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**Tube Ice | Turbo**

# MHG-A FL MODULAR

Manual Part Number 12A4171M11

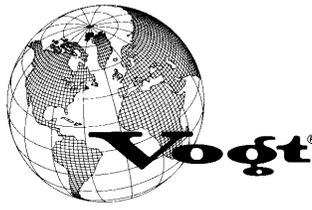
Service Manual  
\$50.00 USD

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**Vogt Ice L.L.C.**  
**1000 W. Ormsby**  
**Louisville, KY 40210**  
 (502) 635-3235  
 FAX #502-635-3024



**Vogt Order Number:** \_\_\_\_\_

**THIS FORM MUST BE SENT TO**  
**VOGT TO ACTIVATE WARRANTY**

**Warranty Registration / Start-Up Form**  
**(Medium & Large Machines)**

**Model Number:** \_\_\_\_\_ **Serial Number:** \_\_\_\_\_

**This form must be filled out completely and signed by the customer in order to assure acceptance by Vogt.**

Date of Start-Up: \_\_\_\_\_ Form Completed By: \_\_\_\_\_

AC Condenser Model Number: \_\_\_\_\_ AC Condenser Serial Number: \_\_\_\_\_

Water Treatment System?  Yes  No Manufacturer: \_\_\_\_\_ Model: \_\_\_\_\_

Bin Manufacturer: \_\_\_\_\_ Model: \_\_\_\_\_ Bin Capacity: \_\_\_\_\_ lbs.

**Distributor**

Company Name: \_\_\_\_\_ Phone: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

**Service Company**

Company Name: \_\_\_\_\_ Phone: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

**Customer (location of equipment)**

Company Name: \_\_\_\_\_ Phone: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

**PRE-OPERATION CHECK**

- Service Manual on hand
  - Machine room suitable 50°F minimum, 110°F maximum
  - Power Supply \_\_\_\_\_ V \_\_\_\_\_ PH \_\_\_\_\_ Hz (machine not running)
  - Compressor crankcase heater on 12 hour minimum
  - All valves opened or closed as tagged
  - Solenoid valve stems in auto position
  - System leak checked/tight
  - Auxiliary equipment overloads wired into control circuit
  - Water supply and drains connected properly
  - Sufficient make-up water supply (minimum 30 PSIG)
  - Instruction manual and warranty certificate left on-site
- Name of person left with: \_\_\_\_\_

**OPERATION CHECK**

- Power Supply \_\_\_\_\_ V \_\_\_\_\_ PH \_\_\_\_\_ HZ (machine running)
- Pump, cutter & other motor direction of rotation correct
- Water pump amps RLA \_\_\_\_\_ Actual \_\_\_\_\_
- Condenser motor amps (if applicable) \_\_\_\_\_
- Incoming potable water temperature: \_\_\_\_\_ °F
- All water distribution in place (visually inspected)
- Make-up water float valve operates properly
- Clear ice  Yes  No
- Hour meter in control panel connected and operating
- Suction Pressure: End of freeze \_\_\_\_\_ End of harvest \_\_\_\_\_
- Discharge Pressure: End of freeze \_\_\_\_\_ End of harvest \_\_\_\_\_

Test Cycle	Make-up Water Temp	Freeze Time Min/Sec	Harvest Time Min/Sec	First Ice Out Min/Sec	All Ice Out Min/Sec	Avg. Hole Size	Ice Lb. Per Harvest	Ice Lb. Per Day
#1								
#2								
#3								
#4								

Note: Ice lb. per day can be found by: \_\_\_\_\_ ice lb. per harvest × 1440  
 (freeze time + harvest time)

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Technician Signature:** \_\_\_\_\_ **End User Signature:** \_\_\_\_\_

**I certify that I have performed all of the above procedures.**

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## **Chapter 1: Introduction TURBO REFRIGERATION CO.**

### **1.1: A Brief History of Our Company**

Henry Vogt Ice Machine Co. was founded as a small machine shop in Louisville, Kentucky in 1880. In 1938, Vogt built the first Tube-Ice® machine and revolutionized the ice-making industry. Our first “sized-ice” machine quickly replaced the old can-ice plants, which required much hard labor and large amounts of floor space for freezing, cutting, and crushing ice by hand.

Turbo Refrigerating has been producing equipment for the ice industry since 1960. Since developing the plate icemaker, TURBO has been the leader in plate-ice making technology.

The ice makers described in this manual are part of a family of products designed specifically to meet the needs of the industrial ice users. The TIG/TIGAR series ice generators were introduced in 1985, they are built with the same high quality standards of engineering used to develop the icemakers of the 60's. Many of the latest developments in technology are used to design the Modular series ice generators. Modular ice generators have also been used in packaged ice applications by adding a TURBO Ice Sizer and improving the ice handling systems. In 2000 an upgraded version of the TIGAR with a new larger evaporator plate was introduced for both the industrial and packaged ice markets. In 2010, The Modular ice maker was introduced

Today, TUBE ICE® and TURBO® carry on the tradition as one of the world's leading producers of ice-making equipment.

### **1.2: Preview**

All the skill in engineering and fabrication that we have learned in over a century of experience is reflected in the Modular Plate Ice Machine.

Furnished with your machine is the “Certificate of Test”, the report of operating data that is a record of the unit's satisfactory operation on our factory test floor. It is evidence of our desire to deliver to you “the finest ice-making unit ever made.”

This manual is designed to assist you in the installation, start-up, and maintenance of your unit. Your Modular plate ice machine will give you a lifetime of service when you install it, maintain it, and service it properly.

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

If you have additional questions, please call your distributor. Also, feel free to phone the factory direct at **(502) 635-3000** or **1-800-853-8648**.

### 1.3: Important Safety Notice

This information is intended for use by individuals possessing adequate backgrounds of electrical, refrigeration and mechanical experience. Any attempt to repair major equipment may result in personal injury and property damage. The manufacturer or seller cannot be responsible for the interpretation of this information, nor can it assume any liability in connection with its use.

**Special Precautions To Be Observed When Charging Refrigeration Systems.** Only technically qualified persons, experienced and knowledgeable in the handling of refrigerant (Appendix A contains the MSDS for R-717) 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. A gage 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 pounds 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 and illegal release of refrigerant into the atmosphere.

<b>! CAUTION !</b>
<b>Immediately close system charging valve at commencement of defrost or thawing cycle if refrigerant cylinder is connected. Never leave a refrigerant cylinder connected to 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.</b>
<b>! CAUTION !</b>

Refrigerant cylinders containing refrigerant should be stored in a cool place. They should never be exposed to temperatures higher than 120°F and should be stored in a manner to prevent abnormal mechanical shocks. Also, transferring refrigerant from a refrigeration system into a cylinder can be very dangerous and is not recommended.

<b>! CAUTION !</b>
<b>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--free of any contaminants or foreign materials--and must be connected to an approved recovery mechanism with a safety shutoff sensor to assure contents do not exceed net weight specified by cylinder manufacturer or any applicable code requirements.</b>
<b>! CAUTION !</b>

### 1.4: Safety Symbols & What They Mean

Prior to installation or operation of the Tube-Ice® machine, please read this manual. Are you familiar with the installation, start-up, and operation of a Tube-Ice® machine? Before you operate, adjust or

service this machine, you should read this manual, understand the operation of this machine, and be aware of possible dangers.

These Safety Symbols will alert you when special care is needed.

### **Please heed**

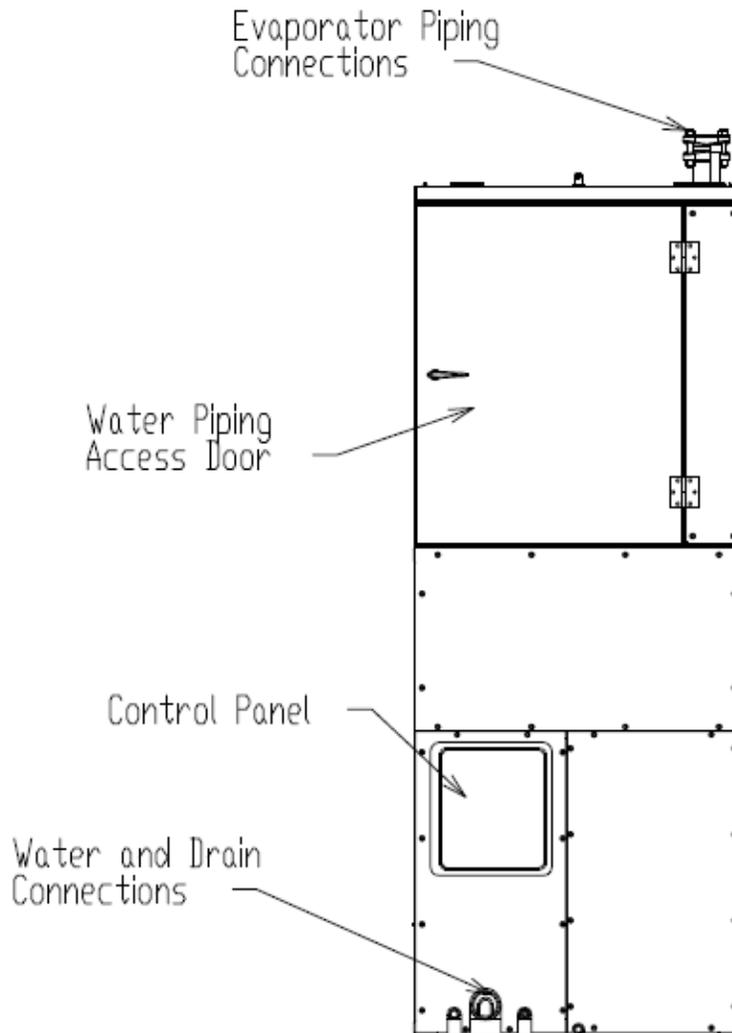
<b>! DANGER !</b>
<b>Indicates immediate hazards and that special precautions are necessary to avoid severe personal injury or death.</b>
<b>! DANGER !</b>

<b>! WARNING !</b>
<b>Indicates a strong possibility of a hazard and that an unsafe practice could result in severe personal injury.</b>
<b>! WARNING !</b>

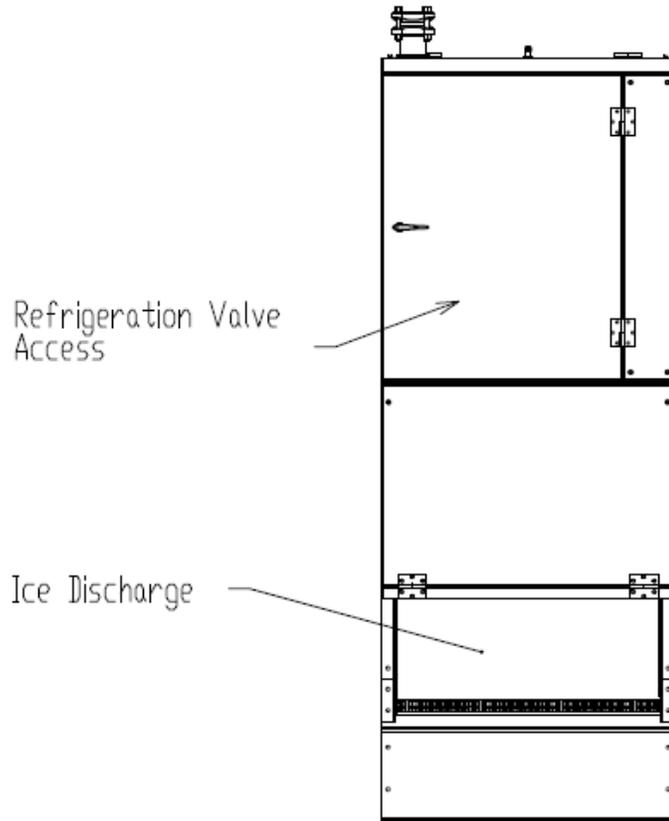
<b>! CAUTION !</b>
<b>Means hazards or unsafe practices could result in personal injury or product or property damage.</b>
<b>! CAUTION !</b>

## 1.5: Modular Ice Maker Introduction

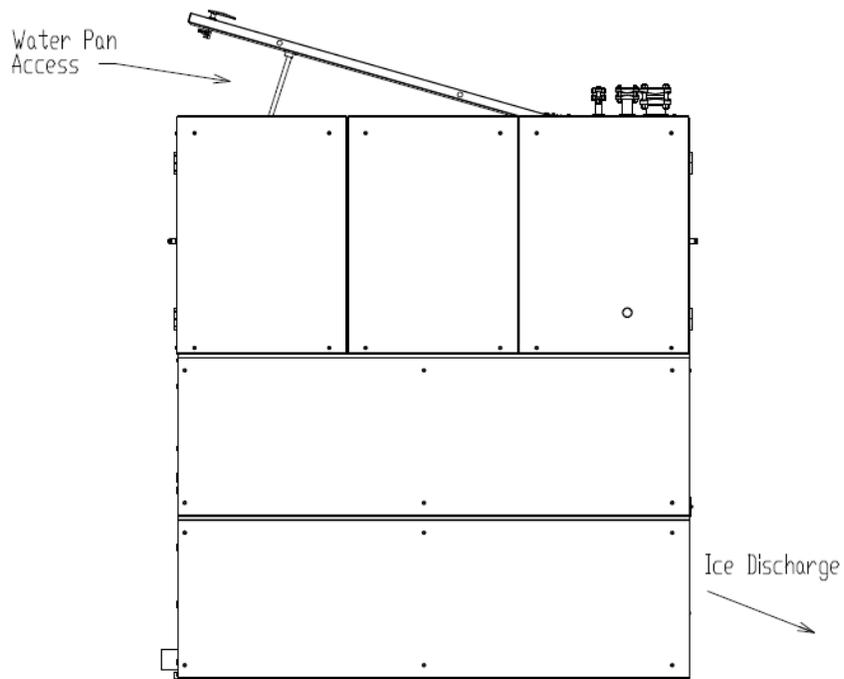
The Modular Fragmented Ice System was introduced to give the customer flexibility in their ice production needs. Below are some figures introducing the Modular product line. These show the basic connections and orientation of the equipment. The Modules were designed to ease in the expansion process of ice plants today. Additional Modules may be set in place beside other Modules. The controls have been designed in a plug and play manner to further simplify expansion.



