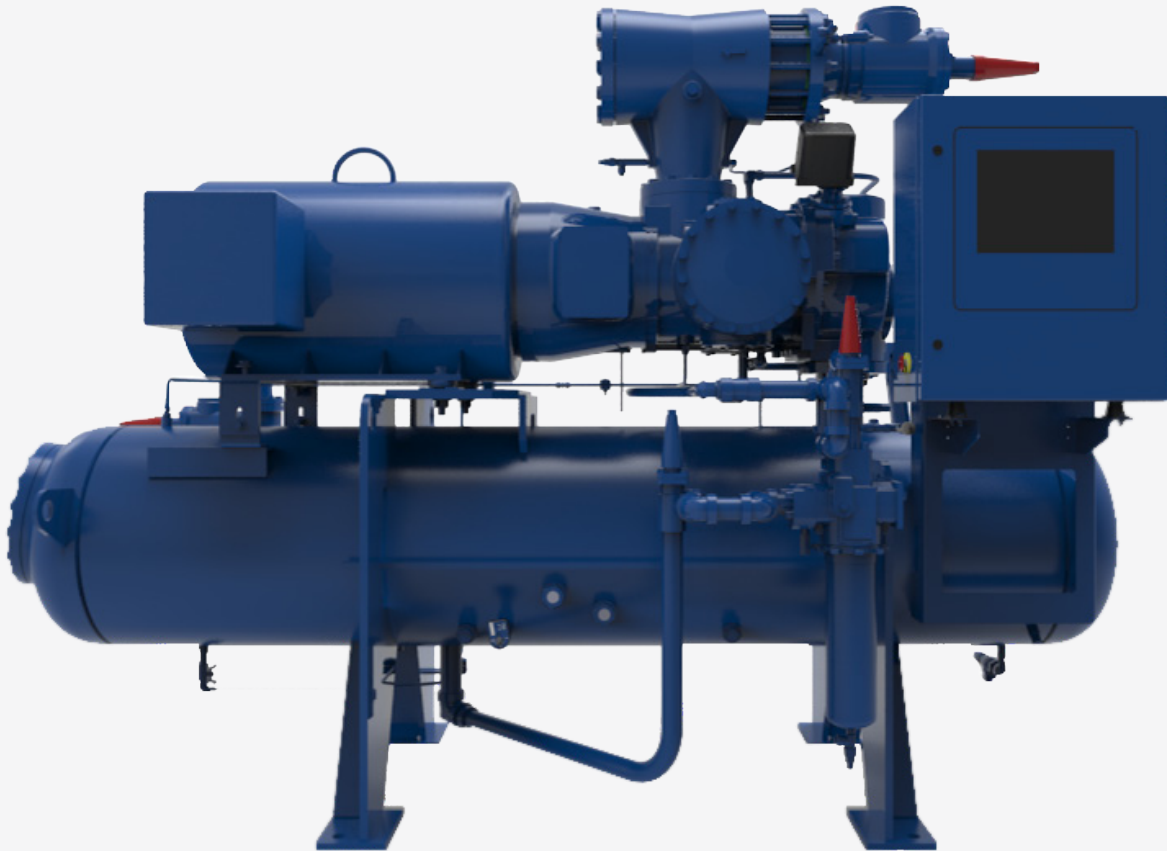


VSMC compressor unit

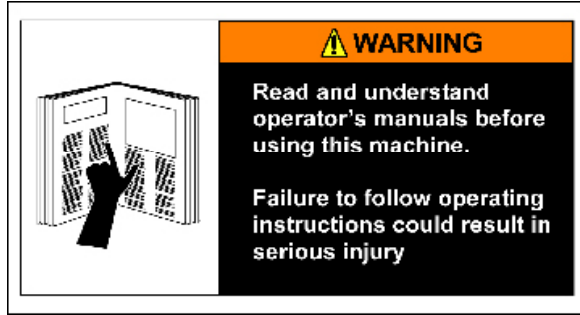
Installation, operation & maintenance manual



Vilter


EMERSON
Climate Technologies

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.

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

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

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

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

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

Equipment Identification Numbers:

Vilter Order Number: _____ Compressor Serial Number: _____
Vilter Order Number: _____ Compressor Serial Number: _____
Vilter Order Number: _____ Compressor Serial Number: _____
Vilter Order Number: _____ Compressor Serial Number: _____

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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:

Section 1: General Information

Section 2: Theory of Operation

Section 3: Installation

Section 4: Operation

Section 5: Maintenance & Service

Section 6: Troubleshooting

Section 7: Warranty and Parts

Appendices

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

Figures and tables are included to illustrate key concepts.

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

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

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

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

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

ADDITIONAL IMPORTANT NOTES

- Additional installation, operation and maintenance instructions can be found in the Vission 20/20 manual (35391SC).
- Due to continuing changes and unit updates, always refer to the Vilter.com website 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 i.

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 on section page 1-4.

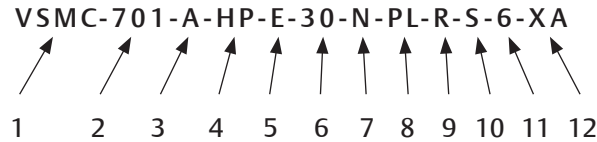


Figure 1-1. Refrigeration Compressor Unit Model Designation

1. Compressor Model

VSMC = Vilter Single Mini-Screw

VSS = Vilter Single Screw

VRS = Vilter Twin Screw

VRSB = Vilter Single Screw Heat Pump

2. Size

VSMC: 152, 182, 202, 301, 361, 401, 501, 601, 701

VSS: 751, 901, 1051, 1201, 1551, 1851, 2101, 2401, 2601, 2801, 3001

VRS: 400...0000

3. Refrigerant Service

A = R-717 (Ammonia) M = R-22

E = R-134a P = R-290 (Propane)

H = R-404A R = R1270 (Propylene)

J = R-410A Z = R-507

4. Application

HP = High Stage with Oil Pump

HN = High Stage, No Oil Pump

B = Booster

S = Swing

5. Driver

E = Electric Motor Drive

V = Variable Frequency Drive

6. Oil Separator Type (Inch, Diameter)

16, 20, 24, 30, 36, 42, 48, 54

7. Economizer

N = No Economizer

E = Economizer

F = Economizer Flanges Only

8. Oil Cooling

PL = Plate

REM = Remote

ST = Shell and Tube

VP = V-Plus

Liquid Injection Cooling (with Port):

LH (High Port)

LM (Medium Port)

LL (Low Port),

L3 (High/Low)

L2 (High/Medium)

L1 (Medium/Low)

9. Oil Cooling Medium

R = Refrigerant A = Air

W = Water G = Glycol

10. Oil Filter

S = Single Filter D = Double Filter

11. Suction Connection

3, 4, 6, 8 = 3", 4", 5", 8"

A = 10" B = 12" C = 14"

12. Customer Features

Blank = None

XA = Special Feature 1

XB = Special Feature 2

XC = Special Feature 3

Section 1 • General Information

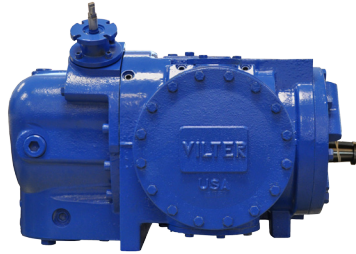
System Unit Identification

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

- Bare Shaft Compressor
- Compressor Unit
- Package Unit

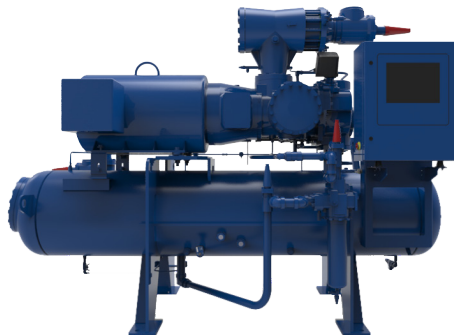
Bare Shaft Compressor

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

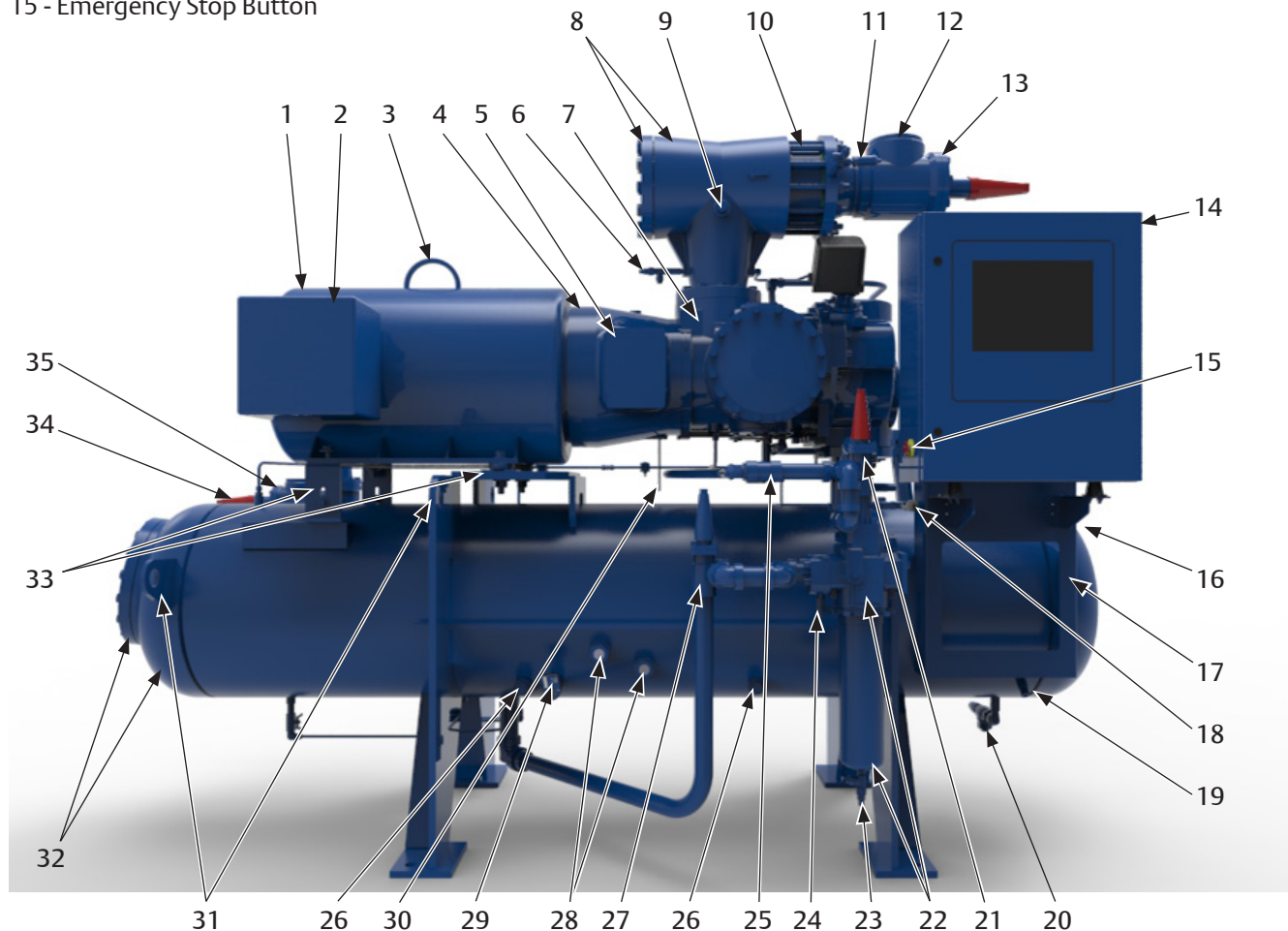
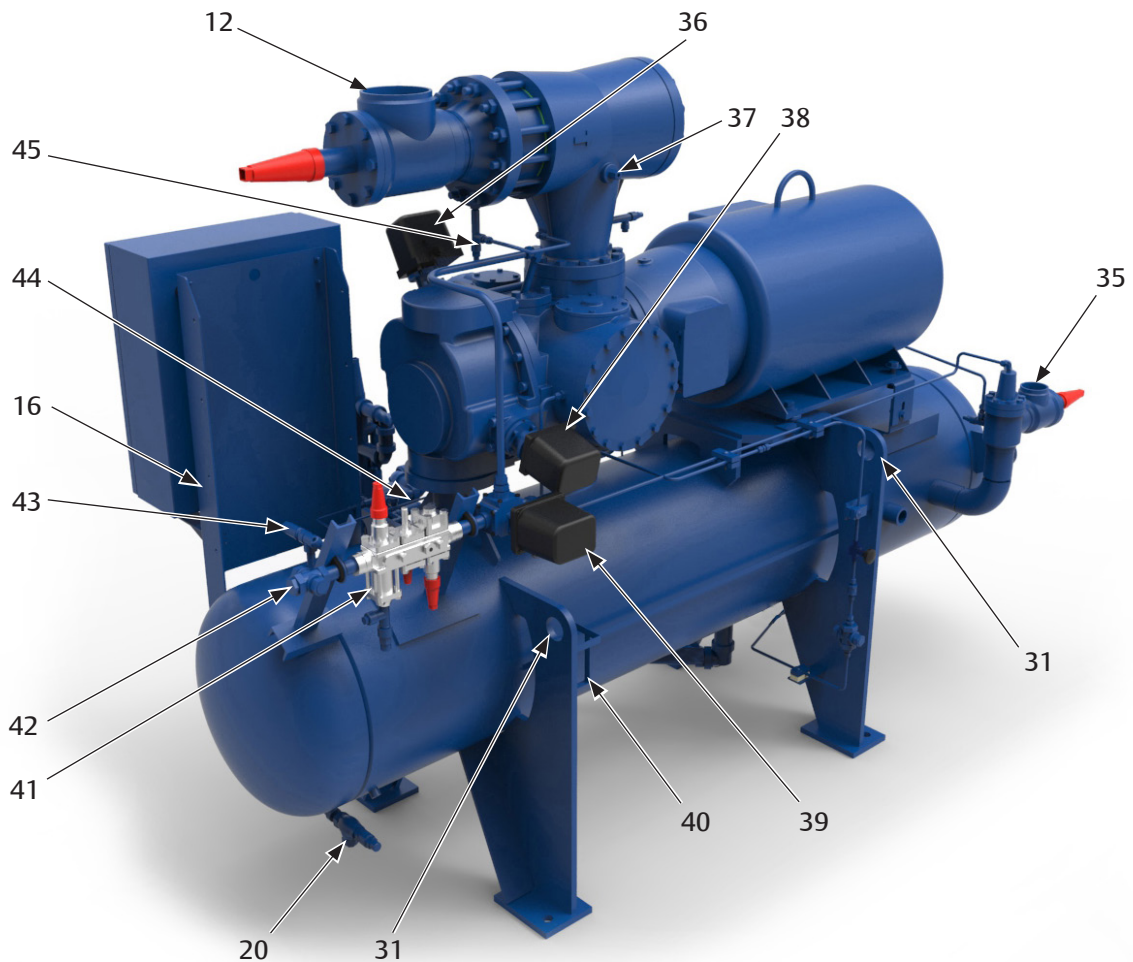


Figure 1-2. Refrigeration Compressor Unit Components (1 of 2)

Section 1 • General Information



- 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

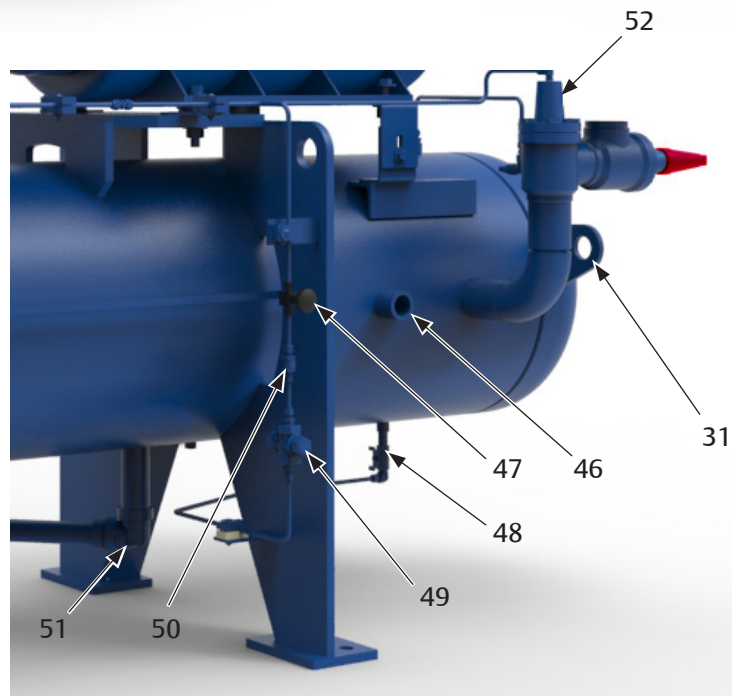


Figure 1-2. Refrigeration Compressor Unit Components (2 of 2)

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	JI	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	TSL	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 Thermo-well	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

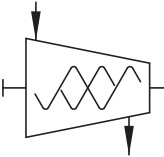
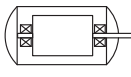
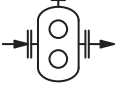
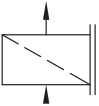
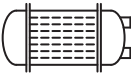

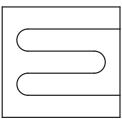

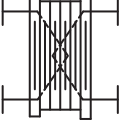
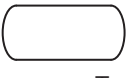
Symbol Identification

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		Scope of Supply
			Relief Valve		

Major Component Identification

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

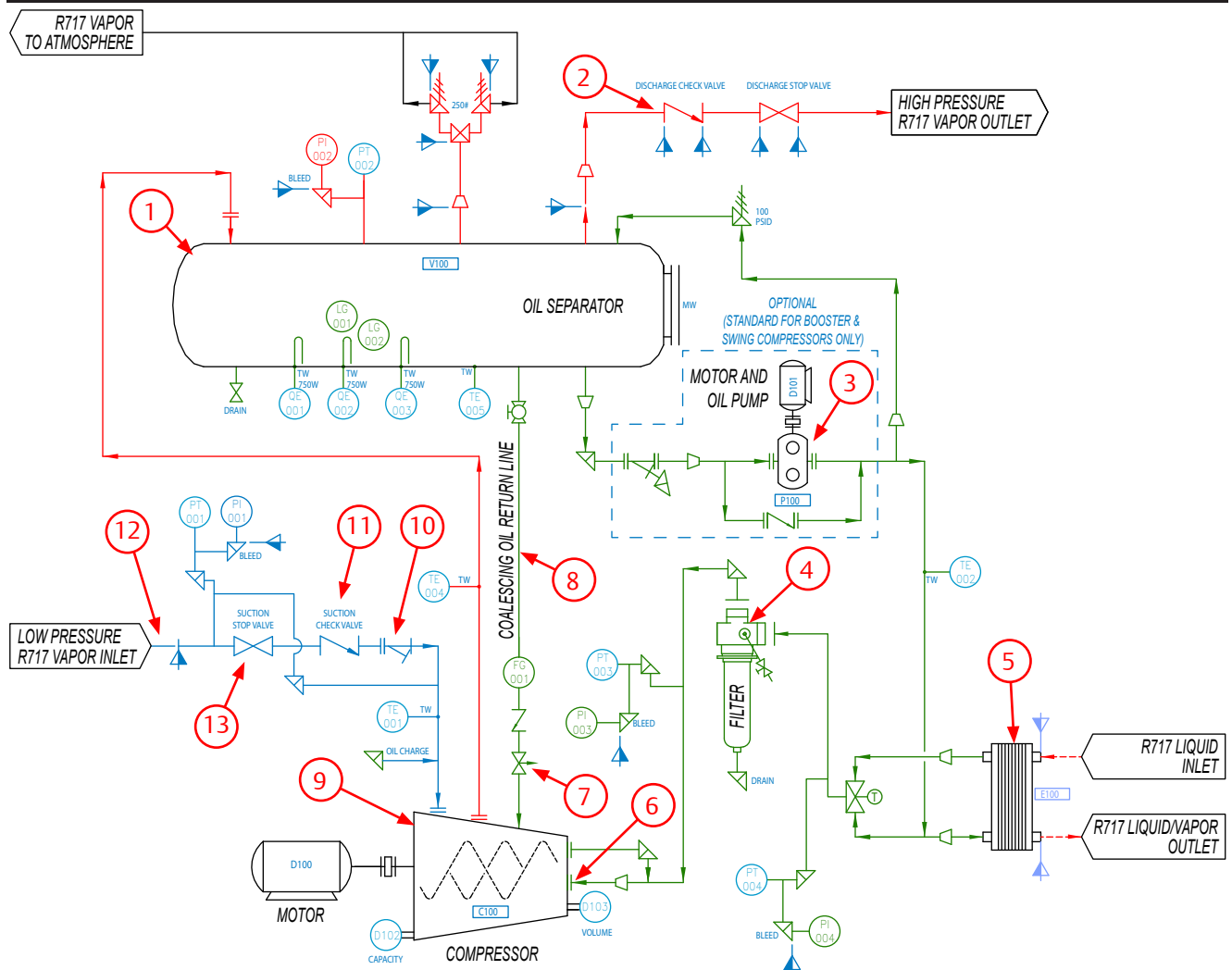
	Compressor		Motor		Positive Displacement Pump
	Filter		Shell and Tube Heat Exchanger		Rotary Pump
	Finned Tube Heat Exchanger		Fan		Plate & Frame Heat Exchanger
			Tank/Drum Vessel		

Section 1 • General Information

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

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.

Refrigerant Flow

The refrigeration compression process begins as refrigerant vapor enters the suction inlet (12). The refrigerant vapor flows through a suction stop valve (13) and suction 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.

Moreover, suction stop valve (13), 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.

Oil Life and Oil Flow

NOTE

An oil pump is not the standard offering for VSMC 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.

Section 2 • Theory of Operation

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.

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

The compressor unit is controlled by the Vission 20/20 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 Vission 20/20 operating manual (35391SC).

TEMPERATURE ELEMENTS AND 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. 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.

KDC Discharge Valve

A KDC discharge valve is typically installed on units without an oil pump. The valve controls the discharge pressure of the compressor during a start-up period to provide oil pressure for lubricating. It also works as a check valve in the discharge line of the compressor. It closes when the compressor is shut down and pressure has equalized through the compressor. The valve stays fully open during normal operation after the start-up sequence.

The KDC discharge valve does not function as a shut-off valve.

For location of KDC discharge valve, refer to Figure 1-2 in Section 1.

Delivery Inspection

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

Rigging and Lifting of Compressor Unit

WARNING

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

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

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

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

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

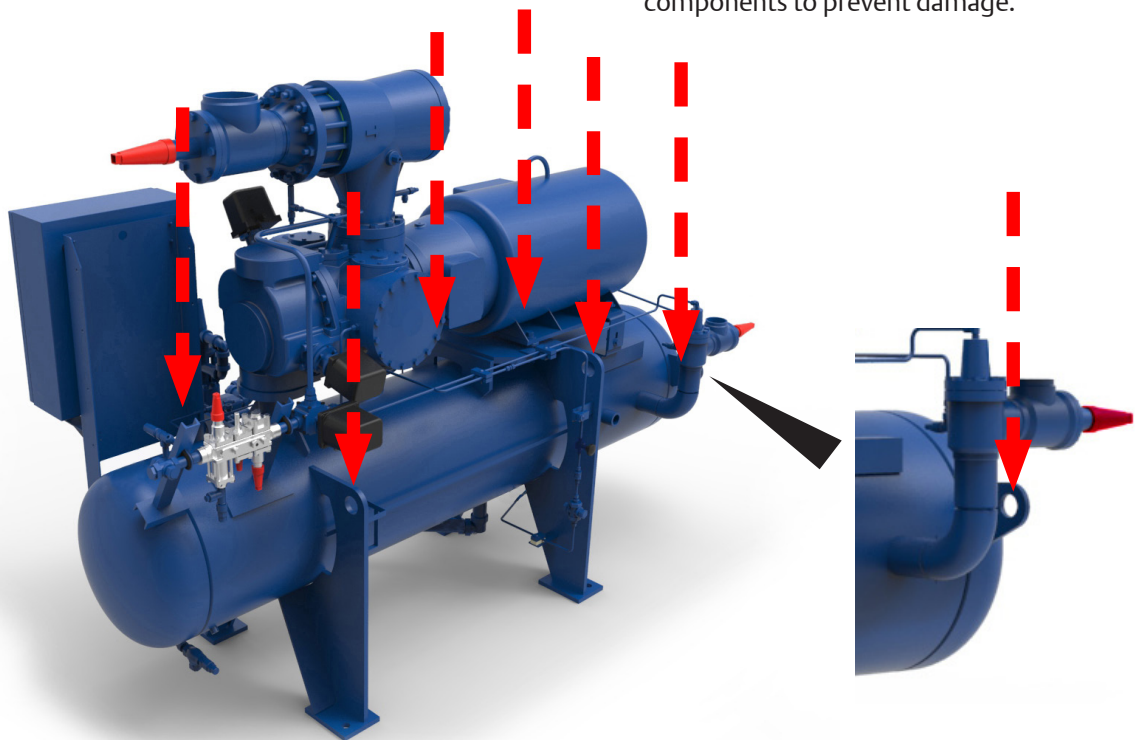


Figure 3-1. Rigging and Lifting Points

Section 3 • Installation

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.

The following are recommendations regarding long term storage:

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

COMPRESSOR MOTOR

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

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

NOTE

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

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

Compressor Unit Inspections Prior to Storage or Installation

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

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

Recommended 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)
- Infrared Heat Gun
- Torque Wrenches (with ranges from 0 to 600 ft-lbs)
- Sockets and wrenches up to 2-1/2" (63.5 mm)
- Voltmeter

Long Term Storage Log

Company: _____ Sales Order Number: _____

Serial Number: _____

Name (Please Print): _____ Initial: _____

Date (M/D/Y): _____

PSI Nitrogen Pressure - Current

PSI Nitrogen Pressure - Recharged (If pressure is low, identify and fix leak prior to recharging, see Compressor Unit Leak Check procedure in Section 5)

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 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)

Name (Please Print): _____ Initial: _____

Date (M/D/Y): _____

PSI Nitrogen Pressure - Current

PSI Nitrogen Pressure - Recharged (If pressure is low, identify and fix leak prior to recharging, see Compressor Unit Leak Check procedure in Section 5)

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 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)

Section 3 • Installation

Foundation

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

Considerations Prior to Starting

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

Site Characteristics:

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

Site Layout:

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

Safety:

NOTE

Always check with a safety engineer before proceeding.

- Arranging equipment with adequate access space for safe operation and maintenance
- Wherever possible, arrange equipment to be served by crane. If not feasible, consider other handling methods
- Make all valves and devices safely accessible
- Use special bright primary color schemes to differentiate service lines
- 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 1 - Concrete Pad with Compressor Unit Dimensions - Side View. The rebar required is ASTM 615, grade 60, sizes #4 and #6. Wires will also be needed to tie the rebar together. The recommended grout is Masterflow 648CP high performance non-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 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

Section 3 • Installation

- 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

Vilter foundation drawing. When all rebar is 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

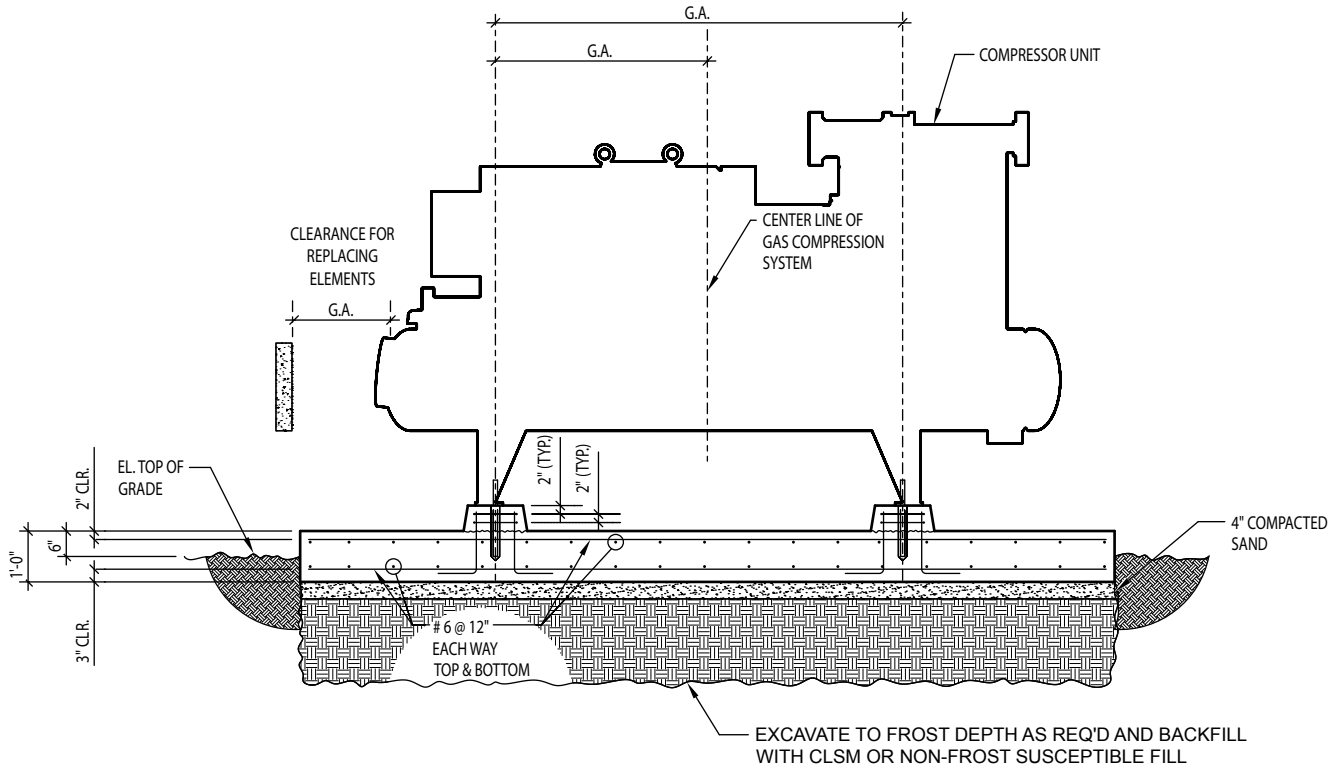


Figure 3-2. Concrete Pad with Compressor Unit Dimensions - Side View

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

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.

Section 3 • Installation

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.

