



**Vogt Tube-Ice®  
Mid-Size Machines  
HFO10 - SYS450**

Manual Part Number 12A4171M16

**Vogt Ice®, LLC**  
1000 W. Ormsby Ave.  
Suite 19  
Louisville, KY 40210 USA  
Since 1880

**Sales + Service:** 1-502-635-3000  
**Parts:** Your Local Distributor  
**SuperCare Technical:** 1-502-635-3510 or 1-502-635-3052

**Service Manual**  
**\$50.00 USD**



## Important Safety Information



Any improper attempt to repair major equipment may result in personal injury, property damage, or loss of life. Before installing, operating, adjusting, or servicing the HFO10, please read this manual and become familiar with its contents, understand the operation of this machine, and be aware of possible dangers.

### Safety Symbols and What They Mean

Heed the following safety symbols, which may appear in this manual and/or on the machine.

Symbol	Meaning
	<b>Danger:</b> Indicates an immediate hazard and that special precautions are necessary to avoid severe personal injury or death.
	<b>Warning:</b> Indicates a strong possibility of a hazard and that an unsafe practice could result in severe personal injury.
	<b>Caution:</b> Indicates that hazards or unsafe practices could result in personal injury or damage to product or property.

## **NOTICE**

This manual belongs to the owner of the following Vogt Ice machine:

Model # \_\_\_\_\_ Serial # \_\_\_\_\_

This manual must remain on the premises with the above-listed machine at all times. After machine start-up, store the manual in a safe place where it can be readily available for future reference in maintaining, troubleshooting, or servicing the machine. Designate a person to be responsible for the manual.

Failure to comply with this notice will result in unnecessary inconvenience and possible additional expenses.

This manual is designed to assist with the installation, start-up, operation, maintenance, troubleshooting, and servicing of this equipment. This Tube-Ice® machine is designed to provide a lifetime of service when installed, maintained, and serviced properly.

This information is intended for use by individuals with adequate backgrounds in electrical, refrigeration, and mechanical expertise. Neither the manufacturer nor seller is responsible for the interpretation of this information, nor can they assume any liability in connection with its use.

If a situation calls for additional information not found in this manual, contact your distributor. If further assistance or information is needed, contact the factory by calling 1-502-635-3000 or faxing 1-502-635-3024.

Please read this manual carefully before attempting installation, operation, or servicing of this professionally designed piece of equipment.

The SuperCare group at Vogt Ice, LLC, provides assistance for all customer service needs, including part sales and warranty support. SuperCare also conducts training schools at the factory and can offer onsite training if needed.

The model and serial number of this Vogt equipment is located on the nameplate attached to the electrical control panel. If an electrical control panel was not furnished with this machine, the nameplate is located on the equipment frame or paneling. To enable SuperCare to handle your questions quickly and accurately, refer to the model and serial number when making inquiries about this machine.

### **Warranty Registration/Start-Up Form**

The Warranty Registration/Start-Up Form on the next page must be completed and returned to Vogt Ice, LLC, within 2 weeks after the official start-up of the machine to initiate and ensure a full warranty. The form must be completed and either mailed to the address below, scanned and emailed to [info@vogtice.com](mailto:info@vogtice.com), or faxed to 1-800-770-8648. This form is also available online at [www.vogtice.com/warrantyregistration/](http://www.vogtice.com/warrantyregistration/).

Please mail the completed form to:

**Vogt Ice, LLC**  
1000 W. Ormsby Ave.  
Suite 19  
Louisville, KY 40210 USA





## Table of Contents

### HFO10 Mid-Size Ice Machine

Important Safety Information .....	3
Safety Symbols and What They Mean.....	3
NOTICE.....	4
Warranty Registration/Start-Up Form.....	4
<b>Chapter 1 Introduction .....</b>	<b>1-1</b>
<b>Chapter 2 How the HFO10 Machine Works .....</b>	<b>2-1</b>
Principles of Operation .....	2-1
Model Number .....	2-2
Piping .....	2-3
Freezing Period .....	2-6
Harvest Period .....	2-6
Refrigeration System Overview .....	2-7
Charging Refrigeration Systems .....	2-8
<b>Chapter 3 Receipt of Machine .....</b>	<b>3-1</b>
State of New Machine .....	3-1
Inspection .....	3-1
Delivery Inspection Checklist.....	3-1
Safety Tags and Labels.....	3-1
Pressure Relief Valves.....	3-1
Machine Location .....	3-2
Equipment Storage .....	3-2
Rated Capacity.....	3-2
<b>Chapter 4 Installation of the HFO10 .....</b>	<b>4-1</b>
Machine Connections.....	4-1
Equipment Layout and Service Access .....	4-5
Lifting Procedures.....	4-6
Equipment Anchoring.....	4-7
Piping and Drain Connections .....	4-8
Water-Cooled Condenser Connections (Water-Cooled Machines Only) .....	4-9
Cooling Tower (Water-Cooled Machines Only).....	4-9
Pressure Relief Valves.....	4-10
Wiring and Electrical Connections.....	4-10
Phase Check.....	4-11
Voltage Imbalance .....	4-11
Current Imbalance .....	4-12
Ice Bin Thermostat Sensor.....	4-12
Installation Checklist.....	4-13
<b>Chapter 5 Start-Up, Shutdown, and Operation .....</b>	<b>5-1</b>
Start-Up Checklist .....	5-1
Start-Up Procedure (Initial Start-Up).....	5-1
Shutdown Procedure.....	5-2
Start-Up and Shutdown Tips .....	5-2

Ice Quality .....	5-2
Adding Refrigerant.....	5-2
<b>Chapter 6 Electrical Controls and Their Functions .....</b>	<b>6-1</b>
Vogt 450 Controller .....	6-8
Variable Frequency Drive (50-Hz Machines Only).....	6-14
<b>Chapter 7 Maintenance .....</b>	<b>7-1</b>
Cleaning .....	7-1
Sanitizing .....	7-2
Water Distributors.....	7-3
Water Tank .....	7-4
Freezer Cover .....	7-4
Water-Cooled Condensers .....	7-4
Chemical Cleaning .....	7-5
Mechanical Cleaning .....	7-6
Compressor Lubrication .....	7-7
Lubrication of the Cutter Motor Gear Reducer .....	7-9
Preventive Maintenance .....	7-9
Daily Checklist.....	7-9
Weekly Checklist.....	7-10
Monthly or Yearly Checklist.....	7-10
Preventive Maintenance Form .....	7-11
<b>Chapter 8 Troubleshooting .....</b>	<b>8-1</b>
Machine Not Running.....	8-1
Freeze-Up from Extended Freeze Period .....	8-2
Freeze-Up from Ice Failing to Discharge.....	8-3
Poor Ice Quality .....	8-4
Low Ice Capacity .....	8-4
High Head Pressure (Water-Cooled Machines).....	8-5
High Head Pressure (Air-Cooled Machines) .....	8-6
<b>Chapter 9 Servicing Operations .....</b>	<b>9-1</b>
Adjustable Blowdown (for Clearer Ice).....	9-1
Automatic Blowdown .....	9-1
Makeup Water Float Valve .....	9-1
Refrigerant Float Switch .....	9-2
Hand Expansion Valve .....	9-3
Freezer Pressure Switch (Vogt 450).....	9-3
Low-Pressure Safety Switch (Vogt 450).....	9-3
High-Pressure Safety Switch (Vogt 450) .....	9-3
Head Pressure (Vogt 450).....	9-3
Fan Cycling Switch (Air-Cooled Machines, Vogt 450).....	9-3
Water-Regulating Valve (Water-Cooled Machines) .....	9-4
Cleaning Water-Cooled Condenser .....	9-4
Compressor Motor Protection .....	9-4
Compressor Motor Protection—Field Diagnosis.....	9-5
Compressor Motor Burnout .....	9-5
Oil Level Safety .....	9-6
Compressor Crankcase Heater (200 Watt).....	9-6
Oil Separator.....	9-6

Control Circuit Protection ..... 9-6

Thawing Timer ..... 9-7

Pumpdown ..... 9-8

Removing Refrigerant..... 9-8

Refrigerant Leaks ..... 9-9

Non-Condensable Gases..... 9-9

Solenoid Valves..... 9-10

Capacity Control Valves ..... 9-11

Circulating Water Pump Motor ..... 9-12

Cutter Gear Reducer ..... 9-12

Cutter Motor Replacement ..... 9-13

Cutter Gear Reducer Removal and Replacement..... 9-13

Water Tank Removal ..... 9-14

Cutter and Bearing Removal and Reinstallation..... 9-14

Crushed Ice Production ..... 9-16

**Appendix A Optional Accessories ..... A-1**

    Power Monitor, Wagner Model DTP-3..... A-1

    The Display ..... A-1

    Adjustment of Parameters in Order of Display ..... A-2

**Appendix B Tables ..... B-1**

**Appendix C Additional Documentation ..... C-1**



## Chapter 1 Introduction

Since Vogt introduced Tube-Ice® machines in 1938, the process of making Tube-Ice® ice has been widely recognized as the most economical means of ice production. These machines' economic and reliable operation has been proven repeatedly in a variety of installations throughout the world. The skill in engineering and fabrication Vogt Ice has learned in more than eight decades of experience is reflected in the HFO10 machine.

Using as little as one-third of the energy required by competing ice makers, Tube-Ice® machines produce the same amount of ice at great savings—in restaurants, sports arenas, packing plants, and wholesale operations around the world.

In addition, Tube-Ice® machines are renowned for their long service life, giving many customers more than 35 years of dependable service. Ask someone who owns one.

The HFO10 machine was introduced in 2017 as the next evolution of the Tube-Ice machine. It was developed to provide end users with a long-term synthetic refrigerant solution driven by a robust semi-hermetic screw compressor.

Hydrofluorocarbon (HFC) refrigerants are experiencing a phase-out in a variety of markets across the globe because of their high Global Warming Potential (GWP). This forces Original Equipment Manufacturers (OEMs) to build forward-thinking business strategies when selecting a replacement refrigerant for use in their equipment.

The challenge with implementing synthetic refrigerants in ice machines is to find the perfect balance between something that will work well in the application and be available for purchase for the foreseeable future. Finding this balance has been Vogt's focus.

Vogt's long-term refrigerant solution is HFO (hydrofluoroolefin) blends with similar properties as R134a. These HFO-based refrigerants have very low GWPs, which are in line with the European Union F-Gas Regulation phase-down and with projected refrigerant regulations in the United States.

In November 2017, at the International Packaged Ice Association convention, Vogt introduced the HFO10 machine. It is the first Tube-Ice machine designed to run on an HFO blend (R513A). This blend, along with other R134a-like HFO blends, is expected to be a long-term synthetic refrigerant solution. However, HFO blends are likely to be replaced by pure HFO refrigerants of the R1234-family. These pure HFOs will be retrofittable to the HFO10 machine, giving it a secure and well-defined future as the market evolves.

In addition to environmental benefits, the HFO10 machines operate at lower head pressures (approximately 130 psi or 9 bar), putting less overall stress on the system. Vogt uses Bitzer's innovative CSH semi-hermetic compact screw compressor, a robust design that is more reliable than a reciprocating compressor. A further benefit of the CSH compressor is that it produces less noise than the equivalent reciprocating design. The HFO10 has excellent energy efficiency, consuming as little as 2.68 kWh per 100 lb (45 kg) of ice produced.

The HFO10 machine is just the beginning of Vogt's new focus to innovate and introduce superior products to the marketplace.



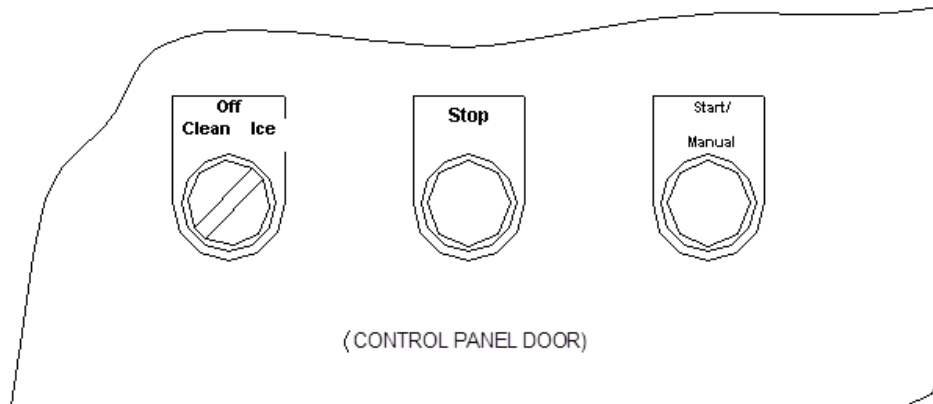
## Chapter 2 How the HFO10 Machine Works



**Warning:** Only service personnel experienced and certified in refrigeration and qualified to work with high-voltage electrical equipment should be allowed to install or work on this Tube-Ice® machine.

### Principles of Operation

Manual operation of the machine is controlled by the three-position **Clean/Off/Ice** selector switch and the **Start** and **Stop** buttons located on the control panel of the freezing unit.



**Figure 1: Control Panel Door**

Automatic operation is controlled by the standard ice bin thermostats, which stop and start the ice maker based on the level of ice in the storage bin.

The type of ice produced, cylinder or crushed (optional), is determined by how the machine cutter is set up.

The unit will only stop when a thawing (harvest) period has been completed, whether by the **Clean/Off/Ice** selector switch or the ice bin thermostat. To stop the machine instantly, push the **Stop** button. To restart the machine, push the **Start** button.

The **Clean/Off/Ice** selector switch must always be set in the **Ice** position during normal ice-making operation. It is set in the **Clean** position only when the equipment needs cleaning.

Air-cooled machines have a solenoid valve, sometimes referred to as the X valve, in the compressor discharge line and a check valve in the liquid return line to the receiver. These valves prevent the migration of refrigerant when the machine is not operating. The X valve is always open when the compressor is running.

## Model Number

The machine nameplate is located on the left side of the control panel. The model number and machine description are located in the top left-hand corner. Figure 2 can be used to verify that the correct model has been received.

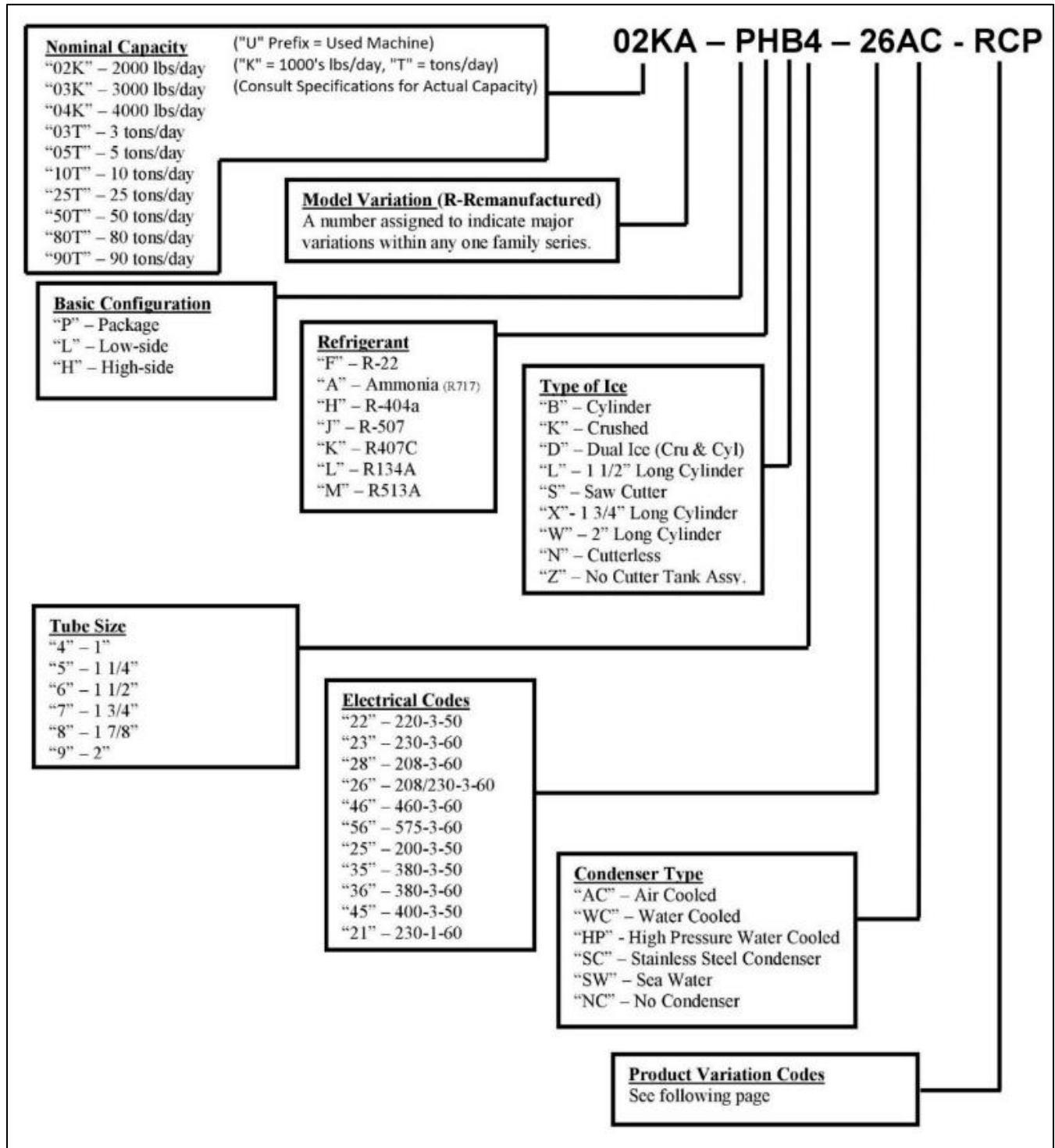


Figure 2: Vogt Model Nomenclature

## Piping

Table 1 lists the piping nomenclature as labeled in Figure 3 and Figure 4, which illustrate the piping schematics of the refrigerant and water circuits of water- and air-cooled Tube-Ice® machines.

**Table 1: HFO10 Piping Nomenclature**

	Description		Description
<b>1</b>	Control Panel	<b>32</b>	A/C Condenser Service Connection
<b>1PG</b>	Suction Pressure Gauge	<b>34</b>	Compressor Suction Service Valve
<b>2PG</b>	Discharge Pressure Gauge	<b>35</b>	Compressor Discharge Service Valve
<b>2</b>	Freezer	<b>37</b>	Oil Charging/Drain Valve
<b>3</b>	Compressor	<b>39</b>	Water Tank Drain Valve
<b>4PS</b>	Dual High/Low Pressure Switch	<b>40</b>	Automatic Water Tank Blowdown
<b>5M</b>	Cutter Motor	<b>41</b>	Condenser Water Regulator (W/C Machines)
<b>5R</b>	Gear Reducer	<b>41A</b>	Condenser Pressure Control (A/C Machines)
<b>6</b>	Water Pump	<b>43</b>	Strainer
<b>7</b>	Water Tank (includes cutter assembly)	<b>44</b>	Receiver Drain Valve
<b>8</b>	Water Distributing Chamber	<b>46</b>	Filter Dryer
<b>12</b>	Makeup Water Float Valve	<b>48</b>	Muffler
<b>13</b>	Heat Exchanger	<b>50</b>	Receiver Safety Valve
<b>15</b>	Condenser	<b>51</b>	Freezer Safety Valve
<b>15R</b>	Receiver	<b>52</b>	Water Regulating Stop Valve (Water-Cooled Only)
<b>16</b>	Thawing Chamber	<b>53</b>	Cold Weather Solenoid Valve "X" (A/C Machines)
<b>17</b>	Expansion Valve	<b>55</b>	Discharge Line Stop Valve For A/C Machines
<b>18</b>	Thaw Gas Solenoid Valve (D)	<b>56</b>	Freezer/Pressure Switch
<b>18S</b>	Thawing Gas Pressure Switch	<b>58</b>	Liquid Outlet Valve (King Valve)
<b>20</b>	Liquid Line Solenoid Valve (A)	<b>59</b>	Receiver Purge Valve
<b>22</b>	Float Switch	<b>69</b>	Freezer Pressure Stop Valve
<b>23</b>	Condenser Water Inlet W/C Machines	<b>70</b>	Oil Return Stop Valve
<b>23A</b>	Makeup Water Inlet 3/4 FPT	<b>88</b>	Accumulator/Heat Exchanger
<b>24</b>	Condenser Water Outlet (W/C Machines)	<b>90</b>	Thawing Gas Stop Valve
<b>25</b>	Water Tank Drain Connection 1-in. FPT	<b>91</b>	Receiver Liquid Return Stop Valve
<b>28</b>	Refrigerant Charging Valve	<b>94</b>	Compressor Oil Pressure Safety Control
<b>30</b>	Receiver Sight Glass	<b>101</b>	Check Valve
<b>31</b>	Gauge Glass Stop Valve		

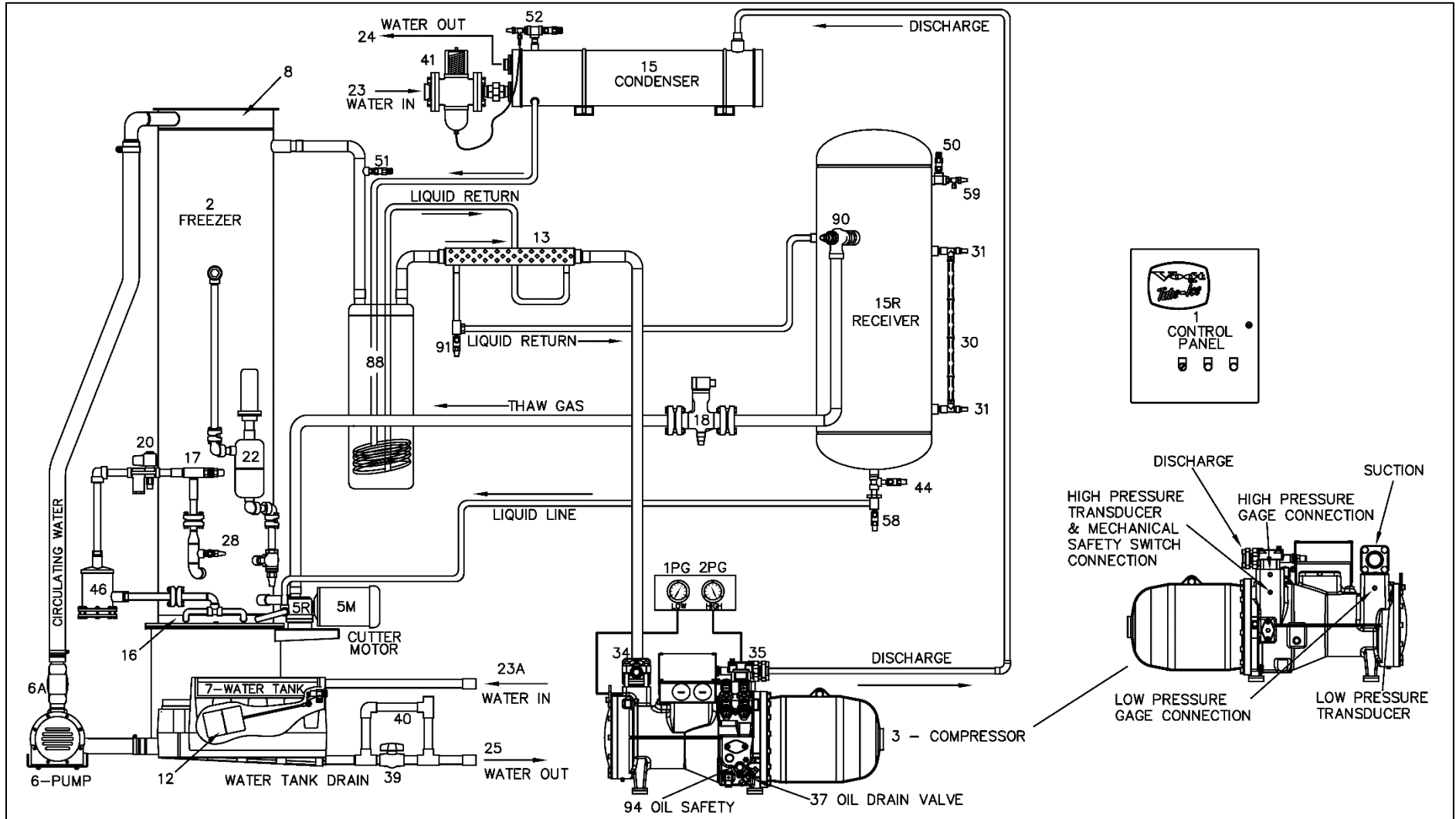


Figure 3: Water-Cooled Piping Schematic

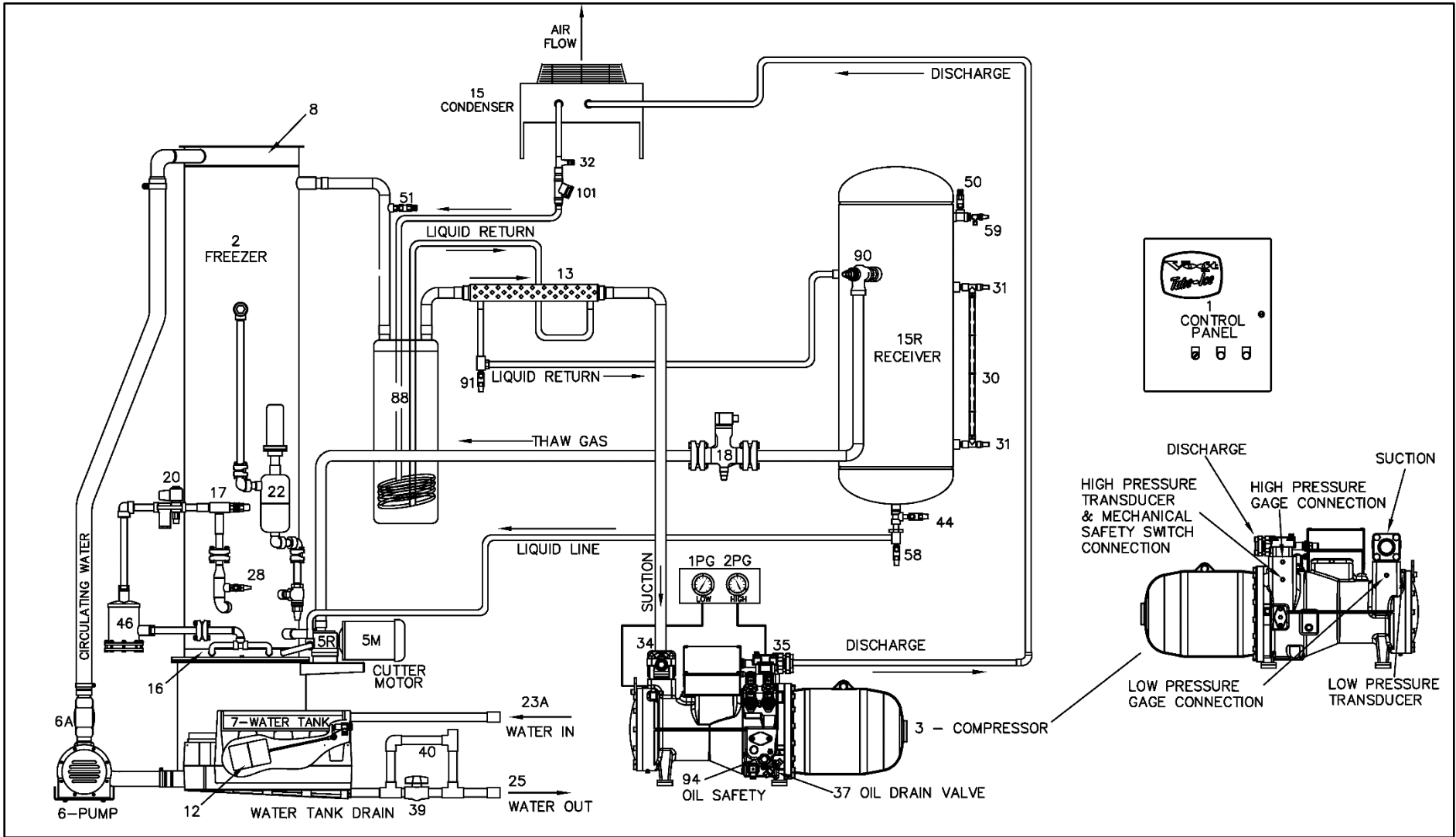


Figure 4: Air-Cooled Piping Schematic

## **Freezing Period**

The freezer is a shell-and-tube type vessel, consisting of an outside shell with vertical tubes inside. Water freezes inside the tubes by the direct application of refrigerant to the shell side (outside) of the tubes. Ice is produced as the water continues to recirculate. As the ice thickens, the freezer suction pressure decreases. The freezer pressure switch automatically initiates the thawing, or harvest, period as the freezer pressure reaches the setpoint of this switch. Refer to *Freezer Pressure Switch (Vogt 450)*.

During the freezing period:

1. Water is constantly recirculated through the freezer tubes by a centrifugal pump.
2. Makeup water is maintained at the appropriate level by a float valve in the water tank.
3. A liquid line solenoid valve (A) is open, and a thaw gas solenoid valve (D) is closed.
4. Refrigerant gas from the top of the freezer passes through the suction accumulator, the heat exchanger, and the compressor.
5. The cool gas is compressed to a high-temperature, high-pressure gas that discharges through the oil separator and into the condenser.
6. In the condenser, heat is removed, and the gas is condensed to a high-temperature, high-pressure liquid.
7. This high-pressure liquid goes through the accumulator boil-out coil and suction line heat exchanger, where it gives up heat to the suction gas for compressor protection.
8. This liquid is subcooled and carried to the receiver.
9. Condensed liquid refrigerant from the receiver flows through the thawing chamber of the freezer, the filter/dryer, the liquid line solenoid valve (A), and then the expansion valve and capillary.
10. At the expansion valve and capillary feed, the refrigerant expands from a saturated liquid state of relatively high pressure to a very low-pressure, low-temperature liquid.
11. The float switch is wired to the liquid line solenoid valve (A).
12. The float switch energizes and de-energizes the liquid line solenoid valve (A) in response to the level of refrigerant in the freezer.
13. The cold liquid refrigerant enters the freezer, where it absorbs heat from the circulating water.
14. This cool gas is pulled out of the freezer at the suction outlet, thereby completing the circuit.

The freezing period is completed by the freezer pressure switch (FPS) in the Vogt 450 controller.

1. The water pump stops, and the liquid line solenoid valve (A) closes.
2. The thawing (harvest) period begins.

## **Harvest Period**

During the harvest period:

1. A control relay (CR) is energized. It stops the water pump and starts the cutter motor.
2. The liquid line solenoid valve (A) closes, the thaw gas solenoid valve (D) opens, and the thaw timer (T) is energized.
3. The defrost pressure switch (DPS) in the Vogt 450 controller opens and closes the D valve to maintain the proper pressure for ice to release without adding unnecessary heat.
4. Warm gas from the receiver is discharged into the freezer through the valve, and the outer edge of the ice slightly thaws for sizing by the rotating cutter.
5. As the ice releases and drops through the rotating cutter and onto the cutter disc, it discharges through the side opening of the water tank.
6. The harvest timer (T) is set for the time required to discharge all of the ice plus 30 seconds (usually 2-1/2 minutes).

**CAUTION**

To prevent refreezing, make sure all ice clears the freezer with at least 30 seconds to spare before the next freezing period begins.

## **Refrigeration System Overview**

The refrigeration system uses hydrofluoroolefin (HFO) blend refrigerant R513A.

It contains:

- Bitzer semi-hermetic compact screw compressor (CSH) with integral oil separator
- Refrigerant float switch
- Expansion valve
- Flooded evaporator (freezer)
- Hot gas defrost

As shown in the piping schematic, the compressor discharge gas leaves the compressor and goes into the condenser. Here, the gas is condensed into liquid as heat is removed from the water as it passes through the condenser during the freezing period.

A reservoir of liquid is accumulated in the receiver and flows as required, passing through the thawing chamber (located in the lower section of the freezer) then through the filter/dryer. The liquid line solenoid valve (A) opens and closes in response to the liquid level in the freezer, as determined by the refrigerant float switch mounted on the side of the freezer.

Liquid refrigerant floods the evaporator and comes in contact with the outside of the ice-making tubes through which water is being circulated. The heat contained in this water passes through the walls of the tubes, lowering the temperature of the water, causing it to freeze and to form a long tube of ice that adheres to the inside of each freezer tube. Since the purest water freezes first, the flowing water keeps the accumulated ice clear by washing separated solids down into the sump area of the water tank. The blowdown valve on the circulating water pump discharge helps to rid the water tank of increased dissolved solids found in harder water by flushing them out of the overflow during water pump operation.

During the harvest period, the water pump stops, therefore, all the water circulating in the freezer drops to the tank, the tank level increases, and the overflow will get rid of that extra water. The overflow is a hole at the top of the tank. Refer to Chapter 9 for more information about automatic blowdown.

The transfer of heat from the water to the liquid refrigerant causes it to boil and convert into a liquid-vapor mixture at the suction connection at the top of the freezer. This liquid-vapor mixture passes through the suction accumulator, where liquid droplets are removed and boiled off from the internal heating coil. The suction line heat exchanger boils off any residual droplets that may have passed through the suction accumulator, providing ample protection for the screw compressor.

