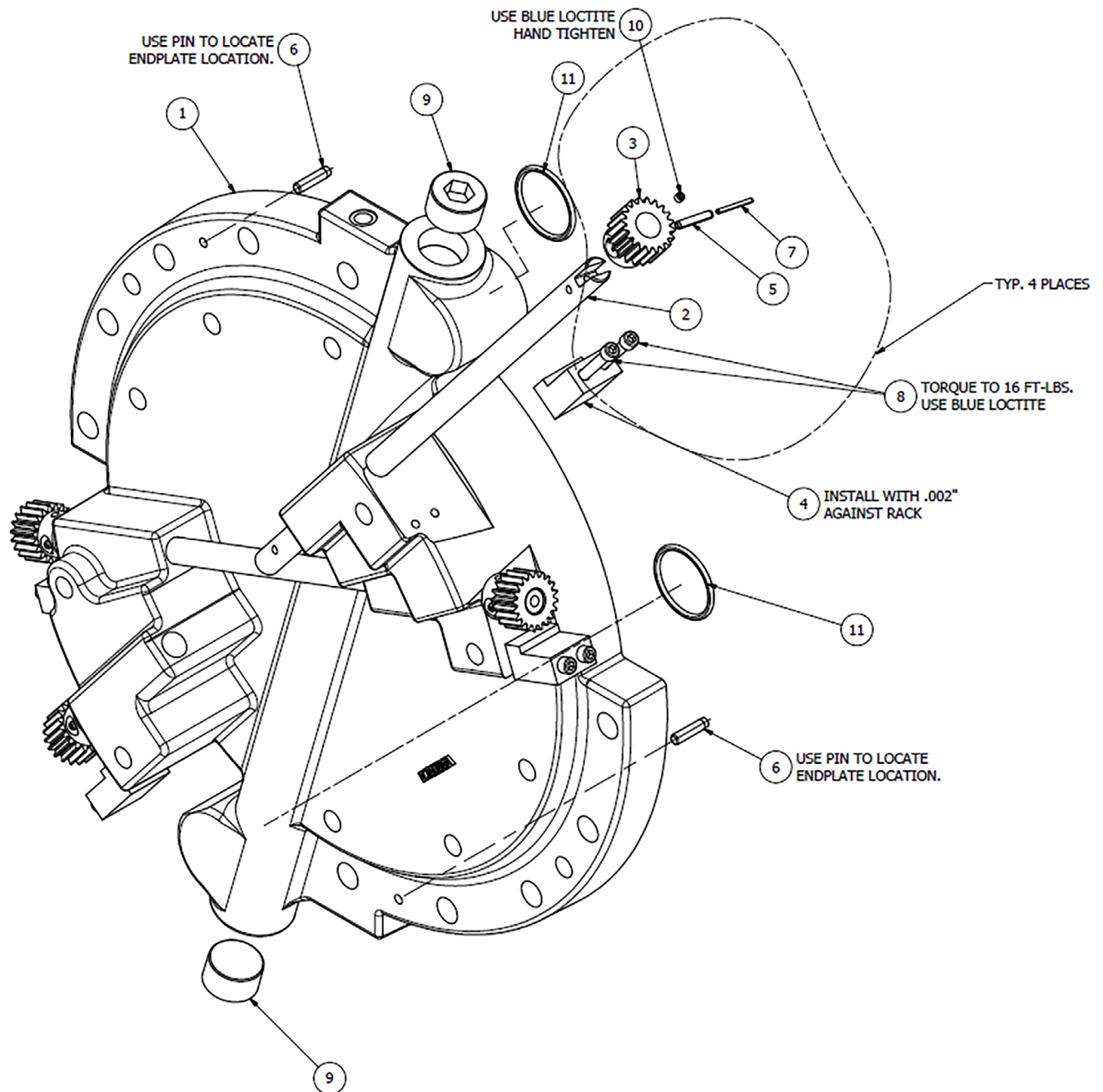
Valve parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Slide Valve Cross Shafts and End Plate

ITEM	DESCRIPTION	MODEL NUMBER									
		VSS 291 thru VSS 601		VSS 751 thru VSS 901		VSS 1051 thru VSS 1301		VSS 1501 VSS 1801		VSS 1551 thru VSS 2101	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
221	SHAFT	2	25843A	2	25844A	2	25845A	2	25793A	2	25793A
222	GEAR	4	25027A	4	25027A	4	25027A	4	25027A	4	25027A
226	RACK CLAMP	2	25913A	4	25913C	4	25913C			4	25913C
227	RACK CLAMP	2	25913B	-	N/A	-	N/A	-		-	N/A
228	SPACER	2	25847A	4	25033C	4	25033C	4	25033C	4	25033C
267	DOWEL PIN	-	N/A	2	2868B	2	2868B	2	2868B	2	2868B
268	EXPANSION PIN	4	1193D	4	1193D	4	1193D	2	1193D	4	1193D
269	EXPANSION PIN	4	2981AA	4	2981AA	4	2981AA	2	2981AA	4	2981AA
270	PIPE PLUG	-	N/A	2	2606E	2	2606E	2	2606E	2	2606A
286	SOCKET HEAD CAP SCREW	8	2795F	8	2795F	8	2795F	8	2795F	8	2795F
297	SET SCREW	2	2060J	2	2060J	2	2060J			2	2060J
298	SET SCREW	2	2060H	2	2060H	2	2060H			2	2060H

Note: N/A: Not Applicable

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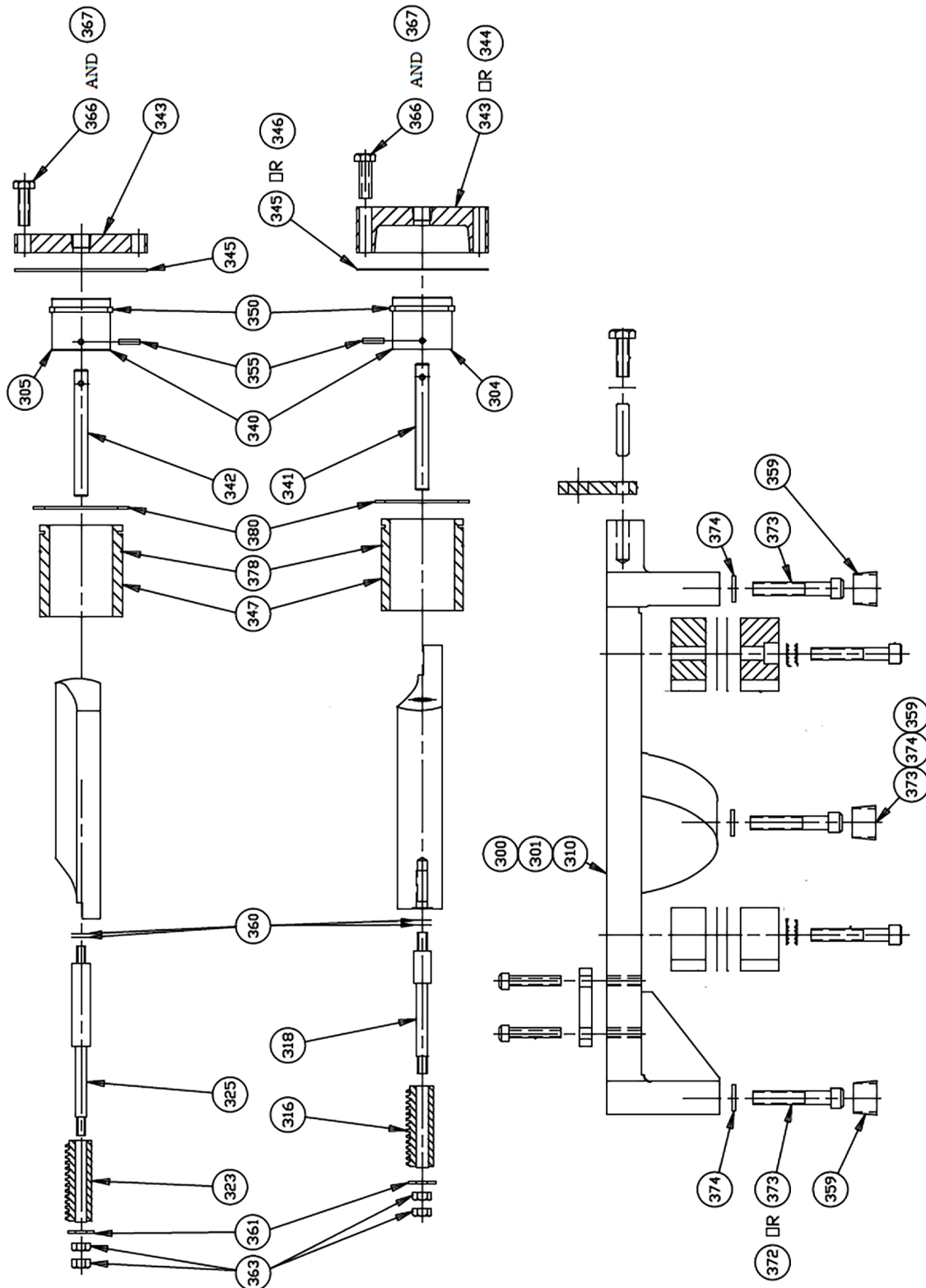


End Plate (VSS 2401 - VSS 3001 Only)

ITEM	DESCRIPTION	MODEL NUMBER	
		VSS 2401 thru VSS 3001	
		QTY	VPN
018	PIPE PLUG SOCKET HEX	2	13163F
019	O-RING (1.609 X 1.887) NEOPRENE	2	2176X
270	FLUSH SEAL PLUG 3/4-14 NPTF SOCKET HEAD	2	2606A
269	ROLL PIN (M2.5 X 26) STEEL	4	2981AA
286	SCREW (1/4-20 NC X 2) CAP SOCKET HEAD ASTM A574	8	2795Q
226	RACK CLAMP	4	25913E
298	SET SCREW (10-32 NF X 3/16) CUP PNT HEX	4	2060H
222	GEAR	4	25027A
220	END PLATE ASSEMBLY	1	A25849FA A25849FAAF* A25849FAV**
221	COMMAND SHAFT	1	A25994F A25994FAF* A25994FV**
268	ROLL PIN (.187 X 1)	4	1193D
267	DOWEL PIN (1/4 X 1) STEEL	2	2868B

Notes - *: AFLAS. **: VITON.

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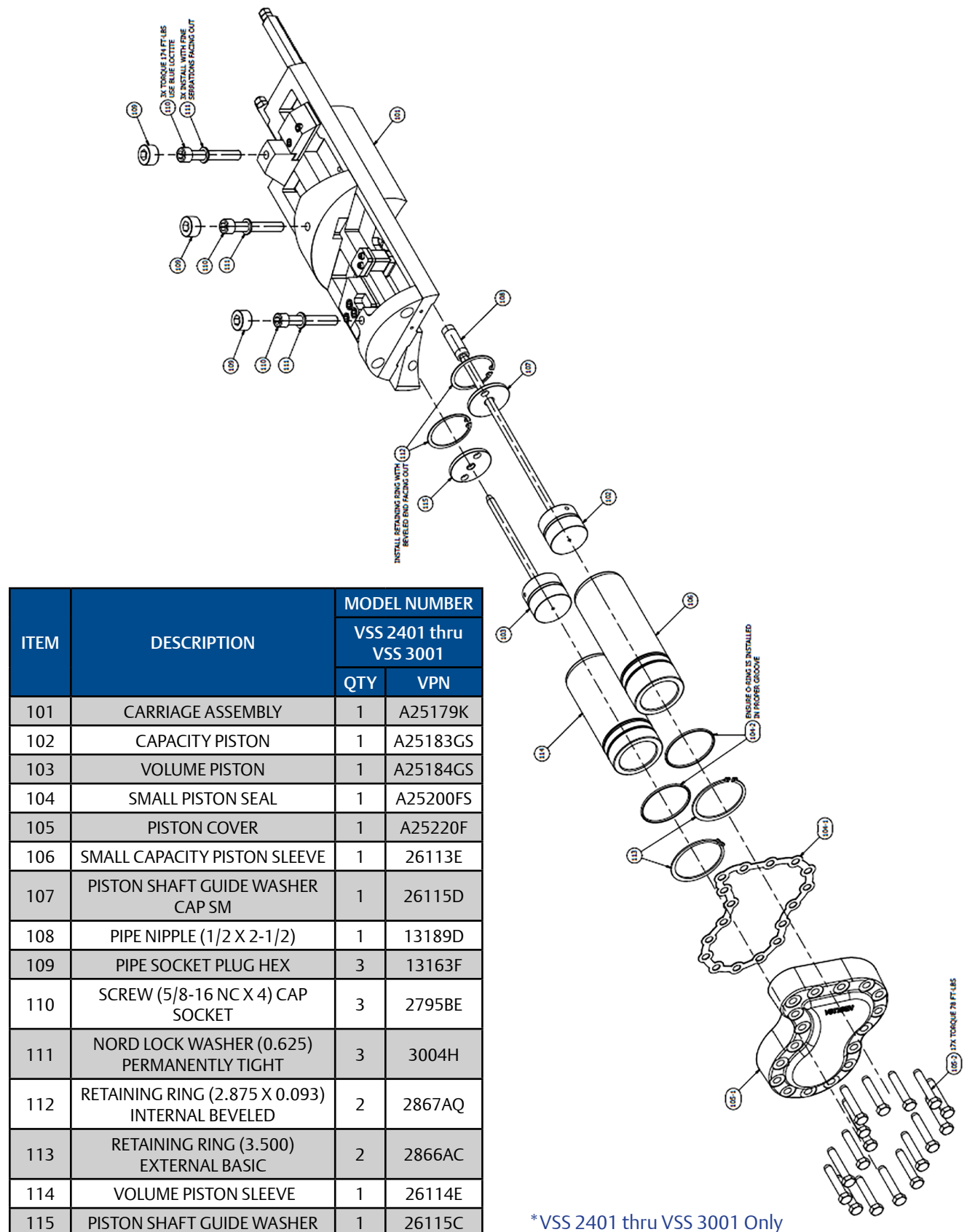


Slide Valve Carriage Assembly

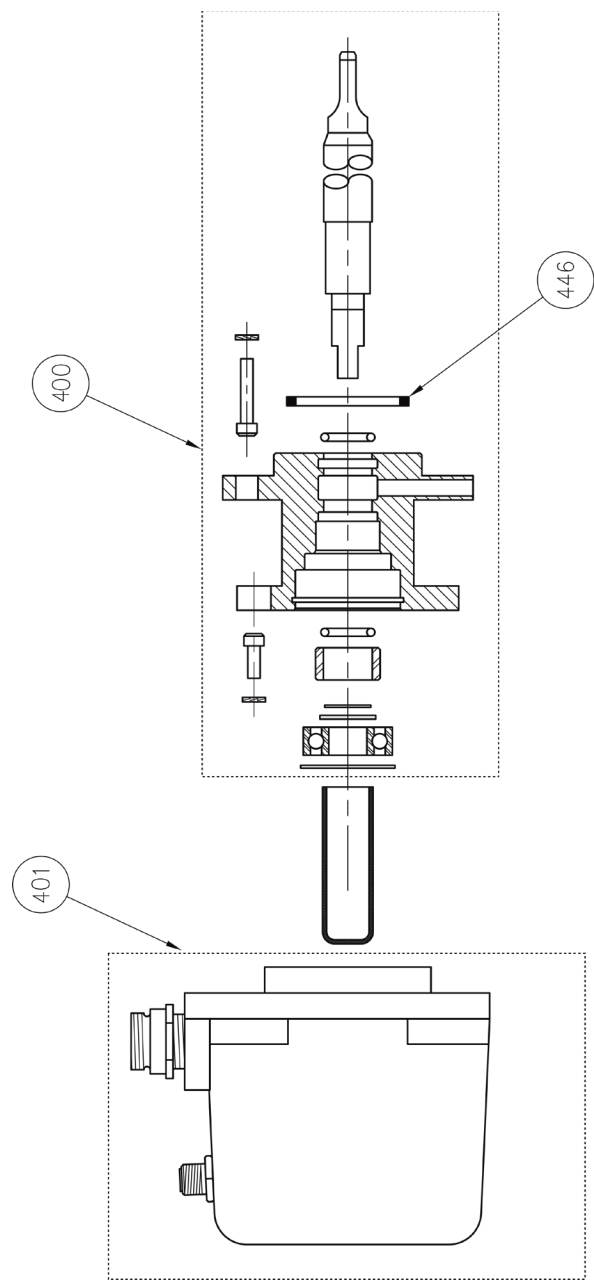
ITEM	DESCRIPTION	MODEL NUMBER							
		VSS 291 thru VSS 601		VSS 751 thru VSS 901		VSS 1051 VSS 1201		VSS 1501 thru VSS 2101	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
300	CARRIAGE ASSEMBLY	2	A25179B	2	A25179C	2	A25179D	2	A25179E
304	CAPACITY PISTON (340, 341, 350, 355)	2	A25183B	2	A25183C	2	A25183D	2	A25183E
305	VOLUME PISTON (340, 342, 350, 355)	2	A25184B	2	A25184C	2	A25184D	2	A25184E
307A	GASKET (345)	2	25900A	-	N/A	-	N/A	2	A25200E
307B	GASKET SET (345, 378)	-	N/A	2	A25200C	2	A25200D	-	N/A
316	RACK	2	25024AH	2	25080AH	2	25080CH	2	25779AH
323	RACK	2	25023AH	2	25080BH	2	25080DH	2	25080DH
325	SHAFT	-	N/A	-	N/A	-	N/A	2	25778A
340	PISTON	-	N/A	4	25076A	4	25138A	4	25782A
341	CAPACITY PISTON SHAFT	-	N/A	2	25078A	2	25078E	2	25784A
342	VOLUME PISTON SHAFT	-	N/A	2	25078B	2	25078F	2	25783A
343A	COVER, SEPARATE VOL. & CAP.	4	25022A	2	25123B	4	25123D	-	N/A
343B	COVER, ONE PIECE CAST	2	25399D	2	25279A	2	25401A	2	25690A
344	COVER, SEPARATE VOL. & CAP.	-	N/A	2	25123A	-	N/A	-	N/A
345A	GASKET, SEPARATE VOL. & n/a CAP COVERS	4	25021A	2	25124B	4	25124C	-	N/A
345B	GASKET, ONE PIECE CAST COVER	2	25900A	2	25902A	2	25901A	2	25384A
346	GASKET, ONE PIECE CAST COVER	-	N/A	2	25124A	-	N/A	-	N/A
347	PISTON SLEEVE	-	N/A	2	25079A	-	N/A	4	25786A
350	PISTON RING SET	4	2953AA	4	2953AB	4	2953AC	4	2953AD
355	EXPANSION PIN	4	1193PP	4	1193PP	4	1193PP	4	1193PP
359	PIPE PLUG	6	2606D	6	2606D	6	2606D	6	2606E
360	LOCK WASHER (PAIR)	4	3004C	4	3004C	4	3004C	4	3004C
361	WASHER	4	13265B	4	13265B	4	13265B	4	13265B
363	NUT	8	2797A	8	2797A	8	2797A	8	2797A
366A	HEX HEAD CAP SCREW, SEPARATE VOL. & CAP. COVERS	24	2796N	12	2796B	24	2796B	-	N/A
366B	HEX HEAD CAP SCREW, ONE PIECE CAST COVER	24	2796B	12	2796P	24	2796P	28	3796BL
367	HEX HEAD CAP SCREW	-	N/A	12	2796BN	-	N/A	-	N/A
373	SOCKET HEAD CAP SCREW	-	N/A	6	2795N	6	2795P	6	2795AG
374	LOCK WASHER (PAIR)	-	N/A	6	3004C	6	3004D	6	3004D
378	O-RING	-	N/A	2	2176Y	-	N/A	4	2176AG
380	RETAINER RING	-	N/A	2	2866C	-	N/A	4	2866G

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Slide Valve Carriage Assembly



Actuator and Command Shaft

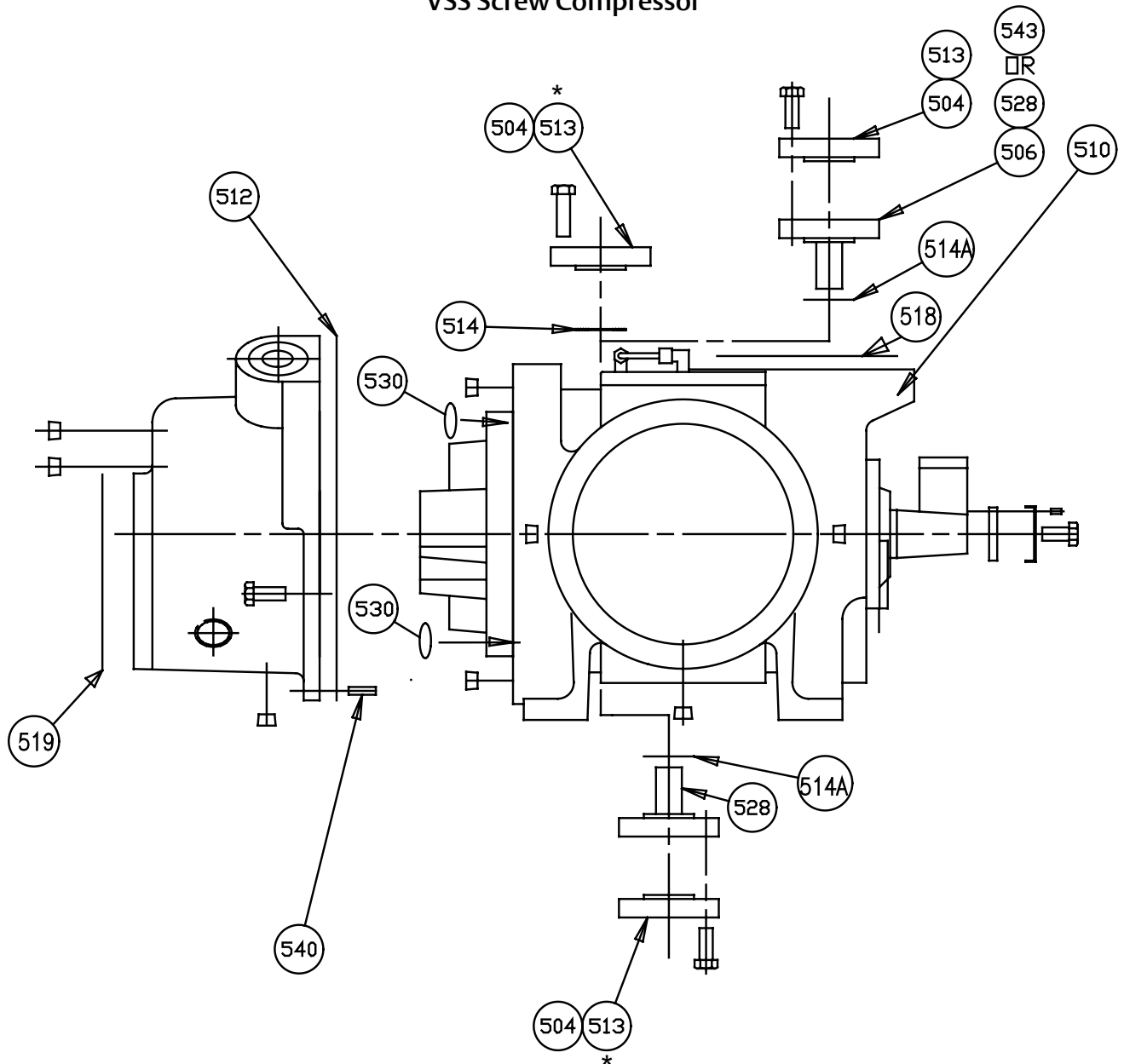


ITEM	DESCRIPTION	MODEL NUMBER					
		QTY	VSS 291 thru VSS 601	VSS 751 thru VSS 901	VSS 1051 VSS 1201 VSS 1301	VSS 1551 thru VSS 2101	VSS 2401 thru VSS 3001
			VPN	VPN	VPN	VPN	VPN
400	COMMAND SHAFT ASSEMBLY	2	A25994B	A25994C	A25994D	A25994E	A25994F
401	SLIDE VALVE ACTUATOR	2	25972D	25972D	25972D	25972D	25972D
446	O-RING SEAL	2	2176X	2176X	2176X	2176X	2176X

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.