**Figure 1-1 Modular Front View**



**Figure 1-2 Modular Back View**



**Figure 1-3 Modular Right Side View**



## Chapter 2: Receipt of Your Vogt Ice Machine

**! CAUTION !**

**Only service personnel experienced in servicing refrigeration equipment and qualified to work on high amperage electrical equipment should be allowed to install or service this Turbo Refrigerating machine. Eye protection should be worn by all personnel working on or around the Turbo Refrigerating machine. It is very important that you are familiar with and adhere to all local, state, and federal, etc. ordinances and laws regarding the handling, storing, and use of refrigerant. An approved mask should be readily available for use in an emergency and all personnel should be aware of its location and proper use.**

**! CAUTION !**

### 2.1: Inspection

As soon as you receive your machine, inspect it for any damage or missing components. If damage is suspected or items are missing, note it on the shipper's papers (i.e., the trucker's Bill of Lading). Immediately make a separate written request for inspection by the freight line's agent. Any repair work, replacement parts, or alteration to the machine without the permission of the Vogt Ice, LLC can void the machine's warranty. You should also notify your Vogt distributor or the factory.

### 2.2: Description Of Machine

A Vogt Ice Modular low side machine is a remote ice producing plant requiring refrigerant suction connection, refrigerant liquid connection, thaw gas connection, make-up water supply, electrical connection, and the proper refrigerant charge.

The machine has been partially factory tested prior to shipment and will require adjustment to meet the high side (condenser unit) operating conditions. See Start-up and Operation for the correct setting of the controls.

The machine is evacuated and charged with nitrogen gas pressure for shipment. This prevents air or moisture from entering the system during transit. There should be a positive pressure (20-25 psig) indicated on the freezer pressure gage when the machine is received. The machine has been cleaned with ice machine cleaner and flushed so that the machine is ready for ice production.

### 2.3: 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.

## 2.4: Safety Valves

Where required, safety pressure relief valves are installed. Vent the pressure relief valves to the atmosphere in such a manner as to comply with local and national codes. Failure to do so creates a safety hazard that could cause injury or loss of life.

<b>! Danger !</b>
<b>Safety Relief Valves should be vented to the atmosphere in a safe manner that complies with local and national codes.</b>
<b>! Danger !</b>

## 2.5: Equipment Storage

If the equipment is received, but must be stored prior to installation, you should protect it from the weather, extreme temperatures, and high humidity. These type of conditions can deteriorate the various components used in the manufacture and assembly of the equipment.

## 2.6: Rated Capacity

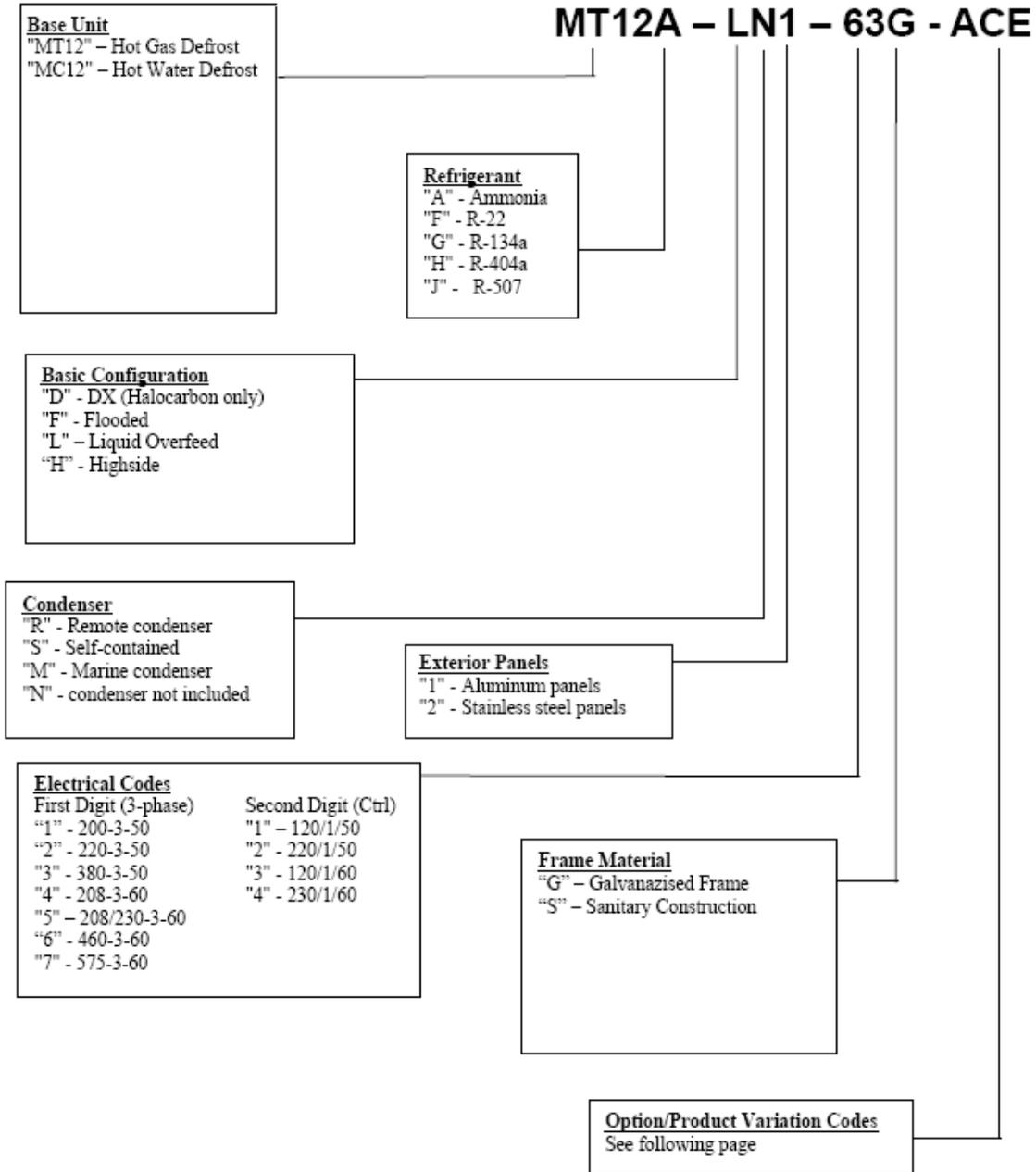
The Turbo Refrigerating machine is rated to produce a given amount of ice when operating under the proper conditions as specified in this manual. You should be prepared to handle the ice produced as it is discharged from the machine and move it to your storage or bagging area promptly.

## 2.7: Model Number

The machine nameplate is located on the front of the control panel. The model number and machine description are located in the top left hand corner. The following figure can be used to verify that the correct model has been received. See Figure 2-1 Model Number Structure.

## Turbo Modular Machines Unified Model Number Structure

(example is for MT12A, aluminum exterior panels, 460/3/60 power, 120/1/60 controls, Galvanized construction, and single point power)



**Figure 2-1 Model Number Structure**



## Chapter 3: Installing Your Vogt/Turbo Modular Unit

**! 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 Turbo Refrigerating® machine.**

**! WARNING !**

### 3.1: Important Notice

The Warranty Registration / Start-Up Form must be completed and returned to Vogt Turbo Refrigerating® to initiate and assure a full warranty.

### 3.2: Machine Room

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 (43.3°C). Heat from other sources (sunlight, furnaces, condenser, etc.) and unusual air current may affect the operation of the machine and should be avoided.

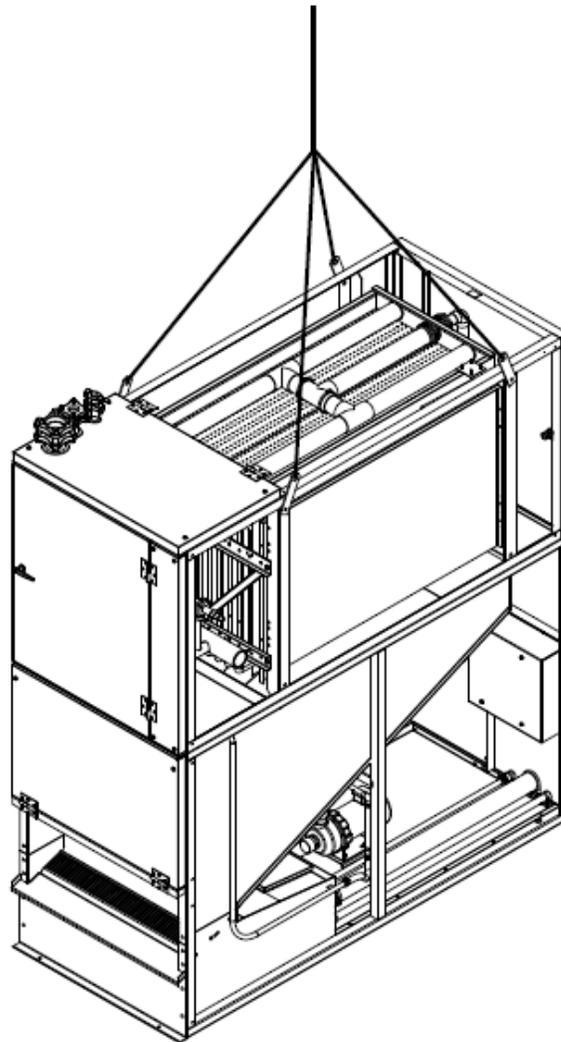
The electrical components of the Turbo Refrigerating machine are rated NEMA 1. The machine should not be located in a hazardous area or sprayed with water. The machine should be installed in an area where water will not stand but will readily drain away from the machine. See Space Diagram for clearances and utility connections, Figure 3-3 Side View Unit Access, and Figure 3-4 Plan View Unit Access.

The Master panel of the Modular system is equipped with an operator interface screen. While this screen is resistant to water, it is not advisable for it to be exposed to direct sunlight as it will be difficult to see and ultraviolet light will degrade the interface over time.

### 3.3: Lifting Procedures

<b>! CAUTION !</b>
<b>The approximate shipping weight of the machine is 2,200 pounds. Always use equipment with adequate load carrying capacity. The Turbo Refrigerating machine is top heavy. Lift from the top to avoid tipping.</b>
<b>! CAUTION !</b>

The machine body has lifting lugs on the top for an eyebolt and hook to be used for lifting purposes. The lifting lugs should be used whenever possible. The machine needs to be lifted from the top to prevent tipping (Figure 3-1 Lifting Procedure). If a forklift is used, make sure its capacity is sufficient. Avoid using forks that do not extend completely under the frame. Do not lift the units using the drain pan as the support.

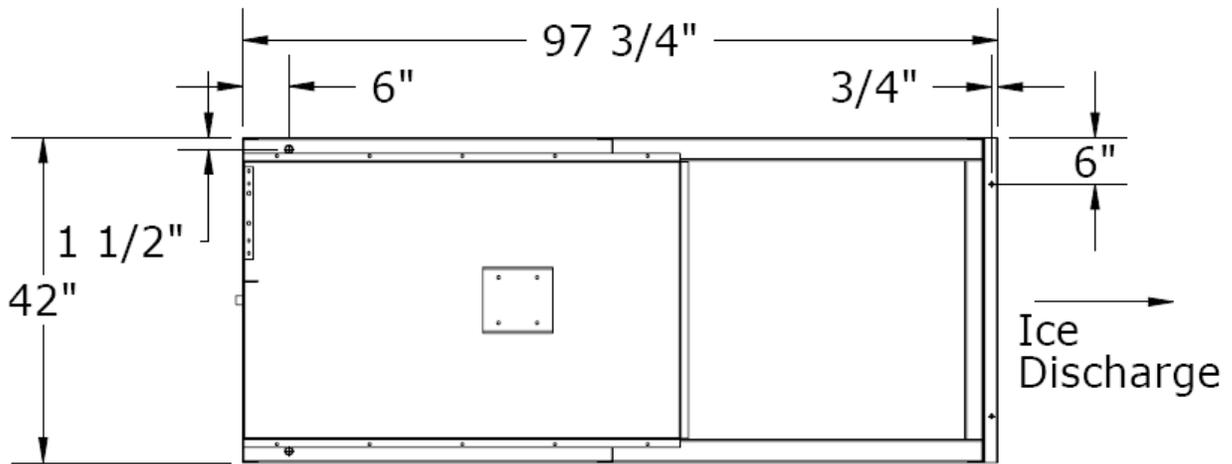


**Figure 3-1 Lifting Procedure**

### 3.4: Equipment Anchoring

The supporting machine foundation should be constructed from concrete or similar material in accordance with all local and federal OSHA codes and building regulations. Figure 3-2 Anchor Points indicate anchor bolt hole locations in the bottom frame of the Modular unit. Consult local codes and regulations regarding seismic and wind load requirements.

<b>! Warning !</b>
<b>Contact your local codes for seismic anchoring requirements in your area. Additional bracing may need to be added to the top of the machine mounted to the lifting lug to meet local codes.</b>
<b>! Warning !</b>



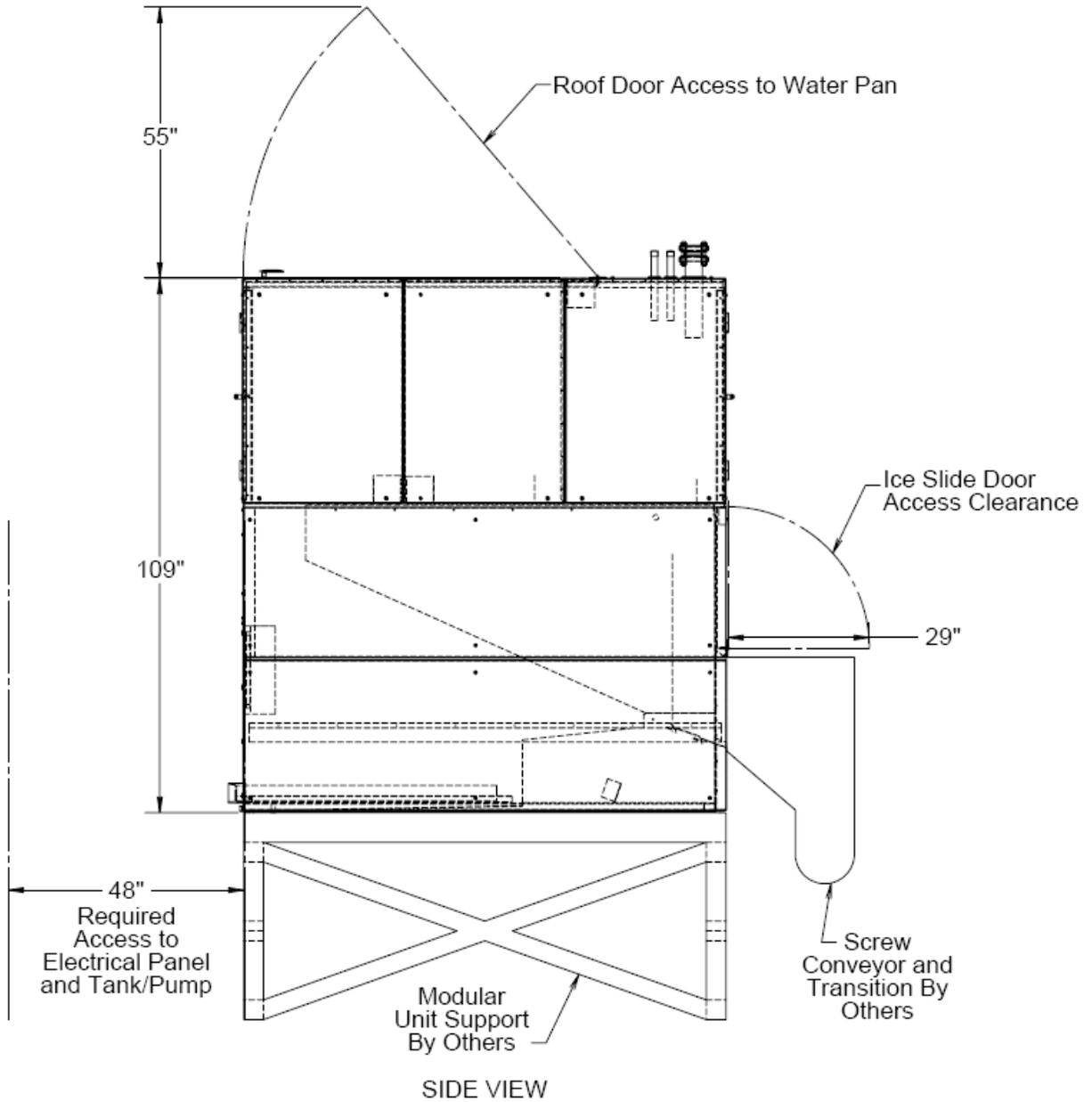
Plan View of Base Frame  
 With Anchor Points