As the ice forms in the freezer tubes, the suction pressure steadily decreases until it causes the freezer pressure switch (FPS) to close, initiating the harvest period.

During the harvest period, the thaw gas solenoid valve (D) is open, allowing warm high-pressure gas from the receiver to enter the freezer. This heat melts a thin film from the outside of the ice, reducing the outside diameter slightly, allowing it to fall free from the freezer tubes. This period lasts approximately 2-1/2 minutes.

**Note:** Freezing times will vary, depending on makeup water temperature and setting of the freezer pressure switch. As you become more familiar with the operation of your machine, you will be able to recognize and correct minor irregularities as they occur, which will help prevent major problems.

### **Charging Refrigeration Systems**

**CAUTION**

Only technically qualified persons, experienced and knowledgeable in the handling of refrigerant and operation of refrigeration systems, should perform the operations described in this manual.

All local, federal, and EPA regulations must be strictly adhered to when handling refrigerants. If a refrigeration system is being charged from refrigerant cylinders, disconnect each cylinder when empty or when the system is fully charged.

Included with the machine is the required charge of R513A refrigerant (approximately 470 lb [213 kg]), isolated in the receiver. Before shipment of the machine, the compressor service valves and the stop valves in the various lines to the condenser and receiver were closed. These valves are tagged with instructions to be opened before start-up of the machine.

Before opening these valves, check all joints for leaks that may have developed during shipment. If no leaks are present, a positive pressure should show on the suction and discharge pressure gauges. They should indicate a pressure approximately equal to the ambient temperature, which can be found using the pressure temperature chart.

A gauge should be installed in the charging line to indicate refrigerant cylinder pressure. The cylinder may be considered empty of liquid refrigerant when the gauge pressure is 25 psig (1.7 bar) or less, and there is no frost on the cylinder. Close the refrigerant charging valve and cylinder valve before disconnecting the cylinder. Loosen the union in the refrigerant charging line carefully to avoid unnecessary release of refrigerant into the atmosphere. Refer to local and national regulations.

**CAUTION**

Immediately close the system charging valve at the commencement of the defrost or thawing cycle if a refrigerant cylinder is connected. Never leave a refrigerant cylinder connected to the system except during charging operation. Failure to observe either of these precautions can result in transferring refrigerant from the system to the refrigerant cylinder, over-filling it, and possibly causing the cylinder to rupture because of pressure from expansion of the liquid refrigerant.

**CAUTION**

It is not recommended that refrigerant be transferred from a refrigeration system directly into a cylinder. If such a transfer is made, the refrigerant cylinder must be an approved, clean cylinder that is free of any contaminants or foreign materials. The cylinder must be connected to an approved recovery mechanism with a safety shutoff sensor to ensure that contents do not exceed the net weight specified by the cylinder manufacturer or any applicable code requirements.

## Chapter 3 Receipt of Machine

### **CAUTION**

Only service personnel experienced in refrigeration and qualified to work with high-voltage electrical equipment should install or work on this machine. Eye protection must be worn by all personnel working on or around the machine. You must be familiar with and adhere to all local ordinances and laws regarding the handling, storing, and use of refrigerants. Refer to the safety data sheet.

### **State of New Machine**

The HFO10 is a packaged ice-making machine, either water-cooled or air-cooled, complete with compressor, oil separator (integral to compressor), receiver, and condenser (if water-cooled). The machine was shipped in a fully pumped down state with all refrigerant stored and isolated in the receiver. All valves on the machine are tagged as to their state (open or closed) and their purpose. The machine was cleaned with ice machine cleaner and flushed so that it is ready for ice production.

### **Inspection**

Upon receipt of the Tube-Ice® machine, inspect it for any obvious damage. If damage is found or suspected, note it on the trucker's Bill of Lading. Immediately submit a separate written request for inspection by the freight line's agent. Any repair work or alteration to the machine without the permission of Vogt Ice, LLC, can void the machine's warranty. Also, notify your Vogt distributor or the factory.

### **Delivery Inspection Checklist**

- Inspect outer casings (if provided)
- Inspect piping and valves
- Inspect refrigerant sight glass for damage

The machine was shipped with a full refrigerant charge stored and isolated in the receiver. Visually check all lines for mechanical damage. If a leak is suspected, check all joints with a refrigerant leak detector supporting HFO blend refrigerants. All leaks should be reported to Vogt Ice, LLC, to obtain authorization and instructions for repair.

The machine is factory tested before shipment and supplied with a Certificate of Test report confirming the conditions under which it operated at the factory and that the machine operated as designed. Minor adjustment may be required at the installation site to achieve optimal performance.

### **Safety Tags and Labels**

Be sure to read and adhere to all special tags and labels attached to valves or applied to various areas of the machine. They provide important information necessary for safe and efficient operation of your equipment. The unit may have valves in the open or closed position and may be tagged with information about the required position for start-up.

### **Pressure Relief Valves**

Pressure relief valves are included on this packaged Tube-Ice® machine. One is located on the freezer (low-side), one is located on the top of the condenser (high-side), and a third is located on the top of the receiver (high-side). Vent each of the pressure relief valves to the atmosphere in compliance with local and national codes.



Failure to do so creates a safety hazard that could cause injury or loss of life.

### **Machine Location**

The machine must be located inside a suitable building and must not be subjected to ambient temperatures below 50°F (10°C) or above 110°F (43°C). Heat from other sources, such as sunlight, furnaces, condensers, or unusual air currents (including fans or air-conditioning air flow) may affect the operation of the machine and should be avoided. The electrical components of the Tube-Ice® machine are rated NEMA 1 or IP10. As such, the machine should not be located in a hazardous area or sprayed with water. The machine should be installed on a drainable condensate drip pan or in an area where there is no possibility of standing water, but readily drain away from the machine.

### **Equipment Storage**

If the equipment must be stored before installation, it should be indoors and protected from extreme temperatures and high humidity. These conditions can deteriorate the various components used in the manufacture and assembly of the equipment.

#### **CAUTION**

This equipment contains the HFO refrigerant blend R513A under pressure. Do not store in an area exposed to temperatures above 115°F (46°C) or in direct sunlight at temperatures above 105°F (40°C).

### **Rated Capacity**

This machine is rated to produce a given amount of ice when operating under the proper conditions as specified in this manual. Be prepared to handle the ice produced as it is discharged from the machine and move it to the storage or bagging area promptly.

## Chapter 4 Installation of the HFO10

### Machine Connections



**Warning:** Only service personnel experienced and certified in refrigeration and qualified to work with high voltage electrical equipment are allowed to install or work on this Tube-Ice® machine.

Preparing the machine for operation requires connecting the following to the appropriate locations on the machine:

- Electrical supply
- Makeup water supply
- Water blowdown drain
- Condenser water inlet and outlet

The diagrams on the following pages show the basic connection locations and orientation of the HFO10 machine.

4-2

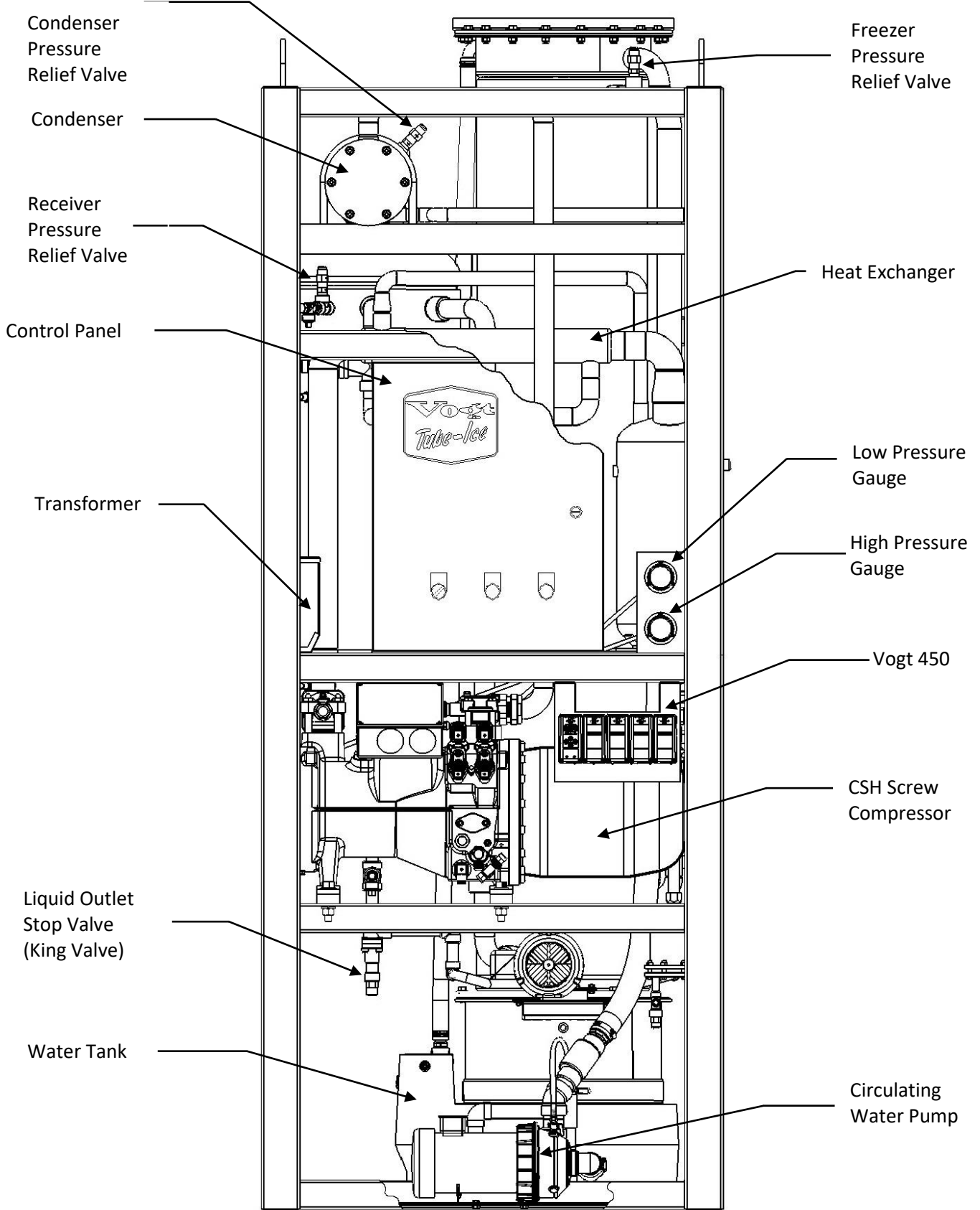


Figure 5: HFO10 Assembly Front View

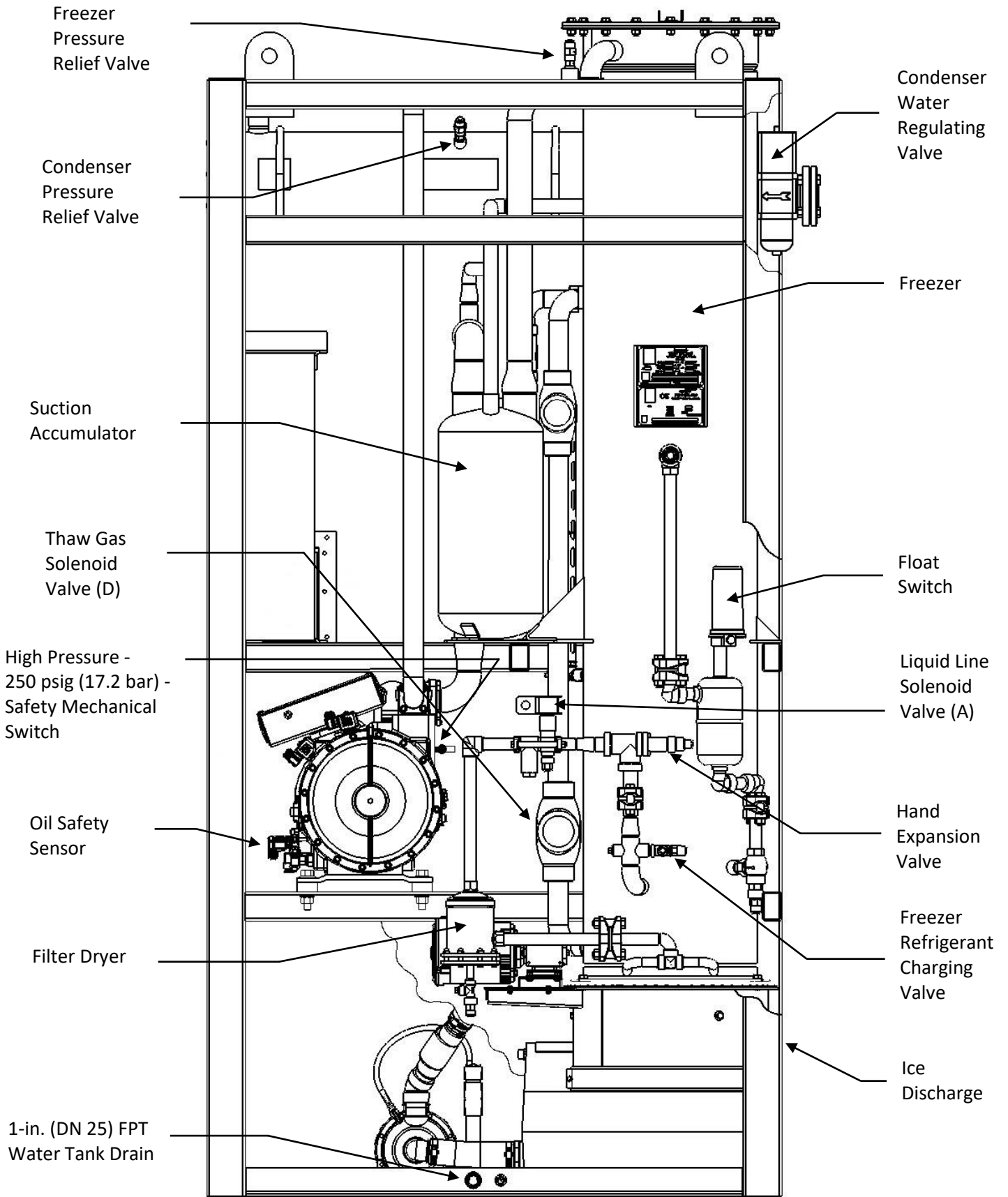


Figure 6: HFO10 Assembly Right Side View

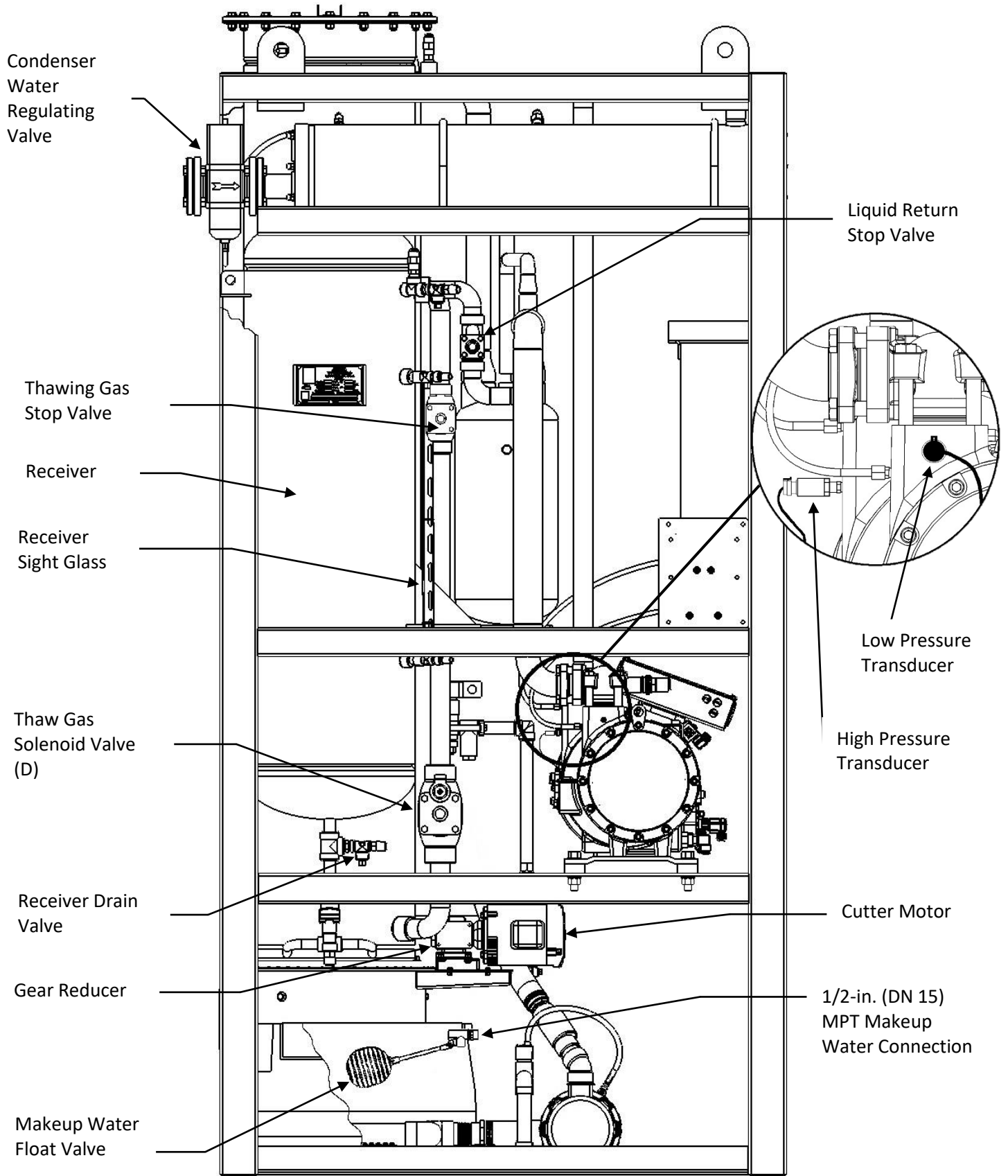


Figure 7: HFO10 Assembly Left Side View

## Equipment Layout and Service Access

### CAUTION

The approximate operating weight for the HFO10 is 5,200 lb (2,359 kg). The HFO10 requires certain clearances around the unit for safety reasons and to provide access for servicing operations. Figure 8 shows clearance requirements.

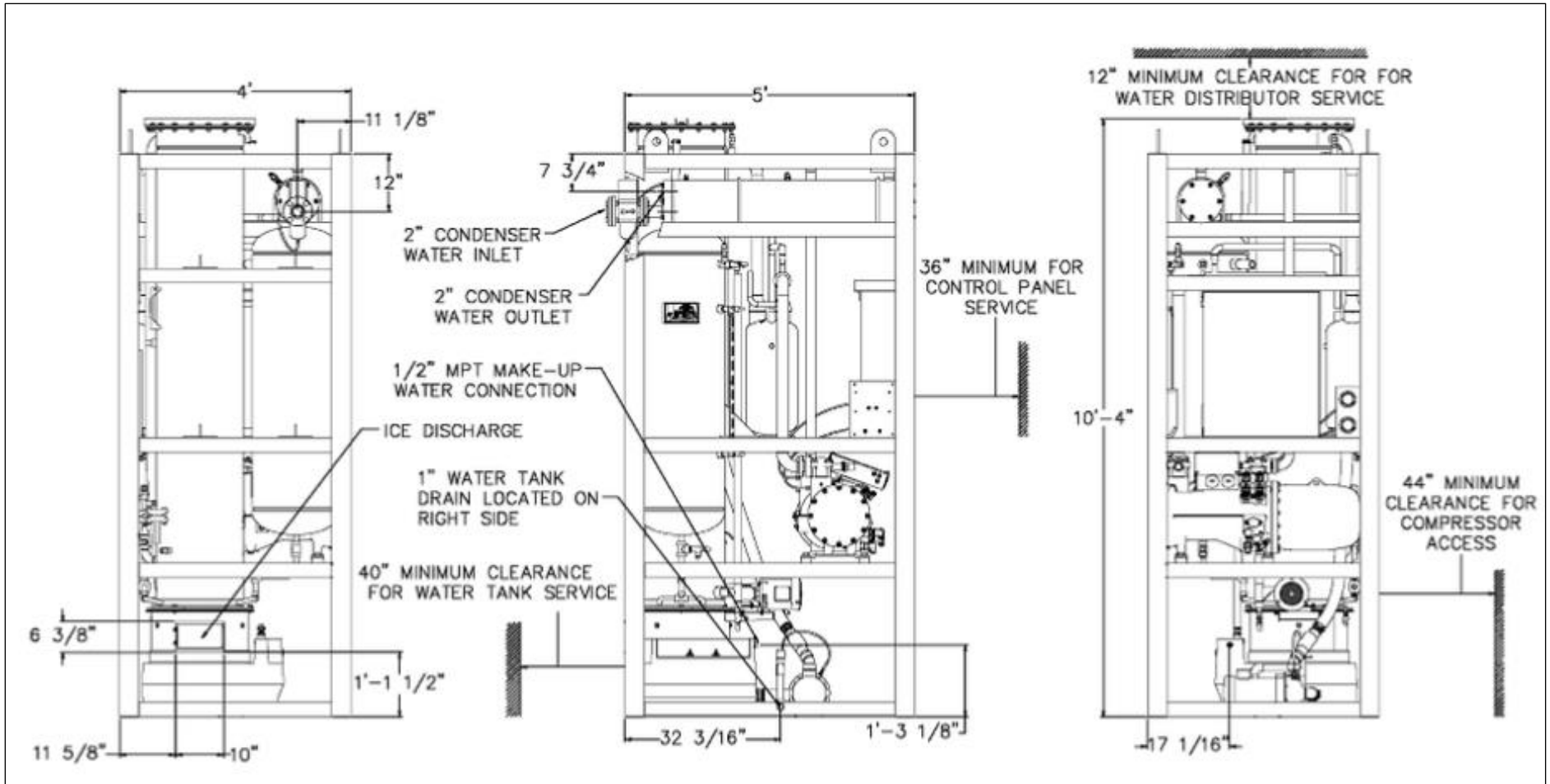


Figure 8: Connections and Clearance Diagram (Water-Cooled Machine)

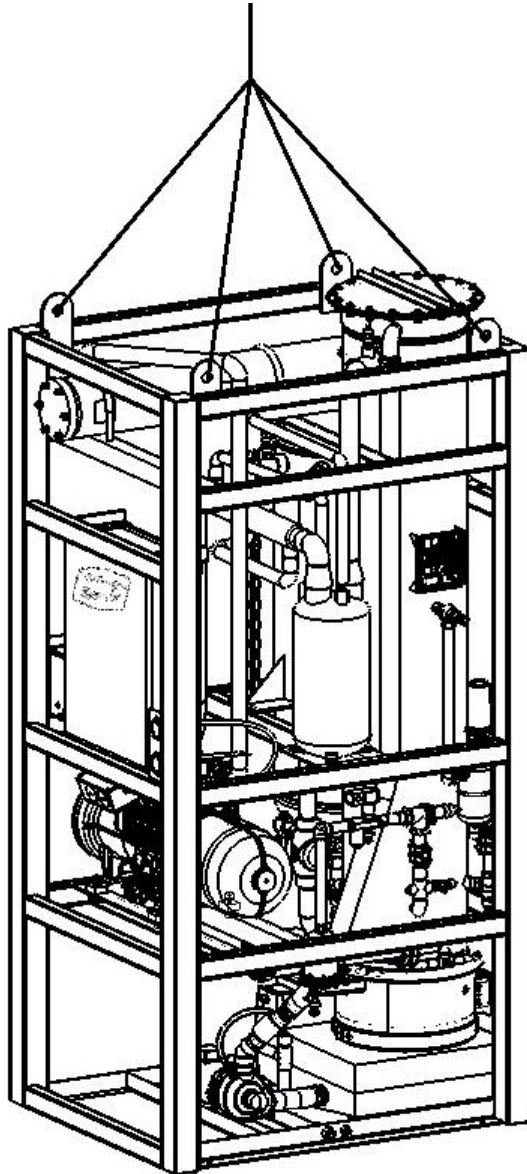
## Lifting Procedures



**Warning:** The machine weighs approximately 5,200 lb (2,359 kg). Use only the appropriate equipment with adequate loading capacity to move and install the machine.

The Tube-Ice® machine is top-heavy. The machine needs to be bound in place to prevent tipping.

Lift only from the top to avoid tipping. The machine frame has lifting lugs at each top corner for screw pin anchor shackle/eyebolt and hook to be used for lifting purposes. The lifting lugs should be used wherever possible.



**Figure 9: HFO10 Lifting Diagram**

If a forklift is used, make sure its capacity is sufficient. The forks must be wide enough apart to prevent tipping sideways and must extend beyond the extremities of the ice machine frame. Do not lift the machine using the drain pan as a support.

## Equipment Anchoring

The supporting foundation should be constructed from concrete or similar material in accordance with all local and federal codes and building regulations. Figure 10 indicates anchor bolt hole locations in the bottom frame of this Tube-Ice® machine. Consult local codes and regulations regarding seismic and wind load requirements. Additional bracing may be required.

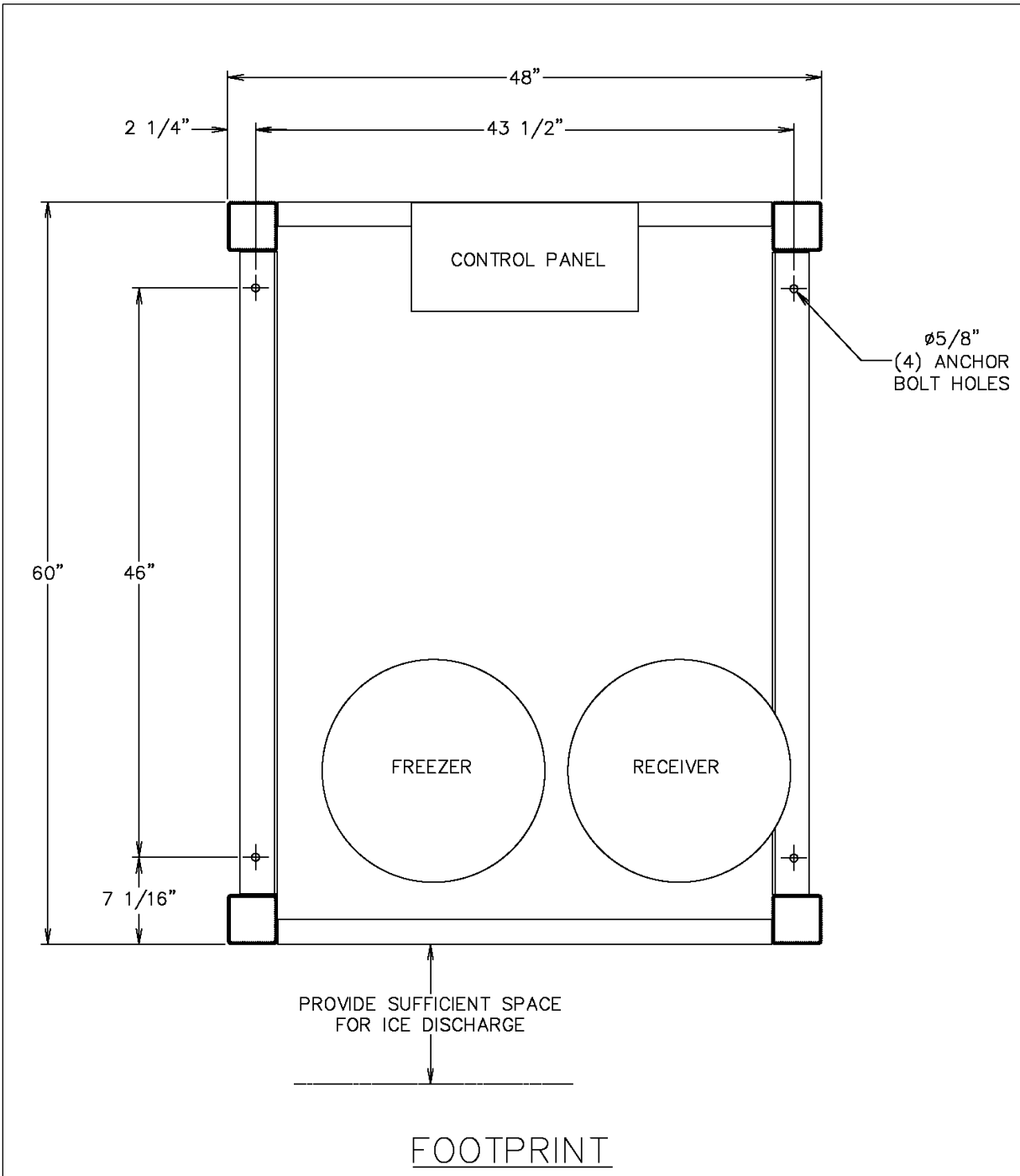


Figure 10: HFO10 Anchor Points

## Piping and Drain Connections

### **CAUTION**

External shut-off valves must be installed in the water inlet lines. The minimum inlet water pressure for satisfactory operation of the machine is 30 psig (2 bar). The maximum allowable pressure is 90 psig (6.2 bar).

Figure 5 to Figure 7 show locations for all connections. Table 2 shows drain sizes.

**Table 2: Water Supply and Drain Sizes**

Makeup Water In	Water Tank Drain	Condenser Water In	Condenser Water Out
1/2 in. (DN 15) MPT	1 in. (DN 25) FPT	2 in. (DN 50) FPT	<ul style="list-style-type: none"> <li>• 2-1/2 in. (DN 65) FPT (Non-Europe)</li> <li>• 2-1/2 in (DN 65) BSPP (Europe)</li> </ul>

The condenser water outlet and water tank drain connections must be extended to an open drain or sump, arranged for visible discharge. Do not allow water to be trapped in the water tank drain line, because this will interfere with the operation of the automatic blowdown system.

### **CAUTION**

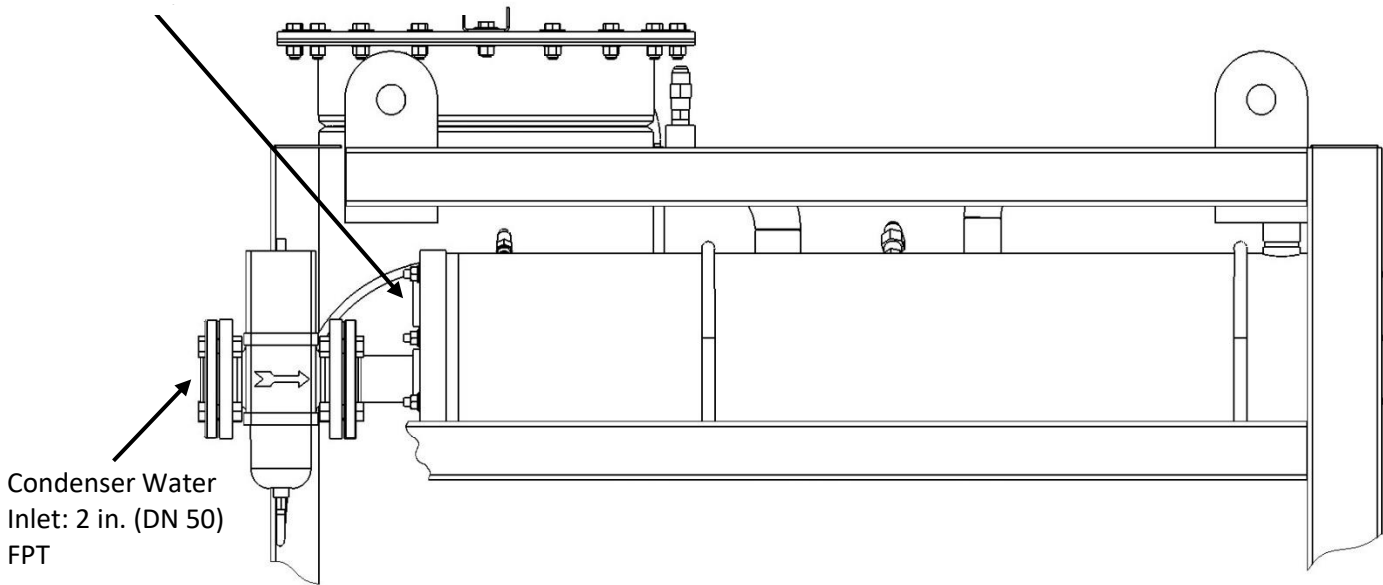
Do not connect these lines into a pressure-tight common header because warm condenser water may back up into the water tank. The condenser water outlet must be piped separately to the drain. Due to variations in water quality by geographic location, water filtering or treatment may be required to reduce maintenance and inhibit hardness buildup on machine components, such as freezer tubes and water valves.

## **Water-Cooled Condenser Connections (Water-Cooled Machines Only)**

The water regulating valve is not installed on the condenser when it is shipped from the factory. Install the regulating valve on the condenser water inlet connection (bottom connection on condenser). Connect the condenser water outlet line to the top connection on the condenser.

### **Condenser Water Outlet**

- 2-1/2 in. (DN 65) FPT  
(non-Europe)



**Figure 11: Water-Cooled Condenser Connections**

## **Cooling Tower (Water-Cooled Machines Only)**

When selecting a cooling tower, pay careful attention to operating wet bulb conditions. Check with your local cooling tower distributor for their recommendations based on actual operating conditions in your area. An average wet bulb temperature of 78°F (25°C) is typical in the United States, but many localities have design wet bulb temperatures as low as 72°F (22°C) or as high as 82°F (28°C). All standard Vogt-supplied cooling towers are sized for 78°F (25°C).