Miscellaneous Frame Components

VSS Screw Compressor



* For VSS Models from 451 to 2101

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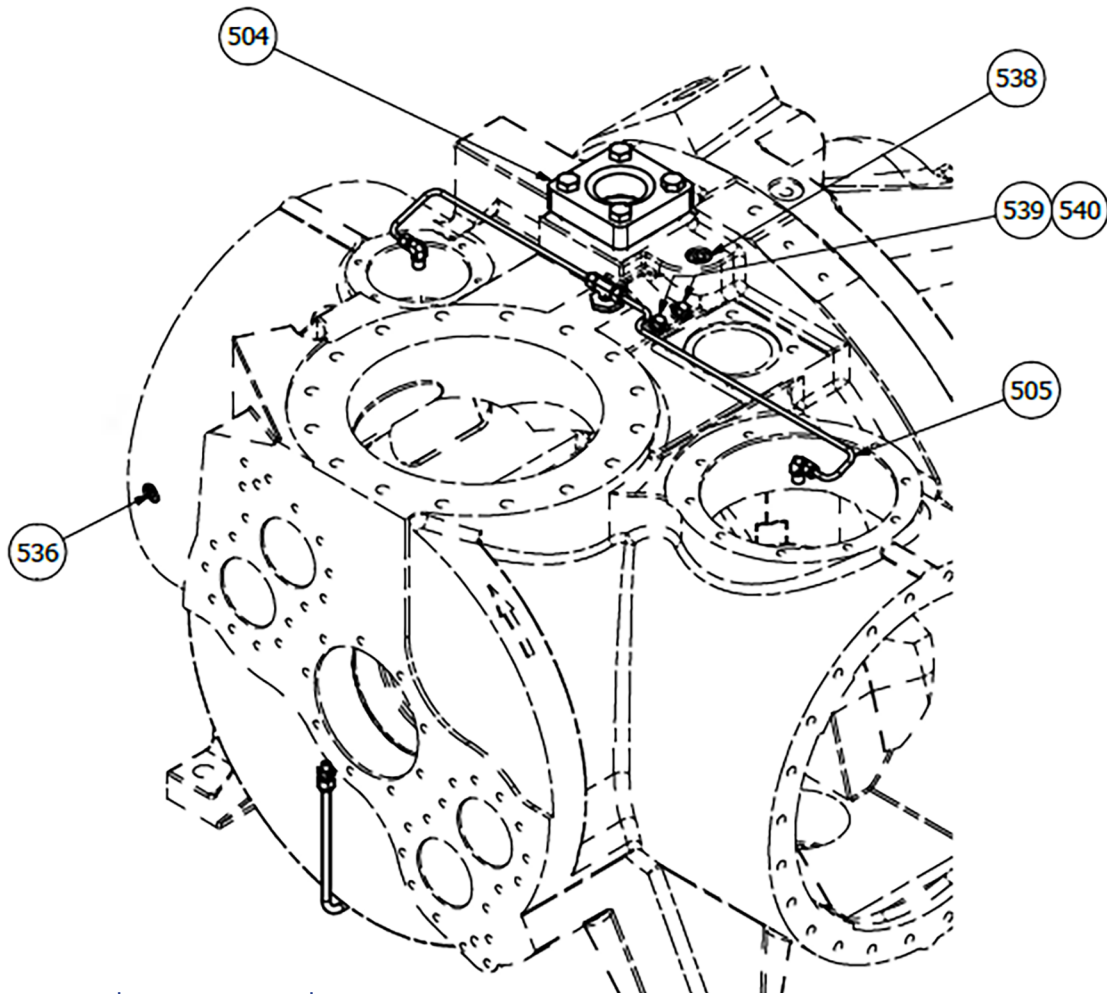
Miscellaneous Frame Components

ITEM	DESCRIPTION	MODEL NUMBER											
		VSS 291 thru VSS 601		VSS 751 thru VSS 901		VSS 1051 thru VSS 1201		VSS 1301		VSS 1501 thru VSS 1801		VSS 1551 thru VSS 2101	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
-	GASKET & O-RING KIT	1	KT710AN	1	KT710B	1	KT710C	1	KT710J	1	KT710D	1	KT710D
504A	FLANGE SET (513A, 514A, 545A)	1	A25190A	1	A25190A	1	A25190B	1	A25190A	1	A25190C	1	A25190C
504B*	FLANGE SET (513B, 514B, 545B)	2	A25190B	-	N/A	2	A25190B	2	A25190B	2	A25190A	2	A25190D
504C*	FLANGE SET (513B, 514C, 545C)	-	N/A	2	A25190A	-	N/A	-	N/A	-	-	-	N/A
506A	PLUG SET, ECONOMIZER (514C, 528, 545B)	1	A25243BE	1	A25243CC	1	A25243DC	1	A25243DD	-	-	-	N/A
506B	PLUG SET, ECONOMIZER (514A, 514C, 528, 545C)	-	N/A	-	N/A	-	N/A	-	N/A	-	-	1	A25243ED
511	DISCHARGE MANIFOLD	1	25502A	1	25540A	1	25597A	-	-	1	25663A	-	-
512	MANIFOLD GASKET	1	25503A	1	25541A	1	25324A	1	25324A	1	25676A	1	25676A
513A	FLANGE	1	25058ASW	1	25058ASW	1	25058B	1	25058ASW	1	12477C	1	12477C
513B	FLANGE	2	25058B	2	25058ASW	2	25058B	2	25058B	-	N/A	2	25058ASW
514A	GASKET	1	11323D	1	11323D	1	11323E	1	11323D	1	11323F	1	11323F
514B	GASKET	2	11323E	-	N/A	2	11323E	2	11323E	-	N/A	2	11323S
514C	GASKET	2	11323D	2	11323S	2	11323E	2	11323E	-	N/A	2	11323G
518	GASKET, SUCTION	1	25199C	1	25199C	1	25199D	1	25199D	1	25199D	1	25199D
519	GASKET, DISCHARGE	1	25199B	1	25199B	1	25199C	1	25199C	1	25199C	1	25199C
528	ECONOMIZER PLUG	2	25397G	2	25397A	2	25391D	2	25391A	1	25393A	2	25393A
530	O-RING	2	2176AB	2	2176J	2	2176J	2	2176AB	-	-	2	2176J
536	PIPE PLUG 3/4" MPT	-	N/A	-	N/A	6	2606A	6	2606A	3	2606E	3	2606A
540	DOWEL PIN	2	2868B	2	2868B	2	2868B	2	2868B	2	2868K	2	2868K
542	PIPE PLUG 3/4" MPT	-	N/A	-	N/A	-	N/A	-	N/A	1	13163F	1	13163F
545A	HEX HEAD CAP SCREW	2	2796GP	2	2796GP	2	2796C	2	2796GP	4	11397E	4	11397E
545B	HEX HEAD CAP SCREW	4	2796C	4	2796C	4	2796C	4	2796C	-	N/A	4	2796GP
545C	HEX HEAD CAP SCREW	-	N/A	4	2796GP	-	N/A	-	N/A	-	N/A	12	11397E
547	HEX HEAD CAP SCREW	8	2796C	24	2796GP	24	2796GP	24	2796F	-	N/A	-	N/A

Note: *: Optional

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Miscellaneous Frame Components



*VSS 2401 thru VSS 3001 Only

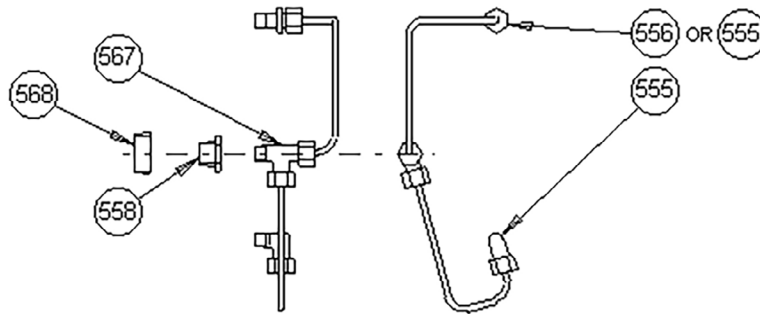
ITEM	DESCRIPTION	MODEL NUMBER	
		VSS 2401 thru VSS 3001	
		QTY	VPN
504	FLANGE SET 1.250 VSS 401MM	1	A25190EA
505	TUBING VSS2401-3001	1	A25201F
536	PLUG 1/2-14NPTF FLUSH SEAL SOC HD	2	2606E
538	PLUG 3/4-14NPTF FLUSH SEAL SOC HD	3	2606A
539	PLUG, LIQUID INJECTION	4	26293A
540	O-RING 0.171X0.499 NEOPRENE	4	2176DD
*	GASKET & O-RING KIT	1	KT710E
*	FLANGE	1	12478G
*	PLUG SET, ECONOMIZER	1	A25243BB

Note - *: Not Shown.

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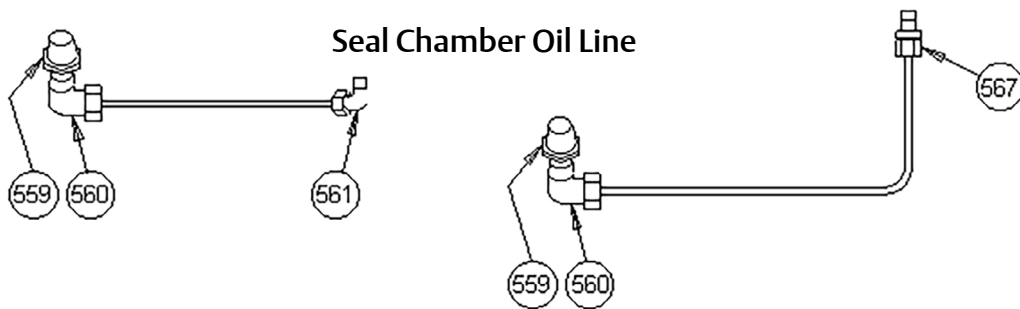
Miscellaneous Frame Components (Tubing and Fittings)

Gaterotor Bearing Supply Lines



VSS 451 THRU VSS 1801

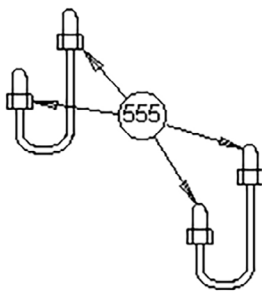
Seal Chamber Oil Line



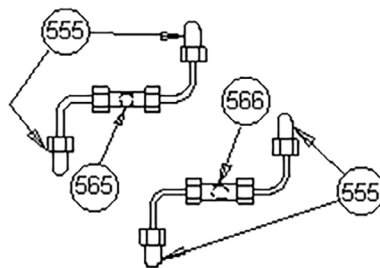
VSS 451 THRU VSS 1201

VSS 1501 & VSS 1801

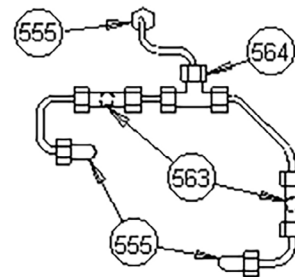
Slide Valve Balance Piston Equalizing Line



VSS 451 & VSS 601



VSS 751 & VSS 901



VSS 1051 & VSS 1201

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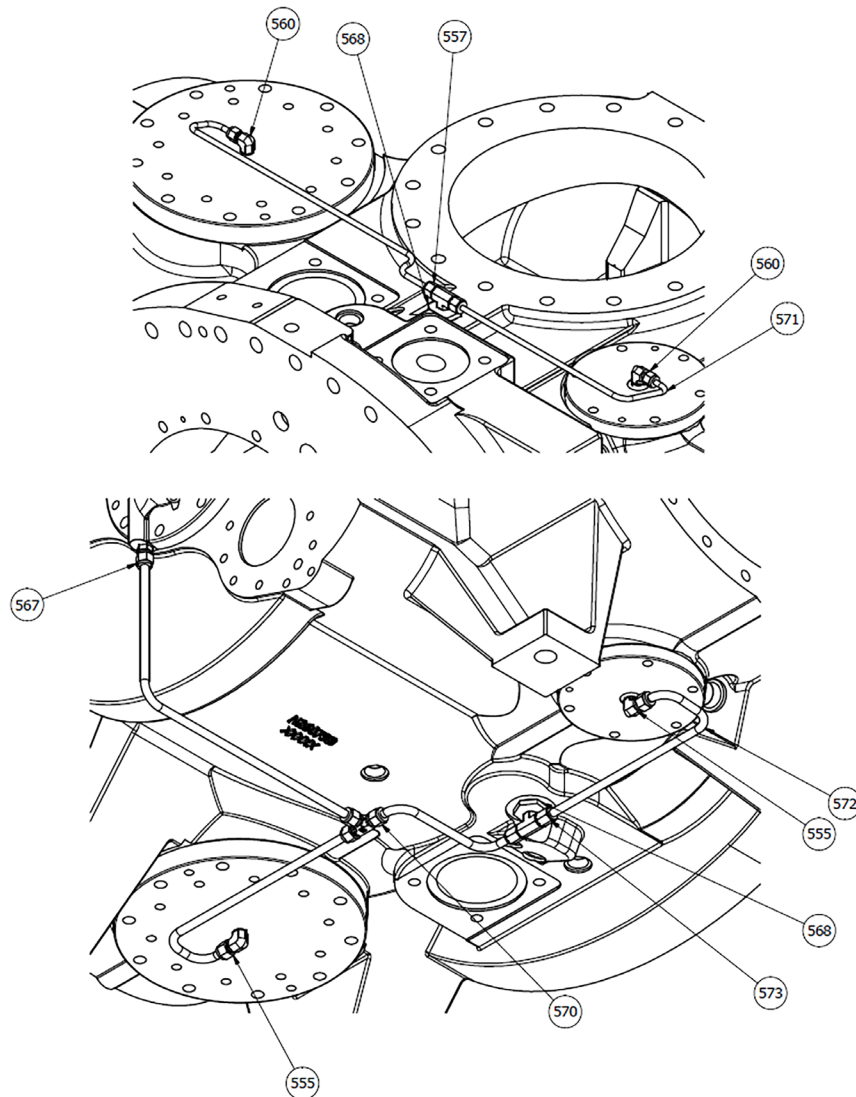
Section 8 • Spare Parts List

Miscellaneous Frame Components (Tubing and Fittings)

ITEM	DESCRIPTION	MODEL NUMBER							
		VSS 451 VSS 601		VSS 751 VSS 901		VSS 1051 VSS 1201		VSS 1501 VSS 1801	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
555	ELBOW 1/4 ODT X 1/4 MPT 90° MALE	5	13375D	5	13375D	3	13375D	2	13375D
556	STRAIGHT 1/4 ODT X 1/4 MPT	1	13229D	1	13229D	2	13229D	-	N/A
557	TEE, RUNNING 1/4 OD X 1/4 MPT MALE	1	1509A	1	1509A	1	1509A	1	13376D
558	HEX BUSHING	1	13231AA	1	13231AA	1	1101H	1	13231AA
559	HEX BUSHING	-	N/A	-	N/A	1	1101K	1	1101K
560	ELBOW 3/8 ODT X 1/2 MPT 90° MALE	1	13375Z	1	13375Z	1	13375Z	1	13375Z
561	ELBOW 3/8 OD X 1/4 MPT 90° MALE	1	13375F	1	13375F	1	13375F	-	N/A
562	PLUG	1	2606E	1	2606E	1	2606A	-	N/A
563	TEE 1/4 ODT X 1/4 ODT X 1/4 MPT BRANCH	-	N/A	-	N/A	2	13376D	-	N/A
564	TEE 1/4	-	N/A	-	N/A	1	13239C	-	N/A
565	TEE 1/4T X 1/4T X 1/4 FPT FEMALE	-	N/A	2	1884A	-	N/A	-	N/A
566	NIPPLE 1/4 X 2-1/2 PIPE	-	N/A	2	13181D	-	N/A	-	N/A
567	CONNECTOR 1/2-13 NC-2 X 1 SET	-	N/A	-	N/A	-	N/A	1	13299C
568	REDUCING BUSHING 1 X 1/4	-	N/A	-	N/A	-	N/A	1	1101M

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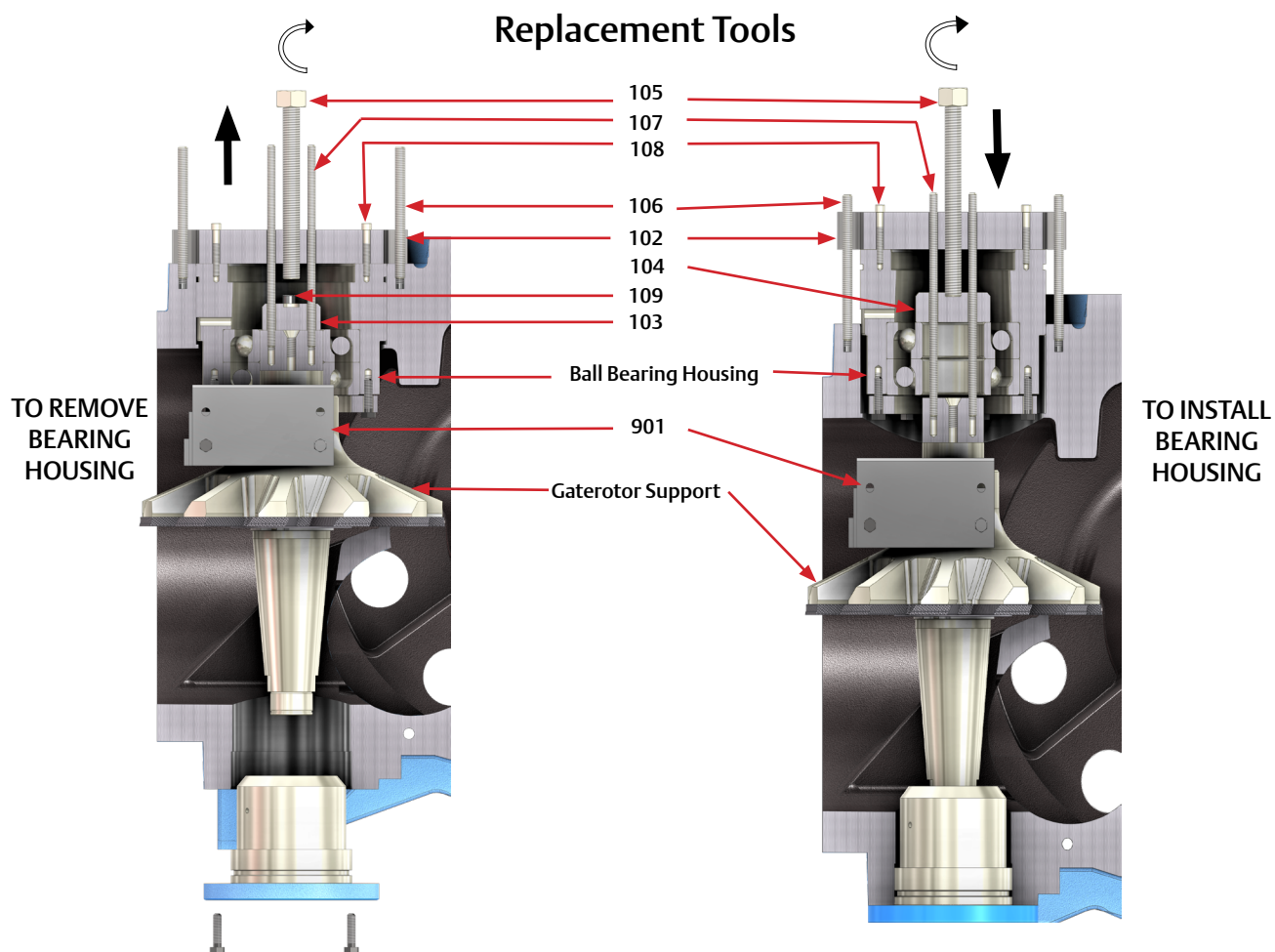
Miscellaneous Frame Components (Tubing and Fittings) (VSS 2401 - VSS 3001)



ITEM	DESCRIPTION	MODEL NUMBER	
		VSS 2401- VSS 3001	
		QTY	VPN
555	MALE ELBOW (3/8 ODX 1/4MPT) 90°	2	13375F
557	BRANCH MLE TEE (1/4ODTX1/4ODTX1/4MPT)	1	13376D
560	MALE ELBOW (1/4ODTX1/4MPT) 90°	2	13375D
567	COMPRESSION CONNECTOR (3/8 ODT X 1/8MPT)	1	13229W
568	BUSHING (1 X 1/4) HEXAGON	2	1101M
570	UNION TUBE TEE (3/8)	1	13239E
573	BRANCH MALE TEE (3/80 DT X 1/4MPT)	1	2084A
571	STEEL TUBING (1/4 X .035) SMLS	2	3509A
572	STEEL TUBING (3/8 X .035) SMLS	4	3509B

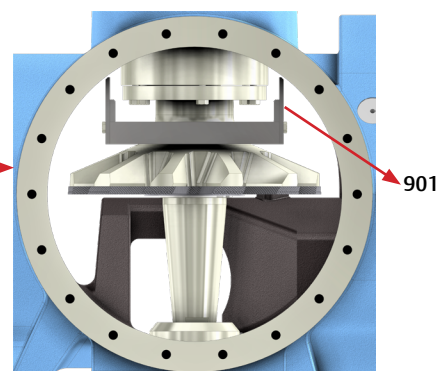
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Section 8 • Spare Parts List



Position	Description
901	STABILIZER
102	BAR PULLER
103	PULLER SHOE
104	PUSHER SHOE
105	SCREW JACKING
106	STUD
107	STUD
108	SCREW
109	SCREW

For VSG 751-901 & VSG 1051/1201 ASSEMBLE SIDE RAILS AS STAMPED. FOR VSSG 291-601 COMPRESSORS, DO NOT USE SIDE RAILS. FOR VSG 1551 & 1801, ASSEMBLE SIDE RAILS ONLY ONE WAY



ITEM	DESCRIPTION	MODEL NUMBER					
		QTY	VSS 291 thru VSS 601	VSS 751 VSS 901	VSS 1051 VSS 1201 VSS 1301	VSS 1551 thru VSS 2101	VSS 2401 thru VSS 3001
			VPN	VPN	VPN	VPN	VPN
900	GATEROTOR TOOLS	1	A25205B	A25205C	A25205C	A25205E	A25205F
901A	GATEROTOR STABILIZER SET (901A, 901B, 901C)	1	A25698A	A25698A	A25698A	N/A	N/A
901B	GATEROTOR STABILIZER SET (901A, 901B, 901C, 901D)	1	N/A	N/A	N/A	A25699A	N/A

Replacement Parts

COMPONENT	DESCRIPTION	VPN	QTY	WHERE USED
VSS Units Horizontal Oil Separator	Oil Separator Defogger Element	2879A	1	20" Oil Separator
			2	24" Oil Separator
			3	30" Oil Separator
			4	36" Oil Separator
			5	42" Oil Separator
	Cover Gasket, 13"x12"	93559A	1	20" Oil Separator
			1	24" Oil Separator
	Cover Gasket, 16"x15"	93560A	1	30" Oil Separator
			1	36" Oil Separator
			1	42" Oil Separator
VSS Units Oil Filter	Oil Filter Element	1833C	1	Single Element Filter Tank
			2	Dual Element Filter Tank
	Filter Tank Cover Gasket (Included with 1833C)	35197A	1	Single or Dual Element Filter Tank
VSS Units Suction Strainer	Strainer Screen, 4" & 5"	2881A	1	4" & 5" Suction Strainer
	Strainer Screen, 6"	2881B	1	6" Suction Strainer
	Strainer Screen, 8"	2881C	1	8" Suction Strainer
	Strainer Cover Gasket	2555E	1	4" & 5" Suction Strainer
	Strainer Cover Gasket	2555F	1	6" Suction Strainer
	Strainer Cover Gasket	2555G	1	8" Suction Strainer
Safety Relief Valves	300 Psig R-717 Relief Valve	1498GG	2	300 Psig R-717 Dual Relief Valve
	250 Psig R-717 Relief Valve	1498EE	2	250 Psig R-717 Dual Relief Valve
	300 Psig Halocarbon Relief Valve, 1/2"x 5/8"	1498GA	2	300 Psig Halocarbon Dual Relief Valve
	300 Psig Halocarbon Relief Valve, 3/4"x 1"	1498GJ, 1498GK, 1498GKA	2	300 Psig Halocarbon Dual Relief Valve
	300 Psig Halocarbon Relief Valve, 1"x 1"	1498GN	2	300 Psig Halocarbon Dual Relief Valve
Replacement Solenoid Valve Coils	Solenoid Coil, 115V/50 Hz., Yellow and Blue Leads	2650W	1	2650 Series Solenoid Valve, 115V/50 Hz.
	Solenoid Coil, 230V/50 Hz., Yellow Leads	2650X	1	2650 Series Solenoid Valve, 230V/50 Hz.
	Solenoid Coil, 120V/60 Hz., Blue Leads	2650Y	1	2650 Series Solenoid Valve, 120V/60 Hz.
	Solenoid Coil, 240V/60 Hz., Red Leads	2650Z	1	2650 Series Solenoid Valve, 240/60 Hz.

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Section 8 • Spare Parts List

Replacement Parts

COMPONENT	DESCRIPTION	VPN	QTY	WHERE USED
Viking Oil Pump	Bare 11 GPM Oil Pump	2954B	1	11 GPM Oil Pump
	Replacement Shaft Seal for 11 GPM Oil Pump	KT718A	2	12 GPM Oil Pump
	Bare 22 GPM Oil Pump	2954E	1	22 GPM Oil Pump
	Bare 31 GPM Oil Pump	2954H	1	31 GPM Oil Pump
	Replacement Shaft Seal for 22 and 31 GPM Oil Pumps	KT718C	1	22 and 31 GPM Oil Pumps
Haight Oil Pump	Bare 10 GPM Oil Pump	3022AU & 2913N	1	10 GPM Oil Pump
	Bare 20 GPM Oil Pump	3022DU & 2913E	1	20 GPM Oil Pump
	Bare 30 GPM Oil Pump	3022GU & 2913E	1	30 GPM Oil Pump
	Replacement Shaft Seal	3022C	1	10, 20, and 30 GPM Haight Oil Pumps
Liquid Injection	2 Ton R-717 Thermostatic Expansion Valve *	2629J	1	2 Ton R-717 Liquid Injection System *
	5 Ton R-717 Thermostatic Expansion Valve **	2629A	1	5 Ton R-717 Liquid Injection System **
	10 Ton R-717 Thermostatic Expansion Valve **	2629B	1	10 Ton R-717 Liquid Injection System **
	15 Ton R-717 Thermostatic Expansion Valve **	2629C	1	15 Ton R-717 Liquid Injection System **
	20 Ton R-717 Thermostatic Expansion Valve ***	2629D	1	20 Ton R-717 Liquid Injection System ***
	30 Ton R-717 Thermostatic Expansion Valve ***	2629E	1	30 Ton R-717 Liquid Injection System ***
	50 Ton R-717 Thermostatic Expansion Valve ***	2629F	1	50 Ton R-717 Liquid Injection System ***
	75 Ton R-717 Thermostatic Expansion Valve ***	2629G	1	75 Ton R-717 Liquid Injection System ***
	100 Ton R-717 Thermostatic Expansion Valve ***	2629H	1	100 Ton R-717 Liquid Injection System ***
	Power Head Assembly	2637A	1	2 thru 15 Ton Thermostatic Expansion Valve
	Power Head Assembly	2637B	1	20 thru 100 Ton Thermostatic Expansion Valve
	120V R-717 Solenoid Valve	2562E	1	5 thru 15 Ton R-717 Liquid Injection System
	120V R-717 Solenoid Valve	2875F	1	20 thru 100 Ton R-717 Liquid Injection System
	Solenoid Valve Coil	2650VA	1	KIT REPLACEMENT W/S&F W/STRAINER

Notes -

*: W/O Flange, W/ EXT 10FT CAP Y764

**: W/O Flange, W/ EXT 10FT Y764

***: W/O Flange, W/EXT 10FT Y830

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**VSM 301-701
Recommended
Spare Parts List**

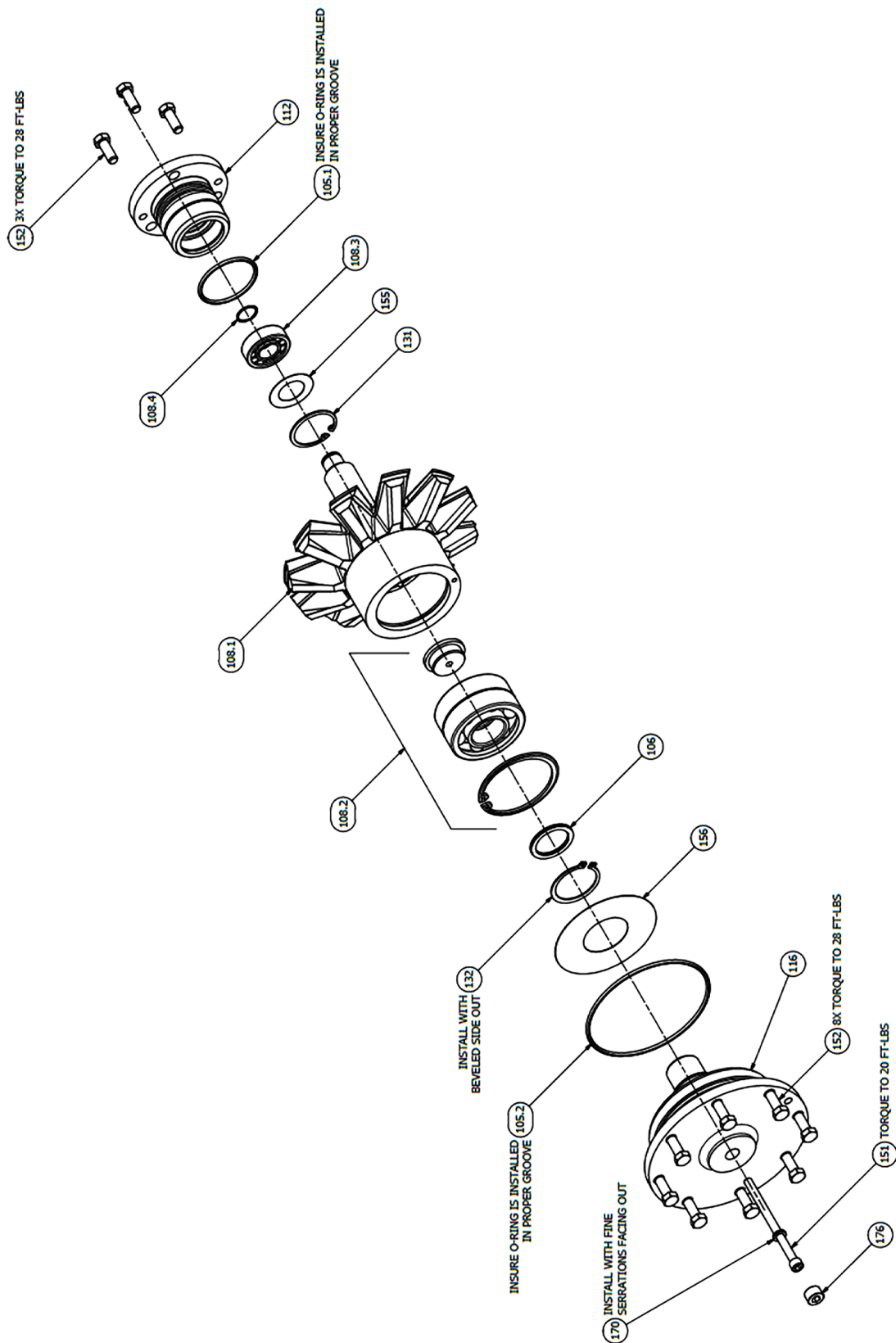
**Refer to the Custom Manual
Spare Parts Section for Specific Applications**

NOTE

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

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Gaterotor Assembly



Section 8 • Spare Parts List

Gaterotor Assembly

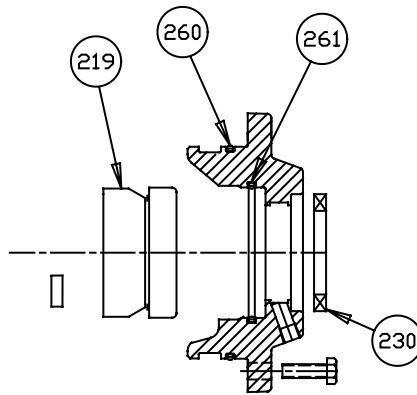
Part totals indicated are for one Gaterotor assembly, machines with two Gaterotors will require double the components listed below.