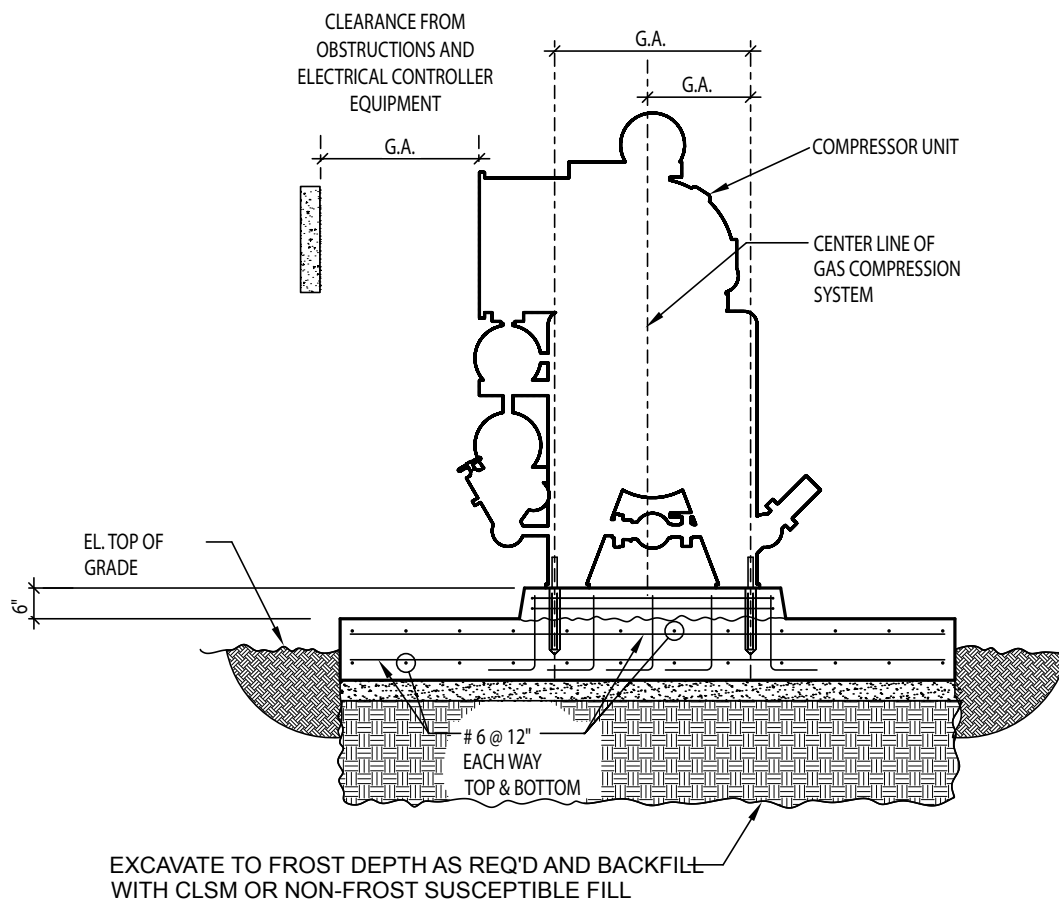


Figure 3-3. Concrete Pad with Compressor Unit Dimensions - Front View

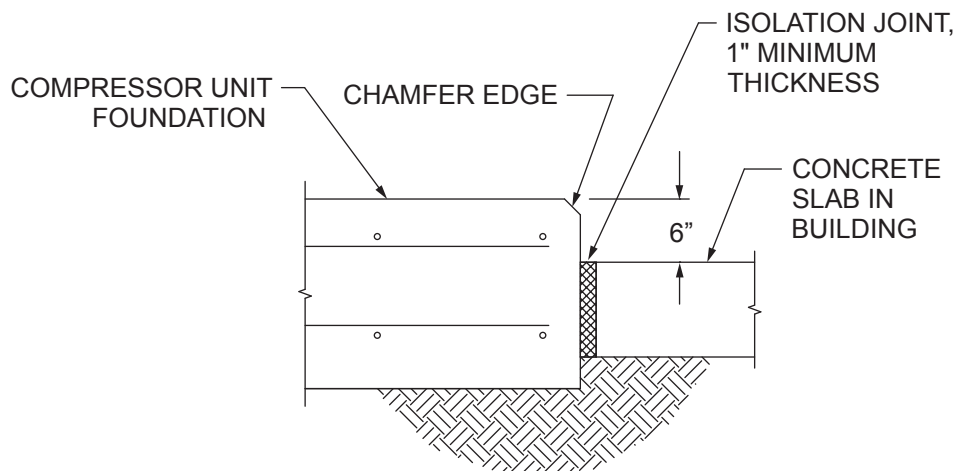


Figure 3-4. Interior Foundation Isolation

Section 3 • Installation

Additional Information

Codes and Standards

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

- ACI
- ASTM
- ASCE 7
- IBC 2006

Operation and Performance

The foundation was designed for:

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

General Design Requirements

The compressor foundation is designed to:

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

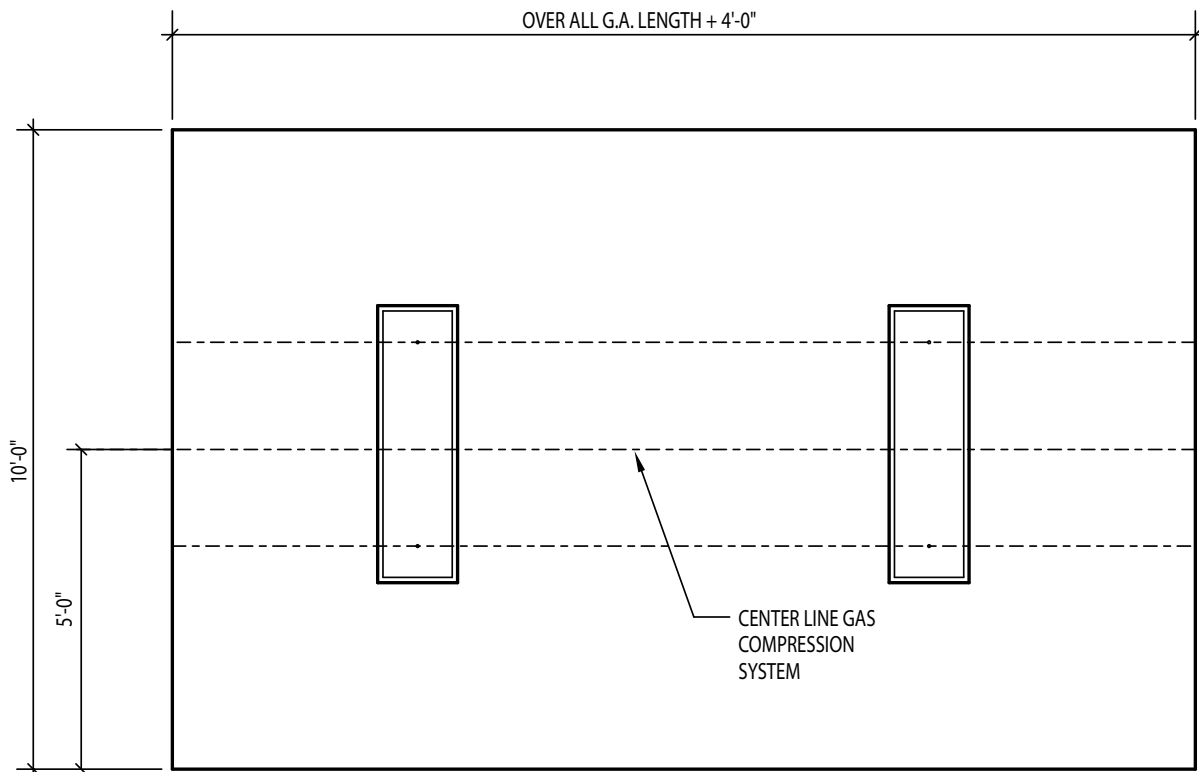


Figure 3-5. Foundation with Housekeeping Pads Dimensions - Top View

Section 3 • Installation

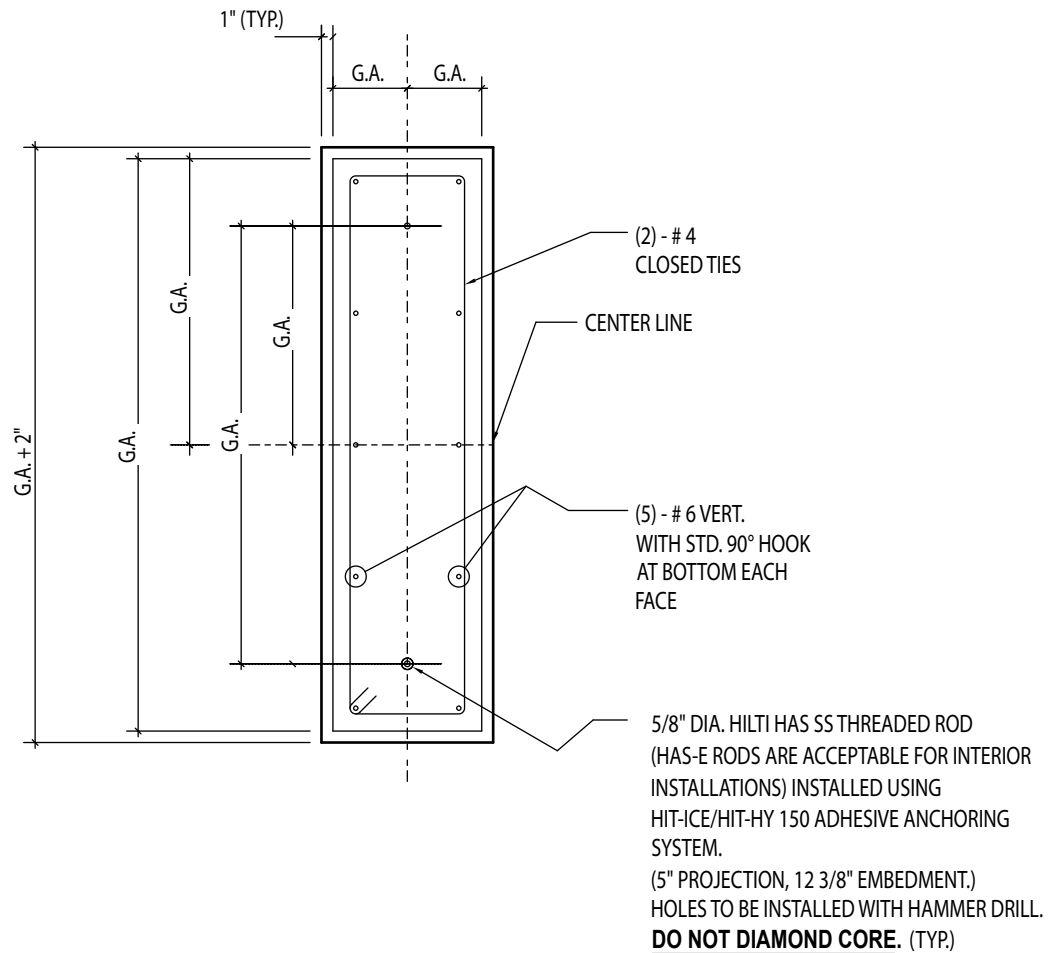


Figure 3-6. Housekeeping Pad Dimension Detail - Top View

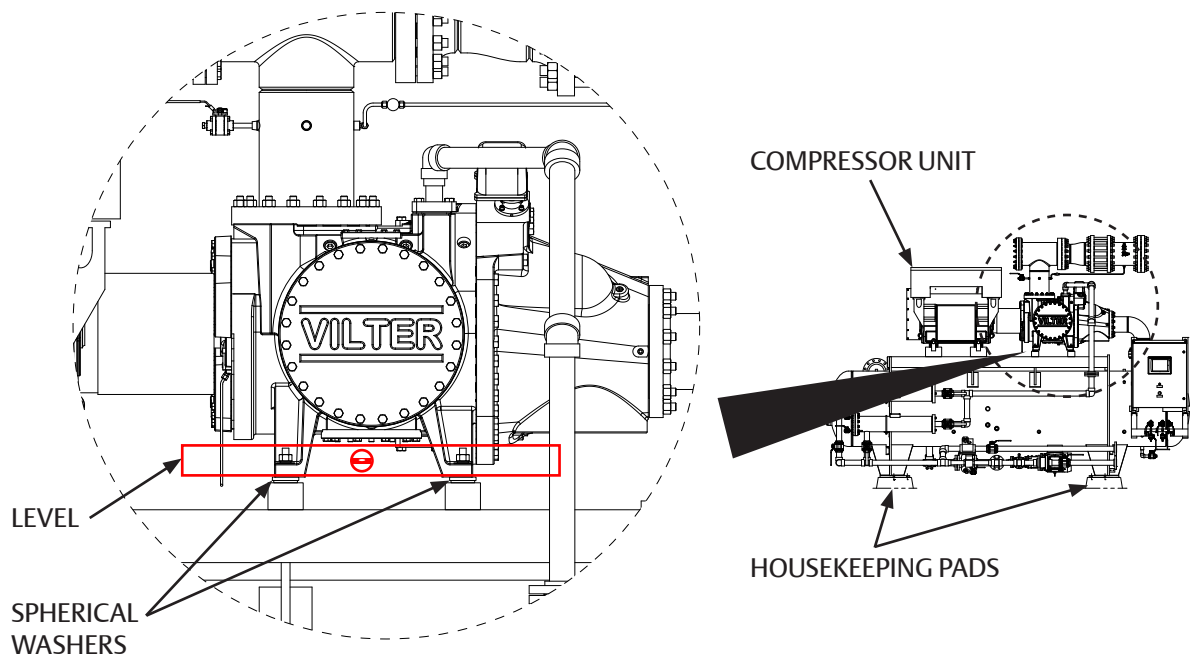


Figure 3-7. Level Compressor Unit Using Top Surface of Spherical Washers

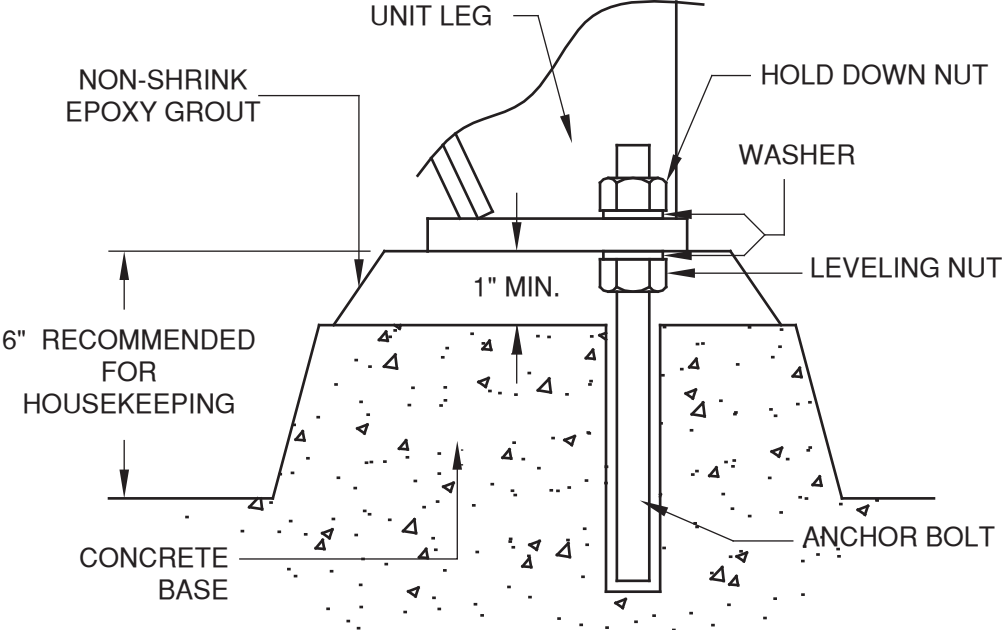


Figure 3-8. Concrete Pad Housekeeping Detail

Section 3 • Installation

Piping

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

The most important issue is the motor-compressor misalignment caused by external forces (F in lbf) and moments (M in ft-lbf) imposed by plant piping. In Figure 3-9 and Table 3-1, 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 / B31.3 as applicable. See guidelines below, particularly with concern to minimizing loads on check valves.

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 <td 1200	1200	1200	
12	1500	1500	1500	1500	1500	1500
14	2000	2000	2000	2000	2000	2000

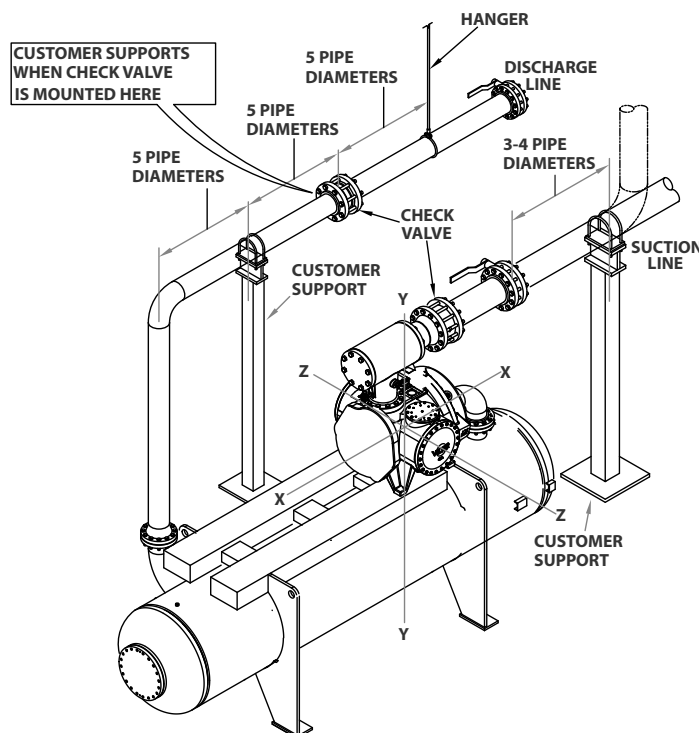


Figure 3-9. Maximum Allowable Flange Loads

Section 3 • Installation

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.

Reference Figure 3-10

1. Control power of 115 VAC 50/60 HZ must be wired to left side of terminal blocks inside the Vission 20/20 cabinet. Line power (1B) shall be connected to 15-amp circuit breaker, CB1. Neutral (1N) is connected to any N terminal blocks. Number of line power feeds required to panel is dependent upon number supplied on compressor, see Figure 3-10.
2. An auxiliary contact from compressor motor starter is required. Connect isolated contact to terminal blocks 1 and 31.

3. A dry contact from control relay CR11 must be wired to compressor motor starter coil. This dry contact is wired to terminal blocks according to supplied drawing. Control power for this coil should come from a source, which will be de-energized with compressor disconnect.
4. A dry contact from control relay CR12 must be wired to oil pump motor starter coil. This dry contact is wired to two terminal blocks according to supplied drawing. Control power for this coil should come from a source, which will be de-energized with compressor disconnect.
5. An auxiliary safety cutout is available to shut down compressor package. A dry contact must be supplied and wired to terminal blocks 1 and 32. The jumper installed on terminal blocks must be removed to use this cutout. If contact is closed, it will allow compressor to run. If contact opens at any time, compressor will shut down.
6. Indication of compressor shutdown status is also available. There is an output on terminal blocks 18 and N where a relay coil can be wired. For output, an energized state represents a “safe” condition. A de-energized state indicates a loss of voltage to relay coil or a “failure” has occurred.
7. Line power for oil separator heaters are required to be wired from the starter panel, see Figure 3-11.

NOTE

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

8. Current transformer supplied in compressor motor conduit box should be checked to ensure that motor leads of one leg are pulled through the transformer. Typically, a wye delta starter 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.

Section 3 • Installation

MCC & CUSTOMER CONTROL CENTER INTERCONNECT WIRING

RUN ALL WIRE CONNECTIONS DIRECTLY TO INTENDED COMPONENTS
DO NOT CONTROL WITH ANOTHER DEVICE
ALL WIRE NUMBERS THAT ARE THE SAME ARE NOT ALWAYS COMMON TO EACH OTHER
(REFERENCE DRAWING NUMBERS)

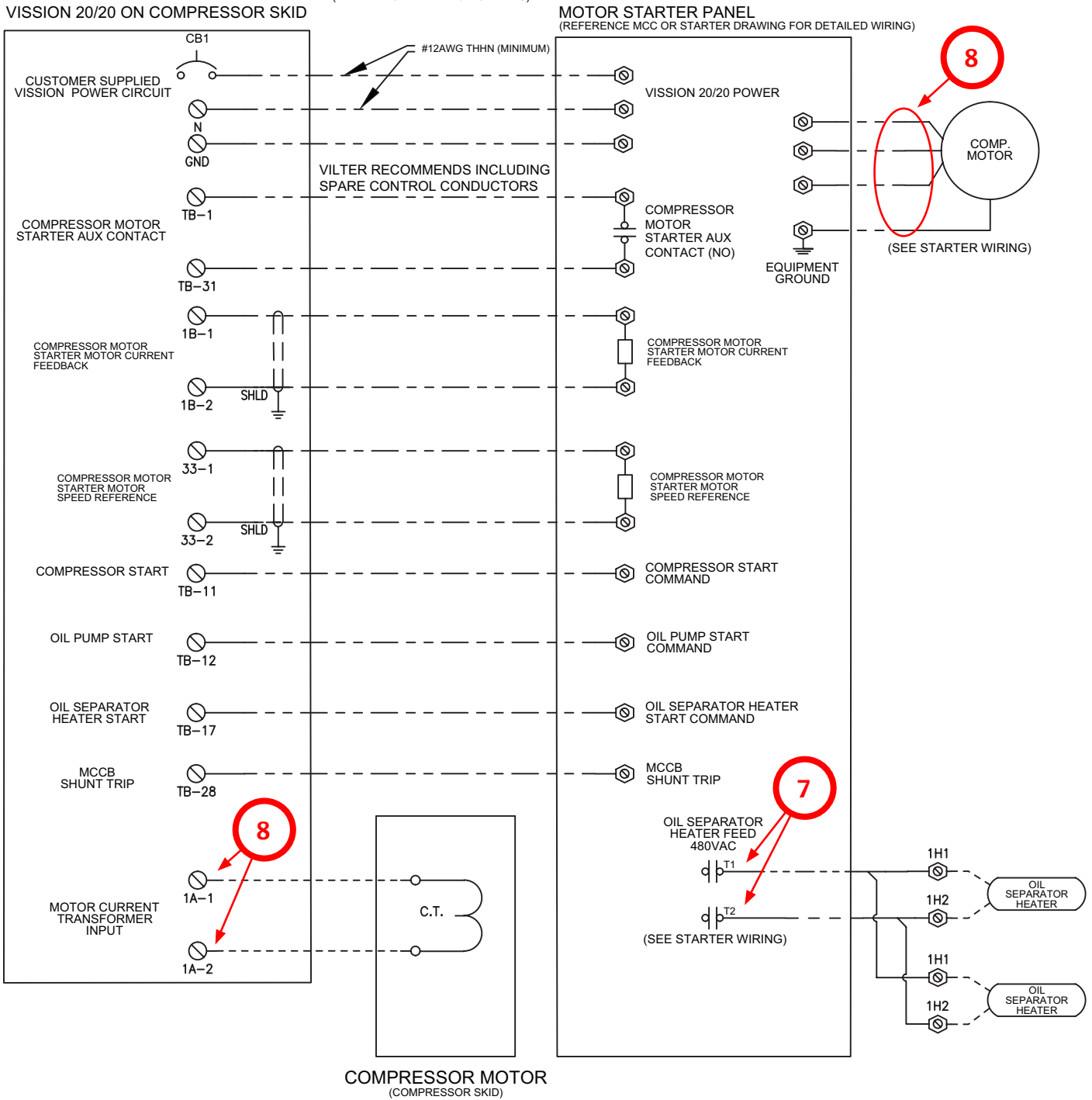


Figure 3-11. Example - Interconnect Wiring Diagram

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 for various refrigerants are listed in ANSI B9.1-1971 code brochure entitled “Safety Code for Mechanical Refrigeration”. 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.

A mixture of four parts water to one part liquid soap, with a few drops of glycerin added, makes a good solution. Apply this mixture with a one inch round brush 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 with the soap mixture previously described. 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.

Evacuating The System

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 60F 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.

Section 3 • Installation

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.

Typically, the compressor unit is shipped from Vilter with no oil charge. The normal operating level is between the two sight glasses on the oil separator, see Figure 3-13. Refer to supplied GA drawing for unit specific oil charge requirement.

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

Tool Required:

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

UNIT INITIAL OIL CHARGING

(Reference Figure 3-14)

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 3-13.
3. Open oil separator drain valve (10) and fill oil separator (1) to Maximum NON-Operating Level, Figure 3-12.
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.

PRIMING OIL LINES AND COMPRESSOR (UNITS EQUIPPED WITH OPTIONAL OIL PUMP)

For units equipped with an optional 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.
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.

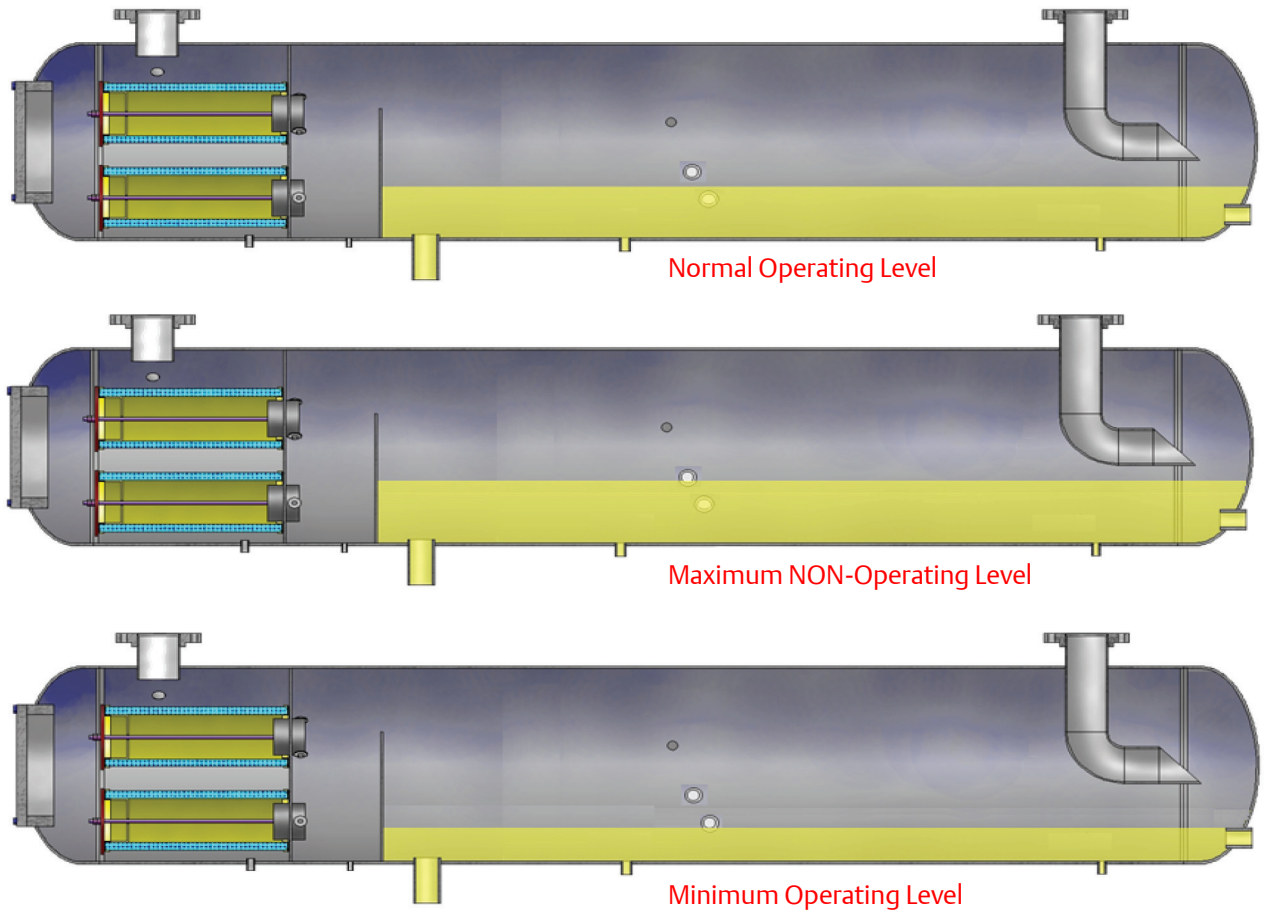


Figure 3-12. Oil Operating Levels

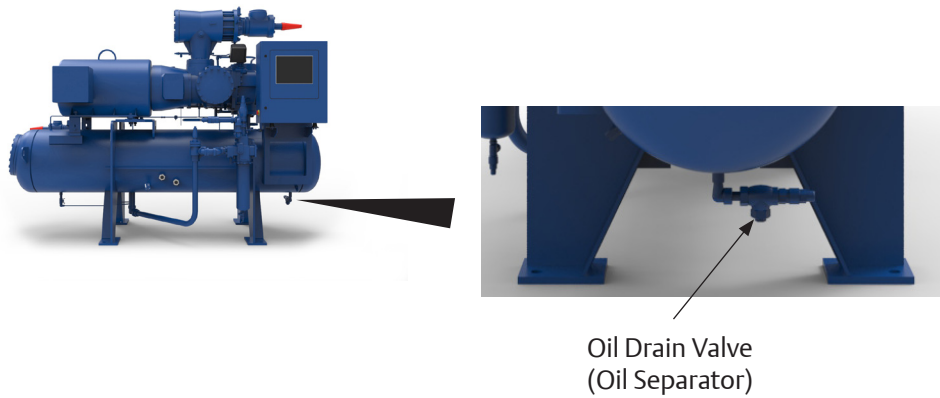


Figure 3-13. Oil Drain Valve

Section 3 • Installation

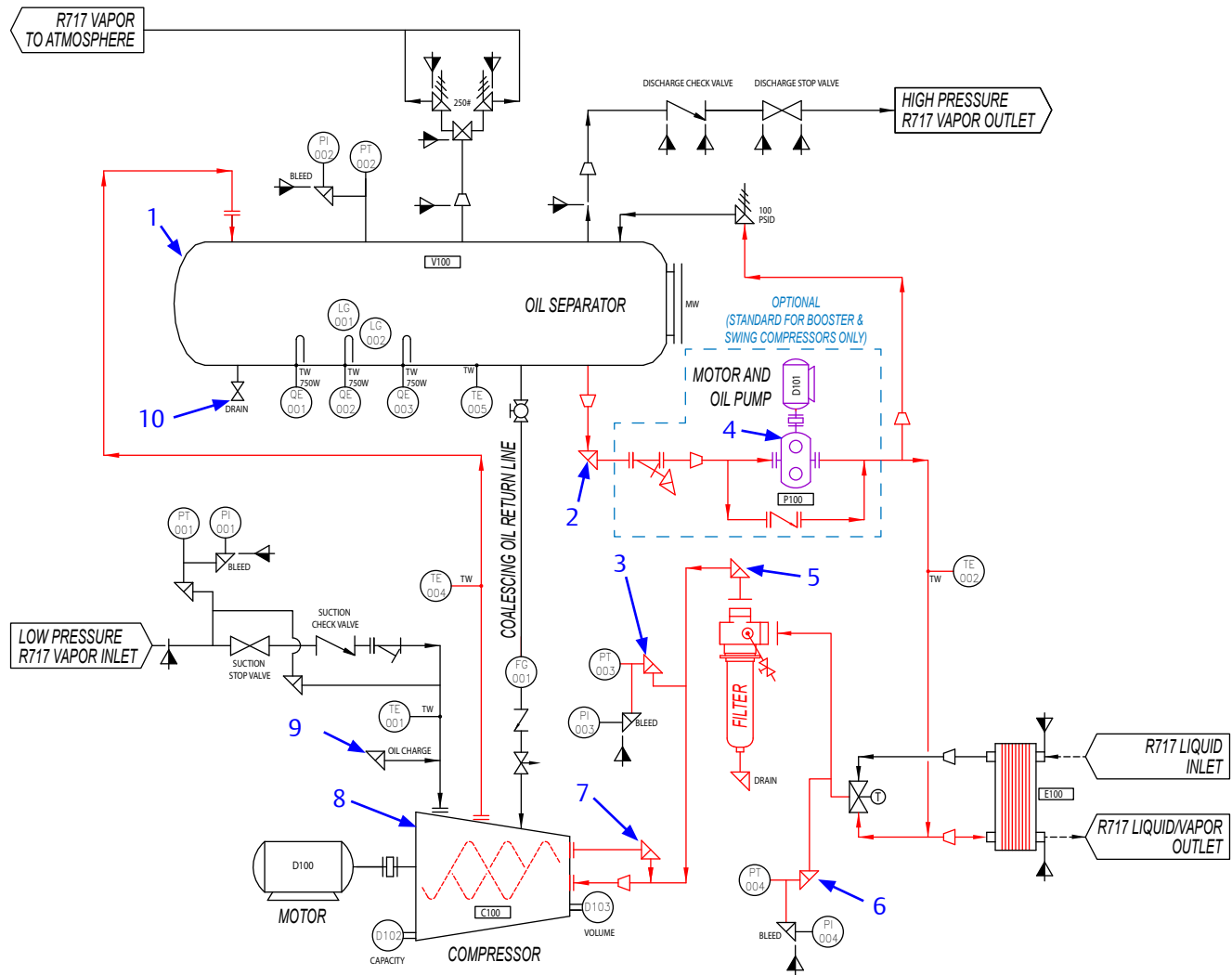


Figure 3-14. Priming Oil Lines and Compressor

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. Correct fan and pump rotation.
4. Evaporator pressure regulators and solenoid valves open.
5. Water pumps and motors correctly aligned.
6. Belt drives correctly aligned and tensioned.
7. 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 micro-processor 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. Invert the refrigerant drum if the drum is not equipped with “Liquid” and “Vapor” valves, and place in such a position so the liquid refrigerant only can enter the system. 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

Section 3 • Installation

without water in the shell and tube equipment to eliminate the possibility of freeze up.

4. After some refrigerant has entered the system, the compressor unit starting procedure may be followed, see Starting procedure in Section 4.
5. Continue charging refrigerant into the system until the proper operating requirements are satisfied. Then, close the liquid charging connection and open the liquid line valve allowing the system to operate normally. To check that enough refrigerant has been added, the liquid sight glass should show no bubbles, and there will be a liquid seal in the receiver. If these two conditions are not satisfied, additional refrigerant must be added.
6. When sufficient refrigerant has been charged into the system, close the charging and 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.

Section 4 • Operation

Operation

All operation (setpoint adjustments, calibrations, monitoring) of the compressor unit is done through the Vision 20/20. For additional procedural information, refer to Vision 20/20 Manual (35391SC).

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.

Dual Oil Filters

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

NOTE

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

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

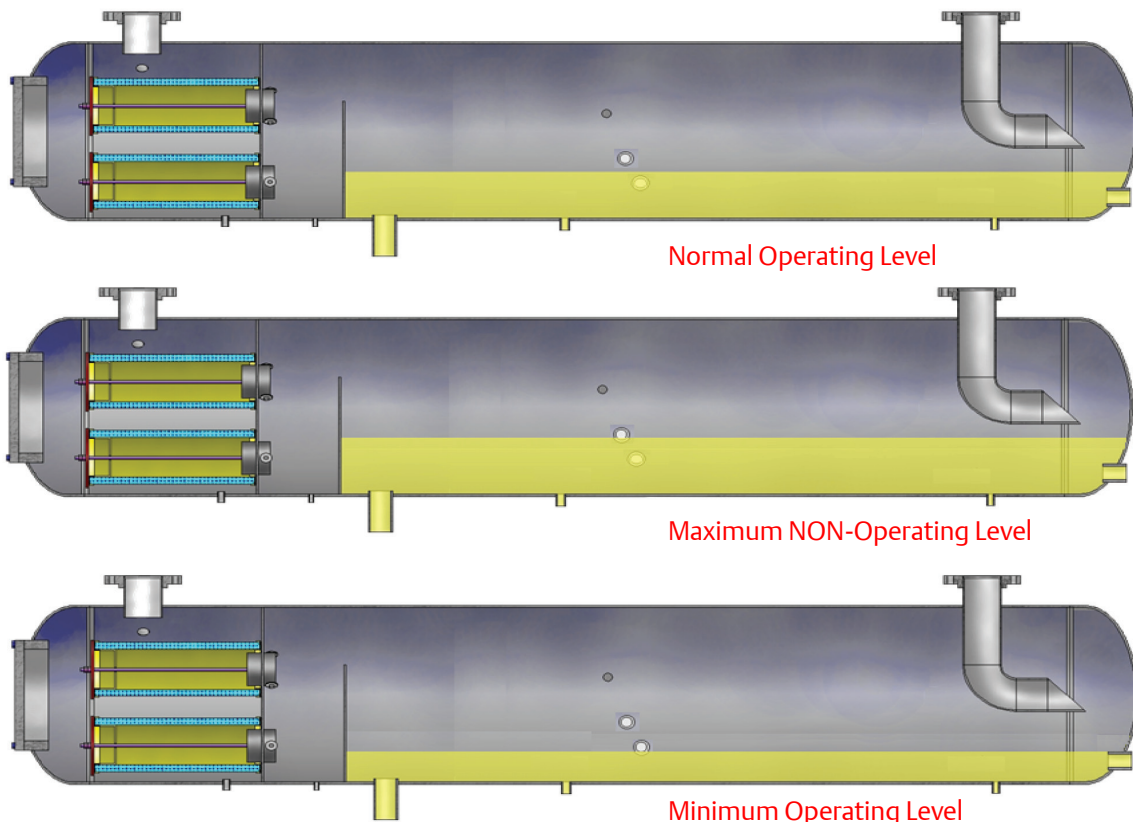


Figure 4-1. Oil Operating Levels

Section 4 • Operation

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 the Vision 20/20 operating manual (35391SC).