The cooling tower water pump must be capable of delivering the required volume of water through the condenser. The pump must be sized for each installation, which depends on cooling tower location, pressure drop through water lines, and water regulating valves. The water piping for the cooling tower and the installation of the pump must be in accordance with the manufacturer's instructions.

Proper water treatment for the prevention of mineral and foreign matter accumulation in the condenser or cooling tower is recommended. A water analysis by an independent laboratory should be completed to determine the proper chemicals to use.

## Pressure Relief Valves

Pressure relief valves are included with this Tube-Ice® machine. One is located on the freezer (low-side), one is located on the top of the condenser (high-side), and a third is located on the top of the receiver (high-side). These valves are designed to vent in emergency conditions. This ensures that the vessel internal pressure does not exceed the maximum allowable pressures as stated on the vessel nameplates.

Vent each of the pressure relief valves to a safe outdoor location away from people and building openings in accordance with local and national codes.



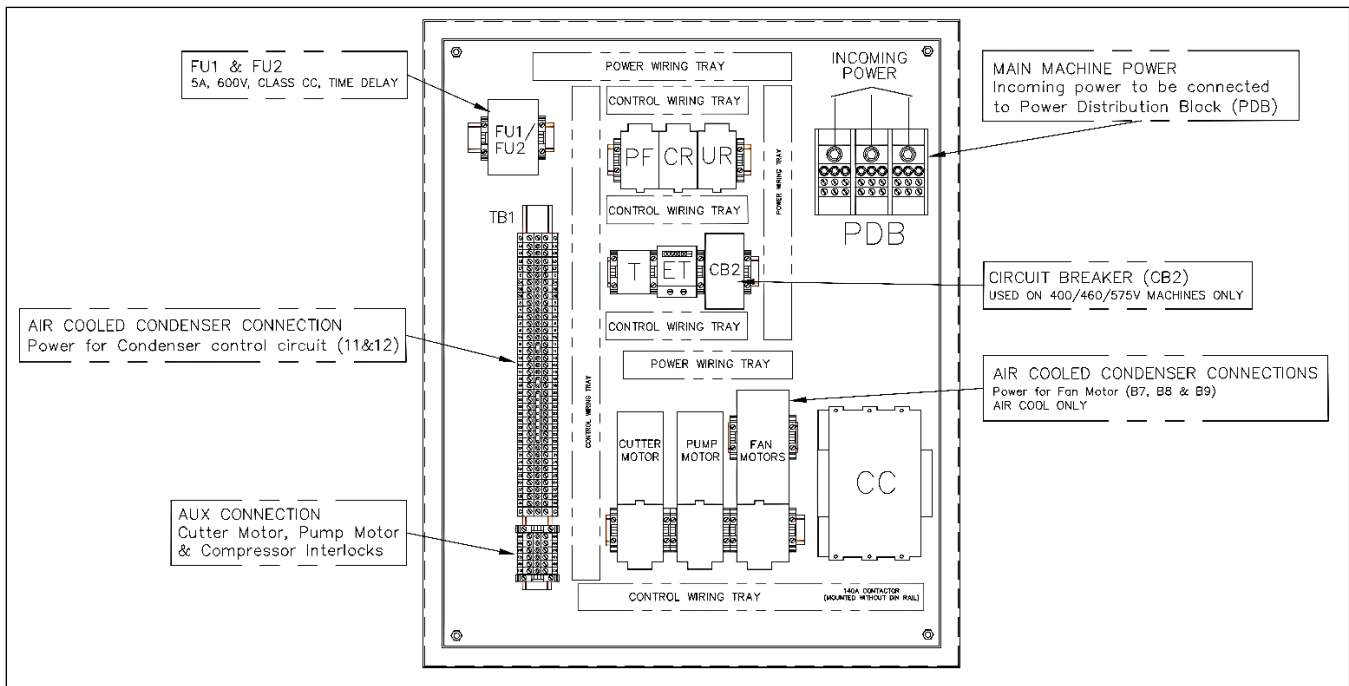
**Warning:** Pressure relief valves must be replaced after five years of service. Before replacing relief valves, review requirements per current local and national codes. Valve replacement should be performed only by service personnel experienced and certified in refrigeration and qualified to work with high-voltage electrical equipment. If a relief valve discharges, the valve must be replaced before putting the machine back into service.

Relief valves do not properly reset after a discharge event. Contact Vogt SuperCare Customer Service at 1-502-635-3000 or 1-800-853-8648 for replacement valves.

## Wiring and Electrical Connections



**Warning:** Only service personnel experienced and certified in refrigeration and qualified to work with high-voltage electrical equipment are allowed to install or work on this Tube-Ice® machine.



**Figure 12: Control Panel Power Connections (60 Hz)**

Table 3 shows how to properly size wiring connections. A fused disconnect must be provided near the Tube-Ice® machine. Connect three-phase power to Terminals L1, L2, and L3 on the power distribution block (PDB) for operation of the Tube-Ice® machine and its controls. Rotation checking of cutter motor and water pump is required. Also, if one leg of the three-phase power is higher or lower, then it should be connected to Terminal L2. Connect the ground wire to the provided ground lug (not shown).

**Table 3: Electrical Specifications**

Standard Voltages	Water-Cooled		
	Full Load Amperage	Min. Ampacity	Max. Fuse
208/230V, 3ph, 60 Hz	92.4	110.8	190
460V, 3ph, 60 Hz	46.1	55.3	95
220V, 3ph, 50 Hz	N/A	N/A	N/A
400V, 3ph, 50 Hz	55.9	68	115

## Phase Check

### **CAUTION**

Do not attempt to start the machine without priming the water pump and insuring proper rotation of both the cutter motor and pump motor.

Cutter and pump motor rotation are synchronized at the factory but must be checked at installation. For ice production, the cutter disc, as viewed at the ice discharge opening, should turn from left to right. The pump rotation should match the marking on the pump housing. The pump must be primed by starting the machine in Clean mode and allowing it to run for several minutes. To change the direction of rotation for the motors, disconnect the power and reverse L1 and L3 (incoming power wires) at the motor contactor in the control panel.

## Voltage Imbalance

Voltage imbalance can cause motors to overheat and fail. Voltage imbalance between any two legs should be no greater than 2%.

Example: Supply voltage = 230V – 3-Phase – 60 Hz

Voltage Readings:

A-B = 220 Volts	} Average = 224 Volts
B-C = 225 Volts	
A-C = 227 Volts	

(A-B)  $224 - 220 = 4$  Volts (Highest Deviation)

(B-C)  $225 - 224 = 1$  Volt

(A-C)  $227 - 224 = 3$  Volts

% Voltage Imbalance =  $100 \times (4/224) = 1.78\%$  “Acceptable”

### **CAUTION**

Contact your local electric utility company if the supply voltage phase imbalance is  $>2\%$ .

### Current Imbalance

Voltage imbalance causes a current imbalance, but a current imbalance does not necessarily mean that a voltage imbalance exists. A loose terminal connection or a buildup of dirt or carbon on one set of contacts would cause a higher resistance on that leg than on the other two legs. Current follows the path of least resistance; therefore, if Terminal L1 is loose or dirty, L2 and/or L3 will have higher current.

Higher current causes more heat to be generated in the motor windings. The maximum acceptable current imbalance is 10%.

Example:

Current Readings:

L1 = 96 Amps	}	Average = 95 Amps
L2 = 91 Amps		
L3 = 98 Amps		

(L1)  $96 - 95 = 1$  Amp

(L2)  $95 - 91 = 4$  Amps (Highest Deviation)

(L3)  $98 - 95 = 3$  Amps

% Current Imbalance =  $100 \times (4/95) = 4.2\%$       "Acceptable"

### Ice Bin Thermostat Sensor

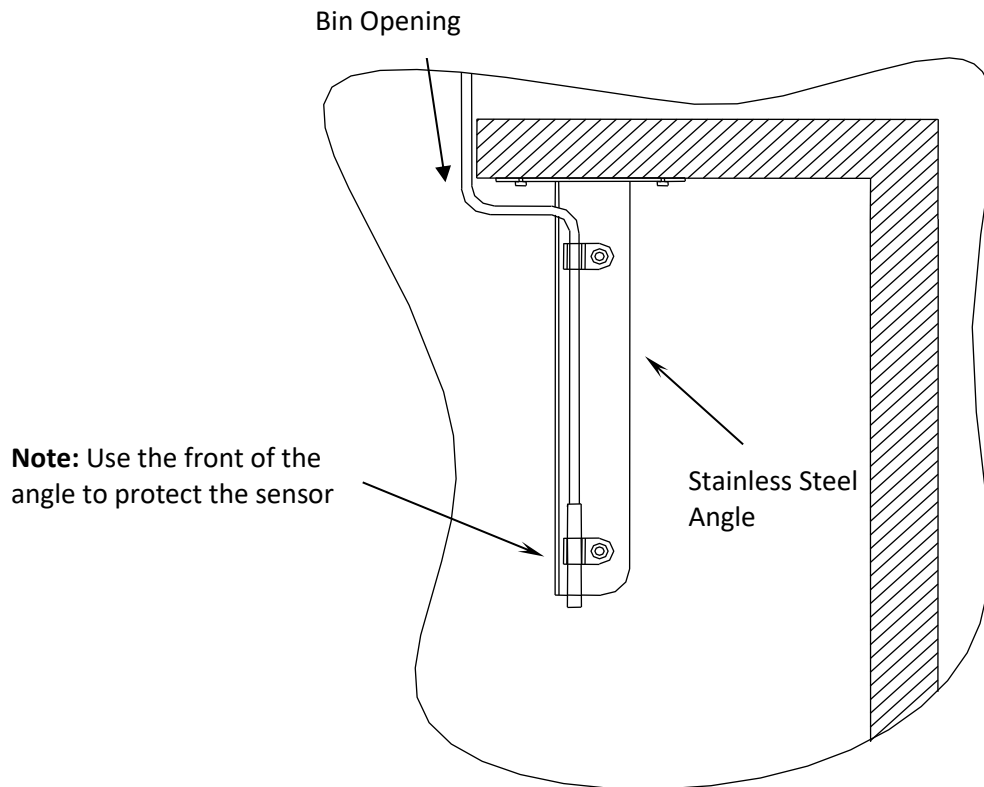
An electronic thermostat, a standard feature on every HFO machine, automates the machine's various cycles.

To ensure proper protection for the machine or auxiliary equipment, the thermostat's sensor must be positioned so that the ice will contact it when the bin is full. The distance between the top of the ice bin and the sensor must allow space for the machine to make an additional discharge of ice after the ice contacts the sensor.

**Note:** The sensor should also be mounted on the back side of the bracket, opposite of the front of the bin to reduce the possibility of damage from ice removal equipment.

The control panel is electrically connected so that the ice bin thermostat will stop the machine only upon the completion of a harvest period (freezer is empty of any ice).

**Note:** Actual location of the sensor will vary based on bin layout and ice distribution system.



**Figure 13: Typical Bin Sensor Mounting Bracket**

## **Installation Checklist**

Complete a visual check of the following before continuing or opening any valves:

- Check all joints for leaks that may have developed during shipment.  
**Note:** The machine was shipped in a pumped down state, but a small positive pressure should remain in the freezer (20–25 psig [1.4–1.7 bar]). Verify with the freezer pressure gauge.
- All refrigerant piping, water supply, and drain connections properly conform to the requirements in this manual and are properly connected to inlets and outlets.
- The electrical supply is properly sized for fuses and for compliance to local and national codes. Refer to the machine nameplate for minimum circuit ampacity and maximum fuse size.
- All field-installed equipment (augers, conveyors, cooling towers, bin level controls, etc.) is properly installed.
- The applicable portion of the **Warranty Registration/Start-Up Form** has been completed and sent back to Vogt Ice.
- Check the oil level of the cutter gear reducer.
- The water distributors at the top of the freezer should be in position and fit snugly against the tubesheet face.

### **CAUTION**

The compressor crankcase heater should be energized for a minimum of two hours, and the oil temperature should be 100°F–110°F (38°C–43°C) before attempting to start the compressor.



## Chapter 5 Start-Up, Shutdown, and Operation

### Start-Up Checklist



**Warning:** Only service personnel experienced and certified in refrigeration and qualified to work with high-voltage electrical equipment should be allowed to install or work on this Tube-Ice® machine.

Make sure all of the following items have been checked before starting the machine for the first time:

- Check that the water inlet connections are attached properly. The water inlet shutoff valves for the condenser and the water tank should be open. The water level in the water tank should be at a height where the makeup water float valve will be closed when the machine is idle.
- Make sure the cutter motor gear reducer is lubricated.
- Check that the compressor crankcase oil level is at the proper height as indicated by the compressor body sight glass.
- Open all necessary valves, including:
  - Compressor service valves
  - Thawing gas-line stop valve
  - King valve
  - Both float switch stop valves
- Except the charging valves, check that all stop valves in the refrigerant system are open, according to the attached tags. All valves are tagged with instructions.
- Immediately after opening the refrigerant valves, check the entire machine for refrigerant leaks with an electronic leak detector or by doing a bubble test.
- Check that all water supply lines are open to the water tank and all water tank drain valves are closed.
- Set the **Ice/Off/Clean** switch to the **Ice** position.
- Close the exterior disconnect switch to energize the crankcase heater, and check supply voltage against that on motor nameplate for compliance before switching on disconnect.

### Start-Up Procedure (Initial Start-Up)

**Note:** The machine will start in harvest mode when set to **Ice**. If the pump is already primed, skip to Step 4.

To perform the start-up of the machine, follow the steps below:

1. Set the **Clean/Off/Ice** selector switch to the **Clean** position.
2. Push **Start** (PB2) to start the water pump.
3. The pump can be stopped and started by pushing **Stop** and **Start**. The water should be circulated for a minimum of 5 minutes to prime the pump, purge the tubing of air, and lubricate the cutter bearing.
4. When there is good water flow, turn the **Clean/Off/Ice** selector switch to **Ice**. The machine will then start in a harvest (thaw) period with the compressor running.
5. At the termination of the harvest (thaw) period, the machine will begin the freeze period.
6. Be sure to observe a minimum of 4 cycles of ice production to confirm the satisfactory operation of the machine (approximate time for 4 cycles is 60–80 minutes).
7. Complete the remaining part of the **Warranty Registration/Start-Up Report** upon initial machine start-up and return it to Vogt Ice, LLC.

## Shutdown Procedure

### **CAUTION**

The red **Stop** button should only be used for emergency shutdown.

For normal shutdown, use the **Clean/Off/Ice** selector switch and follow the steps below:

1. Set the **Clean/Off/Ice** selector switch to the **Off** position. Do not use the machine disconnect to stop the machine. If the disconnect is used, the crankcase heater is de-energized, and liquid refrigerant migrates to the compressor.
2. During a freeze period, the machine will continue to run.
3. At the completion of the freeze period, the machine will harvest and stop. The completion of a cycle (1 freeze plus 1 harvest) ensures that all ice is removed from the freezer to prevent refreeze when the machine is restarted.
4. During a harvest period, the machine will complete the harvest and stop.

### Start-Up and Shutdown Tips

- If the operation of your machine is not controlled by a timer, bin level control, or some other mechanism to automatically start and stop ice production, you should use only the **Clean/Off/Ice** selector switch to start and stop the machine.
- By turning the **Clean/Off/Ice** selector switch to **Off**, the machine will stop after the next harvest period.
- Do not use the **Stop** button or the machine disconnect for normal shutdown of the machine.
- Disconnect the machine only in an emergency or for safety when performing certain service or repairs to the machine. The compressor crankcase heater is de-energized when the machine is shut down.
- The **Start** button can be used to initiate a harvest period. When it is pushed during a freeze period, it will immediately initiate a harvest period

## Ice Quality

Your HFO10 has been set up at the factory to produce the finest Tube-Ice® possible. The ice produced in the freezer should have a small hole in the middle of each tube to avoid permanently damaging the freezer. Table 4 shows recommended hole sizes for determining ice quality. For further information, refer to Chapter 9.

**Table 4: Average Hole Size in Tube-Ice®**

<b>Tube Size in. (mm)</b>	1 (25)	1-1/4 (32)	1-1/2 (38)
<b>Hole Size in. (mm)</b>	1/16–1/8 (1.6–3.2)	1/8–3/16 (3.2–4.8)	1/4–3/8 (6.4–9.5)

## Adding Refrigerant

### **CAUTION**

Be sure to follow all local and federal regulations regarding the handling of refrigerants and their illegal emission into the atmosphere.

Check the refrigerant level after the machine has operated for a few cycles. It should be slightly above the minimum operating level, as indicated on the label on the receiver, a few minutes before the start of a thawing period.

If the level is low at this time, sufficient refrigerant should be added to the system to raise the level above this point.

**Note:** Refrigerant can only be added during the freeze period.

Add no more than 10 lb. (4.5 kg) of refrigerant and allow the machine to operate for several cycles before checking the level again.

It is also possible to check the refrigerant level by pumping down the machine (Refer to *Pumpdown*). When the machine is pumped down, some liquid should be observed in the receiver's sight glass.

Refrigerant must be added in liquid form through the machine's charging valve. No air or other non-condensable gases should enter the system when filling the machine with refrigerant. The compressor crankcase heater must be energized for a minimum of two hours before starting and running the compressor.

While the machine is running, add refrigerant according to the steps below:

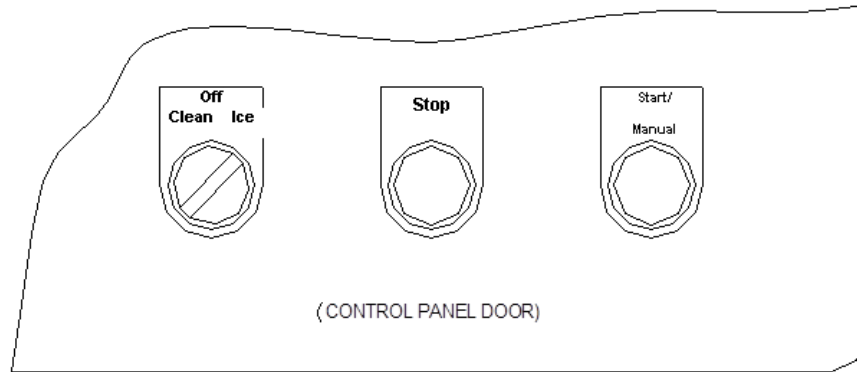
1. Connect the charging valve on the machine to the refrigerant cylinder using a hose or pipe suitable for R513A service. Refer to the instruction card attached to the refrigerant cylinder.
2. Open the valve on the refrigerant cylinder and purge air out of the charging line at the charging valve connection.
3. Open the charging valve on the machine.
4. The charging valve must be closed when the freezer is in a harvest period.



Immediately close the machine charging valve at the start of the harvest period if a refrigerant cylinder is connected. Never leave a refrigerant cylinder connected to the system except during charging operations. Failure to observe either of these precautions can result in transferring refrigerant from the system into the refrigerant cylinder, causing it to overfill and possibly rupture as the liquid refrigerant expands.



## Chapter 6 Electrical Controls and Their Functions



**Figure 14: Control Panel (Exterior View)**

The Vogt 450 has replaced the previous bin thermostat, as well as the freezer pressure switch (FPS), the low-pressure safety, the high-pressure safety, the defrost pressure switch (DPS), and the condenser pressure switch (CPS).

**Note:** If damaged, the sensor can be replaced without replacing the entire unit. The sensor cable can be extended up to 500 feet (150 m) if using a 16 American wire gauge (AWG) wire. For more information, contact Vogt SuperCare Customer Service.

**Table 5: Vogt 450 Controls Part List**

Item	Vogt Part No.	Description
<b>Control Module</b>	12A2117J04	Controller with two SPDT Output Relays
<b>Power Supply</b>	12A2117J07	Power Supply
<b>Relay Module</b>	12A2117J08	Output Module
<b>Low- and High-Pressure Transducers</b>	12A2117J02	Pressure Transducer, 0-500 psig (0-34.5 bar)
<b>Bin Control Temperature Sensor</b>	12A2117J03	Temperature sensor

### CAUTION

To provide proper protection for the Tube-Ice® machine and its component parts, be sure to follow the wiring schematic and electrical specification table when incorporating overloads.

### CAUTION

The crankcase heater should be energized for a minimum of 2 hours. The crankcase must be free of liquid before attempting to operate the compressor.

The following diagrams show the electrical details for the panel layouts, control circuit, and 3-phase power.