ITEM	DESCRIPTION	MODEL NUMBER							
		QTY	VSM 301	VSM 361	VSM 401	QTY	VSM 501	VSM 601	VSM 701
			VPN	VPN	VPN		VPN	VPN	VPN
-	GATEROTOR BLADE REPLACEMENT KITS	AR	KT1098A	KT1098B	KT1098C	AR	KT1098D	KT1098E	KT1098F
-	GATEROTOR BEARING REPLACEMENT KITS	AR	KT759F	KT759G	KT759H	AR	KT759BG (REMAN)	KT759BH (REMAN)	KT759BJ (REMAN)
105	SEAL GATEROTOR	1	A25164A A25164AV*	A25164A A25164AV*	A25164A A25164AV*	1	A25164B	A25164B	A25164B
105.1	O-RING	1	2176L	2176L	2176L	1	2176M	2176M	2176M
105.2	O-RING	1	2176F	2176F	2176F	1	2176R	2176R	2176R
106	SHIM GATEROTOR	1	A25165A	A25165A	A25165A	1	A25165B	A25165B	A25165B
108	SUPPORT GATEROTOR	1	A25222AB	A25222AA	A25222AC	1	A25222BB	A25222BA	A25222BC
108.1	SUPPORT GATEROTOR	1	A25161AB	A25161AA	A25161AC	1	A25161BB	A25161BA	A25161BC
108.2	BALL BEARING	1	A25163A	A25163A	A25163A	1	A25163B	A25163B	A25163B
108.3	ROLLER BEARING	1	2864F	2864F	2864F	1	2864B	2864B	2864B
108.4	RETAINING RING 0.781 ID X .065 X .031	1	2928Y	2928Y	2928Y	1	2928W	2928W	2928W
112	HOUSING GATEROTOR ROLLER BEARING	1	25407B	25407B	25407B	1	25407C	25407C	25407C
116	SUPPORT GATEROTOR BALL BEARING	1	25408B	25408B	25408B	1	25408C	25408C	25408C
131	RETAINING RING	1	2867S	2867S	2867S	1	2867A	2867A	2867A
132	RETAINING RING 1.875 x 0.062 EXTERNAL BEVELED	1	2866J	2866J	2866J	1	2866K	2866K	2866K
151	SCREW	1	2795AP	2795AP	2795AP	1	2795AAA	2795AAA	2795AAA
152	SCREW 3/8-16 NC X 1	11	2796CG	2796CG	2796CG	12	2796CG	2796CG	2796CG
155	SHIM	AR	25977D	25977D	25977D	AR	25977G	25977G	25977G
156	SHIM	AR	25977C	25977C	25977C	AR	25977H	25977H	25977H
170	WASHER .312	1	3004C	3004C	3004C	1	3004C	3004C	3004C
176	PLUG 3/8-18NPTF FLUSH SEAL SOC HD	1	2606D	2606D	2606D	1	2606D	2606D	2606D

Notes - AR: As Required. *: Viton.

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Shaft Seal



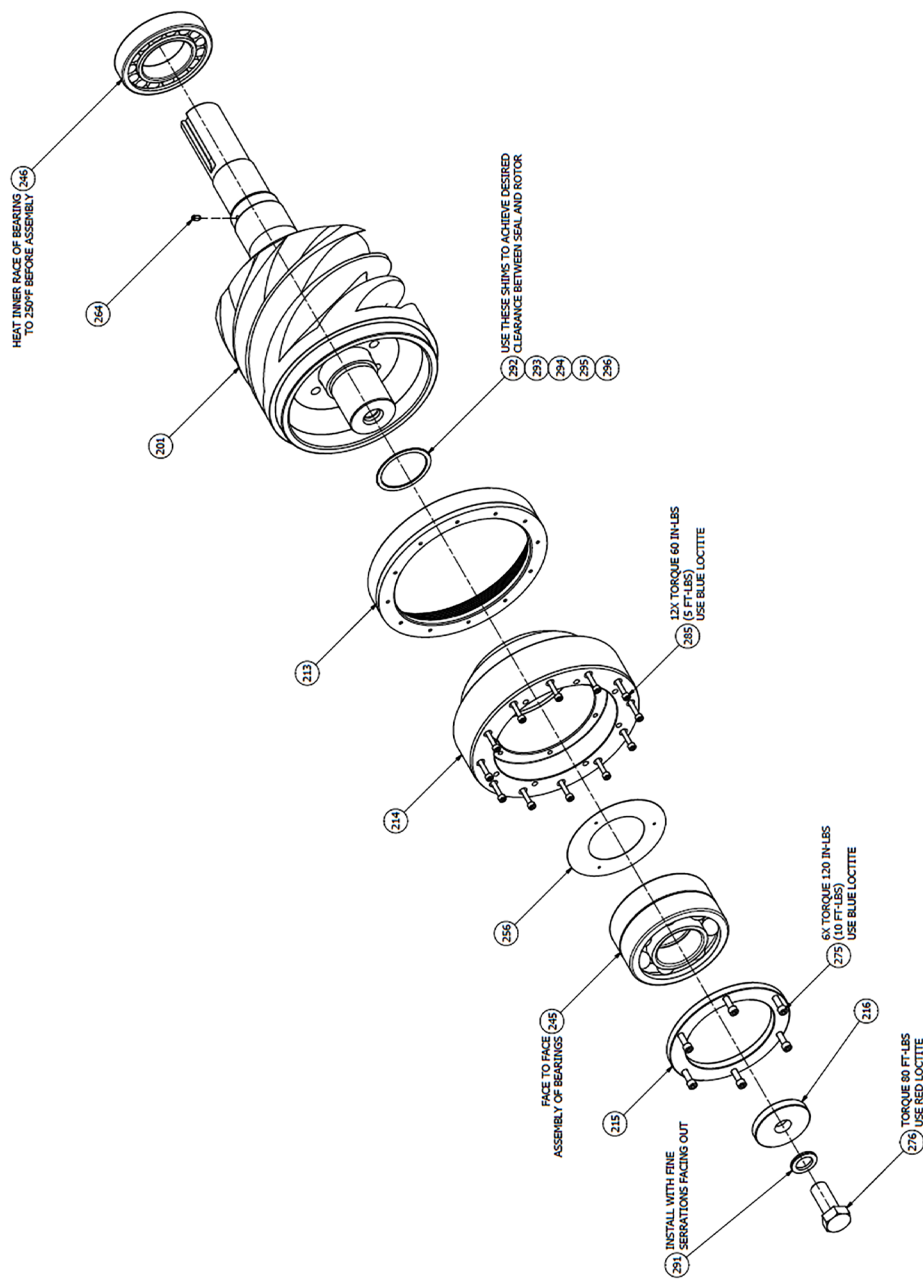
ITEM	DESCRIPTION	MODEL NUMBER		
		QTY	VSM 301-401	VSM 501-701
			VPN	VPN
*	SHAFT SEAL KIT (AMM) 219, 230, & 260	1	KT709D	KT709A
*	SHAFT SEAL KIT (HALO) 219, 230, & 260	1	KT781D	KT781A
219	SHAFT SEAL	1	A	A
230	OIL SEAL	1	2930C	25040A
244	TEFLON SEAL	1	25939A	25939A
252	RETAINER RING	1	2928M	2928M
260	O-RING	1	2176U	2176F
261	O-RING (205 Only)	1	2176AE	N/A

Notes - *: Not pictured. A: Sold only as kit.

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Main Rotor

Models VSM 301-401 Counter Clockwise ONLY
Models VSM 501-701 Clockwise ONLY

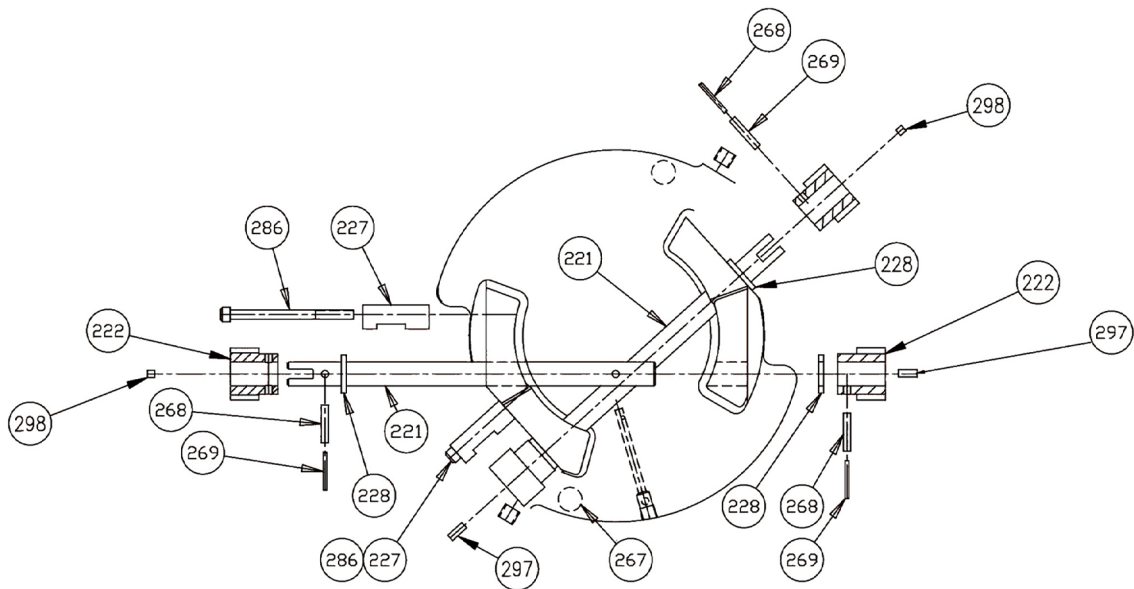


ITEM	DESCRIPTION	MODEL NUMBER						
		QTY	VSM 301	VSM 361	VSM 401	VSM 501	VSM 601	VSM 701
			VPN	VPN	VPN	VPN	VPN	VPN
-	MAIN ROTOR ASSEMBLY	1	A25226AB	A25226AA	A25226AC	A26010BB	A26010BA	A26010BC
201	ROTOR	1	A25716AB	A25716AA	A25716AC	A26007BB	A26007BA	A26007BC

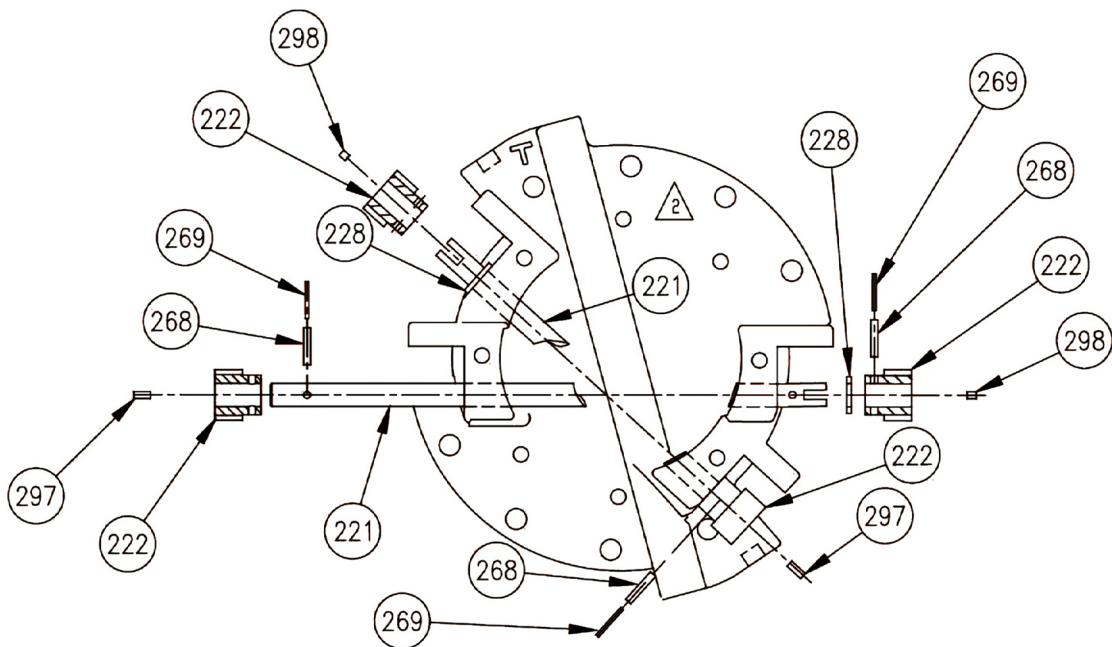
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Slide Valve Cross Shafts and End Plate

Models VSM 301-401 Counter Clockwise ONLY



Models VSM 501-701 Clockwise ONLY



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.

Section 8 • Spare Parts List

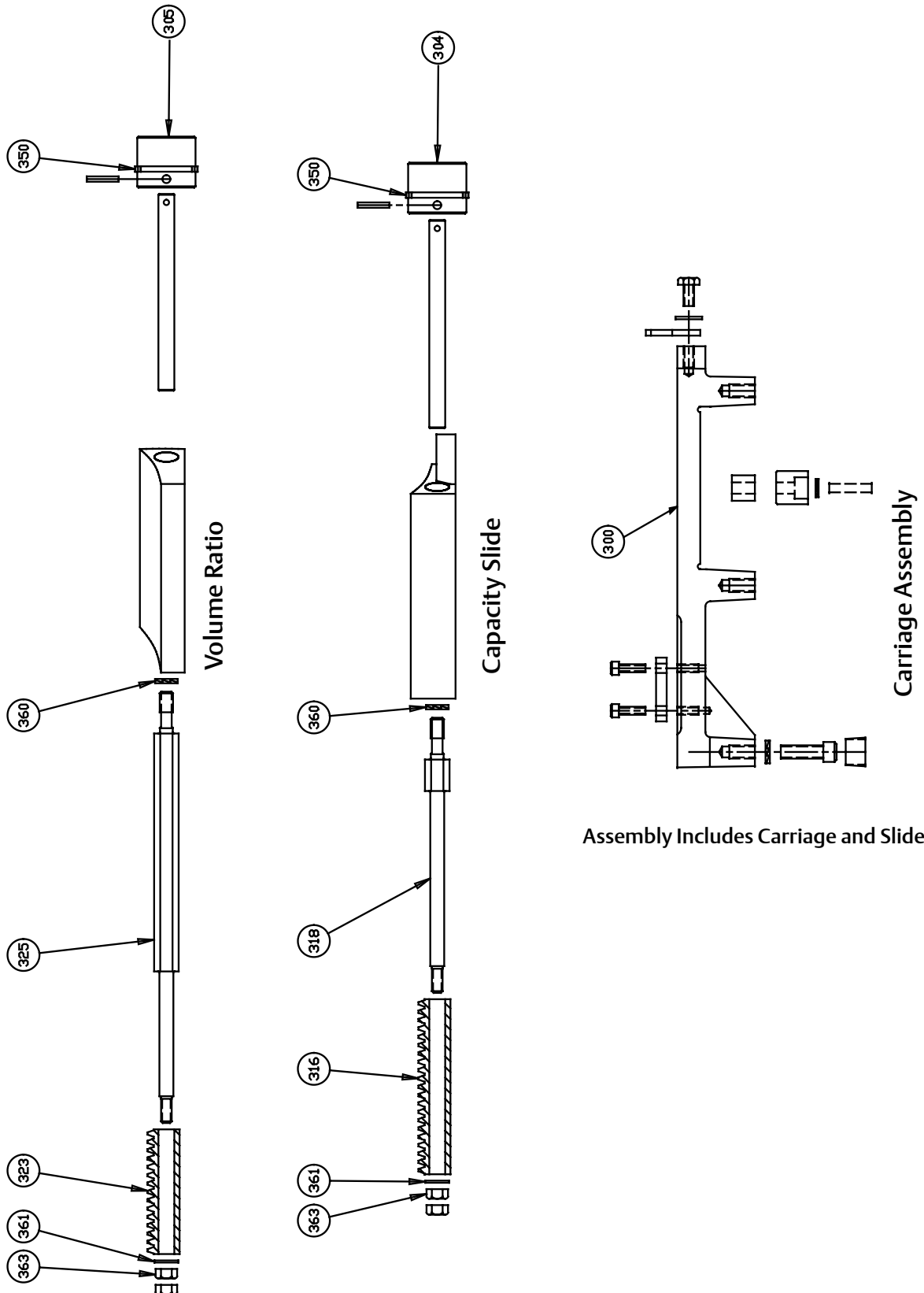
Slide Valve Cross Shafts and End Plate

ITEM	DESCRIPTION	MODEL NUMBER							
		QTY	VSM 301	VSM 361	VSM 401	QTY	VSM 501	VSM 601	VSM 701
			VPN	VPN	VPN		VPN	VPN	VPN
-	OIL BAFFLE ASSEMBLY (1) 217, (1) 244, (1) 248, (1) 249, (1) 252	1	A25942AA	A25942AA	A25942AA	1	A26034B	A26034B	A26034B
-	SHIM ASSORTMENT (2) 240, (2) 241, (1) 242, (1) 243	1	A25177A	A25177A	A25177A	1	A26035B	A26035B	A26035B
217	OIL BAFFLE PLATE	1	25938A	25938A	25938A		26045A	26045A	26045A
220	END PLATE	1	25719D	25719D	25719D	1	26025B	26025B	26025B
221	SHAFT	2	25941A	25941A	25941A	2	25843A	25843A	25843A
222	GEAR	4	25027A	25027A	25027A	4	25027A	25027A	25027A
227	CLAMP	4	25913A	25913A	25913A	-	N/A	N/A	N/A
228	SPACER	4	25847A	25847A	25847A	4	25847A	25847A	25847A
293	SHIM 0.002"	AR	25409AA	25409AA	25409AA	2	26027BA	26027BA	26027BA
294	SHIM 0.003"	AR	25409AB	25409AB	25409AB	2	26027BB	26027BB	26027BB
295	SHIM 0.005"	AR	25409AC	25409AC	25409AC	1	26027BC	26027BC	26027BC
296	SHIM 0.010"	AR	25409AD	25409AD	25409AD	1	26027BD	26027BD	26027BD
244	TEFLON RING	1	25939A	25939A	25939A	1	25929B	25929B	25929B
248	CHECK VALVE	1	3120A	3120A	3120A	1	3120A	3120A	3120A
249	CHECK VALVE	1	3120B	3120B	3120B	1	3120B	3120B	3120B
252	RETAINING RING	1	2829M	2829M	2829M	1	2928N	2928N	2928N
255	WASHER	-	N/A	N/A	N/A	2	25977E	25977E	25977E
256	WASHER	-	N/A	N/A	N/A	2	25977F	25977F	25977F
268	EXPANSION PIN	4	1193D	1193D	1193D	4	1193D	1193D	1193D
269	EXPANSION PIN	4	2981AA	2981AA	2981AA	4	2981AA	2981AA	2981AA
271**	PLUG SOLID	1	25422A	25422A	25422A	-	N/A	N/A	N/A
281	HEX HEAD CAP SCREW	6	2796N	2796N	2796N	8	2796B	2796B	2796B
286	SOCKET HEAD CAP SCREW	8	2795F	2795F	2795F	2	2795D	2795D	2795D
297	SET SCREW	2	2060J	2060J	2060J	2	2060J	2060J	2060J
298	SET SCREW	2	2060H	2060H	2060H	2	2060H	2060H	2060H

Note - **: Required at top located single gaterotor only.

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.

Slide Valve Carriage Assembly



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.

Slide Valve Carriage Assembly

ITEM	DESCRIPTION	MODEL NUMBER		
		QTY	VSM 301-401	VSM 501-701
			VPN	VPN
300	CARRIAGE ASSEMBLY	1	A25179A	A26012B
304	CAPACITY PISTON 340, 341, 350 & 355	1	A25183A	A25183B
305	VOLUME PISTON 340, 342, 350 & 355	1	A25184A	A25184B
316	CAPACITY RACK	1	25023BH	25024AH
318	CAPACITY RACK SHAFT	1	25772C	25772A
323	VOLUME RATIO RACK	1	25023CH	25023AH
325	VOLUME RATIO RACK SHAFT	1	25772D	25772B
350	PISTON RING SET	2	2953AE	2953AA
360	LOCK WASHER (PAIR)	2	3004C	3004C
361	WASHER	2	13265B	13265B
363	NUT	4	2797A	2797A
372*	SOCKET HEAD CAP SCREW	1	N/A	2795M

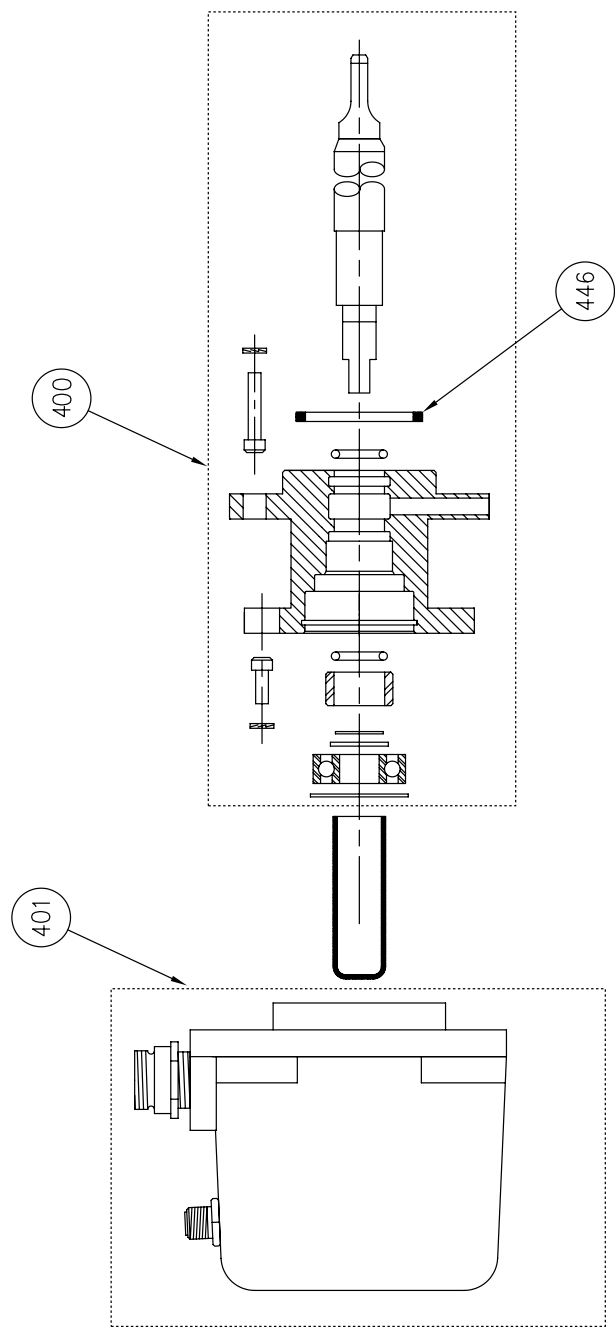
Notes -

There are two slide valve carriages per compressor. Each one each has its own Volume Ratio and Capacity slide valves. The above totals are per side of the compressor, double the quantities if both slide valve carriages are being worked on.

*: Not Pictured.