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.

Units with a KDC valve and no oil pump, when started the unit will build enough pressure to open the KDC valve and volume ratio slide valves are at or below 10% before the compressor will begin normal operation. The amount of pressure that needs to be achieved is 6 psig above the discharge pressure.

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, the compressor slide valves must return below their respective 5% limits before the compressor unit can be restarted.

NOTE

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

Emergency Shutdown

Emergency shutdown is initiated by the following:

1. A shutdown or trip condition of a process variable while the system is in operation. If a process variable reaches a high-high or low-low shutdown setpoint, the compressor unit will automatically stop. A shutdown alarm is also generated on the control panel HMI screen annunciating the specific process variable trip condition.
2. The Emergency Local Stop pushbutton located on the side of the control panel enclosure. When the Emergency Local Stop pushbutton 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 Emergency Local Stop pushbutton must be pulled out to power up the unit and controls.

Section 4 • Operation

Calibrate Slide Valve Actuators

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

WARNING

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

CAUTION

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

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

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

3. 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.

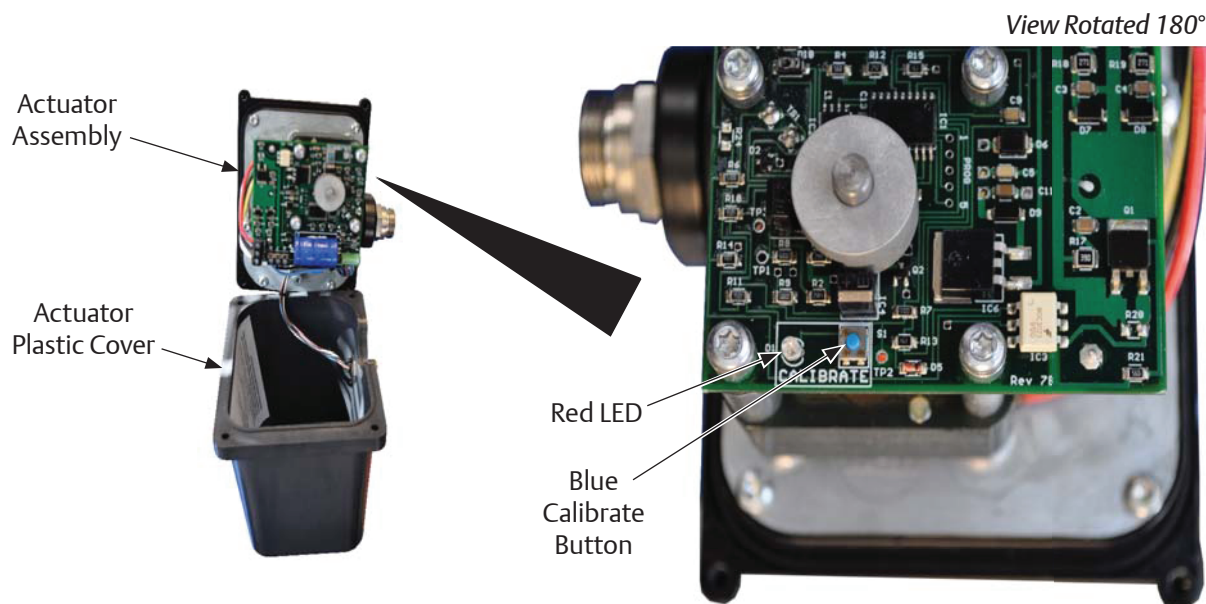


Figure 4-2. Actuator Assembly

Section 4 • Operation

Suction Pressure 1 | **Stopped** | **9.4 Psig Δ**

Anti-Recycle: 00:00
 Oil Pump: Off
 Oil Heater: Off
 Remote Lock Out: On

Suction
 29.4 Psig
 50.0 °F

% CAP
 0.9 %

Discharge
 127.9 Psig
 83.1 °F

Motor
 0.0 Amps
 0 rpm

Oil Filter
 In 169.7 Psig
 Out 160.8 Psig
 Diff 8.9 Psig

% VOL
 1.7 %

Separator
 106.0 °F

Capacity Slide: 0.9 %
 Volume Slide: 1.7 %

Suction Press Control Setpoint: 20.0 Psig

Suction Press: 29.4 Psig
 Temp: 50.0 °F

Discharge Press: 127.9 Psig
 Temp: 83.1 °F

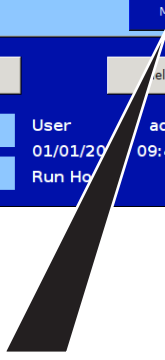
Oil Press Diff: 131.4 Psig
 Filter Diff: 8.9 Psig
 Inj Temp: 102.1 °F
 Sep Temp: 106.0 °F

Motor Amperage: 0.0 Amps

Menu

Maintenance | User Access | Log off | Help

No Scheduled Maintenance | User: admin | 01/01/2008 09:41:42
 No Alarm/Trips Present | Run Hours: 0



Suction Pressure 1 | **Stopped** | **83.8 Psig Δ**

Compressor Control | Service Options

Alarms and Trips | Instrument Calibration

Timers | Slide Calibration

Compressor Scheduling | Trend Chart

Compressor Sequencing | Event List

Condenser Control | Input/Output States

Vilter VFD | Auxiliary I/O

Configuration | Data Backup | Main

Capacity Slide: 0.2 %
 Volume Slide: 4.8 %

Suction Press Control Setpoint: 20.0 Psig

Suction Press: 103.8 Psig
 Temp: 43.1 °F

Discharge Press: 145.9 Psig
 Temp: 102.5 °F

Oil Press Diff: 54.5 Psig
 Filter Diff: 0.9 Psig
 Inj Temp: 100.3 °F
 Sep Temp: 108.9 °F

Motor Amperage: 0.0 Amps

Maintenance | Log on | Language | Help

No Scheduled Maintenance | 04/02/2008 04:24:47
 No Alarm/Trips Present | Run Hours: 3

Figure 4-3. Menu Screen and Slide Calibration Button (Vission 20/20)

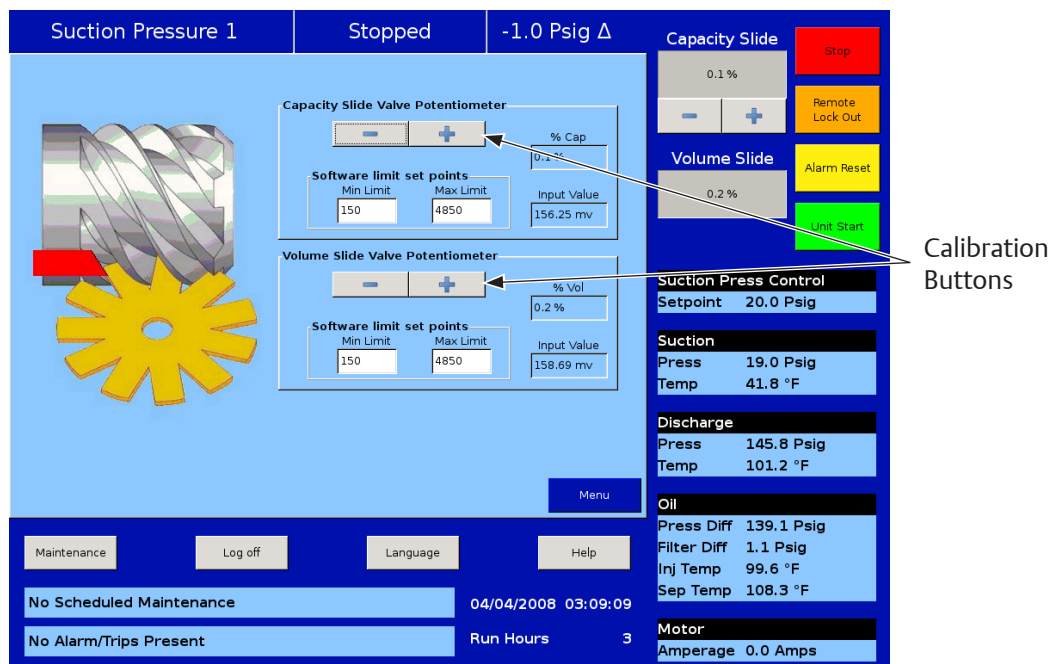


Figure 4-4. Slide Valve Calibration Screen (Vision 20/20)

4. Logging on with high-level access will prompt the Calibration buttons to appear, see Figure 4-4.
5. On the main screen, press “Menu” then press the “Slide Calibration” button to enter the slide calibration screen, see Figure 4-3.
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.

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 4-6.

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 0V when the actuator is running and 5V when it is still. Thus, as stated earlier, the actuator voltage will

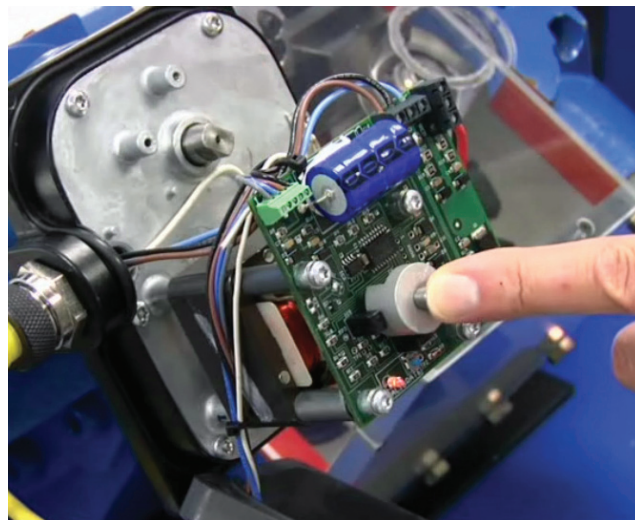


Figure 4-5. Photo-chopper

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

- fluctuate during calibration. After the actuator has been calibrated, 0V output will correspond to the minimum position and 5V 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.

Section 4 • Operation

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
VSMC 152 VSMC 182 VSMC 202 VSMC 301 VSMC 361 VSMC 401	CW	CCW	CW	CCW	0.80	288	3.141"	0.45	162	1.767"
VSMC 501 VSMC 601 VSMC 701	CCW	CW	CCW	CW	0.91	328	3.568"	0.52	187	2.045"

*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.

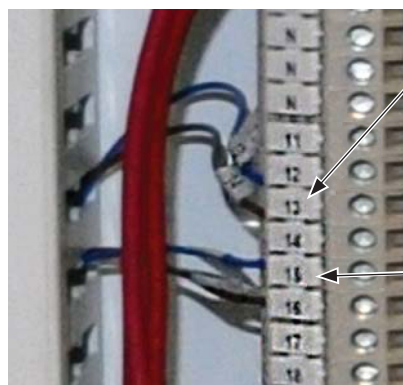
CAUTION

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.

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.
10. Press and hold down on the photo-chopper shaft to disengage the brake slowly, releasing tension from the motor mount, see Figure 4-5. 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.



Capacity Actuator
Wire connections
(13, 14)

Volume Actuator
Wire connections
(15, 16)



NOTE

If the photo-chopper spins faster than 4800 rpm, the actuator will go into an overspeed 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, a 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.

Figure 4-6. Wire Connections for Capacity and Volume Actuators

Section 4 • Operation

Coalescing Oil Return Line Setup

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

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

NOTE

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

1. Open shut-off valve on coalescing side of oil separator, see Figure 4-7.
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.

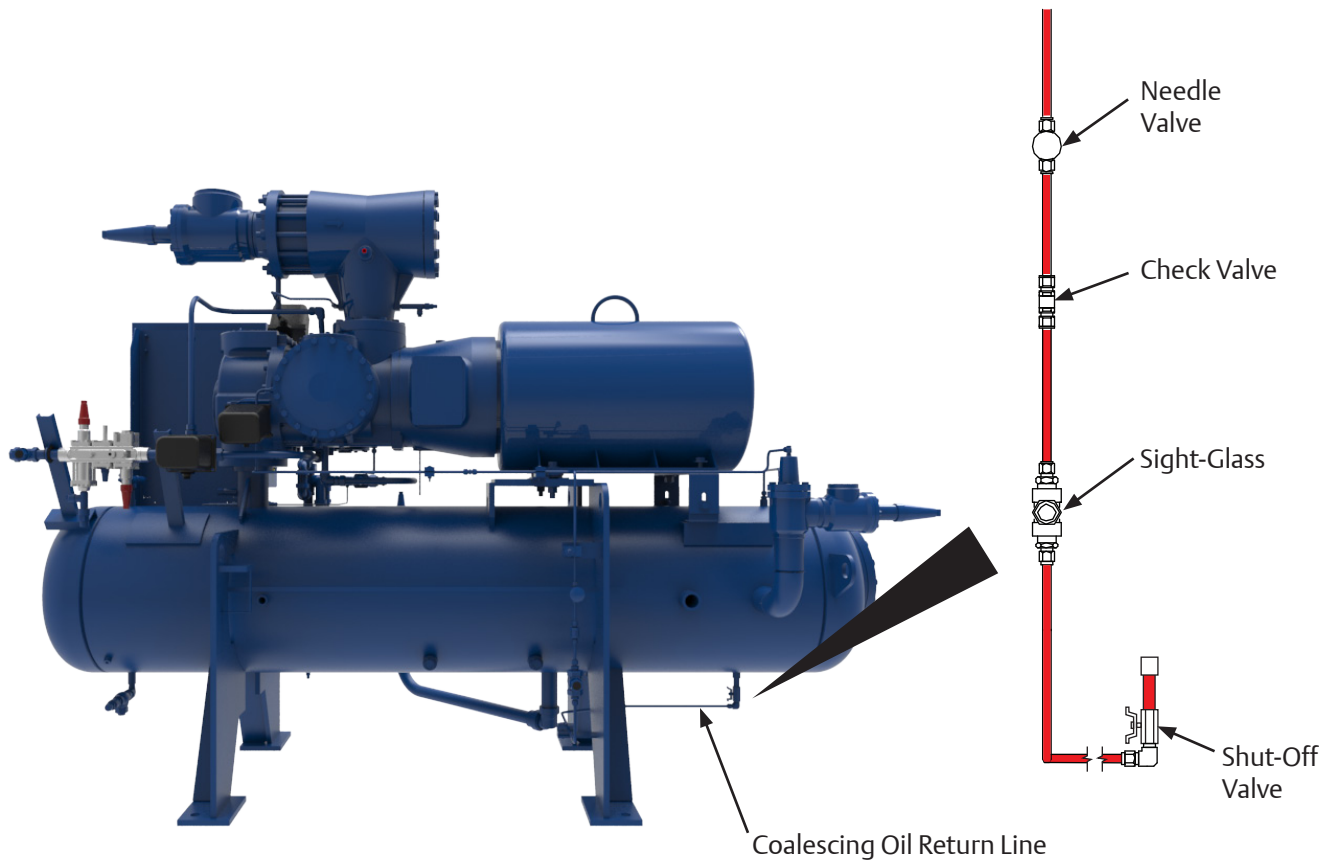


Figure 4-7. Coalescing Oil Return Line

Section 4 • Operation

Suction Equalizing Line Setup

The suction equalizing line allows system pressure to equalize to suction pressure during shutdown periods. The line is connected before the suction stop/check valve to after the suction strainer, see Figure 4-8.

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.

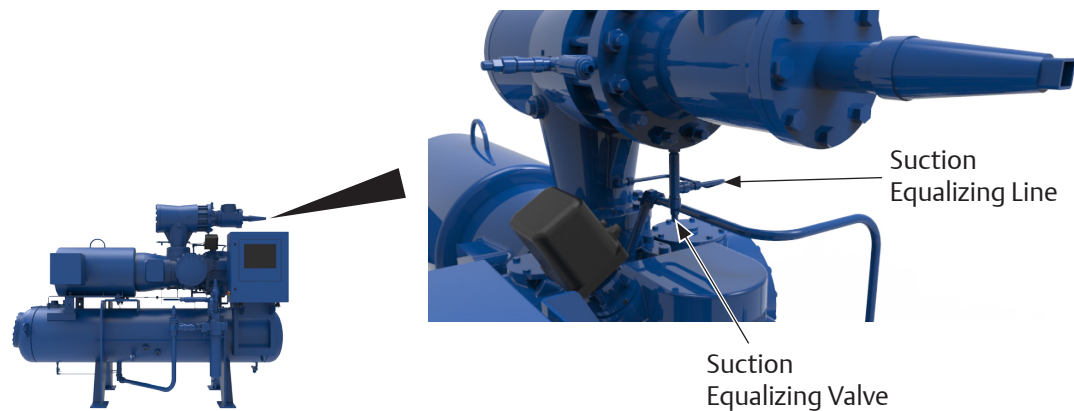


Figure 4-8. Suction Equalizing Line and Valve

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:

3. Close outlet oil filter shut-off valve to inactive oil filter.
4. Close inlet oil pressure shut-off valve for inactive oil filter.

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 oil filter shut-off valve to active oil filter.



Figure 4-9. Dual Oil Filter Setup for Oil Filters with Manifold Heads

Maintenance and Service Schedule

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

Table 5-1. Maintenance/Service Schedule

Group	Inspection/ Maintenance	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	-	-
	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
	Coupling Alignment and Integrity	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Motor (Compressor)	See Motor Manual for proper lubrication procedures and service intervals.													
Control Calibration	Transducers	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	RTDs	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Slide Valve Motors	Slide valve calibration should be inspected monthly. Inspections can be performed through the control panel. If a Non-Movement Alarm appears, calibrate immediately.													
Compressor	Compressor ⁽⁴⁾	-	I	-	I	-	I	-	I	-	I	-	I	-	I
	Bearings	-	-	-	-	-	-	-	-	-	-	-	-	-	-

I = Inspect S = Sampling R = Replace

(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 12 psi or oil analysis requires it.

(4) Inspections include: gate rotor inspection, backlash measurement, shelf clearance, end play measurement (main rotor & gate rotor), gate rotor float, slide valve inspection.

Section 5 • Maintenance/Service

Preventive Maintenance, Checks and Services

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

DAILY

1. Check oil levels.
2. Check all pressure and temperature readings.
3. Check oil filter inlet and outlet pressures for excessive pressure drop. Change filter when pressure drop exceeds 45 psid or every six months, whichever occurs first. The default alarm and trip setpoints are set at 15 psid.
4. Clean strainers each time oil filter is replaced.
5. Check compressor sound for abnormal noises.
6. Check shaft seals for excessive oil leakage. A small amount of oil leakage (approximately 10 drops per minute) 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 8 above plus 9 thru 13)

10. Oil 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)

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 "D" above plus 14 thru 28)

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 panel.
 - Check for loose wiring connections in the Vission 20/20 panel.
 - Check relay and contact operation for relays in the Vission 20/20 panel.
 - Verify set points in the Vission 20/20.
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 for wear.
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

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 lockout/tagout procedure. 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. Lockout/tagout disconnect switches.
3. If suction equalizing valve is not open, open valve 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. Lockout/tagout valves.

NOTE

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

5. Open any other valves that may trap gas or liquid. Lockout/tagout 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.

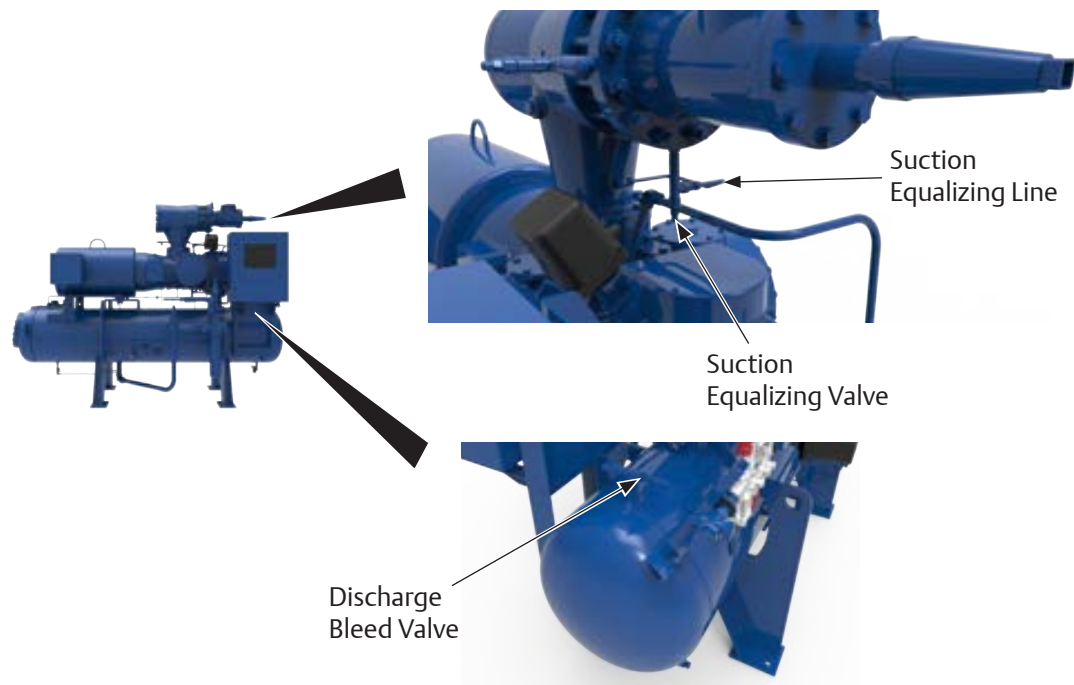


Figure 5-1. Discharge Bleed Valve, Suction Equalizing Line and Valve

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 Chapter VI of ASME B31.3 Process Piping 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. Slowly pressurize compressor unit through suction oil charging port with dry nitrogen.
4. Using appropriate soap solution, check for leaks on joints and connections of the serviced component.
5. If leaks are found, depressurize system and fix leaks. Repeat steps 3 and 4 until all leaks are fixed.
6. Evacuate from suction oil charging port.
7. Close all valves previously opened in the system. Remove tags as per the local lockout/tagout procedure.
8. Turn the motor and oil pump disconnect switches to the ON position.
9. Return compressor unit to service.

Oil System Components

Oil Sampling

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.

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

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

NOTE

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

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

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



Figure 5-2. Oil Analysis Kit

Oil 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 5-3.

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.

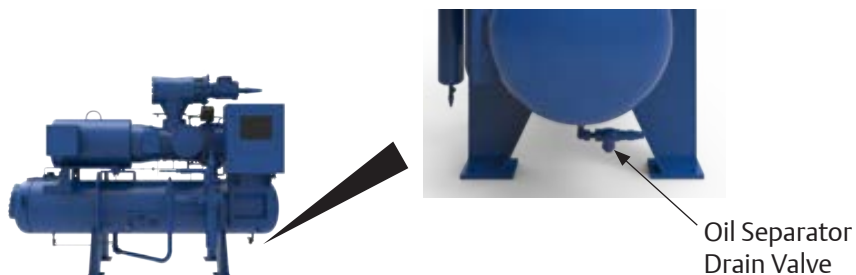


Figure 5-3. Oil Strainer Drain Valve and Oil Separator Drain Valve

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 5-4. 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 5-3. During shutdown, oil can be added to the Maximum Non-Operating Level. For shutdown procedure, see Compressor Unit Isolation procedure.

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

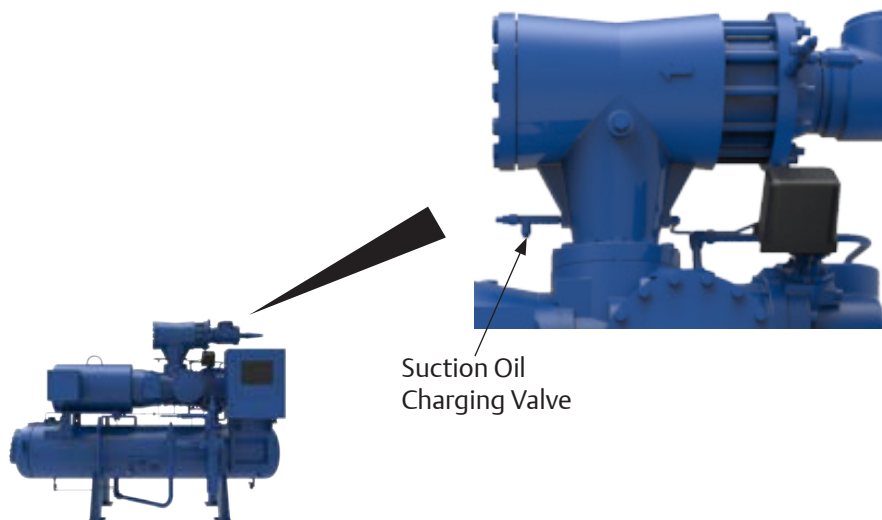


Figure 5-4. Suction Oil Charging Valve

Filter Element Replacement (Single Oil Filter Assembly) and Oil Pump Strainer Servicing

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.

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

PARTS REQUIRED

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

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.

OIL FILTER ELEMENT REMOVAL

(FOR 3111A OIL FILTER HOUSING - See Figure 5-5)

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 PUMP STRAINER SCREEN REMOVAL AND SERVICE

13. Remove four bolts and strainer cover from strainer body.
14. Remove screen from strainer body.
15. Clean screen and interior of strainer body
16. Inspect screen for damage, replace if required.

OIL PUMP STRAINER SCREEN INSTALLATION

17. Install screen in strainer body.

Section 5 • Maintenance/Service

18. Install four bolts to secure strainer cover on strainer body.
19. Tighten bolts, see Appendix A.
20. Close drain valve on oil pump strainer.
21. Install plug on drain valve.
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 3111A OIL FILTER HOUSING - See Figure 5-5)

22. Lubricate new O-ring with clean system oil.
23. Install O-ring on inside of filter head.
24. Install new filter element on internal port of head assembly. Make sure filter element is fully seated.
25. Lubricate threads of locking ring with clean system oil.
26. Hand tighten locking ring only. Install locking ring and filter housing on head assembly until filter housing bottoms. Do not overtighten locking ring.
27. Using dry nitrogen gas, pressurize isolated oil line through bleed valve of filter housing. Check for leaks on replaced components.

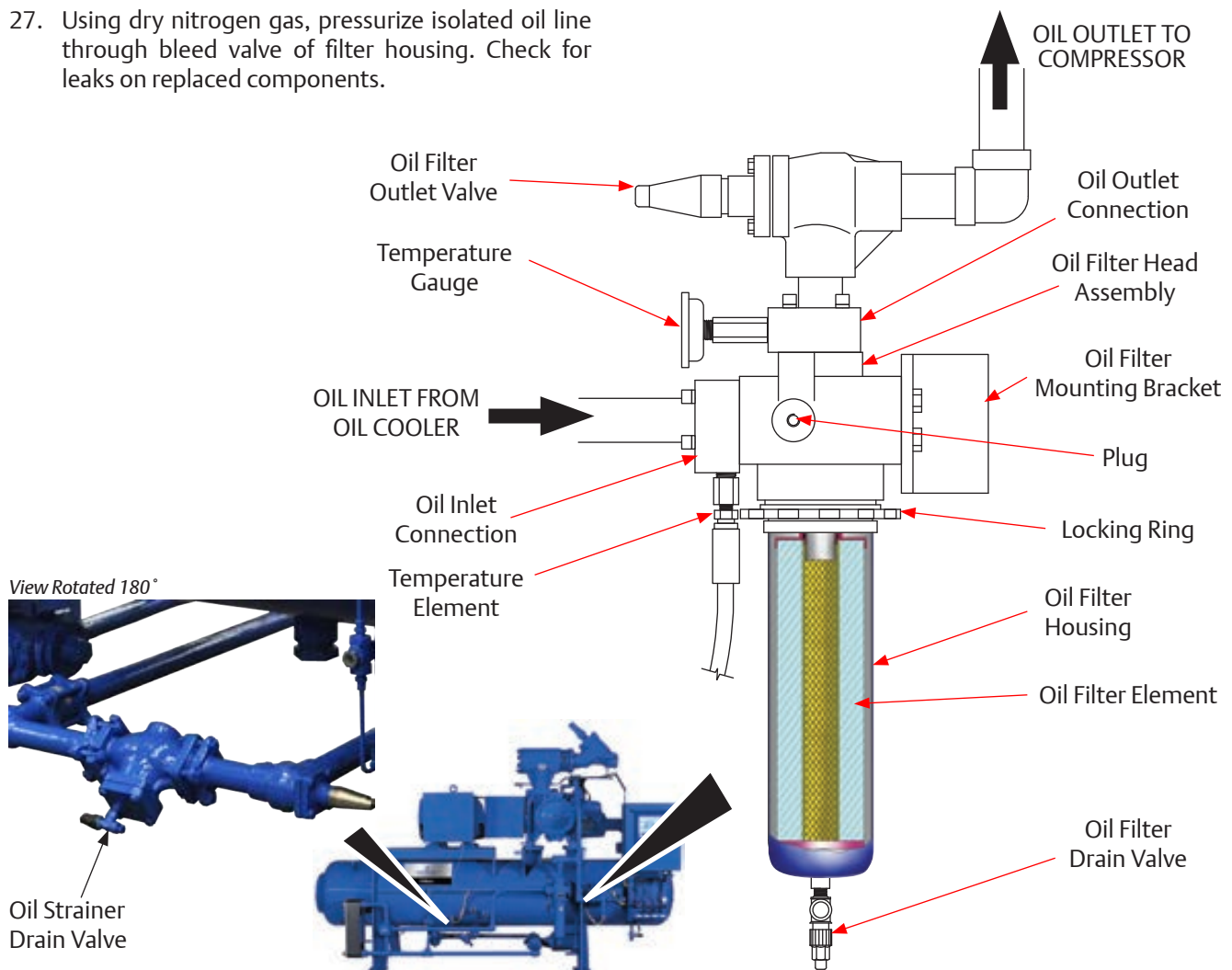


Figure 5-5. Filter Assembly and Oil Strainer Drain Valve (VPN 3111A Oil Filter Housing Shown)

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.

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

PARTS REQUIRED

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

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.

SWITCHING OIL FILTERS FOR MAINTENANCE

(Reference Figure 5-8)

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.

DRAIN OIL FROM ISOLATED OIL FILTER

(Reference Figure 5-9)

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 - See 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.

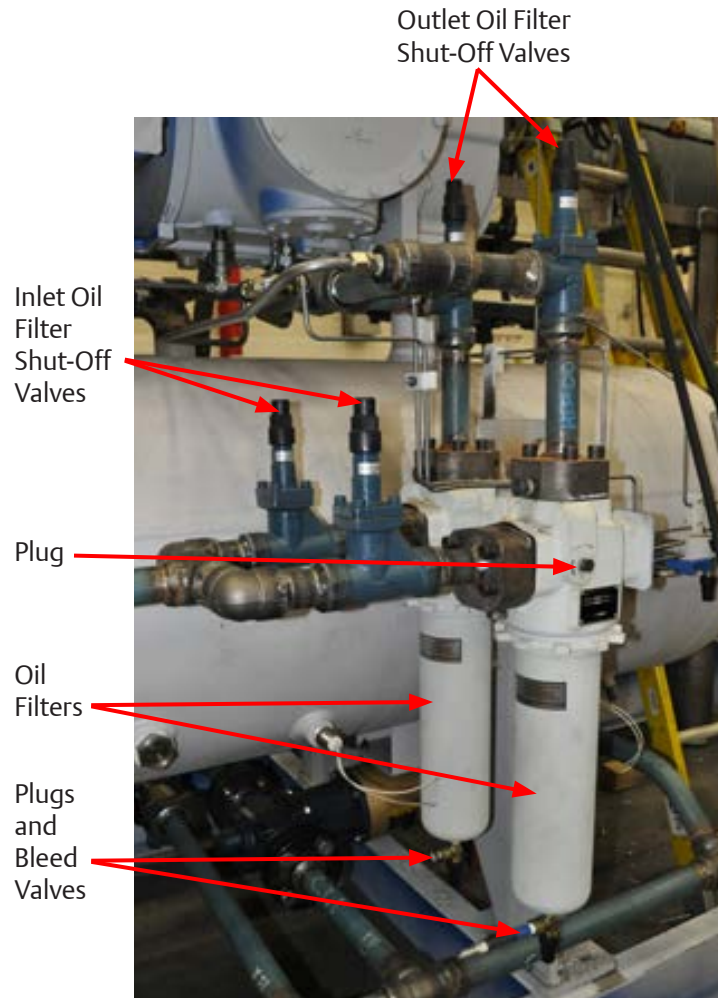


Figure 5-8. Dual Oil Filter (3111A Oil Filter Housings Shown)

OIL FILTER ELEMENT INSTALLATION

(FOR 3111A OIL FILTER HOUSING - See Figure 5-9)

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

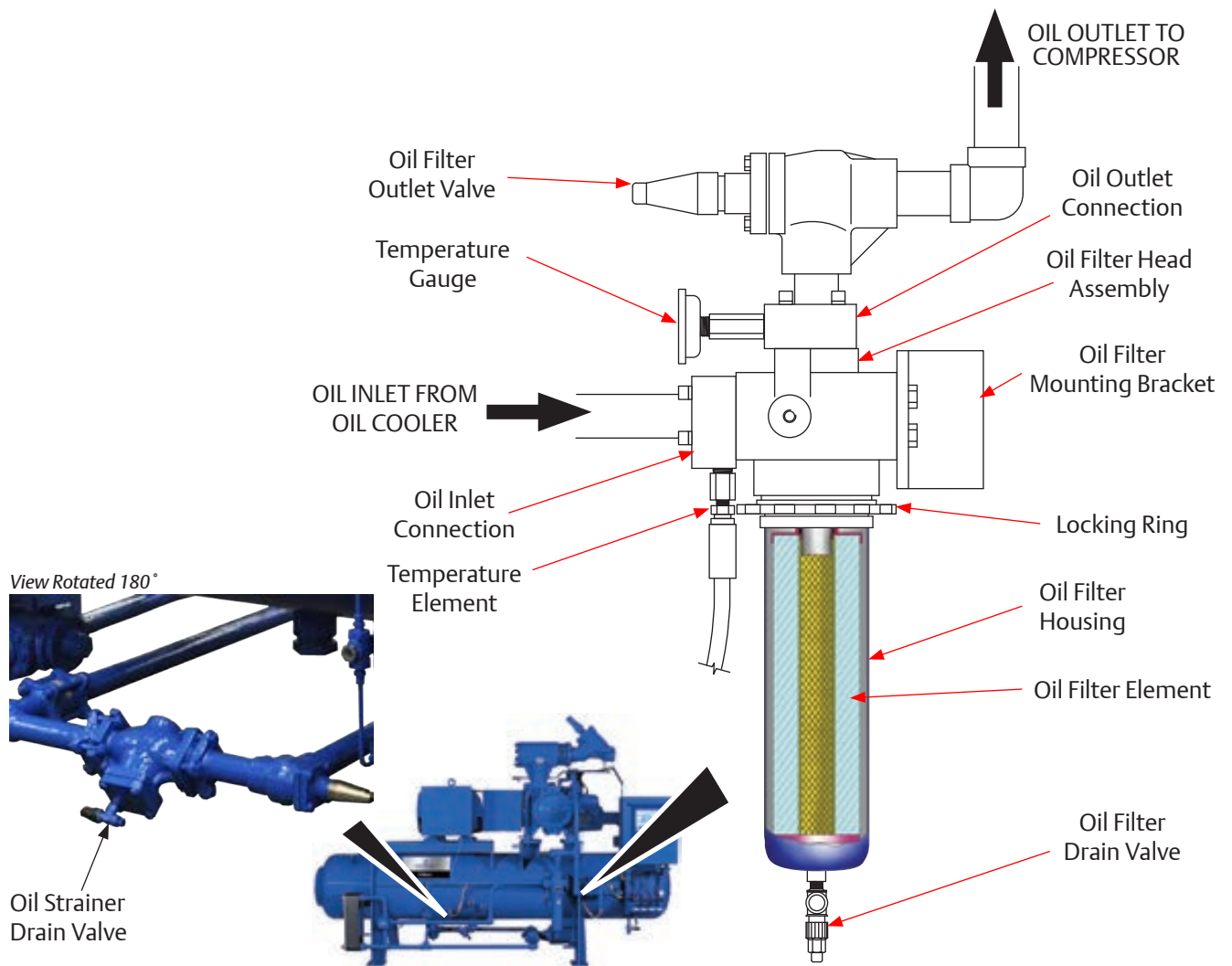


Figure 5-9. Filter Assembly and Oil Strainer Drain Valve (VPN 3111A Oil Filter Housing Shown)

Coalescing Filter Replacement (P/N 2879A, B, C, D, E, AA, AB)

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.

