SPX
WHERE IDEAS MEET INDUSTRY

WILLIAMS
CARVER CO.

Votator® II

SCRAPED SURFACE HEAT EXCHANGER

FORM NO.: 95-03057 REVISION: 11/2012

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.

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Warranty

Seller warrants its products to be free from defect in materials and workmanship for a period of one (1) year from the date of shipment. This warranty shall not apply to products which require repair or replacement due to normal wear and tear or to products which are subjected to accident, misuse or improper maintenance. This warranty extends only to the original Buyer. Products manufactured by others but furnished by Seller are exempted from this warranty and are limited to the original manufacturer's warranty.

Seller's sole obligation under this warranty shall be to repair or replace any products that Seller determines, in its discretion, to be defective. Seller reserves the right either to inspect the products in the field or to request their prepaid return to Seller. Seller shall not be responsible for any transportation charges, duty, taxes, freight, labor or other costs. The cost of removing and/or installing products which have been repaired or replaced shall be at Buyer's expense.

Seller expressly disclaims all other warranties, express or implied, including without limitation any warranty of merchantability of fitness for a particular purpose. The foregoing sets forth Seller's entire and exclusive liability, and Buyer's exclusive and sole remedy, for any claim of damages in connection with the sale of products. In no event shall Seller be liable for any special consequential incidental or indirect damages (including without limitation attorney's fees and expenses), nor shall Seller be liable for any loss of profit or material arising out of or relating to the sale or operation of the products based on contract, tort (including negligence), strict liability or otherwise.

Shipping Damage or Loss

If equipment is damaged or lost in transit, file a claim at once with the delivering carrier. The carrier has signed the Bill of Lading acknowledging that the shipment has been received from the seller in good condition. Seller is not responsible for the collection of claims or replacement of materials due to transit shortages or damages.

Warranty Claim

Warranty claims must have a **Returned Goods Authorization (RGA)** from the Seller before returns will be accepted.

Claims for shortages or other errors, exclusive of transit shortages or damages, must be made in writing to Seller within ten (10) days after delivery. Failure to give such notice shall constitute acceptance and waiver of all such claims by Buyer.

Safety

READ AND UNDERSTAND THIS MANUAL
PRIOR TO INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT

SPX recommends users of our equipment and designs follow the latest Industrial Safety Standards. At a minimum, these should include the industrial safety requirements established by:

1. Occupational Safety and Health Administration (OSHA), Title 29 of the CFR
   Section 1910.212- General Requirements for all Machines
2. National Fire Protection Association, ANSI/NFPA 79
   ANSI/NFPA 79- Electrical Standards for Industrial Machinery
3. National Electrical Code, ANSI/NFPA 70
   ANSI/NFPA 70- National Electrical Code
   ANSI/NFPA 70E- Electrical Safety Requirement for Employee Workplaces
4. American National Standards Institute, Section B11

Attention: Servicing energized industrial equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Recommended practice is to disconnect and lockout industrial equipment from power sources, and release stored energy, if present. Refer to the National Fire Protection Association Standard No. NFPA70E, Part II and (as applicable) OSHA rules for Control of Hazardous Energy Sources (Lockout-Tagout) and OSHA Electrical Safety Related Work Practices, including procedural requirements for:

- Lockout-tagout
- Personnel qualifications and training requirements
- When it is not feasible to de-energize and lockout-tagout electrical circuits and equipment before working on or near exposed circuit parts

Locking and Interlocking Devices: These devices should be checked for proper working condition and capability of performing their intended functions. Make replacements only with the original manufacturer's renewal parts or kits. Adjust or repair in accordance with the manufacturer's instructions.

Periodic Inspection: Industrial equipment should be inspected periodically. Inspection intervals should be based on environmental and operating conditions and adjusted as indicated by experience. At a minimum, an initial inspection within 3 to 4 months after installation is recommended. Inspection of the electrical control systems should meet the recommendations as specified in the National Electrical Manufacturers Association (NEMA) Standard No. ICS 1.3, Preventative Maintenance of Industrial Control and Systems Equipment, for the general guidelines for setting-up a periodic maintenance program.

Replacement Equipment: Use only replacement parts and devices recommended by the manufacturer to maintain the integrity of the equipment. Make sure the parts are properly matched to the equipment series, model, serial number, and revision level of the equipment.

Warnings and cautions are provided in this manual to help avoid serious injury and/or possible damage to equipment:

DANGER: *marked with a stop sign.*
Immediate hazards which WILL result in severe personal injury or death.

WARNING: *marked with a warning triangle.*
Hazards or unsafe practices which COULD result in severe personal injury or death.

CAUTION: *marked with a warning triangle.*
Hazards or unsafe practices which COULD result in minor personal injury or product or property damage.

Care of Stainless Steel

Stainless Steel Corrosion

Corrosion resistance is greatest when a layer of oxide film is formed on the surface of stainless steel. If film is disturbed or destroyed, stainless steel becomes much less resistant to corrosion and may rust, pit or crack.

Corrosion pitting, rusting and stress cracks may occur due to chemical attack. Use only cleaning chemicals specified by a reputable chemical manufacturer for use with 300 series stainless steel. Do not use excessive concentrations, temperatures or exposure times. Avoid contact with highly corrosive acids such as hydrofluoric, hydrochloric or sulfuric. Also avoid prolonged contact with chloride-containing chemicals, especially in presence of acid. If chlorine-based sanitizers are used, such as sodium hypochlorite (bleach), do not exceed concentrations of 150 ppm available chlorine, do not exceed contact time of 20 minutes, and do not exceed temperatures of 104°F (40°C).

Corrosion discoloration, deposits or pitting may occur under product deposits or under gaskets. Keep surfaces clean, including those under gaskets or in grooves or tight corners. Clean immediately after use. Do not allow equipment to set idle, exposed to air with accumulated foreign material on the surface.

Corrosion pitting may occur when stray electrical currents come in contact with moist stainless steel. Ensure all electrical devices connected to the equipment are correctly grounded.

Elastomer Seal Replacement Following Passivation

Passivation chemicals can damage product contact areas of WCB equipment. Elastomers (rubber components) are most likely to be affected. Always inspect all elastomer seals after passivation is completed. Replace any seals showing signs of chemical attack. Indications may include swelling, cracks, loss of elasticity or any other noticeable changes when compared with new components.

Introduction

Models and Specifications

The Votator II can be furnished for horizontal or vertical installation, available in the following models:

Model	Heat Transfer Area	Jacket Type
6 x 84	11 ft^2 (1.0 m^2)	Steam/Liquid Refrigeration
6 x 72	9 ft^2 (0.84 m^2)	Steam/Liquid Refrigeration
6 x 48	6 ft^2 (0.56 m^2)	Steam/Liquid Refrigeration
6 x 36	4.2 ft^2 (0.39 m^2)	Steam/Liquid Refrigeration
6 x 24	3.0 ft^2 (0.28 m^2)	Steam/Liquid Refrigeration

This manual covers the Horizontal and Vertical Votator II, Concentric and Eccentric Designs, and the Extra Heavy Duty Votator II. Every attempt has been made to note where special considerations are needed for each model. These differences are primarily in the installation and maintenance of the units.

Cylinder Assembly

The cylinder assembly consists of a rotating shaft inside of two tubes. The outer tube is called the jacket, and contains working fluid to heat or cool the contents of the inner, product tube. The product tube provides a heat exchange surface for the product.

Standard product tubes are one of the following:

- Pure nickel with a hard chrome plated interior surface.
- Stainless steel with a hard chrome plated interior surface.
- Stainless steel with no plating.

Product Side Pressure Rating

- 400 psi (28 bar) @ 400°F (204°C) - Oval Tube
- 600 psi (42 bar) @ 400°F (204°C) - Std. Votator II
- 800 psi (56 bar) @ 400°F (204°C) - U Stamp Votator II

Jacket Pressure Rating

- 250 psi (17.5 bar) @ 400°F (204°C)
- 150 psi (10.5 bar) @ 400°F (204°C) (oval and high efficiency tubes)

Check the data plate attached to the Votator cylinder for exact specifications of the unit.

Machine Serial Number

The machine serial number is stamped on a serial number nameplate located on the machine side as shown in Figure 1. On vertical units (not shown), the nameplate is on the cylinder. Include the machine model and serial number with each parts order.

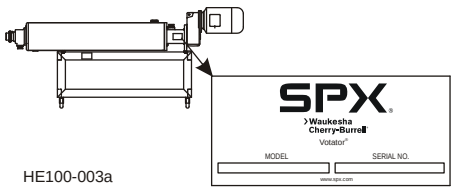


Figure 1 - Machine Serial Number Location

Votator II Media Configurations

The Votator II is available in the following configurations:

- BWS-BRINE/WATER/STEAM For liquid and steam heating and cooling applications.
- LIQUID For water or glycol.
- VAPOR For steam or refrigeration.

Special Considerations for Vertical Votator II

The Vertical Votator II cylinder assembly is shipped for on-site installation on the mounting pole. When receiving the shipment, check for the following or multiples of (depending on the order) shipped separately in their own crate or crates:

- Scraped Surface Heat Exchanger.
- Frame poles (including attached hydraulic cylinder) with hydraulic pump & reservoir assembly(s).
- Accumulators, Refrigeration Valves and Piping, if furnished.
- Mount plates, nuts & bolts, and interconnecting product piping.

Installation

Site Selection Considerations

Foundation & Drainage

The Votator II should be located on a firm foundation, angled to allow liquids to drain away from the unit.

Clearances

- The rear and sides of the unit, or unit cluster, should have adequate clearance to provide easy access for maintenance.
- The front of the **Horizontal** unit should have the following minimum clearances to allow for removal of the mutator shaft:

  6 x 84 Votator II - 102 in (259 cm)
  6 x 72 Votator II - 90 in (230 cm)
  6 x 48 Votator II - 71 in (180 cm)
  6 x 36 Votator II - 59 in (150 cm)
  6 x 24 Votator II - 40 in (102 cm)

- The bottom of the **Vertical** unit should have the following minimum clearances to allow for removal of the mutator shaft:

  6 x 84 Votator II - 96 in (244 cm)
  6 x 72 Votator II - 84 in (214 cm)
  6 x 48 Votator II - 66 in (168 cm)
  6 x 36 Votator II - 54 in (137 cm)
  6 x 24 Votator II - 48 in (122 cm)

Leveling the Unit

The **Horizontal** Votator II should be leveled lengthwise (along the length of the cylinder) and crosswise by adjusting the feet on the legs.

For units that will perform CIP, set the level for a forward pitch of 0.3 degrees (1/16 inch per foot).

If CIP is not required, set the level to what will give the best drainage for the cylinder.

Electrical Power Connections

DANGER: *The Votator II operates with high voltage. Electrical work should be performed by a Licensed Electrician in accordance with local regulations.*

The following electrical components for the Votator II require connection in accordance with the electrical schematics in this manual, tagged vendor specifications, and local regulations:

- **Drive Motor**

  Each cylinder is furnished with a 3-phase, multi-voltage gear motor with a horsepower rating per the application:
  Std. Votator II accepts 7-1/2 HP (5.5 kW), 10 HP (7.5 kW), 15 HP (11kw) or 20 HP (15 kW); Extra Heavy Duty Votator II accepts 25 HP (18.8 kW), 30 HP (22.5 kW) or 40 HP (30 kW). Motor is fixed speed and suitable for use with a variable frequency controller.

- **Hydraulic Pump Motor** (**Vertical** units only)

  A 3/4 (0.5 kW) horsepower, fixed speed motor. A variable frequency controller **should not** be used for this motor.

- **Refrigeration Valves**:
  liquid feed solenoid valve
  dual pressure regulating valve
  level switch
  hot gas pressure regulating valve
  hot gas solenoid valve
- **Freeze Protection Components** (if furnished):
  current sensing relay
  instrument current transformer
  digital current indicator

Mutator Rotation Check

Correct mutator shaft rotation is counterclockwise when looking down the unit from the drive end (indicated by a sticker located near the motor). To check for correct rotation, momentarily start the drive motor and observe the rotation of the shaft in the back of the unit.

If rotation of the shaft is incorrect, the drive motor is wired incorrectly. Have a Licensed Electrician change the wiring so the rotation of the shaft is correct.

Mechanical Seals

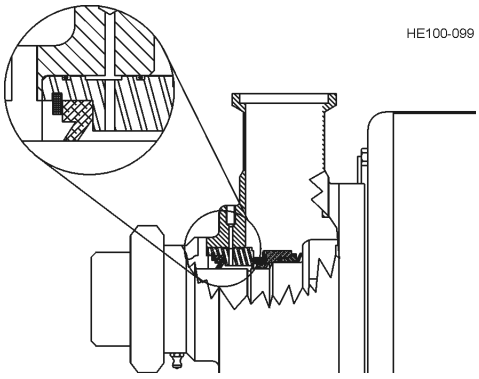


Figure 2 - Single Mechanical Seal

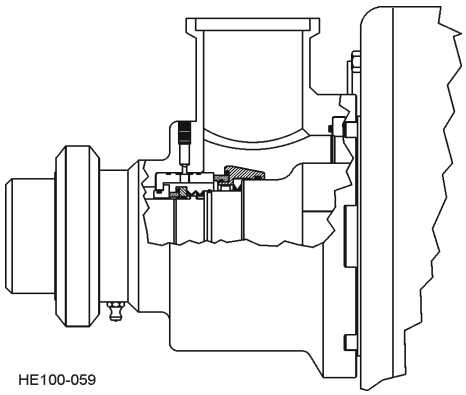


Figure 3 - Double Mechanical Seal

The Votator II is furnished with either a single or double mechanical seal on both ends of the mutator shaft. Units furnished before 2005 were installed with either a single or double mechanical seal configuration. See “2005 Mechanical Seal Design” on page 11 for units furnished between 2005 and 2012. See “2012 Mechanical Seal Design” on page 11 for standard units finished from 2012 to the present. Certain Votator II units have also been supplied with a special "Ball-lock Mechanical Seal" or a "Packing Gland" instead. Consult your order documentation to verify the specific seal configuration for each Votator II unit.

Single Mechanical Seal

The single mechanical seal is normally not flushed but it can be. It is shipped with a lip seal (See Figure 2) designed to contain water or a liquid flush. The spring in the seal must be removed and the seal reinstalled with the lip in the relief position to allow flushing. This will minimize any damage to the contact surface on the stub end of the shaft.

When the single mechanical seal is rotating, there must be product or water flow to provide cooling to the rotating surfaces to avoid permanent damage to the seal assembly.

If the seal is flushed, the fluid flow should be in the range of 5 to 10 gallons per hour and not exceed 5 psig. Piping to seals should be in the bottom of head and out the top and with parallel flow, never in series.

Double Mechanical Seal

The double mechanical seal is furnished with a primary seal for product and a secondary seal to contain a steam or water flush.

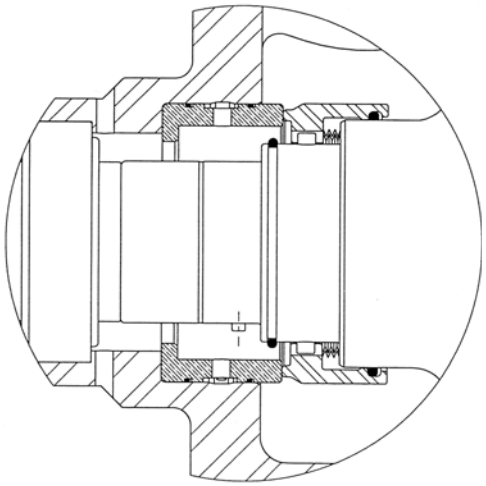


Figure 4 - Single Mechanical Seal

2005 Mechanical Seal Design

Units furnished between 2005 and 2012 have a one-piece chrome-oxide coated rotating body running against a stationary ceramic head insert. It can easily be converted to a double mechanical seal by adding secondary components to contain a steam or water flush.

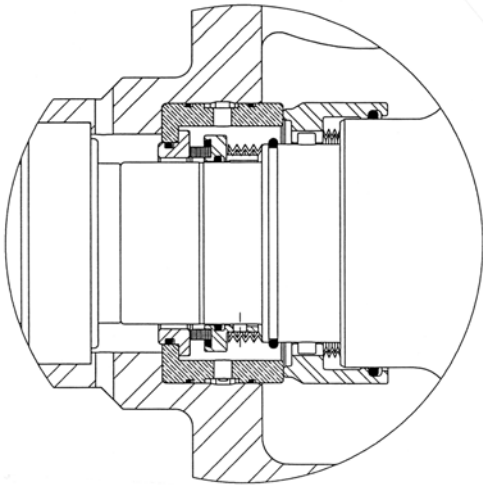


Figure 5 - Double Mechanical Seal

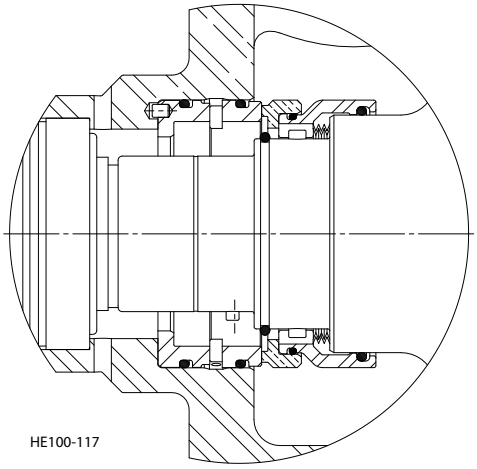


Figure 6 - 2012 Single Mechanical Seal

2012 Mechanical Seal Design

Standard units furnished starting in 2012 have removable rotary seal faces in solid carbon, silicon carbide, tungsten carbide, and narrow-face tungsten carbide materials. The stationary seal faces are made of solid ceramic or silicon carbide. Like the 2005 design, the 2012 single mechanical seal can be converted to a double mechanical seal by adding secondary components to contain a water or steam flush.

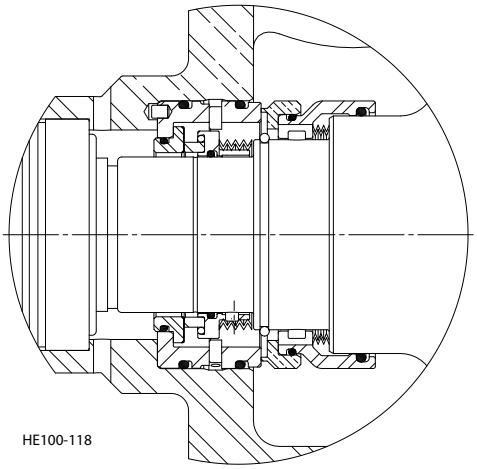


Figure 7 - 2012 Double Mechanical Seal (shown with Narrow-Face Rotary)

Flush Fluid Requirements

The double mechanical seal **must be flushed,** using the threaded flush ports, anytime the mutator shaft is rotated. Failure to do this will result in rapid seal failure due to excessive contaminate and heat buildup.

The fluid flow should be in the range of 5 to 10 gallons per hour, at a typical temperature of 80°F - 120°F (25°C - 49°C). Fluid composition and temperature should be selected to dissolve or suspend any product leakage and cool the mechanical seal faces, and should also be compatible with the sealing o-ring material. Piping to seal cavities for horizontal units should be in the bottom of head and out the top, piped with parallel flow, never with multiple seal cavities in series flow.

Piping

CAUTION: *The safety valve should be installed on the discharge side of product pump for safety and equipment protection.*

DANGER: *Do not install any positive shutoff valves downstream of the Votator II unit.*

WARNING: *Do not allow a volume of liquid to become isolated in the jacket without relief protection. Thermal expansion created as liquid warms can generate enough force to crush tube, causing damage to internal components and drive system.*

Guidelines for Piping

Refer to the general assembly drawings in this manual for jacket connection sizes and locations, and suggested media piping drawings.

- Support ALL piping independently.
- Provide for line expansion and contraction.
- Install a safety valve to protect jacket.
- Provide temperature indicators on both sides of Votator II unit.
- Provide pressure gauge on discharge side of pump.
- When using liquid coolant, provide a method to introduce heating media into jacket to thaw overcooled product.
- Provide liquid coolant system bypass line around unit to allow coolant system to be brought down to operating temperature without circulating coolant through jacket.

Suggested Media Piping for Steam

The steam solenoid is opened, which lets pressure controlled steam from the boiler into the jacket. A temperature sensor monitors the temperature of the product and regulates the steam flow to achieve the required temperature. Heating of the product takes place when the steam condenses into water from the transfer of heat through the jacket.

Table 1: Call Outs For Figure 8

1. Steam IN
2. Strainer
3. By-Pass Line
4. Steam Pressure Regulator
5. Steam Solenoid
6. Temperature Regulator
7. I/P
8. Temperature Control
9. Product OUT
10. Product IN
11. Drain Valve
12. Condensate Trap

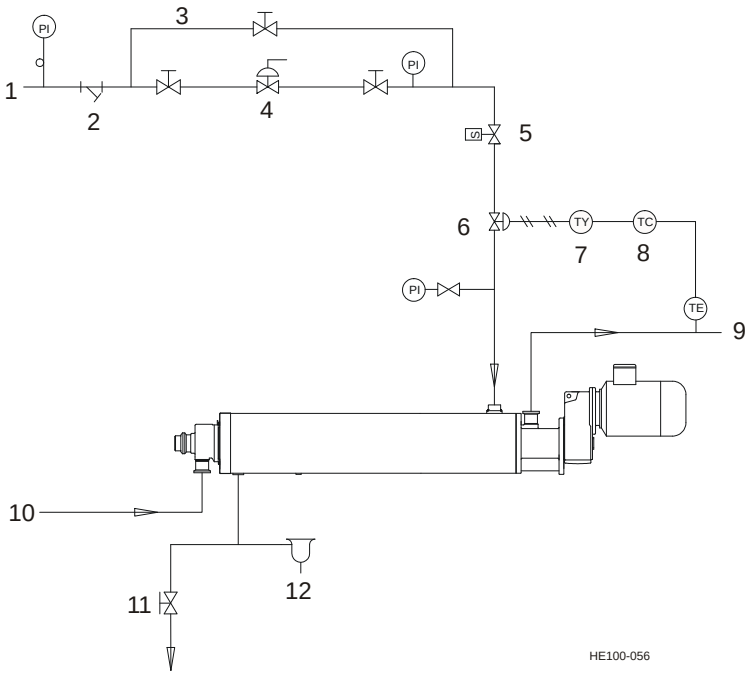


Figure 8- Suggested Media Piping, Steam

Suggested Media Piping for Water or Liquid

The media piping should flow counter-current to the product flow, and should be circulating at a rate of 50 gpm. The suggested arrangement automates the source flow to the actual heat exchange requirements to provide maximum control of the process.

Table 2: Call Outs For Figure 9

1. Media IN
2. Product OUT
3. Product IN
4. Temperature Regulator
5. Media OUT
6. I/P
7. Temperature Control

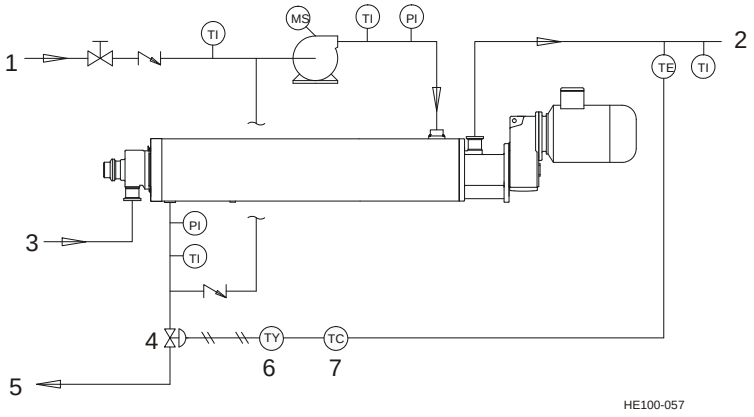


Figure 9 - Suggested Media Piping, Water or Liquid

Refrigeration Piping Installation

Analyze plant refrigeration load capacity thoroughly. The system must be sized to adequately support the additional capacity of this cylinder. All pipes must be clean and free of oil, chips and sealant residue. Excessive residue in plant piping can foul and clog cylinder refrigeration valves and components, causing costly delays in start-up. Refer to appropriate piping schematic in this manual for Liquid Overfeed (LOF) or Gravity Refrigeration System.

WARNING: *Ammonia or Freon lines should be installed by fully trained and qualified Refrigeration Piping Specialists.*

Liquid Line Installation

The liquid line should be installed to provide a constant and steady flow of liquid. Check with system requirements and plant capacities to ensure that refrigeration piping is sized properly.

Suction Line Installation

All Votator II refrigeration units operate best when provided with constant suction pressure. To ensure constant pressure do the following:

- Size suction header for at least 50% above rated capacity of cylinder.
- Do not connect to a header already in use by other equipment with widely varying loads.

CAUTION: *A suction trap or auxiliary receiver should be installed in the line to prevent carry-over back to compressor.*

- Insulate any suction line that passes through a cold room to prevent condensate formation. Install a trap or auxiliary receiver in the line.
- Keep suction pressure at compressor as low as possible. (Lower pressure allows greater cooling capacity.)

Hot Gas Line (if required)

Review the following guidelines when connecting a hot gas line to the system:

- Connection of a hot gas line should be from compressor high side of line past oil trap or separator to minimize drawing in oil.
- DO NOT run line through a cold room or beside a cold suction line.
- Slope line away from equipment at 1/8 inch per foot (1 mm per 100 mm) minimum.
- Install a strainer or filter in addition to recommended shut-off valves and pressure gauge.

DANGER: *Never install a shut-off valve on this line. Never vent or connect relief line back to suction line.*

Pressure Relief Line

The pressure relief line MUST be exhausted to the outside of the building.

CAUTION: *The relief valve is factory set for appropriate pressure and never needs adjusting.*

Never cap relief line or tie back to suction line.

Refrigeration Valves

Liquid Feed Solenoid Valve

Liquid Feed Solenoid Valve is for on/off control of liquid refrigerant flow. Valve is closed when de-energized.

Dual Pressure Regulating Valve

Dual Pressure Regulating Valve is shipped loose for installation in vapor line on discharge side of refrigeration piping. Valve regulates high-pressure for internal relief and low-pressure with on/off solenoid valve for process control. It can be furnished for manual regulating, pneumatic control with clean, dry, and oil free air from 0-60 psig, or with a 115 volt motor mounted on the regulating pilot that responds to a 4-20 milliamp electrical signal. When using air, a decrease in pressure will lower the inlet pressure producing a lower temperature.

Sporlan Level Master Control (LMC) or Level Switch

Gravity Systems with Accumulator are furnished with a Sporlan Level Master Control (LMC) or a Level Switch.