Figure 3-2 Anchor Points

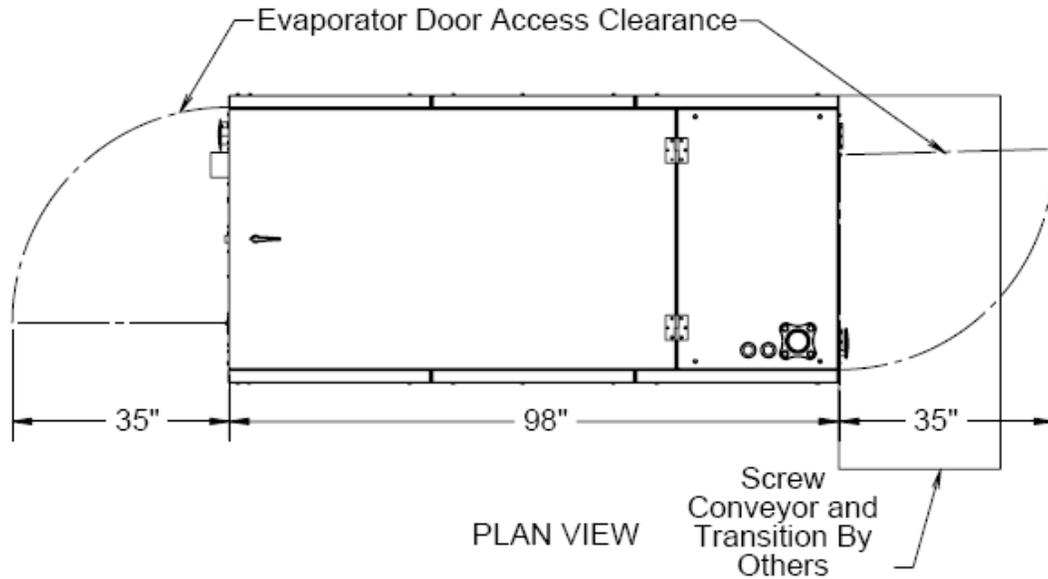
### 3.5: Equipment Layout

<b>! CAUTION !</b>
<b>The approximate machine operating weight for a single module is 3,400 pounds.</b>
<b>! CAUTION !</b>

The Modular unit will require certain clearances around the unit for safety reasons and to provide access for service operations. Clearance is required for access to the control panel, refrigerant control valves in the evaporator section, and water pan access above the unit. Review Figure 3-3 Side View Unit Access and Figure 3-4 Plan View Unit Access for required clearances.



**Figure 3-3 Side View Unit Access**



**Figure 3-4 Plan View Unit Access**

The Modular unit will require some method of moving ice away from the unit (i.e. screw conveyor). The height of the unit in relation to the conveying device will vary based upon the size of that device and the surge volume of the transition into the device.

The transition from the icemaker discharge into the conveying device must be large enough to handle the volume of ice coming out of the icemaker during harvest. Failure to do so will result in ice stacking into the ice slide area. Adequate space must also be allowed for servicing operations such as cleaning and auger repair. The volume of ice discharged from the machine is a function of the thickness of the ice. Below is Table 3-1 Ice Volume. It contains approximate ice volumes based upon the ice thickness for a single Module harvest. It can be used to help determine the required transition size for the conveying device.

Ice Thickness	Volume (cubic feet)
¼"	9
½"	18

**Table 3-1 Ice Volume**

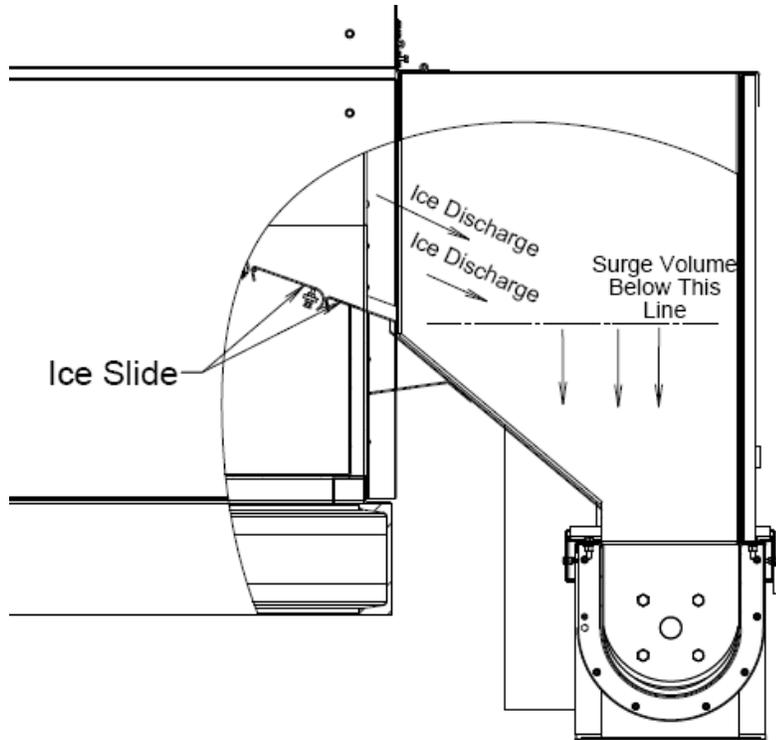
The screw conveyor selected will also have an impact on the size of the transition required for the surge volume. When calculating the size of the transition, be sure to include the volume of the screw conveyor trough immediately in front of the unit and a portion of the trough adjacent to the harvesting unit (if any). See Table 3-2 Screw Trough Volume.

Nominal Screw Conveyor Size	Approximate Trough Volume Available (cubic feet)
9"	3
12"	5
14"	7
16"	9
<b>These volumes include 42" of the width of the unit and a portion of the adjacent space as well.</b>	

**Table 3-2 Screw Trough Volume**

With the above information, you can determine the required transition surge volume for the ice during a harvest. For example, an installation that will be making ¼" thick ice, and conveying it with a 9" screw conveyor will require a total of 9 cubic feet of surge volume. Three cubic feet are handled by the screw conveyor itself, so the transition area will need to absorb 6 cubic feet of ice (9 cubic feet less 3 cubic feet). Keep in mind that the area of the transition for the surge must be below the bottom lip of the ice discharge. See Figure 3-5 Conveyor Transition. The area below the Surge Line shown in the figure needs to accommodate the total Ice Volume expected. Failure to do so may cause excessive water carryover into the conveyor, or cause a freeze up by blocking the ice discharge of the machine. Once the screw conveyor size is selected and the surge volume is determined, the difference in elevation of the Modular unit and screw conveyor can be determined. Remember, the screw conveyor elevation will most likely be below the Modular unit to accommodate the required surge volume as shown in Figure 3-5 Conveyor Transition.

<b>! Caution !</b>
<b>Properly size the screw conveyor transition for best operation of the ice maker.</b>
<b>! Caution !</b>



Cut-away View of Ice Slide and Transition

**Figure 3-5 Conveyor Transition**

### 3.6: Refrigerant Piping Connections

The refrigerant piping connections are located on the top of the unit as shown in Figure 3-7 Refrigerant Connections. Refrigerant mains that are connected to the Module(s) must be properly sized for the refrigeration load. Please consult with the factory if you require assistance in sizing the main lines. Avoid long piping runs. If they can't be avoided, please consult the factory.

<b>! WARNING !</b>
<b>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 Turbo Refrigerating® machine.</b>
<b>! WARNING !</b>

A typical Modular unit piping schematic is shown in Figure 3-6 Module Refrigerant Schematic. The wet suction line is equipped with a suction stop valve that is normally open and actuated by a small pilot solenoid valve. The defrost gas line is equipped with an isolation valve and a solenoid valve. The liquid refrigerant line is also equipped with an isolation valve and a 2 port solenoid valve. All solenoid valves are equipped with a manually opening feature. These valves are controlled by the Module's Programmable Logic Controller (PLC) discussed later in this section. Typical connection sizes are listed in Table 3-4 Refrigerant Connection Sizes.

Not shown in this diagram are the other components required for the refrigeration circuit such as the compressor, condenser, oil separator-oil return system, and surge drum. It is extremely important that these components be sized properly for safe and reliable operation. Failure to size these components correctly will result in poor performance and expensive repairs. If you need assistance in component selection, please contact the factory or your sales representative.

For assistance in sizing the refrigerant mains, please contact the factory.

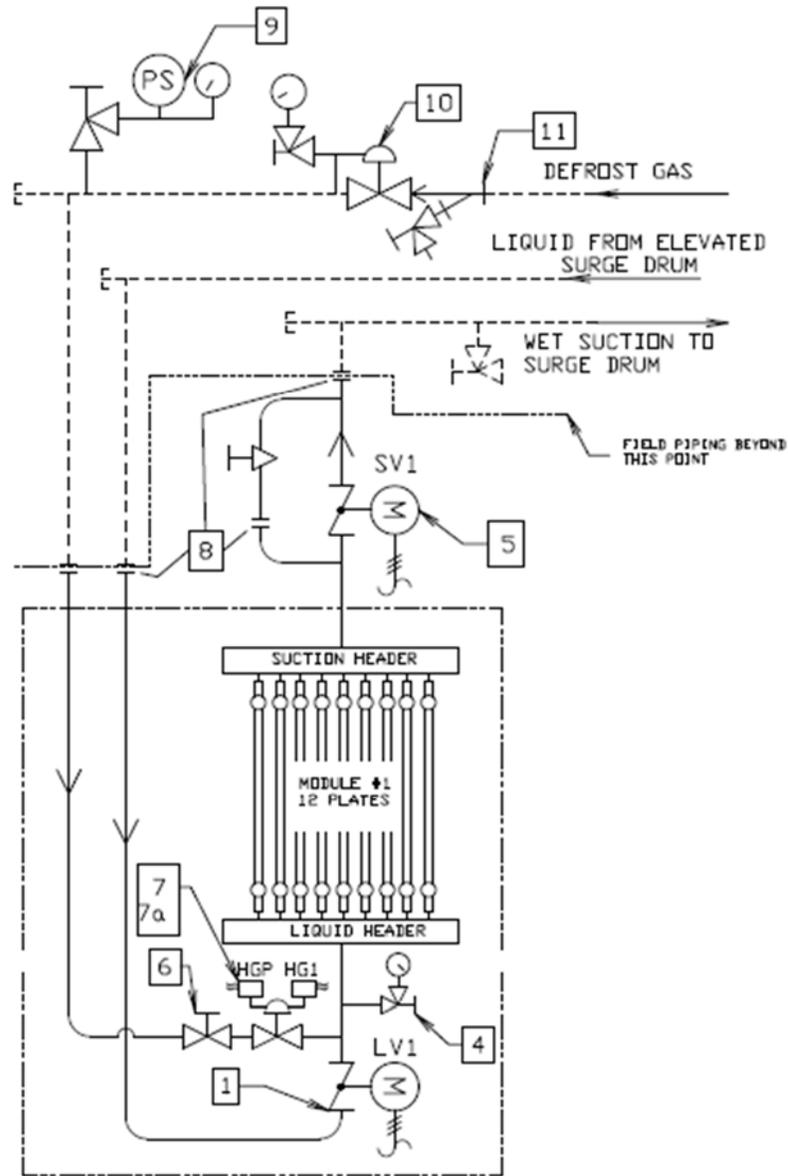
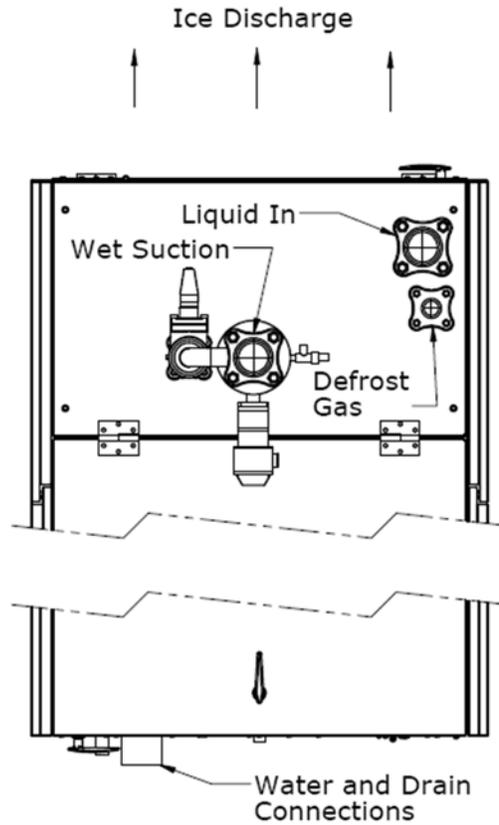


Figure 3-6 Module Refrigerant Schematic

#1-liquid valve	#5-suction valve and bypass valve	#9-pressure switch
	#6-isolation valve	#10-hot gas regulator
	#7, 7a-hot gas small, full port	#11-hot gas strainer
#4-gauge and valve	#8-flange connection	