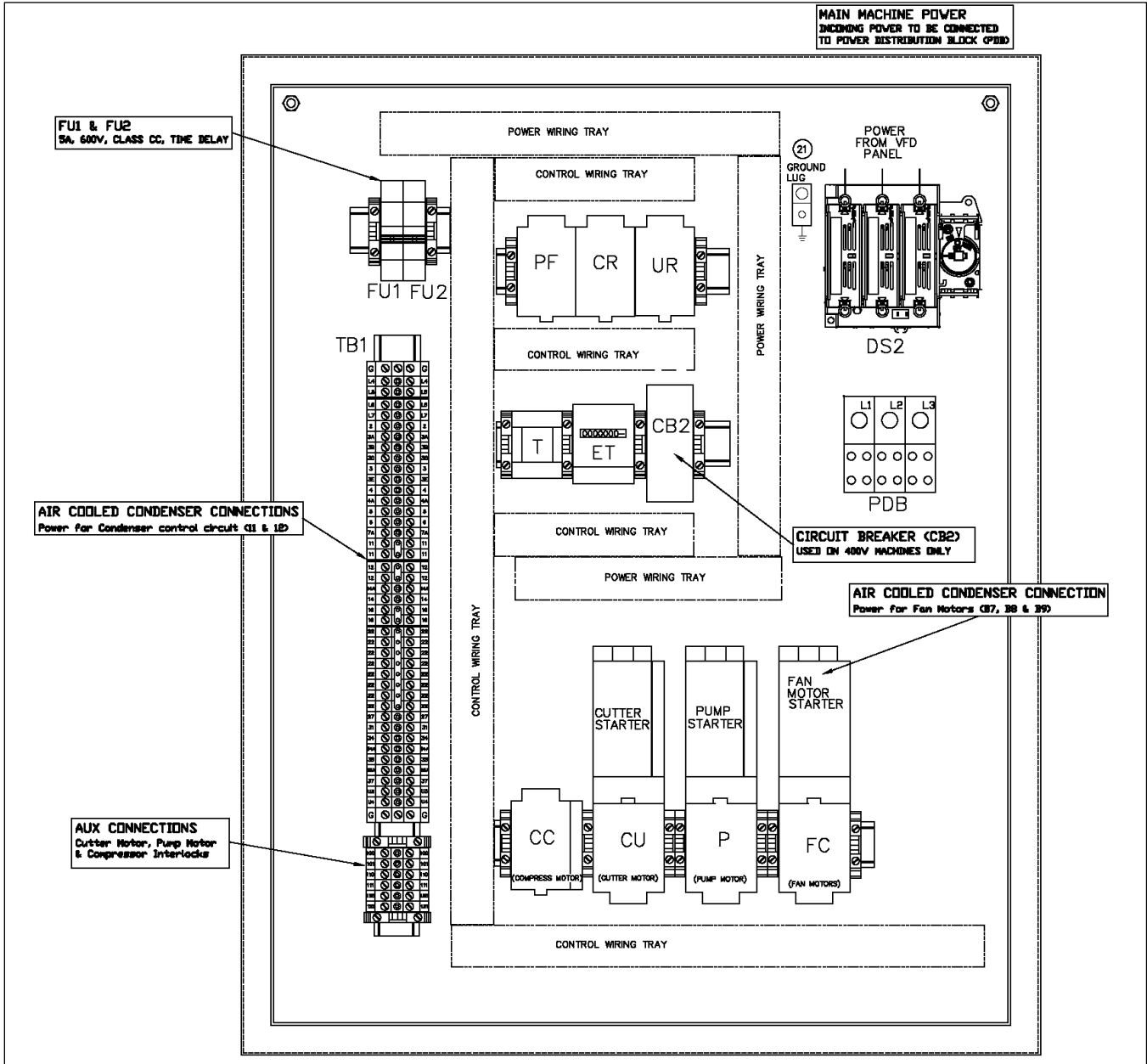


Figure 15: Panel Layout, 50-Hz CE Machines Only

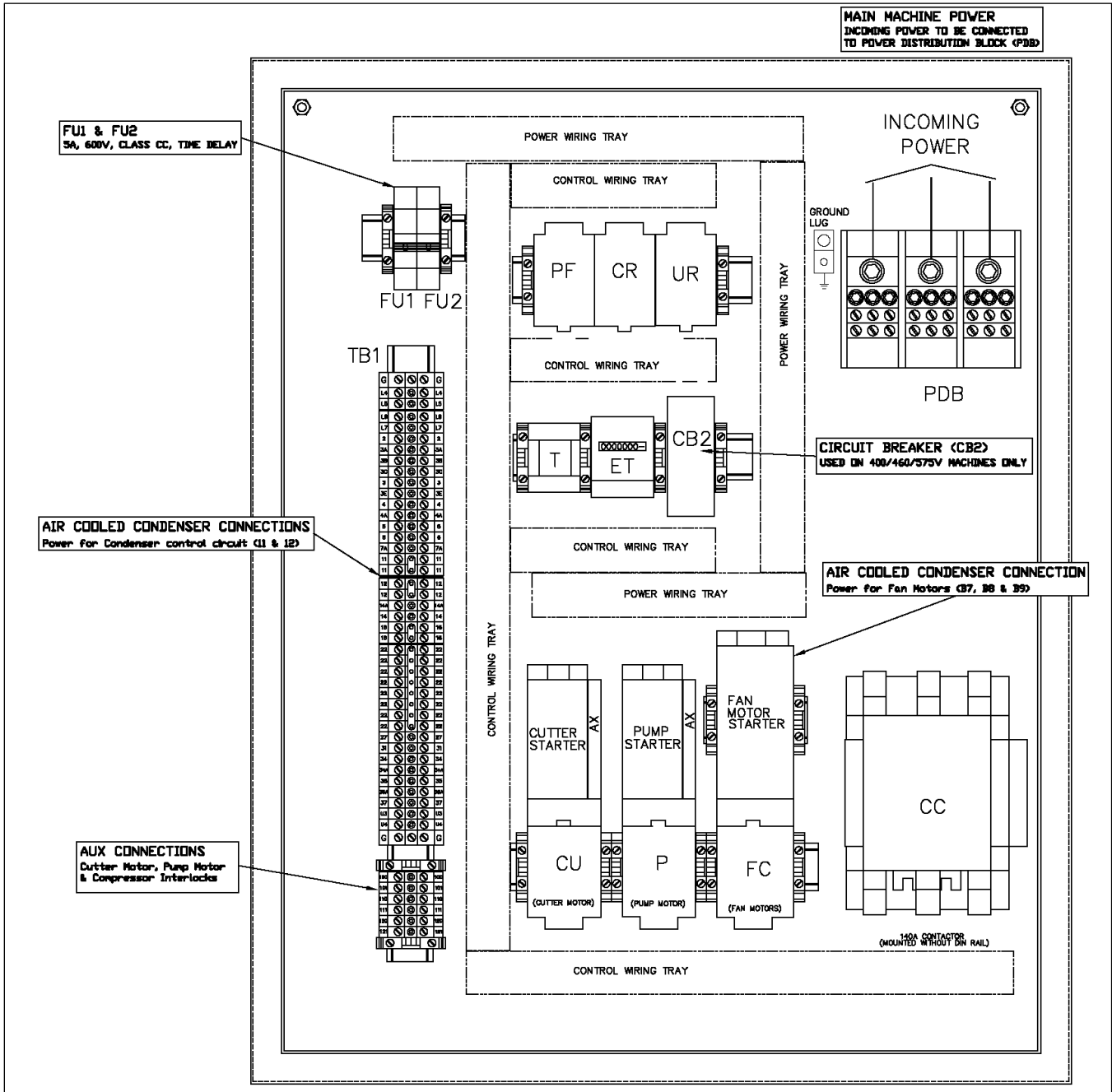


Figure 16: Panel Layout, 60-Hz Non-CE Machines

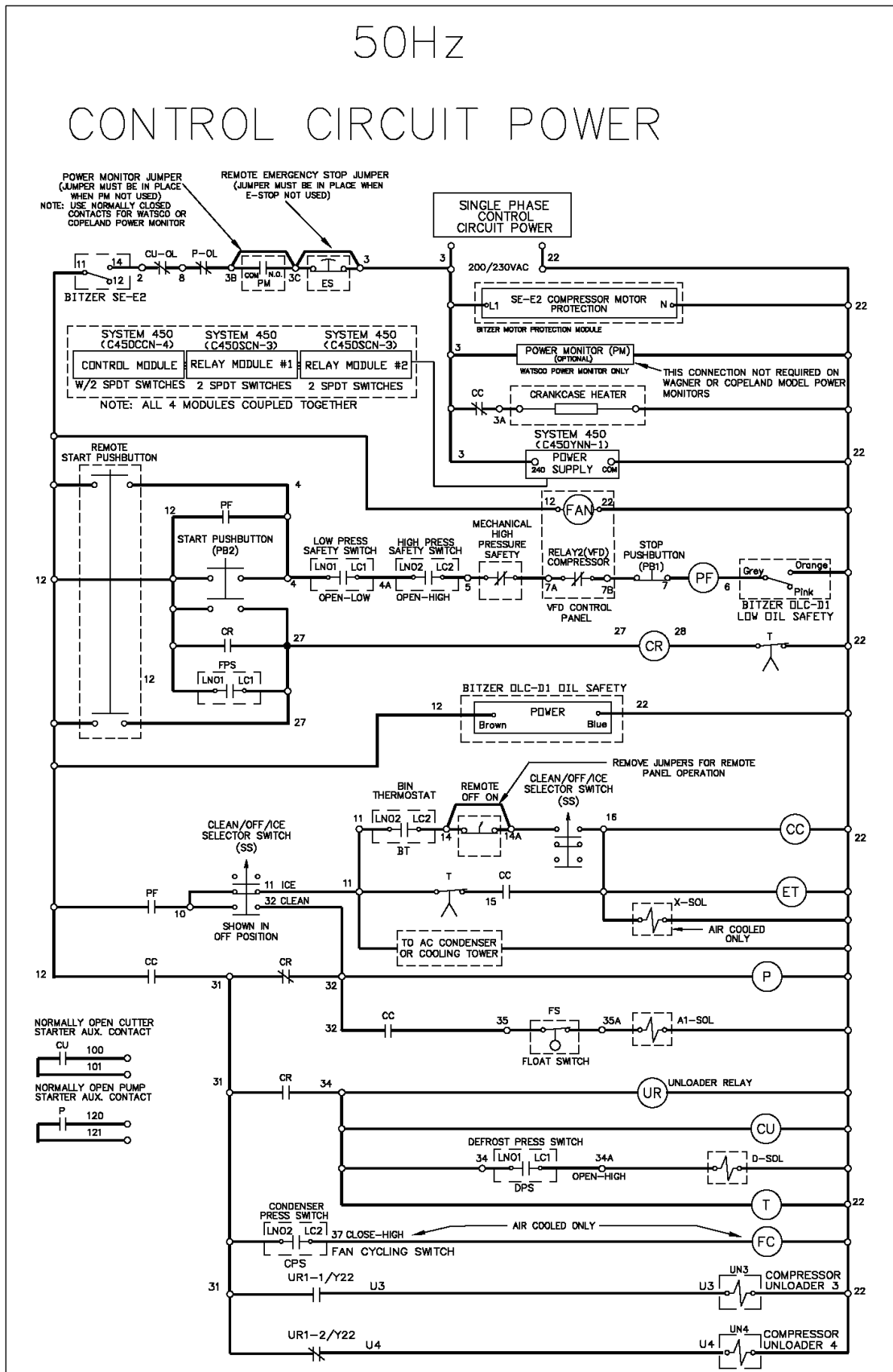


Figure 17: Electrical Schematic, Control Circuit, All Voltages, 50 Hz

# CONTROL CIRCUIT POWER

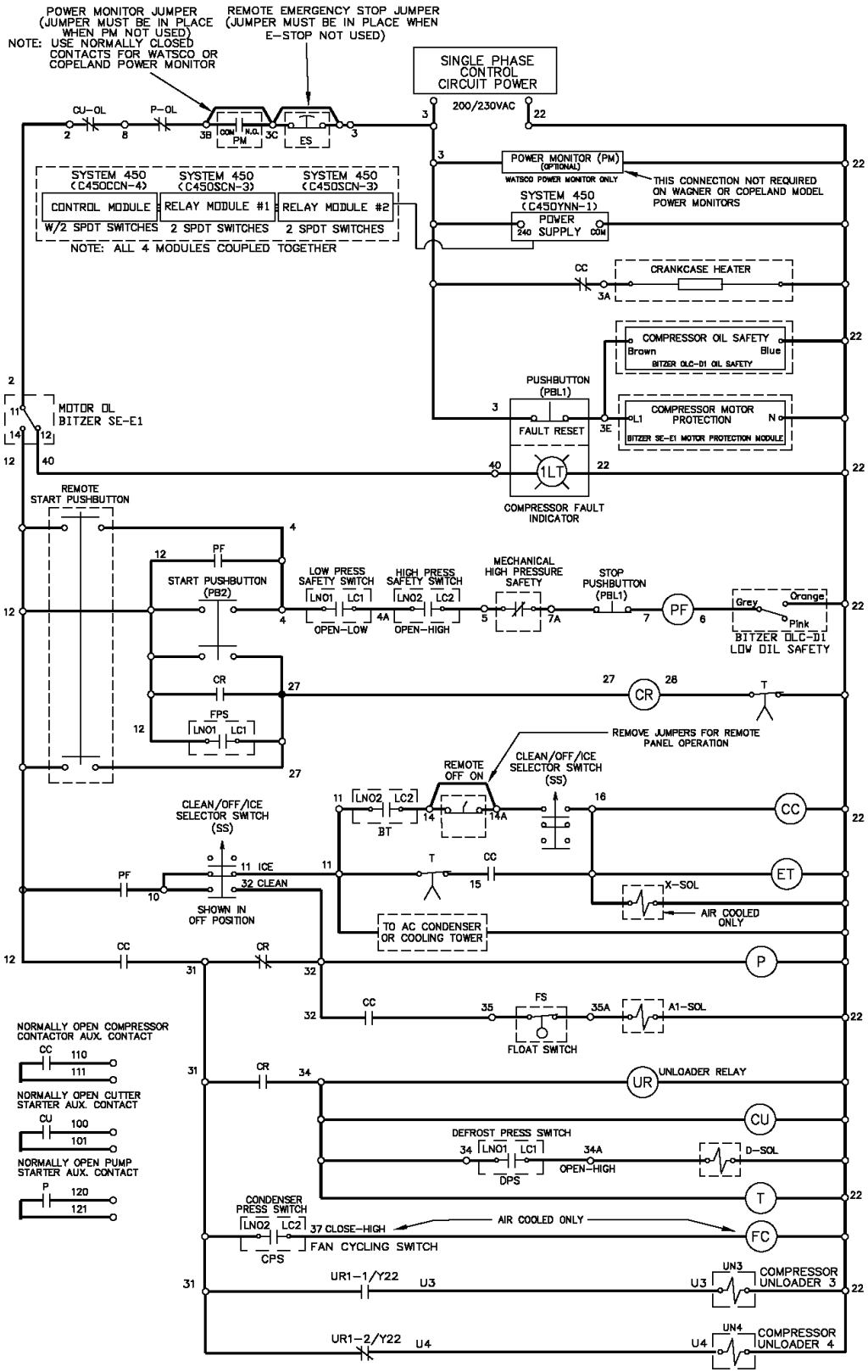


Figure 18: Electrical Schematic, Control Circuit, All Voltages, 60 Hz

50Hz

3-PHASE POWER

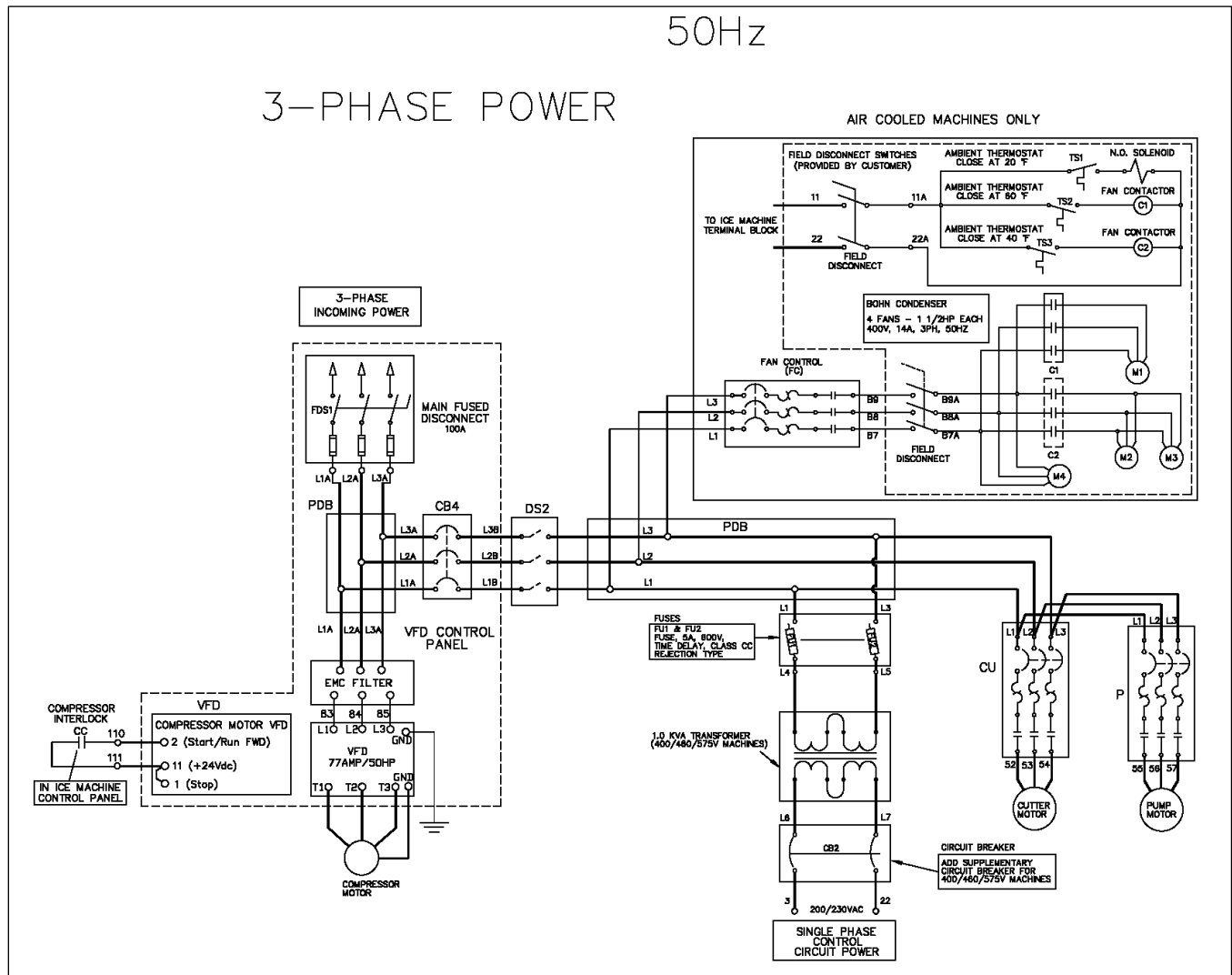


Figure 19: Electrical Schematic, 3-Phase Power, All Voltages, 50 Hz

# 60HZ MACHINES

## 3-PHASE POWER

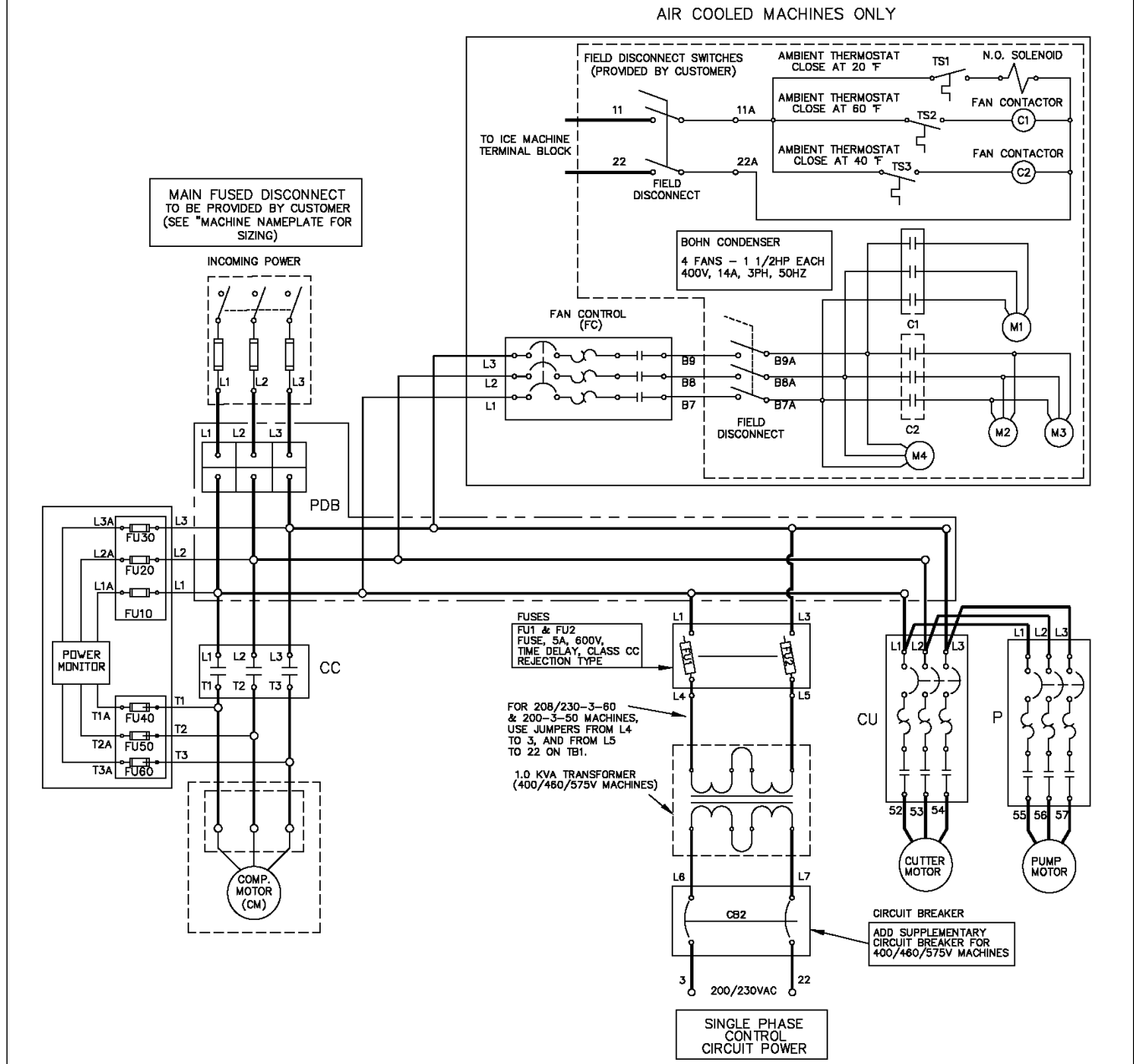


Figure 20: Electrical Schematic, 3-Phase Power, All Voltages 60 Hz

**Vogt 450 Controller**

The Vogt 450 controller is replacing and integrating the former standalone freezer pressure switch (FPS), the bin thermostat, the low-pressure safety, the high-pressure safety, the defrost pressure switch (DPS), and the condenser pressure switch (CPS).





Vogt 450 Low-Pressure Transducer  
(0-500 psi) [0-34.5 bar] Sensor #1



Vogt 450 High-Pressure  
Transducer (0-500 psi)  
[0-34.5 bar] Sensor #3



The Vogt 450 controller screen displays, in order of appearance:

1. The low-pressure value (Sensor 1 – in psig)
2. The bin temperature value (Sensor 2 – Fahrenheit [can be changed to Celsius])
3. The high-pressure value (Sensor 3 - psig)

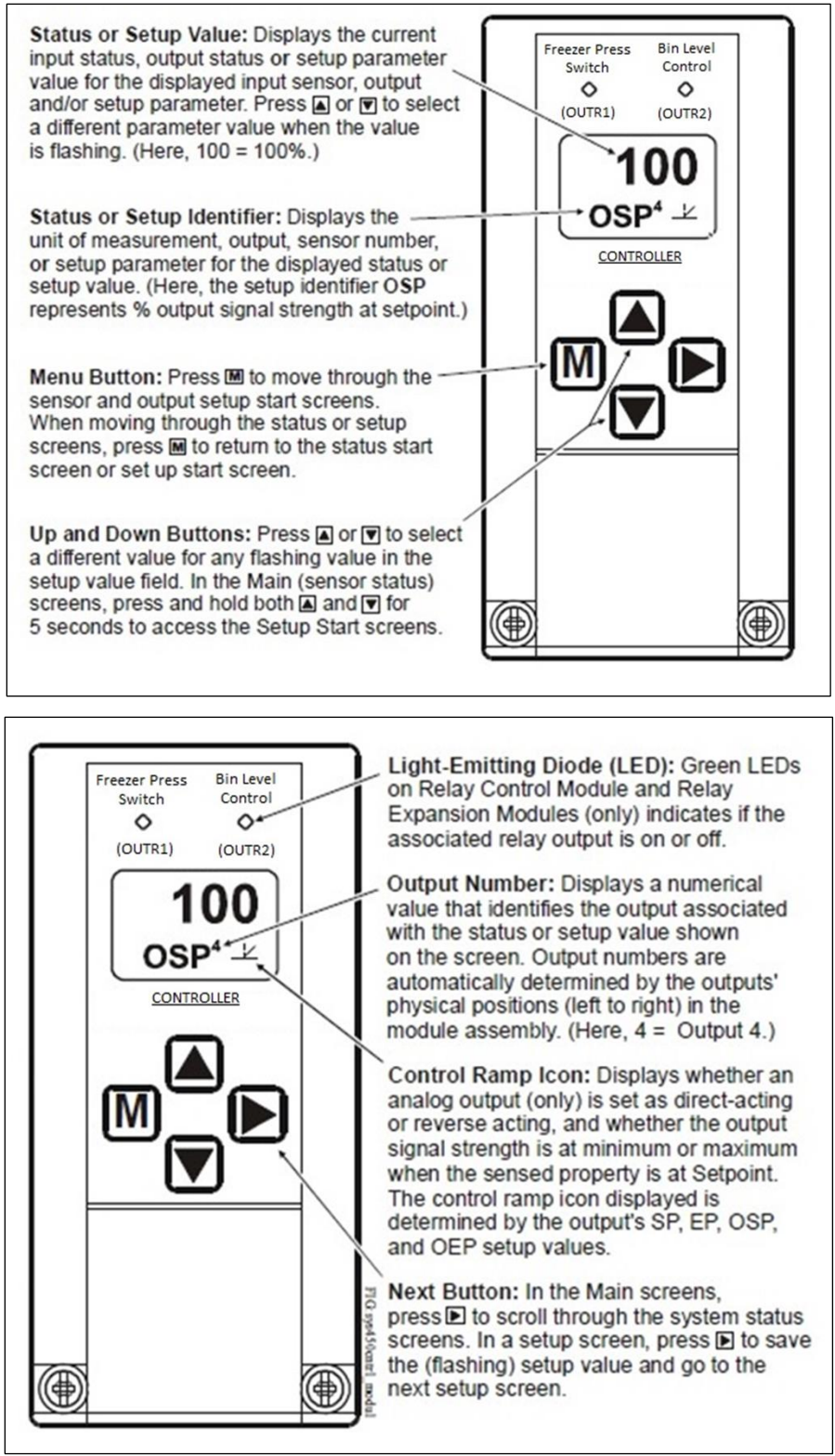


Figure 21: Vogt 450 Controller Display

Figure 22 shows the front of the Vogt 450 with four modules connected, linking the name of the switches in the Vogt 450 controller (OUTR1, OUTR2, OUTR3) with the name of the actuator connected to the switches (FPS2, BC2, Low Pressure Safety).

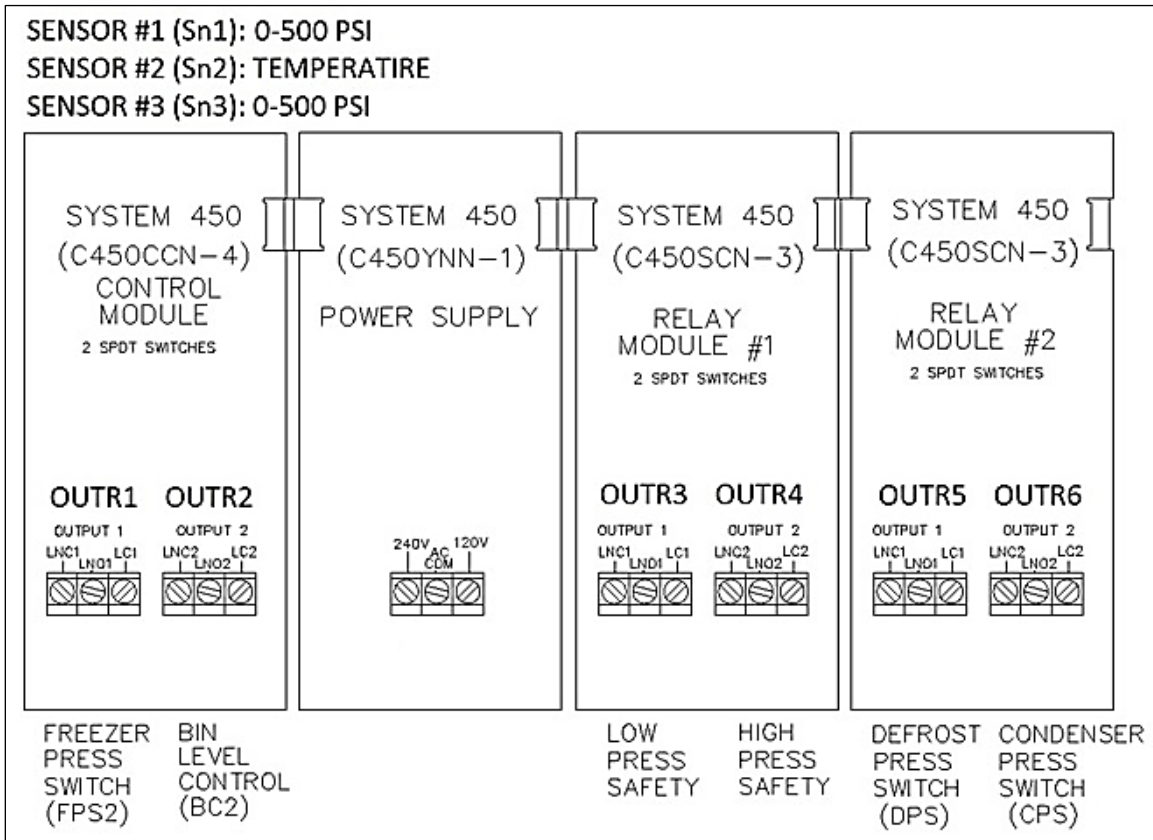


Figure 22: Front of Vogt 450

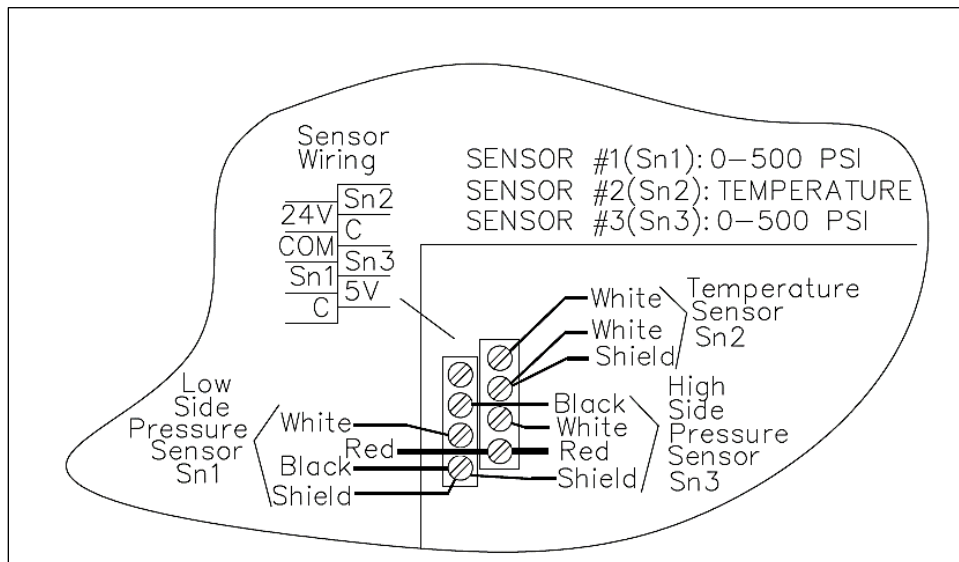



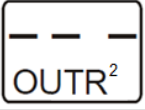

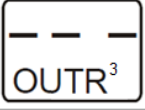

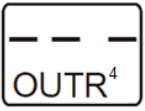

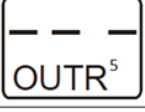


Figure 23: Vogt 450 Sensor Wiring

To modify the setting to adjust the FPS, DPS, and CPS, please follow the instructions below:

- Freezer Pressure Switch (FPS2) = OTR<sup>1</sup>

<u>Step #:</u>	<u>Action:</u>	<u>Result:</u>
<b>1</b>	<b>Press &amp; hold ▲ and ▼</b> For at least 5 seconds	--- SENS
<b>2</b>	<b>Press [M] once</b>	--- OUTR <sup>1</sup>
<b>3</b>	<b>Press ▶ once</b>	16.5 ON <sup>1</sup>
<b>4</b>	<b>Press ▲ or ▼</b> To adjust to the desired value (start with the higher value)	16.0 ON <sup>1</sup>
<b>5</b>	<b>Press ▶ once</b>	25.0 OFF <sup>1</sup>
<b>6</b>	<b>Press ▲ or ▼</b> To adjust to the desired value (start with the higher value)	25.5 OFF <sup>1</sup>
<b>7</b>	<b>Press ▶</b> 7 times until this screen	--- OUTR <sup>1</sup>
<b>8</b>	<b>Press ▲ and ▼</b> To go back to the scrolling screen	40 PSI <sup>1</sup>

- For all the other settings, follow the same steps as the freezer pressure switch (FPS2), except replace Step 2 with the following:

Setting	Step 2 Action		
For Bin Level Control (BC2) = OTR <sup>2</sup>	<u>Step #:</u>  <b>2</b>	<u>Action:</u>  <b>Press  2 times until this screen</b>	<u>Result:</u>  
For Low Pressure Safety = OTR <sup>3</sup>	<u>Step #:</u>  <b>2</b>	<u>Action:</u>  <b>Press  3 times until this screen</b>	<u>Result:</u>  
For High Pressure Safety = OTR <sup>4</sup>	<u>Step #:</u>  <b>2</b>	<u>Action:</u>  <b>Press  4 times until this screen</b>	<u>Result:</u>  
For Defrost Pressure Switch (DPS) = OTR <sup>5</sup>	<u>Step #:</u>  <b>2</b>	<u>Action:</u>  <b>Press  5 times until this screen</b>	<u>Result:</u>  
For Condenser Pressure Switch (CPS) = OTR <sup>6</sup>	<u>Step #:</u>  <b>2</b>	<u>Action:</u>  <b>Press  6 times until this screen</b>	<u>Result:</u>  

### Variable Frequency Drive (50-Hz Machines Only)

A variable frequency drive (VFD) is a type of controller that drives an electric motor by varying the frequency and voltage of its power supply. The VFD also has the capacity to control ramp-up and ramp-down of the motor during start or stop, respectively.

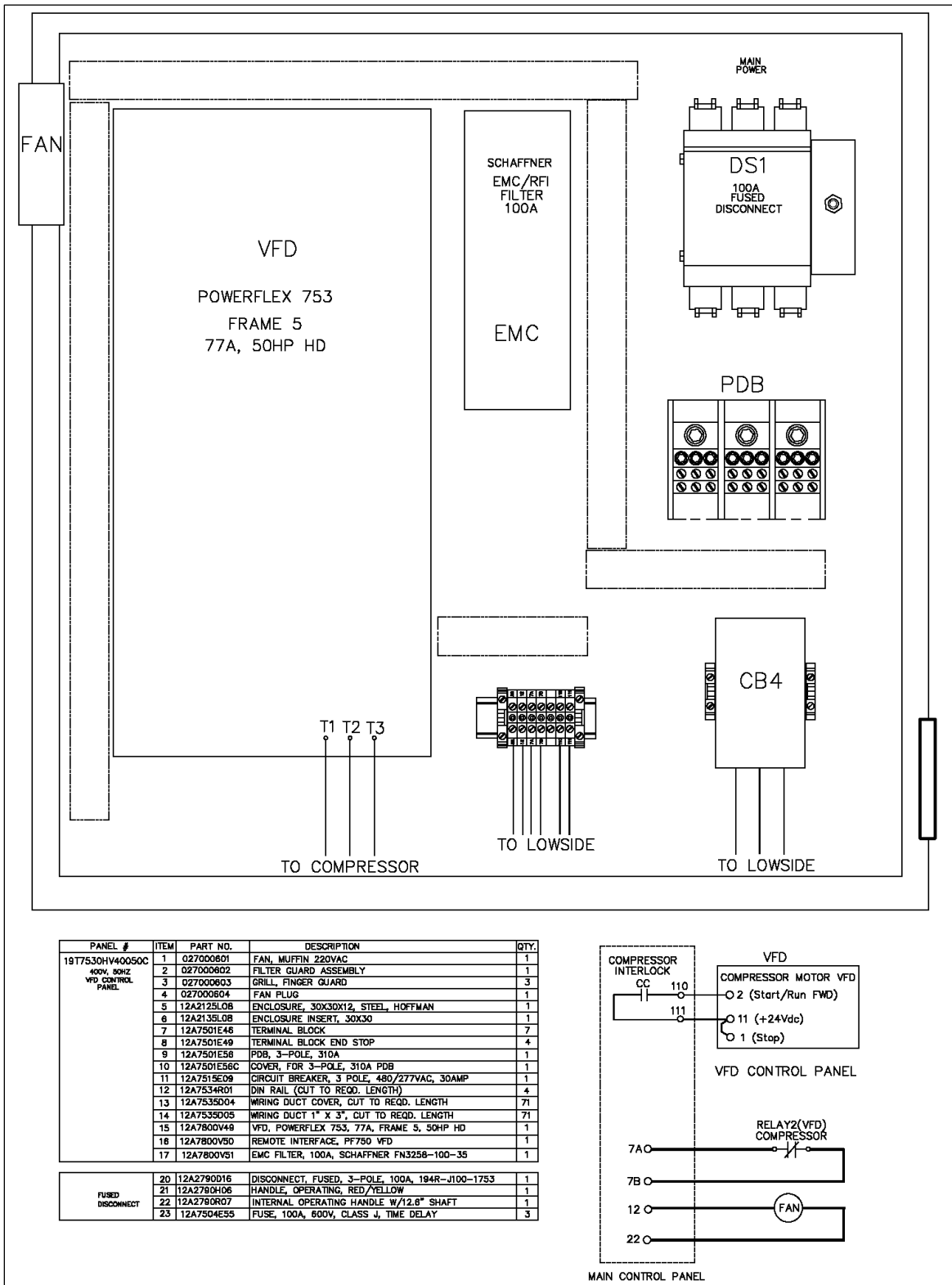


Figure 24: VFD Starter Panel

**Table 6: Control Panel Component Functions**

<b>Component</b>	<b>Function</b>
<b>AX</b>	Auxiliary trip indicator for manual motor starters. Switch opens, turning off the motor when cutter or pump motor starter trips.
<b>CB2</b>	Overload and short circuit protection for control circuit and crankcase heater. (400/460V machines only)
<b>CC</b>	Provides power to the compressor motor. Continuously energized during freezing and thawing. Auxiliary contacts control main power for control circuit components, crankcase heater, control relay, and harvest timer.
<b>CCR</b>	Capacity Control Relay. Controls the loading of the compressor. Y3–25%, Y4–100%.
<b>CR</b>	Control Relay. Controls sequencing of freezing and thawing circuits. Energized during thawing period.
<b>CU</b>	Fan motor starter (manual motor starter and contactor). Starts and stops cutter motor. Provides short circuit and over current protection. Stops cutter motor and ice machine in the event of a mechanical or electrical malfunction that results in excessive motor amperes.
<b>DS</b>	Disconnect switch (CE and Australian approved machines only).
<b>ET</b>	Indicates hours of machine operation. Energized when compressor is operating.
<b>FC</b>	Fan Control motor starter (manual motor starter and contactor). Cycles the fan motor(s) of air-cooled condenser on and off. Automatically activated by the System 450 (air-cooled machines only). Provides short circuit and over current protection. Stops fan motors in the event of a mechanical or electrical malfunction that results in excessive motor amperes.
<b>FU1&amp;2</b>	Overload and short circuit protection for control circuit and crankcase heater.
<b>FU10-60</b>	Short circuit protection for optional power monitor.
<b>P</b>	Pump motor starter (manual motor starter and contactor). Starts and stops pump motor. Provides short circuit and over current protection. Stops water pump motor in the event of a mechanical or electrical malfunction that results in excessive motor amperes.
<b>PBL1</b>	Light indicates a compressor fault. The push button resets the compressor module fault by pressing and holding for 5 seconds. The push button is also used to immediately stop machine operation in case of an emergency.
<b>PB2</b>	Starts machine for manually harvesting. Initiates a harvest period whenever this button is pushed with the <b>Clean/Off/Ice</b> selector switch in the Ice position and machine operating in a freeze period.
<b>PF</b>	Stops the machine when there is a power failure or interruption. Also, stops the machine when the high/low pressure switch, oil pressure safety control, pump overload, cutter overload, compressor overload, or the control circuit breaker is tripped. If the <b>Stop</b> button is pushed, any of the safeties tripped, or there was a power outage, the machine must be manually restarted by pushing <b>Start</b> .

**Control Panel Component Functions, cont.**

Component	Function
<b>SS</b>	Selector switch. Selects operating mode of machine. When in <b>Clean</b> position, only the water pump runs. This allows cleaner to be circulated through the freezer without making ice. In the <b>Off</b> position, the machine will shut down after the completion of a freeze and harvest period. In the Ice position, the machine will cycle on and off based on a control signal (i.e., bin thermostat or timer) or run continuously until manually stopped by setting the switch to the <b>Off</b> position.
<b>T</b>	Controls the time of the thawing period.
<b>TB1</b>	Main terminal block, which is numbered for multiple wire connections and ease of troubleshooting.
<b>Y3</b>	Compressor loader solenoid for 25% loaded condition.
<b>Y4</b>	Compressor loader solenoid for 100% loaded condition.

**Table 7: Part List for VFD Starter Panel – 50 Hz Only**

Item No.	Vogt Part No.	Description
<b>CB4</b>	<a href="#">12A7515E09</a>	3-phase Circuit Breaker, 30 Amp, 600V; Feeds power to the main control panel for the water pump, cutter, and condenser fan motors
<b>DS1</b>	12A2790D16	Fused Disconnect, 100A, 600V
	12A2790H06	Disconnect Handle
	12A2790R07	Internal Operating Handle
	12A7504E55	Fuse, 100A, 600V, Class J, Time Delay
<b>EMC</b>	12A7800V51	EMC/RFI Filter, 100A; Used to clean power lines
<b>VFD</b>	12A7800V49	VFD, Powerflex 753, 77 Amp, Frame 5, 50HP HD; Variable Frequency Drive; used to send 60-Hz power to the screw compressor
	12A7800V50	Remote VFD Interface

## Chapter 7 Maintenance

To achieve the best performance from the HFO10, follow the maintenance instructions listed in this chapter. For questions concerning the maintenance or upkeep of your equipment, contact Vogt Ice, LLC.

### Cleaning

The ice-making section of the Tube-Ice® machine should be cleaned at least twice a year (more often if water conditions cause mineral build-up). Use an approved food-grade ice machine cleaner. The machine is equipped with a Clean mode, which circulates the cleaning solution through the freezer to remove mineral scale using the water pump. Detailed instructions are also attached to the machine.

To clean your Tube-Ice® machine, follow these steps:

1. Pump down the machine and make sure the crankcase heater is working properly. This will eliminate the possibility of refrigerant migrating to the compressor while circulating warm water through the freezer (evaporator).
2. Set the **Clean/Off/Ice** selector switch to the **Off** position. If the machine is running, it will shut down on completion of the next harvest period.
3. Remove ice from the storage area or cover the storage opening.
4. Shut off the water supply and drain the water tank by opening the drain valve. Remove any loose sediment from the tank.
5. Close the drain valve and fill the water tank with warm water. Close the petcock valve on the water pump during the cleaning period. The tank holds approximately 15 gal (57 L).
6. Add the ice machine cleaning solution to the water tank according to the directions of the cleaning solution manufacturer. Vogt recommends Nu-Calgon® Ice Machine Cleaner, which is a food-grade liquid phosphoric acid.
7. Inspect the water distributors by looking through the transparent freezer cover. It may be necessary to clean the cover before inspecting. If required, remove the cover. Clean and remove any solid particles from the two orifices in each distributor. Clean the rubber cover gasket and reinstall the cover.
8. To run the pump only, set the selector switch to the **Clean** position and press **Start**.
9. For up to two hours (max), circulate the cleaning solution until deposits are dissolved or the solution is neutralized. Repeat cleaning if necessary.
10. Press **Stop** to stop the pump, then drain and flush the water tank with fresh water.
11. Open the water supply to the machine.
12. Drain, flush tank again, and refill it with fresh water.
13. Clean the inside of the ice storage area and remove any solution that entered during the cleaning process. Remove the cover, if one was installed, over the opening into the storage area.

To return the machine to ice-making operation, follow the steps below:

1. Make sure the water tank drain valve is closed and the **Clean/Off/Ice** selector switch is in the **Off** position.
2. Turn on the water supply and refill the tank with clean water.
3. Manually open the thaw gas solenoid valve (D) by running the valve stem in. This increases the pressure in the evaporator, allowing the machine to operate. After approximately one minute, put the thaw gas solenoid valve (D) back into the automatic position.
4. When the tank is full, turn the **Clean/Off/Ice** selector switch to the **Ice** position and push **Start**. The machine immediately begins ice production.