The LMC is a thermostatic expansion valve with a 15-watt heater element. As the level in the accumulator drops, the electrically added heat increases the pressure within the thermostatic element and opens the valve. As the liquid level rises, the electrical input is balanced by the heat transfer from the bulb to the liquid refrigerant and modulates or shuts off the liquid flow. Minor adjustments in the level response can be made by adjusting the spring tension of the expansion valve seat.

If a refrigerant level float switch is provided, single or double depending upon specifications, it is used to control the accumulator level by opening or closing a solenoid operated refrigeration valve. These systems contain that valve and an expansion valve with a flow indicating scale.

Refrigerant Return Valve

Some Horizontal Votators have a solenoid operated Refrigerant Return Valve that is in the closed position when the solenoid is de-energized. This valve is used to stop the cooling process and is closed if hot gas is applied.

High capacity freon systems have two solenoid valves: one for hot gas to activate the return valve, the other to bleed the gas to the suction line.

Flow Control Valves

Liquid Overfeed (LOF) or Pumped Refrigeration Systems have a manually adjusted Flow Control Valve with setting scale for refrigerant flow to each Votator cylinder. This valve maintains a constant flow of liquid to the Votator and can serve as a check valve to prevent back flow of liquid during hot gas.

The indicator scale on the valve corresponds to the refrigeration tonnage. The regulator is set by multiplying the tonnage load by the desired re-circulation rate. For example, if the refrigeration load is 10 tons and 200% (3:1) overfeed is desired, the valve should be set at 30 on the scale reading.

Hot Gas Pressure Regulating Valve

Systems with hot gas include a solenoid-operated Pressure Regulating Valve for introducing and maintaining constant downstream pressure for hot gas inlet.

Pumped Refrigeration Systems include a solenoid operated Hot Gas Purge Valve for each Votator hot gas discharge line.

Pressure Relief Valve

DANGER: *Never install a shutoff valve in a relief line.*

This valve is located on the accumulator and should be exhausted to outside the building. The valve is factory set to relieve at the design pressure of the accumulator.

Suggested Media Piping for Liquid Over Feed Refrigeration

The liquid feed solenoid valve, when opened, allows liquid refrigerant to flow into the jacket of the heat exchanger. The flow is regulated by a manually set flow control valve. Cooling is achieved when the pressure control valve is opened, causing the pressure in the jacket to be reduced. This causes the liquid refrigerant to change phase, absorbing heat from the heat exchanger tube and product. The cooling rate is controlled by the back pressure on the system and stops when the valve is closed. Hot gas is used to push all of the remaining liquid from the system into the ammonia low pressure receiver and quickly warm the system. The low pressure receiver in the compressor room is designed to separate the liquid from the vapor before re-compressing.

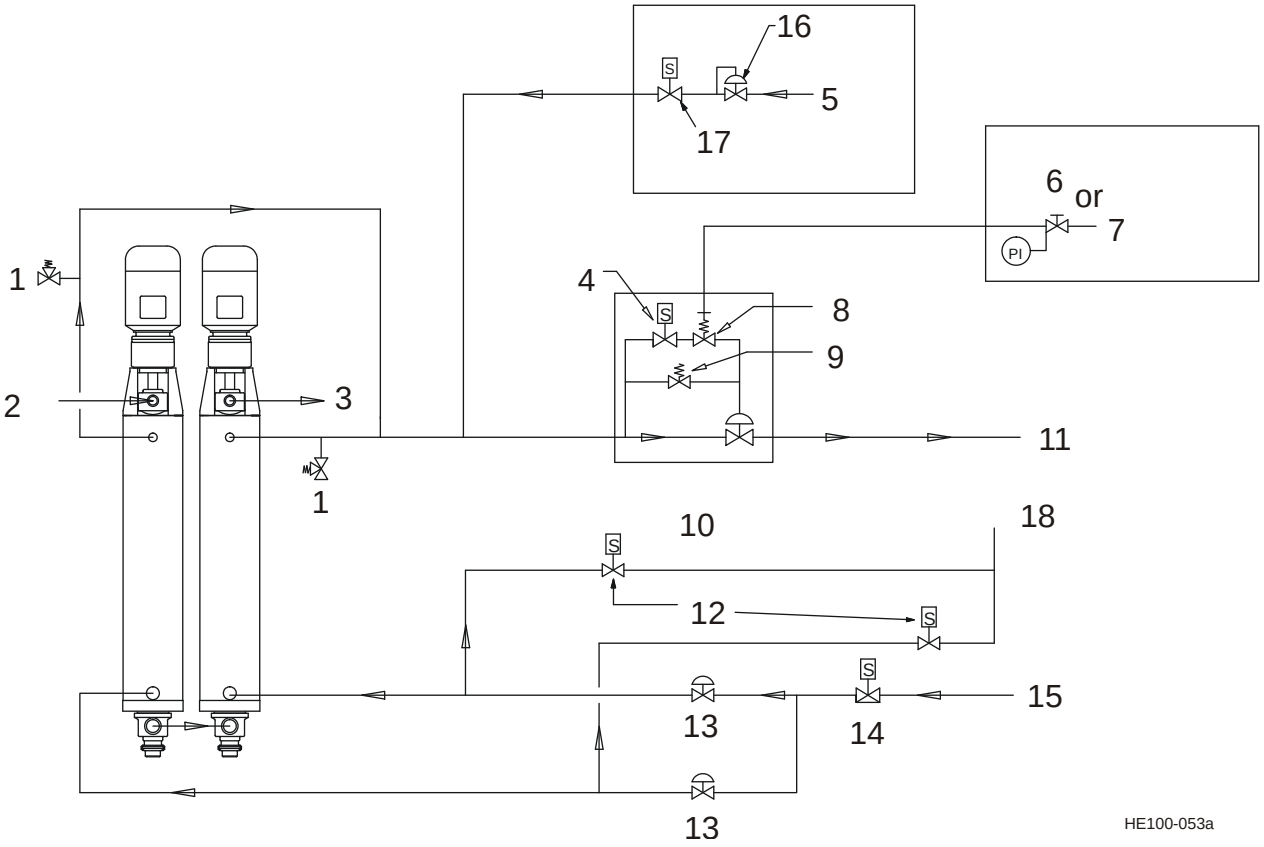


Figure 10- Suggested Media Piping, Liquid Over Feed or Pumped Refrigeration

Table 3: Call Outs For Figure 10 (on page 16)

1. Safety Relief Valve
2. Product IN
3. Product OUT
4. Low Pressure Solenoid Valve, see Item 10
5. Hot Gas
6/7. Electric Control Signal or Instrument Air Regulated to 60 PSI
8. Low Pressure Regulating Valve, see Item 10
9. High Pressure Regulating Valve, see Item 10
10. Dual Pressure Regulating Valve (includes Items 4, 8 and 9)
11. To Refrigerant Low Pressure Receiver
12. Hot Gas Purge Valve
13. Flow Control Valve
14. Liquid Feed Solenoid Valve
15. Liquid Refrigerant from Low Pressure Receiver
16. Hot Gas Reducing Valve
17. Hot Gas Solenoid Valve
18. Hot Gas Pressure Regulating Valve

Suggested Media Piping for Gravity Refrigeration

Liquid refrigerant from the receiver is stored in a surge drum located above the Votator II. The level in the surge drum is automatically controlled by the level system provided with the equipment. Gravity forces the refrigerant into the cooling jacket where it comes into contact with the heat transfer tube. The warm product causes a portion of the liquid refrigerant to change phase, causing the heat transfer tube and the product to be cooled. The cooling rate is controlled by the refrigerant back pressure, and hot gas can be used to push the liquid refrigerant from the Votator cylinder and rapidly warm the system.

NOTE: *Set high pressure regulating valve 5 to 10 psi higher than outlet pressure of hot gas pressure reducing valve and lower than the relief setting.*

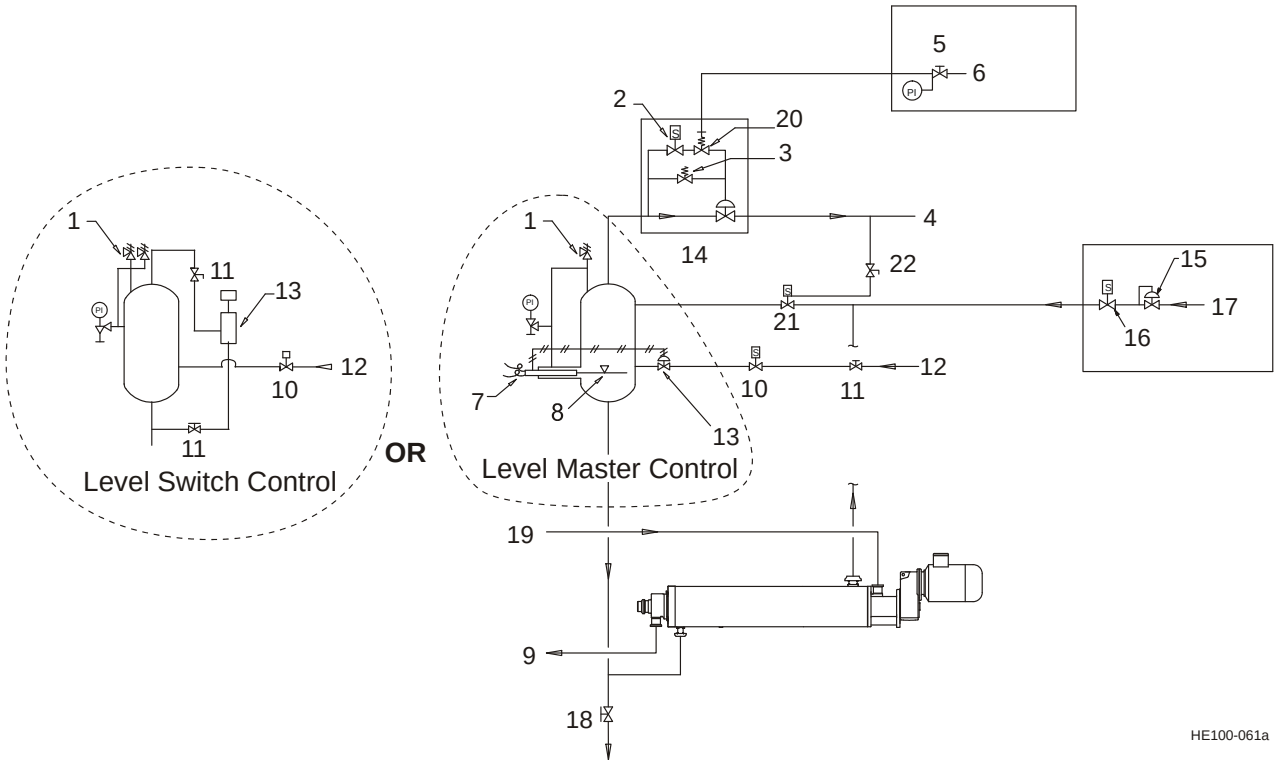


Figure 11 - Suggested Media Piping, Gravity Refrigeration - HORIZONTAL

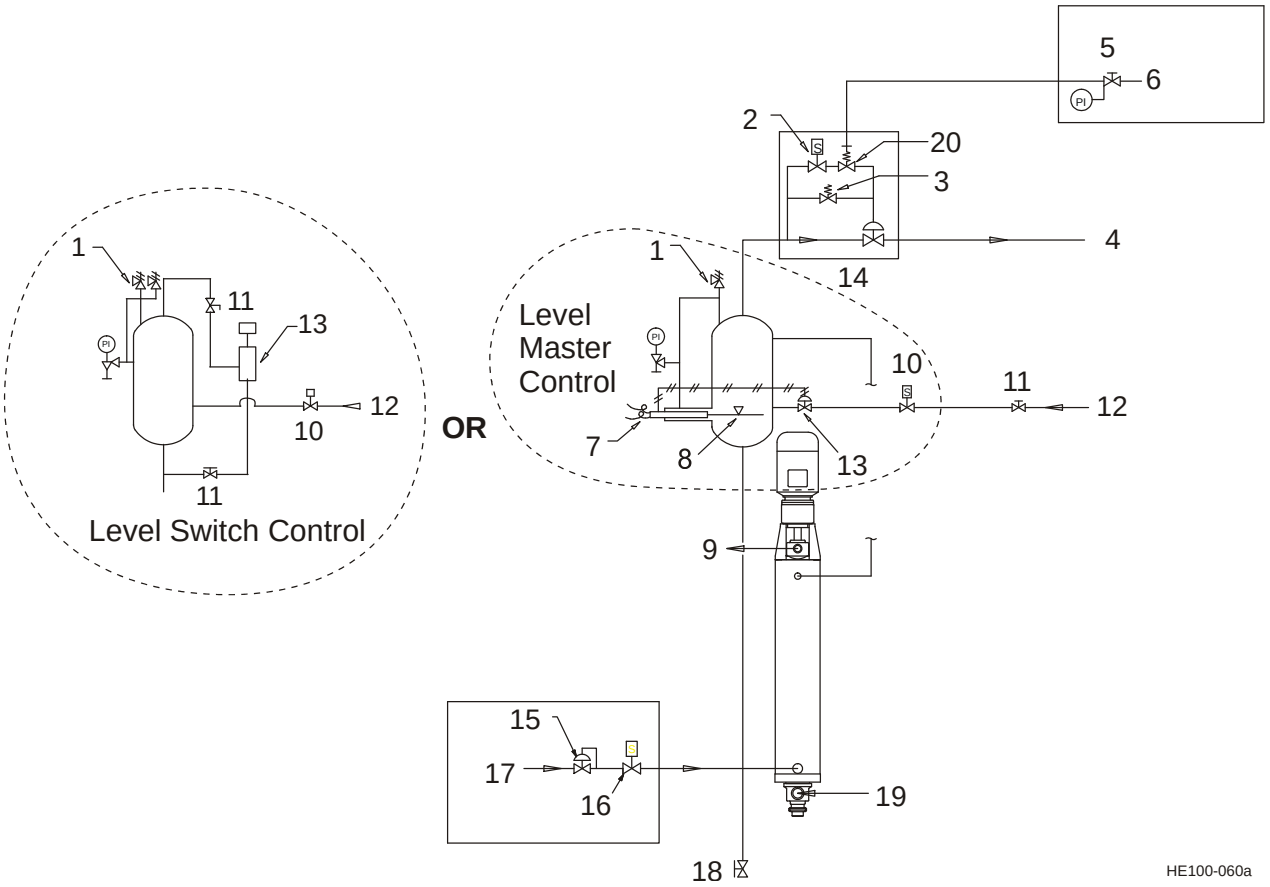


Figure 12- Suggested Media Piping, Gravity Refrigeration - VERTICAL

Table 4: Call Outs for Figure 11 (page 17) and Figure 12

1. Safety Relief Valve (Dual)
2. Low Pressure Solenoid Valve, see Item 14
3. High Pressure Regulating Valve, see Item 14
4. To Low Pressure Receiver
5/6. Electric Control Signal or Instrument Air Regulated to 60 PSI
7. Level Control Heater
8. Normal Operating Liquid Level
9. Product OUT
10. Liquid Feed Solenoid Valve
11. Block Valve
12. Liquid Refrigerant from Low Pressure Receiver
13. Level Control and Liquid Feed Expansion Valve or Level Switch
14. Dual Pressure Regulating Valve (includes Items 2, 3, and 20)
15. Hot Gas Reducing Valve
16. Hot Gas Solenoid Valve
17. Hot Gas
18. Drain Valve
19. Product IN
20. Low Pressure Regulating Valve, see Item 14
21. Refrigerant Return Solenoid Valve (Horizontal only)
22. 1/4" Needle Valve with Regulating Stem (Horizontal only)

Electrical Equipment

The electrical components, if furnished by Waukesha Cherry-Burrell, are loose and require installation by customer.The list below is keyed to the suggested wiring diagrams on the following pages and describe typical components used in analog control panels.

If a Votator PLC Control Panel was purchased for the Votator II unit, Item 3 below is furnished loose for inclusion in Buyer's high voltage panel and Items 7 and 8 are not needed. The PLC panel for Votator II refrigeration units duplicates the control operation shown on the following pages; it serves as the operator station for the Votator II line. See the pertinent manual pages for operating instructions for the PLC panel.

ITEM #	NO. OF CYLINDERS	QTY	DESCRIPTION	FURNISHED BY	
				SPX	Others
1	1	1	Cylinder Drive Motor(s)	X	
	2	2			
	3	3			
2	1	1	Motor Starters: Customer responsible for correct sizing of starter, coil, and thermal overload protection based on motor nameplate voltage, frequency, FLA's, service factor, and horsepower.		X
	2	2			
	3	3			
3	1	1	Current sensing relay and plug-in base set at motor nameplate FLA's (R-K Electronics CJD-120A-5 or equal) (Plug-in base = A-B 700-HN 125 or equal)	X	
	2	1			
	3	1			
4	1	1	Cylinder Start/Stop push buttons (Start = A-B 800H-AR1A or equal) (Stop = A-B 800H-BR6D2 or equal)		X
	2	2			
	3	3			
5	1	1	3-Position selector switch Labeled: "REFRIGERANT SYSTEM MODE" "DEFROST OFF ON" Red, push to test, pilot light Labeled: "REFRIGERANT CONTROLS ON" (A-B 800H-JR2A/800H-PRTH16R or equal)		X
	2	1			
	3	1			
6	1	1	2-Position selector switch Labeled: "VOTATOR REFRIGERATION" "OFF ON" Red, push to test, pilot light Labeled "VOTATOR REFRIGERATION ON" (A-B 800H-HR2A/800H-PRTH16R or equal)		X
	2	1			
	3	1			
7	1	1	Digital current indicator (1/8 DIN) 1.77" x 3.62" Panel Cutout Labeled: "PERCENT FULL LOAD CURRENT" (Red Lion APL-ID-400 or equal)	X	
	2	1			
	3	1			
8	1	1	Instrument transformer (Ohio Semitronics CTD-050A or equal)	X	
	2	1			
	3	1			
9	1	1	Red, push to test, pilot light Labeled: "DEFROST ON" (A-B 800H-HR2A/800H-PRTH16R or equal)		X
	2	1			
	3	1			

Refrigeration Wiring Schematics

Freeze Protection Components

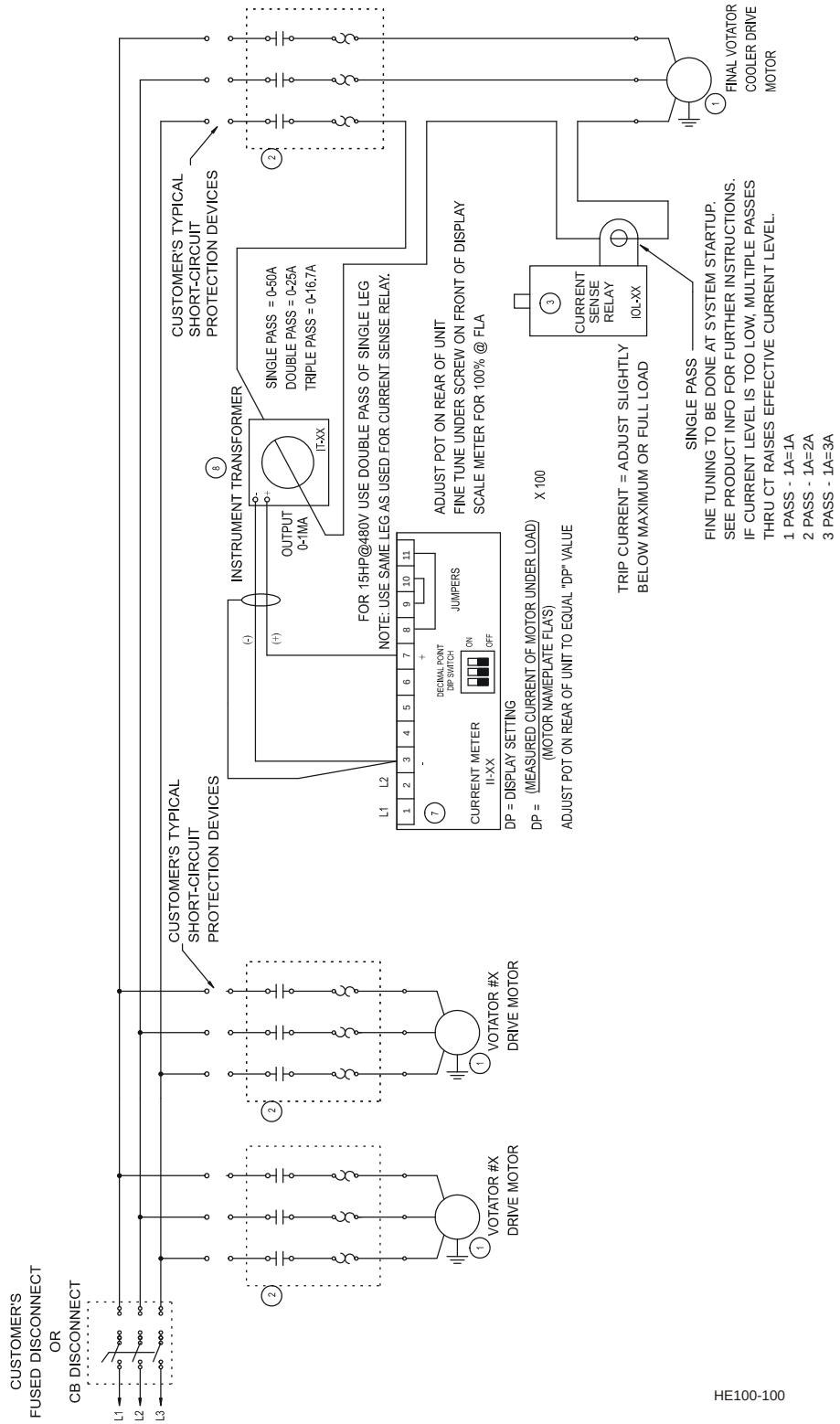


Figure 13- Suggested Electrical Schematic - Freeze Protection Components

Gravity Refrigeration with Level Master Control (LMC)

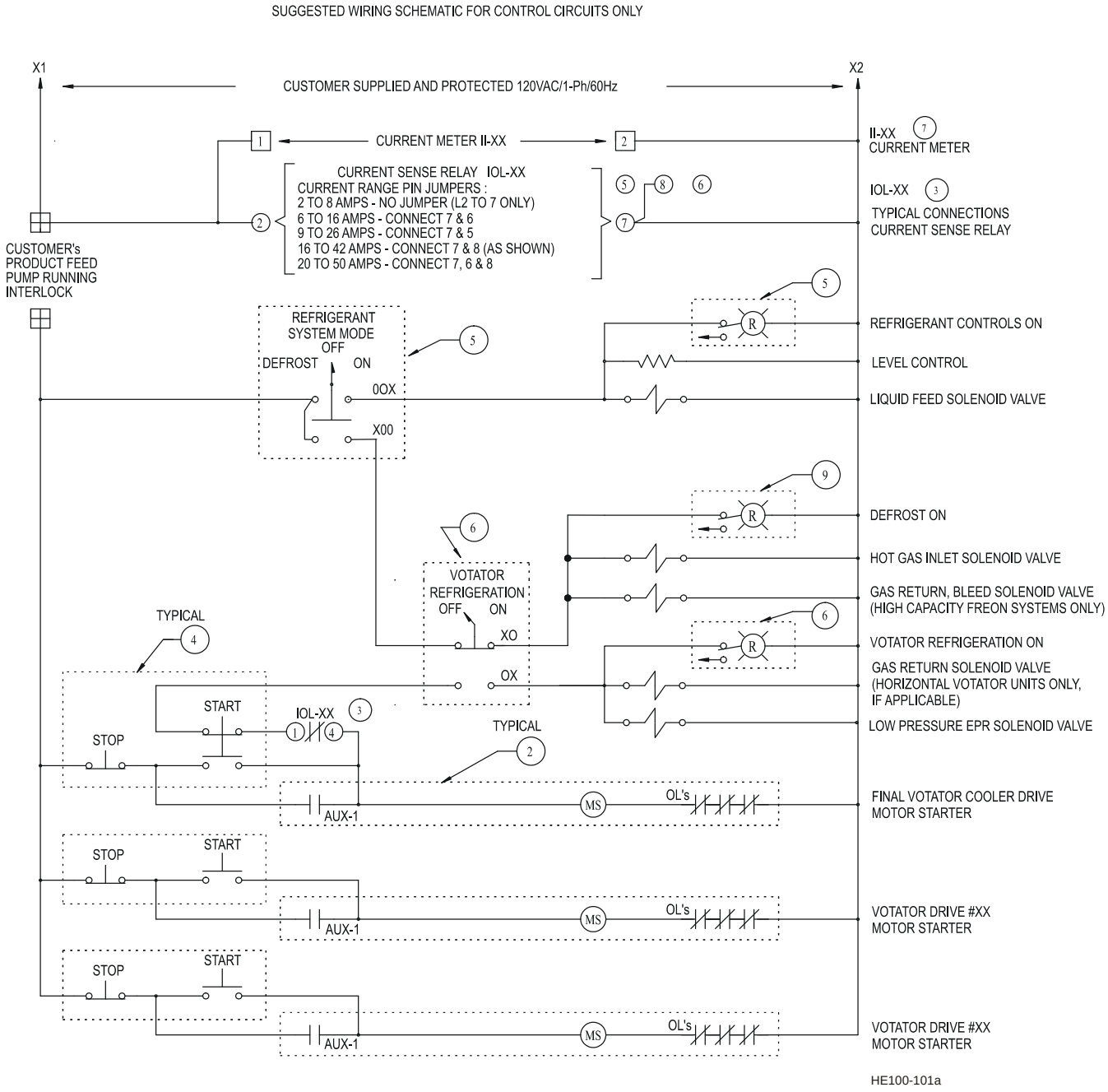


Figure 14- Suggested Electrical Schematic - Gravity Refrigeration with Level Master Control (LMC)