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Actuator and Command Shaft

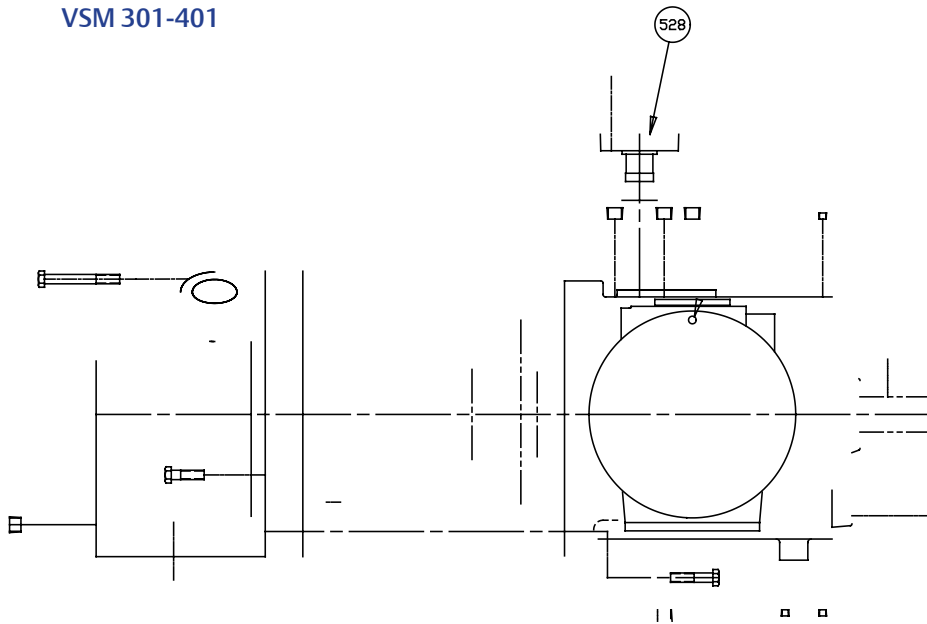


ITEM	DESCRIPTION	MODEL NUMBER		
		QTY	VSM 301-401	VSM 501-701
			VPN	VPN
400	COMMAND SHAFT ASSEMBLY	2	A25994A	A25994B
401	SLIDEVALVE ACTUATOR	2	25972D	25972D
446	O-RING SEAL	2	2176X	2176X

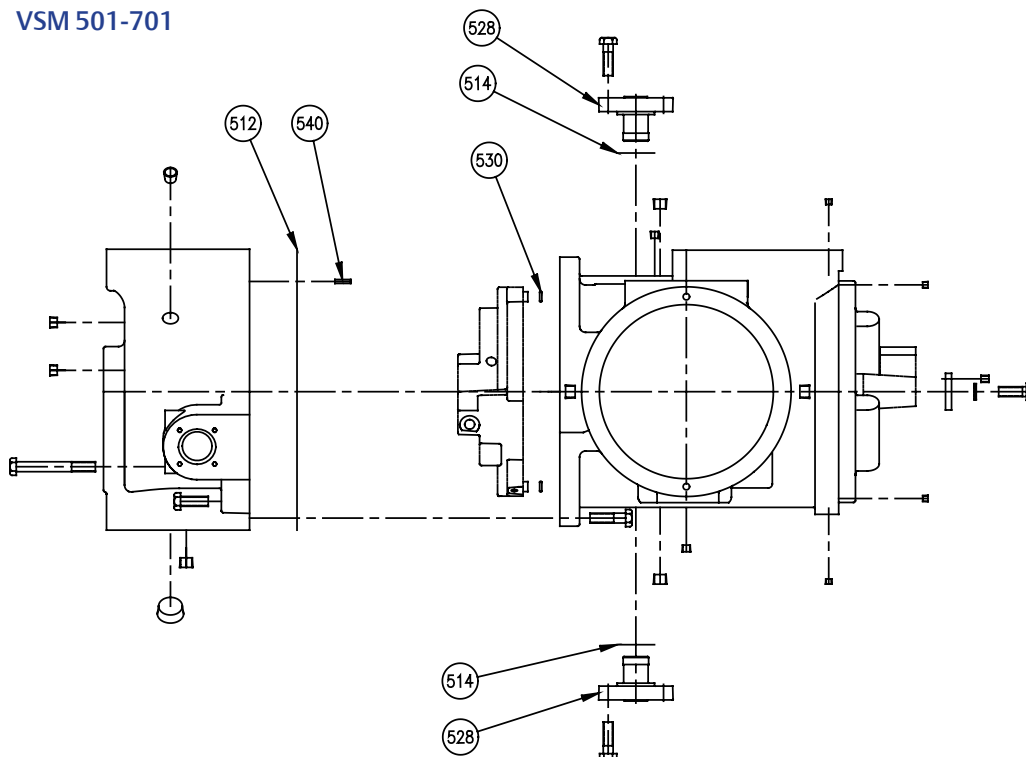
Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Miscellaneous Frame Components

VSM 301-401



VSM 501-701



Filter 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.

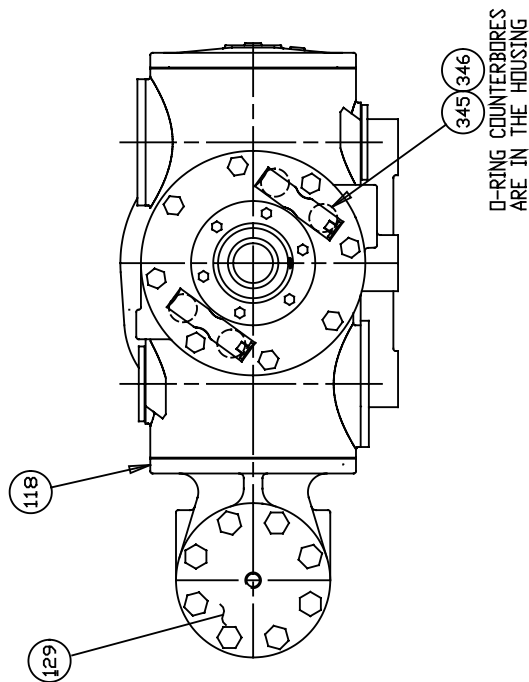
Miscellaneous Frame Components

ITEM	DESCRIPTION	MODEL NUMBER			
		VSM 301-401		VSM 501-701	
		QTY	VPN	QTY	VPN
512	MANIFOLD GASKET	1	25737A	1	26037A
514	ECON-O-MIZER GASKET	2	11323G	2	11323D
522	COUPLING LOCK PLATE	-	N/A	1	25004D
523	LOCK WASHER	-	N/A	1	3004H
528	ECON-O-MIZER PLUG	2	25419A	2	25397K
530	O-RING	-	N/A	2	2176BF
540	DOWEL PIN	2	2868B	2	2868B
542	PIPE PLUG	3	2606C	10	2606B
551	HEX HEAD CAP SCREW	-	N/A	2	2796C
570	BEARING OIL PLUG	1	25978A	-	N/A
571	PLUG	1	25979A	-	N/A
572	SPRING	1	3148A	-	N/A
*	GASKET / O-RING SET	1	KT1075A	1	KT1075B

Note - *: Not Pictured.

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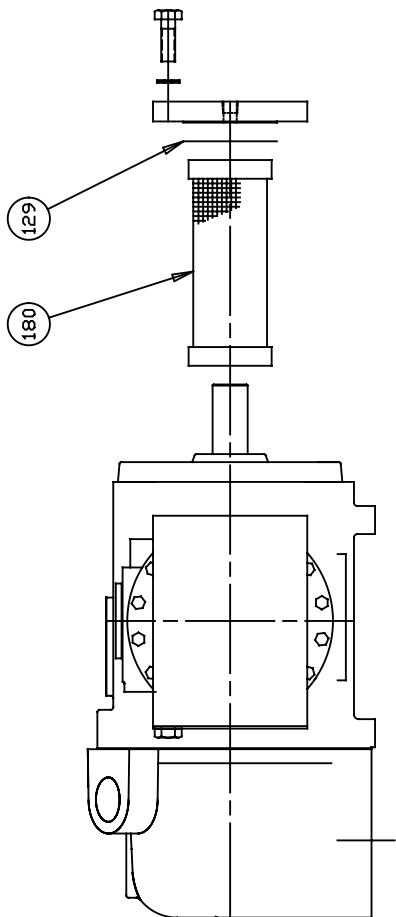
Housing Accessories



Housing Accessories

ITEM	DESCRIPTION	MODEL NUMBER	
		VSM 301-701	
		QTY	VPN
117	GATEROTOR COVER	1	25416B
118	COVER GASKET	2	25259B
129	GASKET	1	11323T
180	INLET SCREEN	1	25920A
343	PISTON COVER *	1	25724B

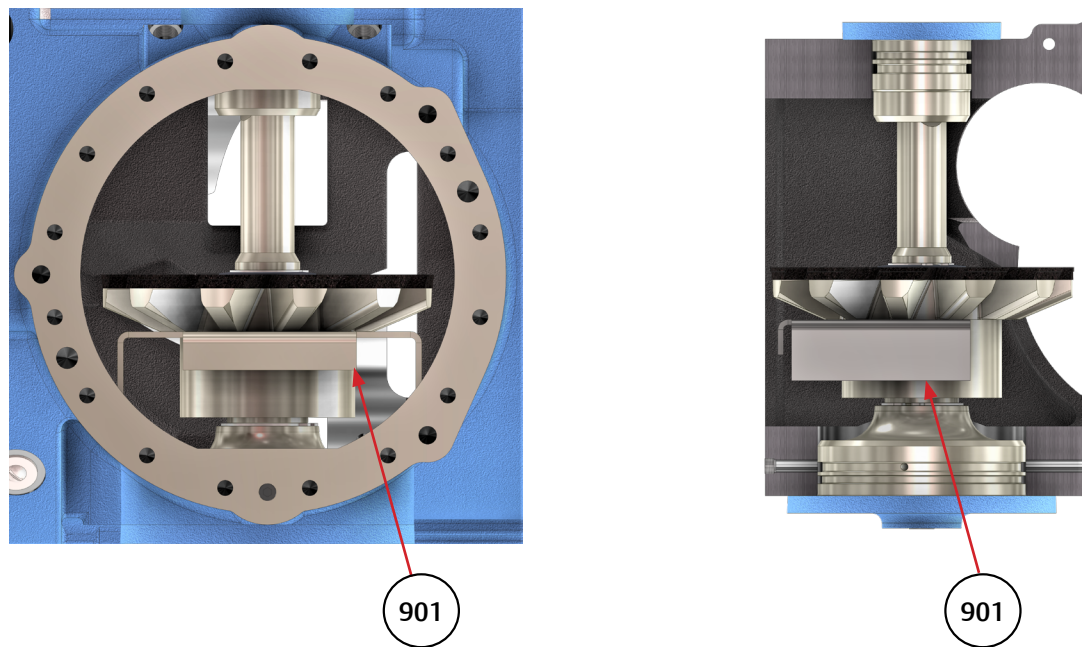
Note - *: Not Pictured.



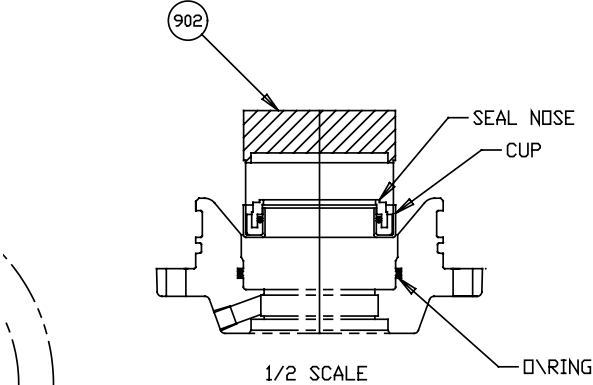
ITEM	DESCRIPTION	QTY	MODEL NUMBER	
			VSM 301-401	VSM 501-701
			VPN	VPN
345	O-RING	4	2176BX	2176CA
346	O-RING	2	2176BG	2176BG

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.

Replacement Tools



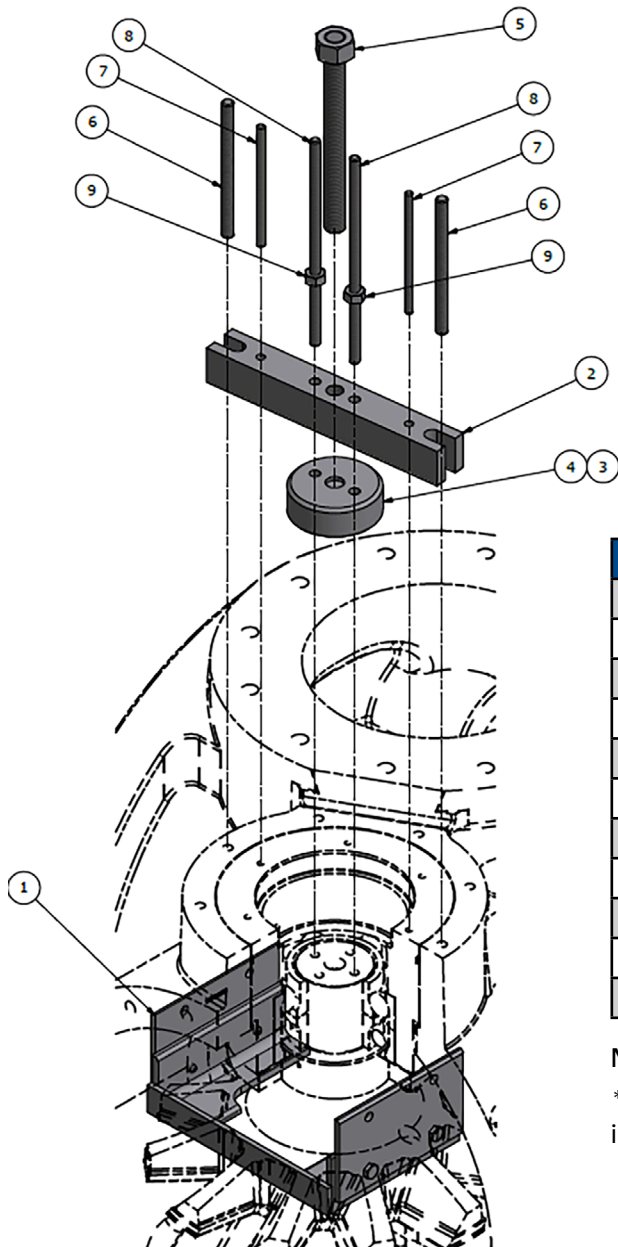
ITEM 902 IS USED TO SET THE STAINLESS STEEL SEAL "CUP" INTO THE SEAL HOUSING WITHOUT TOUCHING THE CARBON "SEAL NOSE"



ITEM	DESCRIPTION	QTY	MODEL NUMBER	
			VSM 301-401	VSM 501-701
			VPN	VPN
900	GATEROTOR TOOLS	1	A25205B	A25205B
901	GATEROTOR STABILIZER	1	25742A	25742B
902	SEAL INSTALLATION TOOL	1	25455A	25455B

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.

Replacement Tools



ITEM	DESCRIPTION	QTY	VPN
-	GATEROTOR TOOL SET	1	A25205B*
1	STABILIZER GATEROTOR ASSEMBLY	1	A25698A
2	BAR BEARING PULLER	1	25204A
3	SHOE PULLER 1.875	1	25157A
4	SHOE PULLER 2.500	1	25157B
5	JACKSCREW	1	A25156B
6	STUD .375-16 X 4.9	2	25908A
7	STUD .250-20 X 4.4	2	25908B
8	STUD .312-18 X 7.5	2	25908C
-	SCREW 1/4-20 NC X 1-3/4 CAP SOCK	2	2795W
9	PLAIN NUT 5/16-18NC-2B HEX	2	1726B

Note -

* Assembly A25205B contains all parts listed. Parts are shown independently for illustration purposes only.

Valter 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.

Appendix A • Torque Specifications

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 5 COARSE (UNC)			8	16	28	44	68	98	135	240	387
SAE GRADE 5 FINE (UNF)				16							
SAE GRADE 8 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 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.

Appendix A • Torque Specifications

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



Customer Name
Customer Address

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. #	*****

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
2939A	HMO	R717	5 gallon pail	R-717 (Ammonia)
2939AFG	HMO	717FG	55 gallon drum	R-717 (Ammonia)
2939B	HMO	R717	5 gallon pail	R-717 (Ammonia)
2939BFG	HMO	717FG	55 gallon drum	R-717 (Ammonia)
3098A	PAG	HC-68	5 gallon pail	R-290
3098B	PAG	HC-68	55 gallon drum	R-290
3099A	PAG	HC-100	5 gallon pail	Hydrocarbon
3100A	Naphthenic	VILTER D	5 gallon pail	R-22, R-123 & R-414A
3100B	Naphthenic	VILTER D	55 gallon drum	R-22, R-123 & R-414A
3101A	POE	FL-100	5 gallon pail	R-22
3101B	POE	FL-100	55 gallon drum	R-22
3103A	PAO	HCL-68	5 gallon pail	Ammonia
3103B	PAO	HCL-68	55 gallon drum	Ammonia
3103C	PAO	HCL-15	5 gallon pail	R-717
3105A	BLEND	F-68	5 gallon pail	R-22, R-123 & R-502
3105B	BLEND	F-68	55 gallon drum	R-22, R-123 & R-502
3106A	POE	B-68	5 gallon pail	All HFC applications (including R-134a, R-404A, R-407C, R-410A, R-507)
3106B	POE	B-68	55 gallon drum	All HFC applications (including R-134a, R-404A, R-407C, R-410A, R-507)
3107A	POE	B-120	5 gallon pail	R-134A, R-404A, R-407C, R-410A
3107B	POE	B-120	55 gallon drum	R-134A, R-404A, R-407C, R-410A
3143A	PAO-100	METHANE	5 gallon pail	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143B	PAO-100	METHANE	55 gallon drum	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143C	PAO-68	METHANE	5 gallon pail	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143D	PAO-68	METHANE	55 gallon drum	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143G	PAO-150	METHANE	5 gallon pail	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143H	PAO-150	METHANE	55 gallon drum	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143J	PAO-100	DIGESTER	5 gallon pail	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143K	PAO-100	DIGESTER	55 gallon drum	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3339A	PAO	CO ₂ GAS	5 gallon pail	CO ₂ , CO
3339B	PAO	CO ₂ GAS	55 gallon drum	CO ₂ , CO
3456A	POE	B-32	5 gallon pail	All HFC applications (including R-134a, R-404A, R-407C, R-410A)
3456B	POE	B-32	55 gallon drum	All HFC applications (including R-134a, R-404A, R-407C, R-410A)
3595A	HMO	NH3-100-CI	5 gallon pail	Ammonia
3595B	HMO	NH3-100-CI	55 gallon drum	Ammonia
3603B	POE	B-68AWAF	55 gallon drum	All HFC applications (including R-134a, R-404A, R-407C, R-410A, R-507)
3603C	POE	B-68AWAF	5 gallon pail	All HFC applications (including R-134a, R-404A, R-407C, R-410A, R-507)
3603D	POE	B-100AWAF	55 gallon drum	All HFC applications (including R-134a, R-404A, R-407C, R-410A, R-507)
3603E	POE	B-100AWAF	5 gallon pail	All HFC applications (including R-134a, R-404A, R-407C, R-410A, R-507)
3636A	PAO	CO ₂	5 gallon pail	Gas streams containing moisture, CO ₂ , CO and/or H ₂ S
3636B	PAO	CO ₂	55 gallon drum	Gas streams containing moisture, CO ₂ , CO and/or H ₂ S
3643A	PAO	XG 105-100	5 gallon pail	Hydrocarbon/natural gas
3643B	PAO	XG 105-100	55 gallon drum	Hydrocarbon/natural gas
3653A	POE	POE-100	5 gallon pail	Air Compressor Lubricant
3653B	POE	POE-100	55 gallon drum	Air Compressor 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.

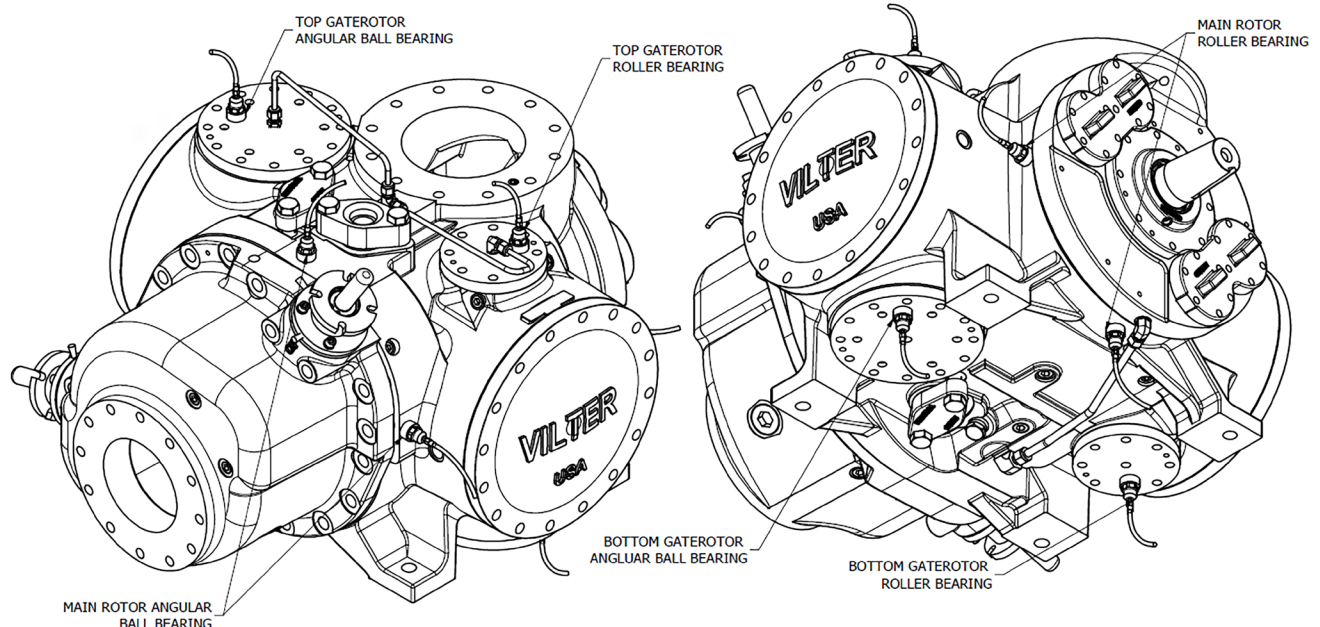


Figure C-1. Compressor Bearing Vibration Measurement Location

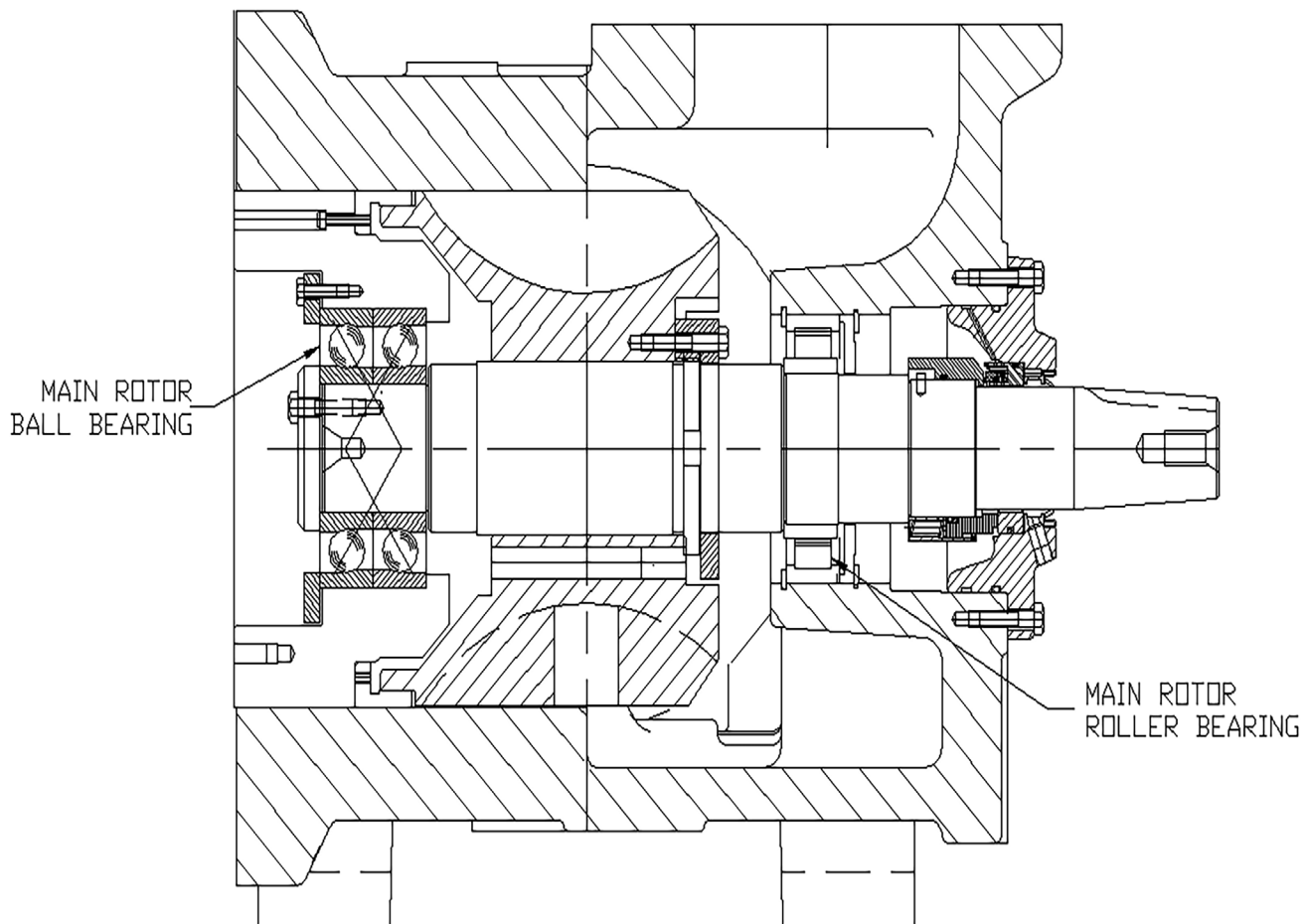


Figure C-2. Main Rotor Cross-Section VSS(C)/VSM(C) Compressors

Continuous and Non-continuous Monitoring

While it is common practice on large or critical machinery to have installed instrumentation for continuous on-line 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 hand-held 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.