Check that the adjustable blowdown petcock valve on the recirculating water pump is adjusted properly. The valve should be adjusted to the minimum rate required to maintain production of clear ice. This should be no more than 1 gal (3.8 L) per minute for most water sources.

**Sanitizing**

To sanitize your Tube-Ice® machine, follow these steps:

1. Pump down the machine and set the **Clean/Off/Ice** selector switch to the **Off** position.
2. Remove ice from the storage area.
3. Shut off the water supply and drain the water tank by opening the drain valve. Remove any loose sediment from the tank.
4. In a clean container, mix 15 gal (56.8 L) of warm water at 90°F–115°F (32°C–46°C) with 24 oz (0.71 L) of Nu-Calgon® IMS-II Sanitizing concentrate (or equivalent, according to the manufacturer's instructions). The concentration should be 200 parts per million (ppm) (8 oz [227 g] per 5 gal [18.9 L]) of active sanitizing solution.
5. Close the drain valve and fill the water tank with the sanitizing solution.
6. Close the adjustable blow down petcock valve on the water pump.
7. Set the **Clean/Ice/Off** selector switch to **Clean** and press **Start** to circulate the sanitizing solution using only the water pump.
8. Mix an additional 5 gal (18.9 L) of warm water at 90°F–115°F (32°C–46°C) with 8 oz (227 g) of Nu-Calgon® IMS-II Sanitizing concentrate (or equivalent, according to the manufacturer's instructions) in the clean container. The concentration should be 200 ppm of active sanitizing solution.
9. Wearing appropriate gloves, submerge a clean sponge in the sanitizing solution and wipe all inside surfaces of the water tank and tank cover, including the makeup water float valve.
10. With the water pump running, add the additional 5 gal (18.9 L) of sanitizing solution to the water tank. Install the water tank cover and allow the sanitizing solution to circulate for at least 20 minutes.
11. While circulating the sanitizing solution, open the adjustable blow down petcock valve and allow the solution to flow down the drain. With the petcock valve open, allow the water to circulate for at least 3 minutes.
12. Press **Stop** to stop the pump.
13. Drain and flush the water tank with fresh water.
14. Open the water supply to the machine.
15. Drain, flush tank again, and refill with fresh water.
16. To sanitize the inside of the ice storage area, flood the area with the sanitizing solution, making sure to wet all surfaces completely for at least 60 seconds. The concentration should be 200 ppm of active sanitizing solution.

To return the machine to ice-making operation, follow the steps below:

1. Make sure the water tank drain valve is closed and the **Clean/Off/Ice** selector switch is in the **Off** position.
2. Turn on the water supply and refill the tank with clean water.
3. Manually open the thaw gas solenoid valve (D) by running the valve stem in. This increases the pressure in the evaporator, allowing the machine to operate. After approximately one minute, put the D-valve back into the automatic position.
4. When the tank is full, turn the **Clean/Off/Ice** selector switch to the **Ice** position and push **Start**. The machine immediately begins ice production.
5. Check that the adjustable blowdown petcock valve on the recirculating water pump is adjusted properly. The valve should be adjusted to the minimum rate required to maintain production of clear ice. This should be no more than 1 gal (3.8 L) per minute for most water sources.

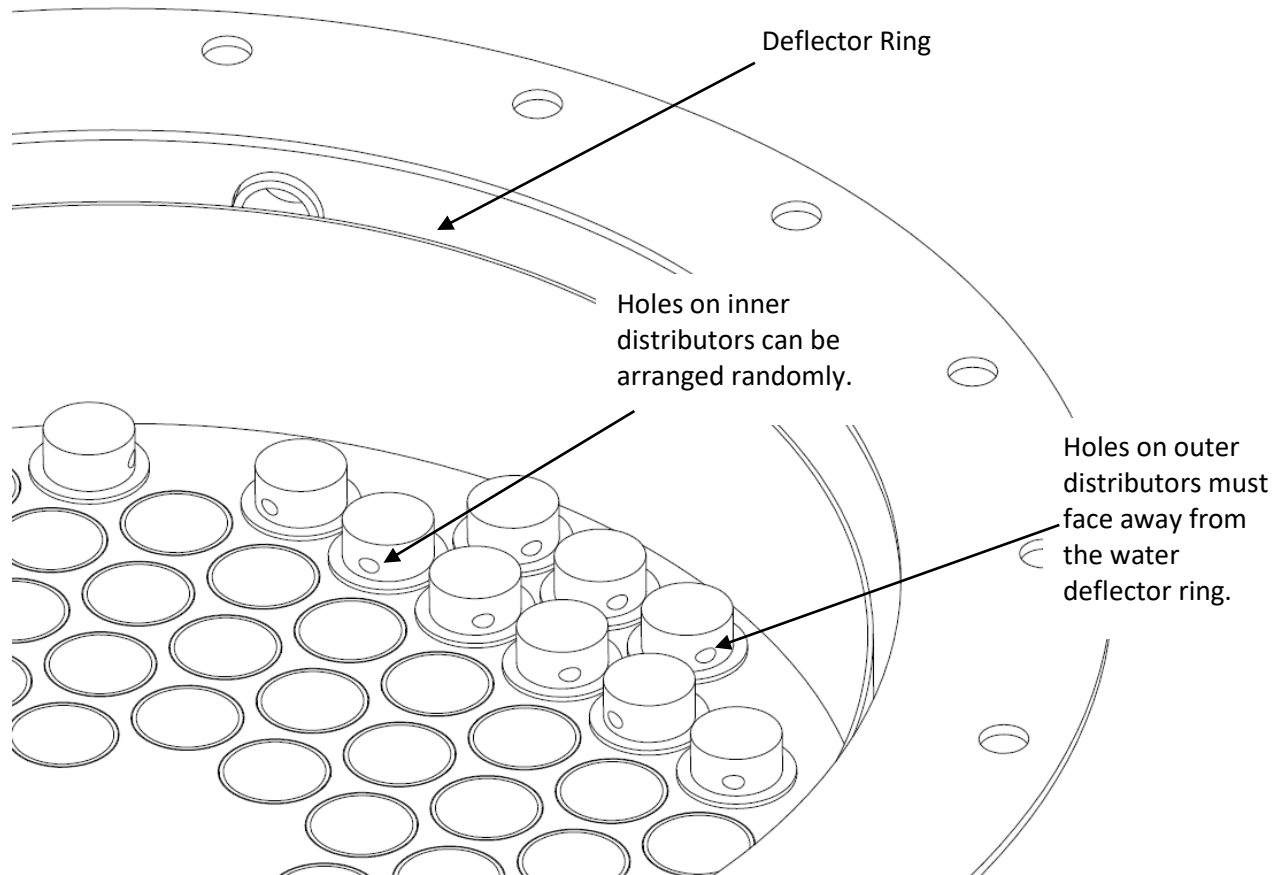
### **Water Distributors**

The water distributors are located under the freezer cover at the top of the freezer. These distributors may require occasional or periodic cleaning to remove solids and foreign particles accumulated from the makeup water. The frequency of this cleaning operation will depend on the characteristics of the water supply (refer Vogt Ice's water quality bulletin). The cleaning operation is needed when:

- Inside diameter of a large proportion of the ice becomes irregular
- Some of the ice is opaque
- There is a notable decrease in ice capacity

To clean the water distributors:

1. Shut down the machine and remove the freezer cover on the top of the freezer.
2. Remove the water distributors (one per tube) with pliers.
3. Use the pliers on the top part of the distributor with a twisting upward motion, taking care not to damage the orifices or the distributor body.
4. Soak the distributors in ice machine cleaner to remove mineral buildup if needed.
5. Rinse distributors thoroughly before reinstalling, tapping them in lightly with a rubber mallet to seat them in the freezer tubes.



**Figure 25: Water Distributor Detail**

Table 8 shows the part numbers and tube quantities for water distributors on the HFO10.

**Table 8: Water Distributor Information**

Tube Size in. (mm)	Number of Tubes	Vogt Part Numbers		
		Water Distributor	Freezer Cover	Freezer Cover Gasket
<b>1 (25)</b>	156	12B2185N11	12B2145C03	12A2600G15
<b>1-1/4 (32)</b>	102	12B2185N21		
<b>1-1/2 (38)</b>	72	12B2185N31		

### **Water Tank**

The production of opaque ice indicates the water in the water tank contains a concentrated number of solids or salts. To remedy this problem, follow the steps below:

1. Shut down the machine.
2. Remove the cover plate on the water tank and open the drain valve.
3. Clean the tank thoroughly by flushing it out with a hose and scrubbing it with a stiff brush. It may be necessary to completely remove the water tank in order to clean all internal surfaces.
4. After cleaning, reinstall the tank if necessary, close the drain valve, and fill the tank with fresh water.
5. Set the **Clean/Off/Ice** selector switch to the **Clean** position and press **Start** to check if the pump is working properly. Air may have collected in the impeller housing, and the pump may have to be stopped and started several times to expel this air.
6. After the pump is checked for proper flow, set the **Clean/Off/Ice** selector switch to the **Ice** position and press **Start** to resume ice production.

### **Freezer Cover**

A clear polycarbonate freezer cover is provided for visual inspection of the water box and water distributors located at the top of the freezer. The cover should be removed and cleaned if it becomes coated with deposits. Generally, if this cover is coated with solids, this is a major indicator that other water contact areas (i.e., water tank and distributors) also require cleaning.

### **Water-Cooled Condensers**

The interval in which condensers require cleaning varies. Some installations seldom need cleaning, while others may require cleaning at least once a year or even several times a year.

Proper operation of cooling towers increases the interval between cleaning considerably. Check the tower overflow rate frequently. If a tower operates with insufficient overflow (nominal 1.5 to 3 gph [5.7 – 11.4 Lph], depending on water quality), the resulting mineral concentration in the water can cause rapid and heavy fouling inside the condenser tubes, requiring excessively frequent cleaning. Also, these conditions often lead to severe corrosion.

Chemical additives, including those used to stop algae and related growths, should be obtained only from a reputable, established supplier. Always follow manufacturer's directions. Excessive treatment of the water can cause more harm than good, and the condensers, pumps, piping, and towers themselves may be damaged.

Double check the system to make sure that fouling is actually causing the trouble. High head pressure alone does not mean a fouled condenser.

Before cleaning, always check for the following conditions:

- Non-condensables in the system or a faulty head pressure gauge—Check standby pressures against refrigerant tables.
- Incorrectly set or defective water regulator valve—Check setting and operation.
- Partly closed compressor discharge service valve—Check the stem position to confirm that it is backseated.
- High-temperature water entering the condenser. Check the cooling tower fan and system.

If none of these problems exist, or they have been resolved, determine the temperature difference between the water leaving the condenser and the refrigerant condensing temperature (saturation temperature [refer to Table 26: Pressure-Temperature Chart], corresponding to the head pressure). If this difference exceeds 10°F (5.6°C), cleaning is required because the difference indicates that good heat transfer is not occurring.

If the difference is less than 8°F (4.5°C), something other than a fouled condenser may be the cause of high head pressure. During normal operation, the temperature difference stays between 5°F and 10°F (2.8°C and 5.6°C) regardless of water inlet temperature, when the water flow is regulated by a pressure-operated water valve. If the difference is less than 5°F (2.8°C), restricted water flow or a low supply pressure is likely. A restriction can be caused by foreign matter in the condenser, but it is likely to be elsewhere in the system.

### *Draining*

Draining of water-cooled condensers is recommended in climates where units may be left exposed to ambient temperatures below 32°F (0°C). Although condensers usually have a vent and drain fittings, the opening of these fittings is not sufficient for a natural gravity flow of water. Water is thus retained in the tube due to the surface tension between the tube and the water and the normal curvature between tube supports.

Experience shows that as much as 20% of the water in the condenser is retained. To break the surface tension between the water and the tubes and to drain all tubes completely, the condenser must be tilted a minimum of 5 degrees. Whether water left in the tubes causes damage depends on how quickly the water freezes and its location inside the condenser. Condenser manufacturers recommend that each tube is blown out individually with compressed air to remove the water. Alternatively, a minimum of 25% ethylene glycol in the system will also prevent the water from freezing, which can rupture the tubes.

### **Chemical Cleaning**

Vogt Ice, LLC, makes no recommendation for any particular chemical preparation because the same chemical may not be effective in all circumstances.

#### **CAUTION**

The warranty on condensers is void if they are damaged by improper cleaning tools or methods. If harsh chemicals are used, be sure to follow the manufacturer's recommendations regarding safe handling of those solutions.

Follow these directions and precautions when cleaning:

- Use only preparations from an established, reliable source.
- Follow directions exactly, particularly regarding amounts to use, and flushing or neutralizing procedures after cleaning.
- Close the water supply to the stop valve and remove the condenser water regulating valve.
- Circulate the solution through the condenser until it is considered clean (no excess scale on tubes or tubesheets).
- Flush the condenser according to the directions provided by the chemical manufacturer.
- Reinstall the water regulating valve and associated piping.
- Open the water-supply stop valve and check for leaks.

### **Mechanical Cleaning**

The following steps should be followed during mechanical cleaning.

1. Close the stop valve in the water supply line.
2. Drain the water from the condenser.
3. Remove the water regulating valve and associated piping from the condenser.
4. Remove the nuts, water plates, and gaskets from both ends of the condenser.
  - If the gasket does not lift off with the end plate, do not attempt to pry it off. This can damage the sealing surface, causing a water leak. To free a sticking gasket, replace the water plate and tap the outside face of the plate with a rubber mallet or block of wood. After a few taps, the gasket will spring free and slip off with the water end plate.
5. Rinse gaskets with running water and use a rag or soft brush to remove foreign matter.
  - Rust, scale, and dirt will not stick to the gasket material.
6. Use clean water and a rag or soft bristle brush to clean the inside of the water end plates and the outer tube sheet surfaces.

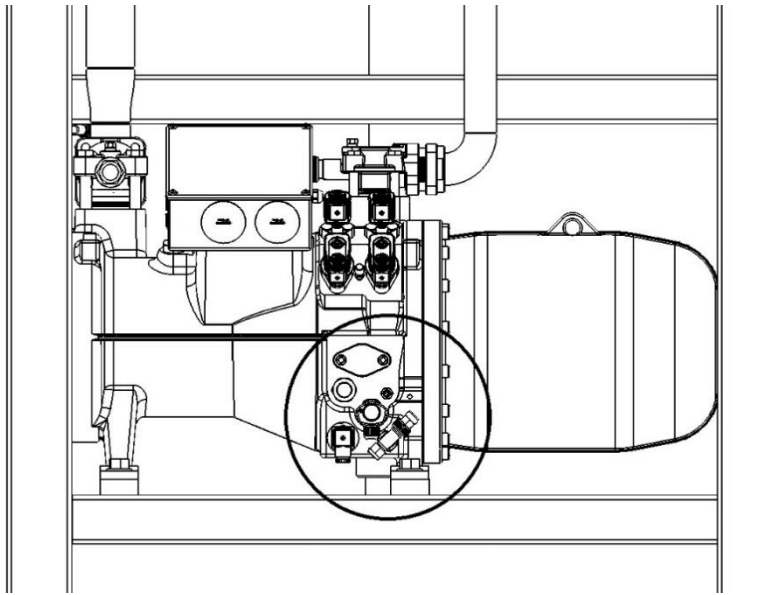
**Note:** Never use a wire brush or strong caustic on these surfaces.

  - These surfaces have been coated with a special material that will give years of protection against corrosion unless damaged.
7. Flush the condenser tubes clear with air, water, or a piece of rag on the end of a stick or wire. This will sufficiently clean the tubes in many cases.
  - If the inside surfaces are smooth, further cleaning is not necessary, even though the surfaces may be discolored. Do not attempt to achieve a bright copper finish on the tubes as they will quickly discolor when in service. The condenser is designed to handle moderate fouling on these surfaces.
  - If a rough coating remains on the insides of the tubes after flushing and wiping, further cleaning is required. The color will vary depending on water conditions. In these circumstances, use a nylon, brass, or copper brush to clean the tubes. Do not use any tool that will score, mark, flake, or otherwise cut into the tubes.

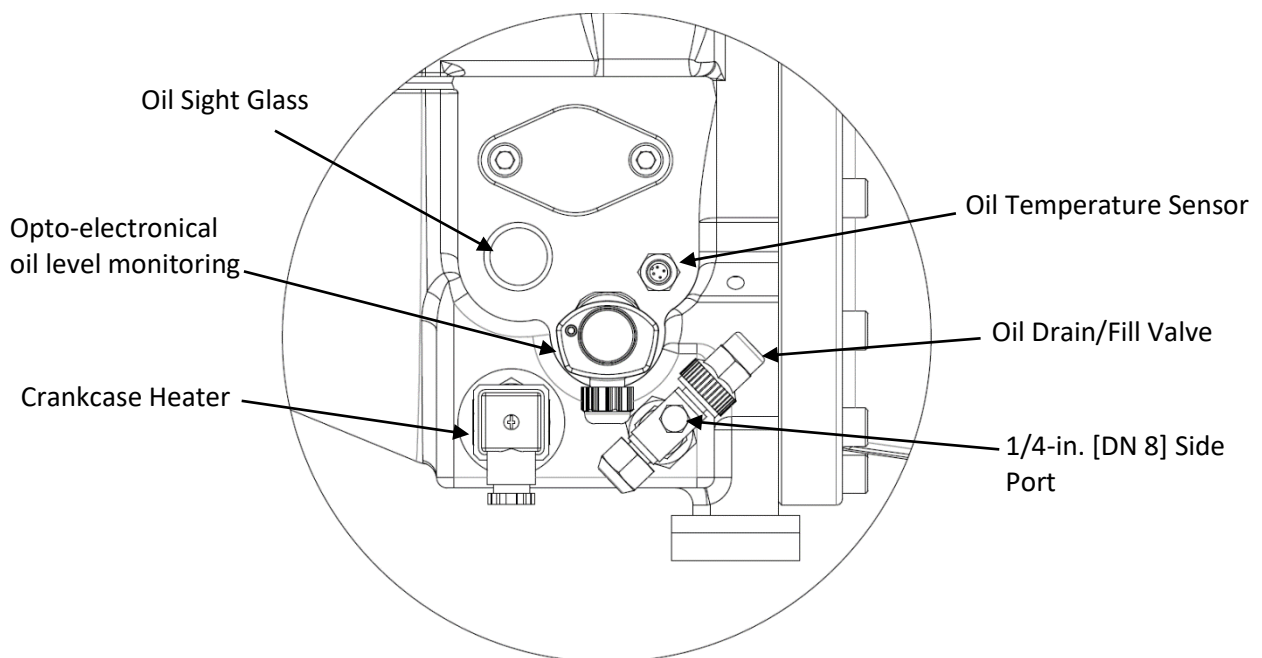
## **Compressor Lubrication**

The HFO10 is built with the industry leading semi-hermetic Bitzer Compact Screw Compressor (CSH). This robust and energy-efficient compressor requires a special synthetic refrigeration compressor oil to reduce friction, the Bitzer BSE 170 oil.

When starting and charging the unit, the oil in the sight glass of the compressor crankcase should be watched carefully for the first hour to ensure that the proper amount of oil is remaining in the crankcase (between the lines on the sight glass). The oil level may be low on initial start-up if electrical current to the crankcase heater was interrupted.



**Figure 26: Front of the Machine - Compressor Section**



**Figure 27: Compressor Oil Section**

If there is a power interruption to the crankcase heater, the heater should be energized for at least two hours before restarting the machine. This allows for evaporation of refrigerant that may have condensed in the crankcase during the shutdown period. If the level is low after start-up, it should begin to return after a short period of operation.

The oil level should be checked frequently, particularly during the start-up operation, to make sure a sufficient amount of oil remains in the crankcase. While it is important to observe the oil splash during operation, the true level can be obtained only when the compressor is stopped. With the compressor idle, the oil level should be at a height of 1/4 to 3/4 of the sight glass but never out of sight above it.

The machine is shipped with the proper amount of oil for operating water-cooled systems. However, it may become necessary to add some oil if new refrigerant is added to the system at a later date. Generally, air-cooled machines will require additional refrigerant and oil to compensate for long piping runs to the condenser.

The tables below detail the type of oil required for the HFO10's screw compressor. Using any other types of oil will void the machine warranty.

**Table 9: Required Compressor Lubricants and Capacity**

Refrigerant	Required Lubricants	Lubricant Type	Water-Cooled Oil Charge oz (ml)
R-513A	Bitzer BSE 170	Polyol Ester Oil	305 (30)

**Note:** The oil specified for this machine is very hygroscopic (it attracts and holds water molecules from the surrounding environment) and should be protected from the atmosphere to all extents possible.

If the compressor needs more oil, use an oil pump. To add oil, remove the large refrigerant valve cap on the Oil Drain/Fill valve in Figure 27. Backseat the valve (large stem out) to close off the 1/4-in (DN 8) side port on the valve body. Remove the 1/4-in. (DN 8) brass seal cap to access the oil fill port on the valve body. Once the seal cap is removed, connect a refrigerant hose to the 1/4-in. (DN 8) port and front seat the valve (large stem in) to open the 1/4-in. (DN 8) port. Using an oil pump, add oil directly to the compressor crankcase until the oil reaches the oil fill mark on the side of the compressor body.

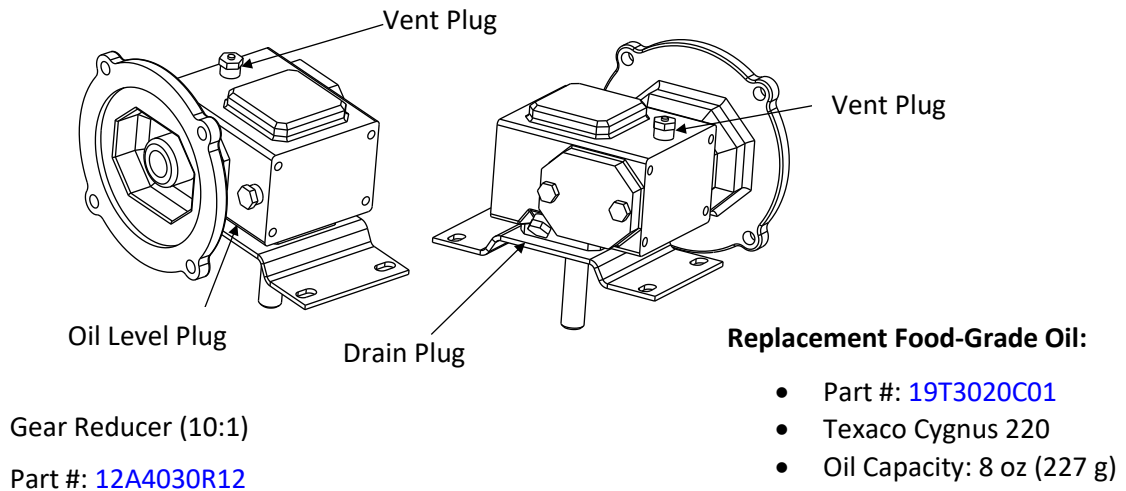
After all oil is added, backseat the valve (large stem out) to close off the 1/4-in. (DN 8) side port on the valve body, remove the refrigerant hose, and replace the 1/4-in. (DN 8) brass seal cap. Front seat the valve (large stem in) and check for leaks at the brass seal cap. If no leaks are found, replace the large refrigerant valve cap on the Oil Drain/Fill valve.

The Bitzer screw compressor is equipped with an opto-electronical oil level sensor, which monitors the compressor's oil level and automatically stops the machine if the oil level is too low. This helps avoid damage to the compressor.

For other compressor maintenance procedures, refer to the Bitzer service bulletin SB-170 operating manual.

## Lubrication of the Cutter Motor Gear Reducer

The oil level for the gear reducer should be checked to see if a leak exists. The oil level should be at the bottom of the plugged opening in the side of the gear housing. Use Mobile 600W cylinder oil or equivalent. Change the oil once a year.



**Figure 28: Cutter Motor Gear Reducer**

## Preventive Maintenance

A preventive maintenance program is recommended for optimum and efficient operation and a long service life. It is recommended that you or a delegated employee make a daily visual check of your Tube-Ice<sup>®</sup> machine. When you are aware of the proper operating conditions and observe them on a daily basis, changes in these conditions can alert you to changes in the operation of the machine that may require maintenance long before a service situation arises.

The following schedule is suggested as a minimum:

### Daily Checklist

- Is the machine running, or is the bin full?
- Bin doors are closed.
- Thermostat bulb is in the bracket.
- All ice discharges during harvest period.
- Machine and components are clean.
- No unusual noises.
- Operating pressures (suction, discharge, hot gas, oil) are within acceptable limits.
- Ice quality (clarity and uniformity) is correct (refer to water conditioning bulletin).
- Harvest period continues at least 30 seconds after the last ice is out.
- Compressor oil level is appropriate.
- Refrigerant operation level is within acceptable limits.
- The frost pattern on the freezer shell extends to the bottom of the suction connection.
- Water float valve is properly adjusted (water should not pour out of the tank during operation or cause the water pump to cavitate).

**Weekly Checklist**

- Weekly or Monthly Calibration and operation of all controls (high- and low-pressure switches, oil pressure switch, etc.) are within limits.
- Cooling tower spray nozzles and pump suction screen are free of scaling and algae (consult water treatment suppliers for corrective measures).
- Water distributors at the top of the freezer are free of scale accumulation.
- Remove solids that have collected in the water tank.
- Check all motor drive units (compressor, pump motors, cooling tower fan, and pump, etc.) for abnormal noise and/or vibrations.
- Observe one complete ice making cycle, record data, and compare with the **Warranty Registration/Start-Up Form**.

**Monthly or Yearly Checklist**

- Check entire system for leaks.
- Check system for leaks after 400 hours or 4 weeks of operation.
- Drain water from the condenser and cooling tower and check condenser tubes. Inspect for damage by corrosion or scale.
- Remove all rust from all equipment, clean, and paint.
- Check all motors for shaft wear and end play.
- Check operation and general condition of all electrical controls, relays, motor starters, and solenoid valves.
- Observe one complete ice making cycle, record data, and compare with the **Warranty Registration/Start-Up Form**.
- Change oil in cutter motor gear reducer.



**Warning:** Pressure relief valves must be replaced after 5 years of service. Before replacing relief valves, review requirements per current local and national codes. Valve replacement should be performed only by service personnel experienced and certified in refrigeration and qualified to work with high-voltage electrical equipment. If a relief valve discharges, the valve must be replaced before putting the machine back into service. Relief valves do not properly reseat after a discharge event. Contact Vogt SuperCare Customer Service for replacement valves.

## Preventive Maintenance Form

This form can be removed and duplicated for record keeping. This page is a complete Preventive Maintenance Schedule that should be performed every 90 days. The Preventive Maintenance page may be copied and given to your service person. It should be signed, dated, and returned to you for permanent record.

**Date:**

**Model No.:**

**Serial No.:**

The following service was performed and checked:

Service	
<input type="checkbox"/>	Last maintenance performed (approx. date) ____ / ____ / ____
<input type="checkbox"/>	Scale condition of water tank and tubes (good - fair - poor)
<input type="checkbox"/>	All drains freely draining (water tank, drip pan, ice bin)
<input type="checkbox"/>	Water distributors cleaned
<input type="checkbox"/>	Ice machine cleaner circulated through system
<input type="checkbox"/>	Condenser clean (water-cooled, if applicable)
<input type="checkbox"/>	Voltage at machine (actual reading) _____, _____, _____
<input type="checkbox"/>	Compressor amps (halfway through freeze cycle) _____, _____, _____
<input type="checkbox"/>	Cutter motor amps while cutting ice _____, _____, _____
<input type="checkbox"/>	Water pump amps while pump running _____, _____, _____
<input type="checkbox"/>	AC condenser motor amps (if applicable) _____, _____, _____
<input type="checkbox"/>	Crankcase heater heats oil
<input type="checkbox"/>	Refrigerant leaks (okay - high - low)
<input type="checkbox"/>	Leak-checked entire system; number of leaks found _____
<input type="checkbox"/>	Compressor oil level in sight glass (1/4 - 1/2 - 3/4 - low - high)
<input type="checkbox"/>	Gear reducer oil level (correct level - low level)
<input type="checkbox"/>	Low-pressure switch setting, psig _____
<input type="checkbox"/>	High-pressure switch setting, psig _____
<input type="checkbox"/>	Bin stat(s) installed and operating properly
<input type="checkbox"/>	Makeup water float valve adjusted properly (pump not cavitating, water tank not overflowing)
<input type="checkbox"/>	Adjustable blowdown adjusted for clear ice
<input type="checkbox"/>	Suction psig at end of freeze CYL _____ CRU _____
<input type="checkbox"/>	Suction psig during harvest (high / low) CYL _____ CRU _____
<input type="checkbox"/>	Discharge psig at end of freeze CYL _____ CRU _____
<input type="checkbox"/>	Ambient temperature at machine ( °F/ °C)
<input type="checkbox"/>	Outside ambient temperature (at air-cooled condenser or cooling tower, °F/ °C)
<input type="checkbox"/>	Makeup water temperature ( °F/ °C)
<input type="checkbox"/>	Freeze period time (minutes)
<input type="checkbox"/>	Harvest period time (minutes)
<input type="checkbox"/>	Total cycle time (Freeze period time + harvest period time, minutes)
<input type="checkbox"/>	First ice out time (seconds)
<input type="checkbox"/>	Last ice out time (seconds)
<input type="checkbox"/>	Ice weight per cycle ( lb/ kg)
<input type="checkbox"/>	24-hour production capacity $\left( \frac{\text{Ice weight per cycle}}{\text{Total cycle time}} \times 1440 \right)$

**Comments:**

**Signature:**



## Chapter 8 Troubleshooting



**Warning:** Only service personnel experienced and certified in refrigeration and qualified to work with high-voltage electrical equipment should be allowed to install or work on this Tube-Ice® machine.



Follow all lock-out and tag-out procedures before servicing any electrical equipment.

**Note:** With the exception of bin control, anytime the machine stops, it must be manually restarted by pushing the **Start** button. If the machine stops during a freeze period, it restarts in a thawing (harvest) period.

This section lists potential problems and suggests solutions for this Tube-Ice® machine. Some of the problems and solutions apply to optional equipment supplied by others and may vary. Many problems are easy to solve if you know what caused them. If your problem is not covered in this section, call the factory directly at 1-502-635-3000 or 1-800-853-8648.

Your machine's electrical system has several built-in safety and overload protection features to stop operation when a single component fails or there is a problem from an outside source, such as a power supply. Make sure all auxiliary equipment is connected to safety and overload circuits so all related equipment is protected.

Always check the machine thoroughly after addressing the problem to prevent the same cause from reoccurring.

### Machine Not Running

Possible Causes	Possible Solutions
<b>Power failure and intermittent power interruption</b>	Check electrical fused disconnect or circuit breaker supplying power to the machine. If power has been off for a period of time, make sure the compressor crankcase heater is energized, the crankcase is warm (100 - 110°F [38 - 43°C]), and there is no liquid refrigerant in the crankcase before running the machine. Push <b>Start</b> to initiate startup in a thawing period.
<b>3.0-amp circuit breaker in the control panel trips</b>	Check compressor crankcase heater, coils of relays, contactors, starters, solenoid valves, and thawing timer for a ground. Repair or replace any defective part and replace fuse. Make sure there is no liquid refrigerant in the compressor crankcase before restarting the machine.
<b>High/low safety pressure switch trips</b>	If the machine stops because the pressure is too low, the switch resets automatically when the pressure increases to the appropriate setting. If the machine stops because the pressure is too high, the switch automatically resets after the pressure drops below the appropriate setting. Check switch settings. Push <b>Start</b> to start the machine in a thawing period. Check the head pressure during the next freeze period. Refer to Chapter 9, (High/Low Pressure Switch).
<b>Optical oil sensor trips</b>	If the machine stops because the oil level is too low, check the compressor oil-level sensor. A solid red light comes on if tripped. To reset the sensor, add oil to the compressor. The oil level should be ¼ – ¾ in the upper sight glass. Once oil is added to the compressor and the red light is off, the machine is ready to restart.

**Machine Not Running, cont.**

Possible Causes	Possible Solutions
<b>Cutter motor overload trips</b>	Check and clear the cutter area and ice discharge path of all ice. Check voltage and overload range adjustment against motor rating. Reset the switch and restart the machine by pushing <b>Start</b> . Check the cutter operation and motor amp draw. If tripping repeats, but there is no ice clogging the cutter area or ice discharge path, check the cutter bearing for wear, the gear reducer for resistance, and the motor for defects or single phasing.
<b>Pump motor overload trips</b>	Check voltage and overload range adjustment against motor rating. Reset the switch, set the <b>Clean/Off/Ice</b> switch to the <b>Clean</b> position, and restart the machine by pushing <b>Start</b> . Check the pump operation and motor amps. If tripping repeats, check for a defective overload, defective motor, or single phasing.
<b>Bin thermostat or bin level control stops machine</b>	Adjust or replace the bin thermostat or level control. Make sure the bin thermostat bulb or level control is located properly in the bin. Refer to <i>Ice Bin Thermostat Sensor</i> .
<b>Defective component in control panel</b>	Check for open circuit. Refer to Figure 12 to identify parts. Replace defective part, restart machine, and check power supply and current draw.