Gravity Refrigeration with Level Switch

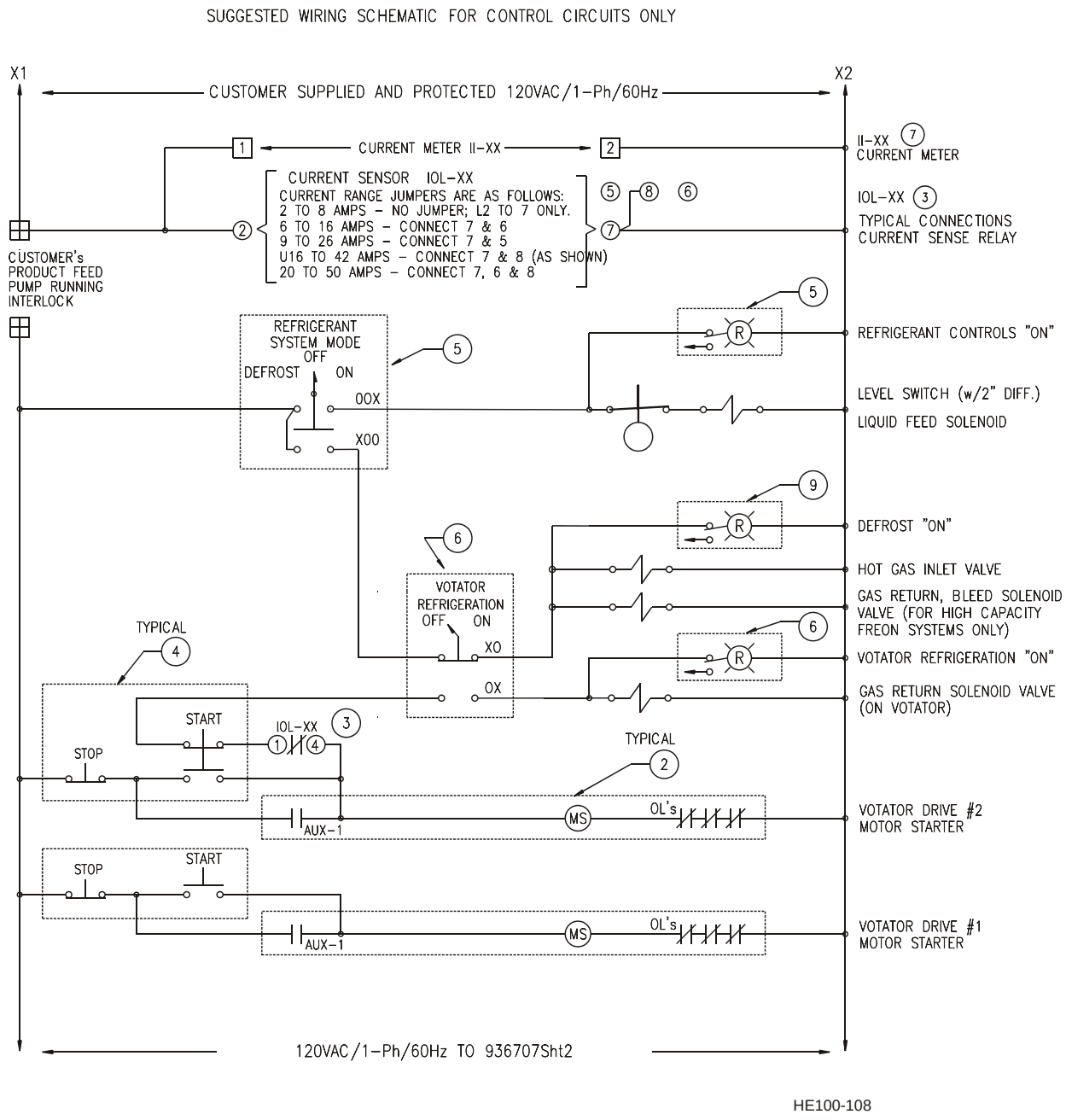


Figure 15- Suggested Electrical Schematic - Gravity Refrigeration with Level Switch

Liquid Overfeed Refrigeration System

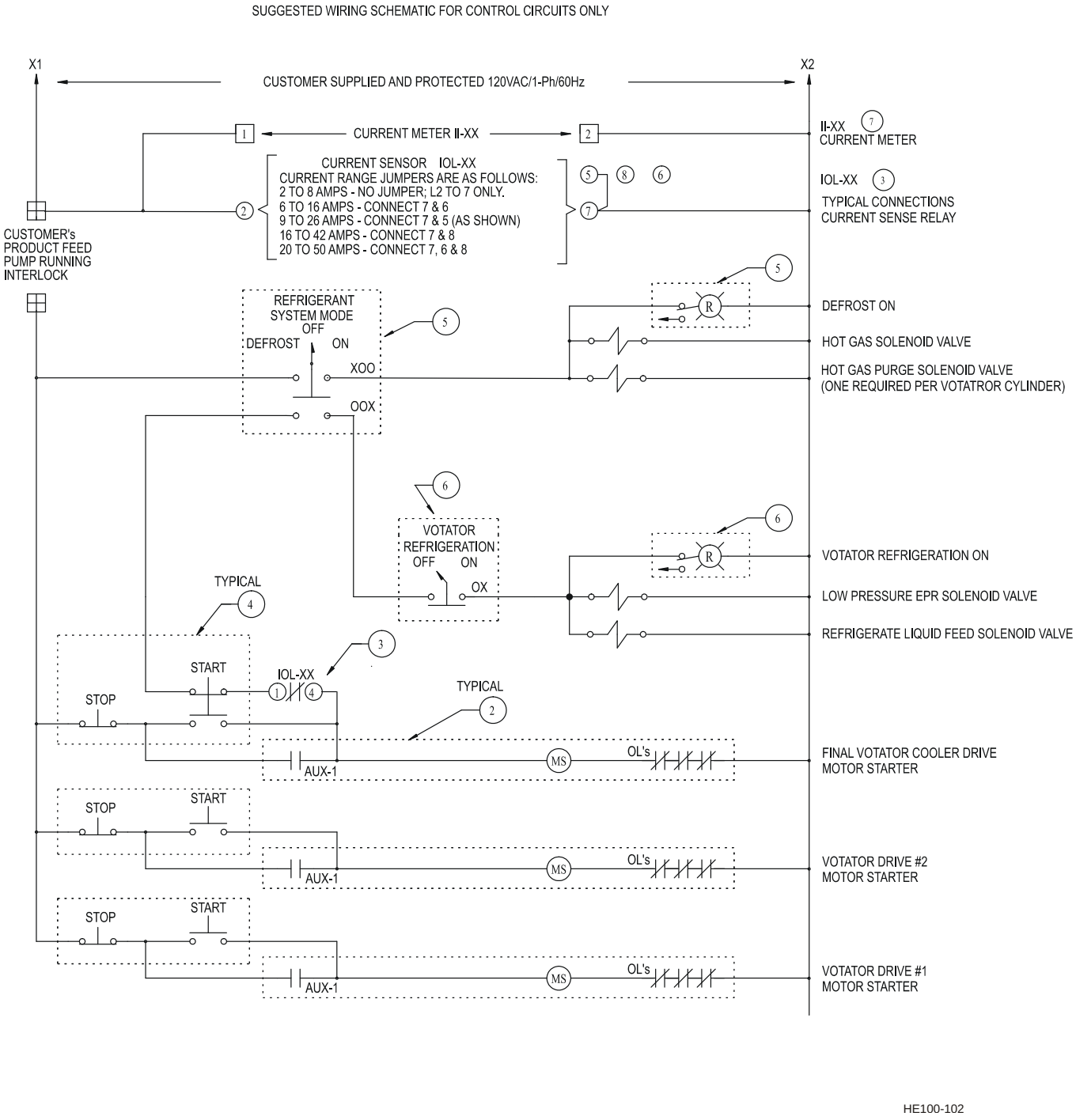


Figure 16- Suggested Electrical Schematic - Liquid Overfeed Refrigeration System

Media System Check

DANGER: *Refrigeration controls should be operated and serviced only by trained and qualified personnel.*

Each cylinder is tested for leaks at the factory. However, vibrations and handling during shipping can loosen piping connections. Before starting a new unit, the system should be checked for media leaks at the Votator II cylinder, the media connections, and the piping to the cylinder using the following procedures:

On units jacketed for steam or liquids, follow steps 1 through 6, and then drain condensate from cylinder.

On units jacketed for refrigeration, follow steps 1 through 6, and then pump down to remove refrigerant.

1. If a media pressure gauge is not installed in system, install one at the media inlet of cylinder before processing.
2. Close off media return line from unit.
3. Open media inlet valve and let pressure increase to 5 psig, then close valve.
4. Check front, back, and all piping connections for leaks.
5. If leaks are not detected, open inlet valve and let system pressurize to 40 to 50 psig, then close valve.
6. Check again for leaks at front, back, and all piping connections.

Special Considerations for Vertical Votator II

The customer is responsible for securing the top and bottom of the pole and scrape assembly. See "Votator II Vertical Mounting Suggestions" in Addendum Section.

Minimum Height - Vertical Votator II

The mounting pole with hydraulic components is assembled at the factory to provide the proper height from the floor when installed. Therefore, **never trim the pole from the bottom.** Check to be sure the cylinders will be positioned with minimum clearance to insure shaft can be removed correctly. See “Clearances” on page 9.

Mounting Pole - Vertical Votator II

Attach post mount to floor. (Stainless steel disk which serves as base for pole.) There is a 13/16" diameter hole through the center of the disk for mounting it to the floor. Make sure post mount is level after installation.

Prepare site for attaching top of pole. Top of pole can be trimmed if needed.

NOTE: *When installing pole, make sure hydraulic cylinder faces toward same side scrape cylinders will be mounted on.*

Put bottom of pole over post mount and raise.

Attach top of pole to top mounting.

NOTE: *Pole MUST be vertical and plumb.*

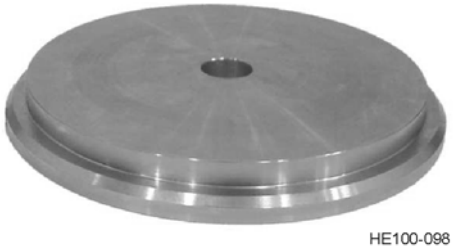


Figure 17 - Mounting Disk

Mounting Scrape Cylinders - Vertical Votator II

Using a crane or other lift device, lift cylinder from pedestal (drive) end. Lifting in any other manner may damage cylinder.

Secure scrape cylinders in place with four (4) stainless steel 5/8-inch bolts and lock washers provided. Maintain minimum distance between protective cap and floor. See “Clearances” on page 9.

Hydraulic System - Vertical Votator II

The **Vertical** Votator II is furnished with a hydraulic cylinder, pump, motor, and fluid reservoir for removing and installing the mutator shaft and heat transfer tube.

Check all fittings and adjustments prior to use; vibrations during shipment may cause them to loosen.

Check and Adjust Hydraulic Cylinder

After heat exchanger cylinders are mounted to the pole, check to ensure the proper distance is maintained between the bottom of the hydraulic cylinder and the floor. See "Vertical Mounting Pole/ Hydraulics" on page 32.

Fill Hydraulic Reservoir

The system is pre-piped, but requires approximately two (2) gallons of Dexron II ATF (ISO VG 32/68) to be added before use. Please consult the factory if it is necessary to substitute fluids.

CAUTION: *Do not mix fluid types. Mixing fluids will damage equipment.*

Remove reservoir from pump assembly and fill to opening for return line. Reservoir is sealed with an O-ring and secured by a clamp ring (See Figure 18, Item A). Pump return line (Figure 18, item B) must be removed to access the reservoir.

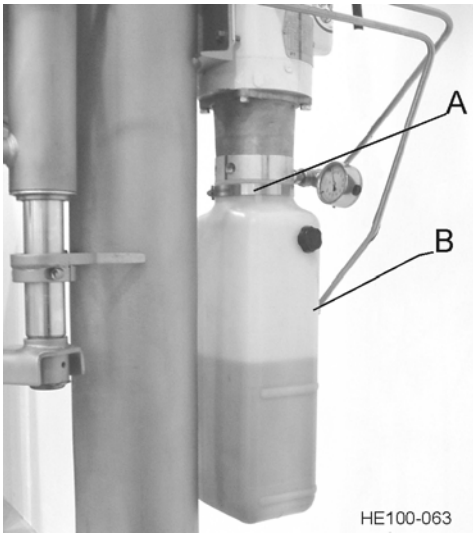


Figure 18- Removal of Reservoir

Figure 19 - Direction Valve

Check Balance and Pressure Settings

Balance and pressure settings should be checked prior to start-up as follows:

1. Start hydraulic pump.

NOTE: *The hydraulic pump must be wired to an on/off switch device. Pump rotation is clockwise when viewed above motor.*

2. Make sure Direction Valve (See Figure 19 - located on front of unit just above bottom product outlet) is functioning properly. It is spring loaded and is moved up for up travel of hydraulic cylinder and down for down travel.

Figure 20 - Balance Valve

3. Make sure the Balance Valve (See Figure 20 - located on the front of the unit, just above the Direction Valve) is set in closed position, which is fully clockwise. Valve is locked in place with a 9/16" jam nut and adjusted with a 5/32" Allen Head set screw. It maintains pressure on hydraulic cylinder when hydraulic pump is off or in neutral position.
4. Check hydraulic pump pressure by moving hydraulic lift foot away from Votator II unit and running cylinder in the full up, dead head position. At this point, it should be adjusted for a gauge reading of 300 to 400 psig at the pump.

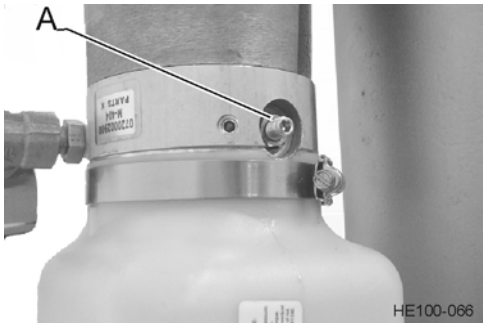


Figure 21 - Pressure Adjustment Screw

5. The pump pressure control (See Figure 21, Item A) should be set to approximately 4-1/2 turns open in the counterclockwise direction from the closed position. This adjustment controls the system pressure and is at maximum when the setscrew is in the closed or full clockwise position. It is adjusted by a 3/16" Allen Head set screw and locked by a 9/16" jam nut.

Gravity Refrigeration System - Vertical Votator II

The Gravity Refrigeration System includes the following items that must be installed:

- Accumulator
- Media piping
- Valves

The accumulator, refrigeration piping, and valves are shipped loose for field installation, as shown in the drawing titled Vertical Refrigeration System located in the addendum section and Votator II Vertical Refrigeration System drawing on page 18 showing the Process Flow Diagram of the Vertical Refrigeration System. It is necessary for on-site installation of these components to insure that the refrigeration system will mate properly with the Votator II cylinders.

A crane, or other lift device, is needed to lift the accumulator mounting bracket in place for installation. Lift the mounting bracket in place with a sling. Bolt the accumulator to the pole.

To simplify installation, piping is provided in three modules:

- the accumulator to the lower manifold
- the lower manifold to the cylinder flange
- the upper manifold to the accumulator

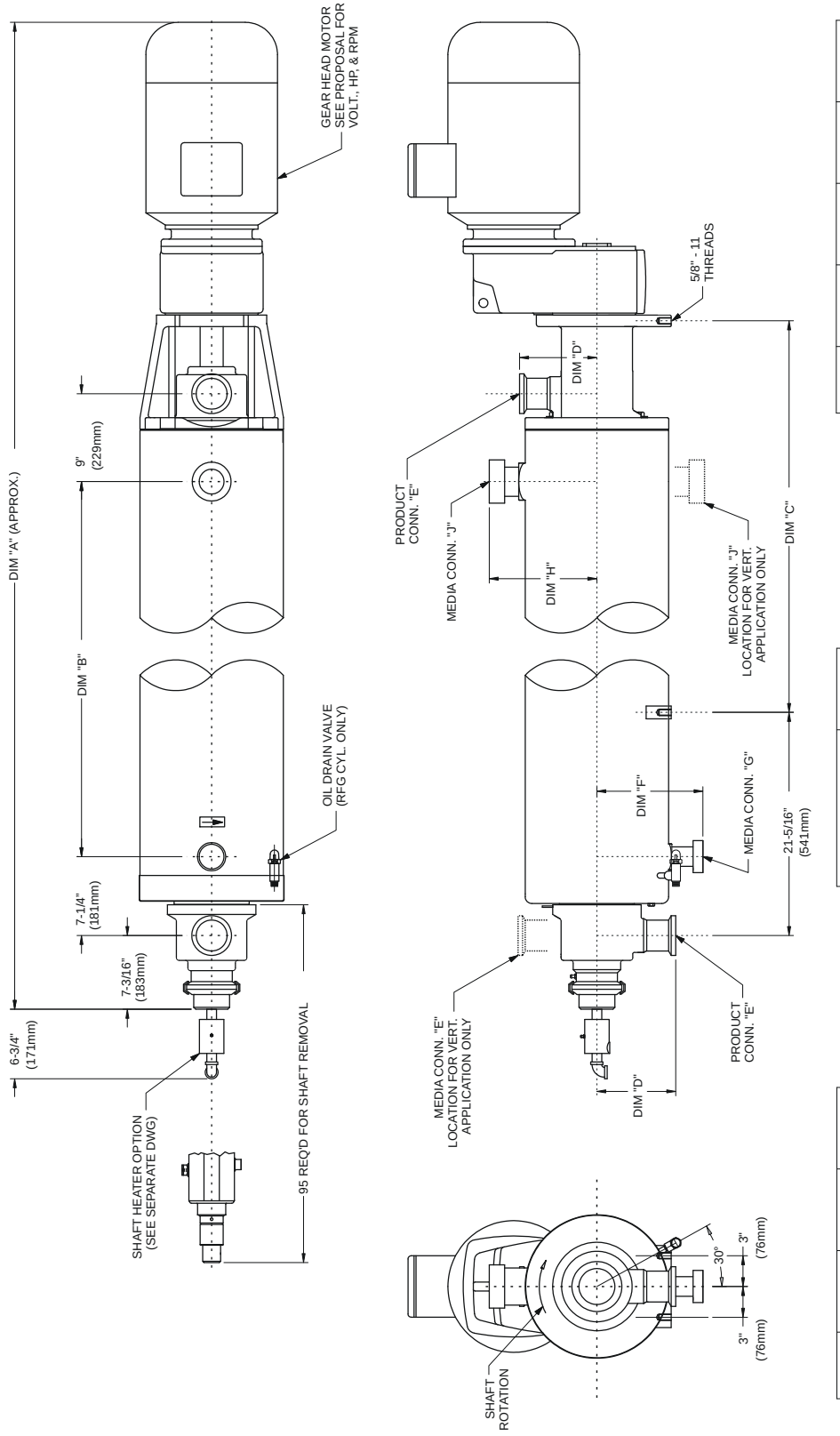
Also included are an elbow for the top of the accumulator and piping legs for connecting the modules.

The refrigeration valves and level control are packed and shipped separately. These components and the piping sections should be installed in accordance with the referenced drawings. A leak test MUST be performed after all welding is complete.

After a leak test has been successfully completed, the system piping should be coated with a paint formulated for corrosion resistance.

Typical Dimensional Data and Hydraulic Lift System

Votator II General Assembly



CYLINDER	DIM "F"	CONN. "G"	DIM "H"	CONN. "J"
RFG	10-1/2" (267mm)	1-1/2" RFG FLANGE	10-1/2" (267mm)	2-1/2" RFG FLANGE
LIQUID	7-5/16" (186mm)	1-1/2" FPT	8-1/4" (210mm)	1-1/2" FPT
STEAM	7-5/16" (186mm)	1-1/2" FPT	8-1/4" (210mm)	1-1/2" FPT

PRODUCT CONN.		DIM "D"
CONN. "E"	3" I-LINE	7-11/16" (195mm)
	3" FLANGED	8-1/4" (210mm)

CYLINDER	DIM "A"	DIM "B"	DIM "C"
6 x 24	67-3/8" (1710mm)	13-1/8" (330mm)	22-3/16" (560mm)
6 x 36	83-9/16" (2122mm)	23-7/8" (606mm)	25-1/2" (648mm)
6 x 48	95-9/16" (2427mm)	35-7/8" (911mm)	37-1/2" (952mm)
6 x 72	119-9/16" (3037mm)	59-7/8" (1521mm)	61-1/2" (1562mm)
6 x 84	131-9/16" (3342mm)	71-7/8" (1826mm)	73-1/2" (1867mm)

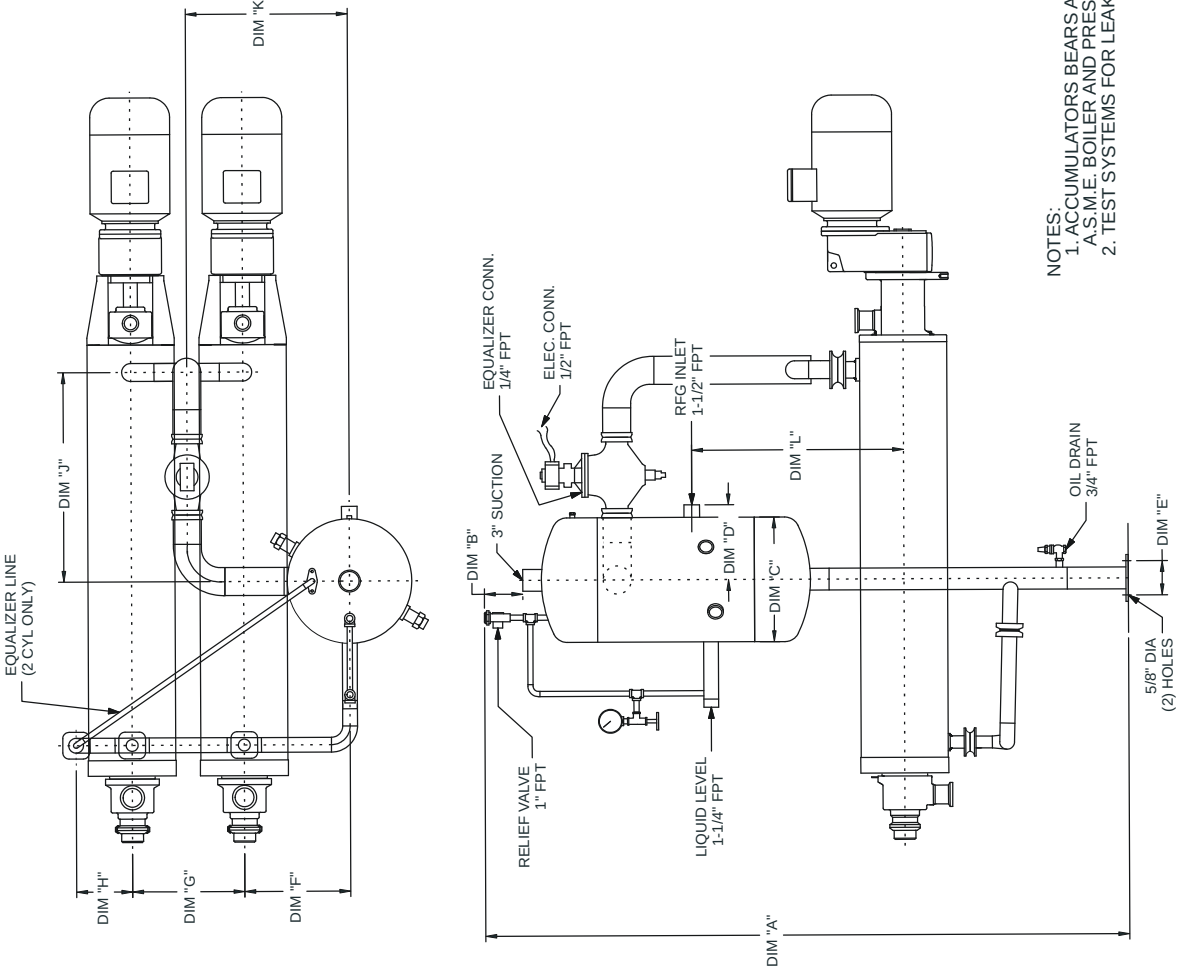
*Dimensions will vary slightly depending on type of motor horsepower.

HE100-050

Votator II General Assembly

Horizontal Refrigeration Assembly

NUMBER OF CYLINDERS	1	2
DIM "A"	96" (2438mm)	104" (2642mm)
DIM "B"	6-7/8" (175mm)	6-3/16" (171mm)
DIM "C"	16" (406mm)	20" (508mm)
DIM "D"	10" (254mm)	12" (305mm)
DIM "E"	4" (102mm)	5-1/2" (140mm)
DIM "F"	16" (406mm)	17" (432mm)
DIM "G"	NA	18" (457mm)
DIM "H"	NA	9" (229mm)
DIM "J"	26" (660mm)	33-5/8" (854mm)
DIM "K"	16" (406mm)	26" (660mm)
DIM "L"	32-1/2" (825mm)	34" (864mm)
MIN. RFG CHARGE	2 CU FT (57 L)	5 CU FT (142 L)
APPROX WEIGHT	450 LB (204 KG)	650 LB (295 KG)

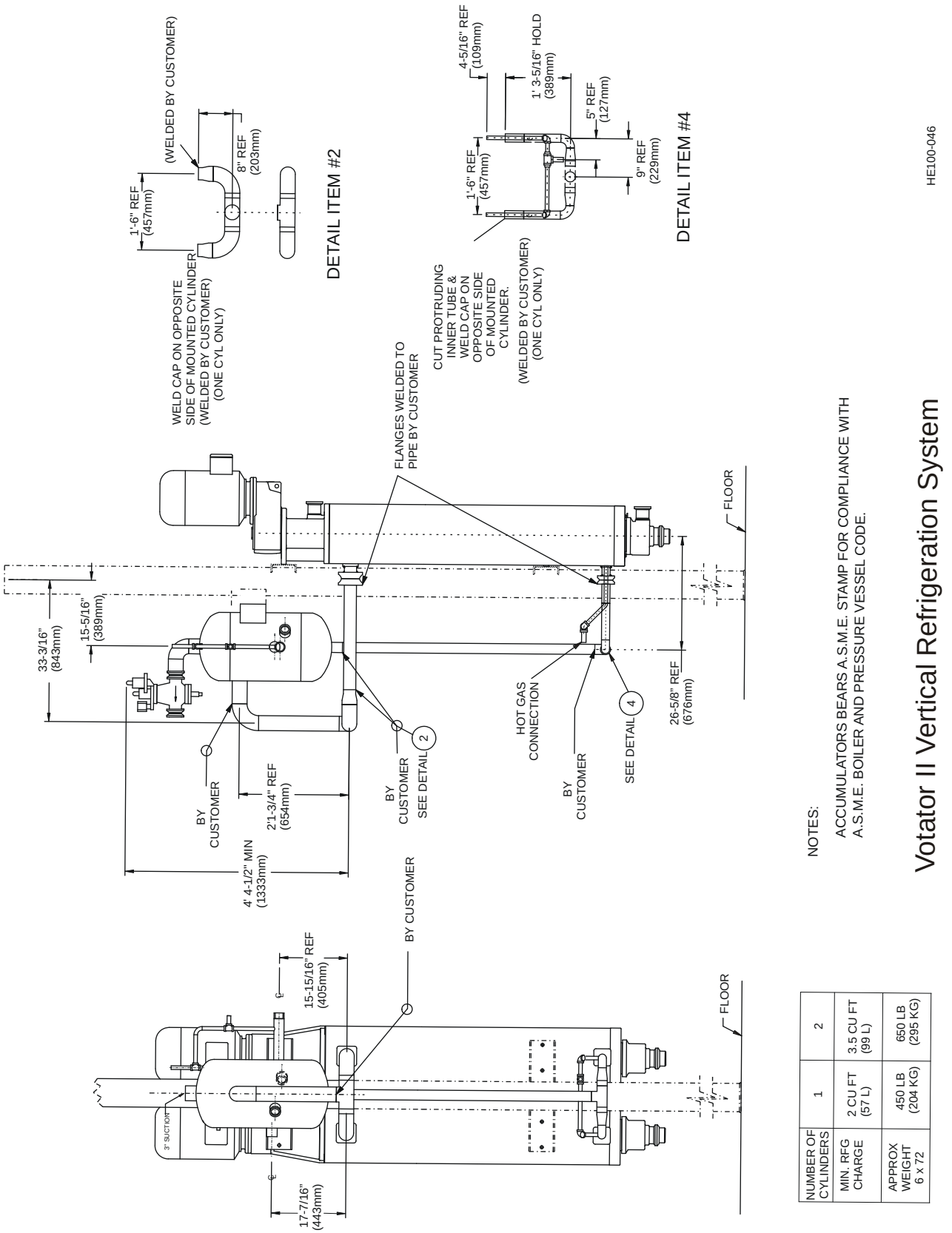


NOTES:
1. ACCUMULATORS BEARS A.S.M.E. STAMP FOR COMPLIANCE WITH A.S.M.E. BOILER AND PRESSURE VESSEL CODE.
2. TEST SYSTEMS FOR LEAKS WITH AMMONIA GAS AT 75 PSI (5.2 BAR).