Table 3-3 Module Refrigerant Schematic Components



Refrigerant Connections Viewed  
 From The Top Of The Unit

**Figure 3-7 Refrigerant Connections**

Connection	Size
Wet Suction	3" 4 Bolt Flange
Defrost Gas	1 1/2" 4 Bolt Flange
Liquid In	3" 4 Bolt Flange
Consult Data Sheet for Variations	

**Table 3-4 Refrigerant Connection Sizes**

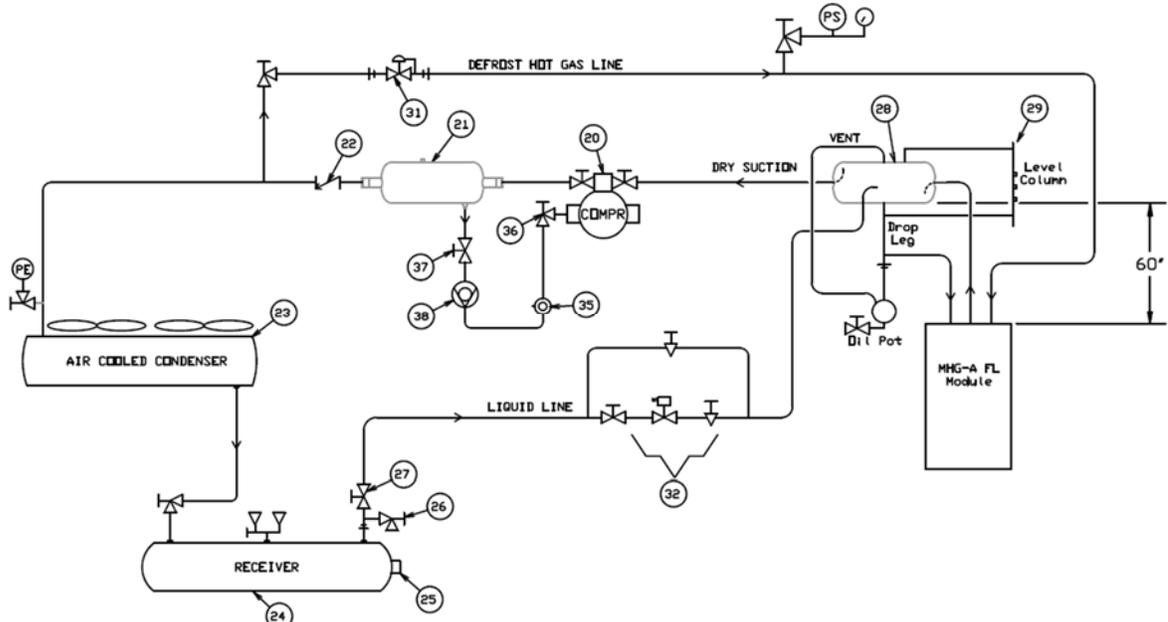


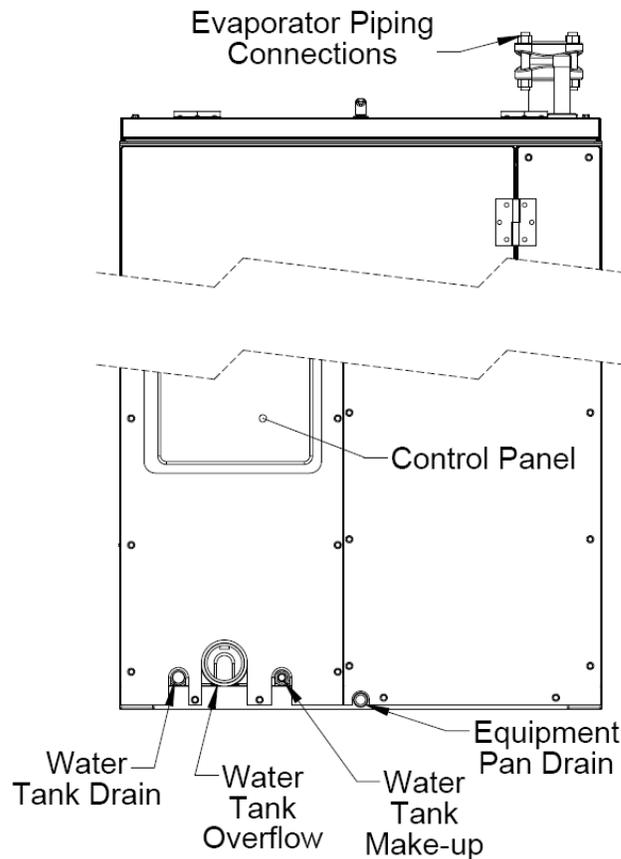
Figure 3-8 Typical Refrigeration High Side

#20 compressor	#25 level indicator	#30 gauge valve	#35 sight glass
#21 oil separator	#26 gauge valve	#31 hot gas pressure regulator	#36 valve
#22 check valve	#27 king valve	#32 high pressure liquid solenoid kit	#37 valve
#23 condenser	#28 low pressure surge drum	#33 N/A	#38 float/drain
#24 receiver	#29 level column w/level controller and high level cut off	#34 check valve	

Table 3-5 Refrigerant High Side Components

### 3.7: Water Piping Connections

The water piping connections are located on the control panel side of the unit (opposite of the ice discharge side). Water supply lines and drains must be plumbed to meet local and national codes. External shut-off valves must be provided in the water inlet line and drain line. The minimum inlet water pressure for satisfactory operation of the machine is 30 psig. The maximum allowable pressure is 100 psig. The water tank overflow connection must be extended to an open drain or sump, arranged for visible discharge.



Water Connections Viewed  
 From Control Panel Side  
 of Unit

**Figure 3-9 Water Connections**

Connection	Size
Water Tank Drain	1" PVC
Water Tank Overflow	3" PVC
Water Tank Make-up	¾" FPT
Equipment Pan Drain	½" FPT

Consult Data Sheet for Variations

**Table 3-6 Water Connection Sizes**

<b>! CAUTION !</b>
<b>External shut-off valves must be provided in the water inlet line and drain line. The minimum inlet water pressure for satisfactory operation of the machine is 30 psig and peak flow requirement is 10 GPM. The maximum allowable pressure is 100 psig.</b>
<b>! CAUTION !</b>

<b>! CAUTION !</b>
<b>The drain lines must NOT be connected into a pressure tight common header due to the possibility that water may back up into the water tank.</b>
<b>! CAUTION !</b>

Water Tank Drain connection is for the purpose of flushing and draining the water tank of impurities, foreign material and cleaning chemicals used during servicing. It should be piped to an open drain or sump for visible discharge. It can be tied in with the overflow line but no others.

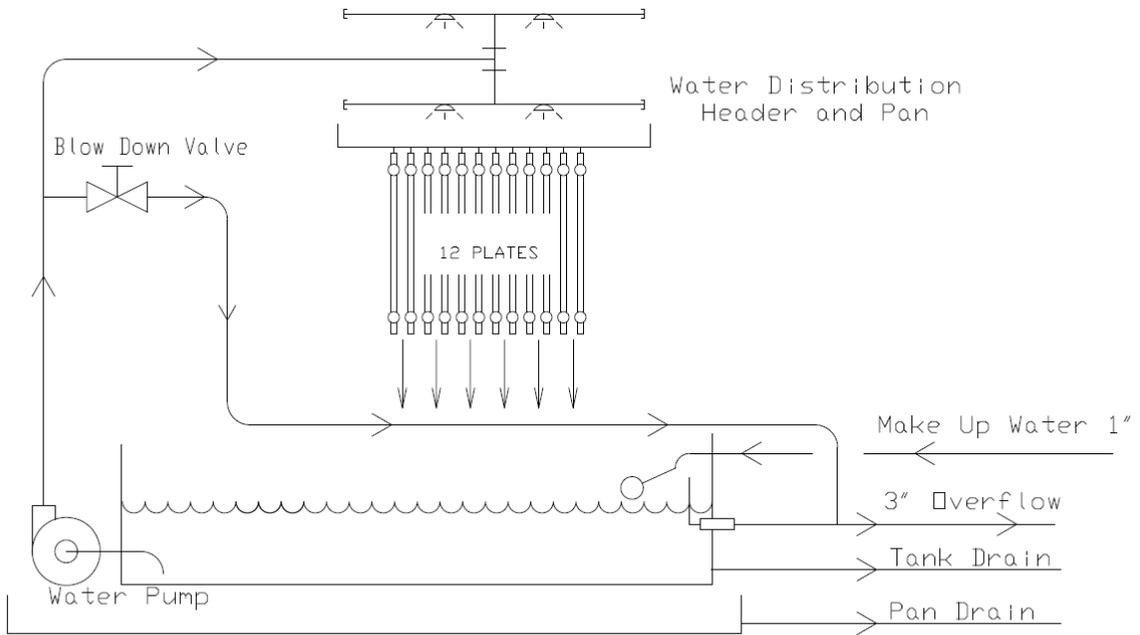
Water Tank Overflow connection on the machine is provided to carry away overflow water during the thawing (harvest cycle). This water contains ice fines accumulated during harvesting and dissolved solids accumulated during the freezing cycle. Do not reduce the size of this line. Three inches is needed to provide sufficient area for ice fines to be flushed out, especially if the incoming make-up water is 55°F (13°C) or below. This overflow line should not tie in with any other drain line except the water tank drain.

Water Tank Make-up required for ice making must be potable water, safe for human consumption, and should be of the highest quality available. The best way to determine water quality is to have a complete water quality analysis by a qualified laboratory.

It is advisable to install a particle filter in the make-up line to trap dirt, sand, rust, or other solid particles prior to entering the water tank and contaminating the ice. Be sure to size the filter large enough to meet the water demands of 10 GPM (peak flow), allowing for a restriction through the filter as it traps these particles. Minimum required supply pressure is 30 psig.

Unless water quality is superior, do not discharge the overflow water to the cooling tower system. This water contains additional dissolved solids left from the ice making process and can lead to excessive condenser fouling or cooling tower chemical usage. It is recommended that a heat exchanger be used in place of direct contact with condenser water.

A blow down valve is supplied internal to the unit and is piped to the Tank Overflow line inside the machine. Blow down may be necessary to flush dissolved solids from the water tank during the freezing cycle. This function is important and helps to maintain good ice quality. If water quality is superior, the supplied valve can be closed to conserve water.



**Figure 3-10 Water Circuit**

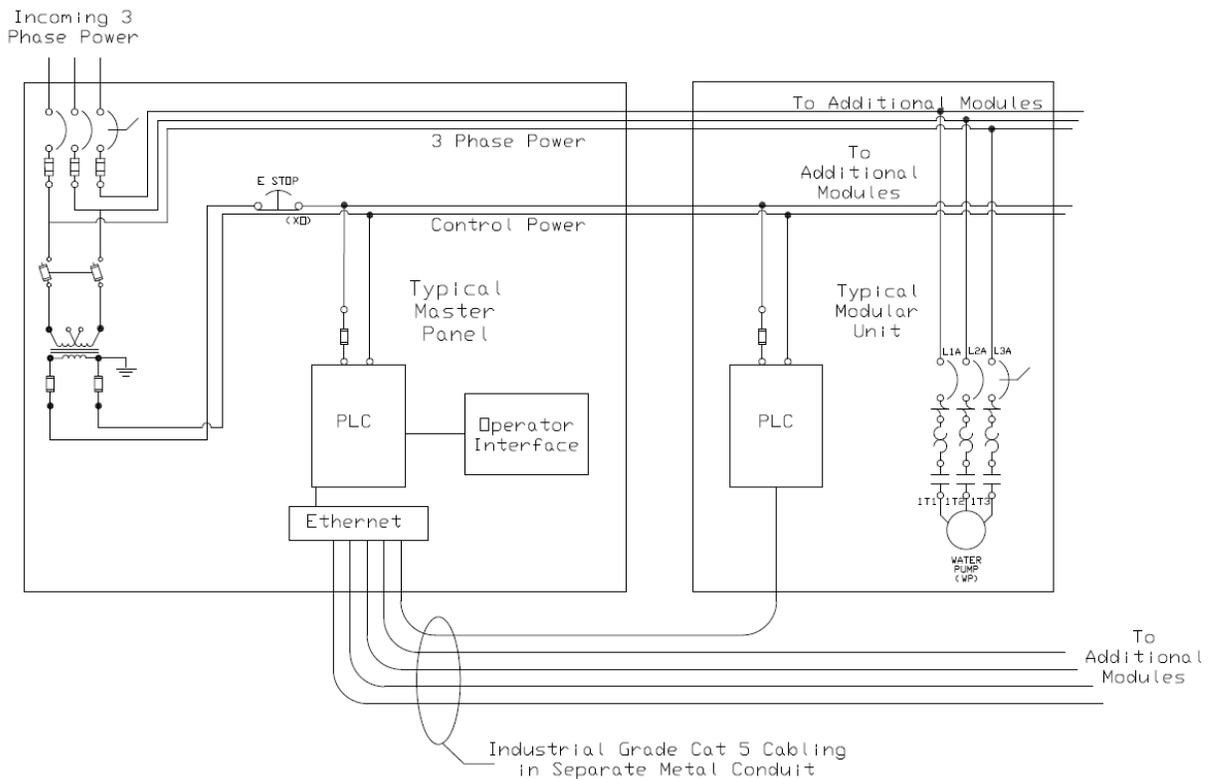
### 3.8: Wiring and Electrical Connections

<b>! WARNING !</b>
<b>Only service personnel experienced in refrigeration and qualified to work with high voltage electrical equipment should be allowed to install or work on the Turbo Refrigerating® machine.</b>
<b>! WARNING !</b>

Wiring of the Modular ice makers consists of connecting three different types of wiring from the Master Panel to each of the Modules: Three Phase Wiring, Control Power Wiring, and Ethernet Communication Wiring. Refer to the wiring diagram for your unit for information about sizing of the conductors and where they should be connected in each panel. The three phase power and control power can be 'daisy chained' from the Master Panel to each Module.