**Freeze-Up from Extended Freeze Period**

Possible Causes	Possible Solutions
<b>Freezer pressure switch setting too low</b>	Adjust freezer pressure switch or replace if defective.
<b>Water tank drain valve or makeup water solenoid open too long</b>	Close, repair, or replace valve as needed.
<b>Thaw gas solenoid valve leaking during the freeze period</b>	Check the manual opening stem to make sure it is in the automatic position (stem screwed out). Check for leakage through the valve by measuring the sound and temperature differences. Close the stop valve at the receiver to confirm leakage. Repair or replace the valve as needed.
<b>Float switch sticks or fails to close</b>	Check to make sure the float switch is opening and closing.
<b>Liquid line solenoid valve (A) is stuck open</b>	Check to make sure the valve is not in the manual open position. Disassemble valve and inspect for debris. Clean valve if required.

## Freeze-Up from Ice Failing to Discharge

Possible Causes	Possible Solutions
<b>Insufficient heat for thawing because of low condensing pressure, non-condensable gases (usually air) in system, low refrigerant charge, or thaw gas pressure switch adjusted too low</b>	The head pressure should be maintained at approximately 130 psig (9 bar) for 513A, which relates to 98.7°F (37.0°C) by adjusting the water regulating valve (water-cooled units) or fan cycling switch (air-cooled units). If non-condensable gases are present in the refrigerant, the saturated temperature will not relate to the pressure reading at the receiver. The refrigerant level in the receiver should be near the operating level (marked by the sticker) at the end of a freezing period to provide enough volume for harvesting. (1-in. [2.54 cm] = approx. 10 lb. [4.5 kg] of 513A).
<b>Thawing time too short</b>	Check the thaw timer (T) which should be adjusted to allow all the ice to clear the cutter and ice discharge opening with at least 30 seconds to spare.
<b>Cutter or cutter disc does not turn</b>	Check cutter reducer and drive gear for proper operation and alignment. Check for broken cutter disc or drive pin and replace as necessary.
<b>Ice backs up into cutter or discharge opening, jamming cutter</b>	Ice mushy due to concentration of solids in the water tank. Perform "Cleaning Procedure" and check automatic and adjustable blowdown. If the machine discharges ice into a chute, it should slope at an angle of 30 degrees for cylinder ice, and 45 degrees for crushed ice. Check bin stat or level control to make sure it will stop the machine before ice backs up into the cutter.
<b>Extended freeze period</b>	Check freezer pressure switch adjustment, refer to Section 9, (Freezer Pressure Switch) and Table 21 Normal Operating Criteria.
<b>Compressor not unloading</b>	Check compressor amps during harvest. A noticeable drop in amperage should occur. Check unloader solenoid coil. If coil is okay, replace unloader head assembly.
<b>Thawing time too short</b>	Check the thaw timer (T), which should be adjusted to allow all the ice to clear the cutter and ice discharge opening with at least 30 seconds to spare.

**Poor Ice Quality**

Possible Causes	Possible Solutions
<b>Excessive concentration of solids in the water tank, indicated by a build-up of mineral deposit on the sides and bottom of the tank</b>	Clean the water tank. Remove the freezer cover and clean the water distributors. Adjust continuous blowdown.
<b>Insufficient water supply indicated by a low level in the tank</b>	Check water pressure—30 psig [2 bar] is the recommended minimum. Check for a water line restriction, partially closed valve, or defective makeup water float valve. Make sure the water tank drain valve is closed.
<b>Water pump rotation wrong direction</b>	Check rotation by referring to the arrow on the pump housing and reverse two wires at the motor if necessary.
<b>Low refrigerant charge</b>	Check refrigerant level mark on the receiver and on the red portion of the gauge glass guard. Perform a pumpdown if necessary. Keep the gauge glass cocks closed when finished checking the level.
<b>Insufficient blowdown during harvest</b>	Check for proper operation of the siphon vacuum break valve. Check for restrictions or traps in the water tank drain assembly.

**Low Ice Capacity**

Possible Causes	Possible Solutions
<b>Low refrigerant charge</b>	Check for and repair leaks. Add refrigerant.
<b>Restriction in liquid line</b>	Check for a partially closed valve or an obstruction at the dryer, strainer, solenoid valve, or expansion valve. The liquid line will normally have frost on the downstream side of a restriction, especially as the suction pressure decreases.
<b>Float switch stuck or failed in open position</b>	Make sure the float switch is opening and closing. Make sure the A valve is getting power.
<b>Thaw gas solenoid valve leaking during the freeze period</b>	Check the manual opening stem to make sure it is in the automatic position (stem screwed out). Check for leakage through the valve by measuring sound and temperature differences. Close the stop valve at the receiver to confirm suspicion of leakage. Repair or replace the valve as needed.
<b>Water distributors at top of freezer are clogged</b>	Remove freezer cover and clean the distributors. Refer to <i>Water Distributors</i> in Chapter 7.
<b>Not enough water for ice making</b>	Check water pressure (30 psig [2 bar] minimum is recommended). Check for a water restriction in the supply line or at the makeup water float valve.
<b>Makeup water float valve stuck open, adjusted too high, or water tank drain valve open or leaking</b>	Repair, replace, or adjust float valve as needed. Close, repair, or replace water tank drain valve as needed.

**Low Ice Capacity, cont.**

Possible Causes	Possible Solutions
<b>Controls for regulating freezing and thawing periods not adjusted properly</b>	For highest capacity, cylinder ice should have a small hole and crushed ice should be about 3/16-in. [4.8-mm] thick. Adjust the freezer pressure switch and thaw timer as needed. Refer to Chapter 9
<b>Excessively high head pressure</b>	Check water regulating valve or fan control adjustment. Clean the condenser if needed. Check refrigerant table for appropriate pressures and temperatures.
<b>Warm makeup water for ice making</b>	Capacity of the machine is proportional to the water temperature during ice making. Warmer water will reduce the ice-making capacity. Refer to HFO10 Capacity Chart.
<b>Drain valve open</b>	Close drain valve.
<b>Low refrigerant charge</b>	Check for and repair leaks. Add refrigerant as needed.
<b>Restriction in liquid line</b>	Check for a partially closed valve, or for an obstruction at the dryer, strainer, solenoid valve, or expansion valve. The liquid line will normally have frost on the downstream side of a restriction, especially as the suction pressure decreases.

**High Head Pressure (Water-Cooled Machines)**

Possible Causes	Possible Solutions
<b>Misadjusted or defective water regulating valve</b>	Adjust or replace valve. Never adjust the valve stem as far open as it will turn, because it will not close when the head pressure drops.
<b>Insufficient water supply</b>	Check size of water line and pump output at the condenser. Refer to the specification sheet for water requirements. Check cooling tower sump level and makeup water supply.
<b>Cooling tower needs maintenance</b>	Check cooling tower fan belt and tighten or replace as needed. Check spray nozzles and sump screen and clean as needed.
<b>Non-condensable gas (usually air) in system</b>	Check refrigerant tables for appropriate pressures and temperatures. If non-condensable gases are present, perform a total pumpdown. Let stand for at least 6 hours, allowing non-condensable gases to collect in the upper part of the receiver. Evacuate the freezer and attach a recovery unit to the top receiver purge valve. Open the valve and recover the vapor for about five minutes. When the freezer is evacuated, open the thaw gas solenoid valve (D) manually for about 15 seconds, letting the top vapor in the receiver blow into the freezer. Close the solenoid valve and evacuate the freezer again. Evacuate to 500 microns and restart the machine.
<b>Fouled (dirty) condenser</b>	Visually inspect condenser and clean as necessary.
<b>Misadjusted or defective water regulating valve</b>	Adjust or replace the valve. Never adjust the valve stem as far open as it will turn, because it will not close when the head pressure drops.

**High Head Pressure (Air-Cooled Machines)**

<b>Possible Causes</b>	<b>Possible Solutions</b>
<b>Condenser fan(s) not running; defective motor, fan control switch, fan contactor, or tripped fan motor overload</b>	Replace any defective parts. Check condenser fan disconnect for thrown switch or blown fuse. Replace fuse and reset switch. If the condenser is split, check the normally open solenoid valve to make sure it is open. Also check the fan sequencing thermostats and fan motor contactors to make sure they are functioning properly.
<b>Dirty condenser causing restricted air flow</b>	Visually inspect condenser and clean as necessary.
<b>Non-condensables (usually air) in the system</b>	Follow same procedure as specified for removing non-condensable gases from water-cooled machines and evacuate the air-cooled condenser as well.

## Chapter 9 Servicing Operations

### Adjustable Blowdown (for Clearer Ice)

A petcock valve, located at the overflow level of the water pump, provides adjustable blowdown from the water tank during the freezing period. The petcock is set at the factory to discharge enough water during the freeze period to produce clear ice. After installation, the petcock should be adjusted to the minimum rate (open as little as possible) required to maintain clear ice, and checked after a few days of ice making to confirm ice is still clear. Figure 29 shows the overall blowdown assembly.

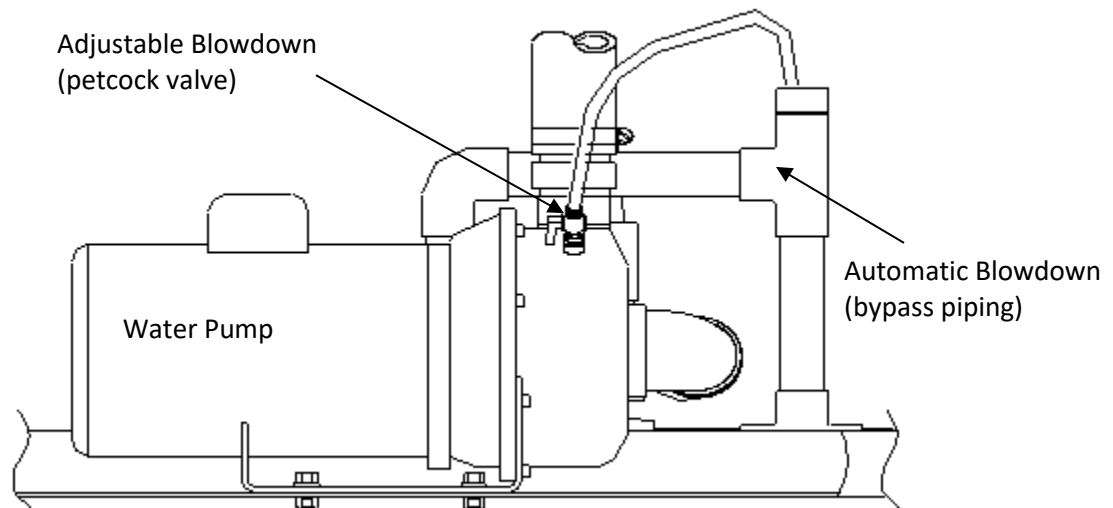


Figure 29: Water Pump/Blowdown Assembly

### Automatic Blowdown

The automatic blowdown or harvest period eliminates or reduces the need for frequent flushing or cleaning of the water tank. This blowdown also removes accumulated salts or solids in the water as a result of the freezing action. During the harvest period, water returning from the freezer raises the tank level and causes an overflow of water. The overflow creates a siphon to remove a fixed amount of water (20% of tank capacity) from the tank.

### Makeup Water Float Valve

The makeup water float valve maintains the proper pumping water level for ice making. The valve is set to maintain an appropriate level (high enough to prevent pump cavitation and low enough to prevent tank flooding) in the water tank during the freezing period so there will be a quantity of bypass or blowdown only during the thaw mode. The water level during the freeze mode must always be below the bypass piping to prevent excessive waste of cold water; otherwise, loss of ice capacity results.

If cleaning the float valve is required, close the stop valve in the makeup water line to the machine and remove the float valve. After the valve is cleaned and reinstalled, ensure the proper water level is being maintained. After the machine stops, and the water in the tank reaches its normal level, there should be no water flow through the float valve or drain bypass.

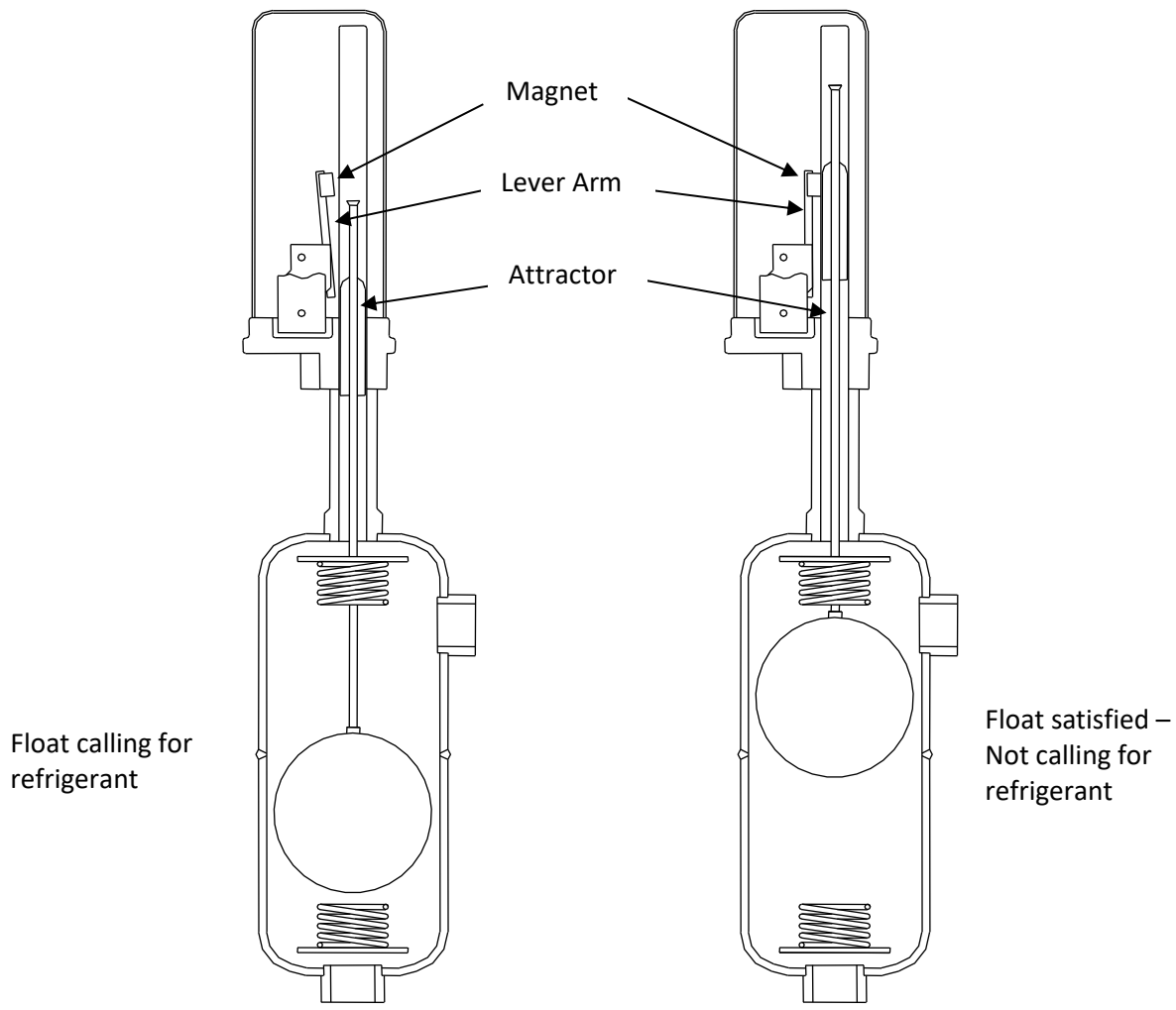
Installation of a 40-mesh strainer in the water supply line is recommended. The strainer protects the float valve from dirt or solids in the water and helps reduce the amount of cleaning.

## Refrigerant Float Switch

The float switch is installed on a header assembly attached to the freezer shell. Valves provide isolation of the float switch assembly if replacement or servicing is necessary. The float switch closes as the level of refrigerant in the freezer rises, and it opens as the level falls.

The float switch is connected to the liquid line solenoid valve (A) coil (refer to piping schematics and wiring diagrams). This solenoid valve is located in the pipeline directly before the hand expansion valve. When the refrigerant level in the freezer drops, the float switch opens and de-energizes this normally open solenoid valve until the liquid level in the freezer rises enough to close the float switch. The float switch has a fixed 1/2-in. (13-mm) differential.

The float switch is installed at the correct height at the factory to provide the highest ice-making capacity. No adjustment is needed.



**Figure 30: Refrigerant Float Switch**

### **Hand Expansion Valve**

The hand expansion valve is located after the liquid line solenoid valve (A). This should be set at a point where the float switch is open for a length of time approximately equal to the time it is closed. The factory setting is about three turns closed from full open.

### **Freezer Pressure Switch (Vogt 450)**

The freezer pressure switch (FPS), Output #1 of the Vogt 450, controls the freezing time period for the production of cylinder or crushed ice.

This switch is set at the factory to produce ice of recommended thickness. Refer to the Certificate of Test, which was provided with the machine for a sample set of pressure readings with corresponding time periods and water temperatures. Do not make adjustments until several ice discharging cycles have been completed.

### **Low-Pressure Safety Switch (Vogt 450)**

The compressor's low-pressure safety switch, Output #3 of the Vogt 450, has electrical contacts, will shut the ice machine off if the compressor suction pressure drops below the cut-out setpoint. The factory setpoint for the low-pressure safety is 5 psig (0.3 bar). The cut-in point where the output contacts "close" is 20 psig (1.4 bar).

### **High-Pressure Safety Switch (Vogt 450)**

The compressor's high-pressure safety switch, Output #4 of the Vogt 450, will shut the ice machine off if the compressor discharge pressure reaches the cut-out setpoint. The factory setpoint for the maximum safe pressure is 200 psig (13.8 bar). The cut-in point where the output contacts "close" is 175 psig (12.1 bar).

### **Head Pressure (Vogt 450)**

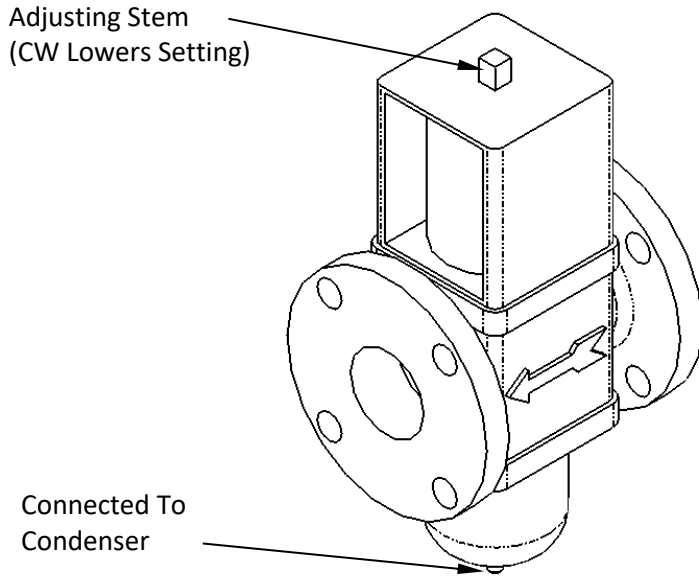
For R513A, the head pressure should be maintained at 130–140 psig (9–9.7 bar) for water-cooled machines and 135–145 psig (9.3–10 bar) for air-cooled machines during the freeze cycle. This pressure can be checked at the compressor discharge valve. It is also displayed on the Vogt 450.

### **Fan Cycling Switch (Air-Cooled Machines, Vogt 450)**

For air-cooled machines, the condenser fan cycling is controlled by the Vogt 450. To set the cut in and cut out, adjust OTR6 on the Vogt 450. Best performance is achieved with a head pressure range of 135–145 (9.3–10 bar) psig.

### Water-Regulating Valve (Water-Cooled Machines)

A water-regulating valve located in the condenser water inlet controls the water flow through the condenser. This valve should be adjusted to maintain a head pressure of 130–140 psig (9–9.7 bar) for R513A. Increasing the water flow will lower the head pressure, while decreasing the water flow will raise the head pressure. The valve is set at the factory during testing. The valve stem should not be opened all the way because it will not close completely when the head pressure drops below its setting.



**Figure 31: Water Regulating Valve**

### Cleaning Water-Cooled Condenser

The shell and tube condenser require occasional cleaning to maintain peak performance.

### Compressor Motor Protection

The Bitzer Compact screw compressor motor is protected by an electronic motor protection module. If this module fails, it must be replaced. Two different modules are used, depending on how the compressor is powered:

- If the machine does not have a variable frequency drive, motor protection is provided by the Bitzer SE-E1 module. (Vogt part number 12A2110P0505)
- If the machine is equipped with a variable frequency drive, the motor protection is provided by the Bitzer SE-E2 module. (Vogt part number 12A2110P0504)

**Table 10: Compressor Parts**

Item	Vogt Part No.	Description
Oil Level Control	12A2110P0507	Optical Oil Level Control, 230V Control Power
Unloader Coil	12A2110P0508	Coil, Unloader, 230V, 8W
Crankcase Heater - 230v	12A7509E25	Crankcase Heater, 230V, 200W, for CSH65/75
Electronic Motor Protection Mod-STD	12A2110P0505	INT SE-E1 Module for Compact Screw with no VFD, 115/230V
Screw Compressor	12A2110Z052	Compressor, Screw, 35HP

## Compressor Motor Protection—Field Diagnosis

The protective devices SE-E1 or SE-E2 monitor motor and discharge gas temperatures, rotating direction, and check for phase loss.

- **Temperature monitoring.** Locks out immediately if pre-set temperatures for the motor, discharge gas, or the oil are exceeded. Acceptable temperature range is -22° to 140°F (-30 to 60°C).
- **Compressor Rotation.** Checks the rotation direction during the first 5 seconds of compressor operation. If the compressor starts with the wrong rotation direction, the module locks out immediately.
- **Phase Loss.** Checks for phase loss in the first 5 seconds of compressor operation and opens relay contact immediately if phase loss occurs. The contact closes after 6 minutes. If three-phase losses occur within 18 minutes, or 10 within 24 hours, the module locks out.
- **Reset.** To reset after a lock out, power must be removed from the module for 5 seconds.

## Compressor Motor Burnout

Compressor motor burnout can have several causes, including:

- **Low Line Voltage.** A compressor motor is designed to operate within the range of  $\pm 10\%$  of its nameplate voltage. Low voltage requires the motor windings to carry more current at the same compressor load. When this current becomes too high or is applied for an extended period, the motor windings overheat, resulting in a failure.
- **Loss of Refrigerant.** The semi-hermetic compressor motor is maintained at proper operating temperature by passing cool suction gas over the motor windings. A loss of refrigerant can cause the winding to overheat, resulting in a failure or burnout.
- **High Head Pressure.** The system is designed to operate at 130 psig (9 bar). Excessive head pressure increases the refrigeration load on the compressor. This increase can cause the windings to overheat, resulting in a failure or burnout.
- **Moisture.** Moisture in contact with refrigerant oil and the presence of heat will form hydrochloric or hydrofluoric acid. The acid will destroy the insulation on the motor windings, causing a short circuit, which can increase motor temperatures in excess of 3,000°F (1,649°C). This extreme temperature will also create a sludge or black residue in the system.
- **Mechanical Failure.** Mechanical failure has been determined to be a major cause of motor burnout. Bearing wear or wipe-out may allow the rotor to drag, overheating the windings and causing a burnout.

Whenever a compressor fails because of a motor burnout, it is important to thoroughly clean the system before replacing the damaged compressor, or a new compressor may also become damaged.

## **Oil Level Safety**

The Bitzer CSH compressor used on the HFO10 uses an optical oil-level control. This consists of a prism and an opto-electronic unit (OLC-D1) (refer to wiring diagram). The prism, a glass cone, is mounted directly into the compressor body and the opto-electronic unit is screwed into the prism. If the oil level drops below the optical sensor, the red LED light comes on, indicating a low oil level. If the sensor does not detect an oil level for 5 seconds, the oil level control switch opens, and the machine shuts off. See Figure 26 and Figure 27 for location on the machine.



**Figure 32: Oil Level Switch**

**Note:** If the LED blinks, there is a problem with the oil sensor (low voltage supply or sensor is installed incorrectly).

## **Compressor Crankcase Heater (200 Watt)**

When electrical power is supplied to terminals L1, L2, and L3 of the control panel, the crankcase heater is energized when the machine is not operating. It is de-energized when the compressor contactor is energized.

In case of a power interruption, or crankcase heater failure, the crankcase heater should be powered on for a minimum of 2 hours before restarting machine manually. See Figure 26 and Figure 27 for location on the machine.

## **Oil Separator**

To handle all oil management needs, an integrated oil separator is installed inside the Bitzer CSH compressor. The integrated oil separator and built-in suction gas-cooled motor simplify the system integration and enable a compact and cost-effective system design.

## **Control Circuit Protection**

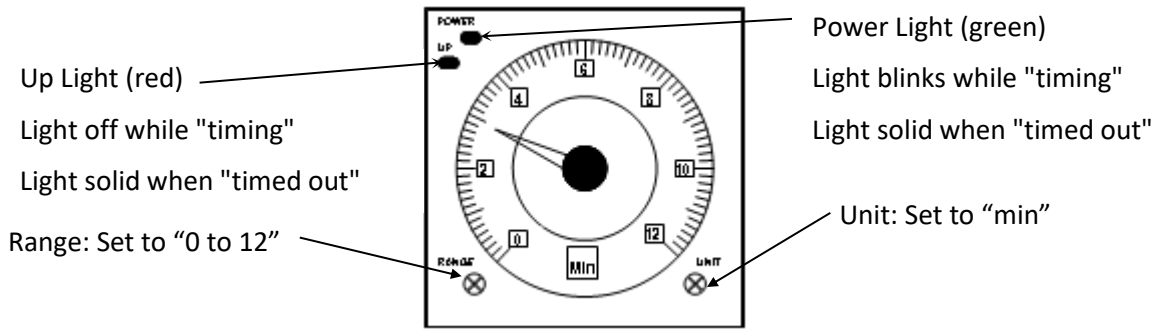
The electrical control circuit of the machine is protected by a 2-pole, 3A circuit breaker. If the breaker opens, the machine stops immediately. Before opening the panel to reset the breaker, open the disconnect switch to the machine and set the **Clean/Off/Ice** selector switch to the **Off** position.

When ready to restart the machine, set the **Clean/Off/Ice** selector switch to **Ice** and press **Start**. A harvest cycle starts, and once completed, a new freeze cycle begins.

## Thawing Timer

The thawing timer governs the ice thawing period. It is located inside the control panel. After the freezer pressure switch is activated, the Vogt 450 energizes the CR relay.

The thawing timer is set from the factory for a time that is at least 30 seconds longer than the time required to harvest the entire discharge of ice. Should it become necessary to change the setting of the timer, turn the adjustment screw clockwise to increase the time, or counterclockwise to decrease the time. After adjustment, verify the new setting is at least 30 seconds longer than the time required for the last piece of ice to be discharged from the machine.



**Figure 33: Thaw Timer**

## Pumpdown

The pumpdown function transfers all the liquid refrigerant from the freezer (evaporator) into the receiver. This function is only performed when the freezer is clear of ice and before or during the following operations:

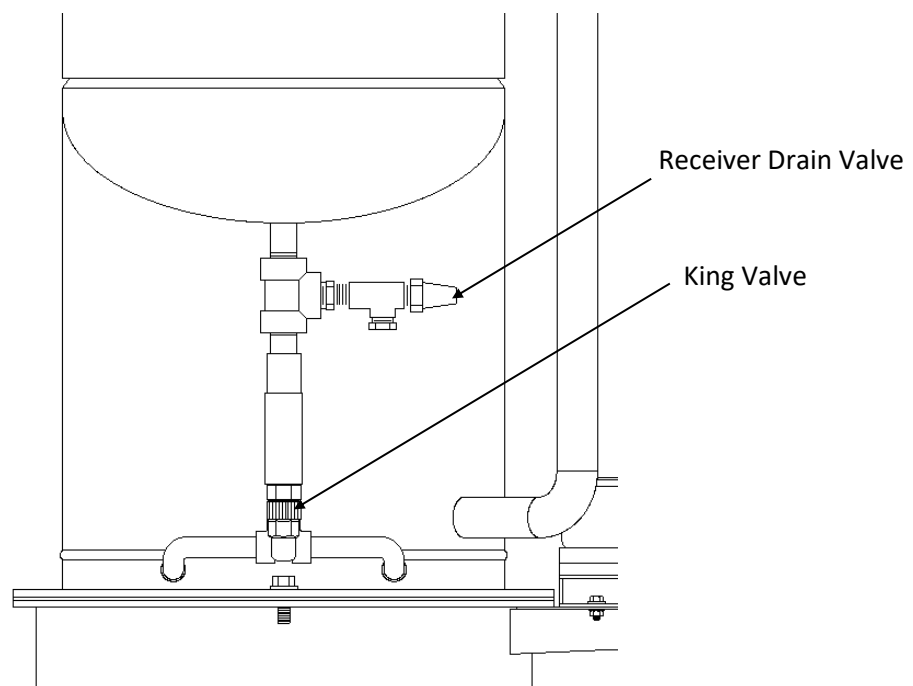
- Checking the total refrigerant charge
- Performing service or repair work on the machine
- Winterizing the machine
- Preparing the machine for disconnecting and moving
- Before cleaning

To perform a pumpdown, follow these steps:

1. Press **Manual Harvest** to clear the freezer of all ice and to stop operation.
2. Close the liquid stop valve (king valve) at the receiver.
3. Open the water tank drain valve partially to allow a continuous flow of warm makeup water into the tank while still maintaining the appropriate water level. An auxiliary supply of warm water (not to exceed 100°F [38°C]) may be used if available.
4. Start the machine and allow it to operate for one harvest.
5. During the harvest cycle, remove the Thaw timer to prevent another thaw cycle.
6. Allow the machine to operate until the low-pressure relay on the Vogt 450 stops the machine at 5 psig (0.3 bar). Set the correct pressure.
7. Close the thawing gas stop valve, the receiver liquid return stop valve, the compressor suction valve, and the compressor discharge valve.

## Removing Refrigerant

To transfer the refrigerant charge from the machine into a separate cylinder or tank, proceed as instructed above under *Pumpdown*. This will isolate most of the refrigerant in the receiver, and the refrigerant recovery unit can be connected to the 1/2-in. (DN 15) receiver drain valve connected to the tee below the receiver. The access port of the liquid stop valve (king valve) is at the bottom of the receiver. Open the valve by turning the valve stem out, and operate the refrigerant recovery unit until the system is considered empty.



**Figure 34: Receiver Drain Valve**



**Warning:** Approved refrigerant recovery equipment, hoses, gauges, and refrigerant containers must be used in compliance with all local and federal regulations. Only qualified personnel should perform refrigerant servicing and recovery processes. Follow these instructions carefully. Severe personal injury can result from improper discharge of refrigerant. It is not recommended to transfer refrigerant from a refrigeration system directly into a cylinder unless this cylinder is an approved, clean cylinder (free of any contaminants or foreign materials). The cylinder must be weighed continuously to assure contents do not exceed the net weight specified by the cylinder manufacturer or any applicable code requirements.

**Note:** Observe all local codes when handling and discharging refrigerant.

## **Refrigerant Leaks**

It is recommended to complete a leak test after the unit has been in operation for approximately one week. Any noticeable change in operating conditions, other than shown on the Certificate of Test, may indicate a loss of refrigerant due to a leak. Always completely evacuate and recover the refrigerant from the vessel or tubing before repairs are attempted.

## **Non-Condensable Gases**

Air and other non-condensable gases in a refrigeration system are not desirable and can cause unsatisfactory machine performance. Non-condensable gas effects are:

- Higher condensing pressure than what should match the condensed liquid temperature according to a pressure-temperature chart
- Greater electrical power consumption
- Reduced refrigeration capacity
- Longer than normal compressor running time
- Slow ice release
- Long thaw cycle

Air collects mostly in high-pressure condensers, receivers, and other high-pressure components. It is most commonly found in the coolest, lowest-velocity area of these components.

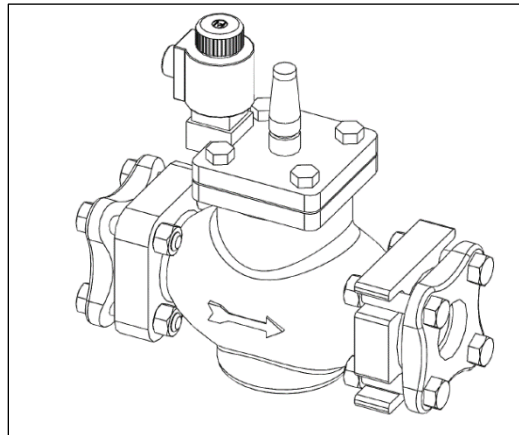
Evaporative condensers usually have purge points at the top of the outlet header of each circuit. Receivers usually have a purge point at the top, away from the inlet, where it is coolest, and the gas velocity is the lowest.

Excessive condensing pressure in water-cooled condensers may also be due to:

- Accumulation of scale in the cooling coil
- Insufficient cooling water
- Excessive water temperature

## Solenoid Valves

All solenoid valves are pilot operated with floating-type diaphragms. For satisfactory operation, make sure the manual opening stem is in the automatic position (stem is fully backseated or out). Correct direction of stem rotation is shown on the stem seal nut with an arrow, as shown in Figure 35.