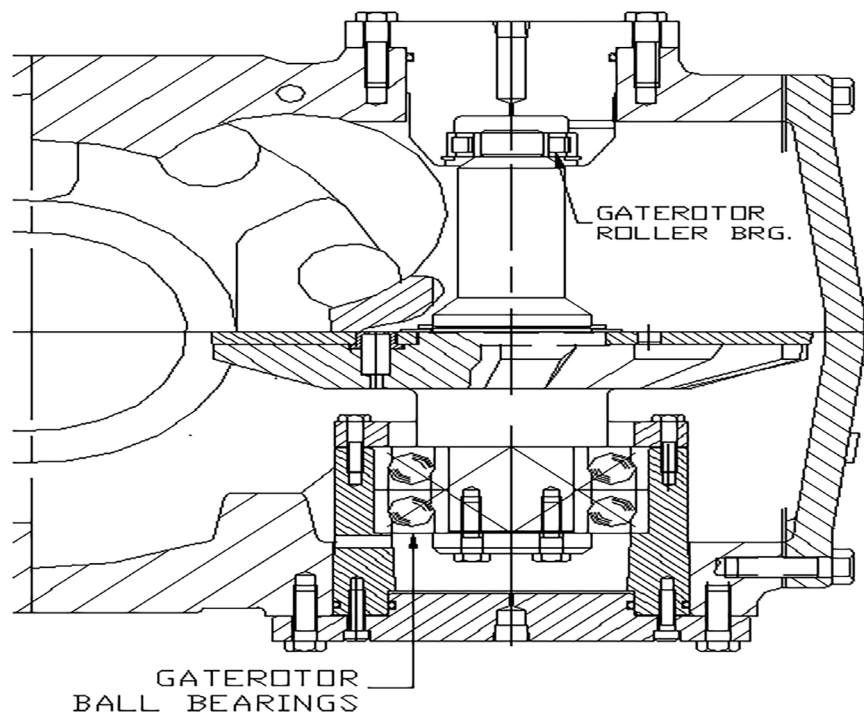
Criterion 1: Vibration Magnitude

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.



NOTE: GATEROTOR RPM = $6/11 (.545) \times$ MAIN SHAFT RPM

Figure C-3. Gaterotor Cross-Section VSS(C)/VSM(C) Compressors

Appendix C • Vibration Measurements - Single Screw Compressor

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 its 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.

Appendix D

Liquid Injection Valve Setup Instructions and ICM/ICAD Motorized Valve Quick Start Guide

Danfoss ICM/ICAD Valve Setup Instructions

The following items need to be setup in order for the valve to operate properly.

1. Press the “Circle” button on the valve. A value of “01” should be shown on the screen.
2. Press the “Circle” button. There should be a value of “1” shown. If not use the up/down arrows to change it to the correct value. Press the “Circle” button when done.
3. Press the “Up” arrow button. A value of “02” should be shown on the screen.
4. Press the “Circle” button. There should be a value of “1” shown. If not use the up/down arrow buttons to change it to the correct value. Press the “Circle” button when done.
5. Press the “Up” arrow button. A value of “03” should be shown on the screen.
6. Press the “Circle” button. There should be a value of “2” shown. If not, use the up/down arrow buttons to change it to the correct value. Press the “Circle” button when done.
7. Press the “Up” arrow button until a value of “04” is shown on the screen.
8. Press the “Circle” button. There should be a value of “50” shown. If not, use the up/down arrow buttons to change it to the correct value. Press the “Circle” button when done.
9. Press the “Up” arrow button until a value of “07” is shown on the screen.
10. Press the “Circle” button. There should be a value of “1” shown. If not, use the up/down arrow buttons to change it to the correct value. Press the “Circle” button when done.
11. Press the “Up” arrow button until a value of “10” is shown on the screen.
12. Press the “Circle” button. Press the up/down arrow button to change the value to “11”. Press the “Circle” button.
13. Press the “Up” arrow button until a value of “26” is shown on the screen.
14. Press the “Circle” button. Press the up/down arrow buttons to change the value to the correct valve that is on the unit. The value number is listed on the valve. The values and valves are as follows:
 - 0: No valve selected. Alarm A1 will become active.
 - 1: ICM20 with ICAD 600
 - 2: ICM25 with ICAD 600
 - 3: ICM32 with ICAD 600
 - 4: ICM40 with ICAD 900
 - 5: ICM50 with ICAD 900
 - 6: ICM65 with ICAD 900
15. Press the “Circle” button.

The valve is now ready to be used.

ENGINEERING
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Quick Start Guide

ICM/ICAD Motorized Valves

Installation, Programming, and Troubleshooting



- The ICM motorized valve is comprised of up to 4 components:
- the valve body – often referred to as the ICV body because it is used for ICM motor valves, ICS pilot operated valves and ICLX solenoid valves.
 - the function module – the flow regulating part of the valve
 - the top cover – on the ICM 20 through 65, the function module and top cover are one part
 - the ICAD motor actuator – the “brains” of the valve

ICM/ICAD overview

The combinations of valve and actuator are as follows:

Actuator	ICAD 600A	ICAD 1200A	Old ICAD 600*	Old ICAD 900*	Old ICAD 1200*
Valve Size	ICM 20	ICM 40	ICM 20	ICM 40	ICM 40
Valve Size	ICM 25	ICM 50	ICM 25	ICM 50	ICM 50
Valve Size	ICM 32	ICM 65	ICM 32	ICM 65	ICM 65
Valve Size		ICM 100			ICM 100
Valve Size		ICM 125			ICM 125
Valve Size		ICM 150			ICM 150

* ICAD 600, 900 and 1200 were discontinued at the end of 2014. ICAD 600A is a direct replacement of ICAD 600 and ICAD 1200A is a direct replacement of ICAD 900 or ICAD 1200.



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1 st and 2 nd generation ICAD differences	4
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Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

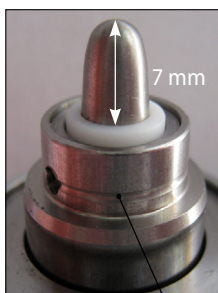
Identifying ICM sizes

All ICM sizes except ICM 20 have a stainless steel ID tag located around the valve stem on the top cover which the ICAD mounts on. When the ICAD is mounted it can be difficult to locate this. The sticker on the valve body of the large valves states ICM and the valve size because the body is shared between the ICM motor valves, ICS pilot operated valves and ICLX solenoid valves.

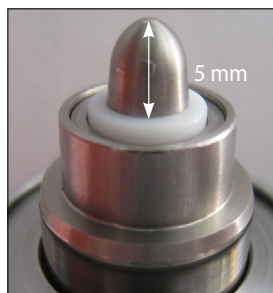
The ICV size is the same size as the ICM size which is needed during programming. ICM 20 only has a sticker on the side of the valve body to identify the size.

If the sticker is missing the size can be identified by the shape of the cone. The below figure shows how to identify the ICM 20 size by looking at the cone.

Different ICM 20 cone and orifice designs



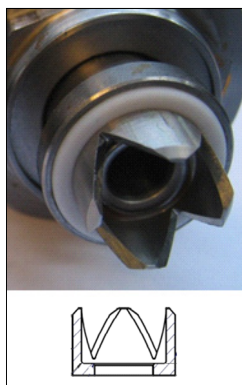
ICM20-A33
A33 has a groove here for identification



ICM20-A (2nd gen.)
Introduced mid 2009



ICM20-A (1st gen.)
Discontinued mid 2009



ICM20-B66
Introduced Jan. 2011



ICM20-B



ICM20-C

Note:

The outside edges of the B66 cone has more of a cylindrical shape compared to the B cone which forms more of a conical shape.

ICM 20 orifice (valve seat)



ICM 20-A33
ICM 20-A (2nd gen.)



ICM 20-A (1st gen.), ICM 20-B,
ICM 20-B66, ICM 20-C

Appendix D • Liquid Injection Valve Setup Instructions and Quick Start Guide

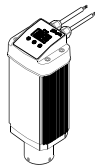
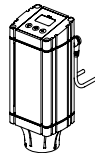


Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Differences between 1st and 2nd generation ICAD motor actuators

The 2nd generation ICAD was released in the beginning of 2010. The part numbers on the label for the 2nd generation start with 027H9... and the 1st generation part numbers started with 027H12... The cables of the 1st generation were mounted through cable glands located in the plastic top whereas the 2nd generation has the cables mounted on connectors located in the aluminum body.

Note: The wire colors are different between the two generations and the following is a table with the differences and pictures of old and new generation.

		1 st Generation ICAD	2 nd Generation ICAD
			
Power cable (3-wire)	+ 19-24 V d.c. fail safe supply	White (+)	Black (+)
	+ 24 V d.c.	Brown (+)	White (+)
	- 24 C d.c. (GND)	Green (-)	Brown (-)
Communication cable (7-wire)	Digital output (common alarm)	White (-)	Black (-)
	Digital output (ICM fully open)	Brown (-)	Brown (-)
	Digital output (ICM fully closed)	Green (-)	Red (-)
	GND - ground	Yellow (-)	Orange (-)
	Analog input (0/4-20 mA)	Grey (+)	Yellow (+)
	Analog input 0/2-10 V / Digital ON/OFF input	Pink (+)	Green (+)
	Analog output 0/4-20 mA	Blue (+)	Blue (+)



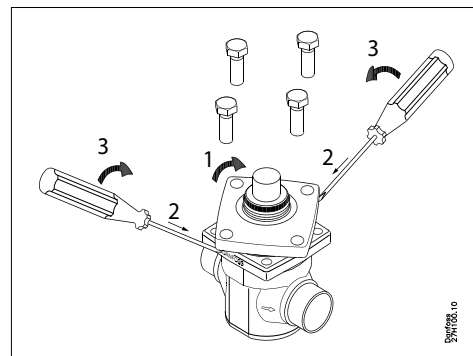
Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Installation

1. All ICM valves and ICAD motor actuators must be installed in horizontal pipelines with the motor actuator in an upright position.
2. Preparation of Valve Body
 ICM 20 (3/4") valves: both the integrated bonnet/function module and the separate valve seat must be removed from the valve body prior to welding. To remove the ICM20-A33 or ICM20-A valve seat use a 13mm socket and to remove the ICM20-B66, ICM 20-B or ICM20-C valve seat, use a 12 mm hex key.

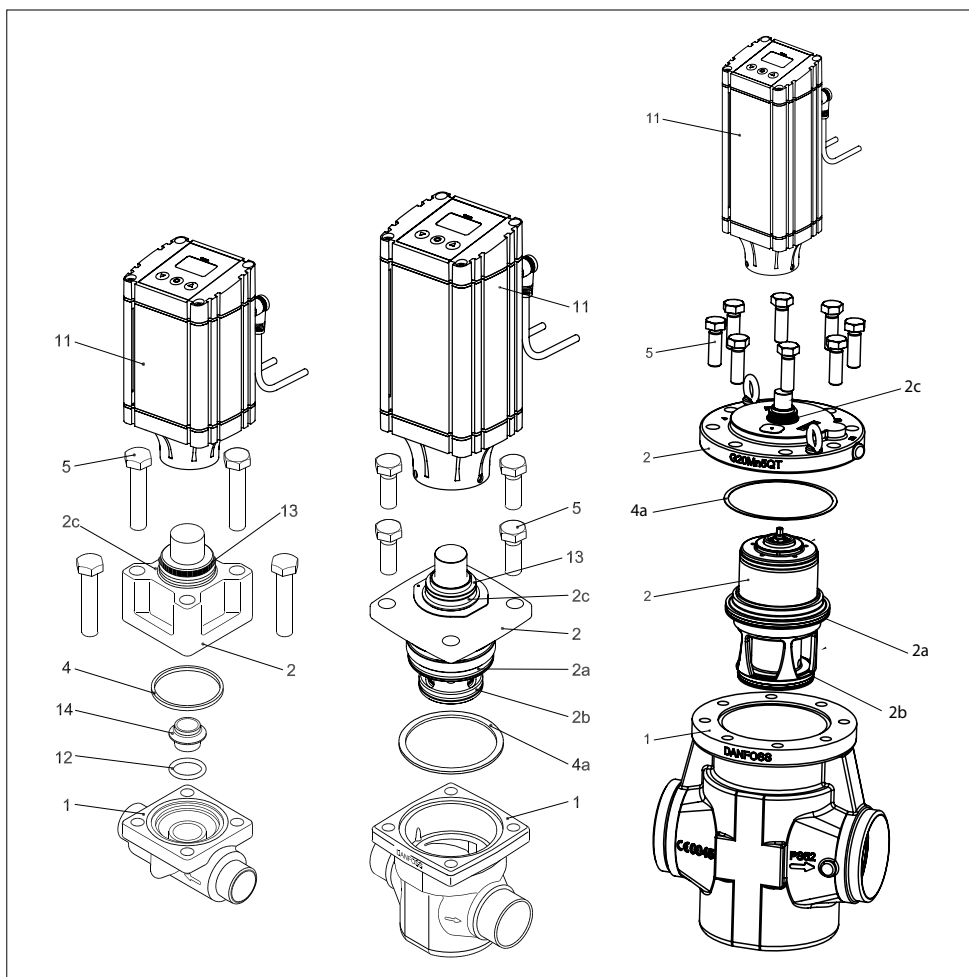
 - ICM 25 to 65 (1" to 2-1/2") valves, the integrated bonnet and function module should be removed as shown in the figure.

 - ICM 100 to 150 (4" to 6") valves, the function module and bonnet are separate pieces and do not need to be removed prior to welding. However, some form of arc welding should be used to weld the valve into the piping and care should be taken to protect the valve stem from becoming contaminated.



Removing the bonnet/function module from the body of the ICM 25 to 65 valves.

No.	Part
1	Housing
2	Top cover / function module
2a	O-ring
2b	O-ring
2c	O-ring
4	Gasket
4a	Gasket
5	Bolts
11	Actuator
12	O-ring
13	O-ring
14	Seat





Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Installation (continued)

Care should be taken to protect the ICM function module when it is removed and stored during installation of valve body.

3. Weld the valve body in line making sure that the arrow on the valve body is pointing in the direction of flow.
 - For ICM 20 through 65, make sure that all debris is removed from valve body before bonnet/function module is re-installed.
 - For the ICM 20, make sure that the removable orifice seat is re-installed in the valve body with the small o-ring between the orifice seat and the body. Use a 13mm socket to tighten the ICM20-A33 or ICM20-A valve seat to a torque of 6.5 ft-lbs (9 N-m). Use a 12 mm hex key to tighten the ICM 20-B66, ICM20-B or ICM20-C valve seat to a torque of 1.5 ft-lbs (2 Nm).
DO NOT OVERTIGHTEN THE REMOVABLE SEAT.
Make sure that the bonnet gasket is installed and in good condition.
 - For the ICM 25 through ICM 65, check that the two o-rings are installed on the function module and that the gasket located on the top of the valve body is installed and all are in good condition.
A light coating of refrigerant oil on the bonnet o-rings and the cover gasket will facilitate assembly of the valve.

4. Install the bolts and torque to the following specifications:

Valve Body	Nm	ft lbs
ICM 20	40	29
ICM 25	100	74
ICM 32	120	88
ICM 40	120	88
ICM 50	140	103
ICM 65	150	110
ICM 100 through 150	220	162

5. Install the ICAD Motor on the ICM valve:

The ICM valve must not be in its full opened position while the ICAD motor is calibrated with the valve (at a later step). Therefore, if the opening degree of the ICM valve was changed from the factory setting, it should be set to an opening degree between 0% and 75% using the manual magnet tool. To easily ensure correct positioning, turn the manual tool counter-clockwise until it is clear that it cannot be turned any further.

 - Make sure that the ICM adapter/valve stem and inner ICAD magnets are completely dry and free from any debris.
 - The ICM adapter O-ring (position 2c in the diagram on page 5) must be removed and Molycote 55 grease (supplied with ICAD motor) needs to be applied in the O-ring groove on the adapter and on the O-ring before it is re-installed on the ICM adapter.
The Molycote grease ensures a good seal between the ICAD motor and the ICM adapter to prevent moisture from entering the ICAD magnets.
 - Place the ICAD motor on the valve stem.
 - Push the ICAD motor completely down to the identification ring on the valve stem. Using a 2.5 mm hex key, tighten the set screws evenly so the ICAD motor is centered on the ICM valve stem. Torque the set screws to approximately 3 Nm (2.5 ft-lbs).

Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Electrical data

Supply voltage is galvanically isolated from input and output wires

Supply Voltage	24 VDC + 10%/-15%	Fail Safe Supply	Min. 19 VDC
Load	ICAD 600A 1.2 A ICAD 1200A 2.0 A	ICAD 600A 1.2 A ICAD 1200A 2.0 A	
Analog Input – Current or Voltage		Analog Output	
Current	0/4 – 20 mA Load: 200Ω	0/4 – 20 mA Load: ≤ 250 Ω	
Voltage	0/2 – 10 VDC Load: 10k Ω		

Digital Input – Digital On/Off input by means of voltfree contact with gold-plated contacts recommended

Voltage Input Used

ON: contact impedance < 50 Ω

OFF: contact impedance > 100 k Ω

Digital Output: 3 pcs. NPN transistor output

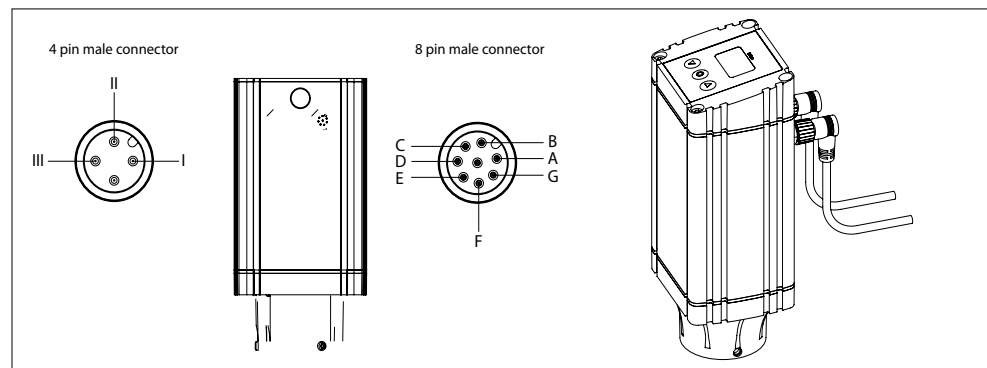
External Supply: 5 – 24 VDC (same supply as for ICAD can be used but note that galvanically isolated system will be spoiled.

Output Load: 50 Ω

Load Max. 50 mA

Wiring the ICAD actuator

There are two cables which are connected to the ICAD motor with M12 connectors:



Communication connector / cable

Ref.	Color		Description	
A	Black	-	Common Alarm	} Digital Output
B	Brown	-	ICM fully open	
C	Red	-	ICM fully closed	
D	Orange	-	GND ground	
E	Yellow	+	0/4 - 20 mA Input*	
F	Green	+	0/2 - 10 V Input. Also used with GND (orange wire) as a digital input #1 for on-off operation or floating 3-point control	
G	Blue	+	0/4 - 20 mA Output*	

Power connector/cable (3 wires)

I	Black	+	Fail safe supply Battery / UPS (uninterruptable power supply) 19 V d.c.
II	White	+	Supply voltage
III	Brown	-	24 V d.c.

* If using floating 3-point control (parameter i02=3) then wire colors yellow and blue are combined to make the 2nd digital input

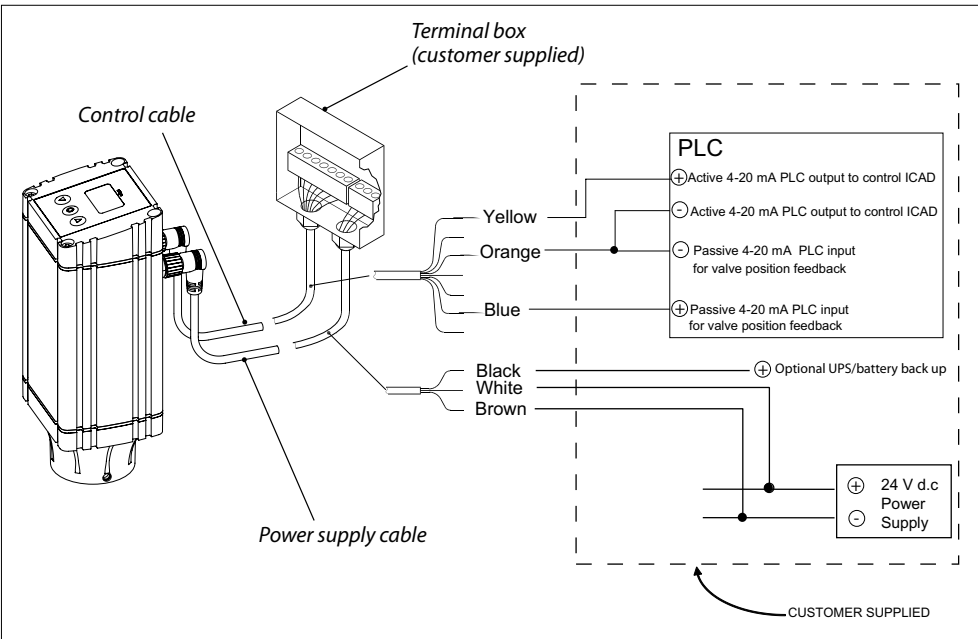


Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Wiring the ICAD actuator

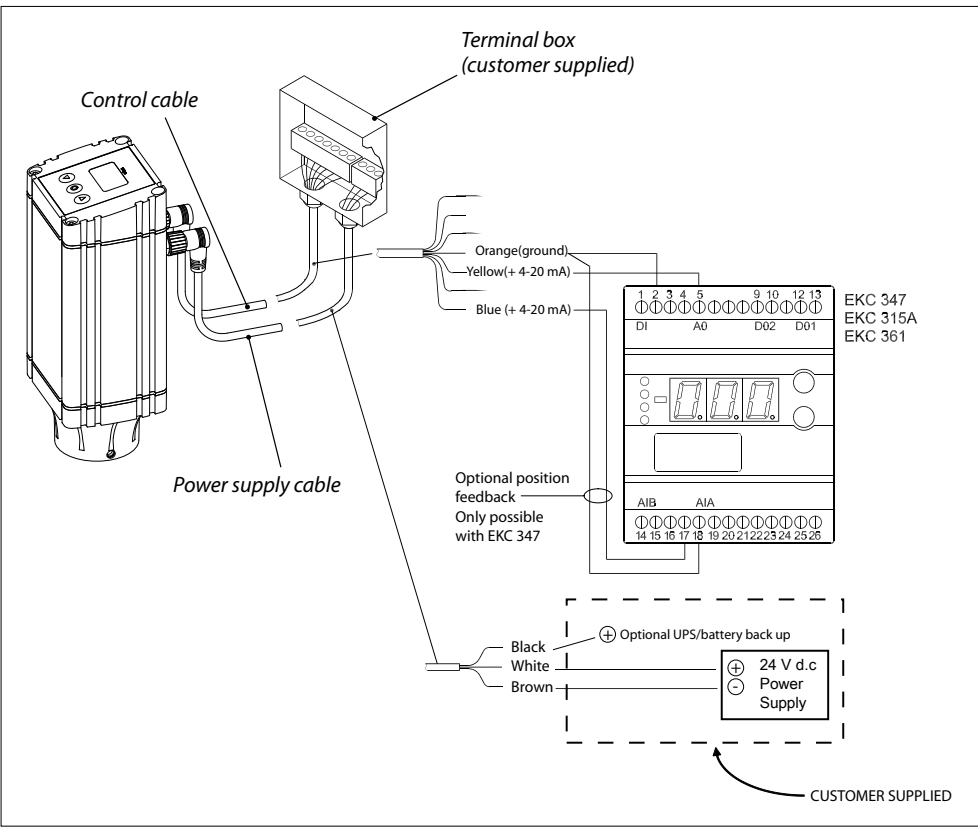
Wiring diagram showing ICAD wired to a PLC or other type of third party electronics

Note: The ICAD supplies the power for the 4-20 mA feedback signal.



Wiring diagram showing ICAD wired to a Danfoss EKC controller

Note: For instructions on completely wiring an EKC controller, please see the relevant EKC controller manual.



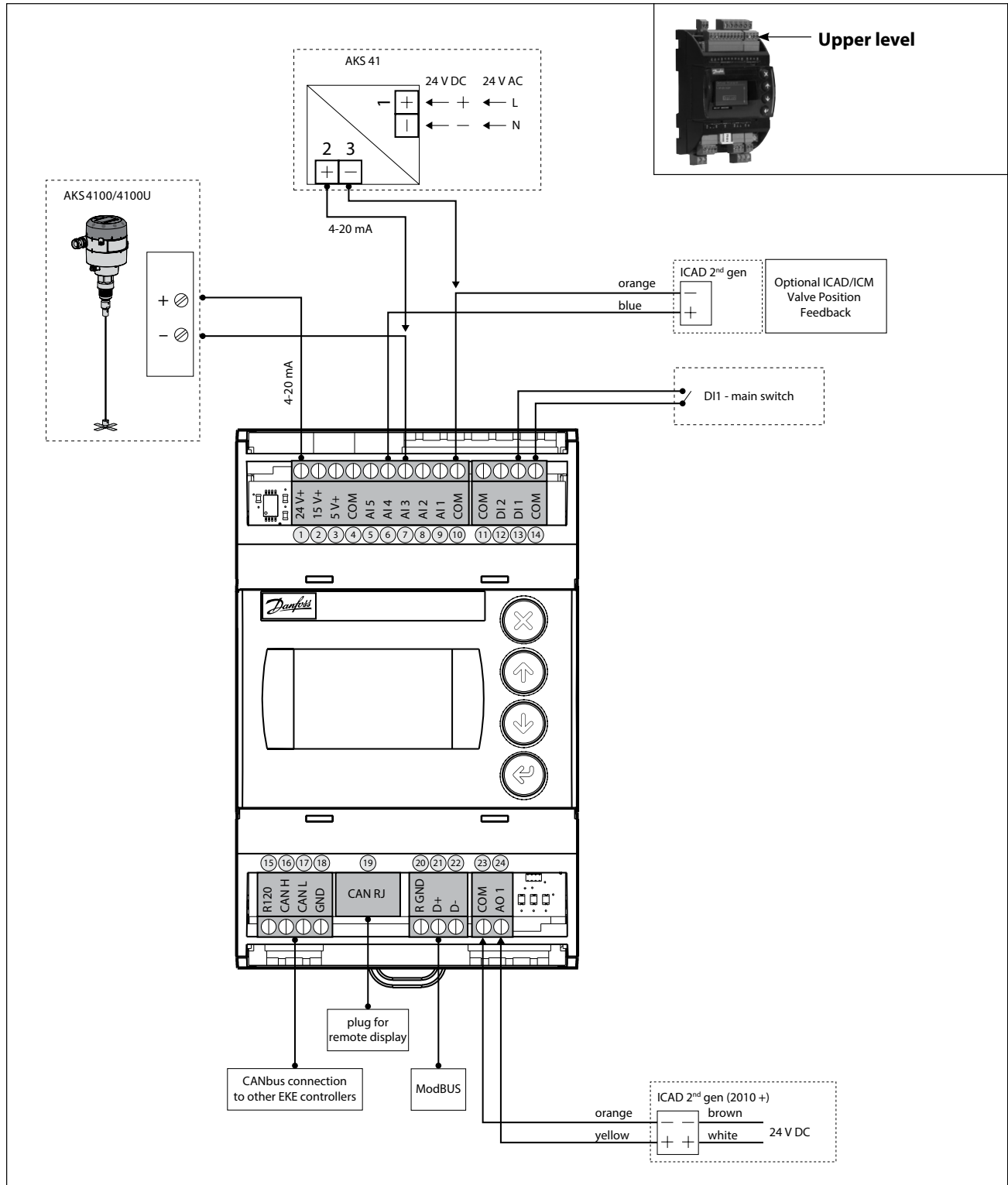


Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Wiring the ICAD actuator continued

Wiring diagram showing ICAD wired to a Danfoss EKE controller

Note: For instructions on completely wiring an EKE controller, please see the relevant EKE controller manual.