Votator II Horizontal Refrigeration Assembly

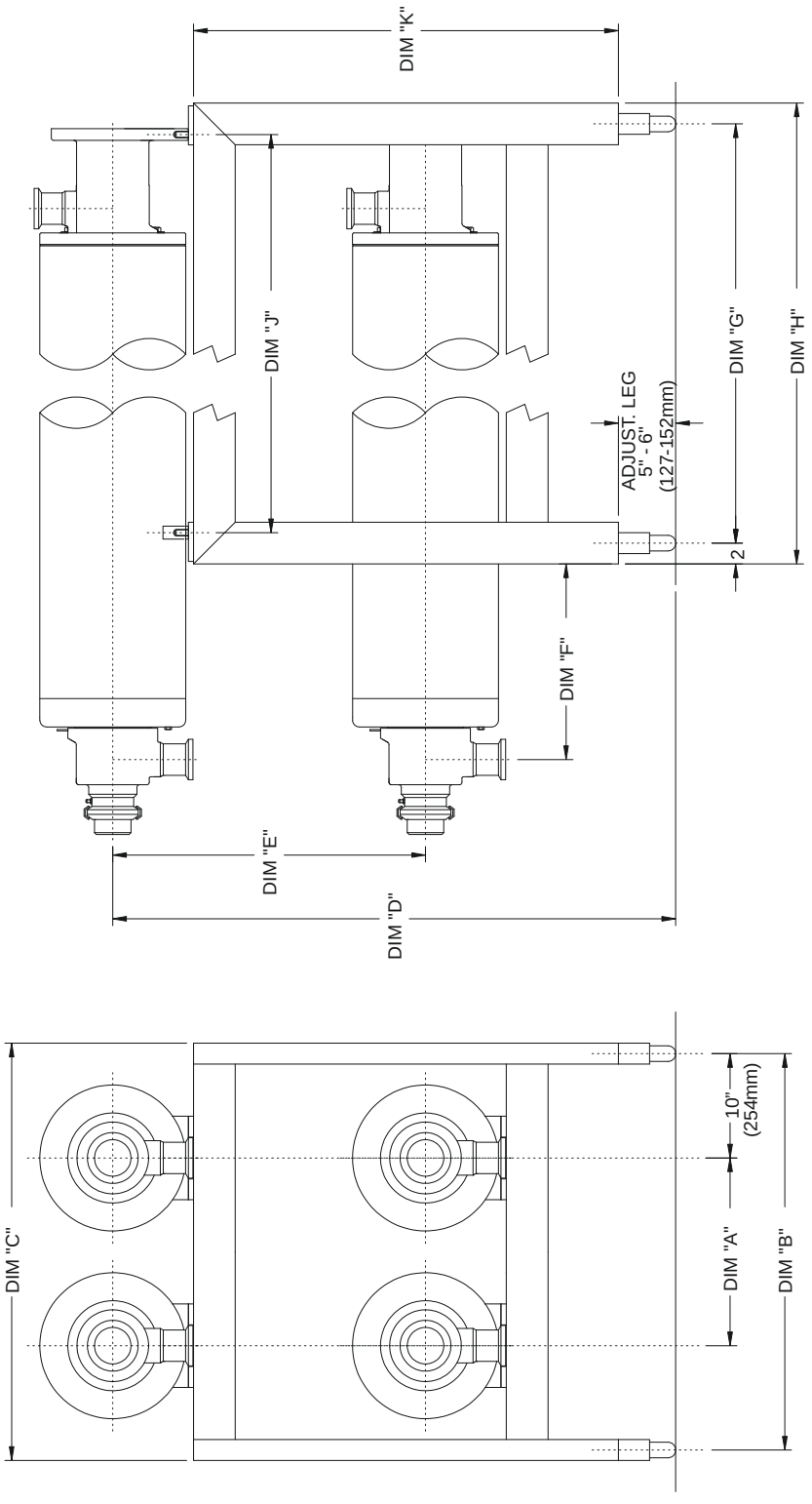
HE100-048

Vertical Refrigeration System



NUMBER OF CYLINDERS	1	2
MIN. RFG CHARGE	2 CU FT (57 L)	3.5 CU FT (99 L)
APPROX WEIGHT 6 x 72	450 LB (204 KG)	650 LB (295 KG)

Horizontal Frame Options



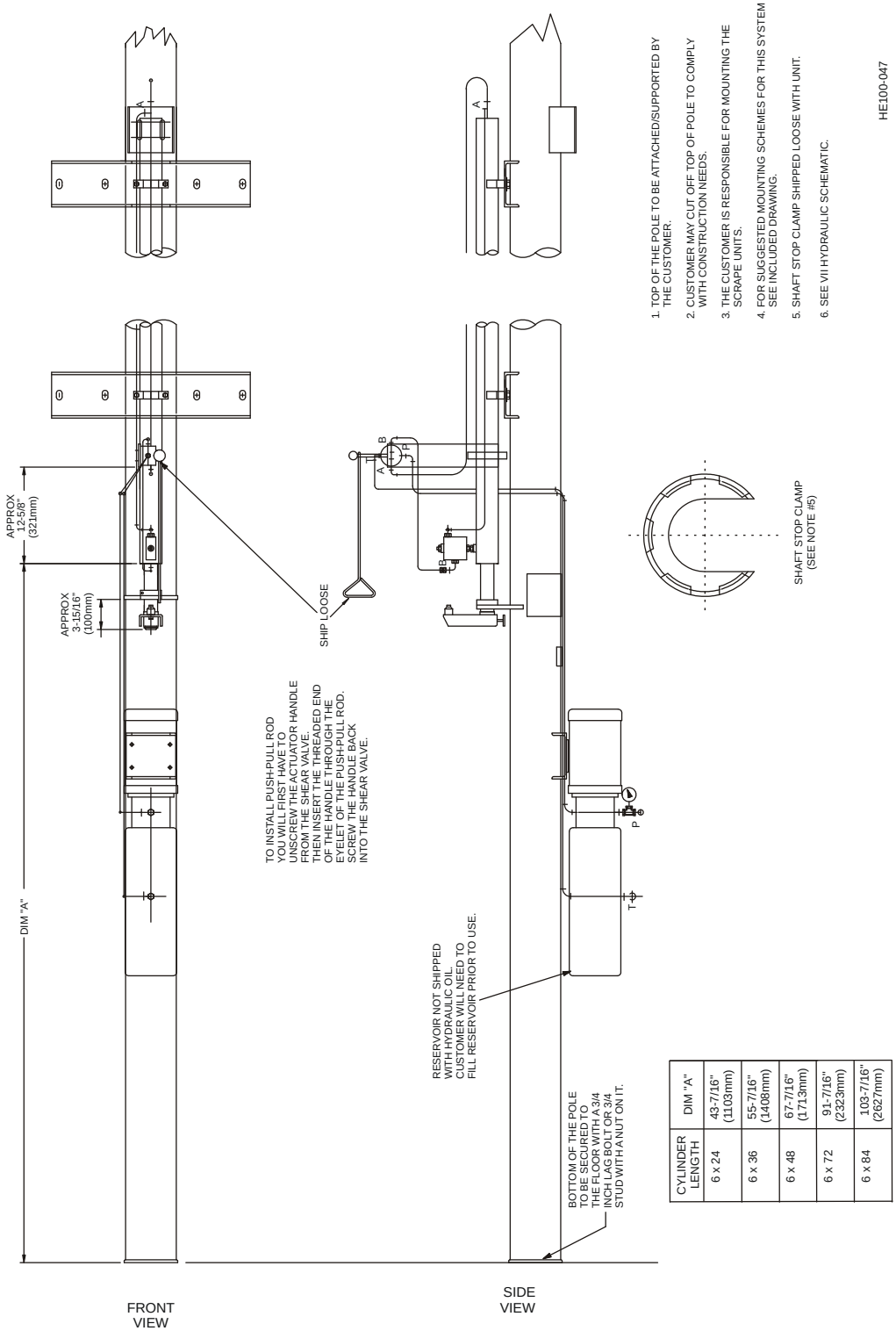
CYLINDER LENGTH	DIM "F"	DIM "G"	DIM "H"	DIM "J"
6 x 24	3-1/2" (89mm)	32" (813mm)	36" (914mm)	25-1/2" (648mm)
6 x 36	14-1/4" (362mm)	32" (813mm)	36" (914mm)	25-1/2" (648mm)
6 x 48	18-3/4" (476mm)	39-1/2" (978mm)	43-1/2" (1105mm)	37-1/2" (952mm)
6 x 72	18-3/4" (476mm)	63-1/2" (1613mm)	67-1/2" (1715mm)	61-1/2" (1562mm)
6 x 84	24-3/4" (629mm)	75-1/2" (1918mm)	79-1/2" (2019mm)	73-1/2" (1867mm)

HE100-049

FRAME CONFIGURATION	DIM "A" (BETWEEN CENTERS)	DIM "B"	DIM "C"	DIM "D"	DIM "E" (BETWEEN CENTERS)	DIM "K"
1 CYL	NA	20" (508mm)	22" (559mm)	36" (914mm)	NA	22-3/4" (578mm)
2 CYL (SINGLE ROW)	18" (457mm)	38" (965mm)	40" (1016mm)	36" (914mm)	NA	22-3/4" (578mm)
2 CYL (1 OVER 1)	NA	20" (508mm)	22" (559mm)	54" (1372mm)	30" (762mm)	40-3/4" (1035mm)
3 OR 4 CYL (2 OVER 2)	18" (457mm)	38" (965mm)	40" (1016mm)	54" (1372mm)	30" (762mm)	40-3/4" (1035mm)

Votator II Horizontal Frame Options

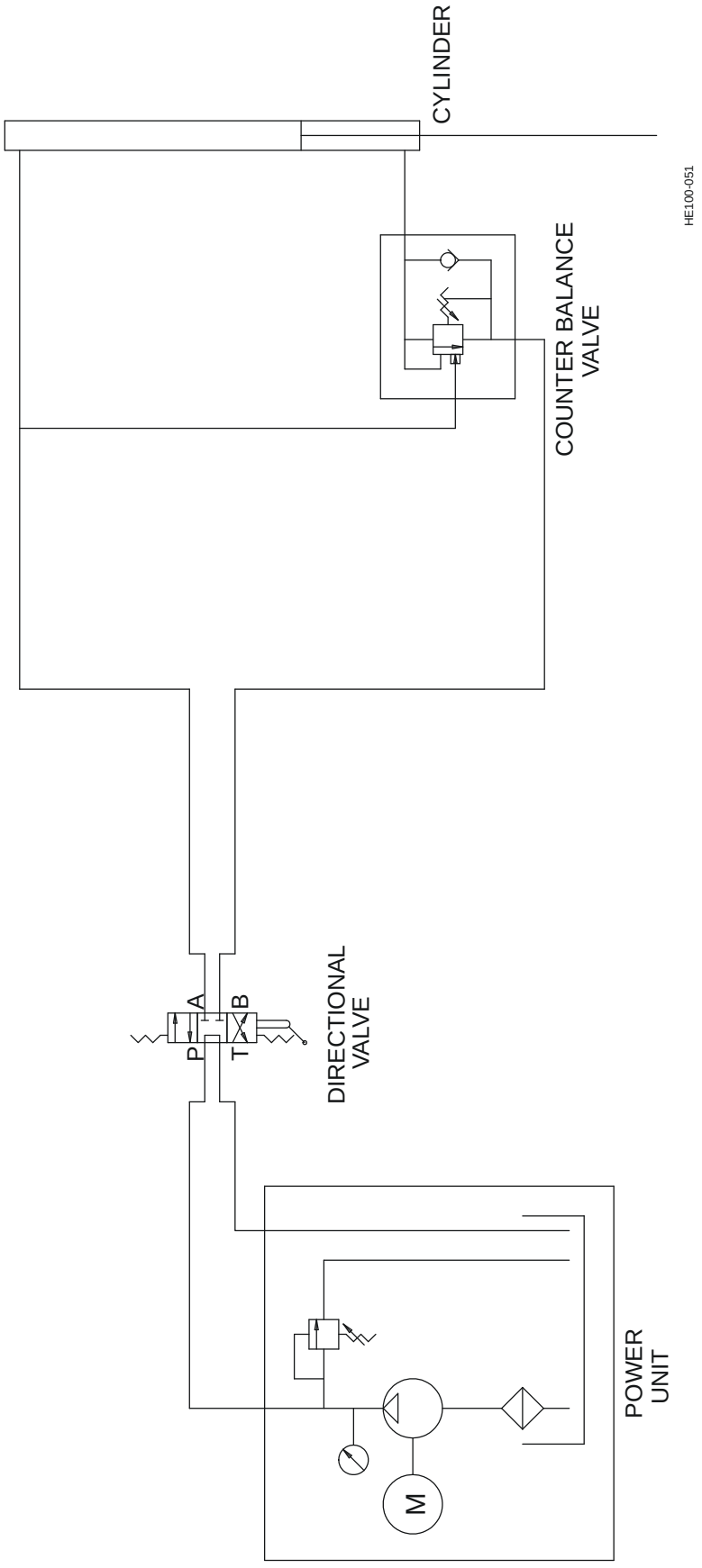
Vertical Mounting Pole/Hydraulics



CYLINDER LENGTH	DIM "A"
6 x 24	43-7/16" (1103mm)
6 x 36	55-7/16" (1408mm)
6 x 48	67-7/16" (1713mm)
6 x 72	91-7/16" (2323mm)
6 x 84	103-7/16" (2627mm)

Votator II Vertical Mounting Pole/Hydraulics

Vertical Hydraulic Schematic



Operation

Pre-Startup Check

These instructions are general and should be used only as a guide. It may be necessary to modify them to conform to actual in-plant requirements. Changes should be documented by plant personnel.

Before starting Votator II, perform the following system checks:

⚠ ***WARNING:*** *Do not operate equipment without guards and interlocks properly installed.*

- Check that Votator II is properly assembled. All product connections, and heating/cooling media connections should be assembled and tight.
- If steam or water flush is required for mechanical seals, open supply valve and set pressure and flow rate.
- Momentarily start motor (1-3 seconds) to determine if shaft is rotating. If shaft is not rotating, turn off power to motor and determine why shaft will not turn.
- Check heating/cooling media to determine if temperature and pressure are at required values and there is an adequate supply of heating/cooling media.
- Check to determine if product is available and pressures are at required values.

For Refrigeration Units Only

- Check that main suction line is fully open.
- Check for proper compressor back pressure.
- Open liquid refrigerant supply valve, turn system refrigerant on and verify that accumulator is full to float level.

Pre-production Run Setup

NOTE: *The following steps are not applicable to aseptic units, which require special sterilization procedures.*

⚠ ***CAUTION:*** *The Votator II has not been passivated as part of the manufacturing process. If the heat transfer tube is chrome plated nickel,* ***DO NOT expose to acid or acid cleaners****.*

The interior of the Votator II heat exchanger tube, mutator shaft, heads, and product piping leading to the unit should be sterilized before running product.

Use sanitizing solution compatible with the materials of the Votator II. If a chlorine solution is used, it must not exceed 50 ppm at 75°F (24°C) and surface contact must be limited to 10 minutes.

Startup Procedure

STARTUP SUMMARY LIQUID/STEAM
Establish seal flush flow (if required).
Check media availability.
Start product or water flow.
Start mutator shaft.
Establish operating pressure (if required).
Admit steam/coolant flow.
Switch to product flow (if necessary).
Adjust media for desired product temperature.
Redirect product flow (if necessary).

STARTUP SUMMARY REFRIGERATION
Establish seal flush flow (if required).
Turn refrigerant "ON".
Start product or water flow.
Start mutator shaft.
Establish operating pressure (if required).
Turn cylinder refrigeration "ON".
Adjust refrigeration PSIG.
Adjust media for desired product temperature.
Redirect product flow (if necessary).

Heating/Liquid Cooling Applications

1. Start product pump using product or compatible liquid, such as water.
2. After product flow is established, start Votator II mutator shaft motor. **Do not run Votator II without product flow.**
3. Establish operating pressure.

NOTE: *Maintain an operating pressure that will result in desired product characteristics. In heating applications, operating pressure should be at a minimum of 15 pounds above jacket steam pressure. This will eliminate internal boiling and fouling of product side of heat transfer cylinder.*

4. Gradually admit dry, saturated steam or coolant to reach system operating temperature. For steam units, open steam valve and immediately open bypass valve at trap to drain condensate. Close bypass valve after all condensate is drained.
5. If running material other than product, switch to product and adjust to desired processing rate.
6. When operating conditions have been reached, redirect product to desired out-flow point.

Refrigeration Applications - Pumped and Gravity Systems

1. Start product pump using product or compatible liquid, such as water.
2. After product flow is established, start Votator II mutator shaft motor. **Do not run Votator II without product flow.**
3. Turn cylinder refrigeration "on".
4. Adjust back pressure control valve on accumulator to approximately 20 psig above normal operating pressure.
5. Gradually reduce setting on back pressure control valve to obtain proper product temperature.
6. If running material other than product, switch to product and adjust to desired processing rate.
7. When operating conditions have been reached, redirect product to desired out-flow point.

Shutdown Procedure

CAUTION: *The steam or refrigeration supply valves must be shut off BEFORE stopping product flow. Failure to do this could result in product burn-on or freezing in heat exchanger cylinders.*

These instructions are general and should be used only as a guide. It may be necessary to modify them to conform to actual in-plant requirements. Changes should be documented by plant personnel. Emergency Shut-Down procedures should be documented by plant personnel after assessing system-wide requirements.

Where product characteristics permit, shut off the mutator shaft, the media flow and the pump. Otherwise, it may be necessary to heat or cool the product to ambient temperature to avoid burn-on or freeze-up.

In instances where product goes to a filler, it may be necessary to provide a surge tank or a recirculation line.

With continuous operations, a steam line connected to the product line can enable steam to soften and remove product in the tube at shut down.

The final option is to have hot water chase product from the tube at the end of the run.

Preventing Tube Scoring

Scoring of the heat exchanger tube can have many causes. The most common are temperature extremes, material problems in the heat exchanger tube, or units operated without product or CIP flow.

The following suggestions will help prevent tube scoring:

- Do not pump cold product into a unit that is still hot from cleaning (this can cause temporary bowing of the tube). Wait until the tube has cooled before running cold product.
- Do not leave sterilizing water or solution in the tube after sterilization is complete. Drain the tube completely of sterilizing water or solution. Fill the tube with product prior to starting.
- Make sure that condensate is drained completely in BWS cylinders. The steam trap must be large enough to carry away all condensate.

Maintenance

Routine Maintenance Checklist - Vertical Votator II

1. Tools required:
   - Rubber or plastic mallet
   - Large adjustable wrench (2-3/8 inch) or WCB model 79-2 Sanitary Wrench for removing the shaft locknut
   - Two adjustable or open-end wrenches (15/16 inch) for removing the bearing clamp on the non-driven head
   - One 3/8 inch nut driver and one common screwdriver for removing the shaft guard on the drive end
   - One small common screwdriver for removing the keeper o-ring on the seal
2. Lock out power.
3. Drain product piping and disconnect.
4. Position hydraulic lift foot under bottom product head.
5. Loosen latch on bayonet lock and disengage head by rotating clockwise.
6. Lower mutator shaft to floor with hydraulic cylinder.
7. Check conditions of scraper blades and replace if necessary. Service top mechanical seal, if required. **Blades are installed with flat side out.**
8. If lower mechanical seal needs servicing, remove shaft from lift cradle, or remove two scraper blades from mid section of mutator shaft and raise mutator shaft so that the center of one set of blade pins is positioned in the middle of the bayonet ring.
9. Install shaft lock clamp and secure with locking latch.
10. Lower hydraulic cylinder so that the clamp supports the mutator.
11. Remove the hinge clamp and bearing cap.
12. Remove shaft lock nut (**left hand threads**) while firmly supporting the product head and carefully removing it from the mutator shaft.
13. The mechanical seals are the same on top and bottom, and if servicing is required:
    - Remove the keeper o-ring and all seal components, seal body with seal ring, backing ring, u-cup and wavy spring. If it is a double mechanical seal, the secondary seal and spring must be removed before disassembling the primary seal.
    - Inspect o-rings and seal faces for scratches or cracks. If the seal parts require replacement, refer to pages 56 and 72 or pages 57 and 70.
    - When assembling the **single mechanical seal**, place the wave spring on the shaft, followed by the seal backing ring and the u-cup with the opening of the cup facing the body of the shaft. Position the seal body and install the keeper o-ring.

- When assembling the **double mechanical seal**, place the wave spring on the shaft and then the seal body with o-ring. Position the seal body and install the keeper o-ring, followed by the secondary seal and wave spring.
- Check all seal assemblies to verify that they are locked in position by the drive pins and that they can be easily compressed.

14. To remove the top product head, remove the shaft guard held in place by four bolts, and rotate the head counter-clockwise to disengage. Check condition of the o-ring in the head before reinstalling.
15. Check the condition of the o-ring in the product head, lubricate it lightly, and carefully place the head with bearing on the mutator shaft. **The grease ring on the bearing should be facing the product side of the head.**
16. Seat bearing in head using a plastic mallet, if required, and install shaft locknut and bearing cap.
17. Apply anti-seize compound to the drive end splines and the next 3 inches of stub shaft length. Place the shaft and head back into the lift cradle if necessary.
18. When installing the mutator shaft in the unit, carefully guide the blades in the cylinder while the mutator is raised. It may be necessary to turn the mutator shaft slightly to align the spline in the motor drive.

WARNING: *To avoid injury, the same person should operate the hydraulic controls and guide the mutator shaft.*

19. Rotate the product head counter-clockwise to engage the bayonet lock, and close the locking hatch.
20. Grease bearing. (Not required for Extra Heavy Duty Votator II.)

Routine Maintenance Checklist - Horizontal Votator II

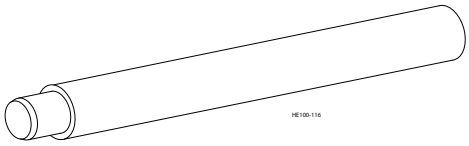


Figure 22 - Head Removal Tool

1. Tools required:
   - Rubber or plastic mallet
   - Large adjustable wrench (2-3/8 inch) or WCB model 79-2 Sanitary Wrench for removing the shaft locknut
   - Two adjustable or open-end wrenches (15/16 inch) for removing the bearing clamp on the non-driven head
   - One 3/8 inch nut driver and one common screwdriver for removing the shaft guard on the drive end
   - One small common screwdriver for removing the keeper o-ring on the seal
   - Head Removal Tool (HRT), part number LL121191. (See Figure 22.)
2. Lock out power.
3. Drain product piping and disconnect.
4. Loosen latch on bayonet lock and disengage head by rotating clockwise.
5. Lift head and pull assembly out about 1 inch, and rest the shaft on the heat transfer tube.
6. Remove the hinged clamp and bearing cap.
7. Remove shaft locknut (**left hand threads**).

CAUTION: *Failing to use the Head Removal tool can result in damage to the seal face. Use of the HRT prevents chipping the stationary seal face on the end of the shaft during removal or replacement of the head.*

8. Insert the Head Removal Tool (HRT) through the bearing and into the threaded end of the shaft, then slide the head over the tool so that the seal face is past the end of the shaft. Grasp the end of the tool and the head and carry it to a table or other stable work surface for further maintenance if needed.
9. Insert plastic shaft skid in unit, install on top and rotate shaft so skid is under shaft. Remove both shaft and skid from unit. Place on a table or cradle.
10. Remove product head on drive end (if required) by removing the shaft guard held in place by four bolts. Rotate the head counter-clockwise to disengage. Check the condition of the o-ring in the head before reinstalling.
11. The mechanical seals are the same on top and bottom, and if servicing is required:
    - Remove the keeper o-ring and all seal components, seal body with seal ring, backing ring, u-cup and wavy spring. If it is a double mechanical seal, the secondary seal and spring must be removed before disassembling the primary seal.
    - Inspect o-rings and seal faces for scratches or cracks. If the seal parts require replacement, refer to pages 56 and 72 or pages 57 and 70.
    - When assembling the **single mechanical seal**, place the wave spring on the shaft, followed by the seal backing ring and the u-cup with the opening of the cup facing the body of the shaft. Position the seal body and install the keeper o-ring.
    - When assembling the **double mechanical seal**, place the wave spring on the shaft and then the seal body with o-ring. Position the seal body and install the keeper o-ring, followed by the secondary seal and wave spring.
    - Check all seal assemblies to verify that they are locked in position by the drive pins and that they can be easily compressed.
12. Inspect the condition of the scraper blades and replace if necessary. Install the new blades while the shaft is on the cradle or table, attaching two rows of scraper blades on the top of the mutator, and place the shaft skid over the blades. Turn the mutator and shaft skid over so that the skid is on bottom of the table or cradle, and install the other two rows of blades on top. **Blades are always installed with the flat side up.**
13. Apply anti-seize compound to the drive end splines and the next 3 inches of stub shaft length.
14. Use the shaft skid to slide the mutator in the heat exchanger cylinder and lift up the mutator slightly to remove the shaft skid.
15. Check the condition of the O-ring in the product head and lubricate it lightly. Replace the bearing in the product head if necessary. **The grease ring on the bearing should be facing the product side of the head.** Insert the HRT into the

end of the shaft. Slide the bearing race over the tool and onto the shaft to protect the stationary seal face during assembly.