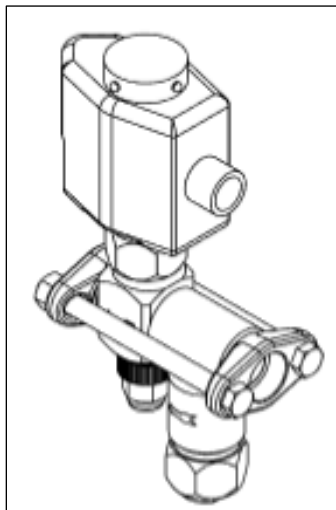


**Figure 35: Thaw Gas Solenoid Valve (D Valve)**

Table 11 shows replacement part numbers for the thaw gas solenoid valve:

**Table 11: Thaw Gas Solenoid Valve (D) Replacement Pats**

Part Description	Vogt Part Number
	Hansen (HS4W)
Complete Valve Without Coil	12A4200A1204
Coil	126229 (208/230V, 50/60 Hz)
Rebuild Kit	New



**Figure 36: Hansen Parker RS Liquid Line Solenoid Valve (A)**

Table 12 shows replacement part numbers for the liquid line solenoid valve (A):

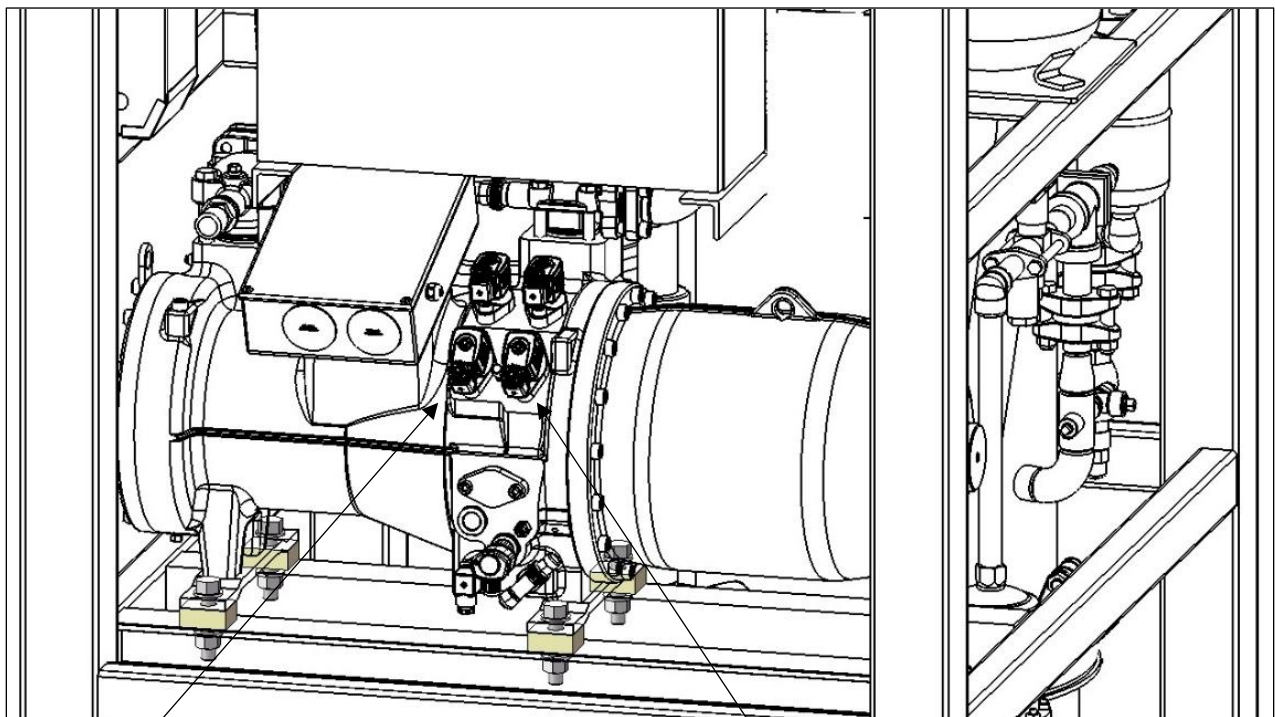
**Table 12: Liquid Line Solenoid Valve (A) Replacement Parts**

Part Description	Vogt Part Number RS (S8F)
Complete Valve w/strainer & 240V Coil	12A4200A0604RS
Coil	126246 (240V, 60 Hz), 126247 (230V, 50 Hz)
Rebuild Kit (Cartridge Assy, Gasket Kit & Solenoid Tube/Plunger Kit)	N/A

## Capacity Control Valves

The Bitzer CSH semi-hermetic compact screw compressor features capacity control solenoids that adjust the slide valve to use only a portion of the screw's length. This reduces the amount of load at which the compressor operates, which allows the ice machine to release all the ice in a timely manner during the harvest period. The solenoids direct the flow of the oil being circulated within the compressor body to control the direction of the slide valve, and the amount that it moves. Only capacity control valves (Y3=25% and Y4=100%) are used for this compressor.

- **100% Loaded Operation (Freeze Period)**—During the freeze period, capacity valve Y4 (100% loaded) is energized, which allows the compressor to operate fully loaded.
- **25% Loaded Operation (Harvest Period Only)**—During the harvest period, capacity valve Y4 de-energizes, and Y3 (25% loaded) is energized to allow the slide valve to unload the compressor.



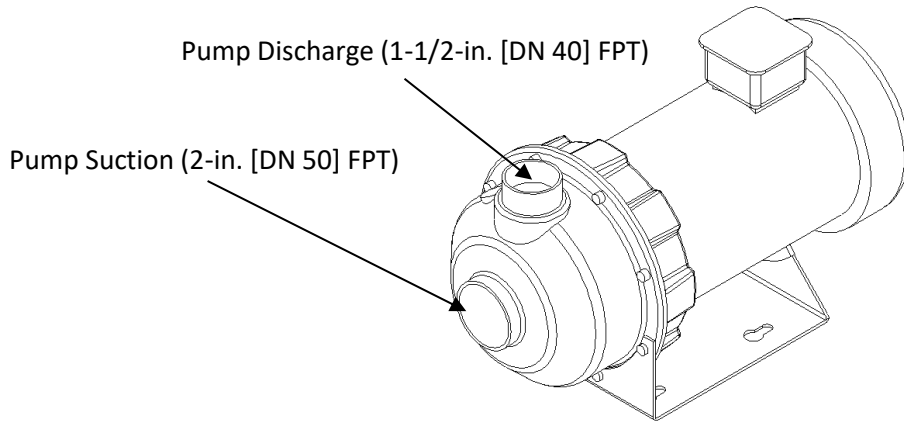
Capacity Valve – Y3 (load 25%)

Capacity Valve – Y4 (load 100%)

**Figure 37: Bitzer CSH Semi-Hermetic Compact Screw Compressor Showing Capacity Valves**

## Circulating Water Pump Motor

The motor bearings are pre-lubricated and sealed. They require no further lubrication. The pump should operate with the water level above the impeller housing. The pump also has a mechanical seal that requires no lubrication and is self-adjusting. However, the pump should not be operated unless it is circulating water. The pump manufacturer recommends that a mechanical seal be kept as a spare. When ordering a seal, specify pump size, type, serial number, and manufacturer’s name as indicated on the nameplate.



**Figure 38: Circulating Water Pump**

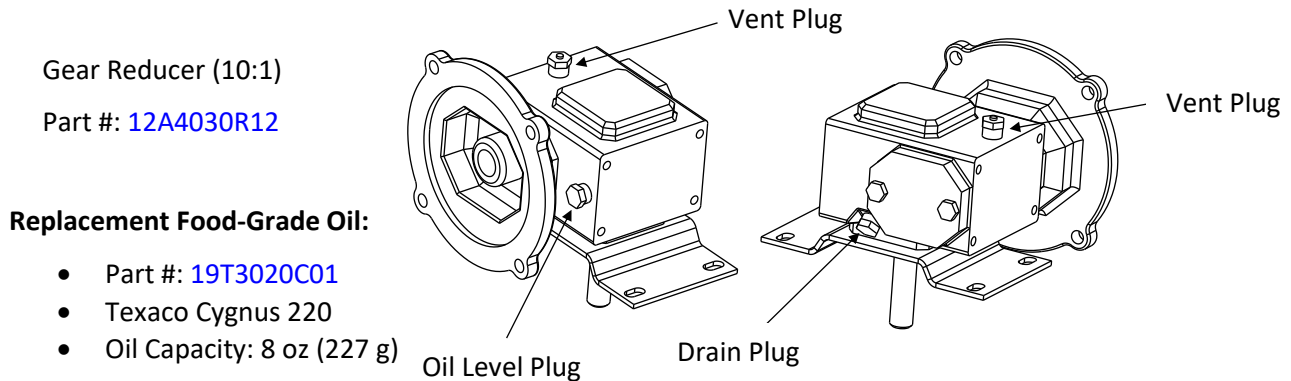
Table 13 shows replacement part numbers for the water pump and seal kit:

**Table 13: Circulating Water Pump Parts**

Part Description	Vogt Part Number
Water Pump Seal Kit	<a href="#">12A4080S12</a>
Water Pump, 60 Hz	<a href="#">12A4020G01</a>
Water Pump, 50 Hz	<a href="#">12A4020G08</a>

## Cutter Gear Reducer

The oil level for the gear reducer should be level with the plugged opening in the side of the gear housing. If not, this is evidence of a leak. Use food-grade oil and change oil once a year. The motor bearings are pre-lubricated and require no further lubrication.



**Figure 39: Gear Reducer**

Table 14 shows replacement part numbers for the gear reducer and lubricating oil:

**Table 14: Gear Reducer Service Parts**

Part Description	Vogt Part Number
Gear Reducer, 10:1, Cylinder Ice	12A4030R12
Food-Grade Lubricating Oil (8 Oz [227 g])	19T3020C01

## **Cutter Motor Replacement**

The cutter motor bearings are pre-lubricated and sealed, requiring no further lubrication or maintenance. If the motor requires replacement, follow the steps below:

1. Turn the power off and lock out the disconnect.
2. Check terminals with voltmeter to confirm the power is off.
3. Remove motor terminal cover and disconnect wires. Mark wires for ease of replacement.
4. Remove four cap screws around the motor flange and separate the motor from the reducer. Watch for shaft key that must be reinstalled later. Replacement motor does not come with a new key.
5. Check the motor electrically for shorts to confirm that it is defective.
6. Apply anti-seize lubricant to the shaft of the replacement motor.
7. Position the shaft key in the motor keyway, align it with the reducer keyway, and install the motor. Make sure that the key stays in position as the shaft is inserted.
8. Install the four cap screws to hold the motor in place on the reducer.
9. Connect the wires and install the terminal cover.
10. Check motor rotation to verify that the cutter turns counterclockwise. Reverse two wires at the motor if necessary, to change rotation direction.

## **Cutter Gear Reducer Removal and Replacement**

To remove the gear reducer, follow the steps below (refer to Figure 41):

1. Turn the power off and lock out the disconnect.
2. Remove the motor from the gear reducer.
3. Slightly loosen the 4 bolts and nuts holding the gear reducer in place.
4. Remove the four bolts holding the mounting plate to the water tank gear enclosure and remove the gear reducer and mounting plate from the tank.
5. Measure the distance between the top of the drive gear and the mounting plate for future reference.
6. Remove the three cap screws from the gear and hub and install 2-1/4-in. [57 mm] -20 x 2-in. [51 mm] long cap screws in the threaded holes of the drive gear. These two screws can be used as jacking bolts to remove the gear from the taper split hub.
7. The split hub is removed by placing a screwdriver in the split and sliding the hub off the shaft.
8. The new gear reducer is installed by reversing the removal procedure.
9. Check that the gear and hub are properly positioned on the shaft. The driver and cutter ring gears must mesh completely along the gear thickness as installed in the machine.
10. Adjust the final gear mesh so that only a slight amount of play exists between the drive gear and the ring gear.
11. Check that all bolts are tightened securely and that there is no excessive gear noise when the cutter motor is running.

## Water Tank Removal

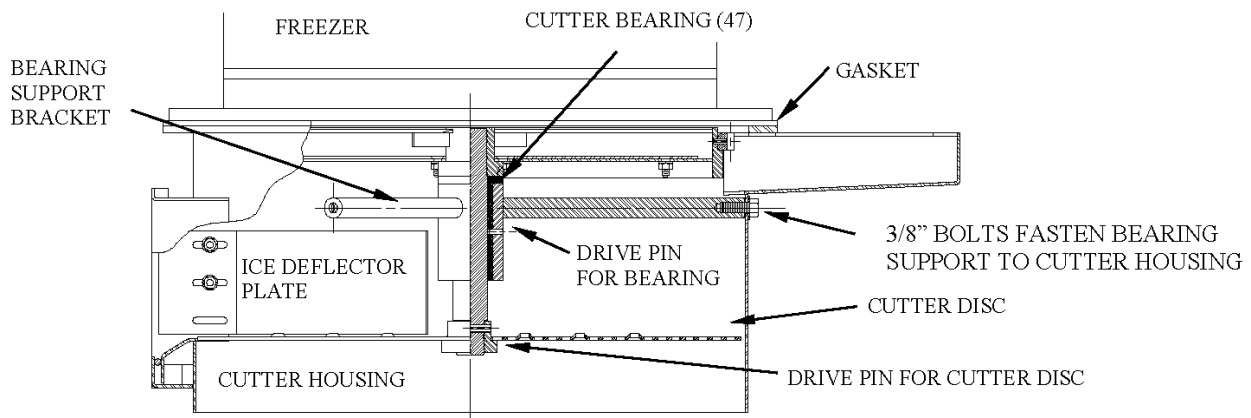
To remove the water tank from the machine, follow the steps below:

1. Turn off and lock out power to the machine.
2. Turn off water supply and disconnect lines from the tank.
3. Drain the tank and disconnect pump suction tube and drain line tubing and water lines.
4. Disconnect the ice discharge chute if installed.
5. Loosen water tank clamp that couples the plastic tank to the cutter housing assembly.
6. The tank can then be removed from the side of the machine where the float valve is installed.

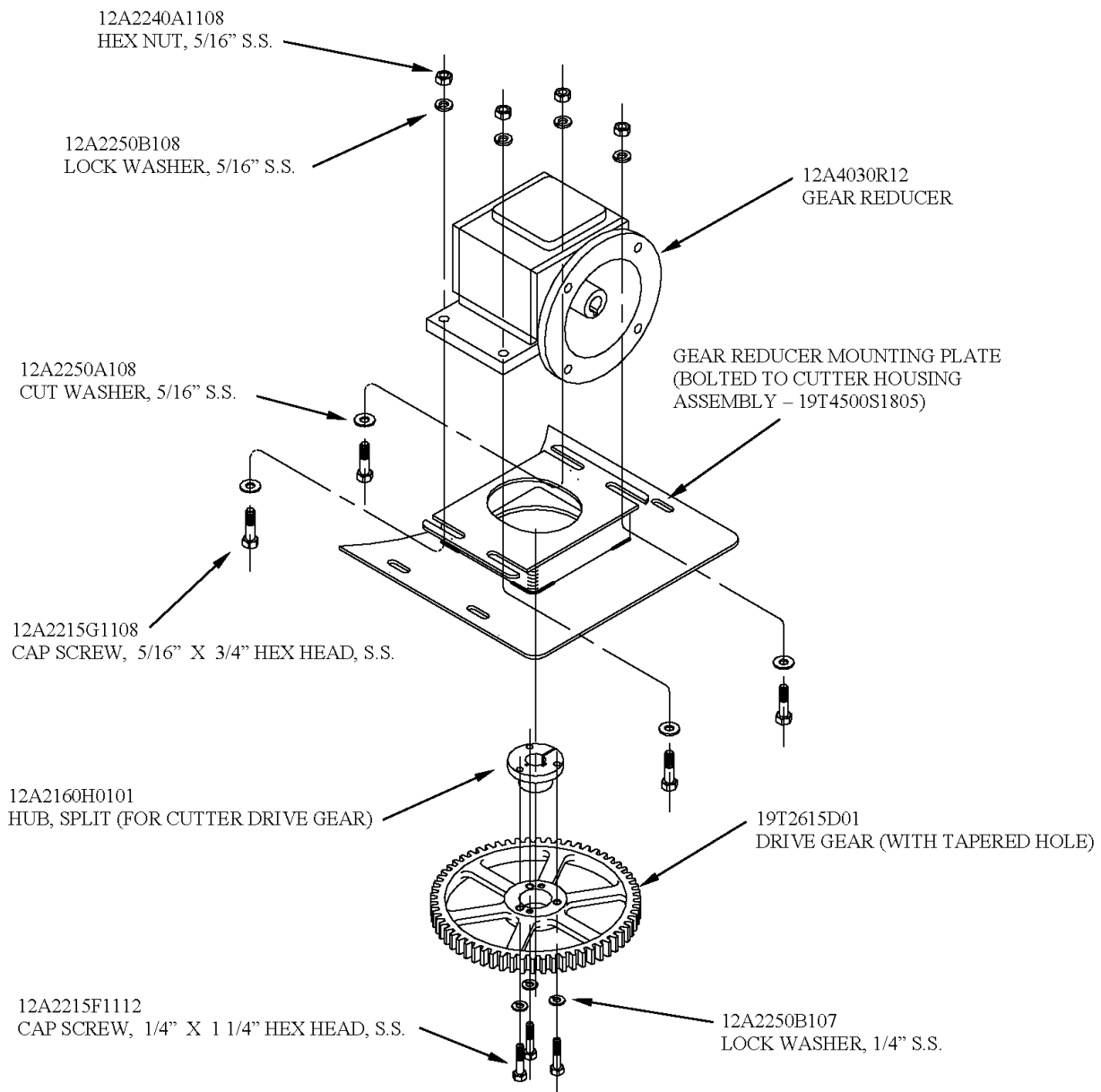
## Cutter and Bearing Removal and Reinstallation

Follow the steps below. Refer to Figure 40 and Figure 41.

1. Turn off the power and lock out the disconnect.
2. Remove the cutter motor from the reducer.
3. Remove the water tank from the machine.
4. With a 1/4-in. (8 mm) or smaller punch, reach into the ice discharge opening and drive the spiral pin out of the disc assembly. Push or drive the disc off the shaft.
5. Lift the cutter assembly out of the bearing surface of the cutter. The surface should be smooth and free of nicks or burrs.
6. Inspect the bearing for wear. No side movement between the shaft and bearing should exist. The bearing thrust flange should be no thinner than 3/16 in. (5 mm). Replace if worn.
7. Before removing the bearing, reference mark the location of the cutter support arms on the side of the tank. The cutter support orientation is specific to the tank.
8. Loosen and remove the three cap screws from the cutter support ends and lift the support out of the water tank.
9. Drive out the 3/16-in. (5-mm) pin located in the side of the cutter support hub that holds the bearing in place.
10. Push the bearing out of the cutter support hub.



**Figure 40: Cutter Assembly**



**Figure 41: Cutter Drive Parts**

To re-install the breaker cutter and bearing, follow steps 1-8 below:

1. Push the new bearing into the cutter support hub.
2. Using the pin hole in the side of the cutter support hub as a guide, drill a 3/16-in. (5-mm) hole through the wall of the bearing.
3. Drive in the 3/16-in. (5-mm) pin through the drilled hole until it is flush with the outside wall of the cutter support hub. Check that the pin does not extend into the surface inner diameter (ID) of the bearing.
4. Slide the new bearing and cutter support onto the cutter shaft and check that it spins freely. If the fit is tight, carefully ream the inner surface (ID) of the bearing until it turns freely.
5. Install the bearing support in the water tank, using the reference marks you made as a guide.

6. Slide the cutter and shaft into the bearing and check the cutter alignment. Lay a straight edge across the top flange of the tank and verify that the clearance between the rim of the cutter and the top of the tank flange is between 0 and 1/16 in. (2 mm). Loosen the bearing support cap screws and move the support arms up or down to achieve proper alignment.
7. Tighten the support screws securely and reinstall the cutter and cutter disc.
8. Install the tank and other parts, reversing the procedure of removal.

**Crushed Ice Production**

HFO10 Tube-Ice® machines with tube sizes of 1-1/4 in. (32 mm) or 1-1/2 in. (38 mm) can be converted to produce crushed ice with no loss in capacity. Some changes are required to convert the machine for crushed ice production, as noted below:

The following parts must be added to the machine:

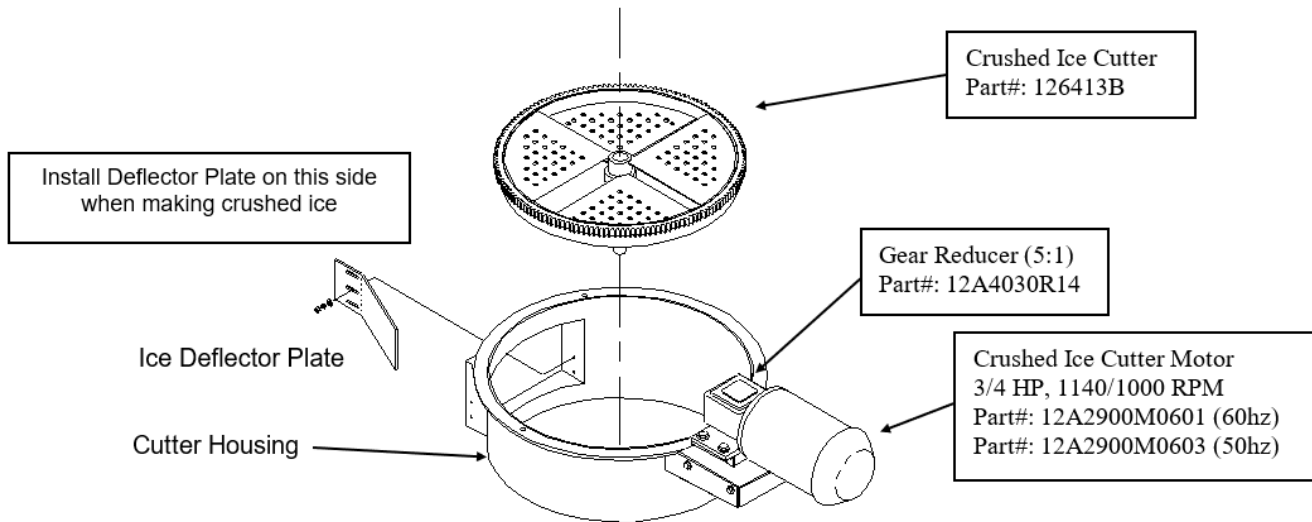
**Table 15: Cutter Parts (Crushed Ice Option)**

Part Description	Vogt Part Number
Crushed Ice Cutter Assembly	<a href="#">126413B</a>
3/4 HP Cutter Motor (60 Hz, 208-230V/460V, 3.2A/1.6A)	<a href="#">12A2900M0601</a>
3/4 HP Cutter Motor (50 Hz, 190V/380V, 4.2A/2.1A)	<a href="#">12A2900M0603</a>
5:1 Cutter Gear Reducer	<a href="#">12A4030R14</a>
Cutter Motor Starter <ul style="list-style-type: none"> <li>• 60 Hz, 208-230V, 2.5-4.0A</li> <li>• 60 Hz, 460v, 1.6-2.5A</li> <li>• 50 Hz, 200V, 4.0-6.3A</li> <li>• 50 Hz, 400V, 1.6-2.5A</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">12A7530E55UL</a></li> <li>• <a href="#">12A7530E54UL</a></li> <li>• <a href="#">12A7530E56UL</a></li> <li>• <a href="#">12A7530E54UL</a></li> </ul>

Change:

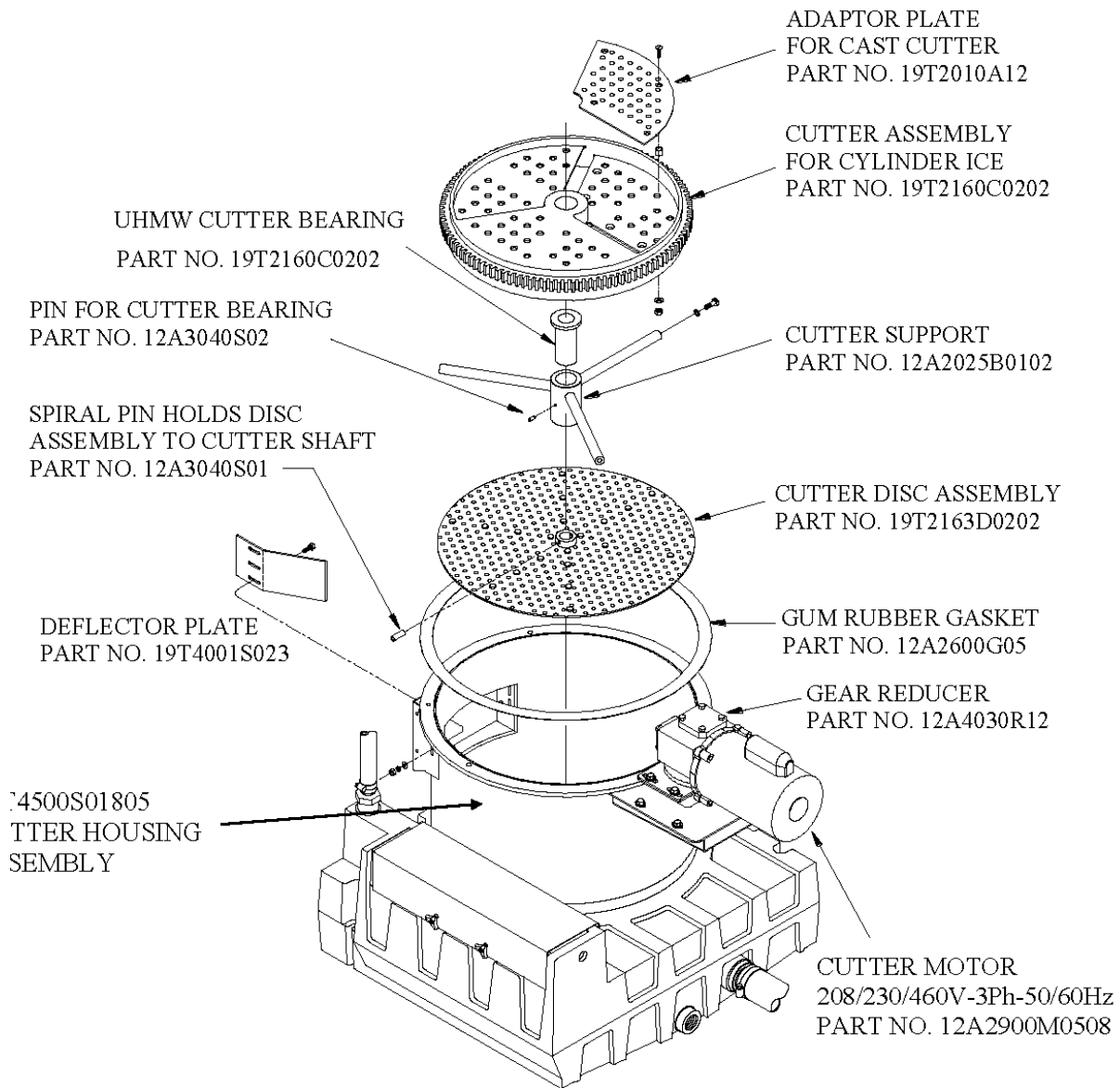
1. Raise the freezer pressure switch setting to make ice 3/16-in. (5-mm) thick (average).
2. Reverse cutter direction.
3. Reverse deflector.

Two people should normally accomplish this conversion process in 6-8 hours (or less). There must be ample room around the machine for the water tank removal. It is recommended that you have good quality water when attempting to produce crushed ice. If the ice is opaque and cloudy, it is subject to clog the cutter mechanism, restrict ice discharge, and bind the cutter. Also, you should not attempt to produce crushed ice when the makeup water temperature is below 50°F (10°C). Colder water can cause a build-up of ice fines in the tank and eventually result in “short-cycling.”



**Figure 42: Cutter Parts (crushed ice option)**

Figure 43 shows the various cutter parts for cylinder ice to help determine which parts require replacement.



**Figure 43: Cutter Parts (Cylinder Ice)**

The following changes must be made to the machine:

- Raise the freezer pressure switch setting to make ice with an average thickness of 3/16 in. (5 mm)
- Reverse the rotational direction of the cutter motor.
- Reverse the installation orientation of the ice deflector plate.

## Appendix A Optional Accessories

The following sections describe the optional accessories available.

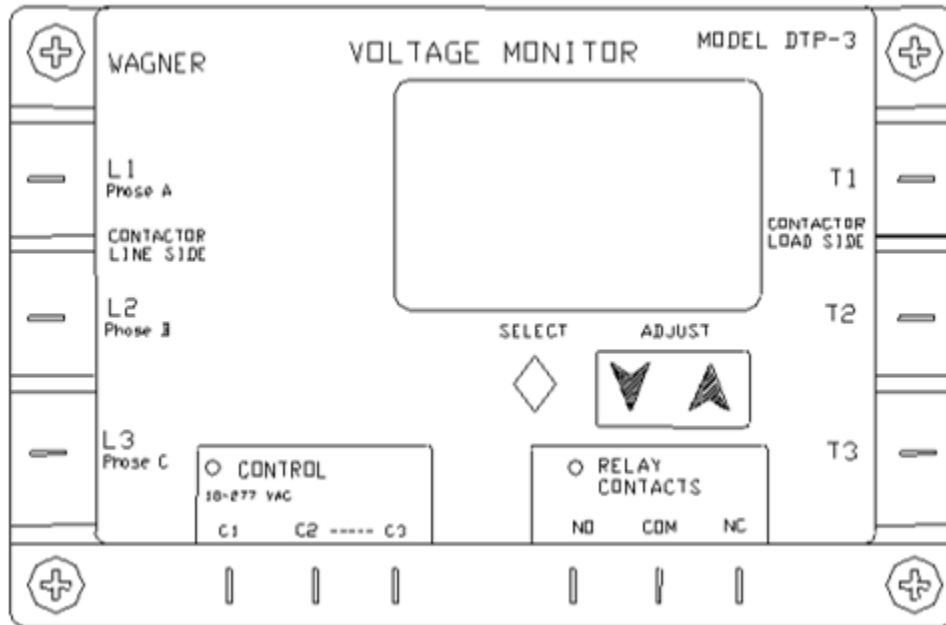
### Power Monitor, Wagner Model DTP-3

All Vogt Tube-Ice® machine models are available from the factory with a three-phase line voltage power monitor, incorporating an LCD display, called the DTP-3, as shown in Figure 44. The units are also available for aftermarket or retrofit installation. These units monitor line voltage inputs from 190 to 610 volts and provide protection against line voltage variances, which can damage or destroy the compressor motor.

Features include:

- Non-volatile system memory to retain settings when power is lost.

If the machine is ordered with this option, the power monitor can be factory set to customer specifications. The Vogt part number for a power monitor retrofit kit is [12A7700K01](#).



**Figure 44: Power Monitor (Voltage Monitor)**

#### The Display

The display normally shows phase A to B, phase B to C, and C to A line voltages. If the unit is on a timer, that timer will be displayed. The timer display may be switched off by pressing **SELECT**. The LCD will then display the normal A-B, B-C, C-A line voltage pairs.

Pressing **SELECT** once shows the contactor load side voltages (if the load side option is connected). The display automatically returns to the display of line side voltage after a few seconds.

Press **SELECT** to step through the parameters, as shown in Table 16. The selected parameter will flash. Use the up and down arrow keys to select the desired operating value.

**Table 16: Power Monitor Parameters**

Parameter (Description, units)	Min.	Max.	Default	Recommended Settings
Line Side Voltage (Nominal Voltage, volts)	90	650	208	Supply voltage
Over Voltage (tolerance, %)	6	18	12	10
Under Voltage (tolerance, %)	6	18	12	10
Phase Unbalance (%)	2	25	6	5
Lockout Time (Delay on Break, seconds)	0.1	25	0.5	120
Delay Time (Delay on Make, seconds)	0	30	0	0
Response Time (Delay on Fault, seconds)	0.1	20	2	2
Control Mode (none)	Off / Auto / On		Auto	On
Contactors Test (Volt Diff)	OFF	5	OFF	OFF

### **Adjustment of Parameters in Order of Display**

The following describes how to adjust the power monitor parameters in order of display if adjustment is needed.