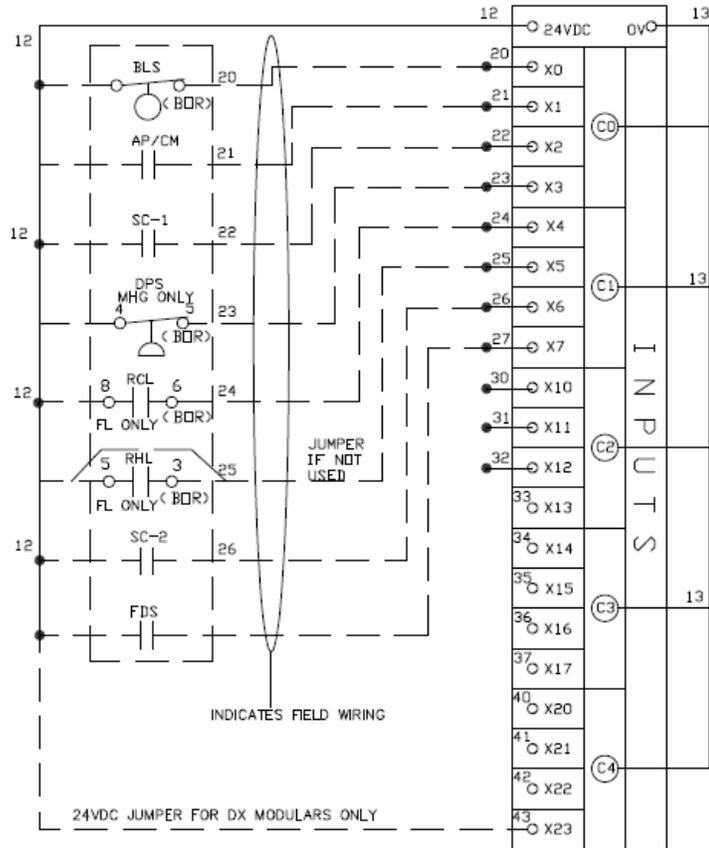
Each Module must have dedicated Ethernet category 5 (or greater) wiring to the Master panel Ethernet switch as shown below in Figure 3-11 Master Panel and Module Connection. The Ethernet wiring must conform to TIA/EIA 568-B per the Telecommunications Cabling Standard (Cabling purchased at most electronics stores is compatible with this standard). Maximum length of any cable is 90 meters.

Each Master panel also has various other electrical connections to ancillary equipment that is required to achieve the best performance for your equipment.



**Figure 3-11 Master Panel and Module Connection**

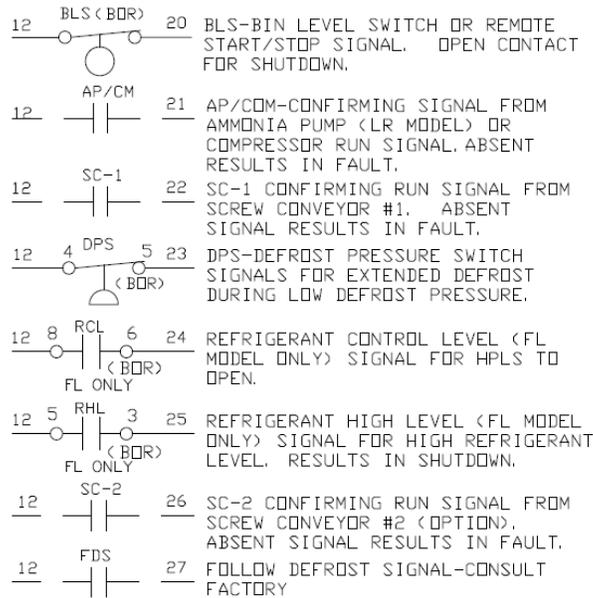




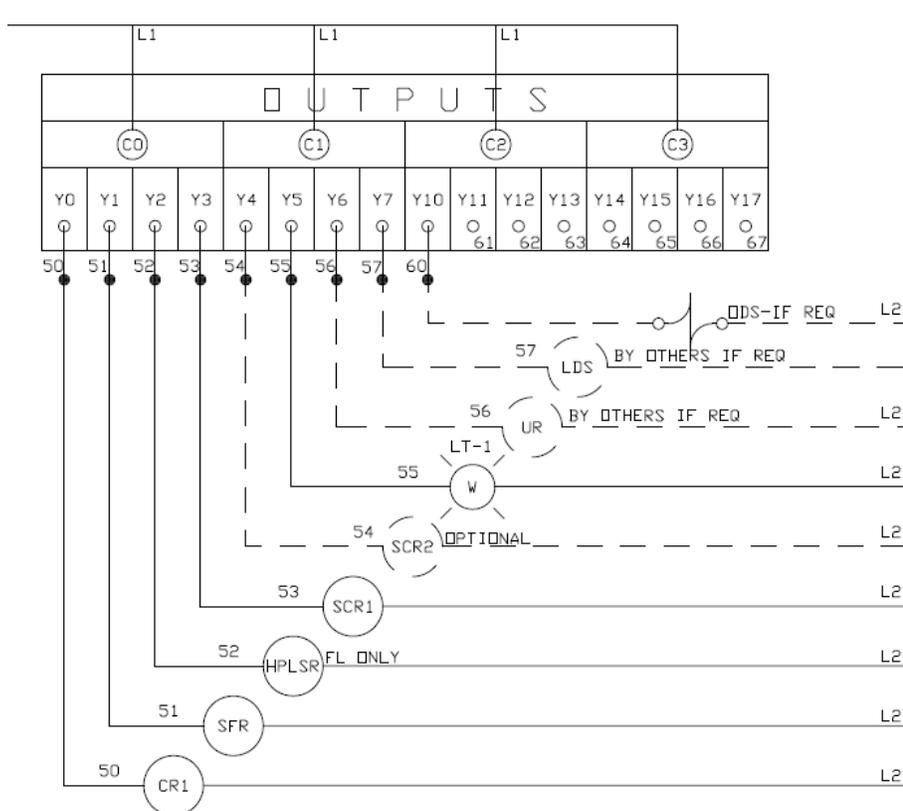
**Figure 3-13 Master Panel Input Wiring**

Figure 3-13 Master Panel Input Wiring shows typical wiring inputs available. Refer to your wiring diagram for specific details about the various connections. Figure 3-14 Input Connections offers a brief description of what the function of each connection. Refer to your diagram for the proper voltage connection and voltage. The 'BOR' abbreviation stands for "Break On Rise", in other words the connection opens on a rise in level. Some connections are required and some optional. Where noted, a jumper wire can be used in place of the shown contact. If you have any questions, please consult the factory for assistance.

### CUSTOMER INPUT CONNECTIONS



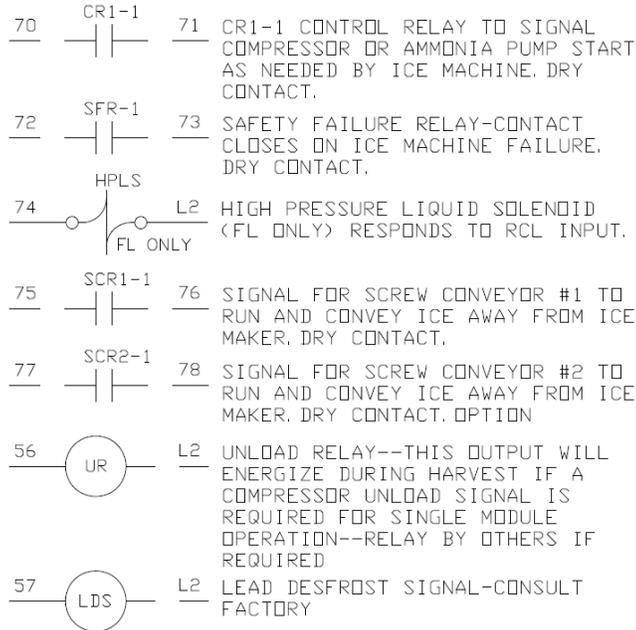
**Figure 3-14 Input Connections**



**Figure 3-15 Master Panel Output Wiring**

Figure 3-15 Master Panel Output Wiring shows typical wiring connections for a Master Panel. Keep in mind the Master panel is able to control several types of Vogt Modular units, so some items are required for certain types of circuits, while others are not. The design of the Modular panel was meant to be flexible and to apply to various types of installations and refrigerant circuits. Figure 3-16 Output Connections shown below offers a brief description of some of the various connections. Refer to the diagram for your equipment for more specific information. Also, shown in Figure 3-17 Drawing Legend, the various abbreviations are explained.

### CUSTOMER OUTPUT CONNECTIONS



**Figure 3-16 Output Connections**

### LEGEND

AP/CM	AMMONIA PUMP/COMPRESSOR
BLS	BIN LEVEL SWITCH
CR1	CONTROL RELAY #1
DPS	DEFROST PRESSURE SWITCH
ETH1	ETHERNET SWITCH
ETH2	ETHERNET SWITCH #2 (FOR 7-12 MODULES)
FDS	FOLLOW DEFROST SIGNAL-CONSULT FACTORY
FU1	FUSES, MASTER PANEL CONTROL CIRCUIT
FU2	FUSES, TRANSFORMER SECONDARY
FU3	FUSES, TRANSFORMER PRIMARY
HPLS	HIGH PRESSURE LIQUID SOLENOID
HPLSR	HIGH PRESSURE LIQUID SOLENOID RELAY (FL)
LDS	LEAD DEFROST SIGNAL-CONSULT FACTORY
LT-1	INDICATOR LAMP
PS1	POWER SUPPLY (24VDC)
RCL	REFRIGERANT CONTROL LEVEL (FL ONLY)
RHL	REFRIGERANT HIGH LEVEL (FL ONLY)
SC-1	SCREW CONVEYOR #1
SC-2	SCREW CONVEYOR #2 (OPTIONAL)
SCR1	SCREW CONVEYOR RELAY #1
SCR2	SCREW CONVEYOR RELAY #2
SFR	SAFETY FAILURE RELAY
UR	UNLOAD RELAY

**Figure 3-17 Drawing Legend**

<b>! CAUTION !</b>
<b>Do not attempt to start machine without insuring proper rotation of the water pump.</b>
<b>! CAUTION !</b>

Pump motor rotation must be checked prior to start-up. The pump rotation should match the marking on the pump housing. Improper pump rotation will lead to poor pump performance and potentially damage the pump. To change rotation of the pump, disconnect power and reverse L1 and L3 (incoming power wires) at the motor contactor.

<b>! Danger !</b>
<b>Only qualified personnel should attempt to change rotation on any motor as high voltage is present at the motor contactors.</b>
<b>! Danger !</b>

The incoming three phase voltage should be checked by a qualified electrician. Voltage unbalance can cause motors to overheat and fail. The maximum voltage unbalance between any two legs should be no greater than 2%. Important: If the supply voltage phase unbalance is more the 2%, contact your local electric utility company.

Example: Supply Voltage=230/3/60	
Voltage Readings: AB=220 Volts BC=225 Volts AC=227 Volts	Average=(220+225+227)/3=224 Volts
Voltage Deviation: AB=224-220=4 Volts (highest deviation) BC=225-224=1 Volt AC=227-224=3 Volts	% Voltage Unbalance=100 x (4/224)=1.78%, Acceptable

**Table 3-7 Voltage Unbalance**

<b>! Danger !</b>
<b>Only qualified personnel should attempt to check incoming voltage or measure motor current. High voltage is present in the control panels and the risk of electrocution is present..</b>
<b>! Danger !</b>

Current Unbalance Voltage unbalance will cause a current unbalance, but a current unbalance does not necessarily mean that a voltage unbalance 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 connection 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 unbalance is 10%

Example:	
Current Readings: L1=96 Amps L2=91 Amps L3=98 Amps	Average=(96+91+98)/3=95 Amps
Current Deviation: L1=96-95=1 Amp L2=95-91=4 Amps (highest deviation) L3=98-95=3 Amps	%Current Unbalance=100 x (4/95)=4.2%, Acceptable

**Table 3-8 Current Unbalance**

### 3.9: Installation Review Checklist

Make a visual check to be sure these steps have been taken BEFORE continuing.

CHECK: \_\_\_\_ PRIOR TO OPENING VALVES, check all joints for leaks which may have developed during shipment. (NOTE: the machine was shipped with a positive pressure of 20-25 PSIG, verify on the freezer pressure gage.)

CHECK: \_\_\_\_ The system is properly evacuated to 500 microns.

CHECK: \_\_\_\_ All refrigerant piping, water supply and drain connections for conformity to requirements stipulated in this manual and properly connected to inlets and outlets.

CHECK: \_\_\_\_ Electrical supply for proper size of fuses and for compliance to local and national codes. See the machine nameplate for minimum circuit ampacity and maximum fuse size.

CHECK: \_\_\_\_ All field installed equipment (augers, conveyors, cooling towers, bin level controls, etc.) for proper installation.

CHECK: \_\_\_\_ The applicable portion of the warranty registration/start-up report for proper completion.

<b>! CAUTION !</b>
<b>The compressor crankcase heater should be energized for a minimum of four hours and the oil temperature should be 100-110°F before attempting to start the compressor.</b>
<b>! CAUTION !</b>



## Chapter 4: How Your Ice Machine Works

<b>! WARNING !</b>
<b>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 Turbo Refrigerating® machine.</b>
<b>! WARNING !</b>

### 4.1: Principle Of Operation

Your Vogt Modular Icemaker is equipped with a Master Control Panel that controls each Module or group of Modules. Each module also has its own control panel which responds to the commands from the Master Control Panel. For a detailed description of the functions of each control panel component, see Section 6.

Starting and running of the Modular system is initiated from the Master Control Panels operator interface. For a detailed description of the function of the controls, refer to Section 6.

If it should become necessary to instantly stop the machine, push the emergency “E-Stop” button located on the Master Control Panel. To restart the machine, reset the E-Stop button and use the Master Switch on the operator interface.

Figure 3-6 and Figure 3-10 illustrate the piping diagram of the refrigerant and water circuits of the Modular Plate Ice machine with numbers for easy reference. Throughout this manual, the numbers you see in parentheses refer to the numbers in this piping schematic.

The evaporator is a plate bank assembly of 12 plates on which ice forms during the freeze cycle. During the freeze cycle, water is constantly recirculated on the exterior of the plates by a centrifugal water pump (Figure 3-10). Make-up water is maintained by a float valve in the water tank.

During the freeze cycle, the liquid valve (1) is open and allows refrigerant to flow (by gravity) into the liquid header. From the header, it enters the evaporator plates circuiting where this liquid refrigerant boils and absorbs heat from the water flowing over the outside surface of the plates. Once reaching the top of the plates, the refrigerant is a mixture of gas and liquid. It then flows out the top of the unit, past the suction valve (5) into the wet suction line. The refrigerant then flows to the elevated surge drum. The surge drum will separate large refrigerant droplets from the gas. The dry suction gas then flows to the compressor. Here the cool gas is compressed to a high temperature, high pressure gas which discharges through the oil separator and into the condenser. In the condenser, heat

is removed and the gas is condensed to a high temperature, high pressure liquid. The high pressure liquid drains to the high pressure receiver (not shown). The liquid is then fed back into the liquid line. From here, flow is allowed past a high pressure liquid solenoid (receiving signals from a level monitor in the surge drum) and hand expansion valve, then into the low pressure elevated surge drum.