16. Seat the bearing in the head, using a plastic mallet, if required.
17. Install shaft locknut and bearing cap, position product head over bayonet ring and turn counter-clockwise. Close locking latch.
18. Grease bearing. (Not required for Extra Heavy Duty Votator II.)

Scheduled Maintenance

The following table is provided only as a guideline. It may be necessary to modify the schedule to conform to actual in-plant requirements. All changes should be documented by plant personnel.

Table 5: Table of Scheduled Maintenance

Frequency	Component	Suggested Service
Weekly	Mutator Shaft Bearing	Lubricate each fitting with a handgun, approximately three shots. Use a suitable NLGI Grade-2 bearing grease. (Not required for Extra Heavy Duty Votator II.)
	Shaft Assembly	Remove shaft assembly at least once a week. Always use the removal trough skid to avoid bottom blades scoring the heat transfer tube. Replace the mechanical seal shell O-rings.
	Product Tube	Inspect the tube's inner chrome surface to be sure it is smooth and bright. If rough areas, marks or chrome plating deterioration exist, locate and correct the cause. Replace the tube, if necessary.
	Scraper Blades	Examine scraper blades weekly, or after 40 operating hours. Based on amount of wear, establish service frequency.
		Maintain blades in good condition for longest machine life and best production rates. Reserve a complete set of spare blades for routine replacement. Worn or rough blades reduce heat transfer and can damage the heat transfer tube.
	Jacket/ Accumulator	Purge gathered oil from accumulator section of accumulator jacket. If ammonia charge is dumped from accumulator daily, oil is carried back with it.
Monthly	Inlet and Outlet Fittings	Replace O-rings on inlet and outlet fittings monthly, or more frequently as needed.
	Gear motor	Check oil level and add as required.
Semi-Annually	Refrigerant	Inspect for oil and/or contaminants.
	Flange O-rings	Replace O-rings at least every 12-18 months.

Preventive Maintenance

- Correct problems as soon as they are discovered.
- Inspect equipment frequently following changes in product formulation, processing conditions or CIP regimen.
- Always note and report any abnormal or unusual conditions.
- Follow a regular preventive maintenance schedule. Many factors determine the interval required for scheduled servicing. The severity of the application and the time between scheduled shutdowns are two of the most significant.

When new units are first put into service, they should be disassembled after each production run and inspected for any obvious wear patterns. These initial inspections will establish a process history, as well as provide a basis for establishing a preventive maintenance schedule. Inspections should focus primarily on tube, shaft, blade and seal components. During normal production runs, any abnormal conditions such as unusual noise, leakage or vibration should be noted and corrective action taken.

Mutator Shaft Bearing

The Votator II has only one serviceable ball bearing assembly, located in the Opposite Drive End Head of the unit. Lubrication of this bearing while in service is done through the use of the grease fitting located on the Opposite Drive End Head.

Install bearing with lubrication ring in line with grease fitting.

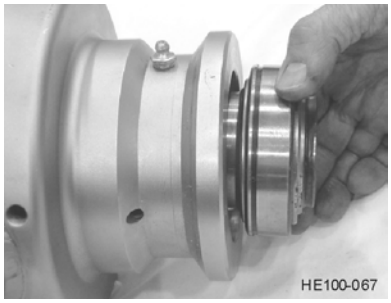


Figure 23 - Lubrication Ring Orientation

Use a suitable NLGI grade-2 bearing grease for the shaft bearing. Do not over-lubricate. Excessively packed bearings will over heat and fail prematurely.

Frequency of lubrication is dependant on the environment; daily if it is in contact with water or steam, otherwise weekly lubrication usually is sufficient.

WARNING: *Never immerse the Front Mutator Shaft Bearing in cleaning solution or subject to steam. Clean bearing with a dry cloth and lubricate.*

Inspection of bearing should be ongoing. If looseness is detected, replace bearing immediately. Worn out bearings cause shaft misalignment that will cause mechanical seals and gearbox to wear out prematurely.

Extra Heavy Duty Votator II Shaft Bearing

The shaft bearing on the Extra Heavy Duty Votator II located in the opposite drive end head is a sealed bearing and does not require lubrication.

Shafts

All shaft surfaces, especially in seal and bearing areas, should be kept smooth and clean. Special care should be taken while cleaning and maintaining seals and bearings to assure that these areas of the shaft are not scratched or damaged.

Shaft porosity can be detected by making an adaptor for the threaded end of the shaft and pressurizing it with air. Pinholes will be detected as air bubbles by submersing the shaft in a water bath. Leaky shafts can be repaired at WCB.

Bent or imbalanced shafts will cause premature bearing, seal and blade wear and may damage tube walls. Shafts should be checked for straightness and balance annually.

Gear Drive

Manufacturer recommendations should be followed for gear oil replacement. When draining oil, examine closely for foreign matter or debris, flushing or gear replacement may be required.

NOTE: Consult the sticker on the NORD gearbox to verify the correct lubricant.

The current standard lubricant for the NORD gearbox is **Mobil SHC Cibus™ 220**. For alternates, see NORD document U11000.

For quantities (fill capacity for an empty gearbox), see Table 6. The gearbox (SK 4282 or SK 5282) is indicated on the identification plate.

Table 6: Lubrication Quantities

NORD gearbox	Orientation	Quantity
SK 4282	Horizontal	4.97 qt.
	Vertical	5.71 qt.
SK 5282	Horizontal	7.93 qt.
	Vertical	9.30 qt.

Blades

Blades that have developed a heel greater than WCB specifications should be sharpened per instructions in this manual. Blades worn beyond the minimum sharpening dimensions should be replaced. Worn blades reduce heat transfer, result in poor performance and may damage product tubes. See “Scraper Blade Maintenance” on page 45.

Mechanical Seals

Votator II heat exchangers are equipped with single or double mechanical seals at each end of the mutator shaft.

NOTE: *Double mechanical seals MUST BE flushed to prevent seal faces from over heating.*

Mechanical seal faces with nicks, blisters, grooves, or any abnormality on the seal face, must be replaced. Elastomers that are brittle, deformed, cut, or have any abnormality must be replaced. It is an excellent practice to replace all elastomers and gaskets whenever maintenance is performed.

Tubes

A frequent cause of tube wall damage is careless handling when removing or installing the mutator shaft. The shaft trough skid should always be used when removing or installing the mutator shaft in the Horizontal Votator II (or the Vertical unit if in a horizontal position) to prevent the blade mounting pins from scoring and damaging the tube wall.

A common way to damage tube ends is to bang or drop the shaft journals when removing or inserting the shaft.

Tubes should be examined for wear anytime the shaft is removed or at least once every 3 months. Chrome plated tubes should be

inspected for flaking of the chrome. Normally, tubes will develop phonographic patterns from blade contact and rotation; this phonographic pattern is generally visible to the eye but is not significant unless detectable by touch. Scoring is significant when the base metal has been damaged; roughness of the tube wall is obvious both visually and by touch. A badly scored tube will make cleaning more difficult, reduce heat transfer, result in poor performance and increase blade wear.

Re-conditioning the tube is the only way to restore performance. If there is suspicion that scoring has penetrated the tube wall, the unit can be pressure tested by turning on the jacket media and observing the inside of the tube for leaks.

Tubes should be removed every 12 to 18 months for cleaning debris from the media side. Jacket side O-rings should be replaced when tubes are reinstalled.

Care of Heat Exchanger Tube

You probably recognize that your Votator® and Thermutator® Heat Exchangers are valuable elements of your production facility. Day in and day out, they continuously and efficiently heat and cool products that often cannot be handled in any other equipment. You may not be aware that these units are considered pressure vessels under the ASME Code, and that SPX is the only facility authorized to make OEM repairs to the removable tubes that maintain their ASME Code certification. This certification is your assurance that the equipment meets its original design pressure rating.

NOTE: *Repair work must be performed by a shop with ASME certified welders. The heat exchanger tubes are ASME coded parts. Failure to get repairs done by an ASME coded machine shop with certified welders will void the warranty and possibly void insurance. SPX has all required certifications necessary for repair of ASME coded parts.*

The removable tubes are wear parts, and must be replaced when they lose too much metal. Their inner surface is scraped by rotating blades and is potentially exposed to corrosive or abrasive products or cleaners. In some cases chrome plating is applied to resist mechanical wear, but it eventually wears away or the tubes become damaged or scored and lose performance. SPX can inspect the tubes against the original drawings and determine whether they can be honed to restore a smooth inner surface, while keeping enough tube wall thickness to satisfy the ASME Code design calculations. Removable tubes that are worn beyond repair are condemned by our facility for your protection.

A breach in the removable tube that occurs during operation could be an extremely costly and hazardous event. In a recent incident, a removable tube was honed by an unauthorized machine shop that removed too much metal. The extremely thin tube wall flexed under the pressure of the product and the scraping blade edge, until one blade penetrated and tore a hole in the tube. Consequences of this kind of failure can include: contamination of product - with a damaging recall; circulation of product throughout a media system like a refrigeration compressor installation; and/or release of a hazardous substance like ammonia refrigerant inside your facility! Even if these are not high risks in your application, your production line will be down or operating at reduced capacity for some time until a replacement tube can be obtained.

Having your tubes professionally repaired by SPX just makes sense, but there are other potential benefits as well. Maintaining ASME certification keeps you in compliance with state and local

regulations, depending on the location of your facility. It is also a requirement of most business insurance carriers, so you are helping to protect your company against potential fines and uninsured losses. With stakes this high, tube repair by SPX is the smart bet.

Product Side

The heat exchanger tube is designed to last a long time with little maintenance.

If tubes wear out prematurely, one or more of the following may be the cause:

- Failure to use shaft trough when removing mutator shaft will cause scratching or gouging of tube wall.
- Careless assembly and installation of blades.
- Rotating shaft without product or product flow.
- Use of the wrong detergent or incorrect use of a detergent.
- Starting shafts against stiffened or solidified product in tubes.
- Starting the flow of jacket media (Ammonia, Freon, Steam, Water, etc.) before establishing full product flow under operating pressures.
- Failure to clear tubes of product after every use.
- Starting operation before dissolving particles such as salt, sugar, detergents, etc.
- Using dull blades or blades that have been sharpened below minimum width specifications.
- Using blades other than those furnished by Waukesha Cherry-Burrell.
- Worn mutator shaft bearings.

Inspection of Chrome Plated Nickel or Stainless Steel Tubes

During each inspection of the scraper blades, inspect the inside surface of the tube for scoring, gouging, and roughness. When the surface of the plating is damaged or worn through, it may be rechromed to original specifications by Waukesha Cherry-Burrell. WCB has the equipment and product knowledge to repair the tube back to factory specifications and determine if the tube will comply with ASME specifications.

⚠ ***CAUTION:*** *Acid cleaners are not recommended for chrome plated nickel heat transfer tubes. Cleaners should be compatible with the elastomers in the heat exchanger.*

Inspection of Stainless Steel Tubes

During each inspection of the scraper blades, inspect the inside surface of the tube for scoring, gouging, and roughness. Shallow score marks, shallow gouges, and roughness can be taken out by honing the tube followed by polishing. Depending on the damage to the tube, Waukesha Cherry-Burrell may be able to rehone the tube to comply with ASME code specifications.

Jacket Side

For Units Using Steam, Water, Or Liquid

The jacket side of the heat transfer tube has a sealed cover that allows the media flow to circulate around the tube. If it becomes coated with foreign matter and heat transfer is reduced, it can be cleaned by pumping a detergent solution compatible with the carbon steel jacket at a rate of about 100 gpm. The frequency of this cleaning process will vary greatly from one installation to another.

For Units Using Refrigerant

The jacket side of the heat transfer tube will become fouled with oil and sludge over time and prevent efficient heat transfer. This tube does not have a sealed flow spiral and can be cleaned by removing it from the jacket. It should be removed for cleaning every 12 to 18 months.

NOTE: *If you plan to clean the tube with anything other than the materials and methods mentioned previously, please contact Customer Service.*

Cleaning the Flanges

Remove the O-rings and clean the grooves thoroughly of all residue and buildup. Care must be taken in cleaning the flanges, as they are part of the seal mechanism of the unit.

Install new O-rings any time the unit is disassembled.

NOTE: *Replace the O-rings every 12-18 months.*

Lubricate the O-rings.

Leak Testing

Each cylinder is thoroughly tested for leaks at the factory. It is necessary to check for leaks in the refrigeration system any time the piping is opened to the atmosphere for maintenance or repair.

WARNING: *Do not open valves or check for leaks until the electrical system checkout is completed. Personnel must wear safety goggles and protective clothing.*

Scraper Blade Maintenance

Blade Inspection

The blades should be inspected for wear and signs of fatigue or cracking at the pin location and should be replaced if damage has occurred. Failure to replace damaged blades may result in breakage, which can damage other blades or the heat transfer tube, and result in blade particles in the product.

CAUTION: *High concentrations of acid or caustic should be avoided if plastic scraper blades are used. Cleaners should be compatible with the elastomers in the heat exchanger.*

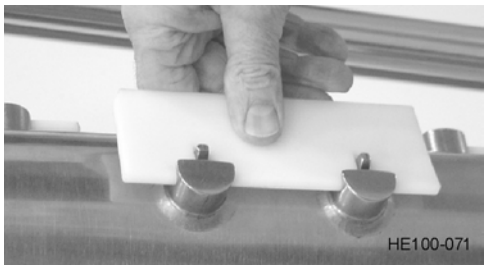


Figure 24 - Scraper Blade Removal

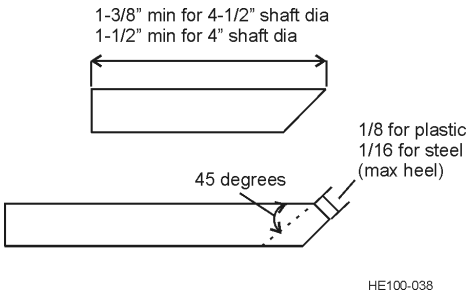


Figure 25 - Blade Wear and Sharpening

Scraper Blade Removal & Replacement

1. Remove scraper blades by lifting up and pulling them from the pins. PEEK Blades have a locking groove.
2. After lifting, push to the right before pulling them from the pins.

NOTE: *Blades should be kept in the same position on mutator shaft throughout life of blade. Make sure blades are removed and reinstalled in the same location on the shaft.*

Reverse this procedure for installation. Make sure beveled edge is installed toward shaft.

Scraper Blade Wear

Worn blades reduce heat transfer efficiency and can cause excessive wear on the product tube wall.

As the scraper blades scrape across the interior of the heat exchanger tube, they wear into the contour of the tube. A flat surface called the heel and a burr or feathered edge develops at the contact area on the side of the blade that is against the tube wall. See Figure 25.

The blades must be maintained to achieve maximum performance. When the heel of the blade reaches a maximum of 1/16" (1.6 mm) on metal blades or 1/8" (3.2 mm) on plastic blades, they must be replaced or re-sharpened.

Blade Sharpening

Scraper blades can be sharpened by several methods, depending on the blade material.

The best method utilizes a high speed 45° cutter and fixture that keeps the backside of the blade perpendicular to the cutting edge. The cutting edge of the blade should be parallel to the back surface of the blade within 1/64".

A new universal blade is 2 inches wide by 6 inches long.

For mutator shafts that are 4-1/2 inches in diameter or larger, the blade should not be sharpened to a blade width of less than 1-3/8 inches.

For mutator shafts that are 4 inches in diameter, the blade should not be sharpened to a blade width of less than 1-1/2 inches.

Stainless steel blades for the 5-1/4 inch mutator shafts are 1-9/16 x 23-29/32. The minimum width after sharpening is 1-3/8 inches and the sharpening edge is at a 15-degree angle.

Maintenance of Horizontal Votator II

Figure 26 - Removal of Hinged Clamp

Figure 27 - Removal of Shaft Locknut

Figure 29 - Shaft Removal

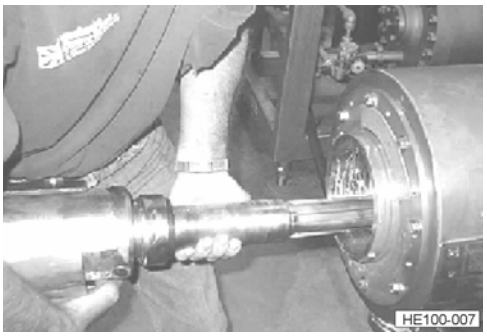


Figure 30 - Removal of Shaft Drive End

DANGER: *Before doing any maintenance work on the Votator II, lock out and tag out equipment.*

Shaft Removal - Horizontal Unit

1. Check to make sure all supply lines to unit are closed, locked out and tagged out.
2. Disconnect product piping and seal flush lines.
3. Rotate head in OFF direction until you feel head disengage.
4. Pull head and shaft assembly out approximately one (1) inch.
5. Remove hinged clamp that holds shaft nut guard in place. See Figure 26.
6. Remove shaft locknut. (Locknut is left hand threaded). See Figure 27.
7. Insert HRT as shown in Figure 28 and slide the head and bearing off the shaft to protect the stationary seal face during disassembly.

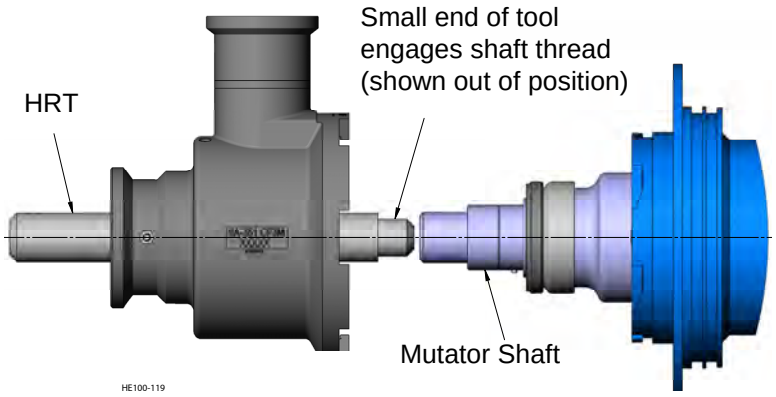


Figure 28 - Use of Head Removal Tool (HRT)

8. Lift shaft so that shaft removal skid can be inserted between shaft and tube.

NOTE: *NEVER remove mutator shaft without using shaft removal skid. Failure to do so will result in permanent damage to heat transfer tube.*

9. Slide shaft removal skid into tube.
10. Pull shaft and shaft removal skid from tube as a unit. This will ensure that tube will not be scored when shaft is removed.

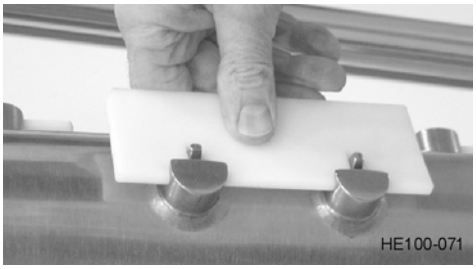


Figure 31 - Scraper Blade Removal

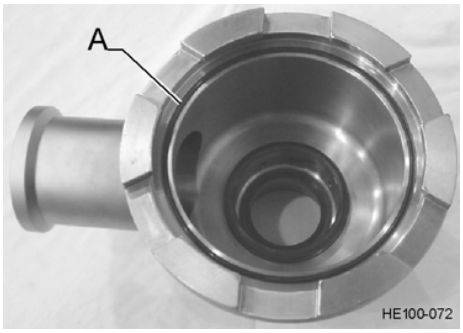


Figure 32 - Drive End Head O-ring

Figure 33 - Mechanical Seal Installation

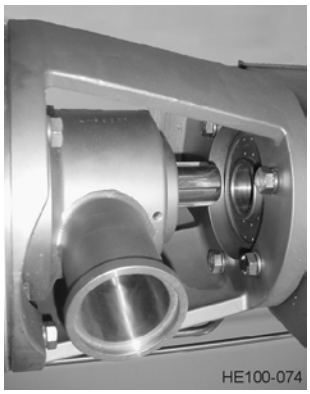


Figure 34 - Align Shaft Splines with Gear Reducer

11. Remove scraper blades and service as necessary. See "Scraper Blade Maintenance" on page 45

NOTE: *Blades should be kept in the same position on the mutator shaft throughout the life of blade. Make sure blades are removed and reinstalled in the same location on the shaft.*

Shaft Installation - Horizontal Unit

1. If the drive end head has been removed, make sure the O-ring (See Figure 32, Item A) is installed in opposite drive end head. Lubricate lightly.
2. Install drive end head (if necessary).
3. Install mechanical seal on drive end of shaft as shown in Figure 33. see "Mechanical Seal Maintenance" on page 56.
4. Install all scraper blades on mutator shaft.

NOTE: *Blades should be kept in the same position on mutator shaft throughout life of blade. Make sure blades are removed and reinstalled in the same location on the shaft.*

5. Place shaft in shaft removal skid.
6. Apply anti-seize compound to the drive end splines and the next 3 inches of stub shaft length
7. Push shaft and shaft removal skid into tube as a unit. This will ensure that tube will not be scored when shaft is replaced.
8. Push spline of shaft partially into gear reducer. Shaft may need to be rotated slightly for splines to seat in gear reducer. See Figure 34.
9. Lift shaft slightly to remove shaft removal skid.

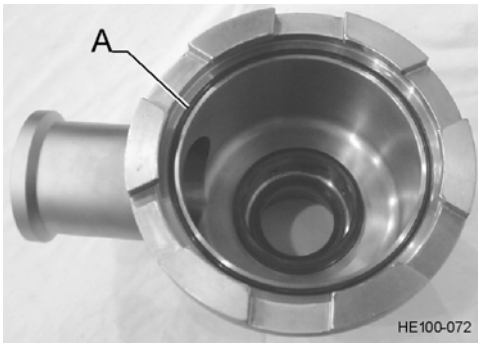


Figure 35 - Opposite Drive End Head O-ring

10. Make sure O-ring (See Figure 35, Item A) is installed in the opposite drive end head. Lubricate lightly

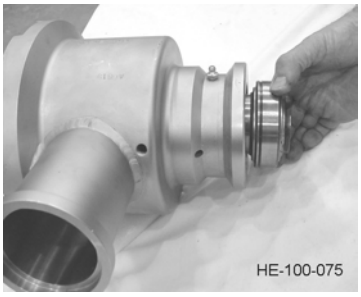


Figure 36 - Install Head Shaft Bearing

11. Install opposite drive end head by reversing procedure for removal of head.
12. Install shaft bearing in head. Install HRT into the end of the shaft and slide head and bearing onto the shaft. Remove HRT.
13. Push on bearing retainer and secure with clamp.
14. Install shaft nut onto shaft **(nut is left hand threaded)** and tighten nut against bearing's inner race

Figure 37 - Installation of Shaft Locknut

15. Lift the shaft and head, place over the tube ring and position bayonet closure. Close locking latch and secure by tightening latch retainer nut.

Figure 38 - Installation of Hinged Clamp

16. Install all product connections and seal flush piping.
17. Inspect unit for correct assembly.
18. Remove tag-out and lock-out. Prepare unit for operation.

Heat Exchanger Tube Removal - Horizontal Unit

DANGER: *Before doing any maintenance work on the Votator II, lock out and tag out equipment.*

1. Check to insure all supply lines to unit are closed and locked and tagged out.
2. Make sure that entire unit is purged of fluids (product, coolant, refrigerant, etc.)
3. Remove mutator shaft and drive end head as described in this section.

DANGER: *Before removing the heat exchanger tube from the jacket, all refrigerant must be evacuated from the jacket assembly.*

4. Remove locking latch and associated hardware that holds front cover in place.

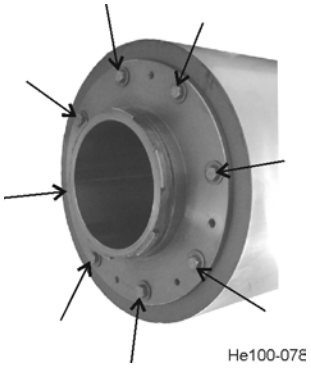


Figure 39 - Removal of Tube to Jacket Bolts

5. Remove the eight (8) 3/8-inch bolts that hold removable tube to jacket. See Figure 39.
6. Take four (4) bolts and thread them into the “B” holes. The “B” holes are located at the 12, 3, 6, and 9 o’clock locations. **DO NOT TIGHTEN!**
7. Using an X pattern, gradually tighten bolts to withdraw tube from jacket. Considerable effort may be needed to overcome any stickiness.

   If tube does not start to pull away from jacket as bolts are tightened, stop and do the following:

   - **Make sure product head on drive end is removed.**
   - Place a block of wood across drive end of tube and apply pressure to force tube opposite the drive end.
   - When tube is loose, use bolts to complete removal.
   - If tube cannot be budged, contact SPX.
8. Pull tube out of jacket. Care should be taken to avoid marring jacket cylinder during heat transfer tube removal. Mark tube and jacket so that tube can be reinstalled in same jacket. See Figure 40. On BWS or liquid units, install a new packing ring.

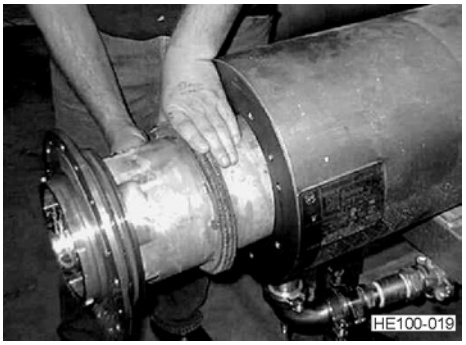


Figure 40 - Tube Removal

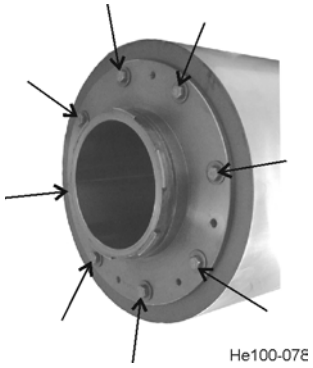


Figure 41- Install Tube to Jacket Bolts

Maintenance of Vertical Votator II

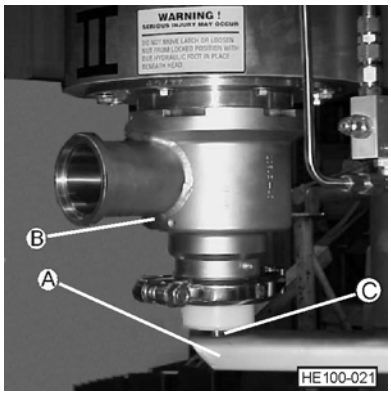


Figure 42- Location Of Hydraulic Arm For Removal

Heat Exchanger Tube Installation - Horizontal Unit

1. Inspect jacket cylinder interior and wipe out all dirt and impurities.
2. Lubricate sealing surfaces inside jacket cylinder and install new O-rings in the tube.
3. Carefully insert tube into jacket cylinder. Support pins of heat exchanger tube should be at 5 o'clock and 7 o'clock positions during insertion.
4. Push tube into cylinder as far as it will go.
5. Thread the eight (8) 3/8-inch bolts through the flange of heat exchanger tube into jacket cylinder.
6. Tighten bolts in a crossing pattern until tube is snugged down to jacket cylinder.
7. Torque bolts to 240 in-lbs (20 ft-lbs).
8. Install front cover.
9. Install latch hardware.
10. Install drive end head.
11. Install shaft (with mechanical seals).
12. Install opposite drive end head.