REMOVAL

1. Isolate the compressor unit, see Compressor Unit Isolation procedure.
2. If required, install lifting eyes on oil separator manhole cover, see Figure 5-10.
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. Remove coalescing filter from oil separator vessel.
9. Repeat steps 7 and 8 to remove additional coalescing filters, as required.

INSTALLATION

10. Position coalescing element over hold-down rod and pipe stub.
11. Push coalescing filter into vessel until fully seated on pipe stub.
12. Position cover plate and flat washer on hold-down rod on end of the coalescing filter.
13. Install nut to secure flat washer and cover plate to coalescing filter. Tighten nut to 25 ft-lbs.
14. Install second nut to prevent first nut from moving.
15. Repeat steps 10 to 14 for installing additional coalescing filters.
16. Position oil separator manhole cover on oil separator vessel.
17. Install bolts to secure oil separator manhole cover to oil separator vessel.
18. Tighten bolts, see Appendix A.
19. Perform Compressor Unit Leak Check procedure.

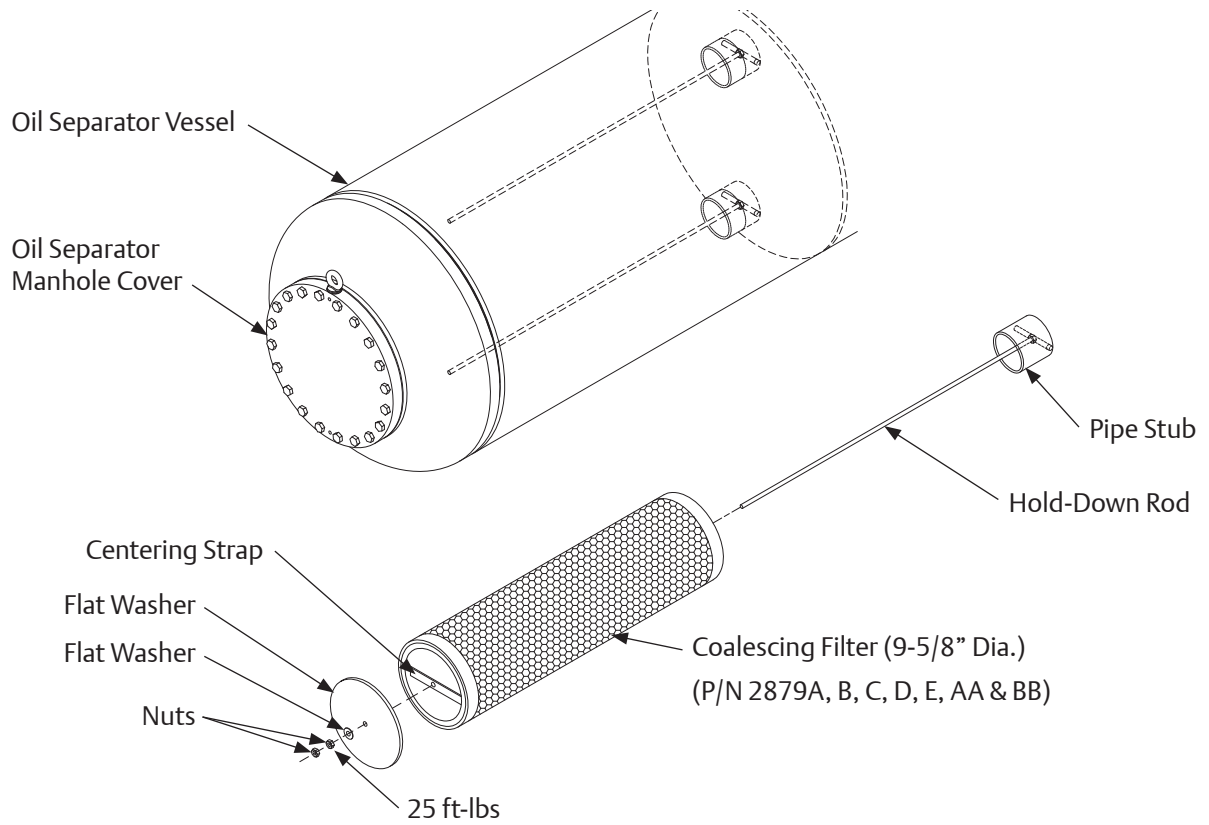


Figure 5-10. Oil Separator Manhole Cover and Coalescing Filter Assembly

Oil Separator Heater Cartridge Replacement

PARTS REQUIRED

- Heater Cartridge, 1000W, 480V (VPN 3555A)
- 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. Remove junction cover to gain access to heater cartridge wires.

NOTE

Note location of wires to aid in installation.

4. Disconnect wires.
5. Remove cable connector.
6. Remove cable and wires from junction.
7. Remove junction from heater cartridge.
8. Remove heater cartridge from thermowell.

INSTALLATION

9. Apply anti-seize to threads of heater cartridge.
10. Install heater cartridge in thermowell.
11. Install junction on heater cartridge.
12. Route cable and wires through junction.
13. Connect wires as noted during removal.
14. Install cable connector.
15. Install junction cover.

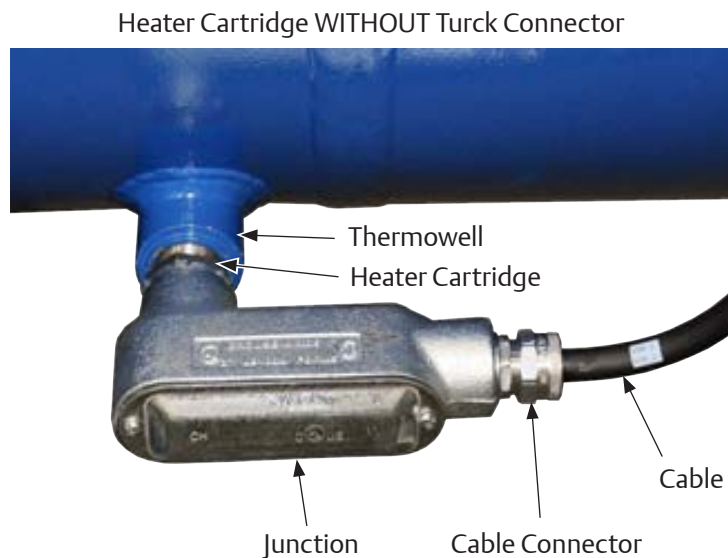


Figure 5-11. Heater Cartridges

Drive Coupling (Type C Sure-Flex) Replacement

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

NOTE

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

REMOVAL

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

WARNING

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

WARNING

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

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

NOTE

Mark locations of hubs prior to removal.

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

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

INSTALLATION

13. Install key and hub on compressor shaft as noted during removal.
14. Install set screw in compressor hub to secure key in keyway, see Table 5-2,
15. Install clamping bolts to secure hub on compressor shaft. Tighten clamping bolts, see Table 5-2,
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 5-2,
19. Install clamping bolts to secure hub to motor shaft. Tighten clamping bolts, see Table 5-2.

Table 5-2. 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)	

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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.
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 5-12.
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.

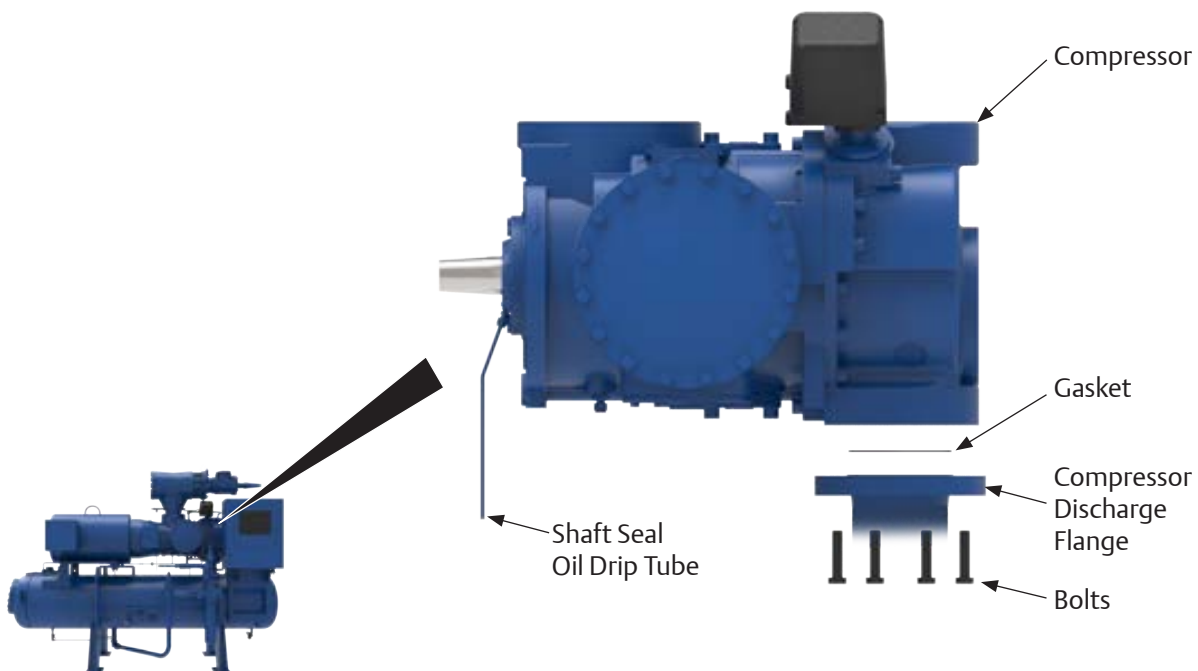


Figure 5-12. Compressor Replacement and Hardware Assembly

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INSTALLATION

18. Install shims and spherical washers on compressor mounting locations, see Figure 5-12.
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.
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.
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.

Compressor Shaft Bearing Float Inspections

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

BEARING AXIAL FLOAT INSPECTION

CAUTION

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

DETERMINE MAXIMUM APPLIED FORCE

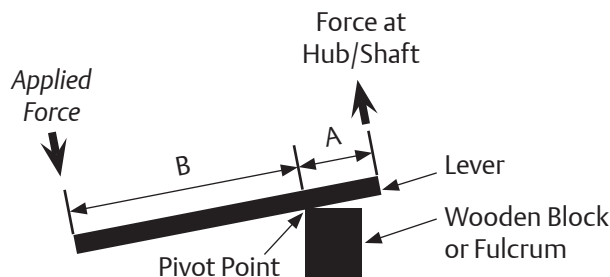
To determine maximum applied force, take maximum applied force at hub/shaft multiplied by length of A and divide by length B. This is the maximum force that should be applied on the lever.

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

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 5-3 shows maximum applied forces for 36" lever with 6" pivot for all compressor models.

MEASURE

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

1. Remove center member, see appropriate Drive Coupling Replacement procedure.
2. Install dial indicator to the compressor frame and zero indicator, see Figure 5-13.
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 5-3, the bearing may need to be replaced. Contact Vilter Customer Service.

BEARING RADIAL FLOAT INSPECTION

6. Install dial indicator to the compressor frame and zero indicator, see Figure 5-14.

NOTE

Do not exceed maximum applied force. For maximum applied forces of all compressor models, see Table 5-3.

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 5-3, the bearing may need to be replaced. Contact Vilter Customer Service.

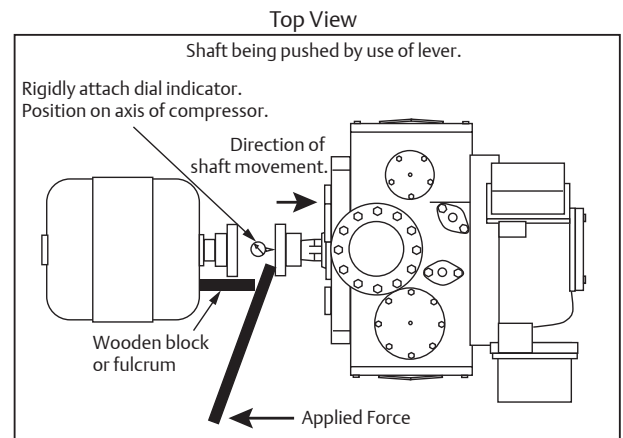
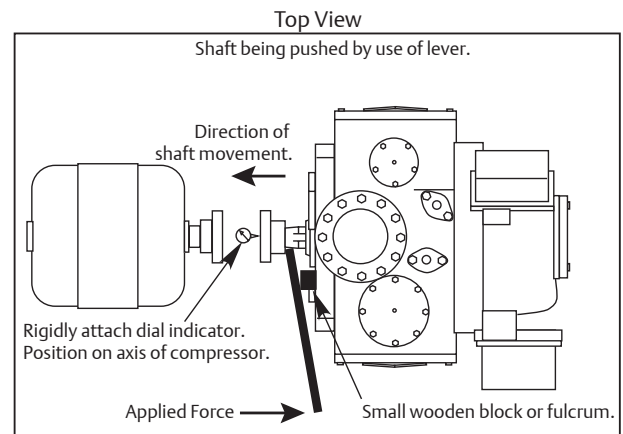


Figure 5-13. Bearing Axial Float Inspection

Table 5-3. Maximum Bearing Float

Compressor Model	Max. Axial Float in. (mm)	Max. Radial Float in. (mm)	Max. Force at Hub/ Shaft lbf (N)	Max. Applied Force (36" Lever, 6" Pivot) lbf (N)
All	0.002 (0.051)	-	300 (1335)	60 (267)
151, 181, 201, 152, 182, 202, 301, 361, 401	-	0.006 (0.152)	100 (444)	20 (89)
501, 601, 701	-	0.007 (0.178)	150 (667)	30 (133)

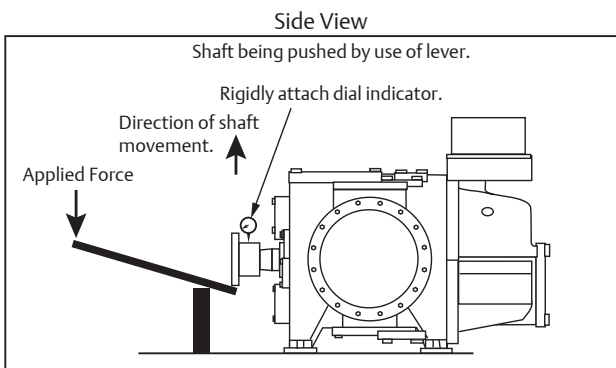


Figure 5-14. Bearing Radial Float Inspection

Gate Rotor Float and Gate Rotor Bearing Float Inspection

GATE ROTOR FLOAT INSPECTION

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

1. Isolate the compressor unit, see Compressor Unit Isolation procedure.
2. Remove the side covers from compressor.
3. Position gate rotor blade and damper pin at 90° to the main rotor, see Figure 5-15.

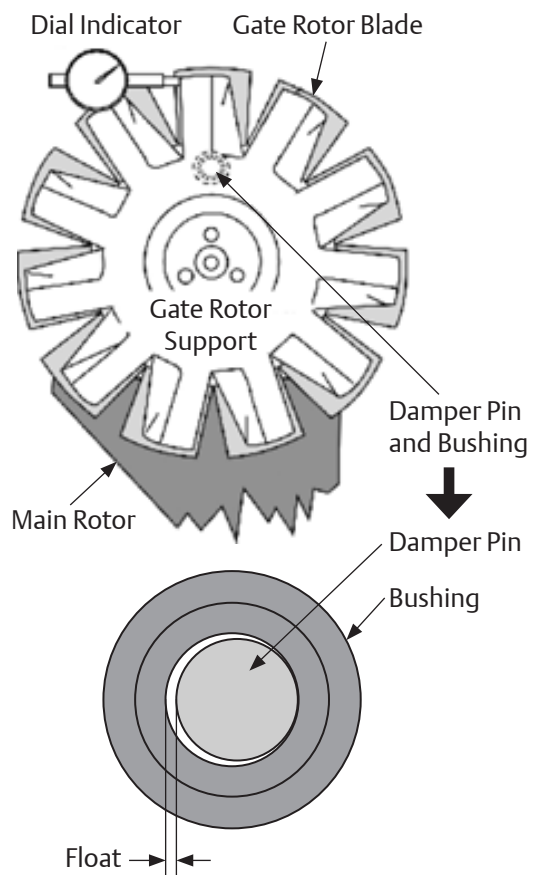


Figure 5-15. Gate Rotor Float

NOTE

Measurements can be an additional 0.020" higher than float dimensions on Table 5-9. If measurement is an additional 0.030" greater than float dimensions, contact Vilter for further assistance.

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

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

Table 5-4. Gate Rotor Float

Model	Float in. (mm)
VSMC 71 - 402	0.045 (1.143)
VSMC 501 - 701	0.045 (1.143)

NOTE

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

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

GATE ROTOR BEARING FLOAT INSPECTION

- Using dial indicator, position a dial indicator on the gate rotor, see Figure 5-16.

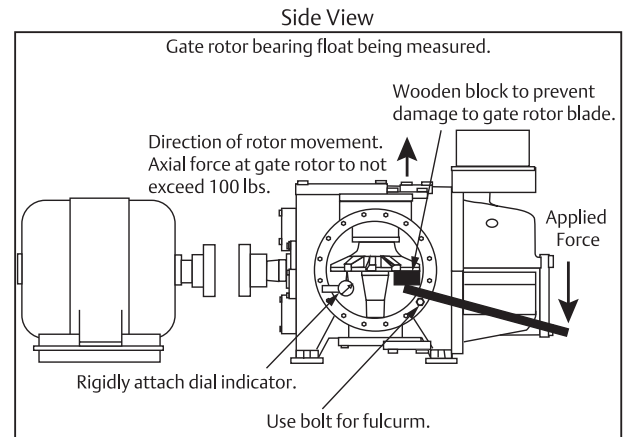


Figure 5-16. Gate Rotor Bearing Float

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

Gate Rotor and Support Clearance

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

1. Place a straight edge along the side of the gate rotor, see Figure 5-18.
2. Measure the gap from the straight edge to the peak of the gate rotor support. For minimum distance, see Figure 5-17.
3. Repeat steps 1 to 2 to check gap along entire gate rotor edge on both sides.

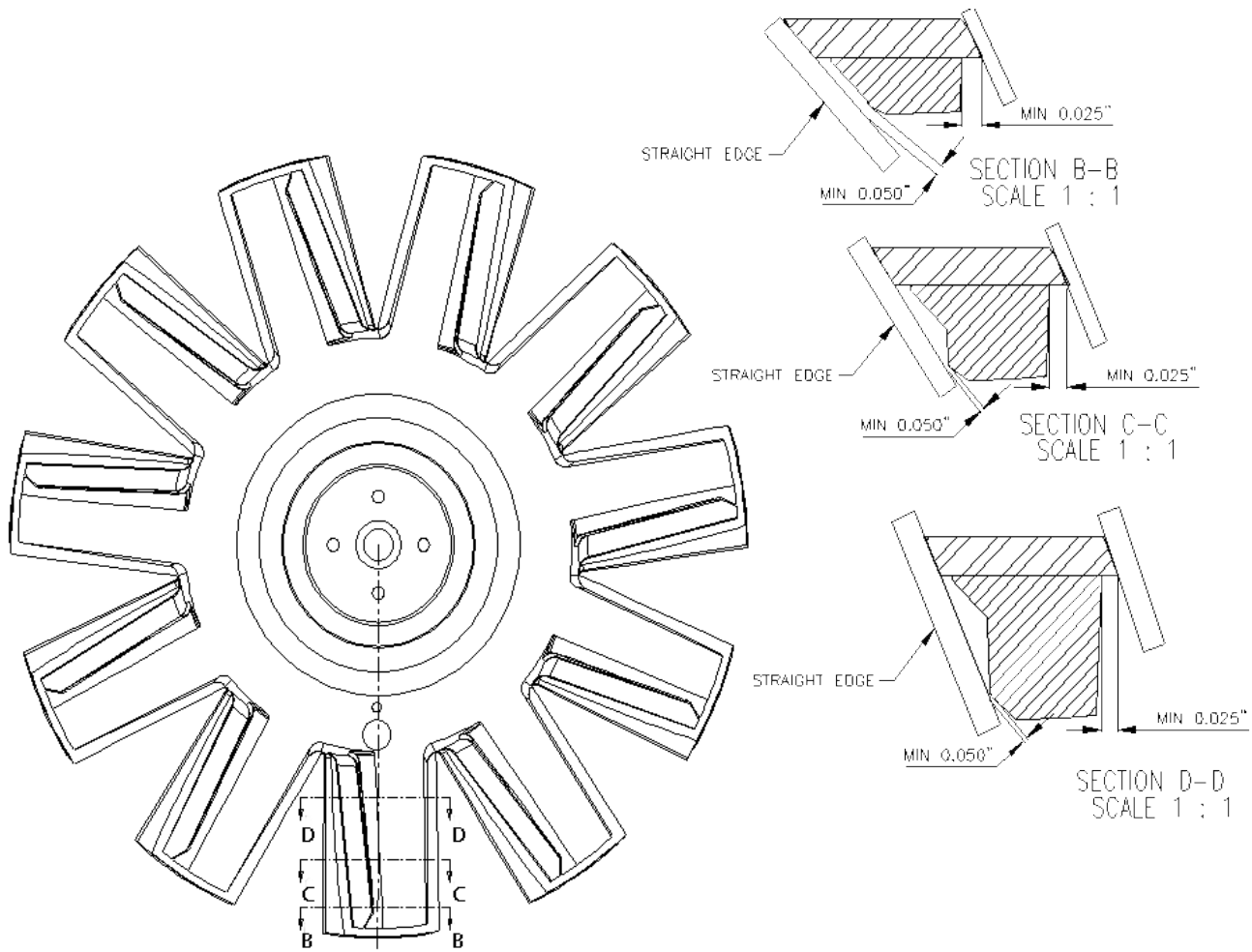


Figure 5-17. Gate Rotor and Support Clearance - Minimum Clearances

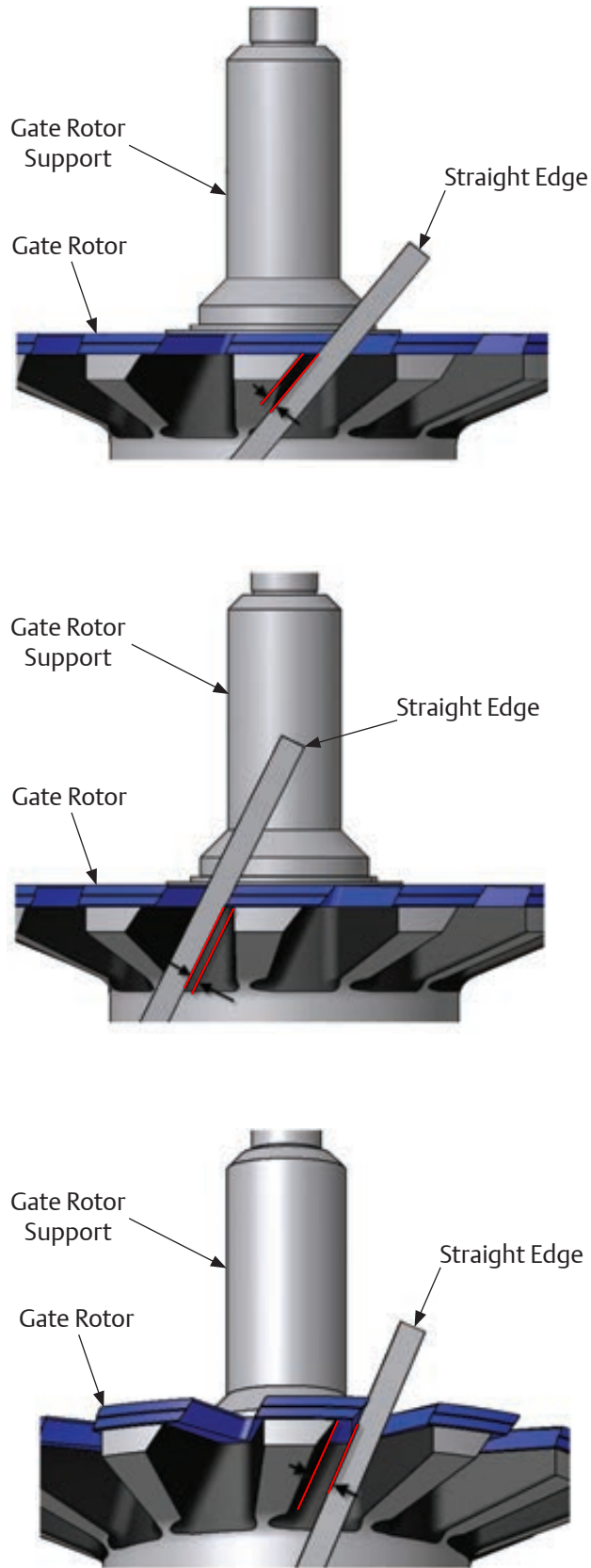


Figure 5-18. Gate Rotor and Support Clearance - Measuring

Gate Rotor Assembly Replacement (VSM 152-701 Compressors)

REMOVAL

Note that for compressors VSMC 152-701 compressor gate rotor assembly have inner races that are secured to the stationary bearing spindle.

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

INSTALLATION

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

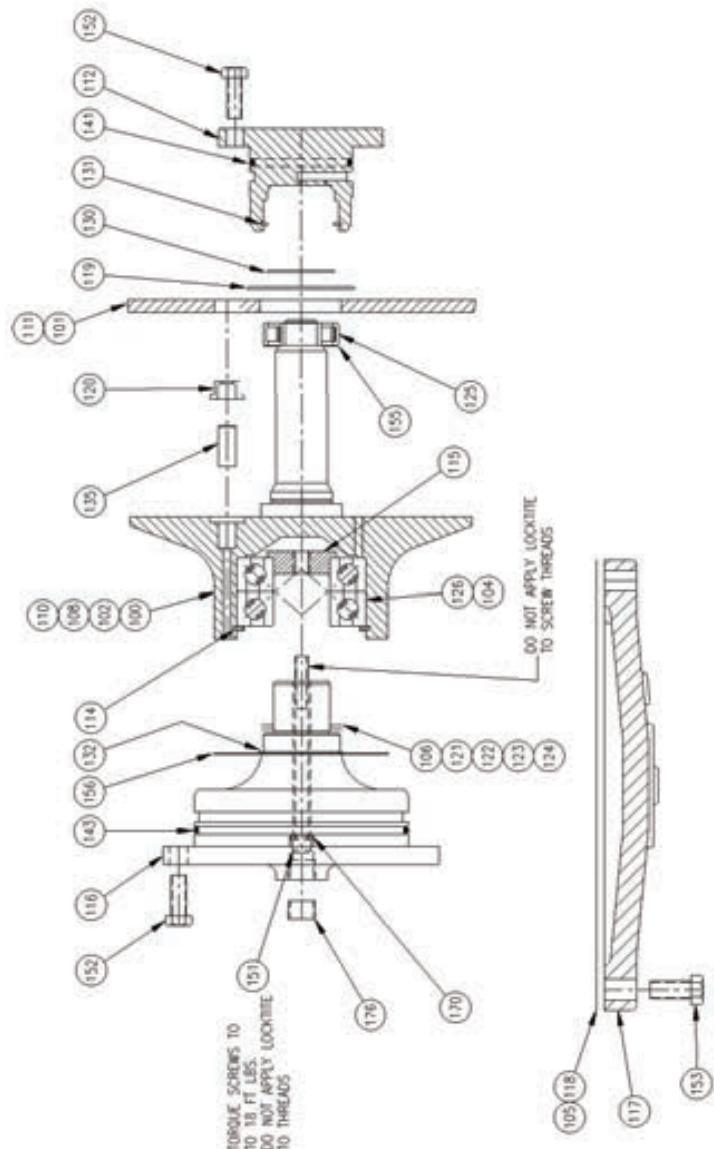


Figure 5-19. Gate Rotor Assembly Breakdown

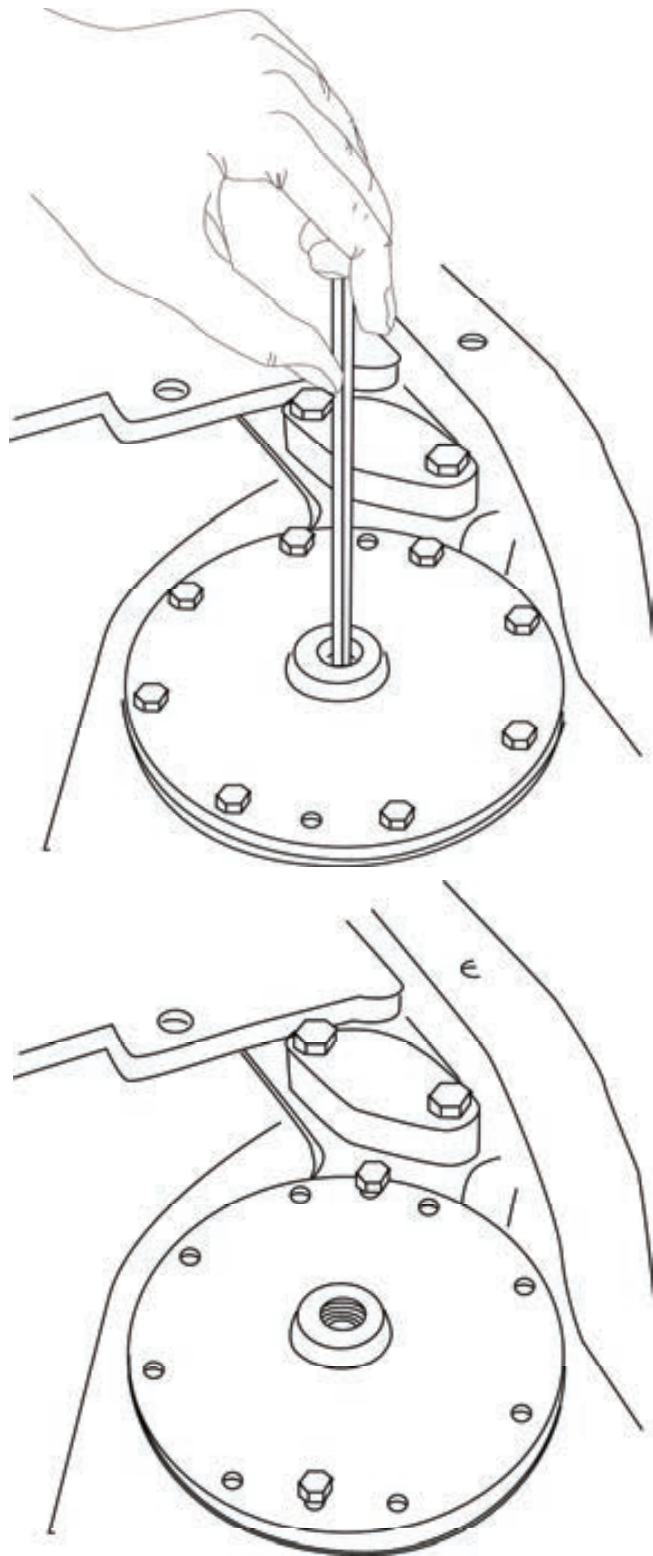
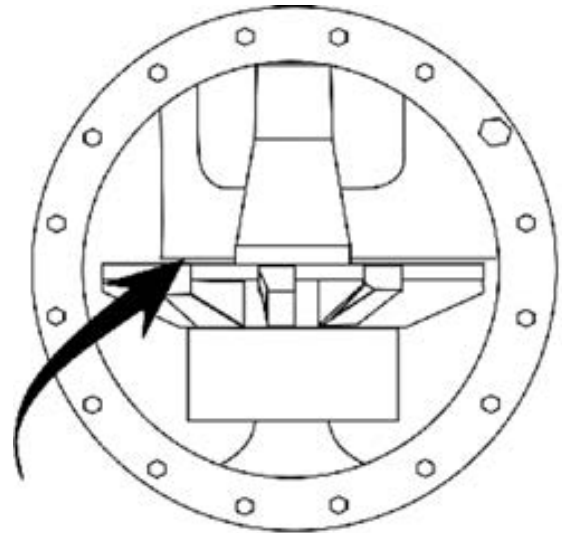


Figure 5-20. Gate Rotor Thrust Bearing

13. Check the clearance between the entire gate rotor blade and the shelf, rotate the gate rotor to find the tightest spot. It should be between 0.003-0.004" (0.076-0.102 mm). Make adjustments, if necessary. It is preferable to shim the gate rotor blade looser rather than tighter against the shelf.
14. Once the clearance is set remove the spindle. Install new O-ring, apply Loctite 242 thread locker to the socket head cap screw clamping the thrust bearings to the spindle. Torque all bolts, see Appendix A.
15. Install side covers with new gaskets. Tighten bolts, see Appendix A. The unit can now be evacuated and leak checked.