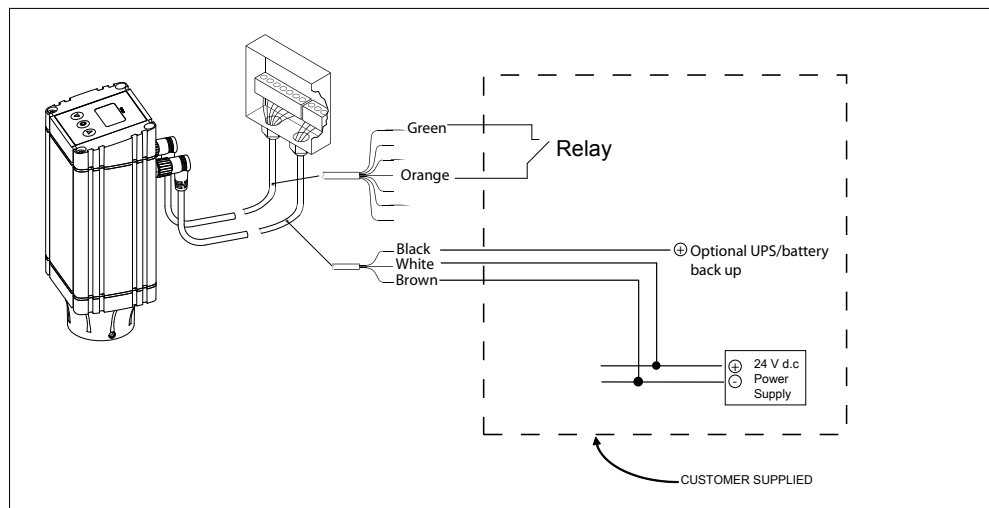




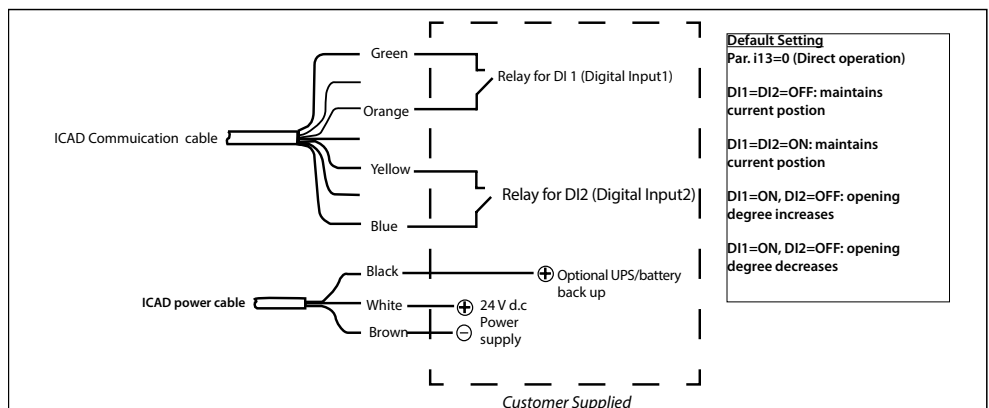
Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Wiring the ICAD actuator
continued

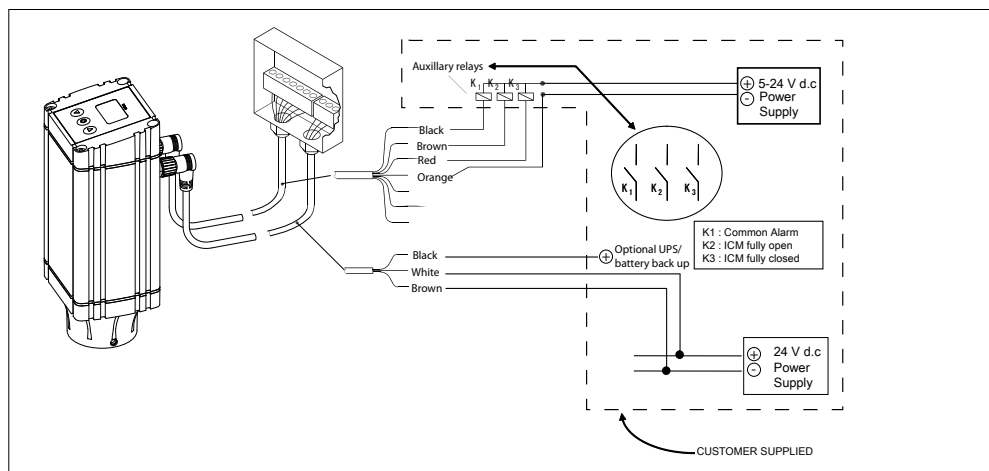
Wiring diagram showing ICAD wired with one digital input for ON/OFF solenoid valve operation
Note: The ICAD motor can be programmed to open or close when the relay is closed. See parameter j09 in programming section.



Wiring diagram for floating 3-point control (open-neutral-close)



Wiring diagram showing ICAD digital outputs wired with customer supplied auxiliary relays
NOTE: The same 24 V d.c. power that powers the ICAD can be used with the ICAD digital outputs to power auxiliary relays (or other small load devices) but the system will no longer be galvanically isolated.





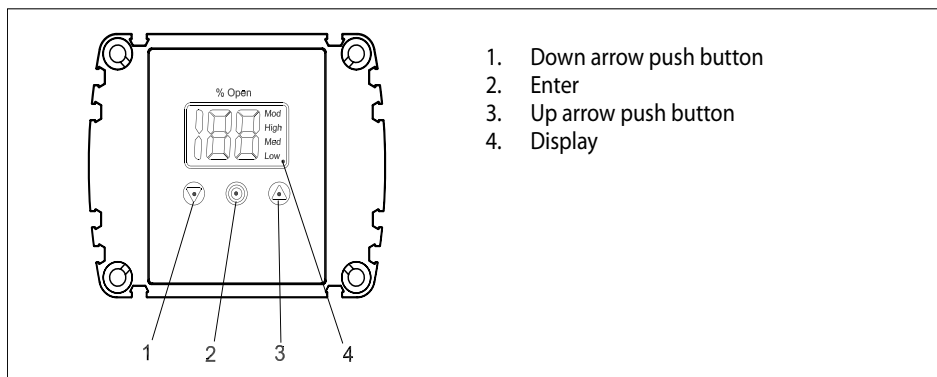
Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

ICAD overview

1. All ICAD actuators are digital stepper motors. As the control signal changes ICAD will electronically count steps up or down from its previous position. The ICAD 600A, ICAD 1200 and 1200A have an optical encoder which will actually measure the steps to recalibrate while operating if needed. In all cases, the ICAD actuators will recalibrate every time that power is cut and then reconnected. Recalibration is also accomplished when the valve is driven closed, the ICAD will take an extra closing step to make sure it is completely closed and start counting from 0 again.
2. The ICAD actuators can also be put into manual mode by using parameter **i01**. Once the parameter has been selected and the manual mode entered, the valve can be opened and closed independent of the control signal. When in the manual mode, the display screen will flash the opening degree and continue to flash until the parameter is restored to its normal operation setting.
3. The ICAD actuator can be controlled with an analog input for modulating control, 1 digital input for open/close solenoid function or with 2 digital inputs for floating 3-point control (open-neutral-close). The speed of the ICAD can be altered (see parameters **i04** and **i14**).
4. The ICAD display will continuously display the ICM valve opening degree in % unless there is an alarm or the parameter list is being viewed. The display will also indicate **Mod** if being controlled by an analog input signal (modulating mode) or if being controlled by digital inputs the display will indicate **Low**, **Med** or **High** depending on the speed setting.
5. The ICAD actuator can be connected to a 24 V d.c. UPS (uninterruptable power supply) and can be programmed for a specific action in the event of a disruption to the normal power supply (see parameters **i07**, **i08** and **i12**). Please note that the UPS provides a discrete short term action in the event of a power failure. It cannot be used for normal operation.
6. The ICAD actuator also has an inverse function (see parameter **i13**). This feature allows the valve to either open or close on a rising analog signal.

Operation the ICAD menu

1. To access the ICAD actuator menu, press and hold the middle button (2) until the menu appears.



2. Once you are in the menu, use the UP (3) and DOWN (1) arrows to move through the list of parameters.
3. To display and/or change the value of the parameter, press the middle button (2) to view the current settings.
 - a) To change the value of a parameter, use the up or down arrow to establish the new value for that parameter.
 - b) Once the new value for the parameter has been selected, press the middle button to save the change and return to the menu.
4. Repeat this procedure for all parameters.
5. Exit from the parameter list by pressing and holding the middle button for 2 seconds or simply wait for the ICAD to return to the main display (approx. 20 seconds).

Appendix D • Liquid Injection Valve Setup Instructions and Quick Start Guide



Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Programming the ICAD actuator

When the ICAD actuator is first powered on, the ICAD display will flash an A1 alarm. This alarm is a reminder that the ICM valve being moved by the ICAD has not been selected in parameter **i26**. Parameter **i26** is password protected and will not appear in the parameter list until the user enters the password in parameter **i10**. The password is "11" and will allow the user to access parameter **i26** where the appropriate valve size can be selected. Once the ICM valve size is selected (see page 3 on how to identify ICM size), the ICAD actuator will calibrate itself to that particular size and will then be ready to receive a control signal.

Description	ICAD parameter	Min	Max	Factory Setting	Stored	Unit	Password	Comments
OD (Opening degree)	-	0	100			%	-	ICM/ICMETS valve Opening Degree (CVE pressure setting) is displayed during normal operation. Running display value (see i01 , i05).
Main Switch	i01	1	2	1	✓	-	No	Internal main switch 1: Normal operation 2: Manual operation. Valve Opening Degree will be flashing. With the down arrow and the up arrow push buttons the OD can be entered manually.
Mode	i02	1	2	1	✓	-	No	Operation mode 1: Modulating – ICM, ICMETS & CVE positioning according to Analog Input (see i03) 2: ON/OFF – ICM only. Operating the ICM valve like an ON/OFF solenoid valve controlled via Digital Input. See also i09 . 3: Neutralzone / 3 point control – ICM only. Increase/Decrease Opening Degree by Digital Input. See fig. 9
AI signal	i03	1	4	2	✓	-	No	Type of AI signal from external controller 1: 0 – 20 mA 2: 4 – 20 mA 3: 0 – 10 V 4: 2 – 10 V
Speed In Modulating Mode Opening/closing speed In ON/OFF Mode Opening speed In Neutralzone/ 3 point control Opening speed = 10	i04	1	100	50/ 100	✓	-	No	Speed can be decreased. Max. speed is 100 % - Not active in manual operation (i01 = 2) For CVE the speed should not exceed 50 (factory setting) If i26 = 1 - 3 then factory setting =100 If i26 = 4 - 10 then factory setting =50 If the valve is opening and (i04 <= 33) or the valve is closing and (i14 <= 33) => Low is displayed. If the valve is opening and (33 < i04 <= 66) or the valve is closing and (33 < i14 <= 66) => Med is displayed. If the valve is opening and (i04 >= 67) or the valve is closing and (i14 >= 67) => High is displayed"
Automatic calibration	i05	0	2	0		-	No	Not active before i26 has been operated. Always auto reset to 0. CA will flash in the display during calibration, if Enter push button has been activated for two seconds 0: No Calibration 1: Normal forced calibration - CA flashing slowly 2: Extended calibration – CA flashing rapidly"
AO signal	i06	0	2	2	✓	-	No	Type of AO signal for ICM valve position 0: No signal 1: 0 – 20 mA 2: 4 – 20 mA
Failsafe	i07	1	4	1	✓	-	No	Define condition at power cut and fail safe supply is installed. 1: Close valve 2: Open Valve 3: Maintain valve position 4: Go to OD given by i12 "
Fail safe supply	i08	0	1	0	✓		Yes	Fail safe supply connected and enable of A4 alarm: 0: No 1: Yes
DI function	i09	1	2	1	✓		No	Define function when DI is ON (short circuited DI terminals) when i02 = 2 1: Open ICM valve (DI = OFF => Close ICM valve) 2: Close ICM valve (DI = OFF => Open ICM valve)
Password	i10	0	199	0		-	-	Enter number to access password protected parameters: i26 Password = 11
Old Alarms	i11	A1	A99	-		-	No	Old alarms will be listed with the latest shown first. Alarm list can be reset by means of activating down arrow and up arrow at the same time for 2 seconds.
OD at power cut.	i12	0	100	50	✓		No	Only active if i07 = 4 If fail safe supply is connected and power cut occurs, the valve will go to the specified OD.
Inverse operation	i13	0	1	0	✓		No	When i02 = 1 0: Increasing Analog Input signal => Increasing ICM Opening Degree 1: Increasing Analog Input signal => Decreasing ICM Opening Degree When i02 = 3 0: DI1 = ON, DI2 = OFF => Increasing valve Opening Degree. DI1 = OFF, DI2 = ON => Decreasing valve Opening Degree DI1 = DI2 = OFF => ICAD/ICM maintain current position DI1 = DI2 = ON => ICAD/ICM maintain current position 1: DI1 = ON, DI2 = OFF => Decreasing ICM Opening Degree DI1 = OFF, DI2 = ON => Increasing ICM Opening Degree DI1 = DI2 = OFF => ICAD/ICM maintain current position DI1 = DI2 = ON => ICAD/ICM maintain current position

Appendix D • Liquid Injection Valve Setup Instructions and Quick Start Guide



Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Parameter list

(continued)

Description	ICAD parameter	Min	Max	Factory Setting	Stored	Unit	Password	Comments
In ON/OFF Mode Closing speed In Neutralzone/ 3 point control Closing speed = 10	i14	0	100	50/100	✓	-	No	See i04. Not applicable to CVE If i26= 1 - 3 then factory setting = 100 If i26= 4 - 10 then factory setting = 50
Manual set point	i15	0	100	0		-	No	When i01= 2, i15 determine the start up value
Encoder operation	i16	0	1	1	✓	-	Yes	NB: Password protected. Password = 7 0: Encoder disabled. Means ICAD operation as ICAD 600A/ICAD 600A-TS/1200A without encoder. 1: Encoder enabled
Forced closing when ICM valve Opening Degree < 3%	i17	0	1	0	✓	-	No	Enable/Disable forced closing. Not applicable to CVE 0: When ICM valve Opening Degree < 3% it will be forced to close regardless of requested ICM valve Opening Degree 1: When ICM valve Opening Degree < 3% no forced to closing will take place
Action when ICAD is losing step See Note 1	i18	0	6	6	✓	-	No	Action when ICAD is losing step. 0: A boost starts if lost step is detected. After 15 sec, the A9 alarm is flashing and DO A Common Alarm is ON. A second boost starts after the time in i19 has elapsed. If the second boost cyklus does not bring the valve back in operation a forced calibration is carried out. 3: A9 alarm flashing after 15 sec. DO A Common Alarm ON. ICAD is locked in actual position. No boost cyklus, Reset by Power OFF/ON, regardless of setting i21 6: Boost cyklus starts if lost step is detected. After 3 boost cyklus the A9 alarm is flashing and DO A Common Alarm is ON. Time interval between boost is set in i19. The boost cyklus continues until the valve is back in operation.
Delay after boost, before A9 alarm See Note 1	i19	0	30	1	✓	Minutes	No	Time delay between two boosts. Linked to i18 function
Max offset value See Note 1	i20	3	15	3	✓	%	Yes	Password=13. Offset value (numeric)=Requested Opening Degree [%] from Analog Input - Opening Degree [%] from encoder (Used with i21)
Define how to Reset/ Suppress A9 alarm See Note 1	i21	0	4	1	✓	-	No	Define how to Reset/Suppress A9 alarm. A9 alarm means A9 flashing in display and DO Common Alarm ON 0: Reset by Power OFF/ON 1: Autoreset when ICAD have succeeded to come back into normal operation. Normal operation defined as: Offset value < i20 (Max offset value) and i22 (delay) has elapsed. 2: A9 alarm is suppressed, meaning no A9 flashing in display and DO Common Alarm remains OFF
Reset delay for A9 See Note 1	i22	1	20	5	✓	Minutes	No	Reset delay for A9. Use when i21= 1 OBSERVE: i22 is recommended always to be bigger than i19 (i22>i19)
Valve configuration	i26	0	9	0	✓	-	Yes	NB: Password protected. Password = 11 0: No valve selected. Alarm A1 will become active 1: ICM 20 with ICAD 600A / ICMTS 20 with ICAD 600A-TS 2: ICM 25 with ICAD 600A 3: ICM 32 with ICAD 600A 4: ICM 40 with ICAD 1200A 5: ICM 50 with ICAD 1200A 6: ICM 65 with ICAD 1200A 7: ICM 100 with ICAD 1200A 8: ICM 125 with ICAD 1200A 9: ICM 150 with ICAD 1200A 10: CVE pilot with ICAD 1200A
Running current factor	i30	0	20	10	✓	-	Yes	Password=19. Mandatory to set, if ICM/ICADs are installed/serviced, with cold liquid (-30 °C (-22 °F) or lower) passing through ICM valve. See also document number AN285243155312
Holding current factor	i31	0	20	10	✓	-	Yes	

Note 1:

After a parameter change, it is necessary to carry out a Power OFF/ON

Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

It is possible to **restore the original factory settings** to the ICAD by the following procedure:

1. Remove the power supply.
2. Activate the up arrow and the down arrow push buttons at the same time.
3. While pushing the up and down arrows, reconnect the power supply.
4. Release the up and down arrows.
5. When the display on the ICAD is alternating between CA and AI, the factory parameters have been restored.

Pre-startup Checklist

- Valve Assembly
 - Bonnet bolts are secure
 - Seat has been replaced in body (ICM 20)
 - The degree of opening of the valve is 75% or less
 - Grease has been applied to o-ring area on valve stem
 - Set screws have been uniformly tightened on ICAD Actuator
 - Power has been connected to actuator (24 V d.c.)
 - Back up power (UPS) has been connected to actuator (optional)
 - Control Wiring has been connected
 - Signal input: digital or analog
 - Feedback wiring (optional)
 - Programming (mandatory parameters)
 - The mode of operation has been set (j02)
 - The input signal type has been set (j03)
 - The ICM valve size has been set (j26)
- Battery back-up (optional) parameters have been established (j07, j08, j12)

Troubleshooting

Overview



The ICAD actuator has a number of very useful service parameters which should always be consulted first. In addition, a manual tool should always be available to manually close the valve completely in the event the ICAD has failed. When using the manual tool, turn the tool clockwise to open the valve and counter-clockwise to close the valve.

NOTE:

When rotating the valve manually you are changing the position of the valve to a value different than what is in the actuator's memory. Therefore, a calibration must be performed when ICAD is remounted to the valve. If power is cut from the actuator prior to using the manual tool or after the valve has been adjusted, no problem will occur as the valve will automatically recalibrate itself once power is restored. Power can easily be disconnected and reconnected by unscrewing and then reconnecting the power cable from the ICAD actuator.

Service parameter (View only)

Service

Description	ICAD parameter	Min	Max	Factory Setting	Stored	Unit	Password	Comments
OD %	j50	0	100	-		%	-	ICM valve Opening Degree / CVE pressure setting
AI [mA]	j51	0	100	-		mA	-	AI signal
AI [V]	j52	0	100	-		V	-	AI signal
AO [mA]	j53	0	100	-		mA	-	A0 signal
DI	j54	0	1	-		-	-	DI signals. Depending of j02 If j02 = 2, one digits are shown. See fig. 8 0 : DI1 = OFF 1 : DI1 = ON If j02 = 3, two digits are shown. See fig. 9 00 : DI1 = OFF, DI2 = OFF 10 : DI1 = ON, DI2 = OFF 01 : DI1 = OFF, DI2 = ON 11 : DI1 = ON, DI2 = ON
DO Close	j55	0	1	-		-	-	DO Closed status. ON when OD < 3 %
DO Open	j56	0	1	-		-	-	DO Open status. ON when OD > 97 %
DO Alarm	j57	0	1	-		-	-	DO alarm status. ON when a Alarm is detected
Display mP SW ver.	j58	0	100	-		-	-	Software version for display microprocessor
Motor mP SW ver.	j59	0	100	-		-	-	Software version for motor microprocessor



Quick Start Guide | ICM/ICAD Motorized Valves - Installation, Programming, and Troubleshooting

Alarms

Description	ICAD alarm text	Definition of event	Comments
No Valve type selected	A1	Alarm ON	At start-up A1 will be displayed
Controller fault	A2	Alarm ON	Internal fault inside electronics. Carry out: 1) Power OFF and Power ON If A2 still active. 2) Make a Reset to factory setting If A2 still active. Return ICAD to Danfoss
AI input error	A3	Alarm ON	Not active if j01 = 2, or j02 = 2 When j03 = 1 and AI A > 22 mA When j03 = 2 and AI A > 22 mA or AI A < 2 mA When j03 = 3 and AI A > 12 V When j03 = 4 and AI A > 12 V or AI A < 1 V
Low voltage of fail safe Supply	A4	Alarm ON	If 5 V < fail safe supply < 18 V. Enabled by j08
Check supply to ICAD	A5	Alarm ON	If supply voltage < 18 V
Calibration extended failed	A6	Alarm ON	Check valve type selected. Check presence of foreign body internally in valve
Internal temperature alarm	A7	Alarm ON	Temperature for stepper motor component too high. Ventilate/lower ambient ICAD temperature
	A8	Alarm ON	Temperature for stepper motor component too high. Ventilate/lower ambient ICAD temperature.
POM mode (Preventive Operational Mode)	A9	See j18 and j21	Only active if j16 = 1 If ICAD meets too high torque from ICM valve (increased friction/sticking surfaces) ICAD automatic goes into POM mode to overcome lost step. (See j18 and j21)

Note: old alarms that may not be active anymore will be saved and listed in parameter i11

Troubleshooting continued

The alarms and service values work together to allow the user to quickly diagnose the source of operating issues. The most common alarms are:

- A1** The user has not selected the valve type. Each ICAD actuator is capable of driving several different valve sizes. Upon installation of the valve, it is mandatory that the user select the valve size from parameter j26.
- A3** The control signal is out of the range of the selected values. The most common causes of this problem are:
 1. Improper wiring
 2. Incorrect selection of control signal (parameter j03)
 3. The source of the control signal is not outputting the correct type of signal.
- A9** The valve is locked, disconnect and remove motor. Use magnetic tool to slowly open/close the valve thru the full range. There should be at no point a sticking/tight spot. You may need to remove the valve bonnet/module to clean debris or replace the bonnet/module if it is damaged. If A9 alarm continues please contact Danfoss with application details.

Of course, there are numerous other alarm messages designed to protect the equipment and help to diagnose problems as pro-actively as possible. Most of these alarms are fairly self-explanatory.

Troubleshooting Tips

The valve does not appear to close or stay closed completely.

- The display shows 0% opening degree but the valve can be driven further closed with the manual tool.
Solution: Recalibrate the valve. In addition, if the manual tool has been used to open or close the valve, the valve should turn very easily. If there appears to be resistance in opening or closing the valve, replace the module.
- The display shows 0% opening degree and the valve cannot be driven closed any further with the manual tool.
Solution: Pull the function module and check to ensure that there are 2 o-rings on the module for ICM 25 and larger. For size ICM 20, make sure valve seat is installed.



Troubleshooting Tips

The valve does not appear to be moving to the correct position.

- Check service value **51**. This is the mA input from the control system. The degree of opening is linearly proportional to the mA input. (For example, if 4-20 mA was chosen as the input range and the service value shows 12mA, the valve should be 50% open.)
Solution: Check parameter **03** to make sure that the correct scale was selected.
- Compare service value **51** to the value reported to be the output from the control system. If necessary, measure the actual current into the ICAD.
Solution: If the two values do not equate, check wiring, paying special attention to wire polarity. If measured mA does not equate to the stated controllers output, the problem is likely to be in the control system. If measured mA does not equate to the value seen in **51** and everything is wired properly, the problem is likely with the ICAD actuator.
- The ICAD was not mounted properly on the valve stem.
Solution: Check to make sure that the ICAD set screws are evenly torqued around the base of the ICAD.

The valve does not appear to be opening fast enough or seems too fast

- The speed of the ICM valves are preset at the factory:
 - For ICM valves 20, 25, and 32, the preset speed is 100%
 - For ICM valves 40, 50, 65, 100, 125, and 150, the preset speed is 50%
- Solution:* Check parameter **04** to note the actual setting and adjust accordingly

The valve position feedback signal is not working with the customer supplied controller/PLC.

- A power supply was installed in the 4-20mA/0-20 mA feedback loop. The ICAD motor actuator supplies power for the 4-20mA/0-20 mA feedback loop.
Solution: Remove any power source that may be supplied to the feedback loop.
- Wiring problem.
Solution: Check the service value of **53** (the analog output signal) to see what the ICAD is outputting. If nothing is revealed, check the output wire (blue) with an ammeter to verify the actual output value.
- The feedback output signal was not turned on in parameter **06**.
Solution: Change this parameter to the appropriate signal.

Frequently Asked Questions

What happens in the event of a power failure?

The ICAD actuator will remain in the position it is in when power is lost. There are two approaches to solving the issue:

- Add a UPS (Uninterruptible Power Supply) device to the power wiring. This is easily accomplished with the brown (-) and black (+) wires in the power cable bundle. A UPS device is available from Danfoss and can provide up to 10 amps of power for up to 90 seconds in order to move the valve to the desired position. Because of the high amperage, the UPS is capable of providing power to several ICAD actuators depending on the size of the actuator. NOTE: The UPS is not a continuous power supply. It is only meant to change the valve position once in the event of a power failure.
- Add a solenoid valve in front of the ICM in order to stop refrigerant flow. This is a simple solution provided that there is no issue associated with the additional pressure drop through the solenoid valve.