DANGER: *Before doing any maintenance work on the Votator II, lock out and tag out equipment.*

Shaft Removal - Vertical Unit

1. Purge all product from unit.
2. Disconnect product piping from opposite drive end head.
3. Lower arm of hydraulic lift so that arm can be positioned under opposite drive end head. (See Figure 42, Item A).
4. Raise arm of hydraulic lift to just below opposite drive end head (See Figure 42, Item B) and position lift pin (See Figure 42, Item C) to go into shaft nut.
5. Raise arm so that lift pin is engaged in head and just barely pushing against shaft nut.

WARNING: *Do not move latch or loosen nut from locked position without hydraulic foot in place beneath head.*

Figure 43 - Disengaging Locking Latch

Figure 44- Shaft Fully Extended

6. Unlatch locking latch.
7. The head has an ON-OFF engraving on the rim, located just above product outlet. Rotate head in OFF direction until head disengages.
8. Lower head until hydraulic rod is fully extended. See Figure 44.
9. Once shaft is in down position, blades may be removed from shaft.

NOTE: *Blades should be kept in the same position on mutator shaft throughout life of blade. Make sure blades are removed and reinstalled in the same location on shaft.*

10. If shaft is to be removed from unit, lift head and shaft off lift pin and move head away from unit while a second person guides spline end of shaft out of unit.
11. Place shaft and head assembly on a table or suitable frame for servicing.
12. Scraper blades can be removed and serviced at this time.

Shaft Installation - Vertical Unit

1. Check the condition of the O-ring in the head and lubricate lightly. Assemble head to shaft if necessary, following procedures under “Shaft Installation - Horizontal Unit” on page 48.
2. Assemble head to shaft.
3. Apply anti-seize compound to the drive end splines and the next 3 inches of stub shaft length.
4. Slide splined end of shaft into unit.
5. Lift head onto lift pin.

Figure 45 - Head Installed on Pin

6. Install scraper blades.

NOTE: *Blades should be kept in the same position on mutator shaft throughout life of blade. Make sure blades are removed and reinstalled in the same location on shaft.*

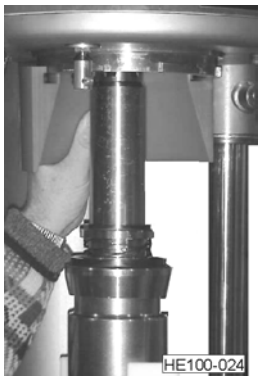


Figure 46 - Align One Half of Blade Alignment Tool

Figure 47 - Blade Alignment Tool Installed

Figure 48 - Close Locking Latch

7. If optional blade aligning tool is used, install it on the bayonet ring of heat transfer tube. Place each half of the ring on the bayonet and rotate it as one piece.
8. Raise shaft slowly, tucking blades into shaft while shaft and blade assembly is being inserted into tube.

NOTE: *If lift binds, STOP and back off hydraulic pressure. Check that blades have not swung fully out and are not binding on the edge of alignment tool. If this happens, check blades and replace as necessary. Restart lift, taking care to guide blades into alignment tool.*

9. If blade aligning tool is not used, the individual controlling hydraulic lift should use one hand to guide each pair of blades into tube.
10. As shaft is raised into gear reducer, it may be necessary to rotate shaft slightly to assure splines are meshed correctly.
11. Continue to raise shaft until head is about six (6) inches from being engaged.
12. Once the last set of blades has been started in tube, remove alignment tool, if used.
13. Continue to raise head slowly, aligning teeth of head with spaces of tube. Raise and turn head so teeth are engaged and product port is facing forward.
14. Close locking latch. See Figure 48.
15. Install product piping and electrical connections.

Heat Exchanger Tube Removal -Vertical Unit

The hydraulic lift on the vertical unit can be used to remove the heat transfer tube from the jacket of the unit.

DANGER: *Before removing the heat exchanger tube from the jacket, all refrigerant must be evacuated from the jacket assembly.*

1. Remove mutator shaft from unit as described in this section.
2. Remove shaft and head from hydraulic lift.
3. Place assembly on a table or maintenance frame.
4. Remove the driven end product head.

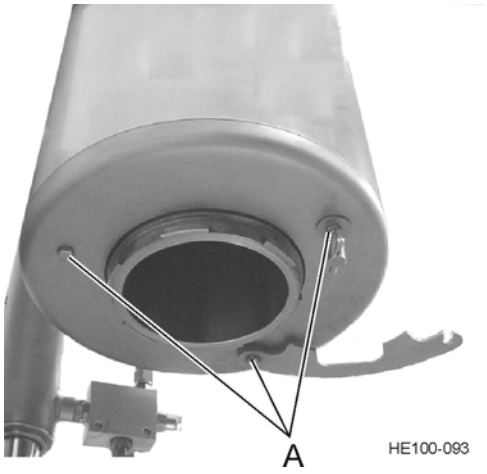


Figure 49 - Remove Front Jacket Cover Bolts

5. Remove the three (3) bolts holding front jacket cover in place.
6. Remove the non-driven product head from mutator shaft.

Figure 50 - Head Reinstalled

7. Reattach head to tube. See Figure 50. Reattach shaft nut cover and clamp, and use lift to position non-driven end head.
8. Loosen bolts on jacket flange.
9. Lower head slightly with hydraulic cylinder to allow tube to move down.

NOTE: *Tube may slide out easily or it may need coaxing out.*

Figure 51 - Insert Jack Screws

10. Lower lift arm slightly to allow tube to move down. At the 12, 6, 3, and 9 o'clock positions, tube flange is threaded for jack screws. Thread two (2) bolts into either the 12 & 6 or 3 & 9 o'clock positions.
11. Tighten bolts about 1/2 turn alternately on each side until flange loosens from jacket. It may be necessary to lower foot on hydraulic cylinder slightly while removing tube from jacket.

Figure 52 - Lower Tube and Service

12. Lower head and tube assembly and service as required.
13. Lubricate and install new O-rings on both ends of tube.
14. Install new packing ring (on steam or liquid tubes).
15. To reinstall tube, reverse the procedure.
16. Torque bolts to 240 in-lbs (20 ft-lbs).

NOTE: *Take care to orient the tube flange holes to line up with the holes in the jacket.*

Mechanical Seal Maintenance

The mechanical seals on the Votator II are the same on both the non-driven and driven ends of the unit. The O-rings and seal materials have been selected for the product specifications. Various options are shown in the Parts Lists starting on page 63.

Single Mechanical Seal

Units furnished before 2005 were installed with either a single or double mechanical seal configuration. For detailed parts drawing breakdown see “Single Mechanical Seal” on page 72.

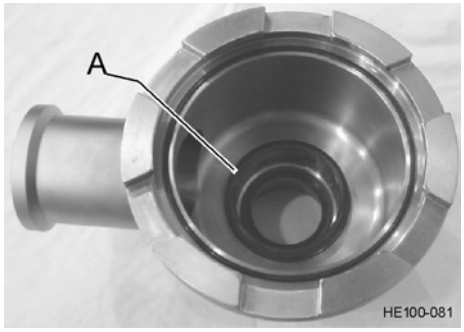


Figure 53 - Seal Head Insert Removal

Seal Head Insert Removal and Installation

The Seal Head Insert located in the product head is removed by tapping the back of the seal with a plastic block or rod. Make sure to hold the insert or use a soft cloth to catch it to prevent it from dropping when removed.

NOTE: *To prevent damage to the seal face do not place the seal face down on any surface during maintenance.*

If the mechanical seal is going to be flushed, the springs in the lip seal should be removed to protect the stub ends on the mutator shaft. Install the seal in the relief position as shown in Figure 54.

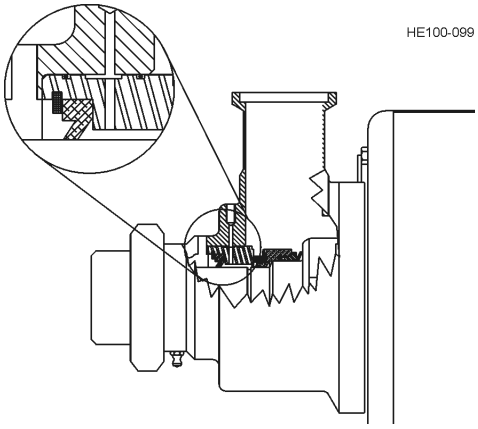


Figure 54 - Lip Seal Orientation

To install a new insert, lubricate the o-rings and the inside bore. Insert in the head with an even distribution of force on the face. The face must be protected with plastic to avoid damage.

Seal Body Insert (Rotating Seal Face) Used Before 2012

The rotating seal face is referred to as the Seal Body Insert. This part is designed to wear at a greater frequency than the seal head insert. An O-ring holds the insert stationary in the seal body.

NOTE: *Do not use a lubricant on the Seal Body Insert O-ring because the insert must remain stationary with respect to the body. If necessary, water can be used as a lubricant.*

The seal insert is symmetrical and can be reversed if one side becomes scratched.

The seal body is held in place on the mutator shaft by two seal drive pins. Each one should be 3/32 inches (+/-0.015) above the stub shaft surface. It is extremely important that these pins are not rounded on the edges and this dimension is maintained. If the pins are higher than 3/32", the seal will jam; if the pins are too low, the body will rotate. See Figure 57.

Install the Seal Body Insert in the Seal Body as follows:

1. Place O-ring in Seal Body.
2. Push Seal Body Insert down evenly with both hands until it bottoms out. See Figure 55.

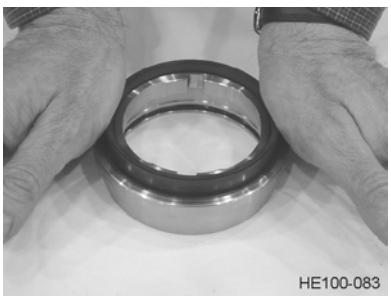


Figure 55 - Press Insert Down Evenly with Both Hands

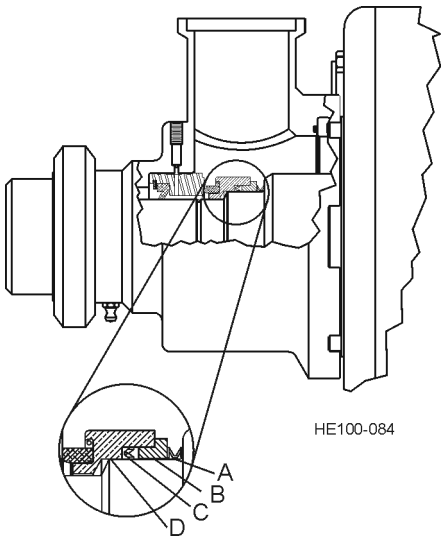


Figure 56 - Orientation of Seal Components

Single Mechanical Seal Installation

After the head insert and the body insert are installed, the remaining components are installed as follows:

1. Place wavy washer spring (See Figure 56, Item A) on shaft.
2. Install seal back-up ring. (See Figure 56, Item B).
3. Install U cup seal with opening toward product side, as shown in Figure 56, Item C.
4. Place seal body (See Figure 56, Item D) on shaft, aligning slots with seal drive pins.

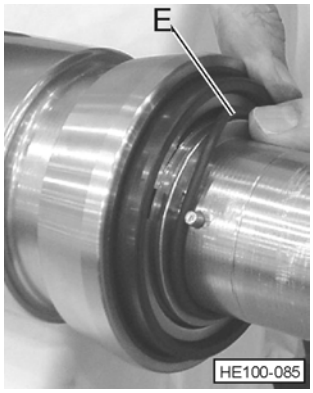


Figure 57 - Install Keeper O-ring

5. Install "keeper" O-ring (See Figure 57, Item E) on shaft to keep rotating parts assembled.
6. Inspect seal to insure that it moves freely with spring and that drive pins keep it stationary with respect to mutator shaft.

One-Piece and Double Mechanical Seals

For detailed parts drawing breakdown, see “Double Mechanical Seal” on page 70. Units furnished before 2005 had a removable seal body insert as described below. In 2005, all single and double mechanical seals were furnished with a one-piece primary seal body. Starting in 2012, a new seal body design with a removable wear face is furnished.

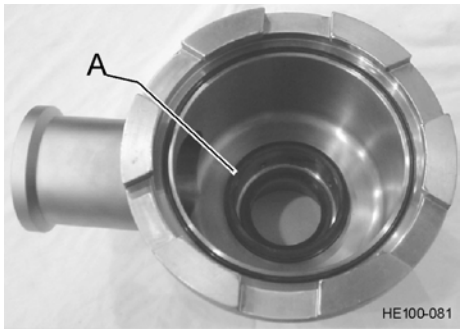


Figure 58 - Seal Head Insert Removal

Primary/Secondary Seal Head Insert Removal and Installation

The primary seal head insert located in the product head is removed by tapping the back of the seal with a plastic block or rod. It contains the secondary seal head insert and the two parts can be removed as an assembly or separately, as the secondary ring is held in the primary by an O-ring. Make sure to hold the insert or use a soft cloth to catch it to prevent it from dropping when removed.

NOTE: *To prevent damage to the seal face, do not place seal face down on any surface during maintenance.*

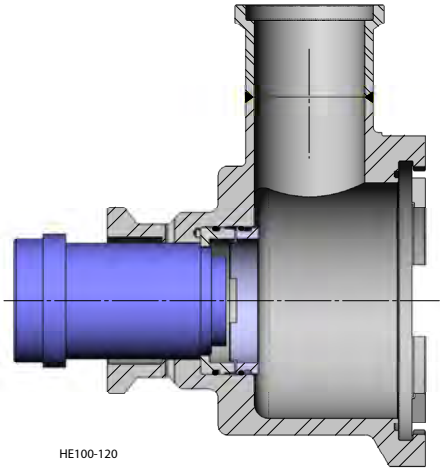


Figure 59 - Gland and Seat Removal

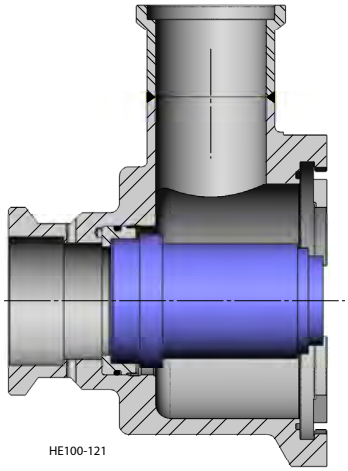


Figure 61 - Gland Installation

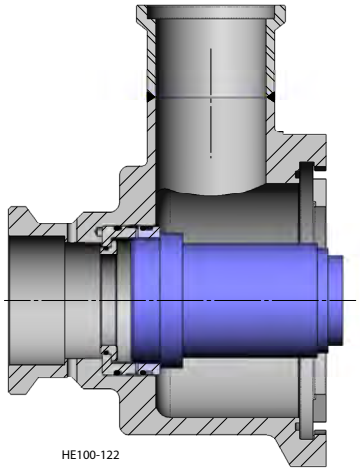


Figure 62 - Seal Installation

To install a new primary or secondary insert, lubricate o-rings and the inside bore. Insert in the head with an even distribution of force on face. Protect the face with plastic to avoid damage.

2012 Primary/Secondary Seal Head Insert Removal and Installation

The primary seal head insert from 2012 onward has two parts, a gland and a seat, but is removed by pushing with the special Seal Installation/Removal tool, part number 130007+ (See Figure 60).

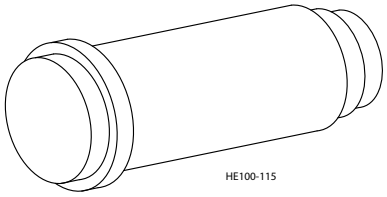


Figure 60 - Seal Installation/Removal Tool

The gland contains the secondary seal head insert, if present, which is held in the primary by an O-ring. Make sure to hold the insert or use a soft cloth to catch it to prevent it from dropping when removed.

NOTE: *To prevent damage to the seal face, do not place seal face down on any surface during maintenance.*

To install a new primary or secondary insert, lubricate all o-rings. Use the fit of the o-ring at the top of the head bore to verify that the inserts are correctly aligned in the bore. Make sure to align the anti-rotation pin with the hole in the bottom of the head bore.

Insert the stainless steel gland into the head, using the 130007+ Seal Installation/Removal Tool with an even distribution of force. Then install the secondary insert into the gland. Finally, align the lugs on the stationary seal face with the spaces between the lugs on the gland, and insert until it meets the gland.

Figure 63 - One-Piece Seal Body

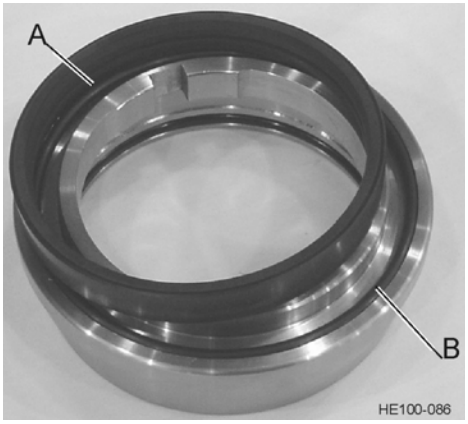


Figure 64 - O-ring Installation on Primary Seal

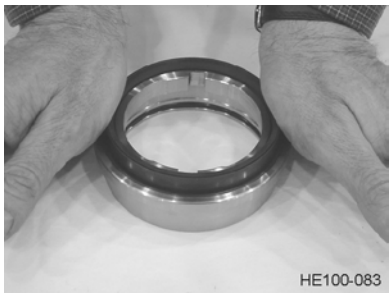


Figure 65 - Press Insert Down Evenly with Both Hands

Figure 66 - 2012 Primary Seal Body

One-Piece Primary Seal Body (Rotating Seal Face)

See Figure 63.

Removable Seal Body Insert (Rotating Seal Face)

The rotating seal face is referred to as the Seal Body Insert. This part is designed to wear at a greater frequency than the seal head insert. An O-ring holds the insert stationary in the seal body.

Assembly of Removable Primary Seal Body

The Primary Seal Body has two O-rings, one on the outside diameter of the ring and the other on the inside diameter that holds the ring stationary.

The O-rings can be hand stretched slightly to fit snugly in the grooves. Preferred assembly is with the O-ring dry. If necessary, water or soapy water can be used as a lubricant.

1. Install one O-ring (See Figure 64, Item B) on outside diameter of ring.
2. Install other O-ring (See Figure 64, Item A) on inside diameter of primary seal.
3. Push insert down evenly with both hands until it bottoms in the housing (Figure 65).
4. Vent trapped air by placing a small flat screwdriver blade between seal ring and outside O-ring.

NOTE: *Air can be become trapped behind Primary Seal Insert after assembly. This air must be vented by placing a small flat screwdriver blade between seal ring and outside O-ring to provide a vent for trapped air.*

5. While the screwdriver is in place, push down firmly on ring.
6. Release screwdriver and check seal to insure that it firm and solid.
7. Place the inner O-ring in the seal body (apply lubrication to this O-ring).

Assembly of 2012 Primary Seal Body

The 2012 primary seal body has one O-ring and three anti-rotation pins that hold the insert stationary on the body.

To install the insert in the seal body:

1. Lubricate and place seal face O-ring in body.
2. Align anti-rotation pins with slots on seal face.
3. Push seal face down evenly with both hands until it snaps over the O-ring.
4. Place the inner O-ring in the seal body (apply lubrication to this O-ring).

Assembly of Secondary Seal Body (For Double Mechanical Seal Only)

The secondary seal body has one O-ring that holds the insert stationary in the body.

To install the insert in the seal body:

1. Place O-ring in body (no lubrication).
2. Push insert down evenly with both hands until it bottoms out.
3. Place O-ring in seal body (lubrication should be applied to this O-ring).

Seal Assembly Installation on Shaft

After the head insert and the body insert are installed, the remaining components are installed as follows:

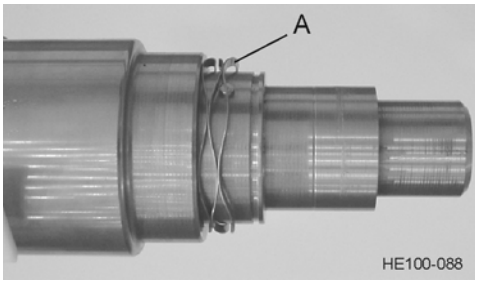


Figure 67 - Install Wavy Spring

1. The primary seal body is held in place on the mutator shaft by two seal drive pins. Each one should be 5/32 inches (+/- 0.015") above the stub shaft surface. The secondary seal body is held in place by one seal drive pin. It should be 3/32 inch (+/-0.015") above the stub shaft surface. It is extremely important that these dimensions be maintained. If the pins are too high, the seal will jam; if they are too low, the body will rotate. See Figure 67 and Figure 70.
2. Place wavy washer spring (See Figure 67, Item A) on shaft.
3. Place seal body (Figure 68) or one piece seal on shaft, aligning slots with seal drive pins.

Figure 68 - Install Seal Body

4. Install "keeper" O-ring (See Figure 69, Item E) on shaft to keep rotating parts assembled.
5. Inspect seal to insure that it moves freely with spring and that drive pins keep it stationary with respect to the mutator shaft.
6. Assemble Secondary Seal Wavy Washer on shaft, if required (See Figure 70).

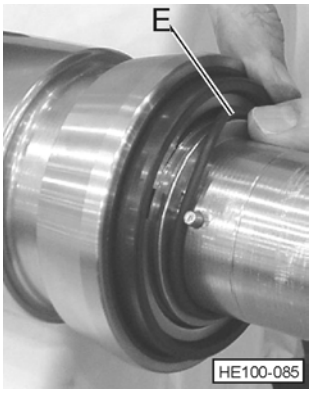


Figure 69 - Install Keeper O-ring

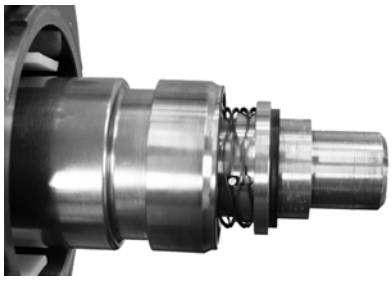


Figure 70 - Double Mechanical Seal Installed

7. Slide seal body over seal body drive pin so that O-ring in body seats in groove in mutator shaft.
8. Check seal to insure that it will move freely with spring and that drive pins hold it stationary with respect to shaft.

Servicing Mechanical Seals - Vertical Votator II

The top mechanical seal can be serviced by lowering the shaft to the floor and removing the seals from the shaft while the spline end is in the heat transfer tube. See Figure 71. See “Mechanical Seal Maintenance” on page 56 for information regarding servicing the seal.

The bottom mechanical seal can be serviced with the mutator shaft in the unit by using the shaft clamp. See Figure 72.

Figure 71 - Exposing Top Mechanical Seal

1. Lower shaft approximately two (2) feet or to a convenient height.
2. Remove top two (2) exposed scraper blades.
3. Position shaft so that blade pins are centered between the bayonet ring on the heat transfer tube.

Figure 72 - Shaft Clamp

4. Install shaft clamp around teeth of tube and shaft. (See Figure 73, Item A)
5. Close locking latch. (See Figure 73, Item B)
6. Lower shaft until a pin from right or left side contacts shaft clamp. **SHAFT MUST BE SUPPORTED BY A PIN AND NOT BY A SCRAPER BLADE.**
7. Lower hydraulic arm and rotate it out of the way.

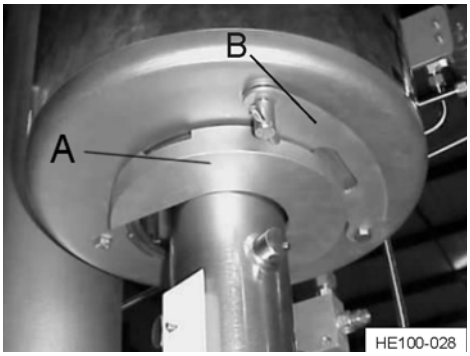


Figure 73 - Installed Shaft Clamp

Figure 74 - Remove Head Clamp

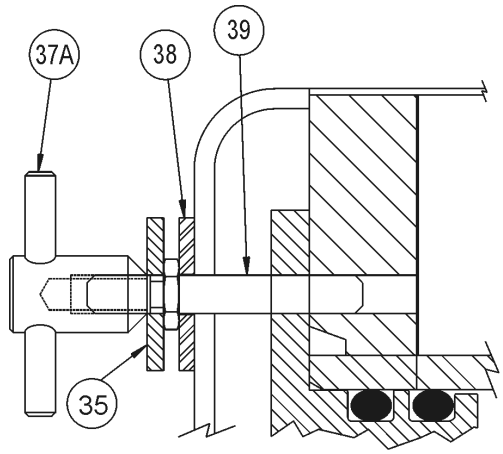
8. Remove clamp on head. (See Figure 74, Item A) and shaft nut guard.
9. While supporting head, remove shaft nut. **(Nut is left hand threaded.)**

Figure 75 - Shaft With Head Removed

10. Grasp head with both hands, remove it from shaft.
11. Seals can now be serviced. See “Mechanical Seal Maintenance” on page 56.
12. To install, reverse the procedure.