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

Figure 5-21. Gate Rotor and Shelf Clearance

Gate Rotor Disassembly

1. To perform gate rotor disassembly, remove gate rotor from compressor, see Gate Rotor Assembly procedure.

GATE ROTOR BLADE REMOVAL

2. Remove the snap ring and washer from the gate rotor assembly. Lift gate rotor blade assembly off the gate rotor support, see Figure 5-22.

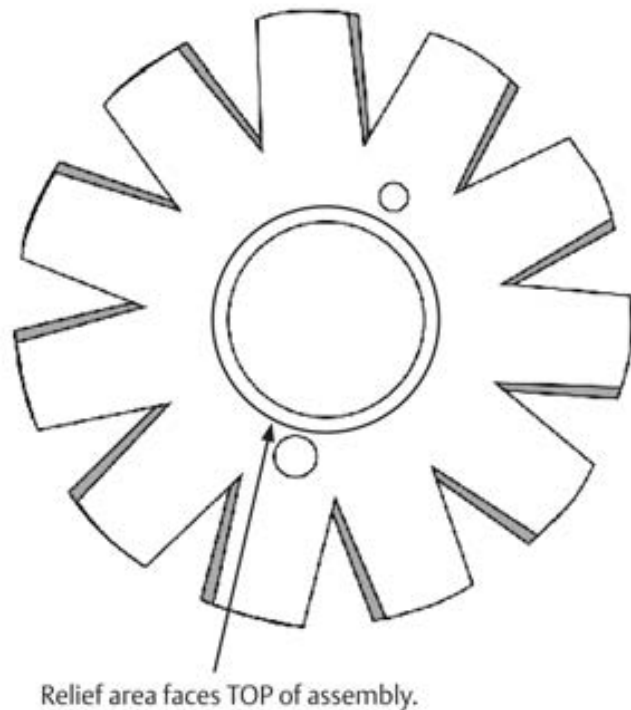
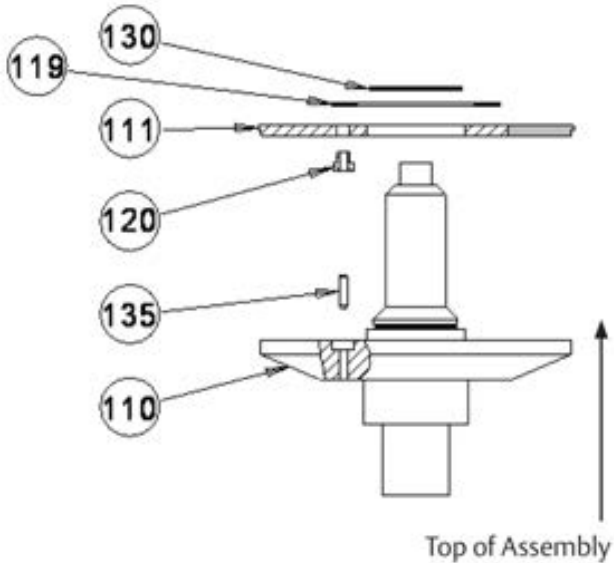


Figure 5-22. Gate Rotor Blade Assembly

3. Check damper pin and bushing for excessive wear. Replace if required.

GATE ROTOR BLADE INSTALLATION

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

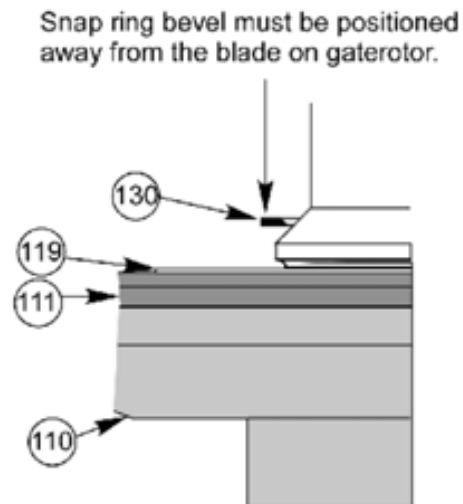
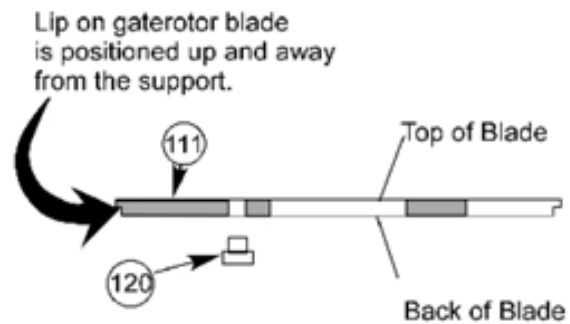


Figure 5-23. Gate Rotor Blade Installation

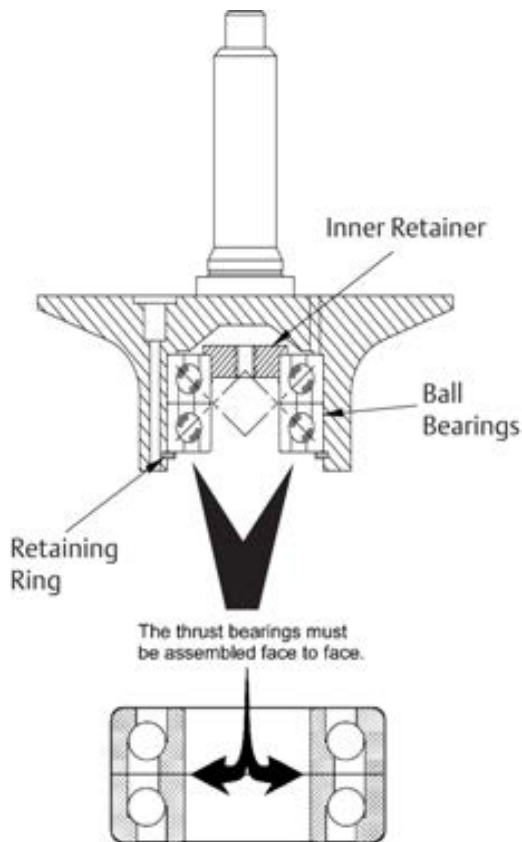


Figure 5-24. Thrust Bearing Installation

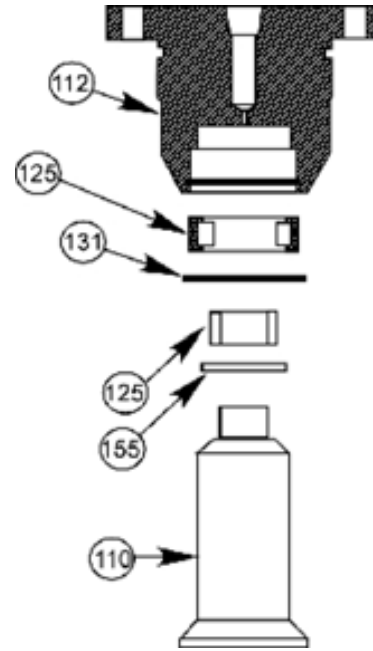


Figure 5-25. Roller Bearing Assembly

GATE ROTOR ROLLER BEARING REMOVAL

7. Remove the snap ring (131), which retains the roller bearing in the bearing housing, see Figure 5-39.
8. Remove the roller bearing (125) from the bearing housing (112).
9. Use a bearing puller to remove the roller bearing race (125) from the gate rotor support (110).

GATE ROTOR ROLLER BEARING INSTALLATION

10. Match up the part numbers on the inner race to the part numbers outer race. Press the bearing race (numbers visible) onto the gate rotor support.
11. Install the outer bearing into the bearing housing so the numbers match the numbers on the inner race. Install the snap ring retainer in the housing. The bevel on the snap ring must face away from the roller bearing.

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Slide Valve Actuator Assembly Replacement

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

REMOVAL

WARNING

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

WARNING

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

NOTE

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

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

NOTE

Note orientation of components to aid in installation.

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

INSTALLATION

CAUTION

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

7. Position actuator assembly on mount as noted in removal.
8. Install lock washers and screws to secure actuator assembly to actuator mount.
9. Tighten screws, see Appendix A.

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.

Command Shaft Assembly Replacement

REMOVAL

NOTE

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

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

INSTALLATION

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

Compressor Shaft Seal Replacement

TOOLS

- 25455A - Shaft Seal Tool (VSMC 152 - 401)
- 25455B - Shaft Seal Tool (VSMC 501 - 701)

REMOVAL

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

NOTE

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

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

INSTALLATION

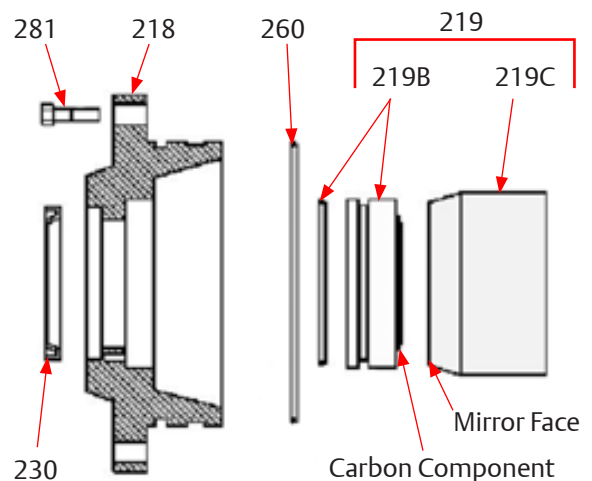


Figure 5-26. Compressor Shaft Seal Assembly

CAUTION

Care must be taken when handling the cup assembly and mating ring when installing. 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.

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6. Clean inside shaft seal cover (218) where cup assembly (219B) meets inside shaft seal cover.
7. If applicable, remove protective plastic from cup assembly (219B). Do not wipe or touch carbon component of cup assembly.
8. If carbon component of cup assembly (219B) needs cleaning, use alcohol and a lint-free cloth to clean.
9. Apply clean compressor lubricating oil to O-ring on cup assembly (219B).
10. Using shaft seal tool or similar, install cup assembly (219B) in shaft seal cover (218).
11. Clean compressor shaft and shaft seal cavity in compressor housing.
12. Apply clean compressor lubricating oil to mating ring (219C) seating area on compressor shaft.
13. 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).

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 cover (218) is installed.

14. Align slot in mating ring (219C) with roll 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.

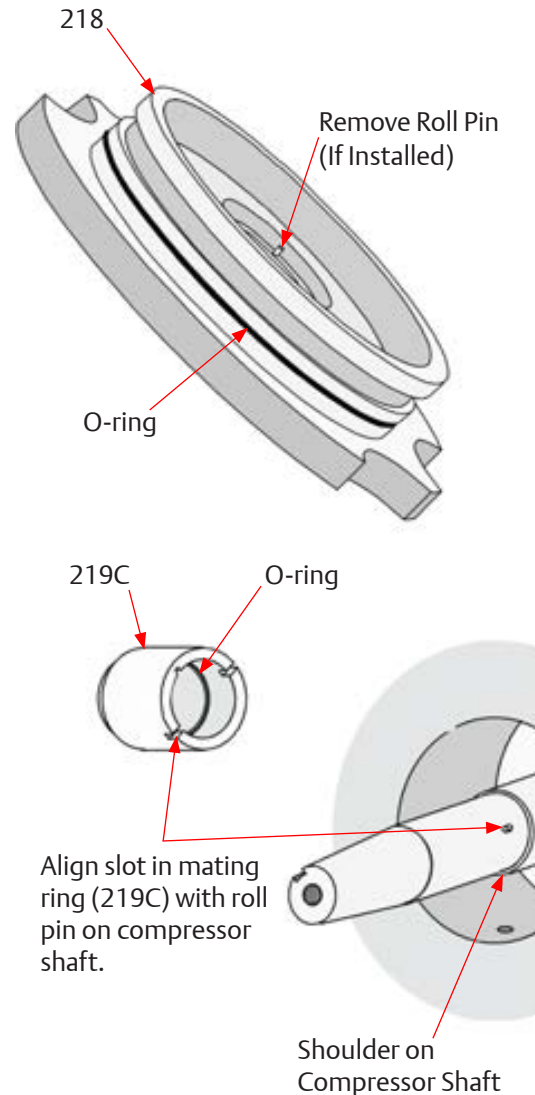


Figure 5-27. Compressor Shaft Seal Installation

Liquid Injection Control Valve Station (Danfoss ICF 20-40 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 5-5 and 5-6.

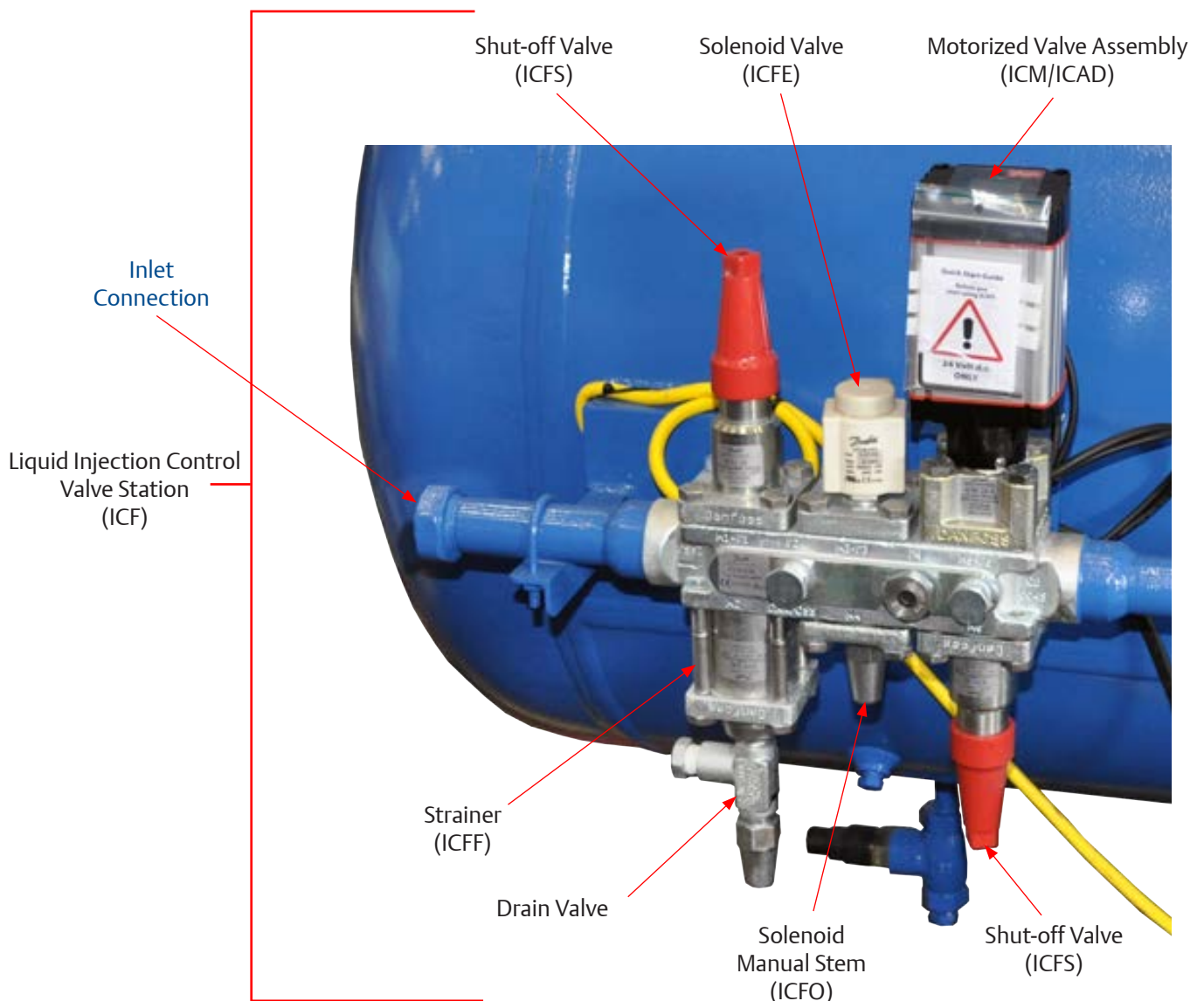


Figure 5-28. Danfoss ICF 20-40 Valve Station (Liquid Injection Control)

Table 5-5. 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 5-6. 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)

Section 6 • Troubleshooting

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

Problem	Reason	Solution
The actuator cannot be calibrated or exit calibration mode	Dirt or debris is blocking one or both optocoupler slots	Clean the optocoupler slots with a Q-Tip and rubbing alcohol.
	The 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.
The actuator goes into calibration mode spontaneously	Push button is being held down for more than $\frac{3}{4}$ 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 white calibrate wire in the grey Turck cable is grounding intermittently	Tape the end of the white wire in the panel and make sure that it cannot touch metal.
	A very strong source of electromagnetic interference (EMI), such as a contactor, is in the vicinity of the actuator or grey cable	Tape the end of the white wire in the panel and make sure that it cannot touch metal. Install additional metal shielding material between the EMI source and the actuator or cable.
The actuator goes into calibration mode every time power is restored after a power loss	There is an intermittent failure of the position sensor	Replace the actuator.
	The motor brake is not working properly (see theory section above.)	Get the motor brake to where it operates freely and recalibrate.
The actuator does not transmit the correct position after a power loss	The motor was manually moved while the position sensor was not powered.	Recalibrate.
	The motor brake is not working properly	Get the motor brake to where it operates freely and then recalibrate.
	The position sensor's EEPROM memory has failed	Replace the actuator.

Section 6 • Troubleshooting

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

Problem	Reason	Solution
The actuator does not transmit the correct position after a power loss	The motor was manually moved while the position sensor was not powered.	Recalibrate.
	The motor brake is not working properly	Get the motor brake to where it operates freely and then recalibrate.
	The position sensor's EEPROM memory has failed	Replace the actuator.
There is a rapid clicking noise when the motor is operating	The 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.
The motor will not move in either direction	The thermal switch has tripped because the motor is overheated	The motor will resume operation when it cools. This could be caused by a malfunctioning control panel. Consult the factory.
	Any of the reasons listed in "The motor operates in one direction only"	See above.
	The command shaft is jammed	Free the command shaft.
	Broken gears in the gearmotor	Replace the actuator.
	Blown relay or fuse.	Check and replace blown relay and/or fuse.
The motor runs intermittently, several minutes on, several minutes off	Motor is overheating and the thermal switch is tripping	This could be caused by a malfunctioning control panel. Consult the factory.
The motor runs sporadically	Bad thermal switch	Replace the actuator.
	Any of the reasons listed in "The motor will not move in either direction"	See above.
The motor runs but output shaft will not turn	Stripped gears inside the gear motor or the armature has come unpressed from the armature shaft	Replace the actuator.

Section 6 • Troubleshooting

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

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

Flash Pattern	Meaning
*=ON _=OFF	
* * * * * * * * * * _ _	Calibration step 1
* _ * _ * _ * _ * _	Calibration step 2
* _ * _____	<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 is 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 multi-meter, measure the DC voltage between terminal 3 of the small terminal block and TP1 on the circuit board (see Note 1). You should measure between 0.1 and 0.2 Volts. 3. Next, measure the DC voltage between terminal 3 and TP2 on the circuit board. You should measure between 0.1 and 0.2 Volts.
* _____	<p>This indicates a skipped state in the patterns generated by the optocouplers as the motor moves. This error means that the slide valve actuator is no longer transmitting accurate position information. The actuator should be recalibrated as soon as possible. This code will not clear until the actuator is recalibrated.</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.

Section 6 • Troubleshooting

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

Flash Pattern	Meaning
<p>* * * _____</p>	<p>The motor has 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 and humid environments when process conditions demand that the slide valve 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 multi-meter between the two TS1 wire pads (see Note 2). If the switch is closed (normal operation) you will measure 0 Volts.</p>
<p>*****</p>	<p>The 24V supply is 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 multi-meter between terminals 3 and 4 of the small terminal block. If the voltage is $\geq 24V$, replace the actuator.</p>
<p>***** —</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 displayed. To clear the error, calibrate the actuator. If this error has occurred and the cause was not the loss of 24V power during calibration, possible causes are:</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.
<p>***** _____ *</p>	<p>Micro-controller program failure. Replace the actuator.</p>

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

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

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

Section 6 • Troubleshooting

Table 6-3. Troubleshooting Guide - General Problems & Solutions for Units 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.

Section 6 • Troubleshooting

Table 6-3. Troubleshooting Guide - General Problems & Solutions for Units 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 your are controlling a step type oil cooler or a VFD oil cooler, verify the correct one is selected in the Configuration Screen and the amount of steps are entered in the Remote Oil Cooler Control Screen. • Check the oil cooler and associated piping to make sure it is full of oil before starting. • Check 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 & Solutions for Units
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 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.

**Table 6-4. Troubleshooting Guide - General Problems & 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 PLC 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.

**Table 6-4. Troubleshooting Guide - General Problems & 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.

Section 7 • Warranty and Parts

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 i.

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

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

PART

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

5. Warranty Consideration:

- Acceptance – A credit will be provided for the customer part sales order.
- Denial – Notification of denial will be provided to the customer.

COMPRESSOR

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

COMPRESSOR MOTOR

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

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

On Site Service Support

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

Warranty does not cover labor 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.

Section 7 • Warranty and Parts

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 i.

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

NOTE

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

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

EXPLANATION OF REBUILD LEVELS

Level 1

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

Level 2

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

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

NOTE

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

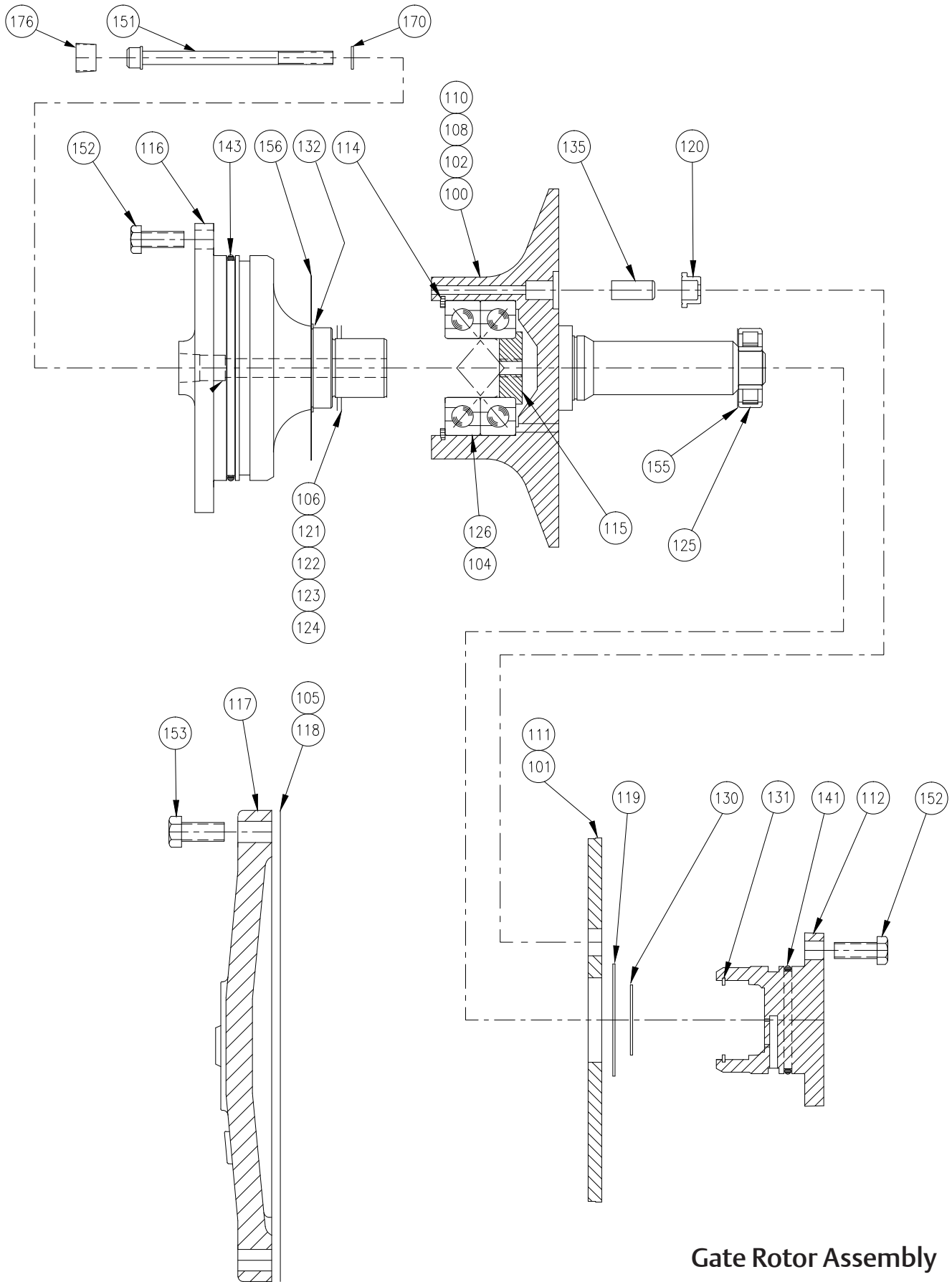
BARE SHAFT COMPRESSOR DESCRIPTION

Single Screw Bare Shaft Compressor features include:

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

VSMC Compressor Repair Parts

Section 7 • Warranty and Parts

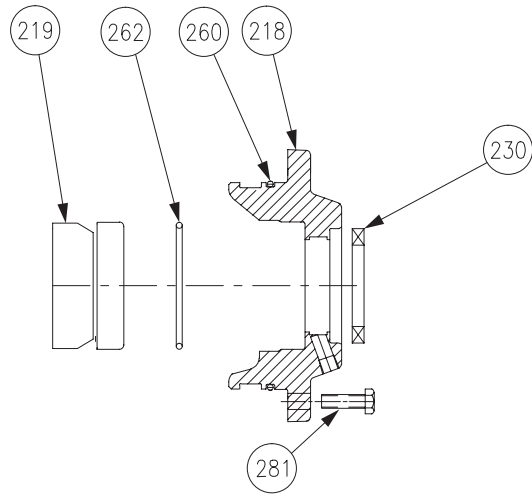


Gate Rotor Assembly

Section 7 • Warranty and Parts

Gate Rotor Assembly

Item	Description	VSMC 71, 151, 301		VSMC 91, 181, 361		VSMC 101, 201, 401	
		Qty	VPN	Qty	VPN	Qty	VPN
101	GATE ROTOR & DAMPER ASSEMBLY 111, 120	1	A25160AB	1	A25160AA	1	A25160AC
105	GATE ROTOR GASKET SET 141, 143	1	A25164A	1	A25164A	1	A25164A
106	SHIM PACK SET 121 (2), 122 (2), 123 (1), 124 (1)	1	A25165A	1	A25165A	1	A25165A
110	SUPPORT	1	25723D	1	25723C	1	25723B
111	GATE ROTOR	1	25718B	1	25718C	1	25718D
112	SMALL BEARING HOUSING	1	25407B	1	25407B	1	25407B
114	SNAP RING	1	2867L	1	2867L	1	2867L
115	RETAINER BALL BEARING	1	25935A	1	25935A	1	25935A
116	BALL BEARING SUPPORT	1	25408B	1	25408B	1	25408B
117	GATE ROTOR COVER	1	25416B	1	25416B	1	25416B
118	GATE ROTOR COVER GASKET	1	25259B	1	25259B	1	25259B
119	WASHER WAVE SPRING	1	3203A	1	3203A	1	3203A
120	DAMPER	1	25760A	1	25760A	1	25760A
121	SHIM 0.002"	AR	25291AA	AR	25291AA	AR	25291AA
122	SHIM 0.003"	AR	25291AB	AR	25291AB	AR	25291AB
123	SHIM 0.005"	AR	25291AC	AR	25291AC	AR	25291AC
124	SHIM 0.010"	AR	25291AD	AR	25291AD	AR	25291AD
125	ROLLER BEARING	1	2864E	1	2864F	1	2864F
126	BALL BEARING	2	2865F	2	2865L	2	2865L
130	RETAINING RING	1	2866H	1	2866H	1	2866H
131	RETAINING RING	1	2867S	1	2867S	1	2867S
132	RETAINING RING	1	2866J	1	2866J	1	2866J
135	DOWEL PIN	1	25910A	1	25910A	1	25910A
141	O-RING ROLLER BEARING HOUSING	1	2176L	1	2176L	1	2176L
143	O-RING BALL BEARING SUPPORT	1	2176F	1	2176F	1	2176F
151	SCREW, SOCKET HEAD CAP	1	2795AP	1	2795AP	1	2795AP
152	SCREW, HEX HEAD CAP	11	2796CG	11	2796CG	11	2796CG
155	SHIM	AR	25977D	AR	25977D	AR	25977D
156	SHIM	AR	25977C	AR	25977C	AR	25977C
170	LOCK WASHER	1	3004C	1	3004C	1	3004C
176	PIPE PLUG	1	2606D	1	2606D	1	2606D
A	KIT, GATE ROTOR REPLACEMENT	1	KT1098A	1	KT1098B	1	KT1098C
B	KIT, GATE ROTOR & BEARING REMAN- UFACTURED	1	KT759F	1	KT759G	1	KT759H



Shaft Seal Assembly

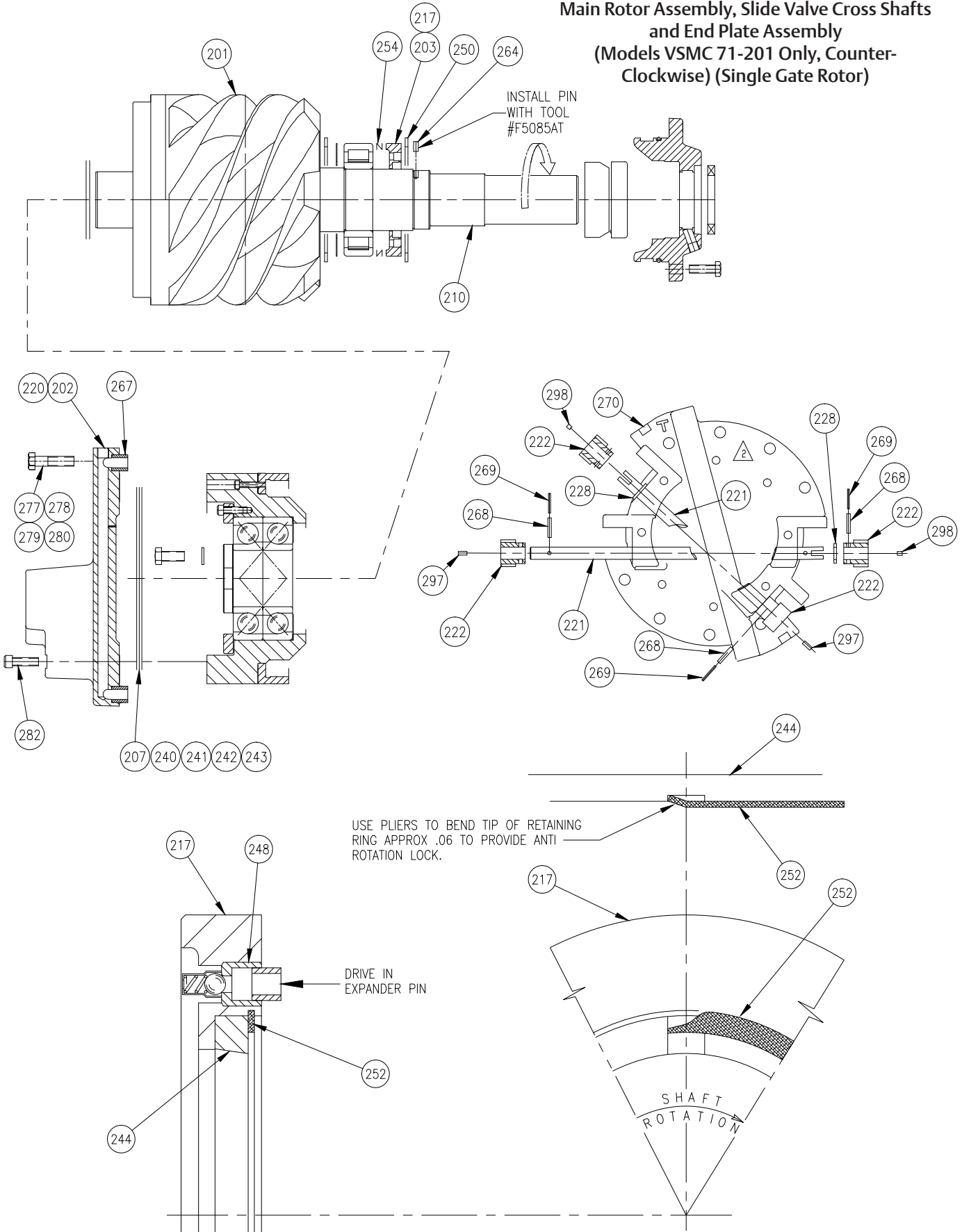
Section 7 • Warranty and Parts

Shaft Seal Assembly

Item	Description	VSMC 71-401		VSMC 501-701	
		Qty	VPN	Qty	VPN
218	SEAL HOUSING	1	25410B	1	25269F
219	SHAFT SEAL	SEE KIT	SEE KIT	SEE KIT	SEE KIT
230	OIL SEAL	1	2930C	1	25040A
260	O-RING	1	2176U	1	2176F
262	O-RING (205 ONLY)	1	2176AE	1	-
281	HEX HEAD CAP SCREW	6	2796N	8	2796B
A	KIT, SHAFT SEAL AMMONIA 219, 230, 260	1	KT709D	1	KT709A
B	KIT, SHAFT SEAL HALO 219, 230, 260	1	KT781D	1	KT781A