How much power do I need to supply to the ICAD?

The total power required depends on the ICAD size and the number of ICAD's powered by the dc power supply. The power for each ICAD is:

- ICAD 600 (ICM 20, 25, and 32), the requirement per valve is approximately 30 watts.
- ICAD 900 (ICM 40, 50, and 65), the requirement per valve is approximately 50 watts.
- ICAD 1200 (ICM 100, 125, and 150) the requirement per valve is approximately 75 watts.
- ICAD 600A (ICM 20, 25, and 32), the requirement per valve is approximately 30 watts.
- ICAD 1200A (ICM 40, 50, 65, 100, 125, and 150) the requirement per valve is approximately 50 watts.

How can I monitor the valve position remotely?

The control wiring bundle provides for a 4 to 20 mA or 0 to 20 mA signal output with the blue (+) and orange (-) wires. The signal can be sent to:

- A remote display
- A PLC or PC
- Another ICAD actuator to provide the same input signal (daisy chain)

At what minimum OD%/mA will the ICAD automatically close and calibrate?

The ICAD will automatically close or be closed when the opening degree is below 3% which corresponds to 4.48 mA. After it is closed it will give a few extra steps to calibrate the valve.

If the 4-20mA signal is lost while the valve is open, will the ICAD close the valve?

Yes, if the input signal is lost while the valve is open, the ICAD will close the valve and flash an A3 alarm which is for an input error.



How many turns/revolutions with the manual tool will fully open/close ICM valve?

- ICM 20: 1.25 turns
- ICM 25: 2.5 turns
- ICM 32: 3 turns
- ICM 40: 4 turns
- ICM 50: 5 turns
- ICM 65: 5 turns
- ICM 100: 12.75 turns
- ICM 125: 15.25 turns
- ICM 150: 18.25 turns

Does the ICAD make a high frequency noise?

Yes, when the ICAD is at standstill, it will generate a high frequency noise which is normal.

What size wire gauge is recommended to run to the ICADs?

The typical wire gauge is 22 AWG. For power wiring, the recommended maximum lengths (for 22 AWG) are:

- ICAD 600 90 feet
- ICAD 900 50 feet
- ICAD 1200 30 feet
- ICAD 600A 90 feet
- ICAD 1200A 50 feet

Heavier wire gauge will allow for longer lengths of power wiring. For example with 17 AWG, maximum lengths are:

- ICAD 600 285 feet
- ICAD 900 170 feet
- ICAD 1200 115 feet
- ICAD 600A 285 feet
- ICAD 1200A 170 feet

Control wire lengths can be as long as 1500 feet.

When running wire to the ICADs, does the wire need to be shielded?

There is no need for shielded cable; however, if used, the EMC capabilities of the ICAD will be improved.

Appendix E

Liquid Injection Valve Station ICF 20-25 Installation Guide



Installation guide

Valve Station

Types ICF 15, ICF 20, ICF 25, ICF SS 20 and ICF SS 25



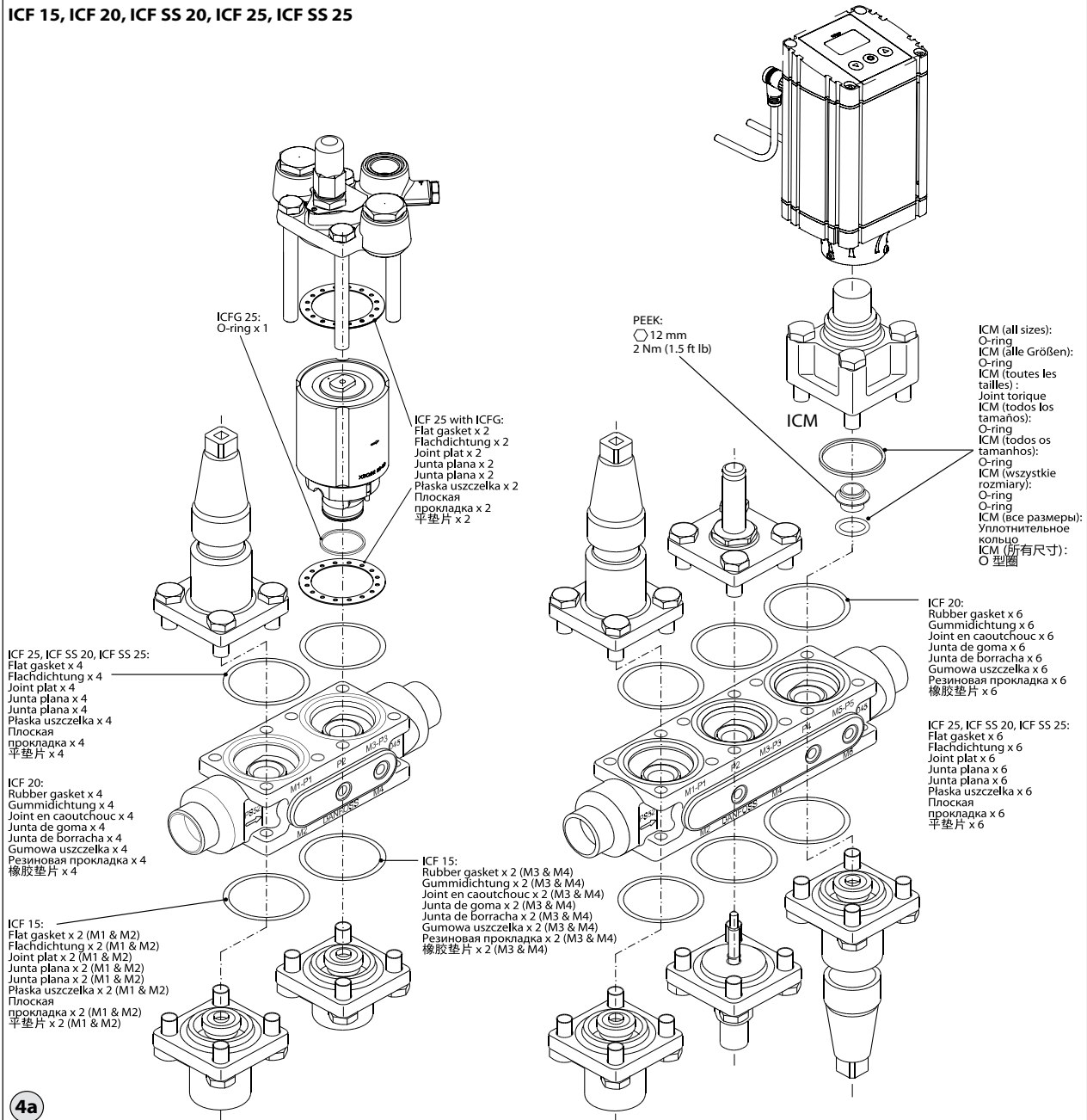
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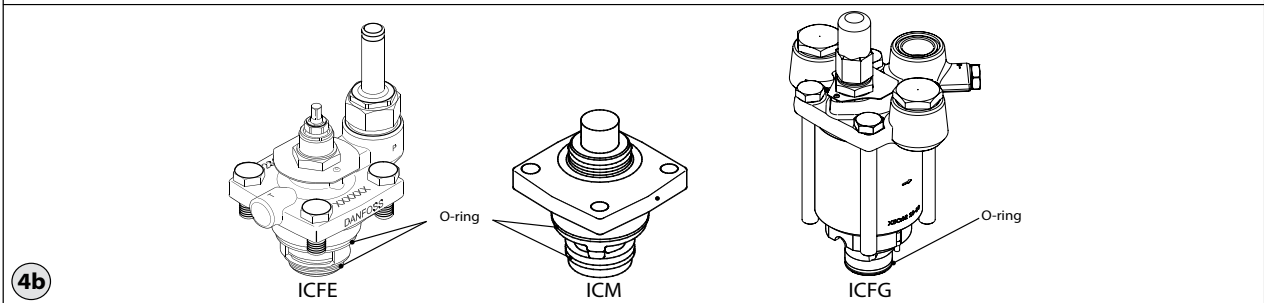
Installation Installation Installation Instalación Instalação Montaż Монтаж 安装			
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Welding Schweißen Soudure Soldadura Soldagem Spawanie Сварка 焊接			
<p>TIG/MIG/SMAW</p> <p>2</p>		<p>Gas welding Gasschweißen Soudure au gaz Soldadura con gas Soldagem a gás Spawanie gazowe Газовая сварка 气焊</p> <p>3a</p>	
Brazing Lötén Brasage Soldadura Brasagem Lutowanie twarde Пайка 钎焊			
<p>3b</p>		<p>3a</p>	
		<p>Ag40 Minimum 450–700 °C Ag40 Minimum 450 – 700 °C Minimum Ag40 450 – 700 °C Ag40 mínimo 450 – 700 °C Mínimo de Ag40 a 450 – 700 °C Ag40, minimum 450 – 700 °C Ag40, не менее 450 – 700 °C Ag40 最低 450 – 700 °C</p>	

Maintenance | Instandhaltung | Maintenance | Mantenimiento |
Manutenção | Serwis | Техническое обслуживание | 维护

ICF 15, ICF 20, ICF SS 20, ICF 25, ICF SS 25

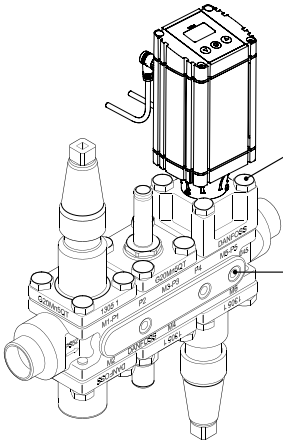


4a



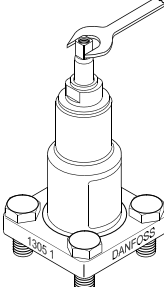
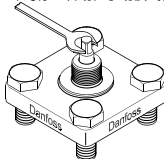


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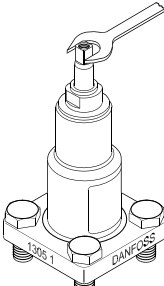
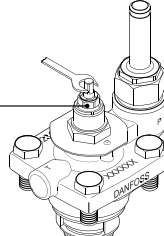
Tightening | Drehmoment | Serrage | Par de apriete | Aperto | Dokręcenie | Затяжка | 紧固

		M1	M2	M3	M4	M5	M6
	ICF 15	22 Nm (16 ft lbs)	22 Nm (16 ft lbs)	35 Nm (25.8 ft lbs)	35 Nm (25.8 ft lbs)		
	ICF 20 ICF SS 20	35 Nm (25.8 ft lbs)	35 Nm (25.8 ft lbs)	35 Nm (25.8 ft lbs)	35 Nm (25.8 ft lbs)	35 Nm (25.8 ft lbs)	35 Nm (25.8 ft lbs)
	ICF 25	60 Nm (44 ft lbs)	60 Nm (44 ft lbs)	60 Nm (44 ft lbs)	60 Nm (44 ft lbs)	60 Nm (44 ft lbs)	60 Nm (44 ft lbs)
	ICF SS 25	80 Nm (58 ft lbs)	80 Nm (58 ft lbs)	80 Nm (58 ft lbs)	80 Nm (58 ft lbs)	80 Nm (58 ft lbs)	80 Nm (58 ft lbs)
	ICF 15-25	60 Nm (44 ft lbs)					
		ICF SS 20-25					
		80 Nm (58 ft lbs)					

ICF 15, ICF 20, ICF SS 20 Manual stem | Handbetätigung | Tige manuelle | Vástago manual |
Operação manual | Wrzeciono obsługi ręcznej | Ручное управление | 手动阀杆

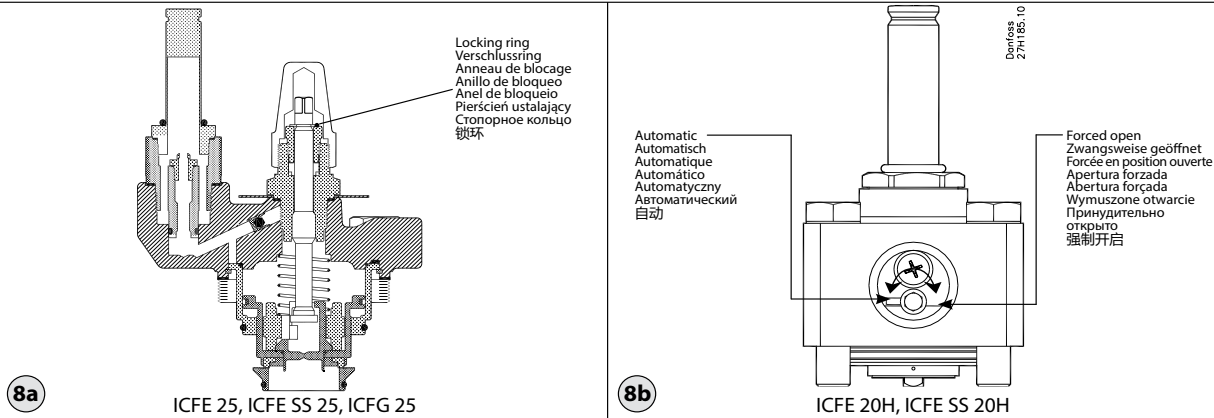
	Max. 25 Nm (18 ft lbs) (Closing ICFR: max. 4 Nm (3 ft lbs)) Max. 25 Nm (18 ft lbs) (ICFR schließen: max. 4 Nm (3 ft lbs)) Max. 25 Nm (18 lb ft) (fermeture ICFR: max. 4 Nm (3 lb ft)) Máx. 25 Nm (18 lb-ft) (Cierre del modulo ICFR: máx. 4 Nm (3 lb-ft)) Máx. 25 Nm (18 lb pés) (Fechamento do ICFR: máx. 4 Nm (3 lb pés)) Maks. 25 Nm (18 lbf x ft) (zamykanie zaworu ICFR: maks. 4 Nm (3 lbf x ft)) Макс. 25 Nm (18 фт-фнт) (закрытие ICFR: макс. 4 Nm (3 фт-фнт)) 最大 25 Nm (18 ft lbs) (关闭 ICFR: 最大 4 Nm (3 ft lbs))		Max. 20 Nm (15 ft lbs) at stop. Automatic mode (ICFE ON/OFF by coil) Max. 20 Nm (15 ft lbs) bei Stopp. Automatikbetrieb (ICFE EIN/AUS durch Spule) Max. 20 Nm (15 lb ft) à l'arrêt. Mode automatique (ICFE ON/OFF par bobine) Máx. 20 N-m (15 lb-ft) en parada. Modo automático (funcion ON/OFF del modulo ICFE, mediante bobina). Máx. 20 Nm (15 lb pés) na parada. Modo automático (ICFE ON/OFF [liga/desliga] por bobina) Maks. 20 Nm (15 lbf x ft) w punkcie zatrzymania. Tryb automatyczny (włącz/wyłącz. zavoru ICFE przez cewkę) Макс. 20 Нм (15 фт-фнт) при остановке. Автоматический режим (включение/выключение ICFE с помощью катушки) 最大 20 Nm (54.86 cm lbs) 时停止转动。自动模式(用盘管开关 ICFE)
	Max. 2.5 Nm (1.8 ft lbs) at stop. Manual mode (ICFE forced open) Max. 2.5 Nm (1.8 ft lbs) bei Stopp. Handbetrieb (ICFE zwangsweise geöffnet) Max. 2.5 Nm (1.8 lb ft) à l'arrêt. Mode manuel (ICFE forcé en position ouverte) Máx. 2.5 N-m (1.8 lb-ft) en parada. Modo manual (funcion de apertura forzada del modulo ICFE) Máx. 2.5 Nm (1.8 lb pés) na parada. Modo manual (abertura forçada da ICFE) Maks. 2.5 Nm (1.8 фт-фнт) w punkcie zatrzymania. Tryb ręczny (wymuszone otwarcie zaworu ICFE) Макс. 2.5 Нм (1.8 фт-фнт) при остановке. Ручной режим (принудительное открытие ICFE) 最大 2.5 Nm (54.86 cm lbs) 时停止转动。手动模式(icfe 强制开启)		
			
6a ICFs, ICFs SS, ICFR, ICFR SS, ICFN, ICFN SS		6b ICFO, ICFO SS	

ICF 25, ICF SS 25 Manual stem | Handbetätigung | Tige manuelle | Vástago manual |
Operação manual | Wrzeciono obsługi ręcznej | Ручное управление | 手动阀杆

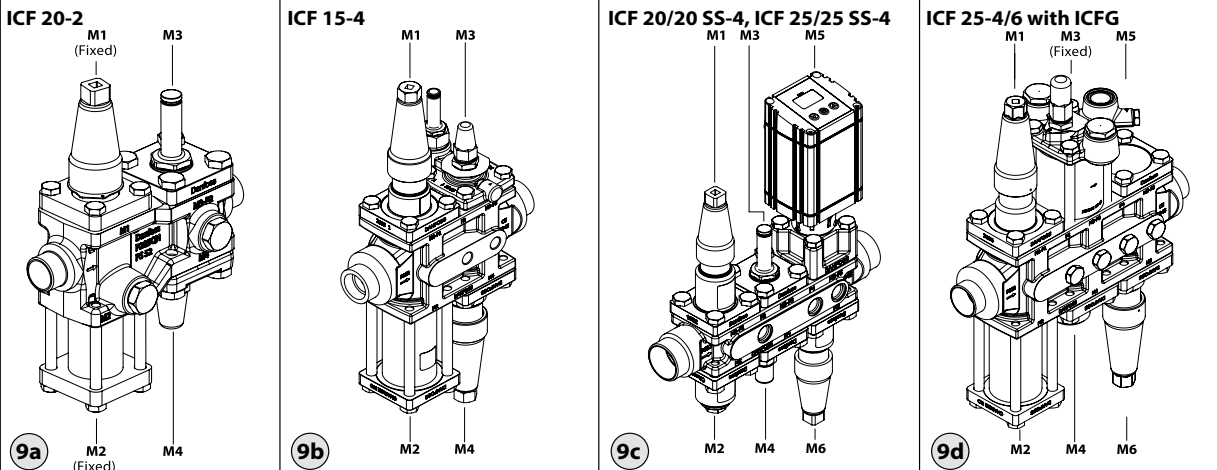
	Max. 40 Nm (30 ft lbs) (Closing ICFR, ICFN: max. 10 Nm (7 ft lbs)) Max. 40 Nm (30 ft lbs) (ICFR, ICFN schließen: max. 10 Nm (7 ft lbs)) Max. 40 Nm (30 lb ft) (fermeture ICFR, ICFN: max. 10 Nm (7 lb ft)) Máx. 40 N-m (30 lb-ft) (Cierre del modulo ICFR, ICFN: máx. 10 Nm (7 lb-ft)) Máx. 40 Nm (30 lb pés) (Fechamento do ICFR, ICFN: máx. 10 Nm (7 lb pés)) Maks. 40 Nm (30 lbf x ft) (zamykanie zaworu ICFR: maks. 10 Nm (7 lbf x ft)) Макс. 40 Nm (30 фт-фнт) (закрытие ICFR: макс. 10 Nm (7 фт-фнт)) 最大 40 Nm (914.40 cm lbs) (关闭 ICFR, ICFN: 最大 10 Nm (213.36 cm lbs))		Max. 4 Nm (3 ft lbs) at stop. Automatic mode (ICFE ON/OFF by coil) Max. 4 Nm (3 lb ft) bei Stopp. Automatikbetrieb (ICFE EIN/AUS durch Spule) Max. 4 Nm (3 lb ft) à l'arrêt. Mode automatique (ICFE ON/OFF par bobine) Máx. 4 N-m (3 lb-ft) en parada. Modo automático (funcion ON/OFF del modulo ICFE, mediante bobina). Máx. 4 Nm (3 lb pés) na parada. Modo automático (ICFE ON/OFF [liga/desliga] por bobina) Maks. 4 Nm (3 lbf x ft) w punkcie zatrzymania. Tryb automatyczny (włącz/wyłącz. zavoru ICFE przez cewkę) Макс. 4 Нм (3 фт-фнт) при остановке. Автоматический режим (включение/выключение ICFE с помощью катушки) 最大 4 Nm (54.86 cm lbs) 时停止转动。自动模式(用盘管开关 ICFE)
	Max. 10 Nm (7 ft lbs) at stop. Manual mode (ICFE forced open) Max. 10 Nm (7 ft lbs) bei Stopp. Handbetrieb (ICFE zwangsweise geöffnet) Max. 10 Nm (7 lb ft) à l'arrêt. Mode manuel (ICFE forcé en position ouverte) Máx. 10 N-m (7 lb-ft) en parada. Modo manual (funcion de apertura forzada del modulo ICFE) Máx. 10 Nm (7 lb pés) na parada. Modo manual (abertura forçada da ICFE) Maks. 10 Nm (7 lbf x ft) w punkcie zatrzymania. Tryb ręczny (wymuszone otwarcie zaworu ICFE) Макс. 10 Нм (7 фт-фнт) при остановке. Ручной режим (принудительное открытие ICFE) 最大 10 Nm (54.86 cm lbs) 时停止转动。手动模式(icfe 强制开启)		
			
7a ICFs, ICFs SS, ICFR, ICFR SS, ICFN, ICFN SS		7b ICFE, ICFE SS, ICFG	

Packing gland
Stopfbuchse
Presse-étoupe
Sobreposta
Sobreposta
Dławnica
Сальник
填料函

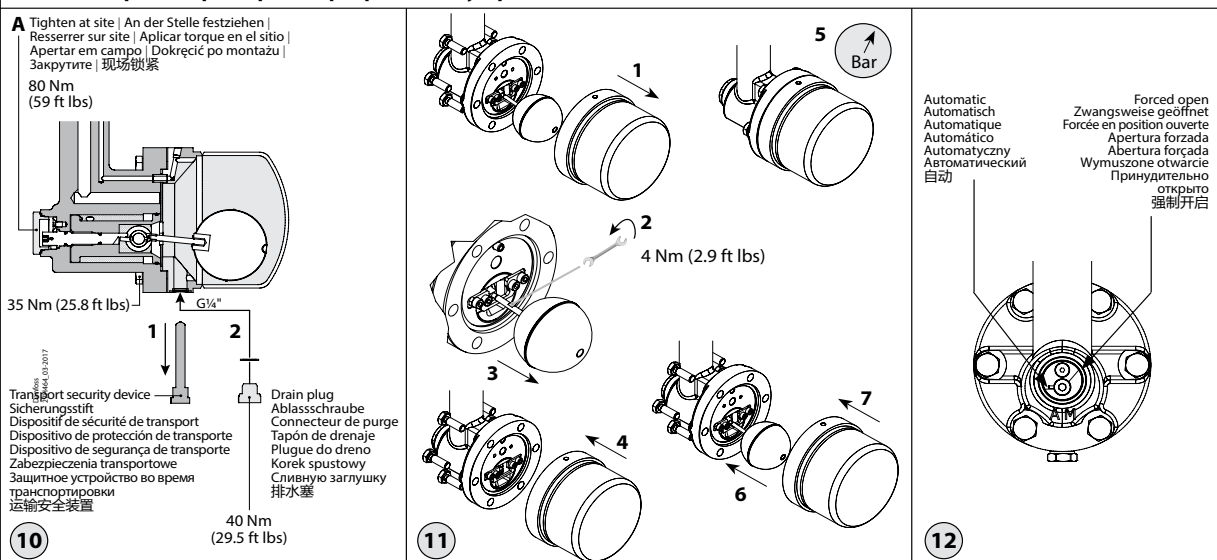
ICFE 25, ICFE SS 25, ICFG 25, ICFE 20H, ICFE SS 20H Manual stem | Handbetätigung | Tige manuelle | Vástago manual |
 Operação manual | Wrzeciono obsługi ręcznej | Ручное управление | 手动阀杆



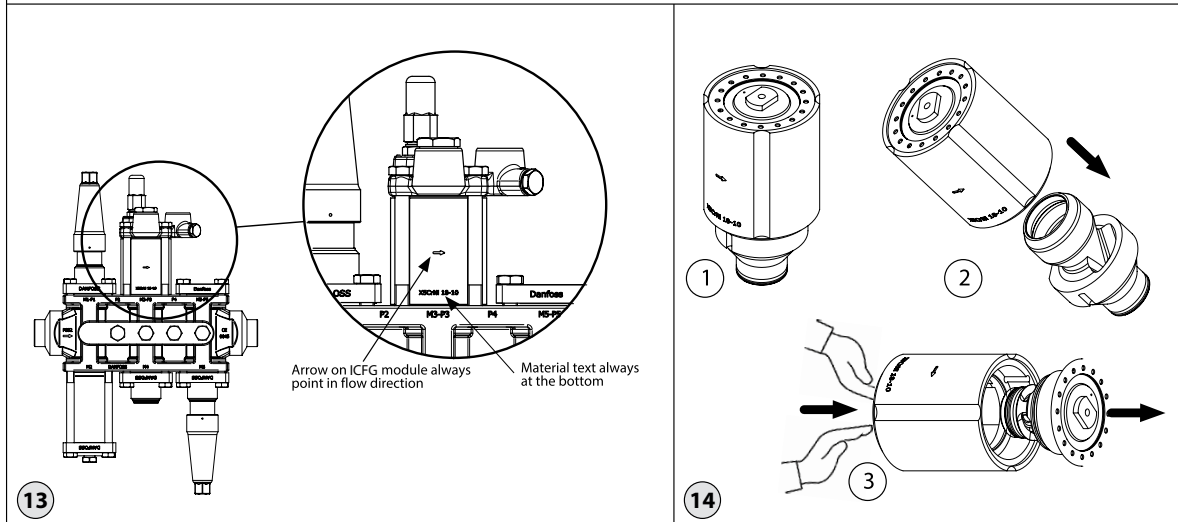
Module location | Moduleinbauort | Emplacement des modules | Ubicación de los módulos |
 Localização do módulo | Usytuowanie modułu | Расположение модуля | 模块位置



ICFD: Disassembly/assembly Transport device and float | ICFD: Entfernen der Transportsicherung und Demontage/Montage des Schwimmers |
 ICFD: Démontage/montage Dispositif de transport et flotteur | ICFD: Desmontaje/montaje de dispositivo de transporte y flotador |
 ICFD: Desmontagem/montagem Dispositivo de transporte e flutuador | ICFD: Demontaż/Montaż zabezpieczenia transportowego i pływaka |
 ICFD: Разборка/сборка. Транспортировочное устройство и поплавок | ICFD: 针对阀门和浮球的运输, 拆卸/安装



ICFG 25: Disassembly/assembly module | ICFG 25: Demontage und montage des modules | ICFG 25: Démontage/montage du module | ICFG 25: Desmontaje/montaje del módulo | ICFG 25: Desmontagem/montagem Módulo | ICFG 25: Demontaž/Montaž modulu | ICFG 25: Раборка/сборка модуля | ICFG 25: 拆卸/安装模块



ENGLISH

Refrigerants

Applicable to HCFC, non flammable HFC, R717 (Ammonia) and R744 (CO₂).