The freeze cycle is completed by action of the programmable controller in the Master Panel. This will initiate a defrost or harvest cycle. There are several preset options available that control the various aspects of the defrost cycle, refer to Section 6 for a complete description of these options. During the defrost cycle, the liquid valve (1) and the suction valve (5) will close. Warm defrost gas from the compressor flows through the hot gas strainer (11) and hot gas regulator (10), then through the now open hot gas valve (7) and is discharged into the refrigerant header and then into the plates. As this happens, the discharge gas begins to condense in the plates thus releasing heat and causing the plates to slightly warm. This results in thawing a thin layer of ice at the surface of the evaporator plate thus breaking the bond between the stainless steel plate and the ice sheet. The remaining ice then drops onto the ice slide for discharging. The remaining hot gas and condensed liquid then flows out the top of the plates and up to the closed suction valve. It is then metered through the suction bypass valve and into the main suction line. Once the defrost cycle is complete, the freeze cycle starts once again and this process repeats until the system is stopped.

If thicker or thinner ice is desired, the Cycle Time must be adjusted on the Master Panel interface. The defrost time is to be set for the time required to discharge all the ice plus 20 seconds longer (usually 60 seconds to 140 seconds) depending on water pump operation.

<b>! CAUTION !</b>
<b>Make sure all the ice clears the evaporator plates with at least 20 seconds to spare before the next freeze period begins. This is to prevent refreezing.</b>
<b>! CAUTION !</b>

## Chapter 5: Start-Up and Operation

<b>! WARNING !</b>
<b>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 Turbo Refrigerating® machine.</b>
<b>! WARNING !</b>

### 5.1: Refrigeration System Review

The MHG-A FL Modular units were designed for R717 ammonia refrigerant. Please refer to your equipment purchase to verify which refrigerant is applicable to your units.

Following the piping schematic (Figure 3-6, and 3-8), you will see that during the machine's freeze cycle, the compressor (20) discharge gas goes through the oil separator (21) to remove any oil present in the discharge gas and return the oil to the compressor crankcase. It is then discharged into the condenser (23) and condensed into a liquid by the removal of heat with water or air (depending on the type of condenser). The liquid then drains into the receiver (24). Liquid from the receiver flows through the high pressure liquid solenoid (which is controlled by a level controller) and hand expansion valve, and then into the surge drum. The liquid is then allowed to flow into the evaporator plates through the liquid valve. The refrigerant floods the evaporator. The heat contained in the water passes through the wall of the plates, lowering the temperature of the water causing it to freeze and form a sheet of ice that adheres to the outside of plates. Since the purest water freezes first, the circulating water continues to wash the dissolved solids down into the sump area of the water tank. The blow down valve helps to rid the water tank of increased dissolved solids by flushing them out the overflow during water pump operation.

The wet suction gas leaves the plates and passes through the suction valve (5). From there the wet suction gas travels up into the refrigerant main suction line back to the wet suction connection on the elevated surge drum. There liquid droplets are removed, and allowing dry gas to enter the dry suction side of the compressor (20). The suction gas is then compressed and discharged once again, completing the cycle. As ice continues to form on the plates, the suction pressure slowly decreases. The freeze cycle concludes when the programmable controller signals the module to begin the harvest sequence.

Note: Freezing time will vary, depending on make-up water temperature and thickness of ice produced. The cycle time should be set (via the operator interface) to provide the correct time to produce ice at the required thickness under the current operating conditions.

During the defrost cycle, the hot gas valve (7) opens. The compressor unloads (when required), allowing the warm high pressure gas from the compressor to enter the evaporator plates. As the plates warm up to slightly above freezing (approximately 40 °F / 5 °C), the ice releases and falls down onto the ice slide and discharges out. Harvesting requires about 60-140 seconds, but can vary depending on ice thickness, suction pressure, discharge pressure, water pump operation and distance from the compressor to the evaporator.

**! IMPORTANT !**

**It is a good idea and will be profitable for you to observe and become familiar with the proper operating characteristics of your Vogt-Ice<sup>®</sup> machine. It will help you to recognize and correct minor irregularities as they occur in order to help prevent major problems.  
“An ounce of prevention is worth a pound of cure.”**

**! IMPORTANT !**

**! 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 Turbo Refrigerating<sup>®</sup> machine.**

**! WARNING !**

## 5.2: Refrigerant Charge

Prior to charging the machine/system with the proper refrigerant, make sure the system is leak tight and free of non-condensable gas or other contaminants. Make sure it is from a reputable supplier who can furnish quality refrigerant.

The refrigerant charge for each module is approximately 135 pounds of R717. Consult factory for total system charges.

Special precautions to be observed when charging refrigeration systems. Only technically qualified persons, experienced and knowledgeable in the handling 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.

Follow these instructions with caution:

### Charging the Receiver

Using a refrigerant approved charging hose, connect one end to the charging valve on the high pressure receiver. Connect the other end of the charging hose to the refrigerant bottle. It is best to have a gage in this line to indicate pressure. Open the charging valve and the fill valve from the bottle (electric band heater around the refrigerant bottle will aid in charging in this method. While observing the level indicator on the high pressure receiver, fill the receiver to the proper volume. Make sure the charging valve is closed and the cylinder valve is closed before attempting to disconnect the hose. Use caution when disconnecting the charging hose, it will contain liquid refrigerant. Adhere to local, state, and federal codes when handling refrigerant.

### Charging into the Low Side

The machine may also be charged from refrigerant cylinders into the surge drum of the circuit. To accomplish this, the compressor will have to operate to lower the pressure in the surge drum. Again, make sure all the necessary valves are opened for operation and the compressor crankcase heater has been energized for a minimum of four (4) hours.

Follow these instructions with caution:

Using an approved for refrigerant charging hose, connect one end to the gauge valve (4) located on the surge drum. Lay a full cylinder of refrigerant horizontally with the cylinder valve outlet pointing up to withdraw liquid and the bottom end raised about 2" higher than the top end. Connect the other end of the charging hose to the cylinder valve. It is recommended that a gage be attached to this line to indicate cylinder pressure. Close the liquid line king valve (27). Open charging valve and carefully purge air from the charging hose. Open the cylinder valve slowly, checking for leaks in the line and allow the suction pressure to build up to approximately 40 psig and check again for leaks in the system.

This process assumes the compressor rotation has been checked and the crankcase heater has had 4 hours to warm the compressor oil. As the compressor may or may not have been supplied by Vogt, follow your compressor manufacturers/suppliers instructions for proper operation of your compressor.

As the pressure continues to rise in the evaporator, start the compressor and lower the pressure in the surge drum. This will also result in some refrigerant being pumped to the high pressure receiver. Make sure water is circulating through the condenser/fans are running and water distribution pan has water flowing through it.

If a refrigeration system is being charged from refrigerant cylinders, disconnect each cylinder when empty or when the system is fully charged. A gage 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 20 pounds or less and there is no frost on the cylinder. Close the refrigerant charging valve and cylinder valve before disconnecting the hose from the cylinder.

**! CAUTION !**

**Immediately close system charging valve at commencement of defrost or thawing cycle if refrigerant cylinder is connected. Never leave a refrigerant cylinder connected to 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 !**

Transferring refrigerant from a refrigeration system into a cylinder can be very dangerous and is not recommended.

As the machine is being charged, continually observe the following operating characteristics:

Discharge pressure - 200 psi to 230 psi maximum

Compressor oil pressure - Mycom W-Series, 18-27 psi, Vilter 450-Series, 35-50 psi.

Other models will vary (check manufacturer's specifications).

Liquid level in receiver

### Compressor oil level

While charging the machine, the low pressure switch will stop operation of the compressor at the set point pressure. The switch will automatically reset at the differential pressure at which time you can restart the machine (some low pressure switches may be manual reset). It is best to use warm water in the tank and open the tank drain valve somewhat to allow cold water to exit and warm water to enter continually. The idea is to prevent ice from freezing on the plates as much as possible while charging. It may be necessary to initiate a short harvest cycle to dispel any ice made.

To initiate a harvest cycle, close the charging valve and press the mode switch on the Module 4 times within 3 seconds (or use the operator interface at the Master Panel) while the compressor is running. This will initiate a harvest and another freeze cycle will start immediately following to continue the charging procedure. Be sure to close the cylinder shut off valve during the harvest period and open it once the machine goes back into the freeze cycle. When the liquid level in the receiver is near the pump down level and the freezer section is down to 15 psi suction with little or no frost on the surge drum shell, you can stop the charging procedure and disconnect the cylinder. Make sure the charging valve is closed and the cylinder valve is closed before attempting to disconnect the cylinder.

When charging is complete, stop the machine, disconnect and lockout the power. Open liquid line king valve on the receiver and you will hear liquid refrigerant flowing through to the liquid solenoid valve. Turn main power disconnect to the on position and the machine is ready for start-up and ice production.

## 5.3: Module Start-up

<b>! CAUTION !</b>
<b>The crankcase heater should be energized for a MINIMUM of 4 hours and the crankcase must be free of liquid before attempting to operate the compressor.</b>
<b>! CAUTION !</b>

Starting the machine in defrost mode:

(NOTE: machine will always start in the harvest mode when started)

Make sure the crankcase oil temperature is approximately 100 °F and there is no liquid refrigerant in the crankcase.

Set each module to the Auto mode via the Mode Switch or use operator interface at the Master Panel.

Make sure each water tank has sufficient water level to satisfy the water pump. If need be, you can turn the water pump to manual on via the operator interface to check.

Push the MCS button to “ON” via the operator interface at the Master Panel.

At the termination of the harvest (defrost) period, the machine will begin the freeze period.

Observe the oil pressure, the oil level, the discharge pressure and listen for any unusual sounds. The compressor should start unloaded and automatically load after several seconds of operation.

Set the defrost gas pressure regulator. See “Defrost Gas Regulator” on Section 5.5 for instructions.

Be sure to observe a minimum of four (4) cycles of ice production to confirm the satisfactory operation of the machine.

Complete the remaining part of the “Warranty Registration/Start-Up Report” and return it to the VOGT ICE®, LLC.

<b>! WARNING !</b>
<b>Only service personnel experienced and certified in refrigeration should be allowed to install or work on this Turbo Refrigerating® machine.</b>
<b>! WARNING !</b>

## 5.4: Hand Expansion Valve

Refrigerant feed to the surge drum is accomplished by setting a hand expansion valve. This valve allows meters refrigerant in conjunction with the high pressure liquid solenoid. The high pressure liquid solenoid is controlled by the refrigerant level controller. The controller should be set for approximately 20%. The hand expansion valve should be set so the solenoid is on about 50% of the time during machine operation. Fine tuning is needed beyond this to prevent unwanted rises in suction pressure.

## 5.5: Hot Gas Regulator and Suction By-pass Valve.

The following is the procedure for hot gas regulator valve adjustment. On single section Modules with dedicated compressor systems, the compressor must unload by 50% or greater during the harvest or a hot gas bypass must be installed to keep the compressor from shutting down on low pressure during harvest.

1. Install gauge and gauge valve in gauge port of regulator.
2. Pressure Regulators usually have two stems, one for manual opening of the valve, and one for adjusting the regulated pressure. Put the manual stem in the automatic position.
3. Start the machine and initiate a harvest.
4. Adjust the hot gas regulator to build pressure to 85-95 psig (1 turn is approximately 13 psig).
5. Adjust the suction valve by-pass (5) to allow a small amount of flow through the suction line. Open until ice release time is satisfactory. Note: opening this valve too far will lower the system capacity.

## 5.6: Module Shut-down

<b>! CAUTION !</b>
<b>The red “E-Stop” button should only be used for emergency shutdown. For normal shutdown use the Master switch on the operator interface.</b>
<b>! CAUTION !</b>

Set the “Master” switch on the operator interface to the “Off” position. Do not use the machine disconnect to stop the machine. If the disconnect is used the crankcase heater will be de-energized and liquid refrigerant will migrate to the compressor.

If in a freeze mode, the machine will continue to run.

At the completion of the freeze cycle the machine will harvest and stop. The completion of a cycle ensures that all ice is removed from the plates to prevent refreeze when the machine is restarted.

If in a defrost, the machine will complete the defrost and stop.

## 5.7: Module Operating 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 Master switch on the interface to start and stop machine.

By turning the Master switch “Off, the machine will stop after the next harvest cycle.

Do not use the machine disconnect for normal shutdown of the machine.

Throw the “Disconnect” 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 disconnect is thrown.

The Mode Switch push button at any Module can be used to initiate a harvest cycle by pressing it 3 times within 3 seconds. When it is pushed during a freeze cycle, it will immediately initiate a harvest cycle and then turn off. If pushed 4 times within 3 seconds, it will immediately initiate a harvest cycle and then go back to the Auto mode.