Section 7 • Warranty and Parts

Main Rotor Assembly, Slide Valve Cross Shafts and End Plate Assembly (Models VSMC 71-201 Only, Counter-Clockwise) (Single Gate Rotor)



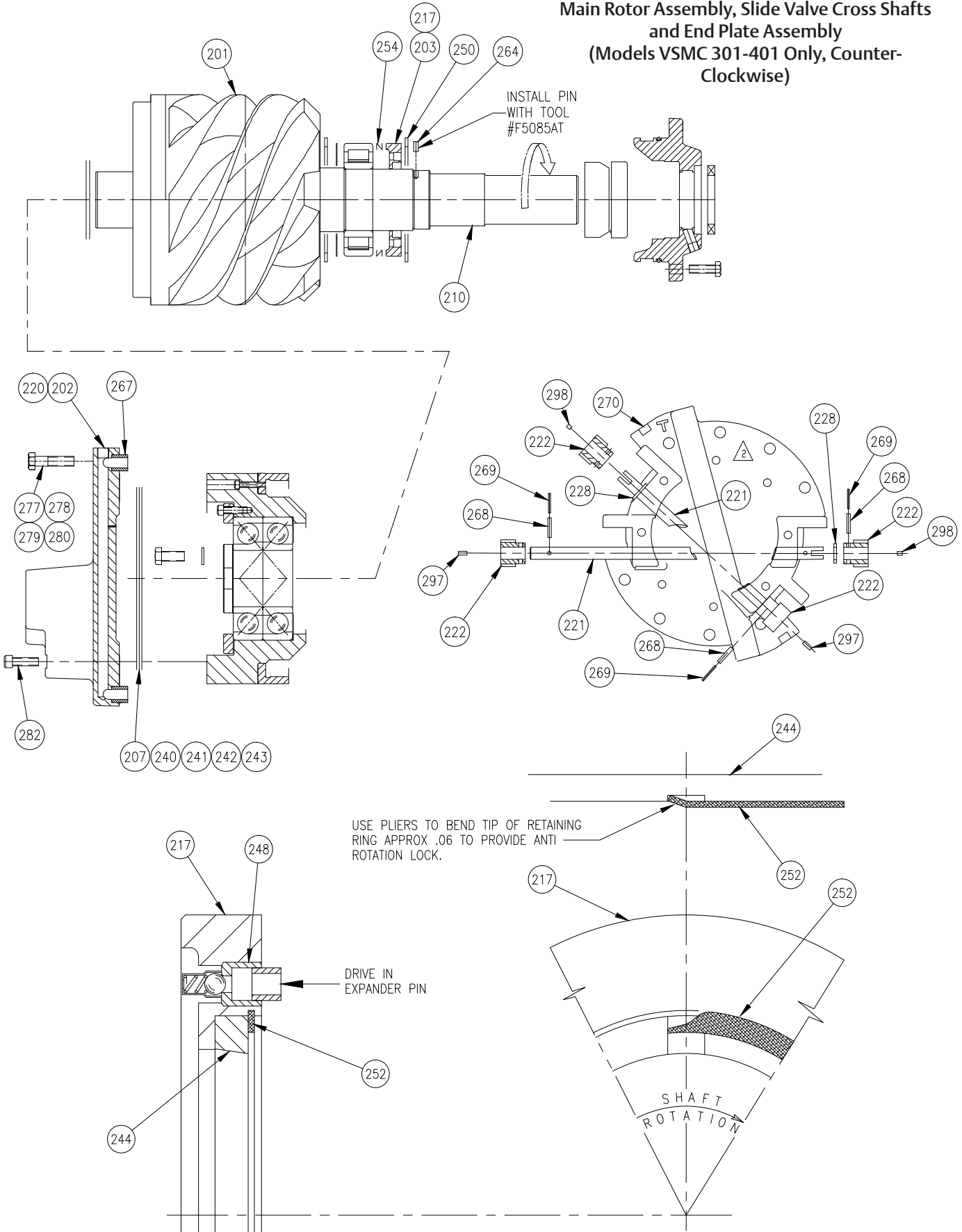
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Main Rotor Assembly, Slide Valve Cross Shafts and End Plate Assembly (Models VSMC 71-201 Only, Counter-Clockwise) (Single Gate Rotor)

Item	Description	VSMC 71 & 151		VSMC 91 & 181		VSMC 101 & 201	
		Qty	VPN	Qty	VPN	Qty	VPN
201	MAIN ROTOR ASSEMBLY	1	A25226AB	1	A25226AA	1	A25226AC
203	OIL BAFFLE ASSEMBLY 217 (1), 244 (1), 248 (1), 249 (1), 252 (1)	1	A25942AA (PER .566") A25942AB (PER .804")	1	A25942AA (PER .566") A25942AB (PER .804")	1	A25942AA (PER .566") A25942AB (PER .804")
207	SHIM ASSORTMENT 240 (2), 241 (2), 242 (1), 243 (1)	1	A25177A	1	A25177A	1	A25177A
217	OIL BAFFLE PLATE	1	25938A	1	25938A	1	25938A
220	END PLATE	1	25719B	1	25719B	1	25719B
221	SHAFT	2	25941A	2	25941A	2	25941A
222	GEAR	4	25027A	4	25027A	4	25027A
227	CLAMP	4	25913D	4	25913D	4	25913D
228	SPACER	4	25847A	4	25847A	4	25847A
240	SHIM .002"	AR	25409AA	AR	25409AA	AR	25409AA
241	SHIM .003"	AR	25409AB	AR	25409AB	AR	25409AB
242	SHIM .005"	AR	25409AC	AR	25409AC	AR	25409AC
243	SHIM .010"	AR	25409AD	AR	25409AD	AR	25409AD
244	TEFLON RING	1	25939A	1	25939A	1	25939A
248	CHECK VALVE	1	3120A	1	3120A	1	3120A
249	CHECK VALVE	1	3120B	1	3120B	1	3120B
250	RETAINING RING	2	2867T	2	2867T	2	2867T
252	RETAINING RING	1	2829M	1	2829M	1	2829M
254	WAVE SPRING	1	2912G	1	2912G	1	2912G
267	DRILL BUSHING	2	3121A	2	3121A	2	3121A
268	EXPANSION PIN	4	1193D	4	1193D	4	1193D
269	EXPANSION PIN	4	2981AA	4	2981AA	4	2981AA
270	PIPE PLUG	3	2606B	3	2606B	3	2606B
277	SOCKET HEAD CAP SCREW	2	2795AQ	2	2795AQ	2	2795AQ
278	SOCKET HEAD CAP SCREW	2	2795AR	2	2795AR	2	2795AR
279	SOCKET HEAD CAP SCREW	4	2795A	4	2795A	4	2795A
280	HEX HEAD CAP SCREW	8	2796Q	8	2796Q	8	2796Q
286	SOCKET HEAD CAP SCREW	4	2795F	4	2795F	4	2795F
297	SET SCREW	2	2060J	2	2060J	2	2060J
298	SET SCREW	2	2060H	2	2060H	2	2060H

Section 7 • Warranty and Parts

Main Rotor Assembly, Slide Valve Cross Shafts and End Plate Assembly (Models VSMC 301-401 Only, Counter-Clockwise)



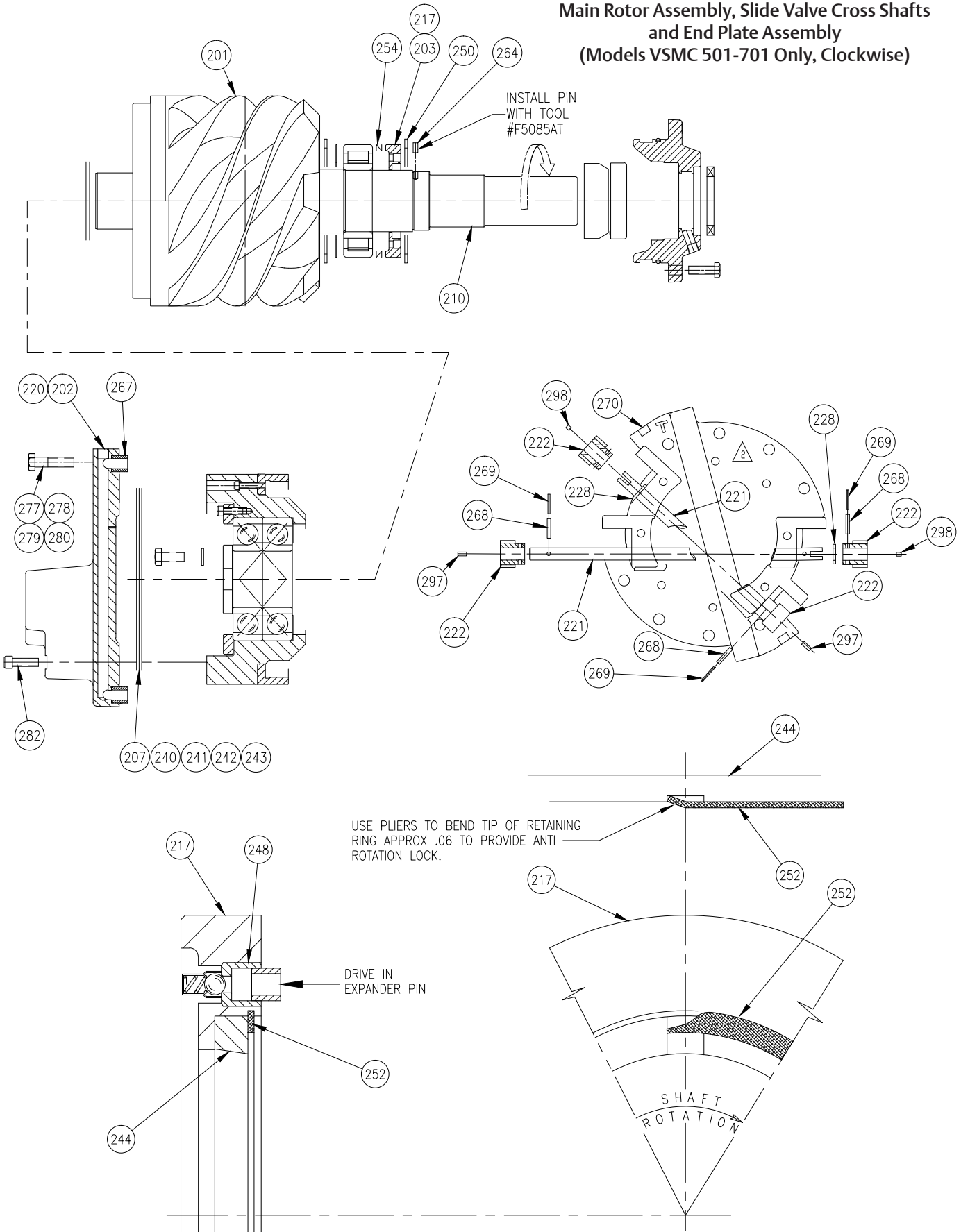
Section 7 • Warranty and Parts

Main Rotor Assembly, Slide Valve Cross Shafts and End Plate Assembly (Models VSMC 301-401 Only, Counter-Clockwise)

Item	Description	VSMC 301		VSMC 361		VSMC 401	
		Qty	VPN	Qty	VPN	Qty	VPN
201	MAIN ROTOR ASSEMBLY (IN RED)	1	A25226AB	1	A25226AA	1	A25226AC
203	OIL BAFFLE ASSEMBLY 217 (1), 244 (1), 248 (1), 249 (1), 252 (1)	1	A25942AA (PER .566") A25942AB (PER .804")	A	A25942AA (PER .566") A25942AB (PER .804")	1	A25942AA (PER .566") A25942AB (PER .804")
207	SHIM ASSORTMENT 240 (2), 241 (2), 242 (1), 243 (1)	1	A25177A	1	A25177A	1	A25177A
217	OIL BAFFLE PLATE (IN GREEN)	1	25938A	1	25938A	1	25938A
220	END PLATE	1	25719D	1	25719D	1	25719D
221	SHAFT	2	25941A	2	25941A	2	25941A
222	GEAR	4	25027A	4	25027A	4	25027A
227	CLAMP	4	25913D	4	25913D	4	25913D
228	SPACER	4	25847A	4	25847A	4	25847A
240	SHIM .002"	A	25409AA	A	25409AA	A	25409AA
241	SHIM .003"	A	25409AB	A	25409AB	A	25409AB
242	SHIM .005"	A	25409AC	A	25409AC	A	25409AC
243	SHIM .010"	A	25409AD	A	25409AD	A	25409AD
244	TEFLON RING	1	25939A	1	25939A	1	25939A
248	CHECK VALVE	1	3120A	1	3120A	1	3120A
249	CHECK VALVE	1	3120B	1	3120B	1	3120B
250	RETAINING RING	2	2867T	2	2867T	2	2867T
252	RETAINING RING	1	2829M	1	2829M	1	2829M
254	WAVE SPRING	1	2912G	1	2912G	1	2912G
267	DRILL BUSHING	2	3121A	2	3121A	2	3121A
268	EXPANSION PIN	4	1193D	4	1193D	4	1193D
269	EXPANSION PIN	4	2981AA	4	2981AA	4	2981AA
270	PIPE PLUG	3	2606B	3	2606B	3	2606B
277	SOCKET HEAD CAP SCREW	2	2795AQ	2	2795AQ	2	2795AQ
278	SOCKET HEAD CAP SCREW	2	2795AR	2	2795AR	2	2795AR
279	SOCKET HEAD CAP SCREW	4	2795A	4	2795A	4	2795A
280	HEX HEAD CAP SCREW	8	2796Q	8	2796Q	8	2796Q
286	SOCKET HEAD CAP SCREW (1/4" SHORTER)	8	2795Q	8	2795Q	8	2795Q
297	SET SCREW	2	2060J	2	2060J	2	2060J
298	SET SCREW	2	2060H	2	2060H	2	2060H

Section 7 • Warranty and Parts

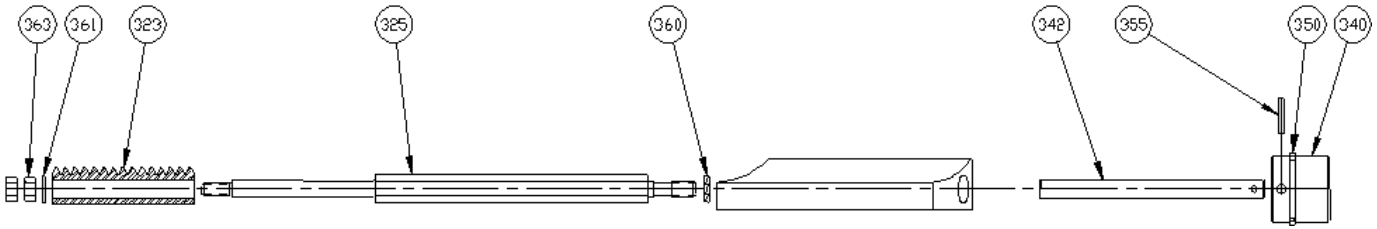
Main Rotor Assembly, Slide Valve Cross Shafts and End Plate Assembly (Models VSMC 501-701 Only, Clockwise)



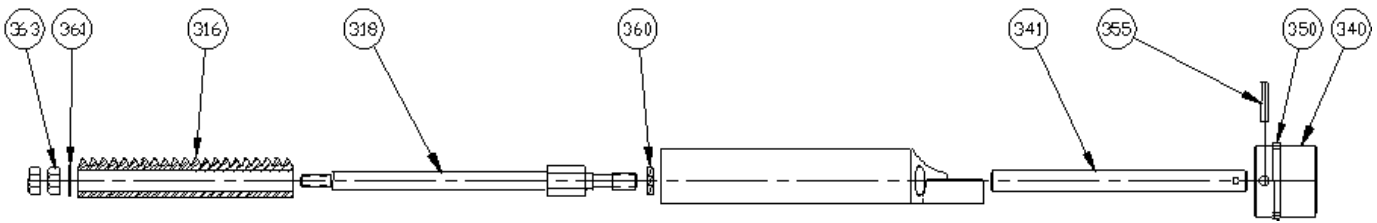
Section 7 • Warranty and Parts

Main Rotor Assembly, Slide Valve Cross Shafts and End Plate Assembly (Models VSMC 501-701 Only, Clockwise)

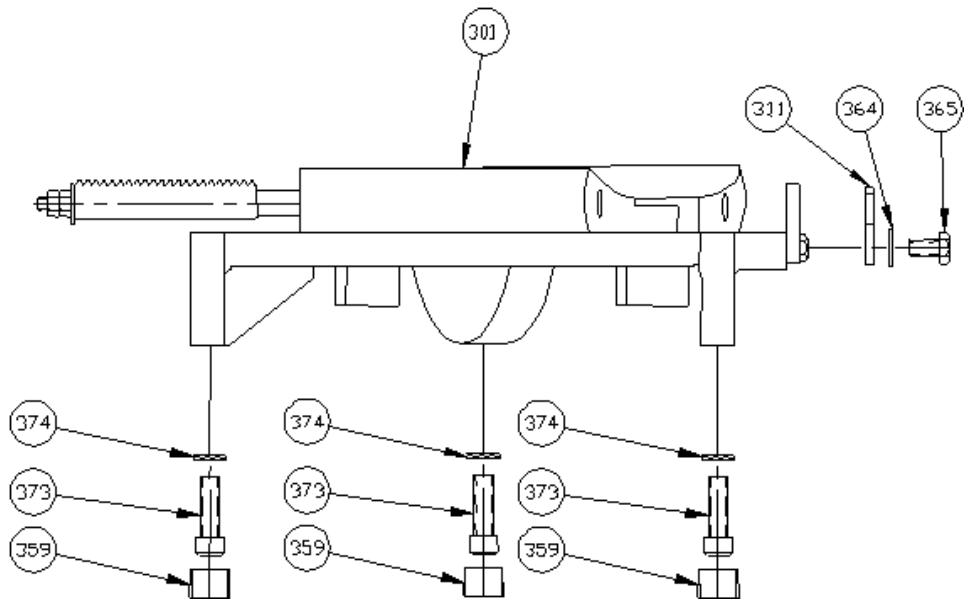
Item	Description	VSMC 501		VSMC 601		VSMC 701	
		Qty	VPN	Qty	VPN	Qty	VPN
201	MAIN ROTOR ASSEMBLY	1	A26010BB	1	A26010BA	1	A26010BC
203	"OIL BAFFLE ASSEMBLY 217 (1), 244 (1), 248 (1), 249 (1), 252 (1)"	1	A26034B	1	A26034B	1	A26034B
207	"SHIM ASSORTMENT 240 (2), 241 (2), 242 (1), 243 (1)"	1	A25177B	1	A25177B	1	A25177B
217	OIL BAFFLE PLATE	1	26045A	1	26045A	1	26045A
220	END PLATE	1	26025B	1	26025B	1	26025B
221	SHAFT	2	25843A	2	25843A	2	25843A
222	GEAR	4	25027A	4	25027A	4	25027A
228	SPACER	4	25847A	4	25847A	4	25847A
240	SHIM .002"	AR	25255AA	AR	25255AA	AR	25255AA
241	SHIM .003"	AR	25255AB	AR	25255AB	AR	25255AB
242	SHIM .005"	AR	25255AC	AR	25255AC	AR	25255AC
243	SHIM .010"	AR	25255AD	AR	25255AD	AR	25255AD
244	TEFLON RING	1	25939B	1	25939B	1	25939B
248	CHECK VALVE	1	3120A	1	3120A	1	3120A
249	CHECK VALVE	1	3120B	1	3120B	1	3120B
250	RETAINING RING	2	2867B	2	2867B	2	2867B
252	RETAINING RING	1	2928N	1	2928N	1	2928N
267	DRILL BUSHING	2	3121A	2	3121A	2	3121A
268	EXPANSION PIN	4	1193D	4	1193D	4	1193D
269	EXPANSION PIN	4	2981AA	4	2981AA	4	2981AA
270	PIPE PLUG	3	2606B	3	2606B	3	2606B
277	HEX HEAD CAP SCREW	2	2796CL	2	2796CL	2	2796CL
278	HEX HEAD CAP SCREW	2	2796CT	2	2796CT	2	2796CT
279	HEX HEAD CAP SCREW	2	2796CZ	2	2796CZ	2	2796CZ
280	HEX HEAD CAP SCREW	6	2796EL	6	2796EL	6	2796EL
286	SOCKET HEAD CAP SCREW	2	2795D	2	2795D	2	2795D
297	SET SCREW	2	2060J	2	2060J	2	2060J
298	SET SCREW	2	2060H	2	2060H	2	2060H



Volume Ratio Slide Valve Assembly



Capacity Ratio Slide Valve Assembly

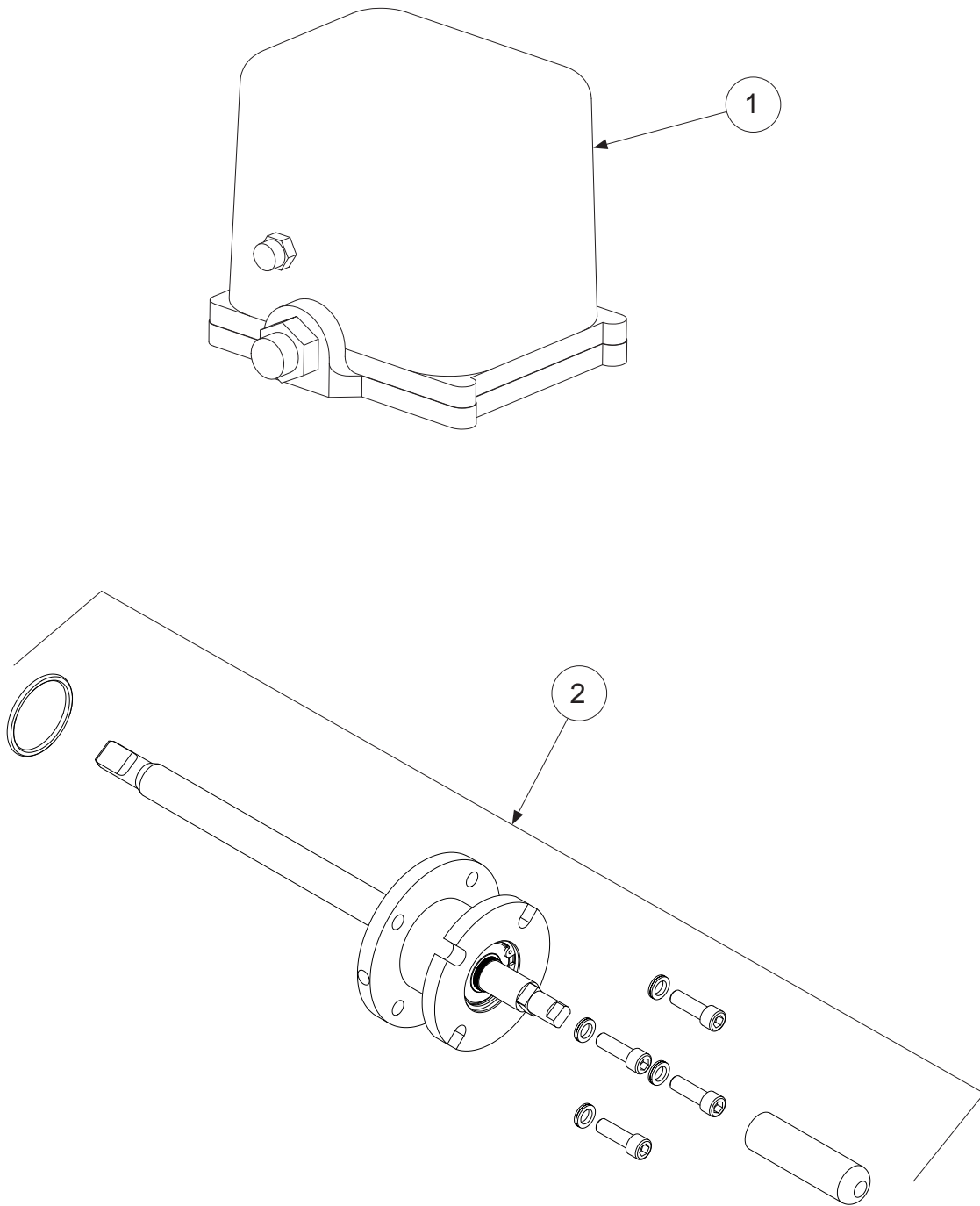


Slide Valve Carriage Assembly

Section 7 • Warranty and Parts

Slide Valve Carriage Assembly

Item	Description	VSMC 71-401		VSMC 501-701	
		Qty	VPN	Qty	VPN
300	CARRIAGE ASSEMBLY	1	A25179A	1	A26012B
304	"CAPACITY PISTON (340, 341, 350 & 355)"	1	A25183A	1	A25183B
305	"VOLUME PISTON (340, 342, 350 & 355)"	1	A25184A	1	A25184B
316	CAPACITY RACK	1	25023BH	1	25024AH
318	CAPACITY SHAFT	1	25772C	1	25772A
323	VOLUME RACK	1	25023CH	1	25023AH
325	VOLUME SHAFT	1	25772D	1	25772B
340	PISTON	2	25017B	2	25017A
341	CAPACITY PISTON SHAFT	1	25018B	1	25019A
342	VOLUME PISTON SHAFT	1	25018C	1	25018A
350	PISTON RING SET	2	2953AE	2	2953AA
355	EXPANSION PIN	2	1193PP	2	1193PP
359	PIPE PLUG	3	2606D	3	2606D
360	LOCK WASHER (PAIR)	2	3004C	2	3004C
361	WASHER	2	13265B	2	13265B
363	NUT	4	2797A	4	2797A
372	"SOCKET HEAD CAP SCREW (NOT SHOWN)"	-	-	1	2795M
373	SOCKET HEAD CAP SCREW	3	2795A	3	2795N
374	LOCK WASHER (PAIR)	3	3004C	3	3004C

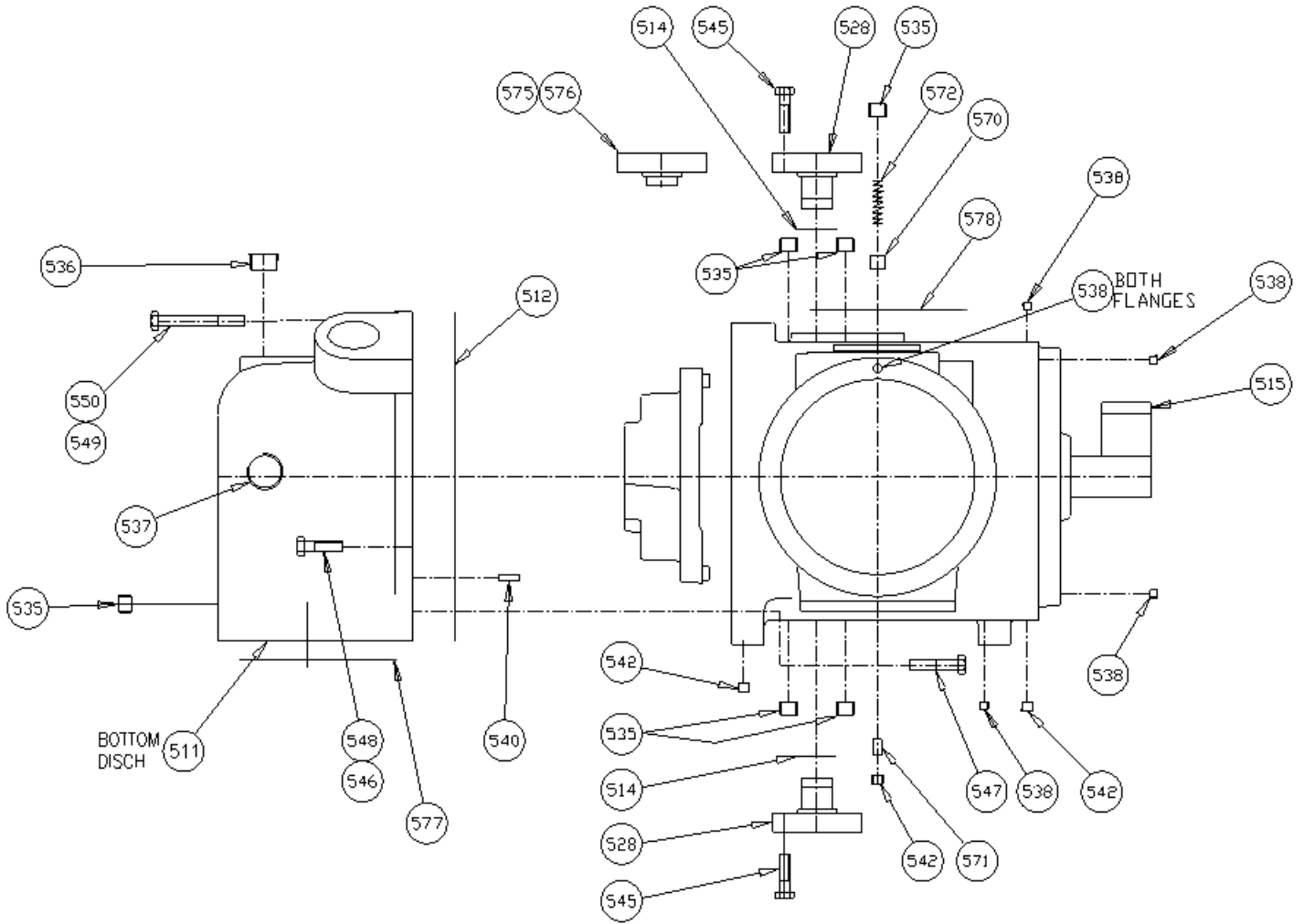


Actuating Motor with Optical Sensor and Command Shaft

Section 7 • Warranty and Parts

Actuating Motor with Optical Sensor and Command Shaft

Item	Description	VSMC 71-401		VSMC 501-701	
		Qty	VPN	Qty	VPN
1A	"ACTUATOR (STARTED 11-01-01)"	1	25972A	-	-
1B	"ACTUATOR (STARTED 06-01-06)"	1	25972D	1	25972D
	COMMAND SHAFT ADAPTER	1	25972K	1	25972K
2	COMMAND SHAFT	1	A25994A	1	A25994B

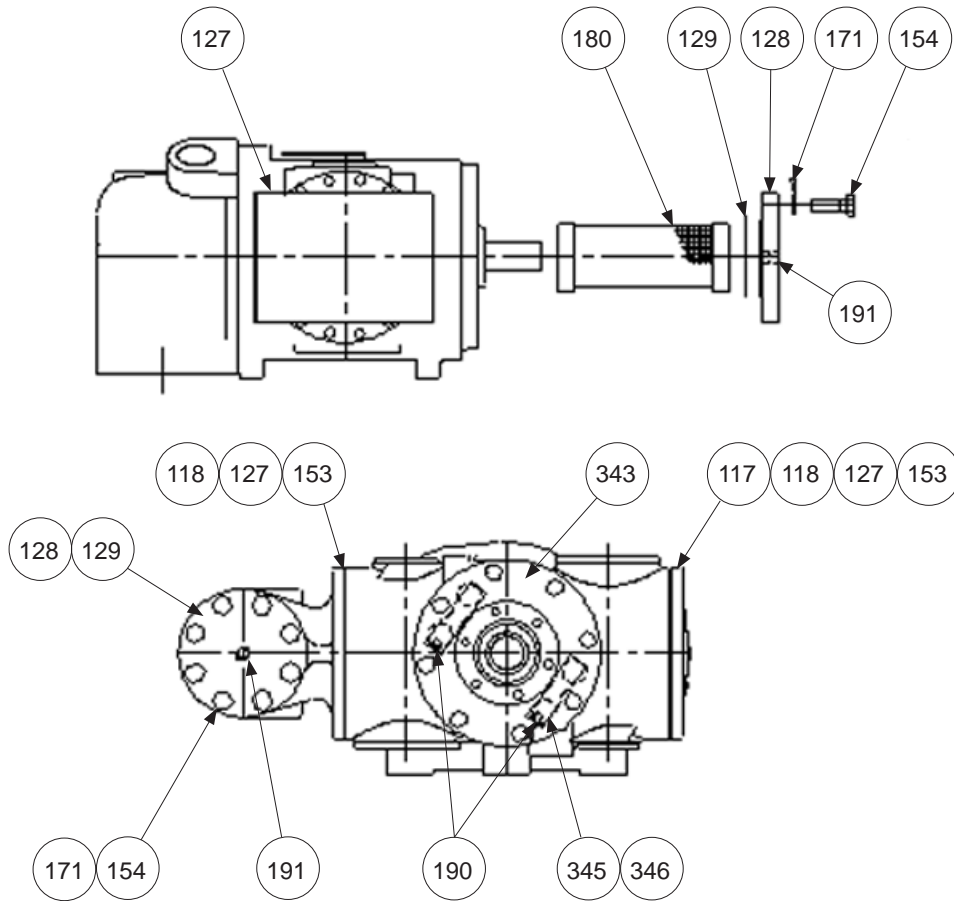


Miscellaneous Frame Components

Section 7 • Warranty and Parts

Miscellaneous Frame Components

Item	Description	VSMC 71-401		VSMC 501-701	
		Qty	VPN	Qty	VPN
511	DISCHARGE MANIFOLD	1	25734B	-	-
511	240MM DISCHARGE MANIFOLD WITH DOWN DISCHARGE	-	-	1	25024BC
511	240MM DISCHARGE MANIFOLD WITH HORIZONTAL DISCHARGE	-	-	1	25024BB
511	240MM DISCHARGE MANIFOLD WITH UP DISCHARGE	-	-	1	25024BA
512	MANIFOLD GASKET	1	25737A	1	26037A
514	ECON-O-MIZER GASKET	2	11322GG	2	11323D
515	KEY	1	13396R	1	13396R
522	COUPLING LOCK PLATE	-	-	1	25004D
523	LOCK WASHER	-	-	1	3004H
528	ECON-O-MIZER PLUG	2	25419A	2	25397K
530	O-RING	-	-	2	2176BF
535	PIPE PLUG	7	2606E	2	2606D
536	PIPE PLUG	1	13163G	6	2606E
537	PIPE PLUG	1	13163G	1	13163G
538	PIPE PLUG	9	2606B	2	2606B
540	DOWEL PIN	2	2868B	2	2868B
542	PIPE PLUG	3	2606C	10	2606B
545	HEX HEAD CAP SCREW	4	2796EL	4	2796C
546	SOCKET HEAD CAP SCREW	7	2795AK	6	2795GD
547	HEX HEAD CAP SCREW	3	2796EN	4	2796F
548	SOCKET HEAD CAP SCREW	-	-	3	2795GH
549	CAP SCREW	3	2796EY	1	2795GP
550	CAP SCREW	2	2796AB	2	2795GS
551	HEX HEAD CAP SCREW	-	-	2	2796C
570	BEARING OIL PLUG	1	25978A	-	-
571	PLUG	1	25979A	-	-
572	SPRING	1	3148A	-	-
575	ECONO FLANGE	1	25944A	1	25058ASW
576	ECONO FLANGE KIT	1	KT770B	-	-
577	SUCTION TO COMPRESSOR GASKET	1	11323W	1	25404A
578	DISCHARGE MANIFOLD TO SEPARATOR GASKET	1	1548CA	1	1548DA