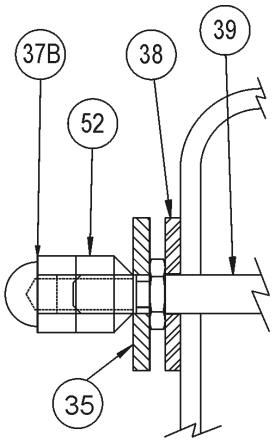
Parts Lists

Latch

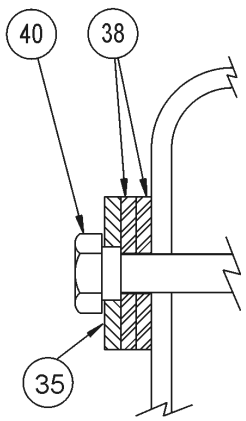


HE100-106

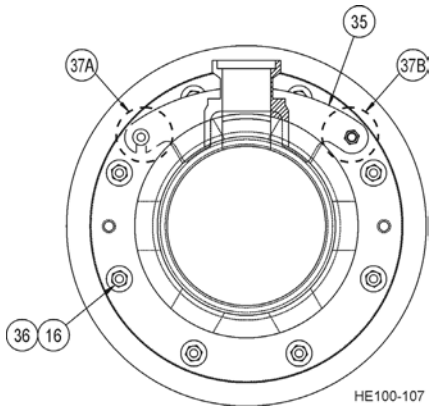
DETAIL A



DETAIL A



DETAIL B



HE100-107

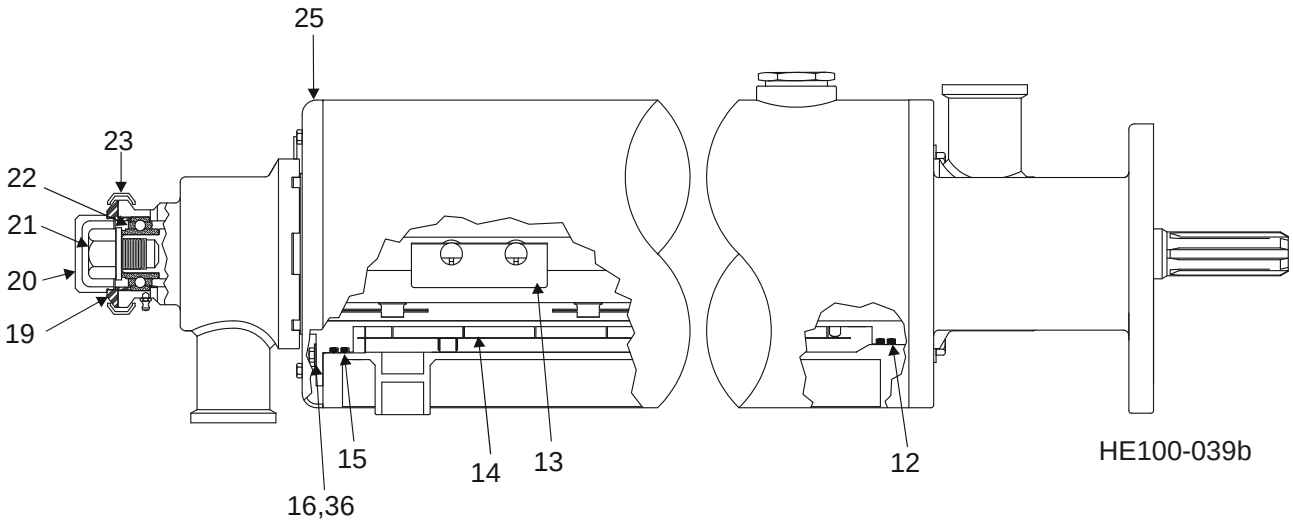
ITEM #	PART DESCRIPTION	QTY	PART #
35	VII Locking Latch	1	LL923221
36	Washer Plain 3/8” 18-8 Narrow	8	43-30
37A	Wing Nut	1	LL2200281
37B	Acorn Nut	1	LL711155
38	Spacer	3	LL2200321
39	Stud	1	LL2200277
40	Hexagon Head Shoulder Screw	1	LL925499
52	Spacer Washer	1	LL931315

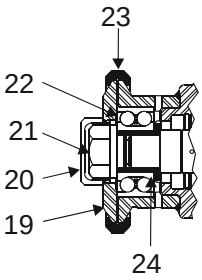
Product Heads

APPLICATION	DESCRIPTION	PART #
Opposite Drive End	Concentric 3” I-Line	LL923245
	Concentric 3” Flanged	LL118415
	Concentric/XHD Bearing 3” Flanged	LL120325
	Concentric/XHD Bearing 3” I-Line	LL119402
	Eccentric 3” I-Line	LL118337
	Eccentric 3” Flanged	LL118419
	Eccentric/Oval/XHD Bearing 3” Flanged	LL120326
	Eccentric/Oval/XHD Bearing 3” I-Line	LL118391
	Eccentric/Oval Spider Head	LL121314
	Concentric Spider Head	LL121359
Drive End	Concentric 3” I-Line	LL923255
	Concentric 3” Flanged	LL118414
	Eccentric/Oval 3” I-Line	LL118336
	Eccentric/Oval 3” Flanged	LL118418

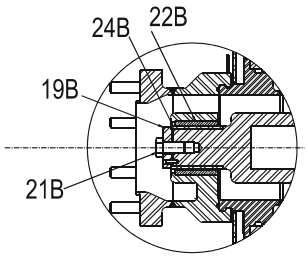
⚠ ***CAUTION:*** *Product heads comply with the ASME pressure vessel code and must not be changed between units of the same design. Also, a concentric head is not interchangeable with an eccentric/oval design.*

Cylinder Assembly

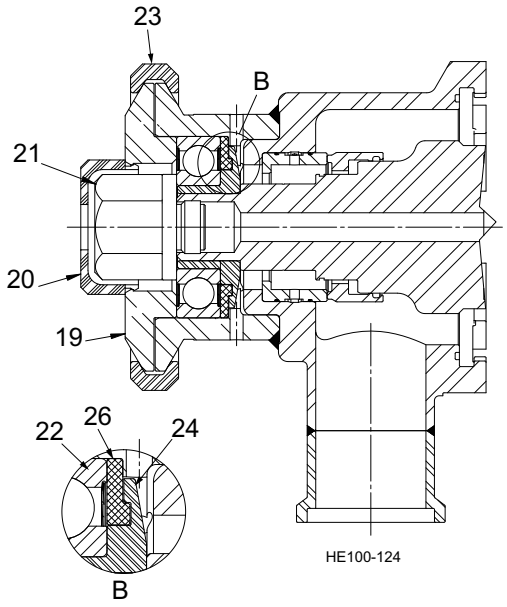




Extra Heavy Duty Bearing Option-obsolete after 2009



Spider Head Option



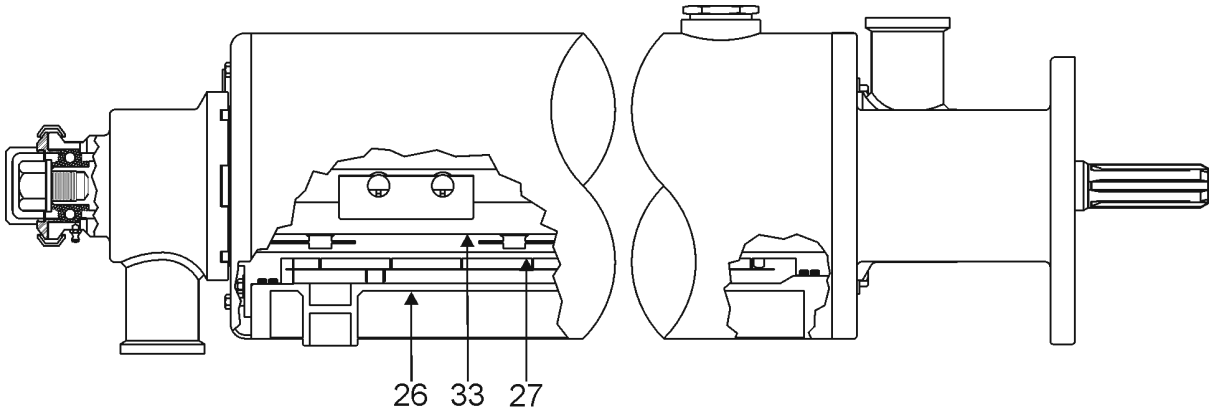
Extra Heavy Duty Bearing Option (Current Design)

Cylinder Assembly

ITEM #	PART DESCRIPTION	QTY	MODEL/MATERIAL	PART #
12	Jacket O-ring (Drive End)	2	EPDM	E70444
			Neoprene (Rfg)	R70444
			Fluoroelastomer	V75444
13	Blades	AR	PEEK	LL118683
			410 SS	LL900127
			Celcon	LL900129
			Brass	LL918089
			410 SS (5-1/4" dia. only)	LL926752
14	Packing, Concentric and Eccentric	1	BWS only	LL710015
	Packing, Oval	1	Liquid Jacket	LL710296
15	Jacket O-ring (Opposite Drive End)	2	EPDM	E70446
			Neoprene (Rfg)	R70446
			Fluoroelastomer	V75446
16	Heavy Hex Head Bolt 3/8-16 x 1	8	ASME SA193-B8, Class 1	LL928781
19	Bearing Retainer	1	Votator II	LL923214
			Extra Heavy Duty Votator II (obsolete after 2009)	LL118393
			Extra Heavy Duty Votator II (Current design)	128476+
19B	Clamp Ring	1	Spider Head Only	LL117678
20	Shaft Nut Guard	1	Horizontal	LL923212
			W/ Shaft Heater (horz or vert)	LL929346
			Vertical	
21	Shaft Locknut	1	Votator II	LL119275A
			Extra Heavy Duty Votator II (obsolete after 2009)	LL118395
			Extra Heavy Duty Votator II (Current design)	128477+
21A	Shaft Locknut Wrench	1	All	79-2
21B	Hex Head Cap Screw	1	Spider Head Only	LL718934
22 *	Ball Bearing	1	Votator II	LL923215
			Extra Heavy Duty Votator II (obsolete after 2009)	LL118392
			Extra Heavy Duty Votator II (Current design)	128473+
22B	Sleeve Bearing	1	Spider Head Only	LL117679F
23	Hinged Sanitary Clamp	1	Votator II	0346223+
			Extra Heavy Duty Votator II (both designs)	0348223+
24 *	Bearing Sleeve	1	Extra Heavy Duty Votator II (obsolete after 2009)	LL118394
			Extra Heavy Duty Votator II (Current design)	128474+
24B	Shaft Sleeve	1	Spider Head Only	LL117680C
26 *	Stator	1	Extra Heavy Duty Votator II (Current design)	128475+
*	XHD Bearing Assembly	1	Extra Heavy Duty Votator II (Current design)	128472+

* For the Extra Heavy Duty Bearing Option (Current Design) only, XHD Bearing Assembly (128472+) includes: item 22, Bearing (128473+); item 24, Bearing sleeve (128474+); and item 26, Stator (128475+). Order part number 128472+ to get these parts assembled at the factory.

Cylinder Assembly - Shaft



HE100-040

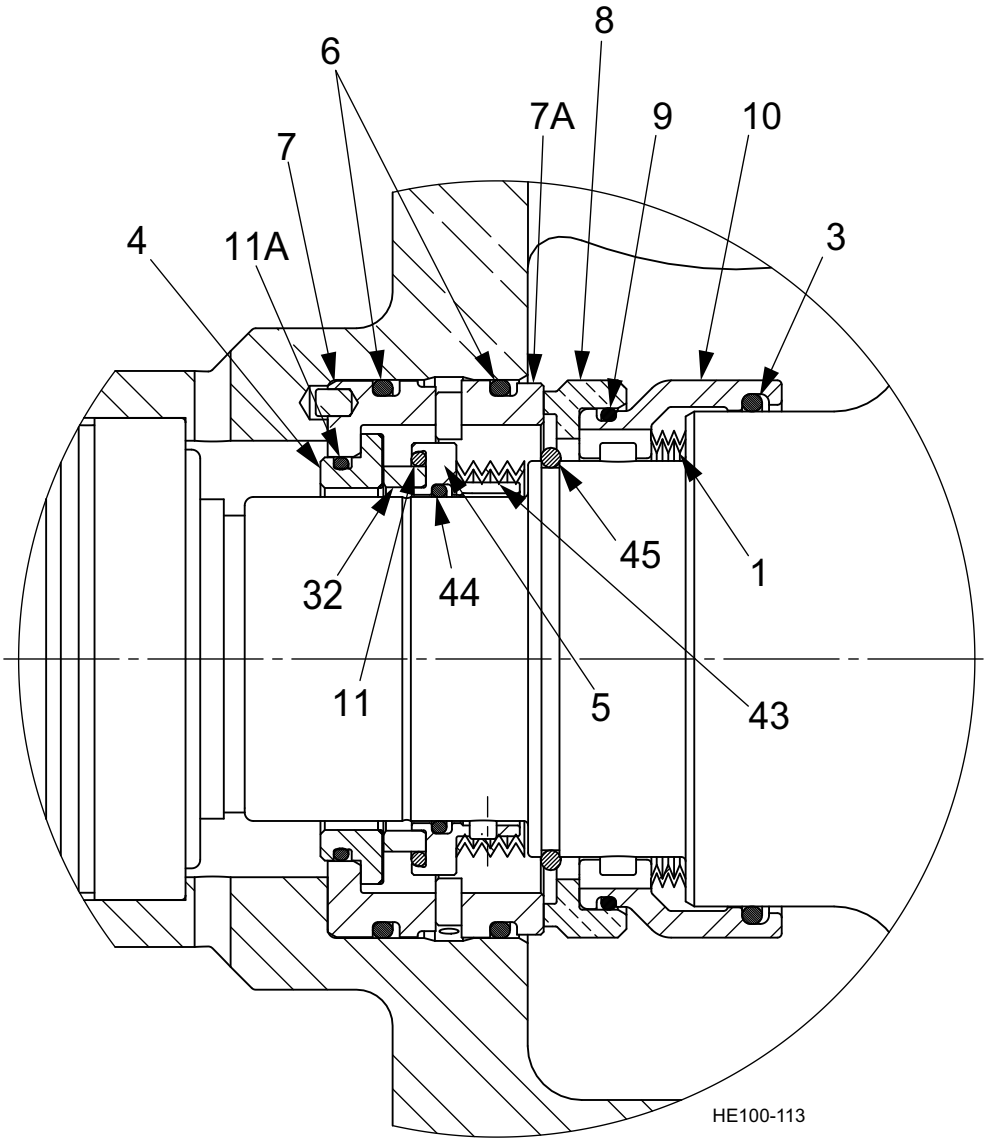
SIZE	SEAL TYPE	SHAFT MODEL	PART #	SEAL TYPE	SHAFT MODEL	PART #
6 x 24	Single Mechanical	5-1/4" dia	LL118919	Double Mechanical	4" dia	LL122760
					4-1/2" dia	LL936881
6 x 36	Single Mechanical	2-1/2" dia	LL935989	Double Mechanical	2-1/2" dia	NA
		4" dia	LL930524		4" dia	LL935518
		4-1/2" dia	LL936898		4-1/2" dia	LL935563
		5-1/4" dia	NA		5-1/4" dia	NA
6 x 48	Single Mechanical	2-1/2" dia	LL935987	Double Mechanical	2-1/2" dia	NA
		4" dia	LL936764		4" dia	LL936743
		4-1/2" dia	LL936765		4-1/2" dia	LL936786
		5-1/4" dia	LL935921		5-1/4" dia	NA
		EHD 4" dia	NA		EHD 4" dia	LL122335
6 x 72	Single Mechanical	2-1/2" dia	LL936763	Double Mechanical	2-1/2" dia	LL935679
		4" dia	LL929847		4" dia	LL934809
		4-1/2" dia	LL935650		4-1/2" dia	LL935423
		5-1/4" dia	LL929872		5-1/4" dia	LL936147
		ECC 4" dia	LL936761		EHD 4" dia	LL123534
		EHD 4-1/2" dia	LL123855		EHD 4-1/2" dia	LL122585
					EHD 5-1/4” dia	LL122617
6 x 84	Single Mechanical	2-1/2" dia	NA	Double Mechanical	2-1/2" dia	NA
		4" dia	NA		4" dia	LL124774
		4-1/2" dia	LL122304		4-1/2" dia	LL121858
					EHD 2-1/2” dia	131148+
					EHD 4” dia	131149+

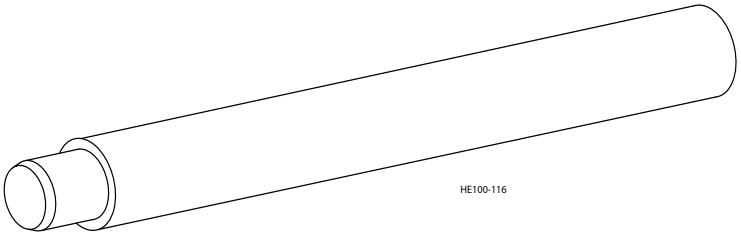
DESCRIPTION	SIZE	PART #
Shaft Skid (horizontal Votator only)	6 x 24	LL934744
	6 x 36	
	6 x 48	
	6 x 72	LL934394
	6 x 84	

Cylinder Assembly - Removable Tube

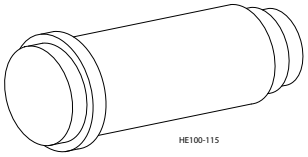
SIZE	APPLICATION	CODE TYPE	DESCRIPTION	PART #
6 x 24	BWS	UM	316 SS TW/WO RINGS	LL936879
		UM	316 SS CR	130906+
		UM	NI/CR	LL122763
	VAPOR	UM	316 SS TW/W RINGS	LL118829
		UM	NI/CR	LL118909
6 x 36	BWS	UM	NI/CR	LL930693
		UM	316 SS TW/WO RINGS	LL930078
		UM	ECC NI/CR	LL934767
	VAPOR	UM	NI/CR (600 PSI)	LL936784
		U	NI/CR (800 PSI)	LL934076
		UM	316 SS TW/W RINGS	LL930077
		UM	316 SS TW/CR/WO RINGS	LL123554
6 x 48	BWS	UM	NI/CR (600 PSI)	LL935920
		UM	316 SS TW/WO RINGS	LL934342
		UM	316 SS CR/WO RINGS	LL936802
		UM	ECC NI/CR	LL936730
	VAPOR	UM	NI/CR	LL936583
		UM	316 SS TW/W RINGS	LL930582
		UM	ECC NI/CR	NA
6 X 72	BWS	UM	NI/CR (600 PSI)	LL929756
		UM	316 SS TW/WO RINGS	LL929263
		UM	316 SS TW/CR/WO RINGS	LL930735
		UM	CS/CR	LL121057
		UM	ECC NI/CR	LL935827
		UM	ECC TW/CR/WO RINGS	LL123513
		UM	OVAL NI/CR (400 PSI & 150 PSI)	LL120327
		UM	OVAL NI/CR (400 PSI & 60 PSI)	LL123535
		U	NI/CR (800 PSI)	LL925501
		U	316 SS (800 PSI)	LL935644
	VAPOR	U	NI/CR (600 PSI)	LL929396
		UM	316 SS TW/W RINGS	LL928761
		UM	CS/CR	LL120274
		UM	ECC NI/CR (600 PSI)	LL929917
		U	316 SS TW/CR/W RINGS	LL930351
		UM	OVAL NI/CR (400 PSI & 150 PSI)	LL119565
		U	NI/CR (800 PSI)	LL925507
		U	316 SS (800 PSI)	LL928641
		U	ECC 316 SS (800 PSI)	LL929819
		UM	ECC 316 SS (600 PSI)	LL119113
6 X 84	BWS	UM	316 SS TW/WO RINGS	LL122017
		UM	NI/CR	129916+
		UM	316 SS TW/CR W/O RINGS	LL125960
		UM	CS/CR	LL121059
	VAPOR	UM	316 SS TW/WO RINGS	LL122018
		UM	316 SS TW/W RINGS	LL122019
		UM	316 SS TW/CR W/RINGS	LL124775
		UM	CS/CR	LL121058
		UM	NI/CR	131130+

2012 Double Mechanical Seal





ODE Head Installation/Removal Tool
LL121191



Seal Installation/Removal Tool
130007+

2012 Single and Double Mechanical Seal

ITEM #	DESCRIPTION	QTY PER SEAL	MATERIAL OPTION	PART #
1	Spring-VII Product Seal (Wavy Washer)	1	Standard	LL922313A
3	O-ring	1	Buna	N75237
			EPDM	E70237
			FKM	V70237-680
4*	Seal ring	1	Chrome oxide	LL934871
5*	Seal Body-VII Secondary	1		LL932357
6	O-ring	2	Buna	N70239
			EPDM	E70239
			FKM	V70239
7	Gland-VII Pinned Seal Seat	1	316LSS	129426+
7A	Seat-Seal Head Insert	1	Ceramic	122986+
			Silicon Carbide	122987+
8	Seal Face-VII Rotary	1	Carbon	129059+
			Silicon Carbide	129061+
			Tungsten Carbide	129062+
			Tungsten Carbide (narrow face)	129402+
9	O-ring	1	Buna	N70152
			EPDM	E70152
			FKM	V70152
10	Seal Body-VII Positive Drive	1	Standard	128896+
11*	O-ring	1	Buna	N70147
			EPDM	E70147
			FKM	V70147
11A*	O-ring	1	Buna	N70146
			EPDM	E70146
			FKM	V70146
32*	Insert-Seal Body	1		LL934083
43*	Spring-VII Outer Seal (Wavy Washer)	1	Standard	LL932362
44*	O-ring	1	Buna	N70140
			EPDM	E70140
			FKM	V70140
45	O-ring	1	Buna	N70230
			EPDM	E70230
			FKM	V70230

NOTE: *Seal face material options (items 7A and 8): Permissible material combinations are: Carbon/Ceramic; Carbon/Silicon Carbide; Silicon Carbide/Silicon Carbide; and Tungsten Carbide/Silicon Carbide.*

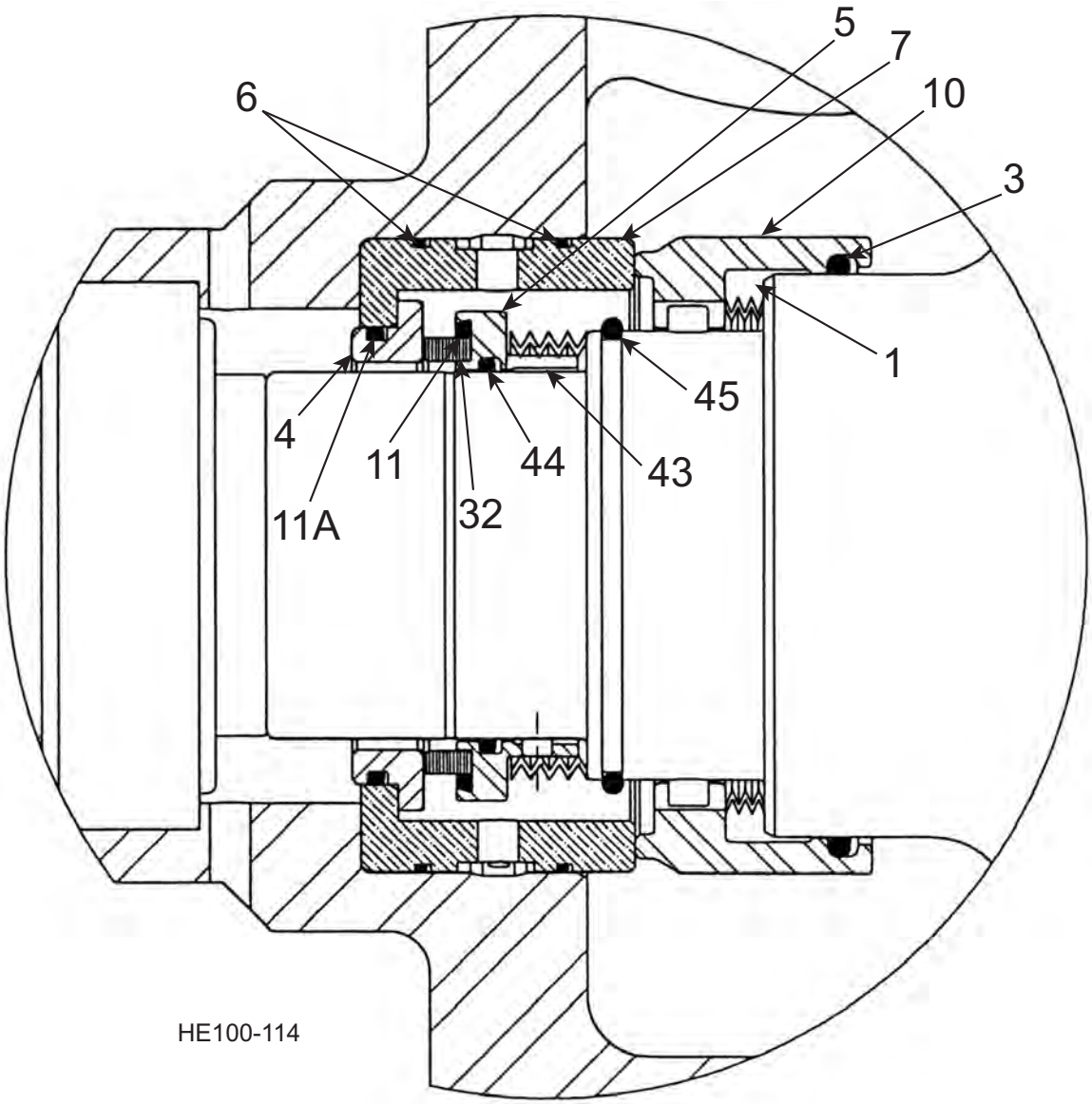
NOTE: *Items 4, 5, 11, 11A, 32, 43, and 44 are required when the seal must be flushed.*

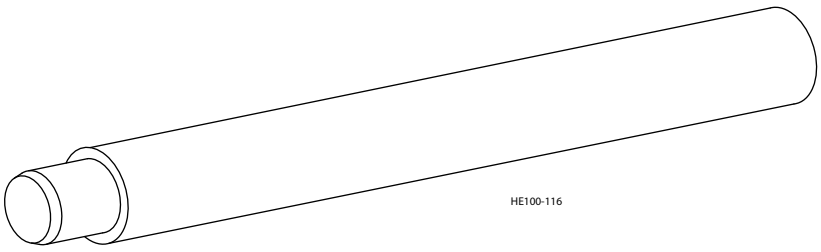
NOTE: *Use ODE Head Installation Tool LL121191 to protect head insert when installing or removing the opposite drive end product head.*

NOTE: *Seal installation tool 130007+ can be used for inserting and removing the gland and seal. The small end is used for secondary seal installation and removal and removal of the gland and seat. The large end is used for gland and seal seat installation.*

* Used on Double Mechanical Seal only.