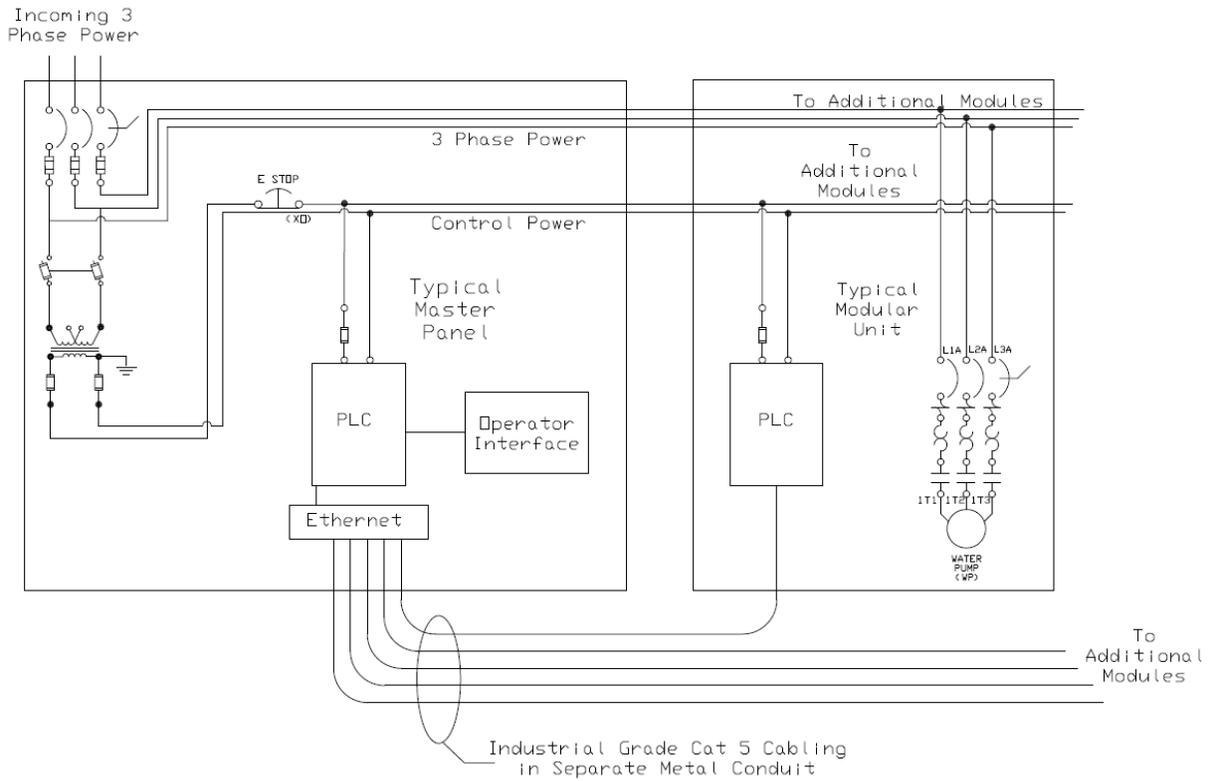
## Chapter 6: Electrical Controls-Description

### 6.1: General

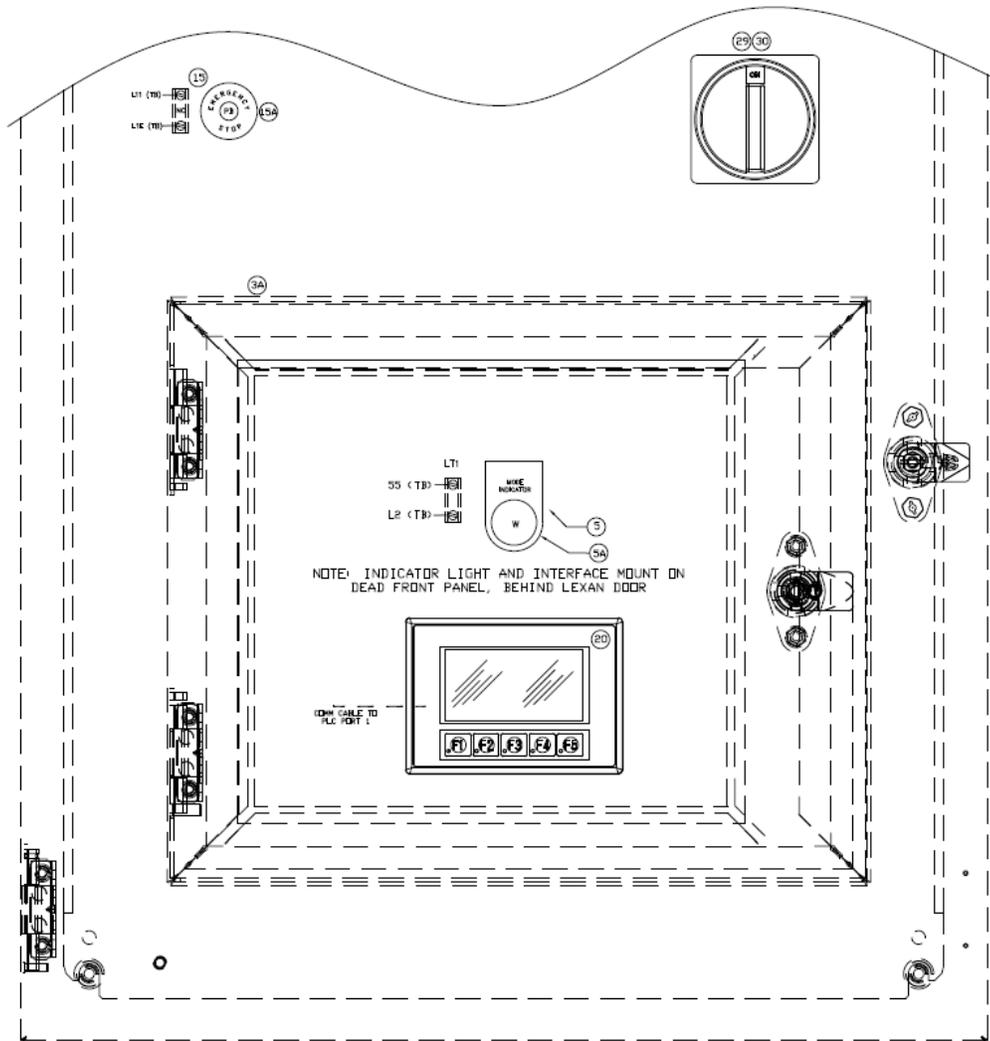
The control system used in the Modular Icemaker(s) is a multi-part system, a Master Panel and its Ice making Modules. Each Master Panel can control up to 18 modules (varies with different PLC configurations). The Master Panel communicates with each Modular Icemaker via an Ethernet connection. This allows 2 way communications with each module, minimizing the control wiring between panels, but maximizing control, information exchange, and future expansion of Ice making Modules.

The Master Panel consists of a Programmable Logic Controller (PLC), a group of control relays, and an Ethernet switch. The Master Panel will signal when refrigeration is needed, sequence the timing of the ice harvesting in each module, and also signal when to run the screw conveyor to convey ice away from the ice making Modules. The Master Panel is also provided with an operator interface that allows control of each ice making module, various set points including refrigeration cycle time, defrost time, pump control, screw conveyor runtime and many more.

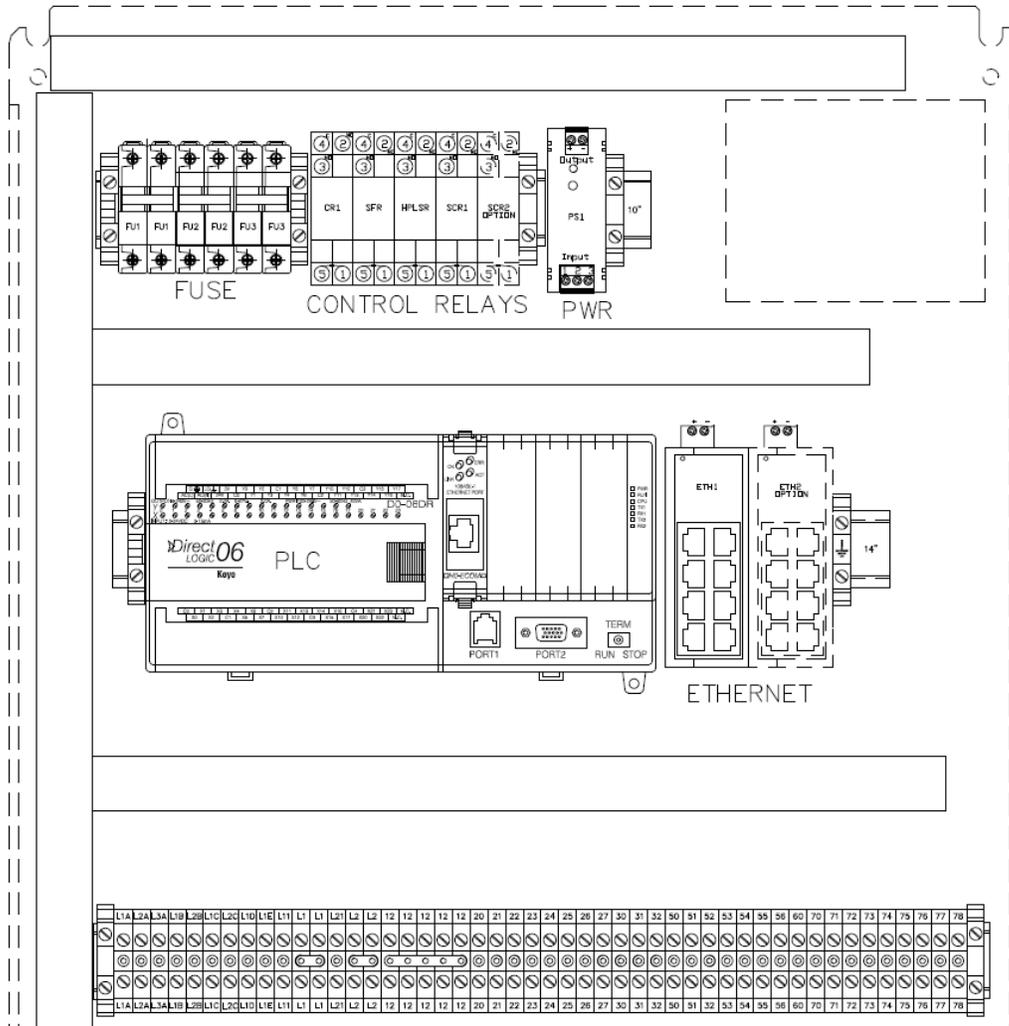
Each Module's control panel is equipped with a PLC, a motor starter for the water pump, and small relays for control of the liquid and suction valves. On the control panel door for each module is a pushbutton and an indicator light. The pushbutton is used to select the STOP, OFF, AUTO, or MANUAL DEFROST modes. The indicator light will respond to pushbutton control and indicate the mode of operation selected. The indicator light will also indicate any failures of the module.



**Figure 6-1 Typical Master/Modular Set-Up**



**Figure 6-2 Exterior Master Panel View**



**Figure 6-3 Internal Master Panel View**

PLC	Programmable Logic Controller-controls the various relays in the panel and contains the program.
FUSE	Fuse-protects the control circuit inside the control panel
PS1	Power Supply for ETH1-provides 24VDC for the ETH1
ETH1	Ethernet Switch-used to connect the CAT5 wiring to each Modular ice maker
CR1	Control Relay 1-used to signal the ammonia pump or compressor high when to run.
SFR	Safety Failure Relay-energized anytime the Master panel fails or detects a failure in one of the Modules
HPLSR	High Pressure Liquid Solenoid Relay-this relay energizes any time the level switch in the surge detects a low level.
SCR1	Screw Conveyor 1 Relay-energizes to indicate when a customer supplied screw conveyor needs to run to carry ice away from any module.

**Table 6-1 Master Control Panel Components**

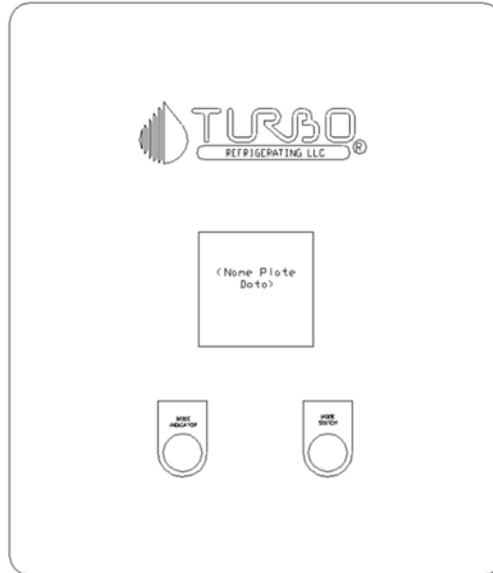


Figure 6-4 Exterior Module Panel View

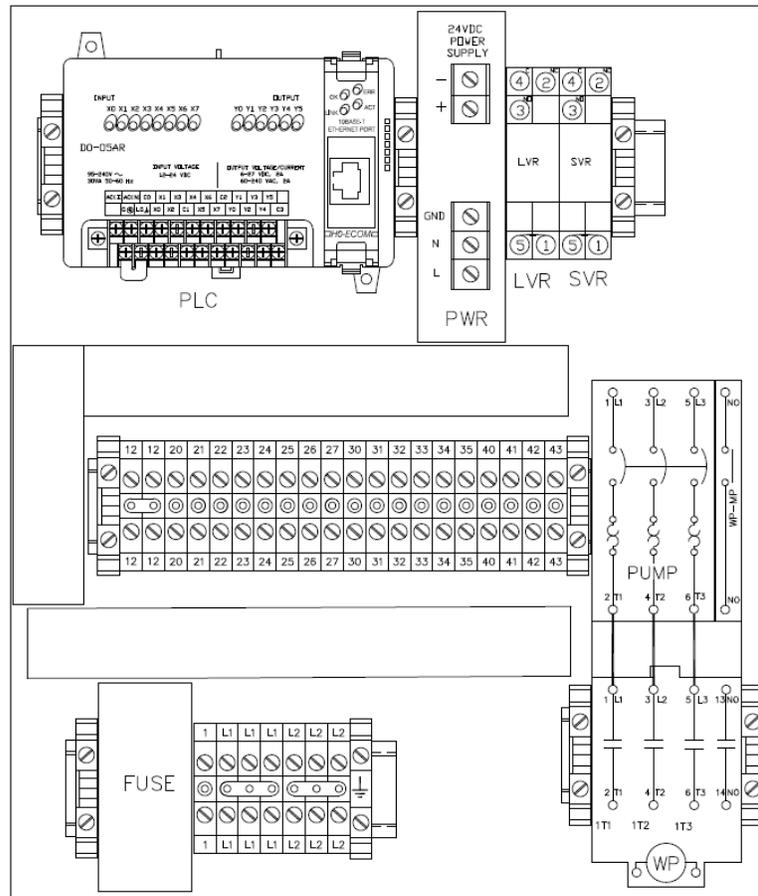


Figure 6-5 Interior Modular Panel View

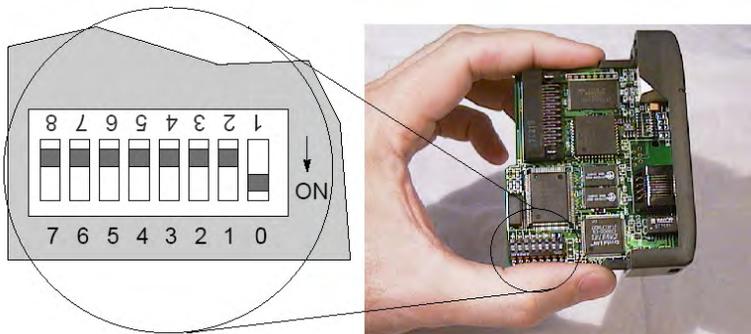
PLC	Programmable Logic Controller-controls the various valves and relays wired to the panel and contains the program.
FUSE	Fuse-protects the control circuit inside the control panel
LVR	Liquid Valve Relay-provides open and close control for motorized liquid valve.
SVR	Suction Valve Relay-provides open and close control for motorized suction valve.
PUMP	Water Pump Motor Starter-starts and provides overload protection for the water pump motor.