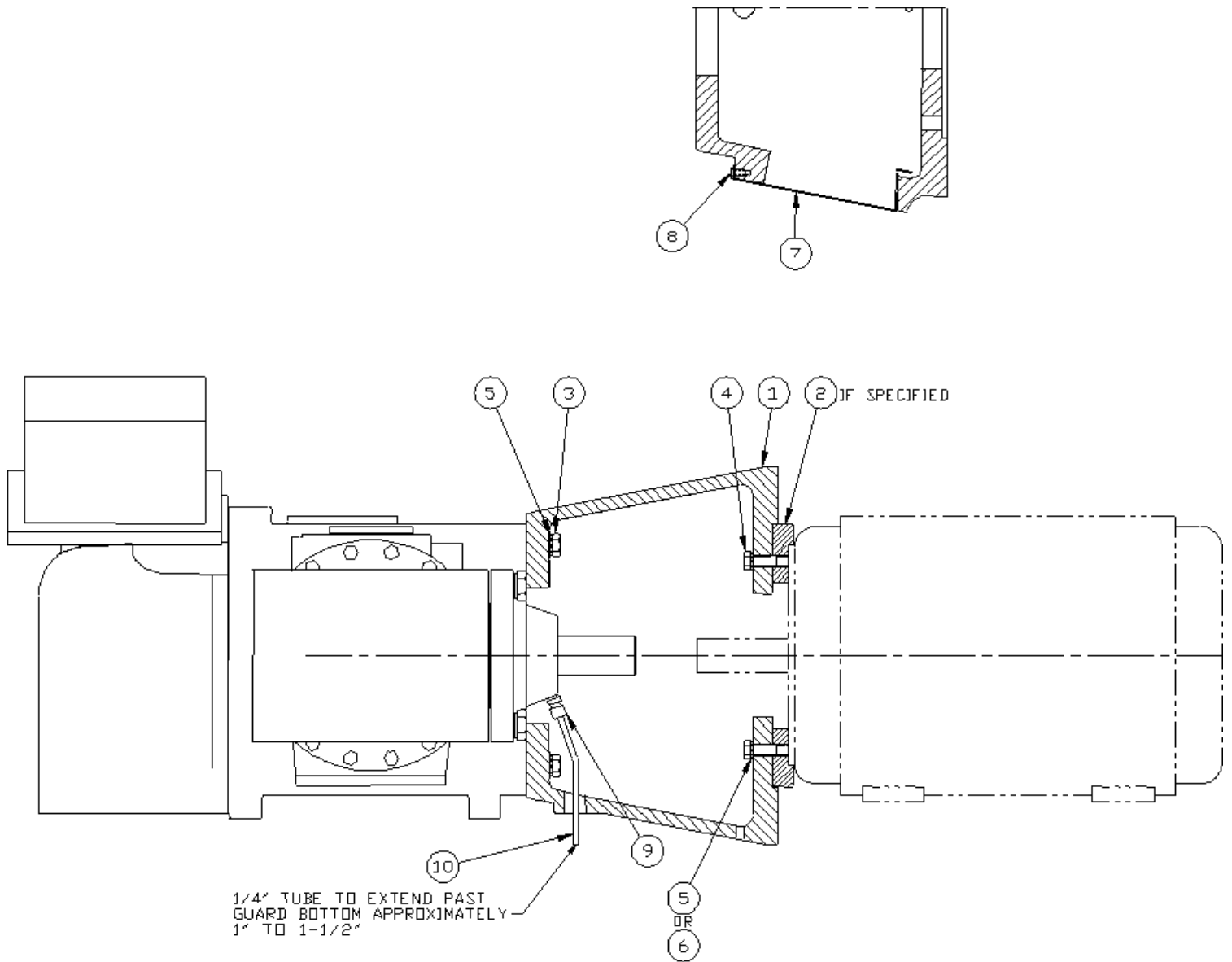


Housing Accessories

Section 7 • Warranty and Parts

Housing Accessories

Item	Description	VSMC 71-401		VSMC 501-701	
		Qty	VPN	Qty	VPN
117	GATE ROTOR COVER	1	25416B	-	-
118	COVER GASKET	2	25259B	1	25024BC
127	SUCTION TEE	1	25735B	1	25024BB
128	BLIND FLANGE WITH TAP	1	25967A	1	25024BA
129	GASKET	1	11323T	1	26037A
153	HEX HEAD CAP SCREW	32	2796DC	2	11323D
154	HEX HEAD CAP SCREW	8	1139BE	1	13396R
171	LOCK WASHER (PAIR)	8	3004J	1	25004D
180	INLET SCREEN	1	25920A	1	3004H
190	PIPE PLUG	2	2606C	2	25397K
191	PIPE PLUG	1	2606E	2	2176BF
343	PISTON COVER	1	25724B	2	2606D
345	O-RING	4	2176BX	4	2176BX
346	O-RING	2	2176BG	2	2176BG



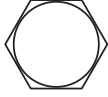




C-Flange Components

Section 7 • Warranty and Parts

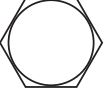


C-Flange Components

Item	Description	VSMC 71-401		VSMC 501-701	
		Qty	VPN	Qty	VPN
1	C-FLANGE	1	CALL HOME OFFICE	1	CALL HOME OFFICE
2	ADAPTER	1	CALL HOME OFFICE	1	CALL HOME OFFICE
3	HEX HEAD CAP SCREW	8	2796F	8	2796F
4	HEX HEAD CAP SCREW	4	2796EL	4	CALL HOME OFFICE
5	LOCK WASHER (PAIR)	8	3004H	8	3004H
6	LOCK WASHER (PAIR)	4	3004L	4	CALL HOME OFFICE
7	PORT COVER	2	25685A	2	25685B
8	HEX HEAD CAP SCREW	2	2796AC	2	2796AC
9	CONNECTOR	1	13229C	1	13229C
10	TUBE (CUT TO LENGTH)	1	S1589A	1	S1589A

Appendix A • Torque Specifications

Torque Specifications (ft-lbs)											
Type Bolt	Head Markings	Nominal Size Numbers or Inches									
		#10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8
SAE Grade 2 Coarse (UNC)		-	5	10	18	29	44	63	87	155	150*
SAE Grade 5 Coarse (UNC)		-	8	16	28	44	68	98	135	240	387
SAE Grade 5 Coarse (UNF)		-	-	18	-	-	-	-	-	-	-
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	115	215	380	614

1) Torque values in this table are not to override other specific torque specifications when supplied.
 2) When using loctite, torque values in this table are only accurate if bolts are tightened immediately after loctite is applied.
 * The proof strength of Grade 2 bolts is less for sizes 7/8 and above and therefore the torque values are less than smaller sizes of the same grade.

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

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

Appendix B • Oil Analysis Report



PRODUCT ANALYSIS REPORT

No Action Required

Customer Name
Customer Address

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

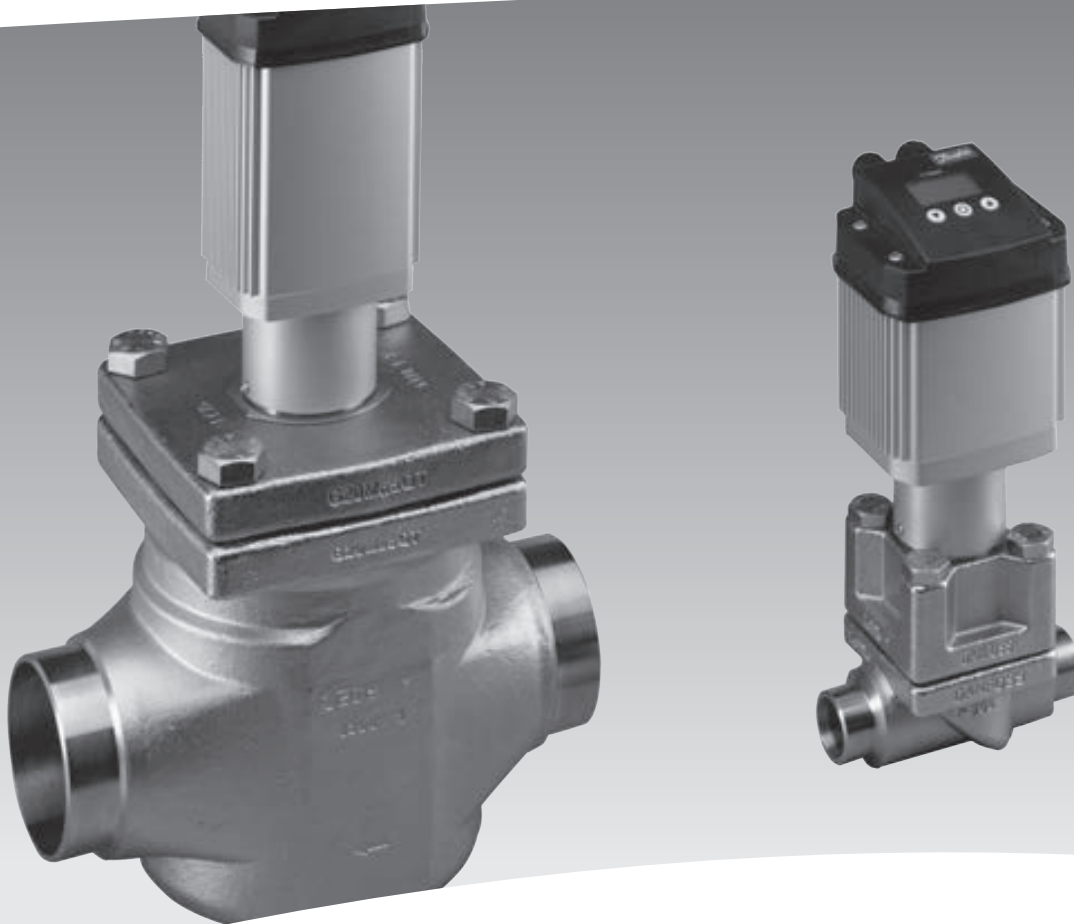
Thank you for this opportunity to provide technical assistance to your company. If you have any questions about this report, please contact us at 1-800-637-8628, or fax 1-989-496-2313 or email us at tslab@oil-services-lab.com **CC List**

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

Appendix C

Danfoss ICM/ICAD Motorized Valve Quick Start Guide



ICM/ICAD Motorized Valve

Installation, Programming, and Trouble-shooting

Contents

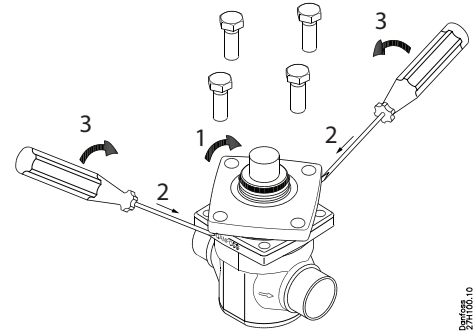
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Wiring the ICAD	5
ICAD Overview	8
ICAD Programming	9
Troubleshooting	
The Manual Tool	10
Service parameters	10
Alarms	11
Tips	11
Common questions.....	12

Installation

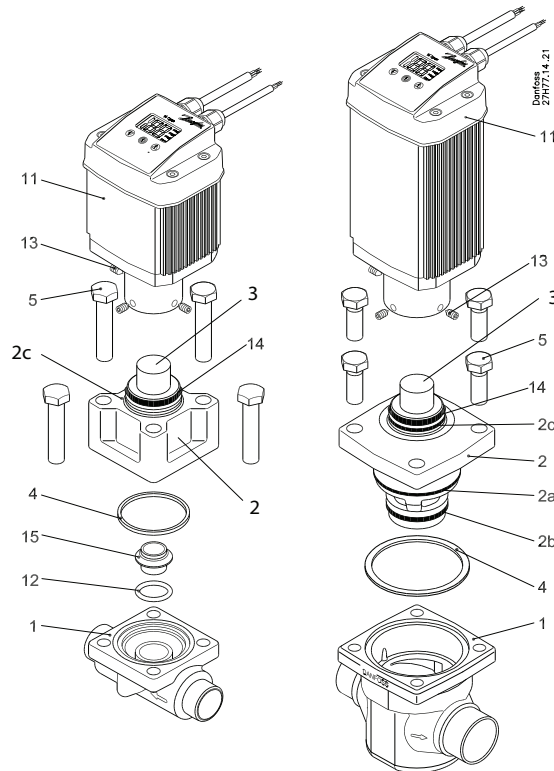
1. The ICM valve and ICAD motor actuator must be installed in horizontal pipelines with the motor actuator pointing upwards.
2. To prevent damage to O-rings and the valve seat, remove the one-piece ICM bonnet and function module from the valve body prior to welding the valve body in the line. For ICM 20 (3/4" size) the valve seat is not integrated with the valve bonnet and must be separately removed from the valve body with a 12 mm hex key prior to welding (see diagrams below).

Removing ICM 25 to 65 bonnets

- 1) Remove the 4 bolts
- 2) Rotate the bonnet as shown
- 3) Pry the bonnet out of the valve body by using screw drivers between the bonnet and valve body as shown



Danfoss 201008.10



No.	Part description
1	ICM body (housing)
2	ICM bonnet/function module
2a	O-ring for bonnet/function module
2b	O-ring for bonnet/function module
2c	O-ring for sealing ICAD motor with ICM valve
3	ICM adapter/valve stem
4	ICM bonnet gasket
5	Bolts for ICM
11	ICAD motor actuator
12	O-ring for ICM 20 seat orifice
13	ICAD screws
14	Guide ring
15	ICM 20 valve seat orifice

Care should be taken to protect the ICM function module while it is removed from the valve body.

3. Weld the valve body in line making sure the arrow on the valve body is pointing in the direction of flow.
4. Remove all debris from the valve body before re-installing the bonnet.
5. Install the bonnet/function module into the valve body.
 - a. For ICM 20, make sure that the removable orifice seat is installed in the valve body with the small O-ring between the orifice seat and body. Make sure the bonnet gasket is installed and in good condition.
 - b. For ICM 25 through ICM 65, check that the two O-rings on the bonnet and gasket located between the bonnet and valve body are installed and in good condition. A light coating of refrigerant oil on the bonnet O-rings will facilitate installation of the bonnet.
6. Install the four bolts and torque to the following specifications:

Valve body	Nm	ft lbs
ICM 20	50	37
ICM 25	80	59
ICM 32	80	59
ICM 40	90	66
ICM 50	100	74
ICM 65	110	81

7. Install the ICAD motor actuator on the ICM valve:
 - a. The ICM valve must not be in its fully 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 further.
 - b. Make sure that the ICM adapter/valve stem and inner ICAD motor magnets are completely dry and free from any debris.
 - c. For applications below freezing, the ICM adapter O-ring (position 2c in the diagram on page 3) must be removed, and Molycote G 4500 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.
 - d. Place the ICAD motor on the valve stem.
 - e. Push the ICAD motor completely down to the identification ring on the valve stem and use a 2.5 mm hex key to tighten the set screws evenly so the ICAD motor is centered on the ICM adapter (torque: 3 Nm/ 2.5 lb-ft).

Wiring the ICAD

Note: The ICAD is powered by a 24 Volt DC power source.

There are two cables pre-mounted and connected to the ICAD motor actuator. Never try to open the ICAD motor because the special moisture seal will be damaged.

The power cable consists of 3 wires:

- Green: (-) common (ground)
- Brown: (+) positive from 24VDC power source
- White: (+) positive from UPS/battery backup (optional)

The control cable consists of 7 wires:

- Yellow: (-) common (ground)
- Gray: (+) positive 4-20mA or 0-20mA input to control ICAD motor
- Blue: (+) positive 4-20mA or 0-20mA output from ICAD for valve position feedback
- Pink: (+) positive 2-10V or 0-10V input to control ICAD motor. Also used as a digital input with the yellow wire for on/off solenoid valve operation.
- White: common alarm (digital NPN transistor output when combined with yellow wire)
- Brown: indicates ICM is fully open (digital NPN transistor output when combined with yellow wire)
- Green: indicates ICM is fully closed (digital NPN transistor output when combined with yellow wire)

Electrical Data

Supply voltage is galvanically isolated from input and output wires.

Supply voltage

24 V d.c., +10% / -15%

Load ICAD 600: 1.2 A

ICAD 900: 2.0 A

Fail safe supply

Min. 19 V d.c.

Load ICAD 600: 1.2 A

ICAD 900: 2.0 A

Analog input - Current or Voltage

Current

0/4 - 20 mA

Load: 200 Ω

Voltage

0/2 - 10 V d.c.

Load: 10 k Ω

Analog output

0/4 - 20 mA

Load: \leq 250 Ω

Digital input - Digital ON/OFF input by means of voltage free contact (Signal/Telecom relays 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

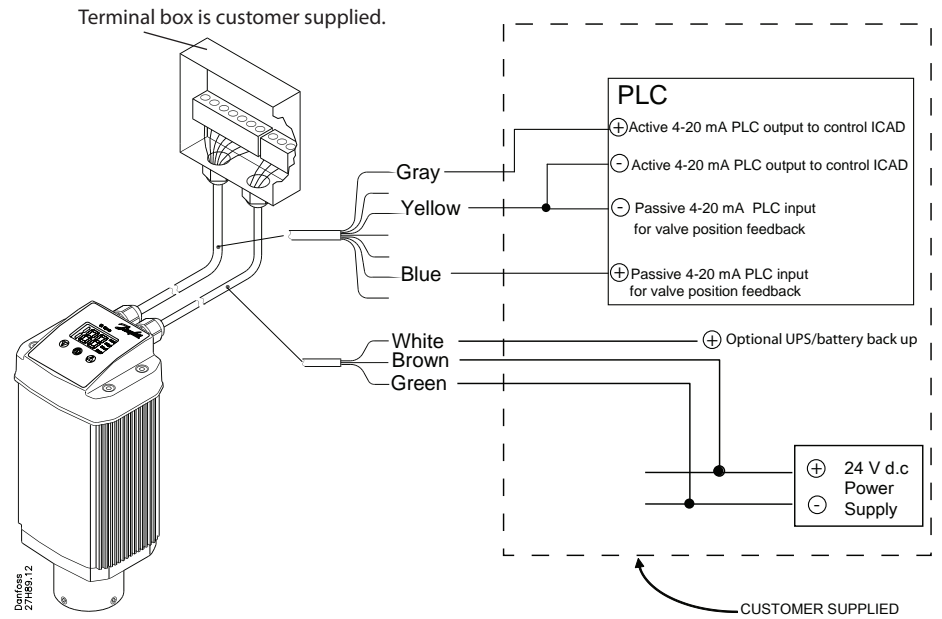
External supply: 5 - 24 V d.c. (same supply as for ICAD can be used, but please note that the galvanically isolated system will then be spoiled).

Output load: 50 Ω

Load: Max. 50 mA

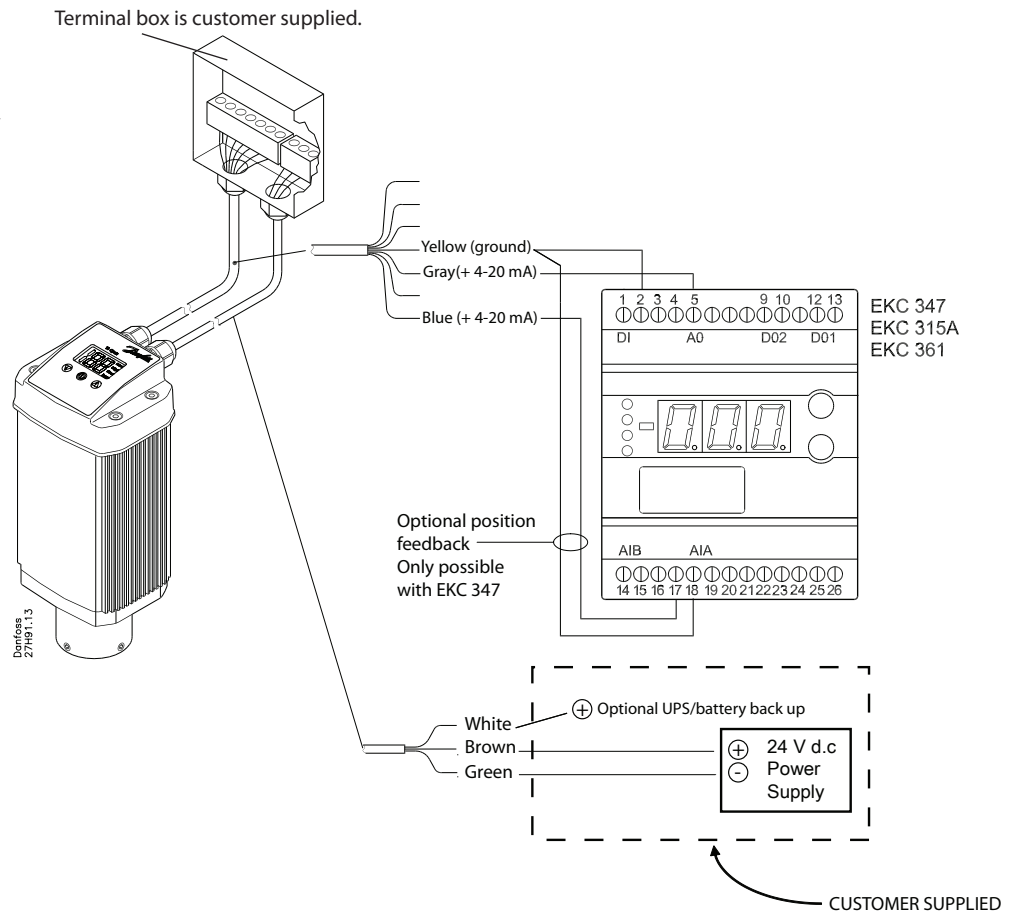
Wiring diagram showing ICAD wired with a PLC or other type of third-party electronics

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



Wiring diagram with Danfoss EKC controllers

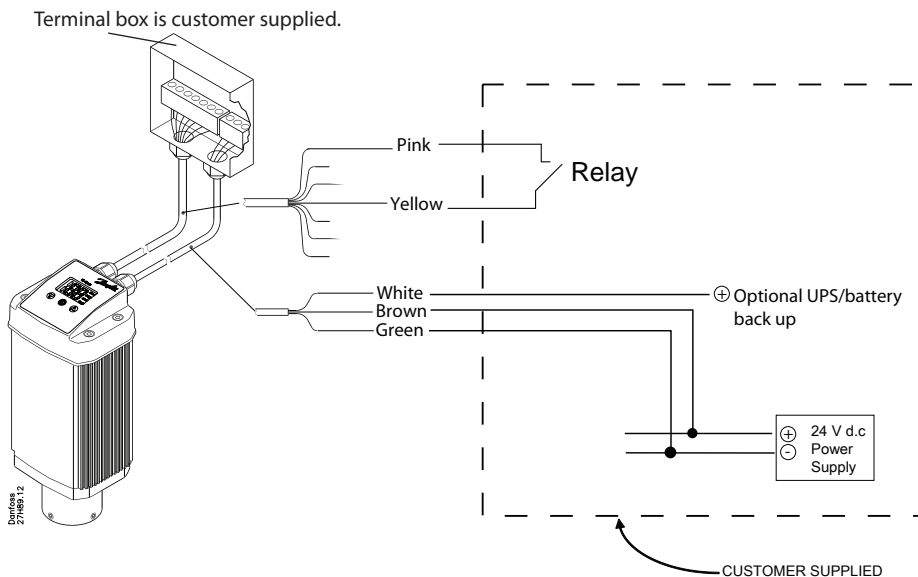
Note:
For instructions on completely wiring an EKC controller, please see the relevant EKC controller manual.



Wiring diagram showing ICAD wired with a digital input for ON/OFF solenoid valve operation

Note:

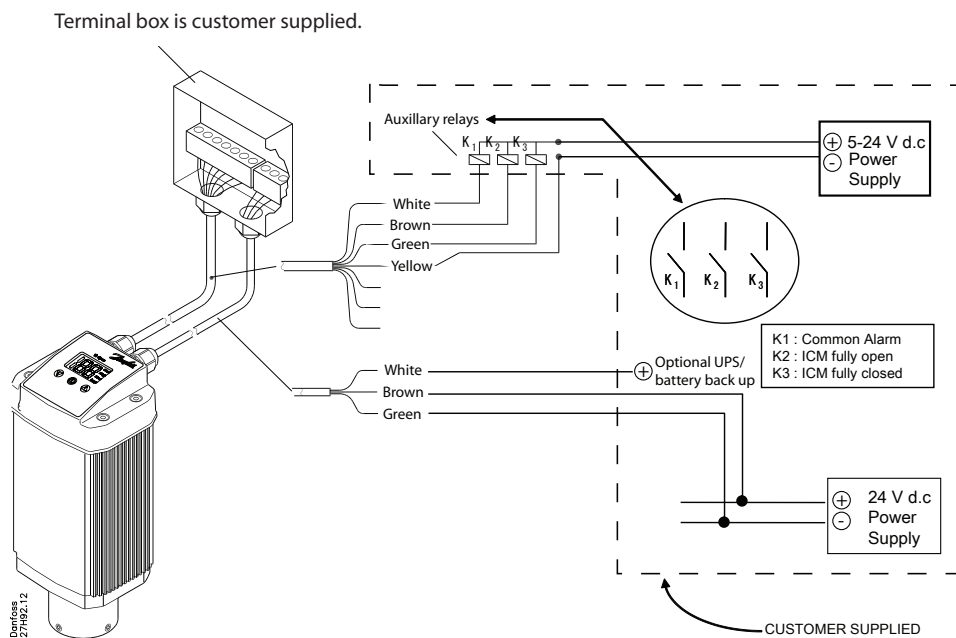
The ICAD motor can be programmed to open or close when the relay is closed. See parameter j09 in programming section.



Wiring diagram showing ICAD digital outputs wired with customer supplied auxiliary relays

Note:

The same 24 Vd.c. power supply that powers the ICAD can be used with the ICAD digital outputs to power auxiliary relays (or other small load devices), but please note that the system will no longer be galvanically isolated.



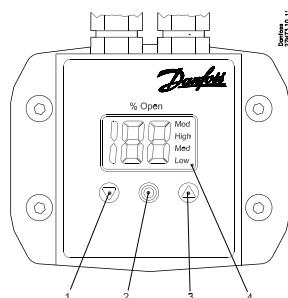
ICAD Overview

Before programming it is important to understand the functionality of the ICAD actuator:

1. The ICAD is a digital stepper motor. As such, it will count steps up and down from the position it believes it is in. Every time, the ICAD is powered on, it will drive itself to the closed position in order to re-establish its base point of reference. It will then move back to the position corresponding to the signal it is receiving from the control wiring.
2. The ICAD can be put into manual mode to move it (using the up and arrows) to a location different from the location that the signal is telling it to be in (see parameter *j01*, p. 6). When in the manual mode, the display screen will be flashing and will continue to flash flashing the % opening of the valve until the ICAD is taken out of the manual mode.
3. The ICAD can be operated in analog mode (for modulating operation) or in digital mode for solenoid operation. The ICAD can receive a variety of control signals (see parameter *j03*, p. 6) and can send a valve position output signal to modulate another ICAD or to a PC or PLC for monitoring. (see parameter *j06*, p. 6)
4. Because the ICAD employs a digital stepper motor, its speed can be adjusted to any percentage of full speed through the parameter menu. (see parameter *j04*, p. 6)
5. The ICAD can be connected to a 24 VDC UPS (Uninterruptible Power Supply) and can be programmed for actions when the normal power has been cut and the ICAD is operating off of the UPS power. (see parameter *j07* and *j12*, p. 6)

Operating the ICAD Menu

1. In order to access the menu, PRESS and HOLD the middle button (2) until the menu screen appears.



1. Down arrow push button
2. Enter
3. Up arrow push button
4. Display

2. Once you are in the menu, use the up (3) and down (1) arrow keys to move through the list of parameters.
3. To display the current setting of a parameter press the middle button.
 - a. To change the value of a parameter setting, use the up or down arrow to establish the new setting while in that particular parameter's display mode.
 - b. Once the new setting for a parameter has been selected, push the center 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. The ICAD will automatically exit if no buttons are pushed for 20 seconds.

Programming the ICAD

When the ICAD motor is first powered, the ICAD display will flash an A1 alarm. This means that the ICM valve size that is being used with the ICAD motor needs to be selected in parameter **j26**. Parameter **j26** is password protected and will not appear in the parameter list until the user enters the password in parameter **j10**. The password is "11," and will allow the user to access parameter **j26** where the appropriate valve size is selected. When the ICM valve size is selected, the ICAD will calibrate itself to the ICM valve and will then be ready for control by a 4-20mA signal. For most applications, this is the only programming that will need to be done if the ICAD is going to be controlled by a 4-20mA input.

ICAD Parameters

Description	Display name	Min.	Max.	Factory setting	Unit	Comments
ICM OD (Opening Degree)	-	0	100	-	%	ICM valve Opening Degree is displayed during normal operation. Running display value (see j01 , j05).
Main Switch	j01	1	2	1	-	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	j02	1	2	1	-	Operation mode 1: Modulating – ICM positioning according to Analog Input (see j03) 2: ON/OFF - operating the ICM valve like an ON/OFF solenoid valve controlled via Digital Input. See also j09 .
Analog Input signal	j03	1	4	2	-	Type of Analog Input signal from external controller 1: 0 - 20 mA 2: 4 - 20 mA 3: 0 - 10 V 4: 2 - 10 V
Speed at ON/OFF and Modulating Mode	j04	1	100	100	%	Speed can be decreased. Max. speed is 100 % Not active when j01 = 2 If j02 = 2 the display will indicate speed in display. Low , Med and High also means ON/OFF operation. If j04 < = 33, Low is displayed 33 < If j04 < = 66, Med is displayed If j04 > = 67 High is displayed
Automatic calibration	j05	0	1	0	-	Not active before j26 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.
Analog Output signal	j06	0	2	2	-	Type of A0 signal for ICM valve position 0: No signal 1: 0 - 20 mA 2: 4 - 20 mA
Fail safe	j07	1	4	1	-	Define condition at power cut when fail safe is installed. 1: Close valve 2: Open valve 3: Maintain valve position 4: Go to OD given by j12
Digital Input function	j09	1	2	1	-	Define function when DI is ON (short circuited DI terminals) when j02 = 2 1: Open ICM valve (DI = OFF = > Close ICM valve) 2: Close ICM valve (DI = OFF = > Open ICM valve)
Password	j10	0	199	0	-	Enter number to access password protected parameters: j26 Password = 11
Old Alarms	j11	A1	A99	-	-	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 powercut	j12	0	100	50	-	Only active if j07 = 4 If fail safe supply is connected and powercut occurs ICM will go to entered OD.
ICM configuration	j26	0	6	0	-	NB: Password protected. Password = 11 At first start up A1 will flash in display. Enter valve type 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

Troubleshooting

The Manual Tool



The manual tool should always be ordered with any ICM/ICAD assembly. This tool gives the user the ability to remove the ICAD actuator and manually rotate the valve in the open or close direction depending on need and application. When using the manual tool, a clockwise rotation will open the valve and a counter-clockwise rotation will close the valve.

NOTE:

It is very important to remember that when rotating the valve manually you are changing the position from that in the actuator's memory. If power is removed from the actuator prior to using the manual tool, no problem will occur because, once the ICAD is powered up again, it will automatically recalibrate to the fully closed position before returning to the position in memory to which the control signal last set the valve. This recalibration will not occur if power is not removed from the ICAD prior to using the manual tool, and erroneous operation will likely occur. Always remove power before using the manual tool, and restore power afterward to ensure recalibration and trouble-free operation.

Service Parameters

The user will be able to troubleshoot and determine many of the conditions and set points within the ICAD by accessing the Service Menu. A list of those service parameters follows below:

Service Menu

Description	Display name	Min.	Max.	Unit	Comments
OD %	i50	0	100	%	ICM valve Opening Degree
AI [mA]	i51	0	20	mA	Analog Input signal
AI [V]	i52	0	10	V	Analog Input signal
AO [mA]	i53	0	20	mA	Analog Output signal
DI	i54	0	1	-	Digital Input signal
DO Close	i55	0	1	-	Digital Output Closed status. ON when OD < 3 %
DO Open	i56	0	1	-	Digital Output Open status. ON when OD > 97 %
DO Alarm	i57	0	1	-	Digital Output alarm status. ON when an alarm is detected
MAS mP SW ver.	i58	0	100	-	Software version for MASTER Microprocessor
SLA mP SW ver.	i59	0	100	-	Software version for SLAVE Microprocessor

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

To restore factory settings:

1. Remove the power supply.
2. Activate down arrow and up arrow push buttons at the same time.
3. While holding the up and down arrow reconnect the power supply.
4. Release down arrow and up arrow push buttons.
5. When the display on ICAD is alternating between showing: **CA** and **A1** the factory resetting is complete.