Double Mechanical Seal





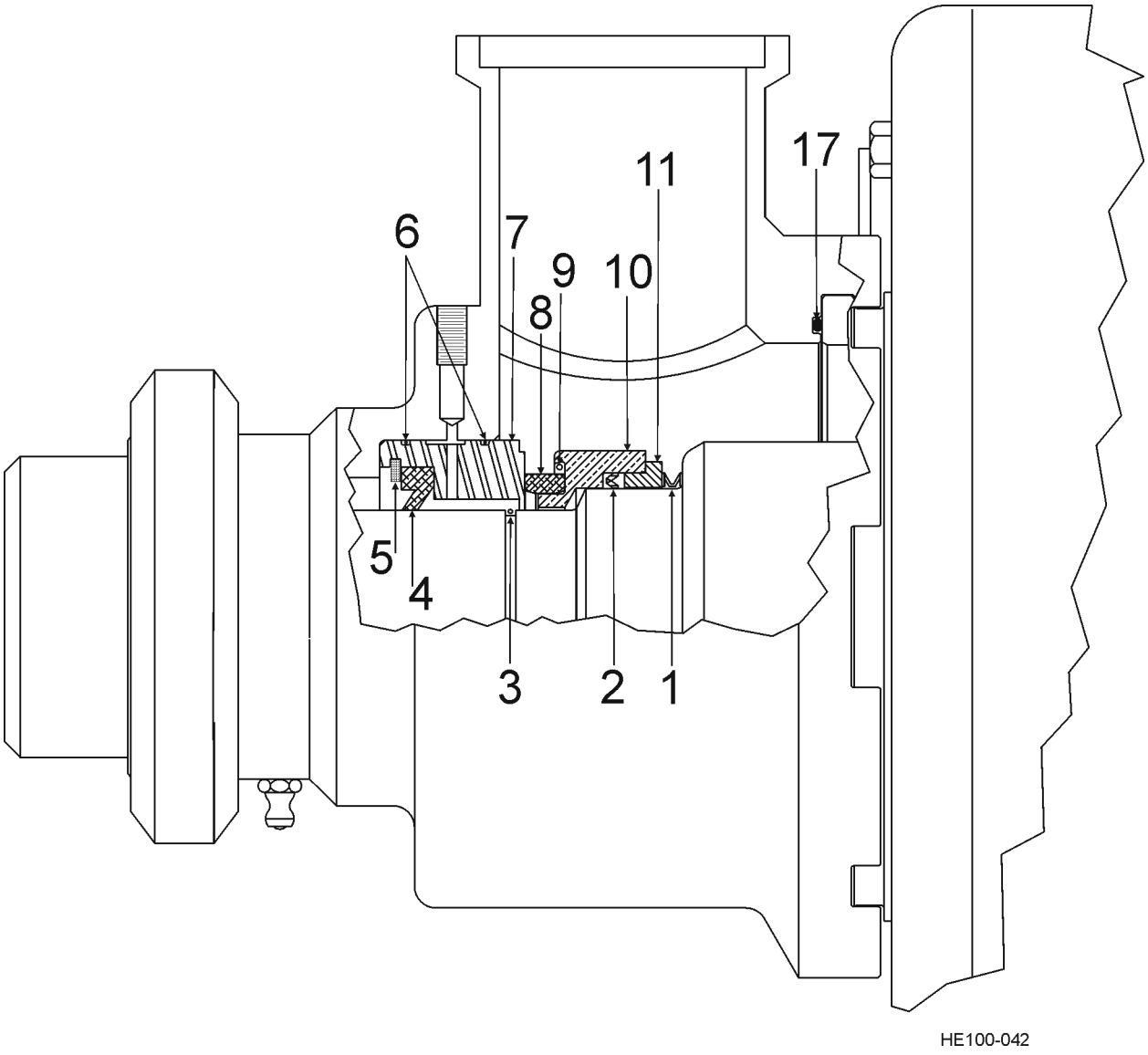
ODE Head Installation/Removal Tool
LL121191

One Piece Single & Double Mechanical Seal

ITEM #	DESCRIPTION	QTY PER SEAL	MATERIAL OPTION	PART #
1	Wavy Washer (Primary)	1	Standard	LL922313
3	Seal Body O-ring (Primary)	1	Buna	N75237
			Fluoroelastomer	V70237-680
			EPDM	E70237
4*	Seal Ring (Secondary), if required	1	All	LL934871
5*	Seal Body (Secondary), if required	1	All	LL932357
6	Seal Head Insert O-ring (Primary)	2	Buna	N75044
			Fluoroelastomer	V70044-680
			EPDM	E70044
7	Seal Head Insert (Primary)	1	Ceramic	LL934873
10	One Piece Seal Body (Primary)	1	Chrome Oxide/316SS	LL122411
11*	Seal Ring/Body O-ring (Secondary)	1	Buna	N70147
			EPDM	E70147
11A*	Seal Ring/Body O-ring	1	Buna	N70146
			EPDM	E70146
17	Product Head O-ring	2 per cyl	Buna	N70259
			Fluoroelastomer	V70259-680
			EPDM	E70259
32*	Seal Body Insert (Secondary)	1	All	LL934083
43*	Wavy Washer (Secondary)	1	All	LL932362
44*	Seal Body O-ring (I.D. Secondary)	1	Buna	N70140
			EPDM	E70140
45	Seal Keeper O-ring (Primary)	1	Buna	N70230
			EPDM	E70230

NOTE: *Use ODE Head Installation Tool LL121191 to protect head insert when installing or removing the opposite drive end product head.*

Single Mechanical Seal



Single Mechanical Seal

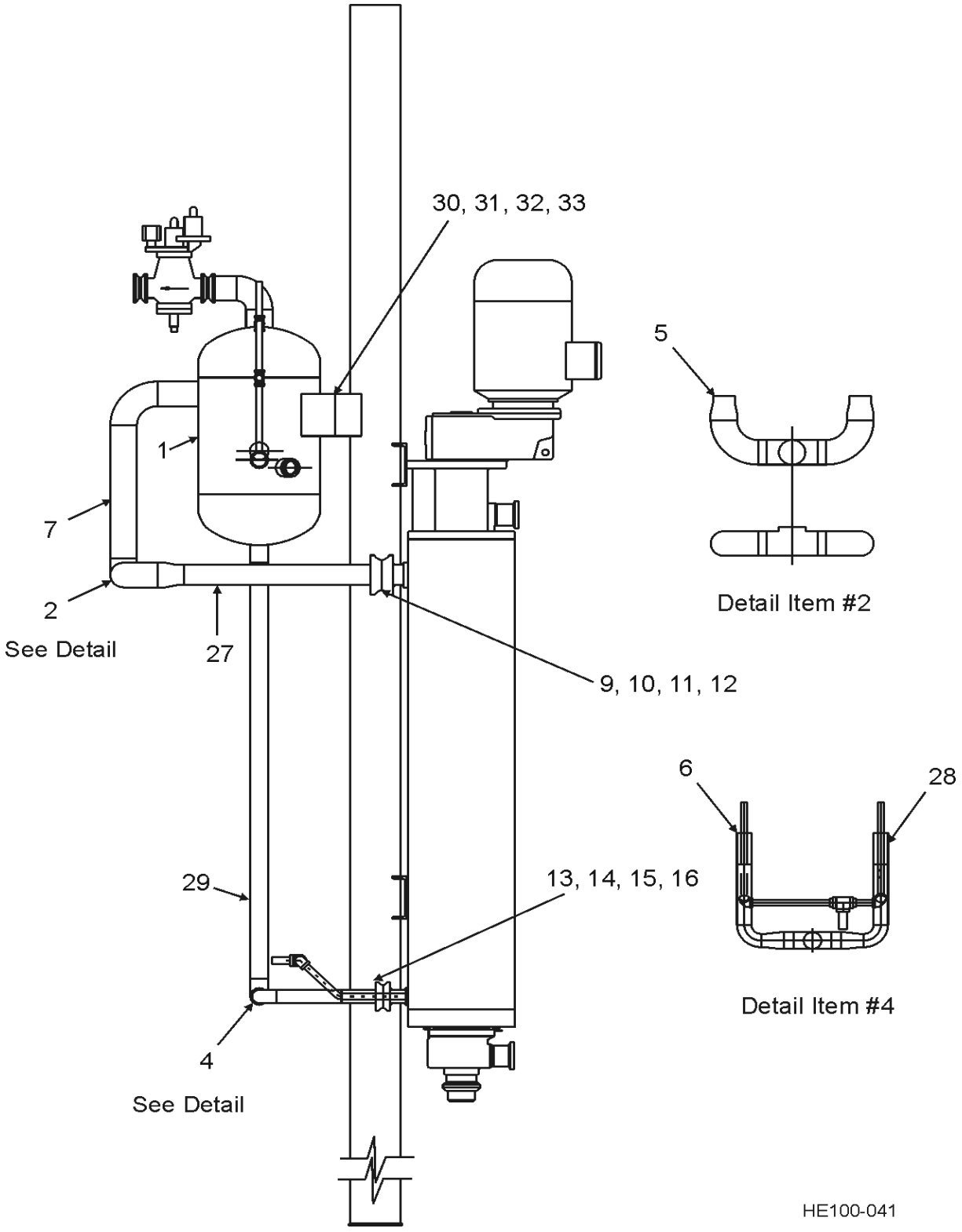
ITEM #	DESCRIPTION	QTY PER SEAL	MATERIAL OPTION	PART #
1	Wavy Washer	1	Standard	LL922313
			Particulate Option	LL19625A
2	Seal Body U-cup	1	Buna	LL700014A05
			Fluoroelastomer	LL700014A08
			EPDM	LL700014A03
3	Seal Keeper O-ring	1	Buna	N75226
			Fluoroelastomer	V70226-680
			EPDM	E70226
4	Flushing Lip Seal	1	All	LL925472
5	Retaining Ring	1	All	LL930685
6	Seal Head Insert O-ring	2	Buna	N75044
			Fluoroelastomer	V70044-680
			EPDM	E70044
7	Seal Head Insert	1	Chrome Oxide/316 SS	LL923210
			Ceramic	LL928508
8	Seal Body Insert	1	Carbon	LL110892A4
			Siliconized Graphite	LL929270
			Ceramic	LL110892C1
			Pin Option (Ceramic)	LL934610
9	Seal Body Insert O-ring	1	Buna	N75235
			Fluoroelastomer	V70235-680
			EPDM	E70235
10	Seal Body	1	Standard	LL110893A
			Pin Option	LL927352
11	Seal Back Up Ring	1	Standard	LL110203Cl
17	Product Head O-ring	2 per cyl	Buna	N70259
			Fluoroelastomer	V70259-680
			EPDM	E70259

NOTE: *Use ODE Head Installation Tool LL121191 to protect head insert when installing or removing the opposite drive end product head.*

NOTE: *Items 4, 5, 11, 11A, 32, 43, and 44 are required when the seal must be flushed.*

* Used on Double Mechanical Seal only.

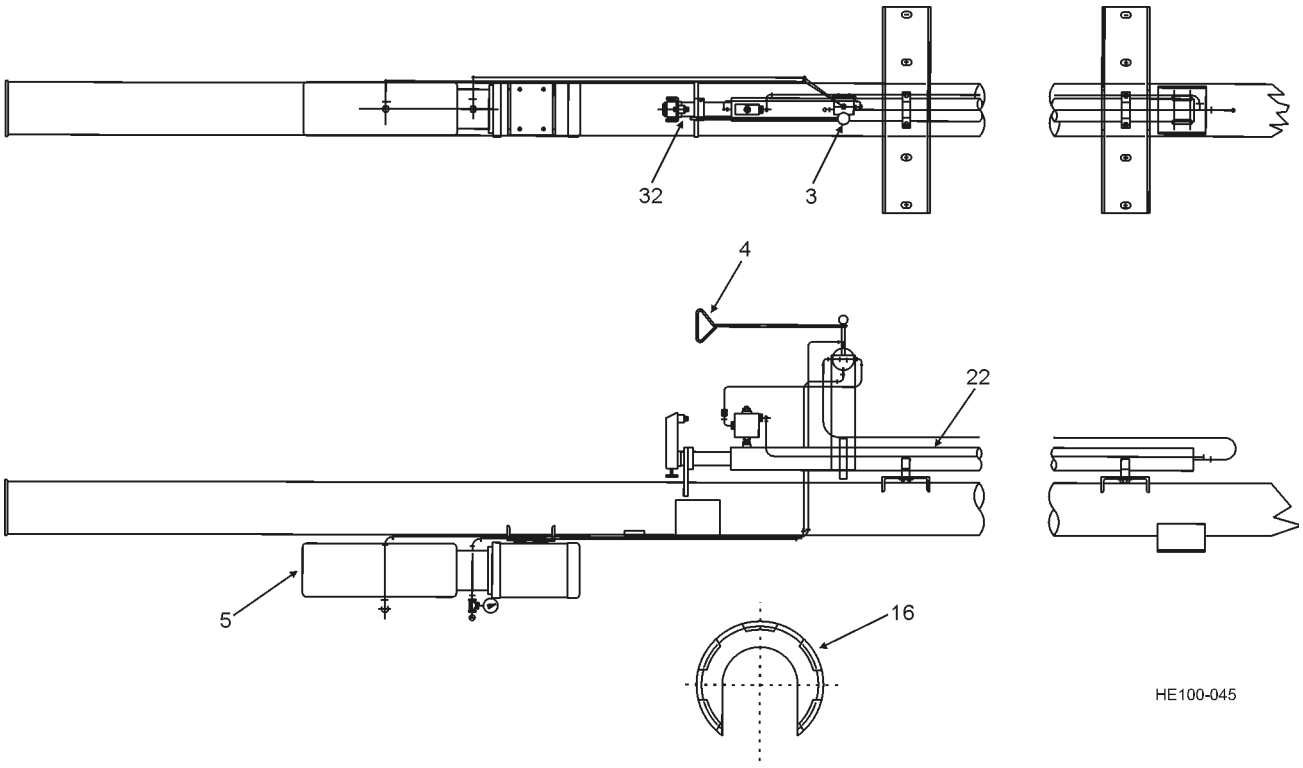
Vertical Refrigeration Piping



Vertical Refrigeration Piping

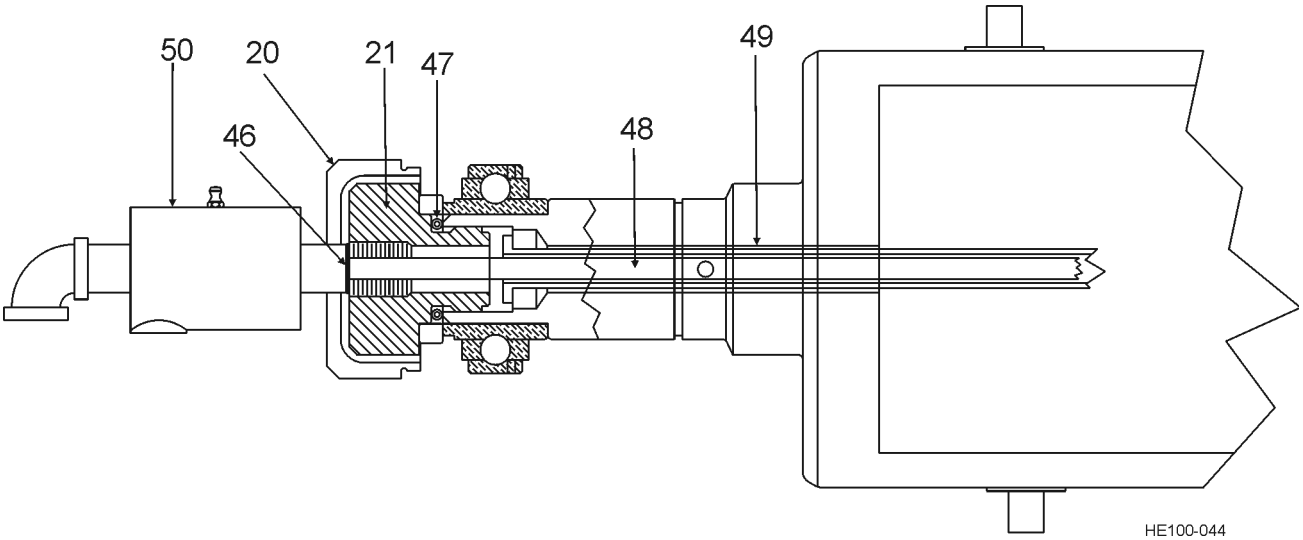
ITEM #	DESCRIPTION	QTY PER ACC	NOTES	PART #
1	Accumulator	1	16" Diameter	LL929516
2	Refrigeration Piping	1	Upper Accumulator Piping	LL930348
4	Refrigeration Piping	1	Lower Accumulator Piping	LL930349
5	Weld Cap	AR	One Cylinder Only	LL901386
6	Weld Cap	AR	One Cylinder Only	LL901387
7	Refrigeration Piping	1	Upper Accumulator Piping	LL930347
9	S W Refrigeration Flange	AR	2-1/2 Male	LL700017A62
10	Refrigeration Flange Gasket	AR	2-1/2	LL710260
11	Square Head Machine Bolt	4 per flg	3/4 - 10 x 3-1/2 Lg	LL723931
12	Hex Nut	4 per flg	3/4 - 10	LL710112
13	S W Refrigeration Flange	AR	1-1/2 Female	LL919616
14	Refrigeration Flange Gasket	AR	1-1/2	LL917488
15	Square Head Machine Bolt	4 per flg	5/8 - 11 x 3 Lg	LL301535
16	Hex Nut	4 per flg	5/8 - 11	LL710011
27	Carbon Steel Pipe	AR	2-1/2 Sch 40	LL006396
28	Carbon Steel Pipe	AR	1-1/2 Sch 80	LL003028
29	Carbon Steel Pipe	AR	2 Sch 40	LL001149
30	Hex Head Cap Screw	2	1/2 - 13 x 1 Lg	LL712482
31	Flat Washer	2	1/2	LL710292
32	Spring Lockwasher	2	1/2	LL712553
33	Hex Nut	2	1/2 - 13	LL711662

Vertical Frame/Hydraulics



ITEM #	DESCRIPTION	QTY PER POLE	MODEL	PART #
3	Hydraulic Valve	1	All	LL928736
4	Push - Pull Handle	1	All	LL929343
5	Hydraulic Power Assembly	1	3/4 HP CLR	LL928737
	Pump/Adapter Kit Only	1		LL928737-1
16	Shaft Stop Clamp	1	4” Shaft	LL935529
			4-1/2” Shaft	LL931279
			5-1/4” Shaft	LL935191
22	Hydraulic Cylinder	1	6 x 24 Cylinder	LL121897
			6 x 36 Cylinder	LL121898
			6 x 48 Cylinder	LL121899
			6 x 72 Cylinder	LL121884
			6 x 84 Cylinder	LL121900
32	Pivot Pin	1	All	LL928742

Shaft Heater (Optional)



ITEM #	DESCRIPTION	MODEL	QTY	PART #
20	Shaft Nut Guard	All	1	LL929346
21	Shaft Locknut	All	1	LL119275A
46	Gasket	All	1	LL117720
47	O-ring	All	1	N70222-674
48	Shaft Heater Pipe	6 x 24 Cylinder	1	LL123001
		6 x 36 Cylinder	1	LL112278E
		6 x 48 Cylinder		
		6 x 72 Cylinder		
		6 x 84 Cylinder		
49	Heater Pipe Support	6 x 24 Cylinder	1	LL936930
		6 x 36 Cylinder	1	LL934075
		6 x 48 Cylinder	1	LL936598
		6 x 72 Cylinder	1	LL929942
		6 x 84 Cylinder	1	LL123553
50	Rotary Joint	All	1	LL700043D61

Votator II Blades

MATERIAL	REMARKS	PART NO.	QUANTITY				
			6x84	6x72	6x48	6x36	6x24
410SS		LL900127	28	24	16	12	8
CELCON		LL900129					
BRASS		LL916284					
17-7 SS		LL900124					
PEEK		LL118683					
410SS	Open Style	LL125801					
BRASS		LL918089					
17-7 SS		LL919100					
CELCON	Open Style with holes	LL900133					
PEEK		LL121856					
DELRIN	For 5-1/4" shaft only	128675+	N/A	8	4	N/A	2
		128675M1	N/A	2	2	N/A	N/A
		128675M2	N/A	2	2	N/A	N/A
410SS	For 5-1/4" shaft only	LL926752	N/A	8	4	N/A	2
		LL926752M1	N/A	2	2	N/A	N/A
		LL926752M2	N/A	2	2	N/A	N/A
POLY	For 5-1/4" shaft only	LL3005185	N/A	12	8	N/A	2

HE100-004

Labels

PART NUMBER	DESCRIPTION
LL927603	Corrosion Prevention
LL725499	Caution/Warning Shaft Guard
LL119170	Danger - Contents Under Pressure
LL125098	3-A Label
LL119169	Safety Instructions
LL930514	SPX/WCB Logo Horizontal
LL930513	SPX/WCB Logo Vertical
LL931360	Caution/Warning Product Head Locking Latch (Vertical)
LL931407	Caution/Warning Product Head Locking Latch (Vertical)

Troubleshooting

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
Freeze-up.	Power failure.	Check power supply.
	Product outlet temperature too low.	Adjust process to raise product outlet temperature.
	Product flow rate too low.	Adjust process to increase product flow. Check that pump is matched to process.
	Product ran out of supply tank prematurely.	Adjust supply to prevent supply lines from running dry.
	Incorrect start-shutdown procedure.	Refer to “Startup Procedure” on page 35.
Heat transfer not at expected level.	Process not set correctly.	Check current process to system specs at time of installation.
	Product pressure lower than steam pressure in jacket.	Utilize back valve to assure that system pressure is at a minimum of 10 psi (0.7 bar) above the media pressure.
	Oil in system.	Check and drain oil regularly from accumulator and other oil separators, oil legs or pots in refrigeration system.
	Steam on jacket super heated.	Use only dry and saturated steam.
	Oil deposits on transfer tube.	Remove heat transfer tube and clean any deposits on tube. Add filter system to remove impurities from cooling agents.
	Liquid flow rate on jacket too low.	Use jacket recycle loop at a flow of 50 GPM.
	One or several system valves or floats not functioning properly.	Inspect and test system valves and floats as indicated in “Preventive Maintenance” on page 41. Replace as necessary.
	Water and air in cooling system.	See “Water and Air in Refrigeration System” on page 82.
Tube Scoring.	Temperature extremes.	Replace tube if scoring becomes great. Refer to “Care of Heat Exchanger Tube” on page 43.
Lower back pressure required to achieve desired refrigerant temperatures.	System operating at a high vacuum causing water in refrigeration system.	Refer to “Water and Air in Refrigeration System” on page 82.
Increased compressor head pressure.	Air in refrigeration system.	Refer to “Water and Air in Refrigeration System” on page 82.

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
Increased gas discharge temperature.	Air in refrigeration system.	Refer to “Water and Air in Refrigeration System” on page 82.
Seal head will not install properly.	Twisted when installed.	Lubricate before installing.
	Installed wrong size, distorted O-ring, or cut O-ring.	Replace O-ring.
	Wrong O-ring compound (ring is a different color than normal).	Replace with specified O-ring. If unsure of correct O-ring, contact WCB.
	Damaged seal head insert.	Replace entire seal.
	Recess in head for seal head insert damaged.	Contact WCB for repair instructions.
Leakage across seal body.	O-ring twisted when installed.	Lubricate before installing.
	Wrong O-ring compound (ring is a different color than normal).	Replace with specified O-ring. If unsure of correct O-ring contact WCB.
	Damaged seal body.	Replace entire seal.
	Damaged seal backing ring.	Replace seal backing ring.
	Damaged shaft at O-ring sealing surface.	Contact WCB for repair instructions.
	Seal ring rotating in seal body.	Assemble ring in body without lubrication.

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
Product leaking: • **Between lapped or polished surfaces of seal head insert and seal body.** • **Around O-rings of interface of head and seal head insert.** • **Around interface of seal body and shaft.**	Seal insert cocked when installed.	Remove and reinstall, making sure the o-ring is not twisted.
	Seal body and/or seal faces worn or damaged.	Replace entire seal.
	Seal insert cracked.	Replace seal insert.
	Seal springs weak.	Replace springs.
	Seal backing ring deformed.	Replace backing ring.
	Seal body freedom diminished.	Disassemble, clean, inspect, lubricate pieces and reassemble.
	Seal drive pin worn or missing.	Replace with new seal drive pin.
	Seal retaining ring out of place.	Inspect retaining ring and lip seal. Replace as necessary.
	Insufficient spring pressure to hold body and insert together after several hours of running.	Replace springs.
	Seal body and/or seal insert damaged by handling.	Always lay seal faces on clean cloth. Move mutator shaft into operating position carefully. Do not ram shaft into place. Inspect seal for damage, replace as necessary.
	New or repaired seal body installed against a worn or damaged seal insert, a worn part, or a worn seal body.	Both need to be in good condition. Replace.
	Excessive wear of seal body insert.	Do not operate shaft for more than a few moments without product in cylinder.
	Seal drive pins too high.	Install per dimensions on page 56 or 60 of manual.

Unthawing A Frozen System

To unthaw a system that has frozen-up, perform the following procedures. The cause of freeze-up **MUST BE** corrected before operation is restarted. See the Troubleshooting Chart starting on page 79 for cause and solution aids.

1. Turn refrigeration or coolant source OFF.
2. Heat mutator shaft with shaft heater attachment using hot water (if applicable).
3. Cautiously pump hot water or hot product through unit. Immediately shut down pump if excessive pressure is encountered. If hot gas defrost line is connected, thaw by blowing hot gas through the jacket
4. Continue pumping until shaft can be rotated by bumping the motor.
5. Severe freeze-ups may necessitate disassembly of equipment to remove blockage.
6. Resume normal start-up procedure. The cause of freeze-up **MUST BE** corrected before operation is restarted. See the Troubleshooting Chart on page 79 for cause and solution aids.

Water and Air in Refrigeration System

Water and ammonia combine to form ammonium hydroxide, which combines with oil to form sludge. Sludge is extremely difficult to remove.

Water condenses at the accumulator's pressure and temperature and remains to dilute the liquid ammonia. Ammonia diluted with water has a higher boiling point that requires lower back pressure to achieve the desired refrigerant temperature.

Air in ammonia increases the compressor head pressure and increases the gas discharge temperature. Higher head pressure and temperature may carbonize or vaporize oil. Air also contains moisture that the ammonia refrigerant absorbs.

To avoid difficulties with water and air:

- Regularly purge refrigeration system of air and noncombustible gases. An automatic air purger in the system is recommended.
- Grease all valve stems to keep packing soft. Soft packing allows a better seal to prevent leakage of air past stems, if the systems ever separate on a vacuum.
- Tighten up stuffing boxes to seal out air and moisture.
- Avoid operating system on a high vacuum.


WILLIAMS
WC
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Votator® II

SCRAPED SURFACE HEAT EXCHANGER

WHERE IDEAS MEET INDUSTRY

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