- **Line Voltage**—This gives an active display of the line voltage to the machine. By default, this is the normal display.
- **Load Side Voltage**—If connected, this provides an active display of the load side voltage in the machine.
- **Voltage Setpoint** (VAC Flashes)—Press the UP and DOWN arrows. This may be set to the normal operating voltage of the device being protected. Adjustment increments are 1 volt.
- **Under/Over Voltage Tolerance** (UNDERVOLTAGE/OVERVOLTAGE Flashes)—Press the UP and DOWN arrows. The tolerance is displayed in percentages.
- **Imbalance Voltage Tolerance** (% IMBALANCE Flashes)—This value may be adjusted by pressing the UP and DOWN arrows.
- **Lockout Time** (SECONDS Flashes)—This value may be adjusted by pressing the UP and DOWN arrows. This is the delay-on-break timer value.
- **Delay Time** (RESP. SECONDS Flashes)—This display shows time in seconds and tenths of seconds. This value may be adjusted by pressing the UP and DOWN arrows. This is the time that a fault is allowed before shutdown occurs.
- **Control Mode** (ON OFF AUTO Flashes)—This value may be adjusted to OFF (load will not turn on), ON (load will turn on whenever no faults exist and timers are finished), and AUTO (load will turn on when a control input is active).
- **Contactors Fault Monitor Mode** (CONTACTOR FAULT Flashes)—This option allows for monitoring of the contactor and provides lock-out if the line voltage and load side voltage vary by more than five (5) volts. Pressing the UP or DOWN arrow will toggle between OFF (default) and ON. The load side of the contactor must be connected to the load terminals of the power monitor to use this option.
- **Display of Fault Memories** (MEM Flashes)—Pressing UP or DOWN arrow displays the last fault conditions that shut down the machine. The first 25 faults are recorded. The top number displayed represents the fault memory. The middle number represents the total number of faults that have occurred since the fault memory was cleared. To clear the memory, press and hold both the UP and DOWN arrows until the display is cleared.

**Notes**

- If the SELECT button is pressed and no parameters are changed by pressing the UP or DOWN arrow keys, the DTP-3 will automatically return to a display showing the line voltage.
- New settings are saved in permanent memory when the display returns to showing the line voltage. New settings may be verified by pressing the SELECT button to scroll through the parameters.
- To prevent tripping on a one (1) volt change, the DTP-3 automatically calculates cut-in voltages for the return from undervoltage conditions. The cut-out out voltage is always based on user voltage and tolerance settings, while the cut-in voltage is 3% closer to the nominal voltage setting. This quality is referred to as hysteresis. This is to help reduce oscillation that may occur on a weak power distribution system. When the load is switched off due to undervoltage, the line voltage will increase. Without hysteresis, the monitor would switch the load back on, the line voltage would again drop, and cause continuous on-off-on cycling.



## Appendix B Tables

**Table 17: HFO10 Specifications (460/400V, 3-phase, 60/50 Hz)**

Tube Size		in. (mm)	1 (25)	1-1/4 (32)	1-1/2 (38)
Nominal Capacity <sup>(1)</sup>		lb/day (kg/day)	20,000 (9,072)	18,000 (8,165)	16,500 (7,484)
Overall Dimensions (L x W x H)		in. (m)	48 x 60 x 129 (1.2x1.5x3.3)	48 x 60 x 129 (1.2x1.5x3.3)	48 x 60 x 129 (1.2x1.5x3.3)
Shipping Weight		lb (kg)	4,800 (2,178)	4,800 (2,178)	4,800 (2,178)
Operating Weight		lb (kg)	5,200 (2,360)	5,200 (2,360)	5,200 (2,360)
Refrigerant Charge (R513A)		lb (kg)	470 (213)	470 (213)	470 (213)
Total FLA Water Cooled <sup>(2)</sup>	60 Hz	Amps	44.0	44.0	44.0
	50 Hz	Amps	53.5	53.5	53.5
Total FLA Air Cooled <sup>(2)</sup>	60 Hz	Amps	65.0	65.0	65.0
Maximum Fuse	60 Hz (WC/AC)	Amps	95/120	95/120	95/120
	50 Hz (WC)	Amps	115	115	115
Minimum Ampacity	60 Hz (WC/AC)	Amps	54/95	54/95	54/95
	50 Hz (WC)	Amps	65.6	65.6	65.6
Water Requirements					
-makeup <sup>(3)</sup>		gpm (m <sup>3</sup> / hr)	3.0 (0.68)	3.0 (0.68)	3.0 (0.68)
-condenser <sup>(4)</sup>		gpm (m <sup>3</sup> / hr)	80 (18.2)	80 (18.2)	80 (18.2)
Connection Sizes					
-makeup water		MPT in. (DN mm)	1/2 (15)	1/2 (15)	1/2 (15)
-tank drain		FPT in. (DN mm)	1 (25)	1 (25)	1 (25)
-condenser water inlet (standard)		FPT in. (DN mm)	2 (50)	2 (50)	2 (50)
-condenser water outlet (standard)		FPT in. (DN mm)	2-1/2 (65)	2-1/2 (65)	2-1/2 (65)
-AC condenser inlet		ODC in. (mm)	2-1/8 (54)	2-1/8 (54)	2-1/8 (54)
-AC condenser outlet		ODC in. (mm)	2-1/8 (54)	2-1/8 (54)	2-1/8 (54)
Compressor	60 Hz	HP/KW/RLA <sup>(7)</sup>	35/26.1/40.3	35/26.1/40.3	35/26.1/40.3
	50 Hz	HP/KW/RLA <sup>(7)</sup>	35/26.1/48.7	35/26.1/48.7	35/26.1/48.7
Water Pump	60 Hz	HP/KW/FLA	1.5/1.1/2.4	1.5/1.1/2.4	1.5/1.1/2.4
	50 Hz	HP/KW/FLA	2/1.5/3.6	2/1.5/3.6	2/1.5/3.6
Cutter Motor	60 Hz	HP/KW/FLA	0.5/0.4/0.92	0.5/0.4/0.92	0.5/0.4/0.92
	50 Hz	HP/KW/FLA	0.5/0.4/1.1	0.5/0.4/1.1	0.5/0.4/1.1

Tube Size	in. (mm)	1 (25)	1-1/4 (32)	1-1/2 (38)
THR	BTU/hr (kW)	275,000 (73.3)	275,000 (73.3)	275,000 (73.3)
Marley Cooling Tower <sup>(5)</sup>		4822	4822	4822
-dim. (L x W x H)	ft (meters)	4 x 5 x 6.5 (1.2x1.5x2.0)	4 x 5 x 6.5 (1.2x1.5x2.0)	4 x 5 x 6.5 (1.2x1.5x2.0)
-shipping weight	lb (kg)	650 (295)	650 (295)	650 (295)
-operating weight	lb (kg)	1260 (571)	1260 (571)	1260 (571)
-fan	HP/KW/FLA	1/0.8/3.6	1/0.8/3.6	1/0.8/3.6
Tower Pump				
-flow	gpm (m <sup>3</sup> /hr)	78 (17.7)	78 (17.7)	78 (17.7)
-TDH minimum	ft (m)	80 (24.4)	80 (24.4)	80 (24.4)
-electrical data	HP/KW/FLA	3 /2.2/9.6	3 /2.2/9.6	3 /2.2/9.6
-connections (inlet x outlet)	FPT in. (DN mm)	4 x 3 (100 x 80)	4 x 3 (100 x 80)	4 x 3 (100 x 80)
-shipping weight	lb (kg)	65 (29.5)	65 (29.5)	65 (29.5)
Bohn Air-Cooled Condenser <sup>(6)</sup>		BNHD06A044	BNHD06A044	BNHD06A044
- # of Fans / HP		6/1.5	6/1.5	6/1.5
- electrical data	total KW/FLA	11.5/42	11.5/42	11.5/42
-inlet connection	ODC in. (mm)	2-1/8 (54)	2-1/8 (54)	2-1/8 (54)
-outlet connection	ODC in. (mm)	2-1/8 (54)	2-1/8 (54)	2-1/8 (54)
-shipping weight	lb (kg)	2200 (999)	2200 (999)	2200 (999)
-operating weight	lb (kg)	1990 (903)	1990 (903)	1990 (903)

(1) Nominal capacity is based on 70°F (21°C) makeup water, 100°F (38°C) condensing temperature, 70°F (21°C) amb, and 0% blowdown.

(2) FLA for 230-volt models is approximately 2x that of 460-volt models. Total FLA does not include cooling tower.

(3) Makeup water is maximum value and includes 10 gallons (38 liters) per cycle blowdown.

(4) Condenser flow rate is for 85°F (29°C) entering water temperature and 100°F (38°C) condensing.

(5) Tower sized for 80°F (27°C) wet bulb temperature.

(6) Recommended air-cooled condenser is based on 15°F (8°C) TD.

(7) RLA=MCC/1.56

**Vogt reserves the right to change designs and specifications without notice.**

Table 18: HFO10 Capacity Chart, 50/60 Hz

Makeup Water Temp. (°F)	Rated Capacity (lb/day)						Makeup Water Temp. (°F)	Rated Capacity (lb/day)					
	Cylinder			Crushed				Cylinder			Crushed		
	1 in.	1-1/4 in.	1-1/2 in.	1 in.	1-1/4 in.	1-1/2 in.		1 in.	1-1/4 in.	1-1/2 in.	1 in.	1-1/4 in.	1-1/2 in.
40	21700	19100	17600	N/A	19864	18304	60	20600	18400	16900	N/A	19136	17576
41	21660	19080	17580	N/A	19843	18283	61	20540	18360	16860	N/A	19094	17534
42	21620	19060	17560	N/A	19822	18262	62	20480	18320	16820	N/A	19053	17493
43	21580	19040	17540	N/A	19802	18242	63	20420	18280	16780	N/A	19011	17451
44	21540	19020	17520	N/A	19781	18221	64	20360	18240	16740	N/A	18970	17410
45	21500	19000	17500	N/A	19760	18200	65	20300	18200	16700	N/A	18928	17368
46	21440	18960	17460	N/A	19718	18158	66	20240	18160	16660	N/A	18886	17326
47	21380	18920	17420	N/A	19677	18117	67	20180	18120	16620	N/A	18845	17285
48	21320	18880	17380	N/A	19635	18075	68	20120	18080	16580	N/A	18803	17243
49	21260	18840	17340	N/A	19594	18034	69	20060	18040	16540	N/A	18762	17202
40	21700	19100	17600	N/A	19864	18304	70	20000	18000	16500	N/A	18720	17160
41	21660	19080	17580	N/A	19843	18283	71	19830	17850	16350	N/A	18564	17004
42	21620	19060	17560	N/A	19822	18262	72	19660	17700	16200	N/A	18408	16848
43	21580	19040	17540	N/A	19802	18242	73	19490	17550	16050	N/A	18252	16692
44	21540	19020	17520	N/A	19781	18221	74	19320	17400	15900	N/A	18096	16536
45	21500	19000	17500	N/A	19760	18200	75	19150	17250	15750	N/A	17940	16380
46	21440	18960	17460	N/A	19718	18158	76	18980	17100	15600	N/A	17784	16224
47	21380	18920	17420	N/A	19677	18117	77	18810	16950	15450	N/A	17628	16068
48	21320	18880	17380	N/A	19635	18075	78	18640	16800	15300	N/A	17472	15912
49	21260	18840	17340	N/A	19594	18034	79	18470	16650	15150	N/A	17316	15756
50	21200	18800	17300	N/A	19552	17992	80	18300	16500	15000	N/A	17160	15600
51	21140	18760	17260	N/A	19510	17950	81	18130	16340	14850	N/A	16994	15444
52	21080	18720	17220	N/A	19469	17909	82	17960	16180	14700	N/A	16827	15288
53	21020	18680	17180	N/A	19427	17867	83	17790	16020	14550	N/A	16661	15132
54	20960	18640	17140	N/A	19386	17826	84	17620	15860	14400	N/A	16494	14976
55	20900	18600	17100	N/A	19344	17784	85	17450	15700	14250	N/A	16328	14820
56	20840	18560	17060	N/A	19302	17742	86	17280	15540	14100	N/A	16162	14664
57	20780	18520	17020	N/A	19261	17701	87	17110	15380	13950	N/A	15995	14508
58	20720	18480	16980	N/A	19219	17659	88	16940	15220	13800	N/A	15829	14352
59	20660	18440	16940	N/A	19178	17618	89	16770	15060	13650	N/A	15662	14196
							90	16600	14900	13500	N/A	15496	14040

- Capacity rating based on 70°F ambient conditions, 100°F SDT temperature.
- Capacity rating is average for the model. Individual machines may vary up to 5% above or below.
- Capacity rating is for clear ice production with makeup water containing no more than 200 ppm total dissolved solids.

**Table 19: Condenser Water Usage**

Condensing Temp. °F (°C)	Entering Water Temp. °F (°C)	Leaving Water Temp. °F (°C)	Water Flow gpm (m <sup>3</sup> /hr)	Pressure Drop psig (mbar)	Average Total Heat of Rejection BTU/hr (kw)
100 (38)	50 (10)	81 (27)	26 (5.9)	0.09 (6.2)	275,000 (80.6)
100 (38)	55 (13)	85 (29)	27 (6.1)	0.11 (7.6)	275,000 (80.6)
100 (38)	60 (16)	88 (31)	29 (6.6)	0.13 (9.0)	275,000 (80.6)
100 (38)	65 (18)	91 (33)	32 (7.3)	0.16 (11)	275,000 (80.6)
100 (38)	70 (21)	93 (34)	36 (8.2)	0.23 (16)	275,000 (80.6)
100 (38)	75 (24)	94 (34)	44 (10)	0.34 (23)	275,000 (80.6)
100 (38)	80 (27)	84 (29)	57 (13)	0.60 (41)	275,000 (80.6)
100 (38)	85 (29)	94 (34)	89 (20)	1.36 (93.8)	275,000 (80.6)
105 (41)	90 (32)	99 (37)	89 (20)	1.34 (92.4)	275,000 (80.6)
110 (43)	95 (35)	104 (40)	89 (20)	1.33 (91.7)	275,000 (80.6)

**Table 20: Makeup Water Usage**

Makeup Water (10 gal [38 L]/cycle blowdown)	Cylinder Ice			Crushed Ice		
	Tube Size in. (mm)			Tube Size in. (mm)		
Temp. °F (°C)	1 (25)	1-1/4 (32)	1-1/2 (38)	1 (25)	1-1/4 (32)	1-1/2 (38)
<b>40 (4)</b>	2.56 (6.50)	2.25 (5.72)	2.19 (5.56)	3.00 (7.62)	2.62 (6.65)	2.54 (6.45)
<b>50 (10)</b>	2.49 (6.32)	2.21 (5.61)	2.14 (5.44)	2.92 (7.42)	2.58 (6.55)	2.49 (6.32)
<b>60 (16)</b>	2.42 (6.15)	2.16 (5.49)	2.09 (5.31)	2.84 (7.21)	2.53 (6.43)	2.43 (6.17)
<b>70 (21)</b>	2.35 (5.97)	2.12 (5.39)	2.04 (5.18)	2.74 (6.96)	2.47 (6.27)	2.38 (6.05)
<b>80 (27)</b>	2.14 (5.44)	1.93 (4.90)	1.86 (4.72)	2.49 (6.32)	2.25 (5.72)	2.16 (5.49)
<b>90 (32)</b>	1.93 (4.90)	1.74 (4.42)	1.68 (4.27)	2.25 (5.72)	2.02 (5.13)	1.94 (4.93)

Table 21: Normal Operating Criteria, English Units

			Suction Pressure (psig)	Discharge Pressure (psig)	Harvest Times (secs)			Ice per Cycle	Freeze Time (minutes)				
			End of Freeze	Average During Freeze	First	All Ice	Total	Average	Water Temperature (deg. F)				
			R513A	R513A	Ice	Out	Harvest	lb	90	80	70	60	50
50/60 Hz	Cylinder	1 in.	12	135	30	120	150	235	17.9	16.0	14.4	13.9	13.5
		1-1/4 in.	10	135	30	120	150	245	21.0	18.8	17.0	16.6	16.2
		1-1/2 in.	7	135	30	120	150	235	19.8	17.8	16.0	15.6	15.2
	Crushed	1 in.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		1-1/4 in.	16	135	15	105	150	175	13.7	12.1	10.9	10.6	10.3
		1-1/2 in.	13	135	15	105	150	175	13.3	11.8	10.6	10.3	10.0

Table 22: Normal Operating Criteria, Metric Units

			Suction Pressure (bar)	Discharge Pressure (bar)	Harvest Times (secs)			Ice per Cycle	Freeze Time (minutes)				
			End of Freeze	Average During Freeze	First	All Ice	Total	Average	Water Temperature (deg. C)				
			R513A	R513A	Ice	Out	Harvest	Kg	32	26.7	21	15.6	10
50/60 Hz	Cylinder	25 mm	0.83	9.31	30	120	150	107	17.9	16.0	14.4	13.9	13.5
		32 mm	0.7	9.31	30	120	150	111	21.0	18.8	17.0	16.6	16.2
		38 mm	0.5	9.31	30	120	150	107	19.8	17.8	16.0	15.6	15.2
	Crushed	25 mm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		32 mm	1.1	9.31	15	105	150	79.4	13.7	12.1	10.9	10.6	10.3
		38 mm	0.90	9.31	15	105	150	79.4	13.3	11.8	10.6	10.3	10.0

Table 23: 10TA Acceptance Ranges for R513A

<b>Machine Type (All 50/60 Hz)</b>			
<b>Parameter</b>	<b>Tube Size in. (mm)</b>		
	<b>1 (25)</b>	<b>1-1/4 (32)</b>	<b>1-1/2 (38)</b>
<b>Minimum Ice Weight per Cycle (lb/kg)*</b>	230/104	240/109	250/113
<b>Maximum Ice Weight per Cycle (lb/kg)*</b>	240/109	250/113	240/109
<b>Minimum Ice Harvest Pressure (psig/bar)*</b>	11/0.76	8/0.55	6/0.41
<b>Maximum Harvest Pressure (psig/bar)*</b>	14/0.96	12/0.8	9/0.62
<b>DPS Setting, Close (psig/bar)</b>	20/1.38	20/1.38	20/1.29
<b>DPS Setting, Open (psig/bar)</b>	42/2.9	42/2.9	42/2.9
<b>Minimum Discharge Pressure** (psig/bar)</b>	130/8.9	130/8.9	130/8.9
<b>Maximum Discharge Pressure** (psig/bar)</b>	140/9.6	140/9.6	140/9.6
<b>Minimum Harvest Time (30 seconds out, minutes)</b>	2.0	2.0	2.0
<b>Maximum Harvest Time (minutes)</b>	3.0	3.0	3.0
<b>Low Pressure Safety Cutout (cut-out, psig/bar)</b>	5/0.34	5/0.34	5/0.34
<b>Low Pressure Safety Cutout (cut-in, psig/bar)</b>	20/1.38	20/1.38	20/1.38
<b>High Pressure Safety Cutout (cut-out, psig/bar)</b>	200/13.8	200/13.8	200/13.8
<b>High Pressure Safety Cutout (cut-in, psig/bar)</b>	175/12	175/12	175/12

\*Cylinder ice, DPS=defrost pressure switch

\*\*Water-cooled

Table 24: HFO10 Spare Parts List

	Item	Vogt Part No.	Description	Qty.
<b>Vogt 450</b>	Control Module	12A2117J04	Controller with 2 SPDT Output Relays	1
	Power Supply	12A2117J07	Power Supply	1
	Relay Module	12A2117J08	Output Module	1
	Bin Control Temperature Sensor	12A2117J03	Temperature Sensor	
	Low- & High-Pressure Transducers	12A2117J02	Pressure Transducer, 0-500 PSI	1
<b>Control Panel Parts</b>	Cutter/Water Pump & PF (power failure) contactor	<a href="#">12A7516E23</a>	Contactor (9Amp, 3 Pole, with 1 N.O. Aux, 208/240V Coil)	1
	Compressor Contactor (230V power)	<a href="#">12A7516E48</a>	Compressor Motor Contactor (140 Amp, 3 Pole)	1
	Compressor Contactor (460V power)	<a href="#">12A7516E30</a>	Compressor Motor Contactor (72 Amp, 3 Pole)	
	Compressor relay (400V power w/vfd)	<a href="#">12A7517E28</a>	Compressor Relay for starting VFD	
	Aux contacts for CC (for 140A)	<a href="#">12A7518E43</a>	Aux. Outside Contact (2 Amp, 2 N.O., Side Mount)	1
	Aux contacts for CC (for 72A)	<a href="#">12A7518E30</a>	Aux. Contact (10 Amp, 1 NO/1NC, Side Mount)	1
		<a href="#">12A7518E31</a>	Aux. Contact (10 Amp, 2 NO, Side Mount)	1
		<a href="#">12A7518E32</a>	Aux. Contact (5 Amp, 2 NO, Top Mount)	1
	Harvest Timer	<a href="#">12A7503E22</a>	Thawing Timer (Delay On Make) 100-240V	1
	CR (control relay) & UR (unloader relay)	<a href="#">12A7517E27</a>	Control Relay (10 Amp, 2 N.O./2 N.C., 208/240V Coil)	1
	Control circuit fuses	<a href="#">12A7504E18</a>	Fuse, 5A, 600V, Time Delay Class CC rejection type	2
	<b>Cutter Tank Parts</b>	Water Pump	<a href="#">12A4020G01</a>	Water pump, 1 1/2HP, 3-phase
Cutter motor		<a href="#">12A2900M0508</a>	Cutter motor, 1/2 hp, 3-phase	1
Gear Reducer		<a href="#">12A4030R12</a>	Grove, 10:1 gear reducer	1
Makeup water float valve		<a href="#">12A4200H0402</a>	Float valve, 1/2-in. (13 mm) MPT locknut & gasket, lead free brass	2
Water distributor set		<a href="#">12B2185N31</a>	Water distributor, 1 1/2-in. (38 mm) tubes	72
		<a href="#">12B2185N21</a>	Water distributor, 1 1/4-in. (32 mm) tubes	102
		<a href="#">12B2185N11</a>	Water distributor, 1-in. (25 mm) tubes	156
Freezer cover gasket		<a href="#">12A2600G15</a>	Gasket, gum rubber, freezer cover	1
Cutter housing gasket (freezer flange to cutter tank)		<a href="#">12A2600G05</a>	Gasket, cutter housing	1
Water tank gasket (cutter assembled to tank)		<a href="#">12A2600G17</a>	Gasket, gum rubber, water tank	1
Water tank ice discharge splash curtain		<a href="#">12A4078C04</a>	Splash curtain	1

**HFO10 Spare Parts List, cont.**

	<b>Item</b>	<b>Vogt Part No.</b>	<b>Description</b>	<b>Qty.</b>
<b>Refrigeration Parts</b>	Refrigerant float switch (electrical switch only)	<a href="#">12A7500E24</a>	Refrigerant float switch, electrical switch only	1
	Suction gauge (150 psi) (10 bar)	12D2590G14	Gauge, 2.5-in. (64 mm), Liquid filled, 30-in. (76.2 cm) - 150 psi	1
	Discharge gauge (300 psi) (20 bar)	12D2590G15	Gauge, 2.5-in. (64 mm), Liquid filled, 30-in. (76.2 cm) - 150 psi	1
	Liquid line solenoid valve (A)	12A4200A0604 RS	RS valve, with 230V coil	1
	Thaw gas valve	12A4200A1204	Hansen valve. Less coil	1
	Thaw gas valve coil, Hansen	<a href="#">126229</a>	Coil, Hansen, 208-240V	1
	Condenser Water regulating valve	12A4200E1402	Valve, condenser water regulating	1
<b>Compressor Parts</b>	Oil level control	12A2110P0507	Optical Oil level control, 230V control power	1
	Unloader coil	12A2110P0508	Coil, Unloader, 230V, 8W	1
	Crankcase Heater - 230V	12A7509E25	Crankcase Heater, 230V, 200W, for CSH65/75	1
	Electronic motor protection mod-STD	12A2110P0505	INT SE-E1 module for Compact Screw with no VFD, 115/230V	1
	Screw Compressor	12A2110Z052	Compressor, Screw, 35HP	1

Table 25: Control Panel Components and Part Numbers

Item No.	Vogt Part No.	Description
AX	12A7518E33UL	Aux. Trip Indicator, 6A, 1NO / 1NC
CB2	12A7515E22	Control Circuit Breaker, 6 Amp, 2 Pole (400V & 460V machines only)
CC 460V	12A7516E30	Compressor Motor Contactor (72 Amp, 3 Pole)
	12A7518E30	Aux. Contact (10 Amp, 1 N.O./1 N.C., Side Mount)
	12A7518E31	Aux. Contact (10 Amp, 2 N.O., Side Mount)
	12A7518E32	Aux. Contact (5 Amp, 2 N.O., Top Mount)
CC 208/230V	12A7516E48	Compressor Motor Contactor (140 Amp, 3 Pole)
	12A7518E43	Aux. Outside Contact (2 Amp, 2 N.O., Side Mount)
	12A7518E44	Aux. Inside Contact (2 Amp, 2 N.O., Side Mount)
CC 400V (50 Hz)	12A7517E28	Compressor Control Relay (10A, 3 N.O./1 N.C., 208/240V Coil)
	12A7518E31	Aux. Contact (10A, 2 N.O., Side Mount)
CCR	12A7517E27	Unloader Relay
CR	12A7517E27	Control Relay (10 Amp, 2 N.O./2 N.C., 208/240V Coil)
CU	12A7516E23	Contactor (9Amp, 3 Pole, with 1 N.O. Aux, 208/240V Coil)
	12A7530E52UL	Cutter Manual Motor Starter, 0.63-1.0A (460V, 60 Hz)
	12A7530E53UL	Cutter Manual Motor Starter, 1.0-1.6A (400V, 50 Hz)
	12A7530E54UL	Cutter Manual Motor Starter, 1.6-2.5A (200/208/230V, 50/60 Hz)
ET	12B7503E17	Timer, Elapsed, Panel Mount, 220V (50Hz)
	12B7503E18	Timer, Elapsed, Panel Mount, 220V (60Hz)
FC Air-Cooled Only	12A7516E27	Condenser Fan Contactor (30 Amp, 3 Pole, 1 N.O. Aux. Contact, 208/240V Coil)
	12A7530E58UL	Fan Manual Motor Starter, 10.0-16.0A (400/460V, 50/60 Hz)
	12A7530E63UL	Fan Manual Motor Starter, 23.0-32.0A (200/208/230V, 50/60 Hz)
FU1 & FU2	12A7504E18	Fuses, 5A, 600V, Class CC, Time Delay
FU10-FU60	12A7504E29	Fuses, 1A, 600V, Class CC, Fast Acting (For optional Power Monitor)
P	12A7516E23	Contactor (9Amp, 3 Pole, with 1 N.O. Aux, 208/240V Coil)
	12A7530E55UL	Pump Manual Motor Starter, 2.5-4.0A (400V/460V, 50/60 Hz)
	12A7530E56UL	Pump Manual Motor Starter, 4.0-6.3A (208/230V, 60 Hz)
	12A7530E57UL	Pump Manual Motor Starter, 6.5-10.0A (200V only)
PBL1	12A7500E79	Contact Block/Mounting Latch (2 N.C.)
	12A7500E157	Light Module, Red LED, 240V
	12A7500E158	Lighted Push Button (Red)

**Control Panel Components and Part Numbers, cont.**

<b>Item No.</b>	<b>Vogt Part No.</b>	<b>Description</b>
<b>PB2</b>	<a href="#">12A7500E56</a>	Start Push Button (Green)
	<a href="#">12A7500E73</a>	Contact Block/Mounting Latch (2 N.O.)
<b>PM</b>	<a href="#">12A7700P01</a>	Power Monitor, Universal Phase Protector (Optional)
<b>PF</b>	<a href="#">12A7516E23</a>	Power Failure Contactor (9 Amp, 3 Pole, 1 N.O. Aux. Contact, 208/240V Coil)
<b>SS</b>	<a href="#">12A7500E61</a>	Selector Switch, 3 Position
	<a href="#">12A7500E77</a>	Contact Block/Mounting Latch (2 N.O./1 N.C.)
<b>T</b>	<a href="#">12A7503E22</a>	Thawing Timer (Delay On Make) 100-240V
	<a href="#">12A7503E39</a>	Timer Base (8 Pin, Guarded Terminal)
<b>TB1</b>	N/A	Main Terminal Block Assembly

Table 26: Temperature – Pressure Chart for R513A

Deg (°F)	Sat Liq P (psig)	Sat Vap P (psig)	Deg (°F)	Sat Liq P (psig)	Sat Vap P (psig)	Deg (°F)	Sat Liq P	Sat Vap P	Deg (°F)	Sat Liq P	Sat Vap P
-40	-5.9	-6	25	26	26	66	71.3	71.3	107	147.1	147.1
-35	-4.6	-4.7	26	26.8	26.8	67	72.7	72.7	108	149.4	149.4
-30	-3.1	-3.2	27	27.6	27.6	68	74.2	74.2	109	151.8	151.8
-25	-1.5	-1.6	28	28.5	28.4	69	75.7	75.7	110	154.1	154.1
-20	0.2	0.1	29	29.3	29.3	70	77.2	77.2	111	156.5	156.5
-15	2.2	2.1	30	30.2	30.2	71	78.7	78.7	112	159	158.9
-10	4.3	4.3	31	31.1	31.1	72	80.2	80.2	113	161.4	161.4
-9	4.8	4.7	32	32	32	73	81.8	81.8	114	163.9	163.8
-8	5.2	5.2	33	32.9	32.9	74	83.4	83.4	115	166.4	166.3
-7	5.7	5.6	34	33.8	33.8	75	85	85	116	168.9	168.9
-6	6.2	6.1	35	34.8	34.7	76	86.6	86.6	117	171.4	171.4
-5	6.7	6.6	36	35.7	35.7	77	88.2	88.2	118	174	174
-4	7.2	7.1	37	36.7	36.6	78	89.9	89.9	119	176.6	176.6
-3	7.7	7.6	38	37.7	37.6	79	91.5	91.5	120	179.3	179.2
-2	8.2	8.1	39	38.6	38.6	80	93.2	93.2	121	181.9	181.9
-1	8.7	8.7	40	39.7	39.6	81	94.9	94.9	122	184.6	184.6
0	9.3	9.2	41	40.7	40.7	82	96.7	96.7	123	187.3	187.3
1	9.8	9.7	42	41.7	41.7	83	98.4	98.4	124	190	190
2	10.4	10.3	43	42.8	42.7	84	100.2	100.2	125	192.8	192.8
3	10.9	10.9	44	43.8	43.8	85	102	102	126	195.6	195.6
4	11.5	11.4	45	44.9	44.9	86	103.8	103.8	127	198.4	198.4
5	12.1	12	46	46	46	87	105.7	105.7	128	201.3	201.2
6	12.7	12.6	47	47.1	47.1	88	107.5	107.5	129	204.2	204.1
7	13.3	13.2	48	48.2	48.2	89	109.4	109.4	130	207.1	207
8	13.9	13.8	49	49.4	49.4	90	111.3	111.3	131	210	209.9
9	14.5	14.4	50	50.5	50.5	91	113.2	113.2	132	213	212.9
10	15.1	15.1	51	51.7	51.7	92	115.2	115.2	133	216	215.9
11	15.8	15.7	52	52.9	52.9	93	117.1	117.1	134	219	218.9
12	16.4	16.4	53	54.1	54.1	94	119.1	119.1	135	222.1	222
13	17.1	17.1	54	55.3	55.3	95	121.1	121.1	140	237.8	237.7
14	17.8	17.7	55	56.6	56.5	96	123.2	123.2	145	254.3	254.2
15	18.5	18.4	56	57.8	57.8	97	125.2	125.2	150	271.6	271.5
16	19.2	19.1	57	59.1	59.1	98	127.3	127.3			
17	19.9	19.8	58	60.4	60.4	99	129.4	129.4			
18	20.6	20.6	59	61.7	61.7	100	131.5	131.5			
19	21.3	21.3	60	63	63	101	133.7	133.7			
20	22.1	22	61	64.3	64.3	102	135.9	135.9			
21	22.8	22.8	62	65.7	65.7	103	138.1	138.1			
22	23.6	23.6	63	67.1	67.1	104	140.3	140.3			
23	24.4	24.4	64	68.5	68.5	105	142.5	142.5			
24	25.2	25.1	65	69.9	69.9	106	144.8	144.8			

**Table 27: Constants**

<b>Specific Heat of Water</b>	1 BTU/(lbm °F) 1 calorie/gram °C
<b>Specific Heat of Air</b>	4.19 Kj/(kg °C) 0.24 BTU/(lbm °F)
<b>Tube-Ice Density</b>	32-35 lb/ft <sup>3</sup> 0.51-0.56 gm/cm <sup>3</sup>
<b>Ice Latent Heat</b>	144 BTU/hr (42 watts/hr)
<b>Water Sensible Heat</b>	1 BTU/(lb °F) (4,182 Joules/kg °C)
<b>Ice Melting Effect 1 Ton Refrigeration</b>	12,000 BTU/hr (3.5 kw/hr)
<b>Atmospheric Pressure</b>	14.7 psia (760 mmHg)
<b>Weight of Water</b>	62.4 lb/ft <sup>3</sup> 1,000 kg/m <sup>3</sup> 8.33 lb/gal
<b>1 gpm Water 3.79 L/min</b>	12,013 lb/day 5,449 kg/day
<b>Weight of Air</b>	0.0749 lb/ft <sup>3</sup> (0.0100 lb/gal)
<b>1 Horsepower</b>	2,545.6 BTU/hr (46 watts)
<b>1 Kilowatt</b>	1.34 horsepower 3,411 BTU/hr
<b>Gravitational Acceleration</b>	9.81 m/sec <sup>2</sup>

## **Appendix C      Additional Documentation**

The following lists other documents for your reference.

- OSHA Standard: The Control of Hazardous Energy (Lockout/Tagout) (29 CFR 1910.147)
- R513A Safety Data Sheet
- Bitzer CSH Compressor Manual
- Water Conditioning Technical Service Bulletin 88-5
- Compressor Oil BSE-170 Safety Data Sheet
- Gear Reducer Oil Safety Data Sheet



## Notes



## Notes





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Since 1880