Exception:

ICFD is designed for ammonia and CO₂ only
ICFD 20 = ammonia version
ICFD 20C = CO₂ version

The use of ICF valve stations with flammable hydrocarbons is not recommended.

The ICF is only recommended for use in closed circuits. For further information please contact Danfoss.

Temperature range

ICF in general:

-60/+120 °C (-76/+248 °F)

ICFD 20: -50/+50 °C (-58/+122 °F) at 28 bar g (406 psi g)

ICFD 20C: -50/+50 °C (-58/+122 °F) at 52 bar g (754 psi g)

Pressure range

The general ICF is designed for:

Max. working pressure: 52 bar g (754 psi g)

ICF 20-2 housing with 65 bar function modules only:

Max. working pressure: 65 bar g (943 psi g)

ICFD 20 (Ammonia):

For ICF with ICFD module the max. working pressure is 28 bar g / 406 psi g. If the refrigeration system include ICFD 20 module, a test pressure of the system must not exceed 28 bar g / 406 psi g, unless the ICFD float is temporarily taken out before test. See fig. 11.

ICFD 20C (CO₂):

For ICF with ICFD 20C module the max. working pressure is 52 bar g / 754 psi g. If the refrigeration system include ICFD 20C module, a test pressure of the system must not exceed 52 bar g / 754 psi g, unless the ICFD float is temporarily taken out before test. See fig. 11.

Application

The ICF can be used in suction, liquid, hotgas

and liquid/vapor lines. The ICF is available with 2, 4 or 6 function modules. The ICF regulates the flow of the medium by modulation or on/off function, depending on function modules installed in the ICF.

Regulating range

Dependent on the chosen type and combination of modules installed in the valve.

Installation (fig. 1)

The ICF must be installed according to fig. 1. The ICF must be installed with the arrow in the direction of the flow).

ICM, ICFD and ICFG modules require horizontal valve orientation.

The ICF will be delivered with all the function modules fully assembled. The modules can be taken out for service or inspection and may be rotated 4 x 90° in relation to the valve body upon installation. Please make sure that the position of ICFD allows space for modules at each side of the ICFD. The ICF may be fitted with a spindle for manual opening of the solenoid valve.

The ICF is designed to withstand a high internal pressure. However, the piping system should be designed to avoid liquid traps and reduce the risk of hydraulic pressure caused by thermal expansion.

It must be ensured that the ICF is protected from pressure transients like "liquid hammer" in the system.

Welding (fig. 2 and 3)

The ICF valve station can be welded by using either TIG/MIG/SAW welding (fig. 2) or gas welding/ brazing (fig. 3 a/b). Always keep inlet and outlet protecting caps on the valve until the valve is ready to be installed, in order to prevent rust formation inside the valve station.

TIG/MIG/SAW welding

It is not necessary to remove any of the function modules prior to TIG/MIG/SAW welding (fig. 2) and auxiliary cooling is not needed at normal heat impact.

At excessive heat impact due to high ambient temperature, sun radiation, a wet cloth is recommended around the valve housing.

Every precaution must be taken to minimize welding spatter.

For ICF valve stations equipped with a stop valve in the first module (M1) and a stop-, regulating- or stop/check valve in the last module (M4 or M6), it is recommended to open these valves slightly (approx. 1 turn from closed position) to minimize welding heat impact to the Teflon seats.

After welding it is recommended to close these valves again to avoid potential pull through of gases, and keep them closed until the system is ready for operation. All other valve modules are able, in any module position, to compensate for normal welding heat impact and need no special attention.

Gas welding/ brazing

Remove all inserts before welding/ brazing (fig. 3 a/b).

Auxiliary cooling needed when brazing (fig. 3b) to reduce heat impact.

Follow these steps during brazing (fig. 3b):

1. Remove topcover/insert
2. Clean connections with cleaning agent
3. Wrap around wet cloth
4. Apply flux on piping ends
5. Apply inert gas internal
6. Heat up piping
7. Braze with recommended brazing material and within temperature range specified
8. Remove residual flux

Every precaution must be taken to minimize welding spatter.

After welding, clean the valve inside for welding spatter and welding debris.

It is recommended to reinstall the modules right after welding and to close the manual-operable M1 and M4/M6 in order to protect the interior of the valve until the system is ready for operation. In case the valve is not assembled immediately make sure that rust protective oil is applied to the inside surfaces.

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The housing must be free from stresses (external loads) after installation. The ICF must not be mounted in systems where the outlet side of the ICF is open to atmosphere. The outlet side of the ICF must always be connected to the system or properly capped off, for example with a welded-on end plate.

Surface protection and identification (not applicable for SS versions)

The external surface is zinc-chromated to provide corrosion protection according to EN 12284:2003 8.13. The Zinc-Chromatization does not cover the welding connections. After installation has been completed the external surface of the valve must be protected against corrosion with a suitable top coating. Coverage of the ID label when painting the ICF is recommended.

Precise identification of the ICF is made via the ID label on each of the 2, 4 or 6 function modules.

Maintenance (fig. 4)



Do not mix up carbon steel parts with stainless steel parts.

Service

The ICF valve stations are easy to service. Do not open the ICF while it is still under pressure. Upon opening and removal of the function modules:

- Check that the flat gaskets and/or O-rings between the function module and the housing and O-rings on the function module has not been damaged. Replace flat gaskets and O-rings if not intact.

A valve with damaged O-rings or flat gaskets do not regulate in accordance with its specifications.

Flat gaskets are present in ICF 15 module M1/M2 and ICF 20-2/ICF 25/ICF SS 25 all modules.

Rubber gaskets are present in these locations: (see fig 4a, 4b)

ICF 15: 1 rubber gasket in each module M3/M4
ICF 20-4/6 and ICF SS 20-4/6: 1 rubber gasket in all modules



CO₂ applications

When used in CO₂ systems the O-rings (see fig. 4a and 4b) can swell (grow).

At service it is recommended to replace the actual number of used O-rings before the function modules are reinstalled in the ICF valve body.

ICFD 20C defrost module for CO₂:
Make sure that the module is type ICFD 20C

- Check that the piston and cylinder is free of scratches and look for wear marks. If the wear is excessive the function module should be replaced to prevent false pilot signal around the piston ring.
- Check that the movement of the cylinder and valve seat is free and with low friction.
- If the teflon valve plate has been damaged, the function module must be replaced.
- On ICM 20 motor valve modules check that the PEEK seat has not been damaged or scratched. If damaged or scratched; replace the PEEK seat. (Allen key 12 mm, torque 2 Nm (1.5 ft lb)).

Assembly

Remove any dirt from the housing before the ICF is assembled.

- Check that all channels in the ICF are free of particles or similar debris. If possible, apply some refrigeration oil to ease the insertion of the modules and to protect the O-rings.

Tightening (fig. 5, 6 and 7)

Tighten the top cover with a torque wrench, to the values indicated in the table (see fig. 5).

Operating the manual stem (fig. 6 to 8) ICF 15, ICF 20, ICF SS 20 (fig. 6a and 6b)

- ICFS/ICFS SS - stop valve module
 - ICFR/ICFR SS - manual regulating valve module
 - ICFN/ICFN SS - stop/check valve module
 - ICFO/ICFO SS - manual opening module
- Before remounting the cap on the modules ICFS/ICFS SS (stop valve module), ICFR/ICFR SS (manual regulating valve module) or ICFN/ICFN SS (stop/check valve module) please ensure that the gasket is present in the cap. Then tighten the cap with 16 Nm (12 ft lbs).

ICF 25, ICF SS 25 (see fig. 7a)

- ICFS/ICFS SS - stop valve module
 - ICFR/ICFR SS - manual regulating valve module
 - ICFN/ICFN SS - stop/check valve module
 - ICFE/ICFE SS - manual opening module
- Before remounting the cap on the modules ICFS/ICFS SS (stop valve module), ICFR/ICFR SS (manual regulating valve module) or ICFN/ICFN SS (stop/check valve module) please ensure that the gasket is present in the cap. Then tighten the cap with 24 Nm (18 ft lbs).

Packing gland (ICFE/ICFE SS) (see fig. 7b):

If the packing gland is leaking, tighten it carefully with a wrench. Do not apply too much force.

Danfoss recommends that you conduct a stepwise tightening of the packing gland. For each turn check for possible leaks.

Operating the manual stem on ICFE 25/ ICFE SS 25 solenoid module (see fig. 8a):

To force open the solenoid by the manual stem turn it **counter clockwise** full way up (manual mode).

To operate the solenoid in automatic mode, turn the manual stem **clockwise** until the locking ring stops.

Do not force the spindle further. If the locking ring is damaged or removed the spindle will start to leak.

The valve cannot be forced closed by the manual stem.

Operating the manual stem on ICFE 20H/ICFE SS 20H solenoid valve module (see fig. 8b)

Remove the cap on the side of the ICFE 20H/ICFE SS 20H

At 9 o'clock position the manual opener is disabled (not active).

To force the ICFE 20H/ICFE SS 20H solenoid to open use a 5 mm Allen key and turn it clockwise to 3 o'clock position.

ICFD defrost module

Transportation protection

Remove the transport security device (pos. 1 in fig 10). Insert the drain plug + alu gasket attached to the valve (pos. 2 in fig 10) and tighten with the torque indicated.

Test pressure maximum

If the system test pressure needs to exceed:

ICFD 20 (Ammonia): 28 bar g / 406 psi g

ICFD 20C (CO₂): 52 bar g / 754 psi g

it is necessary to prepare the ICFD module like shown in fig. 11:

1. Unscrew the 6 flange bolts and remove the Float housing.
2. + 3. Unscrew and remove the Lever together with the Float assembly using A/F 4 mm. **Caution** - float end of lever must not be unscrewed and do not use float for unscrewing.
4. Remount the Float housing and tighten the 6 flange bolts with the torque indicated in fig 10.
5. Test with the system pressure higher than:
ICFD 20 (Ammonia): 28 bar g / 406 psi g
ICFD 20C (CO₂): 52 bar g / 754 psi g
6. Reinstall the Lever together with the Float assembly using A/F 4 mm. Do not use float for tightening.
7. Remount the Float housing and tighten the 6 flange bolts with the torque indicated in fig 10.

It is recommended to replace the float housing gasket with a new gasket after this repeated compression.

Operating the manual stem on ICFD defrost module (see fig. 12)

Remove the cap on the side of the ICFD (pos. A in fig. 10).

At 9 o'clock position the manual opener is disabled (A = Automatic mode).

To force the ICFD to open use a 5 mm Allen key and turn it clockwise to approx.

2 o'clock position till it reaches the mechanical stop (M = Manual open mode).

Always return the manual opener to automatic mode for normal operation.

Remount the cap A in fig 10 and tighten with torque 80 Nm (59 ft lbs).

It is recommended to replace the Alu gasket if further openings of cap are required.

Operating the manual stem on ICFG 25 (see fig. 8a)

Always pay attention to the spindle during operation of the manual opener

1. Make sure that the locking ring is positioned on the spindle and is intact. A new locking ring is available in the inspection kit for the valve.
2. Pay attention to the locking ring reaching the top nut of the packing gland when turning the manual stem **clockwise** for opening the valve. **Never use excessive torque and stop turning when the locking ring gets in contact with the top nut.**
3. When turning the spindle **counter clockwise**, for deactivation of the manual opener, to the top point, tighten the spindle further counter clockwise to 8 Nm (5.9 lb/ft) torque.



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Module location (fig. 9a, 9b, 9c)

ICF with two modules

Function	Module Type	Can be installed in these locations	
ICFE/ICFA	Solenoid valve module	M1	
ICFE20H	Solenoid valve module	M1*	
ICFO	Manual opening module		M2
ICFB	Blank top cover	M1	M2
ICFW	Welding module	M1	M2
ICFC	Check valve module		M2
ICFC 20P1	Check valve module		M2
ICFN 20	Stop & check valve module		M2
ICFR	Manual regulating valve module	M1	M2
ICM	Motor valve module	M1	
ICFD 20	Defrost module		M2
ICFS	Shut-off valve module	M1	M2
ICFF	Strainer module		M2
ICM	Motor operated valve module	M1	

*) Not in combination with ICFO

ICF with four modules

Function	Module Type	Can be installed in these locations			
ICFS/ICFS SS	Stop valve module	M1 *)	M2	M3	M4
ICFR/ICFR SS	Manual regulating valve module	M1	M2	M3	M4
ICFF/ICFF SS	Filter (strainer) module		M2 *)		M4
ICFE/ICFE SS	Solenoid valve module			M3	
ICFC/ICFC SS	Check valve module				M4
ICFN / ICFN SS	Stop/check valve module				M4
ICM/ICM SS	Motor valve module	M1		M3	
ICFB/ICFB SS	Blank top cover	M1	M2	M3	M4
ICFA/ICFA SS	Electronic expansion valve module (not for ICF 25)	M1		M3	
ICFE 20H/ICFE SS 20H	Solenoid valve module (not for ICF 25)	M1		M3	
ICFO/ICFO SS	Manual opening module (not for ICF 25)				M4
ICFW/ICFW SS	Welding module	M1	M2	M3	M4
ICFD	Defrost module		M2		M4
ICFG	Pilot-operated servo module			M3	

ICF with six modules

Function	Module Type	Can be installed in these locations					
ICFS/ICFS SS	Stop valve module	M1	M2	M3	M4	M5	M6
ICFR/ICFR SS	Manual regulating valve module	M1	M2	M3	M4	M5	M6
ICFF/ICFF SS	Filter (strainer) module		M2		M4		M6
ICFE/ICFE SS	Solenoid valve module			M3			
ICFC/ICFC SS	Check valve module				M4		M6
ICFN / ICFN SS	Stop/check valve module				M4		M6
ICM/ICM SS	Motor valve module	M1		M3		M5	
ICFB/ICFB SS	Blank top cover	M1	M2	M3	M4	M5	M6
ICFA/ICFA SS	Electronic expansion valve module (not for ICF 25)	M1		M3		M5	
ICFE 20H/ICFE SS 20H	Solenoid valve module (not for ICF 25)	M1		M3		M5	
ICFO/ICFO SS	Manual opening module (not for ICF 25)				M4		
ICFW/ICFW SS	Welding module	M1	M2	M3	M4	M5	M6
ICFD	Defrost module		M2		M4		M6
ICFG	Pilot-operated servo module			M3			

Module locations are indicated by M1, M2, M3, M4, M5 and M6. With respect to refrigerant flow, M1 is closest to inlet.

location not possible

*) ICF 15 - M1 and M2 modules are fixed (stop valve and filter, respectively)

Use only original Danfoss parts, including O-rings and gaskets for replacement.
Materials of new parts are certified for the relevant refrigerant.
In cases of doubt, please contact Danfoss.

Appendix F

Hand-Held Slide Valve Calibration Tool

Hand-Held Slide Valve Calibration Tool
By Vilter™ (VPN 75002)

The Slide Valve Calibration Tool allows the operator to perform the calibration procedure of Vilter’s slide valve actuators (VPN 25972D) single-handedly, while standing at the actuator, without multiple trips to the panel screen, or the need of another person at the panel.

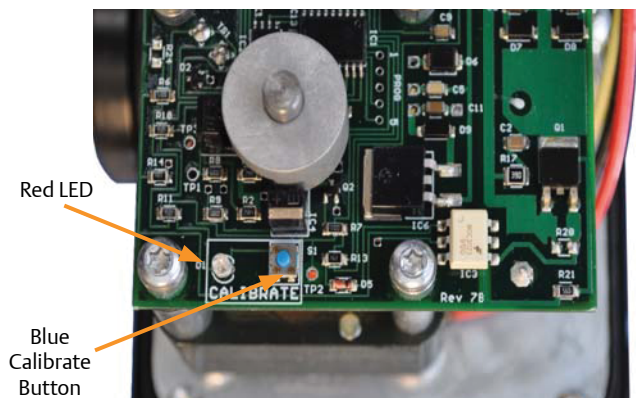
How It Works

The calibration tool replaces the power cable that feeds the actuator during normal operation, and provides 115 volts to the actuator motor using the CW and CCW push buttons. The regular control cable which provides 24 volts DC to the actuator must be connected at all times.

The greatest advantage from this set up is that the operator can perform the whole calibration procedure in front of the compressor, and therefore can easily detect if the actuator is driving the slide valves up against the mechanical stop inside the compressor.

Calibration Procedure

- 1. Look for the motor control cable on the actuator (connector J2), and disconnect it. Connect the calibration tool’s turck connector to the actuator.
- 2. Remove the screws securing the actuator cover to the actuator assembly, and carefully lift the actuator cover and tilt it towards connectors. Raise the cover high enough to attain access to the blue calibration button and be able to see the red LED on the top of assembly.
- 3. Press “CW” or “CCW” on the calibration tool to move the slide valve and check for the correct rotation, see the Increase Direction for **Single Screw Compressors Table** on the next page to establish which one is the **increase** button and which one the **decrease** button for your compressor model.



For use in non-hazardous locations
(VPN: 75002)

Features

The calibration procedure may be performed directly at the actuator, so the operator can immediately detect when the actuators start to slow down and reach the mechanical stop
Using this tool bypasses the standard calibration procedure which requires several trips between the actuator and the control panel, or to have two operators available
Electrical Rating of 125V and 5A (not fuse protected)
Light and easy to move around the compressors room
Pendant switch for easy access and comfortable handling

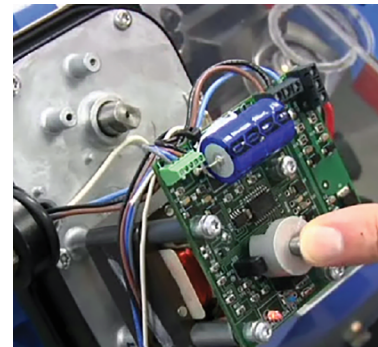
- 4. Quickly press and release the blue push button on the actuator once. This places the actuator in calibration mode. The red LED will start flashing rapidly.
- 5. Use the **decrease** button on the calibration tool to drive the slide valve to its minimum “mechanical stop” position. Release the **decrease** button when the slowing of the motor rotation and a winding sound from the actuator motor is noted.
- 6. Press and hold down on the photo-chopper shaft to disengage the brake slowly, releasing tension from the motor mount. Use the **increase** button to pulse the actuator to where the slide is just off of the mechanical stop and there is no tension on the motor shaft.

Appendix F • Hand-Held Slide Valve Calibration Tool

**Slide Valve Increase Direction
for Single Screw Compressors Table**

Compressor Model Number	Capacity Slide Valve	Volume Slide Valve
151 VSM/VSG	CW	CW
152 VSM/VSG	CW	CW
181 VSM/VSG	CW	CW
182 VSM/VSG	CW	CW
201 VSM/VSG	CW	CW
202 VSM/VSG	CW	CW
291 VSS/VSSG	CW	CW
301 VSM/VSG	CW	CW
341 VSS/VSSG	CW	CW
361 VSM/VSG	CW	CW
401 VSM/VSG	CW	CW
451 VSS/VSSG	CW	CW
501 VSM/VSG	CCW	CCW
601 VSM/VSG	CCW	CCW
601 VSS/VSSG	CW	CW
701 VSM/VSG	CCW	CCW
751 VSS/VSG	CCW	CCW
791 VSS/VSG	CCW	CCW
891 VSS/VSG	CCW	CCW
901 VSS/VSG	CCW	CCW
1051 VSS/VSG	CCW	CCW
1201 VSS/VSG	CCW	CCW
1301 VSS/VSG	CCW	CCW
1501 VSS/VSG	CCW	CCW
1551 VSS/VSG	CCW	CCW
1801 VSS/VSG	CCW	CCW
1851 VSS/VSG	CCW	CCW
2101 VSS/VSG	CCW	CCW
2401 VSS/VSG	CCW	CCW
2601 VSS/VSG	CCW	CCW
2801 VSS/VSG	CCW	CCW
3001 VSS/VSG	CCW	CCW

- Quickly press and release the blue button on the actuator again. The red LED will now flash at a slower rate, indicating that the minimum slide valve position (zero position) has been set.
- Use the increase button on the calibration tool to drive the slide to its maximum “mechanical stop” position. Release the increase button when the slowing of the motor rotation and a winding sound from the actuator motor is noted.
- Press and hold down on the photo-chopper shaft to disengage the brake slowly, releasing tension from the motor mount. Use the decrease button to pulse the actuator to where the slide is just off of its mechanical stop and there is no tension on the motor shaft.



- Quickly press and release the blue button on the actuator one more time. The red LED will stop flashing. The actuator is now calibrated and knows the minimum and maximum positions of the slide valve it controls.
- Disconnect the calibration tool's turck from the actuator, and connect the motor control cable on the actuator (connector J2).

Order Vilter Slide Valve Calibration Tool Using VPN 75002

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Appendix G • Pre Start Up For Remote Oil Coolers

▲ IMPORTANT! FOR REMOTE OIL COOLERS ONLY. READ BEFORE PROCEEDING.

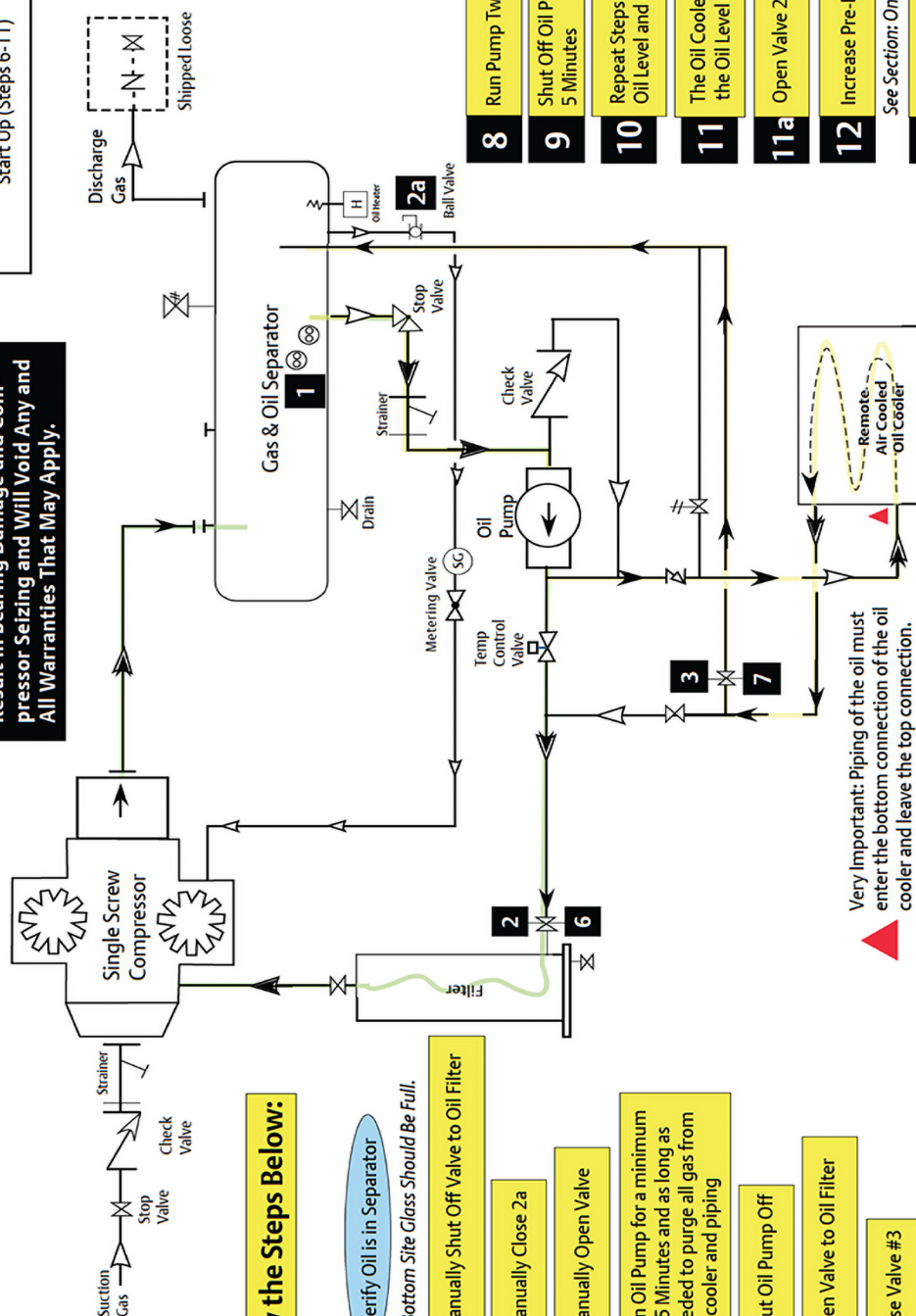
▲ Remote Coolers Only

Pre Start Up for Proper Oil Separator Level and to Prime the Cooler

WARNING

Failure to Follow These Steps Will Result in Bearing Damage and Compressor Seizing and Will Void Any and All Warranties That May Apply.

— Shows the Flow for Priming the Oil Cooler (Steps 1-5)
— Shows the Flow for Priming the Compressor Prior to Start Up (Steps 6-11)



Follow the Steps Below:

1 Verify Oil is in Separator

Note: Bottom Site Glass Should Be Full.

2 Manually Shut Off Valve to Oil Filter

2a Manually Close 2a

3 Manually Open Valve

4 Run Oil Pump for a minimum of 5 Minutes and as long as needed to purge all gas from oil cooler and piping

5 Shut Oil Pump Off

6 Open Valve to Oil Filter

7 Close Valve #3

Very Important: Piping of the oil must enter the bottom connection of the oil cooler and leave the top connection.

8 Run Pump Two Times for Only 1-2 Minutes

9 Shut Off Oil Pump and Wait an Additional 5 Minutes

10 Repeat Steps 2-9 Until Oil Separator is at Proper Oil Level and Oil Cooler is Primed

11 The Oil Cooler is Considered Primed When the Oil Level (Separator) is Constant

11a Open Valve 2a

12 Increase Pre-Lube Time to 10 Seconds

See Section: On Set Points In Compact Logix Manual.

13 Proceed to Start-Up

See Section: On Start Up Check List In Manual.

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](https://www.copeland.com)

[Copeland.com/Vilter](https://www.copeland.com/Vilter)

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