Alarms

There are a number of alarms which are excellent indicators of improper installation or set-up:

Description	ICM alarm text	Comments
No valve type selected	A1	At start-up A1 and CA will be displayed
Controller fault	A2	Internal fault inside electronics
Input error	A3	Not applicable if ; 01 = 2 or ; 02 = 2 When ; 03 = 1 and AI > 22 mA When ; 03 = 2 and AI > 22 mA or AI < 2 mA When ; 03 = 3 and AI > 12 V When ; 03 = 4 and AI > 12 V or AI < 1 V
Low voltage of fail safe supply	A4	If 5 V d.c. < Fail safe supply < 18 V d.c.
Check Supply to ICAD	A5	If supply voltage < 18 V d.c.

Troubleshooting Tips

Problem	Possible cause and solution
The valve is not working and an A1 is flashing in the display.	The ICM valve size was not selected in parameter ; 26 . See the programming section on page 9.
The valve does not appear to be opening or closing properly	<ol style="list-style-type: none"> 1. The ICAD was not mounted properly on the valve stem. Solution: Check to make sure that the ICAD was mounted evenly on the ICM valve 2. The ICAD is not receiving a proper input signal. Solution: Use the service parameters (;51 for a mA input or ;52 for a voltage input) to check the input signal that the ICAD is receiving.
The valve position feedback signal is not working when using customer supplied controller/PLC	<ol style="list-style-type: none"> 1. A power supply was installed in the 4-20mA/0-20mA feedback loop. The ICAD motor actuator supplies the power for the 4-20mA/0-20mA feedback loop. Solution: Remove any power source that may be supplied to the feedback loop. 2. Wiring problem. Solution: Check the service parameter ;53 to see what the ICAD is outputting. If this does not reveal anything, check the current output (yellow and blue wires in ICAD control cable) with an ammeter. 3. The feedback output signal was turned off in parameter ;06. Solution: Check to make sure the setting in parameter ;06 is correct.
<i>For all other problems, contact Danfoss.</i>	

Common Questions***What happens in the event of a power failure?***

The ICAD will remain in the position it is in when power is lost. There are two ways to address this condition:

- Add a UPS (Uninterruptible Power Supply) to the power wiring. This is easily accomplished with the green and white wires in the power cable. A UPS is available from Danfoss. The UPS can provide service for up to 9 ICAD 600's or up to 6 ICAD 900's.

Note: The UPS is not a continuous power supply. It is used to change the valve position (usually to close the valve) in the event of a power failure. Therefore, the system is not to be run in the UPS mode.

- Add a solenoid valve in front of the ICM. This is a very 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 both the ICAD size and the number of ICAD's powered by the DC power supply. The power for each ICAD is:

- For the ICAD 600 (used on ICM 20, 25, and 32), the power requirement is approximately 30 W
- For the ICAD 900 (used on ICM 40, 50, and 65), the power requirement is approximately 50 W

How can I monitor the valve position remotely?

The control wiring provides for a 4 to 20 mA or 0 to 20 mA signal output (blue and yellow wires). This signal can be sent to:

- A remote display
- A PLC or PC
- Another ICAD motor to give the same opening position

Appendix D

Danfoss ICM/ICAD Valve Setup Instructions

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.

Appendix E

Danfoss Valve Station ICF 20-40 Installation Guide

Installation Guide

Valve Station

ICF 20-40

027R9782

027R9782

Direction and position		
ICF xx-4	ICF xx-6	ICF xx-4 / ICF xx-6 with ICM
<p>Fig. 1a</p>	<p>Fig. 1b</p>	<p>Fig. 1c</p>

Welding

TIG/MIG/SAW welding

Inlet and outlet stop valves must be closed all the time before commissioning of the installation in order to prevent rust formations in the valve. The stop valves are closed when delivered from the factory. ICF must be cooled during the welding (e.g. by means of a wet cloth).

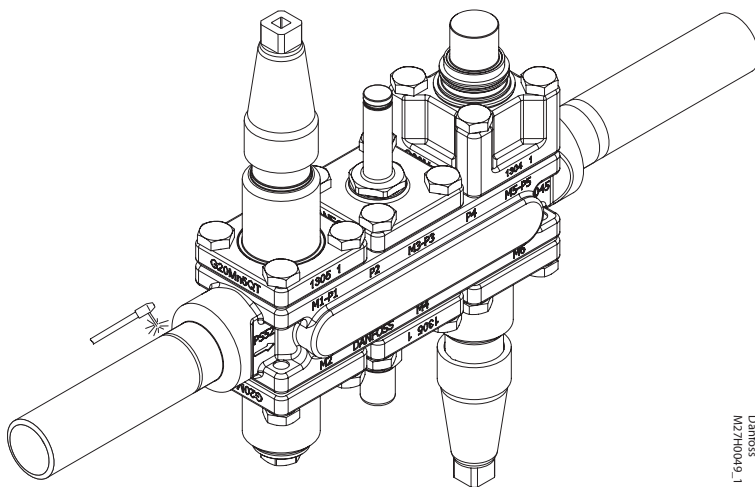


Fig. 2

Other welding methods

Remove all parts before welding. When the valve is assembled make sure that some rust protective oil is supplied in the valve. Before commissioning inlet and outlet valves must be closed at all time.

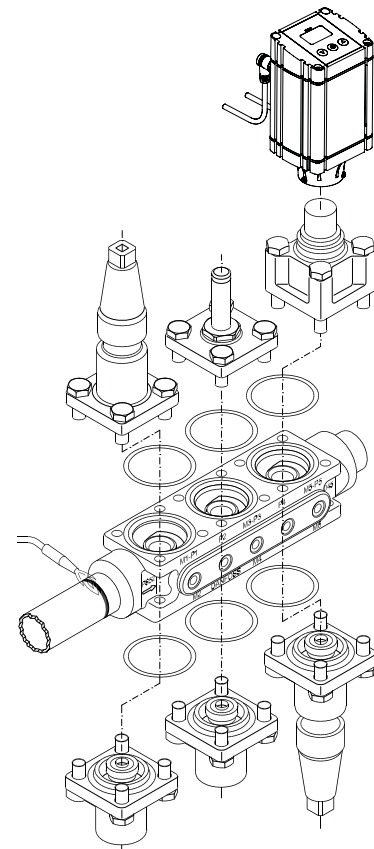


Fig. 3

Service and maintenance



For both ICF 20 and ICF 25-40 with ICM and ICFE 25-40

Please Note:

When used in CO₂, the o-rings (see fig. 4) on the ICM and ICFE 25-40 modules can swell (grow).

At service it is recommend that new o-rings are installed, before the ICM and ICFE 25-40 function modules are reinstalled in the ICV valve body.

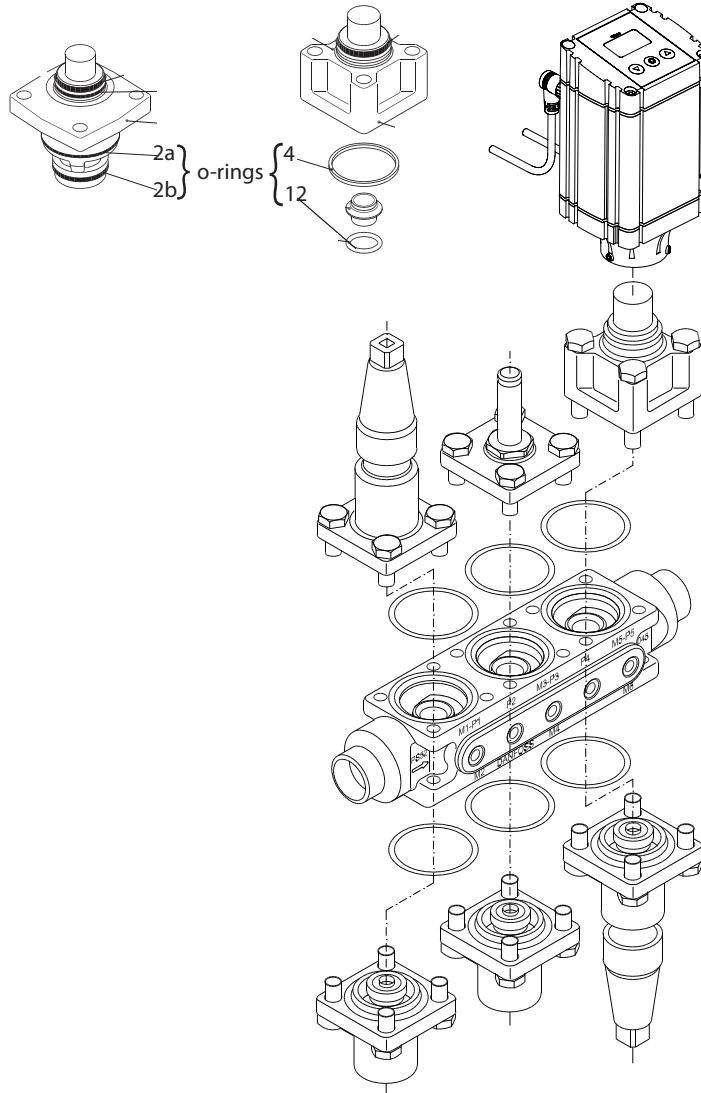
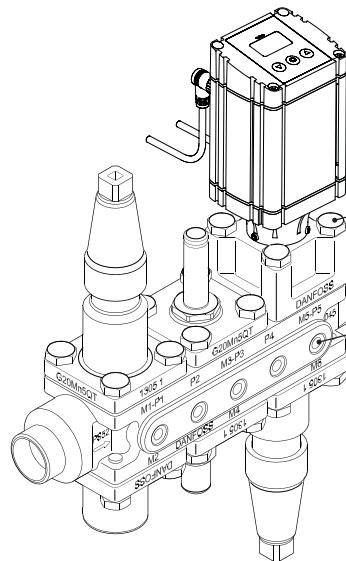


Fig. 4

Danfoss 2FH170.10

Tightening torques

For the 4 bolts in all ICF modules

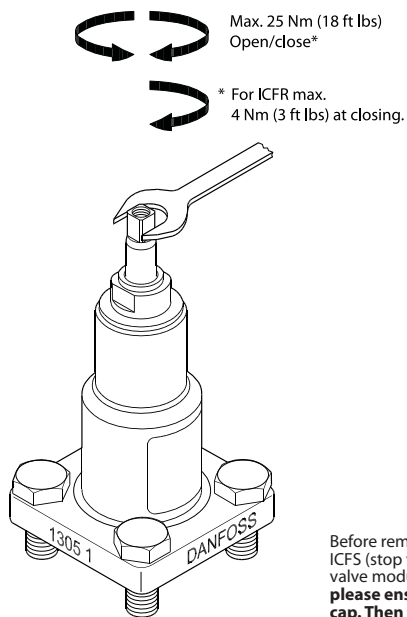


ICF 20:	ICF 25-40:
50 Nm (36 ft lbs)	80 Nm (58 ft lbs)
50 Nm (36 ft lbs)	50 Nm (36 ft lbs)

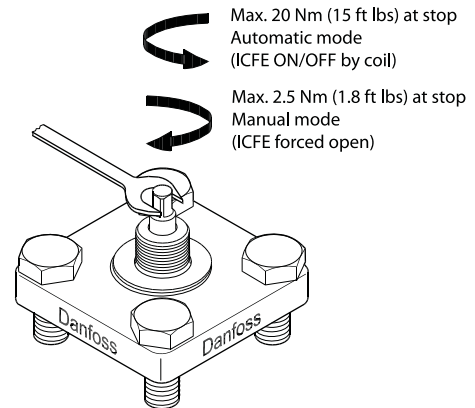
Fig. 5

ICF 20

ICFS - stop valve module
ICFR - manual regulating valve module
ICFN - stop/check valve module



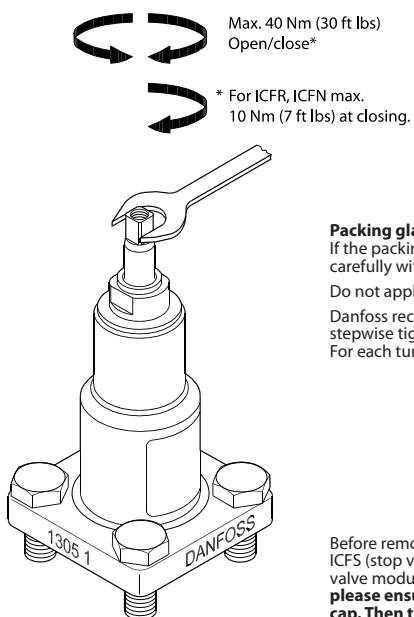
ICFO - manual opening module



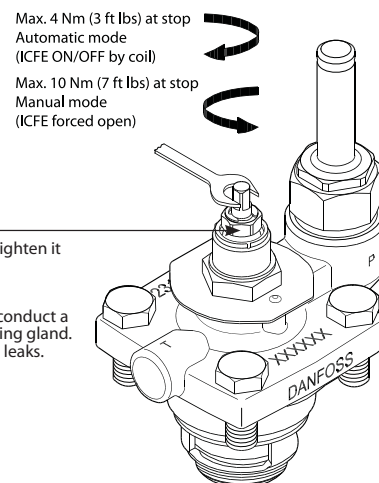
Before remounting the cap on the modules
ICFS (stop valve module), ICFR (manual regulating
valve module) or ICFN (stop/check valve module)
**please ensure that the gasket is present in the
cap. Then tighten the cap with 16 Nm (12 ft lbs).**

ICF 25 - 40

ICFS - stop valve module
ICFR - manual regulating valve module
ICFN - stop/check valve module



ICFE - solenoid valve module



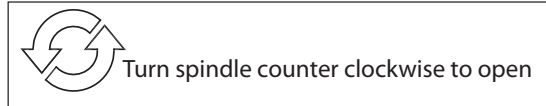
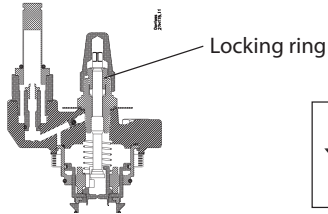
Packing gland
 If the packing gland is leaking, tighten it
carefully with a wrench.
 Do not apply too much force.
 Danfoss recommends that you conduct a
stepwise tightening of the packing gland.
 For each turn check for possible leaks.

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

Operating the manual opener on ICFE 25 solenoid module

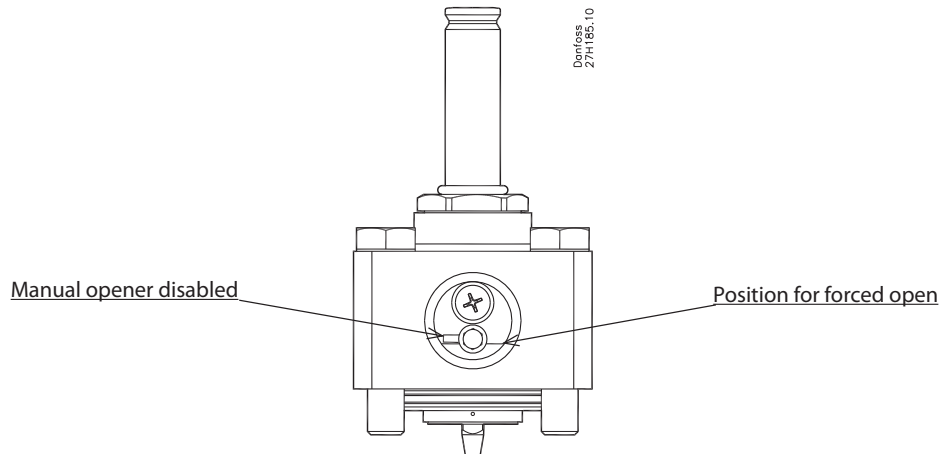
To force open the solenoid by the manual stem turn it **counter clockwise** full way up. (Manual mode)
 To operate the solenoid in automatic mode, turn the manual stem **clockwise** until the locking ring stops.
 Do not force the spindle further. If the locking ring is damaged or removed the spindle will start to leak.
The valve cannot be forced closed by the manual stem.

ICFE 25-40 solenoid valve module



Operating the manual opener on ICFE 20H solenoid valve module

Remove the cap on the side of the ICFE 20H
 At 9 o'clock position the manual opener is disabled (not active)
 To force the ICFE 20H solenoid to open use a 5 mm Allen key and turn it **clockwise** to 3 o'clock position.



Module location

ICF 20-4

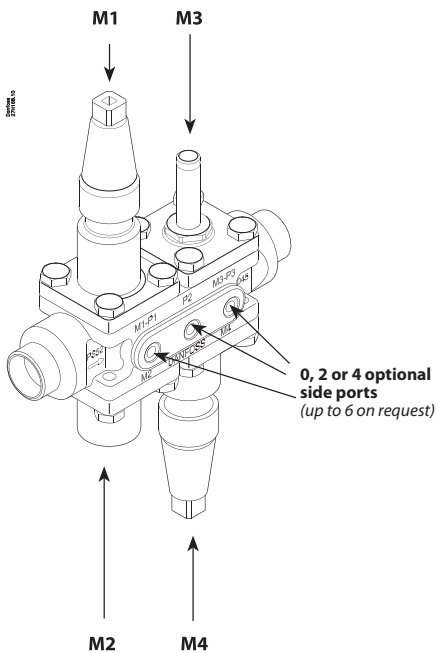


Fig. 6

In order to supply the ICF valve station best suited for liquid lines and hot gas lines certain function modules are dedicated to specific module ports.

Function	M1	M2	M3	M4
ICFS 20 - Stop valve module				
ICFR 20A - Manual regulating valve module				
ICFF 20 - Filter module	⊗		⊗	
ICFE 20 - Solenoid valve module	⊗	⊗		⊗
ICFE 20H - Solenoid valve module				⊗
ICFA 10 - Electronic expansion valve module		⊗		⊗
ICFO 20 - Manual opening module	⊗		⊗	
ICFC 20 - Check valve module	⊗		⊗	
ICFN 20 - Stop/check valve module			⊗	
ICM 20-A, B or C - Motor valve module		⊗		⊗
ICFB 20 - Blank top cover				

⊗ location not possible

ICF 20-6

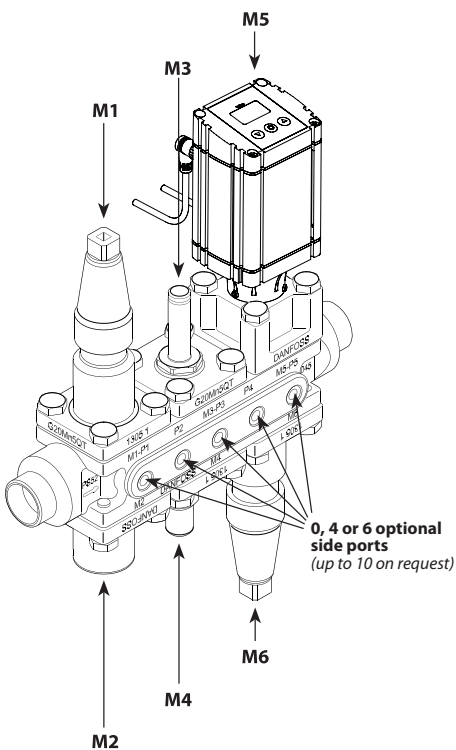


Fig. 7

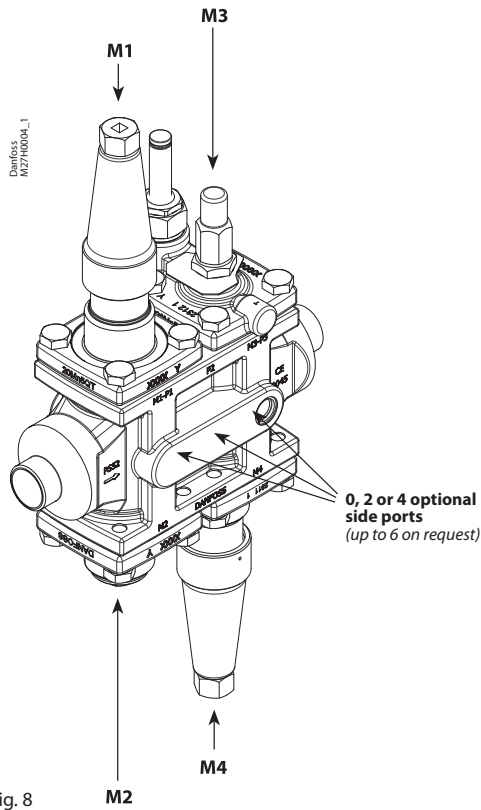
In order to supply the ICF valve station best suited for liquid lines and hot gas lines certain function modules are dedicated to specific module ports.

Function	M1	M2	M3	M4	M5	M6
ICFS 20 - Stop valve module						
ICFR 20A - Manual regulating valve module						
ICFF 20 - Filter module	⊗		⊗		⊗	
ICFE 20 - Solenoid valve module	⊗	⊗		⊗	⊗	⊗
ICFE 20H - Solenoid valve module				⊗		⊗
ICFA 10 - Electronic expansion valve module		⊗		⊗		⊗
ICFO 20 - Manual opening module	⊗		⊗		⊗	
ICFC 20 - Check valve module	⊗		⊗		⊗	
ICFN 20 - Stop/check valve module			⊗		⊗	
ICM 20-A, B or C - Motor valve module		⊗		⊗		⊗
ICFB 20 - Blank top cover						

⊗ location not possible

Module location

ICF 25-4 → 40-4

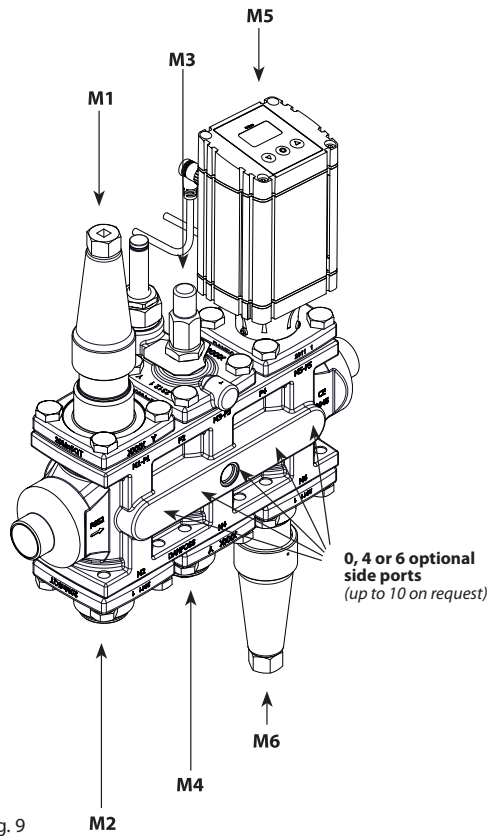


In order to supply the ICF valve station best suited for liquid lines and hot gas lines certain function modules are dedicated to specific module ports.

Function	M1	M2	M3	M4
ICFS 25-40 - Stop valve module				
ICFR 25-40 A or B - Manual regulating valve module				
ICFF 25-40 - Filter module	⊗		⊗	
ICFE 25-40 - Solenoid valve module	⊗	⊗	⊗	⊗
ICFC 25-40 - Check valve module	⊗		⊗	
ICFN 25-40 - Stop/check valve module	⊗		⊗	
ICM 25-A or C - Motor valve module		⊗	⊗	⊗
ICFB 25-40 - Blank top cover				
ICFW 25-40 - Welding module, 25DIN				

⊗ location not possible

ICF 25-6 → 40-6



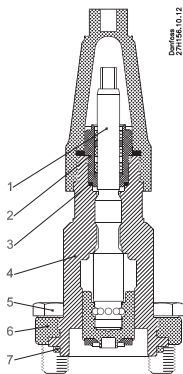
In order to supply the ICF valve station best suited for liquid lines and hot gas lines certain function modules are dedicated to specific module ports.

Function	M1	M2	M3	M4	M5	M6
ICFS 25-40 - Stop valve module						
ICFR 25-40 A or B - Manual regulating valve module						
ICFF 25-40 - Filter module	⊗		⊗		⊗	
ICFE 25-40 - Solenoid valve module	⊗	⊗	⊗	⊗	⊗	⊗
ICFC 25-40 - Check valve module	⊗		⊗			
ICFN 25-40 - Stop/check valve module	⊗		⊗			
ICM 25-A or C - Motor valve module		⊗	⊗	⊗	⊗	⊗
ICFB 25-40 - Blank top cover						
ICFW 25-40 - Welding module, 25DIN						

⊗ location not possible

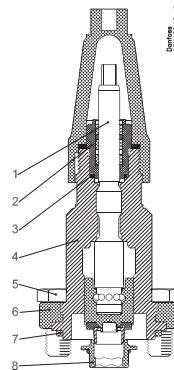
The function modules - ICF 20

ICFS 20 stop valve module



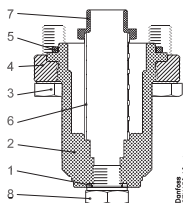
1. Spindle
2. Thread part
3. AL-gasket
4. Bonnet
5. Hex-head bolt
6. Flange
7. Gasket

ICFR 20 manual regulating valve module



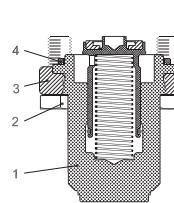
1. Spindle
2. Thread part
3. AL-gasket
4. Bonnet
5. Hex-head bolt
6. Flange
7. Gasket
8. Seat

ICFF 20 filter module



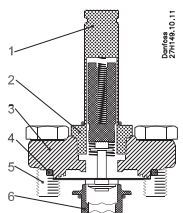
1. Gasket
2. Bonnet
3. Hex-head bolt
4. Flange
5. Gasket
6. Filter element
7. Plug
8. Plug 1/4" RG or 3/8" NPT

ICFC 20 check valve module



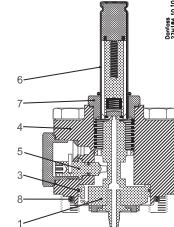
1. Bonnet
2. Hex-head bolt
3. Flange
4. Gasket

ICFE 20 solenoid valve module



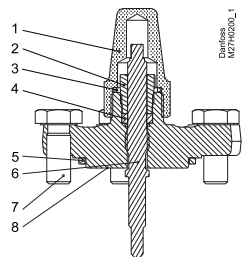
1. Armature tube
2. Armature tube nut
3. Flange
4. Gasket
5. Hex-head bolt
6. Seat

ICFE 20H solenoid valve module



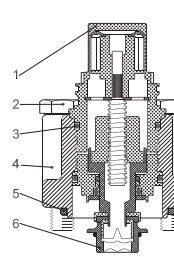
1. Piston
3. Piston ring
4. Bonnet cylindre
5. Manual opener
6. Armature tube
7. Armature tube nut
8. Gasket

ICFO 20 manual opening module



1. Seal cap
2. Gland nut
3. Seal cap gasket
4. Sealing ring
5. Rubber gasket
6. Spindle
7. Hex-head bolt
8. Flange

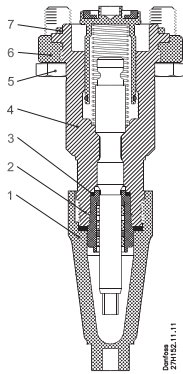
ICM 20 A, 20 B or 20 C motor valve module



1. Adapter
2. Hex-head bolt
3. O-ring
4. Bonnet
5. Gasket
6. Seat

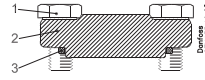
The function modules - ICF 20

ICFN 20 stop/check valve module



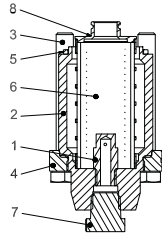
1. Spindle
2. Thread part
3. AL-gasket
4. Bonnet
5. Hex-head bolt
6. Flange
7. Gasket

ICFB 20 blank top cover module



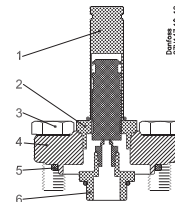
1. Hex-head bolt
2. Flange
3. Gasket

ICFF 20E extended filter module



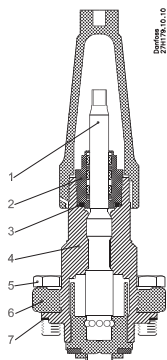
1. Dirt protection plug
2. Bonnet
3. Hex-head bolt M12x80
4. Flange
5. Gasket
6. Filter element
7. Plug 3/8" NPT
8. Filter adaptor

ICFA 10 Electronic expansion valve



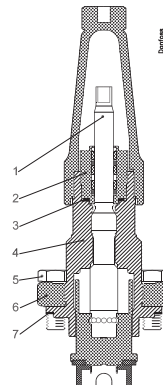
1. Armature tube
2. Armature tube nut
3. Hex-head bolt
4. Flange
5. Gasket
6. Adaptor

ICFS 25-40 stop valve module



1. Spindle
2. Thread part
3. O-ring
4. Bonnet
5. Hex-head bolt
6. Flange
7. Gasket

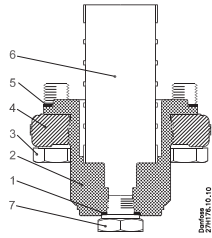
ICFR 25- 40 A or B manual regulating valve module



1. Spindle
2. Thread part
3. O-ring
4. Bonnet
5. Hex-head bolt
6. Flange
7. Gasket

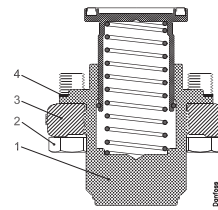
The function modules - ICF 25-40

ICFF 25-40 filter module



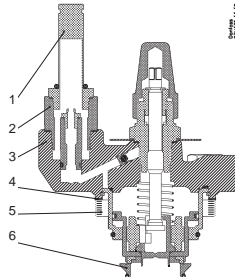
1. Al gasket
2. Bonnet
3. Hex-head bolt
4. Flange
5. Gasket
6. Filter element
7. Plug 1/4" RG or 3/8" NPT

ICFC 25-40 check valve module



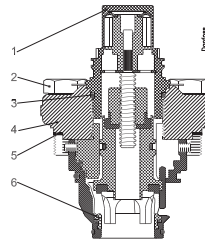
1. Bonnet
2. Hex-head bolt
3. Flange
4. Gasket

ICFE 25-40 solenoid valve module



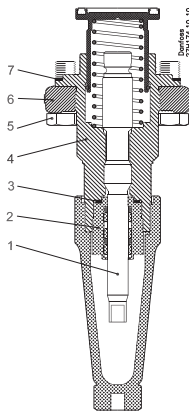
1. Armature tube
2. Armature tube nut
3. Bonnet
4. Gasket
5. Hex-head bolt
6. Seat

ICM 25 A or 20 B motor valve module



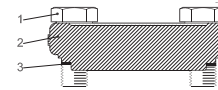
1. Adapter
2. Hex-head bolt
3. O-ring
4. Bonnet
5. Gasket
6. Seat

ICFN 25-40 stop/check valve module



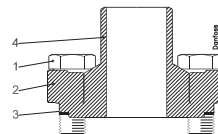
1. Spindle
2. Thread part
3. O-ring
4. Bonnet
5. Hex-head bolt
6. Flange
7. Gasket

ICFB 25-40 blank top cover module



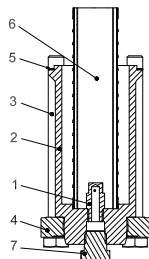
1. Hex-head bolt
2. Flange
3. Gasket

ICFW 25-40 Welding module 25 DIN



1. Hex-head bolt
2. Flange
3. Gasket
4. Weld connection

ICFF 25-40E extended filter module



1. Dirt protection plug 3/8" NPT
2. Bonnet
3. Hex-head bolt M12x140
4. Flange
5. Gasket
6. Filter element
7. Plug 3/8" NPT

ENGLISH

Installation

Refrigerants

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

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

-60/+120°C (-76/+248°F)

Pressure range

The ICF is designed for a max. working pressure of 52 bar g (754 psi g).

Technical data

The ICF can be used in suction, liquid, hotgas and liquid/vapor lines. The ICF are available with 4 or 6 function modules. The ICF regulates the flow of the medium by modulation or on/off function, depending on function modules installed on the ICF.

Regulating range

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

Installation

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

The ICF will be delivered with all the function modules fully assembled. The modules can be taken off for service or inspection and may be rotated 4 x 90° in relation to the valve body upon installation.

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

The ICF valve station can be welded by using either TIG/MIG/SMAW welding (fig. 2) or gas welding (fig. 3).

Attention!

It is not necessary to remove any of the modules before TIG/MIG/SMAW welding; however, it must be ensured that the valve is cooled during the welding (e. g. by wet cloth) and that the ICF is protected against weld splatter. Inlet and outlet stop valves must be closed all the time before commissioning in order to protect ICF against rust formations.

The ICF valves are delivered with closed stop valves. During Gas welding the modules must be removed.

Avoid welding debris and dirt in the valve body and the function module. 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

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. Protection 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 4 or 6 function modules.

Maintenance

Service

The ICF valve stations are easy to service. Do not open the ICF while the it is still under pressure.

Debris blocking the bolt hole will need cleaning. Upon opening and removal of the function modules:

- Check that the O-rings on the function module has not been damaged. A valve with a damaged o-ring might not modulate according to the specification.

For both ICF 20 and ICF 25 - 40 with ICM



Please Note:

When used in CO₂, the o-rings (see fig.4) on the ICM and ICFE 25-40 modules can swell (grow).

At service it is recommend that new o-rings are installed, before the ICM function module is reinstalled in the ICF valve body.

- 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.

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)

Tighten the top cover with a torque wrench, to the values indicated in the table.

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.

Drawings are only for illustration, not for dimensioning or construction. Danfoss accepts no responsibility for errors and omissions.

Danfoss Industrial Refrigeration reserves the right to make changes to products and specifications without prior notice.

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