**Table 6-2 Module Control Panel Components**

## 6.2: Configuring a New System or Module

Both the Master Panel and any Modular Panel in your system will have a PLC in it. In order for these PLCs to communicate, they have an Ethernet card installed in an expansion slot (varies with PLC model). If your system has the standard factory PLC, these cards must be properly configured to allow communication between the various panels (if non-standard PLC is used, consult factory). Configuration is accomplished by the setting of DIP switches on the Ethernet card (labeled ECOM on the front of the card in your PLC). Following are the steps to configure your ECOM card:

1. Turn off all power to the control panels.
2. Locate the ECOM card in your PLC and disconnect the Ethernet cable from the port on the front.
3. Remove the ECOM card from the PLC by releasing the clips on top and bottom of the card and gently pulling the card out of the PLC.
4. Locate the DIP switches as shown in the photo below.



**Figure 6-6 DIP Switch Setting**

5. Using the table below, set the DIP switches accordingly.
  - a. Master Panel must have the ID# settings shown (usually already set at the factory).
  - b. Do not use duplicate DIP switch settings on any 2 modules.
  - c. Harvest order of the Modules is determined by the ID# from lowest to highest.
  - d. ID#s need to be consecutive.
6. Re-install the ECOM card in the slot from which it was removed.
7. Re-attach the Ethernet cable.
8. Restore the power to the control panels.

DIP switch settings for ECOM									ID#
Switch-->	7	6	5	4	3	2	1	0	
Master Panel	On	Off	Off	On	On	On	On	On	31
Module (Slave) #1	On	Off	Off	Off	Off	Off	Off	On	1
Module (Slave) #2	On	Off	Off	Off	Off	Off	On	Off	2
Module (Slave) #3	On	Off	Off	Off	Off	Off	On	On	3
Module (Slave) #4	On	Off	Off	Off	Off	On	Off	Off	4
Module (Slave) #5	On	Off	Off	Off	Off	On	Off	On	5
Module (Slave) #6	On	Off	Off	Off	Off	On	On	Off	6
Module (Slave) #7	On	Off	Off	Off	Off	On	On	On	7
Module (Slave) #8	On	Off	Off	Off	On	Off	Off	Off	8
Module (Slave) #9	On	Off	Off	Off	On	Off	Off	On	9
Module (Slave) #10	On	Off	Off	Off	On	Off	On	Off	10
Module (Slave) #11	On	Off	Off	Off	On	Off	On	On	11
Module (Slave) #12	On	Off	Off	Off	On	On	Off	Off	12
Module (Slave) #13	On	Off	Off	Off	On	On	Off	On	13
Module (Slave) #14	On	Off	Off	Off	On	On	On	Off	14
Module (Slave) #15	On	Off	Off	Off	On	On	On	On	15
Module (Slave) #16	On	Off	Off	On	Off	Off	Off	Off	16
Module (Slave) #17	On	Off	Off	On	Off	Off	Off	On	17
Module (Slave) #18	On	Off	Off	On	Off	Off	On	Off	18
Module (Slave) #19	On	Off	Off	On	Off	Off	On	On	19
Module (Slave) #20	On	Off	Off	On	Off	On	Off	Off	20

**Table 6-3 DIP Switch Setting**

### 6.3: Modular Unit Operation

In the first part of this chapter, it was mentioned that the Modular unit control panel door has a pushbutton (Mode Switch) and an indicator light (Mode Indicator). The Mode Switch is wired to an input on the PLC. To change modes of a Modular unit using the Mode Switch, it is necessary to press the button a specified number of times within a certain time frame. The PLC is programmed to count the presses of the Mode Switch and then put the module into the desired mode. The Mode Switch only changes the mode for that module. The Mode Indicator will flash a designated number of times to acknowledge the selection immediately after the mode has been changed. The Mode Indicator will only flash the selected mode code one time. Below is a table that describes the modes available via the Mode Switch. Any other control changes must be completed via the operator interface on the Master Panel.

Mode Switch Presses	Mode Initiated	Mode Description
Press and hold for 3 seconds	Off	If the unit is already in an active ice making cycle, it will defrost after the full cycle and then turn off. If the unit is in a standby mode, it simply turns off.

2 times in 3 seconds	Auto	Sets the unit for continuous automatic operation.
3 times in 3 seconds	Manual Defrost then off	Causes the unit to begin a manual defrost. Once defrost is complete, that module will turn off.
4 times in 3 seconds	Manual Defrost then Auto	Causes the unit to begin a manual defrost. Once defrost is complete, that module will go to Auto.
5 times in 3 seconds	Instant Stop	Stops the Module instantly.

**Table 6-4 Functions of Mode Switch**

The Mode Indicator will indicate which mode has been selected and will also indicate failures. Failures will flash continuously until reset. Following is a table to decode the various indicator flashes that may be seen.

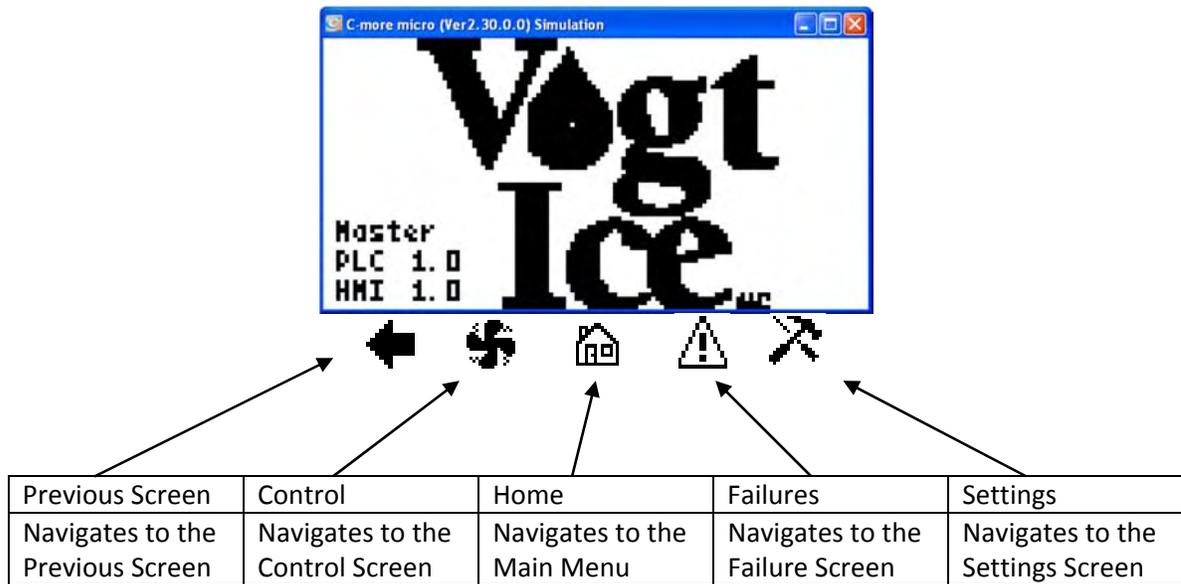
Mode Indicator Flashes	Description
One Flash	Module has shifted to the Off mode
Two Flashes	Module has shifted to the Auto mode
Three Flashes	Module has shifted to the Manual Defrost mode. Once defrost is complete, the module will turn off.
Four Flashes	Module has shifted to the Manual Defrost mode. Once defrost is complete, the module will go to the Auto mode.
One Flash every 5 seconds	Failure-Water Pump on this module has failed.
Two Flashes every 5 seconds	Failure-This Module has lost communication with the Master Panel.
Three Flashes every 5 seconds	Failure-A failure has been detected at the Master Panel.

**Table 6-5 Indicator Light Action**

Modes can also be changed for any module at the Master Panel via the operator interface. See the Master Panel Operation section of this chapter.

## 6.4: Master Panel Operation

The Master Panel is where the bulk of all control changes and timer presets are modified. The panel has been designed to allow expansion from 1 ice making module to 18 ice making modules (varies with PLC). The program in the PLC is designed to look for modules connected to the system and automatically adjust the timing of the defrost signal to each module. This helps to prevent overloading of any screw conveyors downstream of the modules. All control of the Modular Icemaker system is done via the Master Panel with the operator interface. This includes timer presets, water pump function, operating mode of each Module, current status of each Module. Factory presets can also be restored via the interface. The operator interface has five function buttons (depending on model) and several screens for the input of set points and timer presets. These screens are organized into groups. Below are the tables/figures below for a list of these groups and a description of what they control offered with our standard interface. Other PLC and interface models appear different, but offer similar function.



**Figure 6-7 Function Buttons on Interface**

Upon application of control power to the Master Panel, you will see a screen appear that shows the Vogt Ice logo. That screen also shows the version of program for the PLC and the Operator Interface. After a few seconds, the screen will change to the Main Menu.

Once the main menu appears, the system is ready to operate. The Main Menu has four choices available: Settings, Control, Failures, and Status.



**Figure 6-8 Interface Main Menu**

- Settings: The Settings Menu will present you with four more choices, Ice Maker, Advanced, Pumps, and Water Make-Up Settings.
- Control: The Control Menu will present you with four choices, MCS Screen, Module Control, Conveyor Purge, and Module Pump Control.
- Failures: The Failure Menu will present you with two choices, Present Failures, and Failure History.
- Status: The Status Menu will present you with four choices: Inputs, Outputs, Modules, Hour Meter.

Over the next few pages is menu flow table and definitions that help to define where various settings are located. Note the number in parenthesis and look to the table below for a definition of that item.

Note: a description is located in the next table for those items with ( )				
Main Menu 	Settings 	Ice Maker	Cycle Time (1)	
			Standard Defrost Time (2)	
			Manual Defrost Time (3)	
			Extended Defrost Time (4)	
			When to Extend Defrost (5)	
			Shut Off Liquid (6)	
			Hot Gas Main Valve Delay (7)	
		Advanced Settings (Password Protected-99)	Modules	Number of Modules (8)
				Number of Other Sections (9)
				Modules Begin At __ (10)
			Screw Conveyor	Screw Run Time (11)
				Screw Delay Time (12)
		Pumps	Restore Defaults (13)	
			Run Pump During Defrost (14)	
			Drying Time (15)	
			Stop Pump After Defrost Begins (16)	
			End of Defrost Rinse (17)	
		Water Make-Up (MCL Only)	Start at End of Defrost (18)	
			Anti-Slush On/Off (19)	
			Anti-Slush Stop Pump Set Point (20)	
			Anti-Slush Restart Pump Set Point (21)	
	Make Up Delay (22)			
	Make Up On-Time (23)			
	Make Up Off-Time (24)			
	Control 	MCS Screen	Make Up Cycle Count (25)	
			Master On/Off (26)	
			Module Control (27)	
		Module Control (27)	Quick Look (28)	
			Stop (29)	
			Off (30)	
			Auto (31)	
			Manual Defrost, then Off (32)	
		Manual Defrost, then Auto (33)		
		Conveyor Purge	Purge (34)	
	Module Pump Control	Manual Pump Control (35)		

	Failures 	Present Failure/Clear (36)	
		Failure History (37)	
Status 		Inputs (38)	
		Outputs (39)	
		Modules (40)	
		Hour Meter (41)	

**Table 6-6 Interface Menu Map**

Menu Item		Description
1	Cycle Time	Length of the entire cycle for any given Module. To make thicker ice, increase this value. Entered in minutes and seconds. (mm:ss)
2	Standard Defrost Time	Length of a normal defrost cycle entered in seconds.
3	Manual Defrost Time	Determines how long a manual defrost cycle will last. Entered in seconds.
4	Extended Defrost Time	Extended defrost will occur under two conditions: #1--Low Discharge Pressure, and #2—After XX number of complete cycles (Cycle Extend Count) to help clear any residual build up. This setting determines the length of the extended defrost. Entered in seconds.
5	When To Extend	Extended defrost will occur under two conditions: #1--Low Discharge Pressure, and #2—After XX number of complete cycles (Cycle Extend Count) to help clear any residual build up. This setting determines how many cycles of the Module must occur before the defrost is extended for one cycle. Entered as complete cycles.
6	Shut Off Liquid	Determines how long before defrost that the liquid feed valve should close for that module. Entered in seconds.
7	Hot Gas Main Valve Delay	The defrost valve used in the MHG series is a two port valve. This setting determines how long the main port is delayed when defrost begins. Entered is seconds.
8	Number of Modules	The number of Modules connected to the Master Panel. This is a password protected setting
9	Number of Other Sections	How many other sections from other TIG/TIGAR/CLINE machines are sequenced with the Modules. This is a password protected setting
10	Modules Begin at	Enter the number in the sequence the first Module is located starting with zero. This is a password protected setting
11	Screw Run Time	Determines how long the screw conveyor continues to run after defrost is complete. Entered in seconds. This is a password protected setting
12	Screw Delay Time	Determines how long the screw conveyor start is delayed after the start of defrost. This is a password protected setting

13	Restore Default	Restore factory default times. These are safe settings and may not provide optimal performance for your equipment. This is a password protected setting
14	Run Pump During Defrost	MHG option. Allows the pump to run during defrost, which provides the best/shortest defrost time.
15	Drying Time	If the water pump is set to stop during defrost, this determines how long before defrost begins that the pump will stop. Entered in seconds.
16	Stop Pump After Defrost Begins	This allows the pump to run for the first portion of the defrost cycle and then stop. Can minimize water carryover into the screw conveyor, but will require a longer defrost time. Entered in seconds.
17	End of Defrost Rinse	If the pump is stopped during defrost, this will allow it to restart before the end of defrost to rinse the plates. Entered in seconds.
18	Start at End of defrost	If the pump is stopped for defrost, this tells the pump to restart at the conclusion of defrost.
19	Ant-Slush On/Off	Activation switch for the Anti-Slush feature of the MCL units. Stops the pump in the early stages of the freeze cycle to prevent slushing, then restarts its. MCL Only
20	Anti-Slush Stop Pump Set Point	The number of seconds into the freeze cycle the pump will stop for the Anti-Slush feature. MCL only. Entered in seconds.
21	Anti-Slush Restart Pump Set Point	The number of seconds until restart of the pump for the Anti-Slush feature. MCL only. Entered in seconds.
22	Make-Up Delay	Delay time until the tank water solenoid re-opens during the freeze cycle. Entered in seconds. MCL only.
23	Make-Up On Time	Amount of time the tank water solenoid is open during the freeze cycle. Entered in seconds. MCL only.
24	Make-Up Off Time	Time delay between multiple open cycles for the tank water solenoid. Entered in seconds. MCL only.
25	Make-Up Cycle Count	Number of repetitions the tank water solenoid will go through during the freeze cycle. MCL only.
26	Master On/Off	Controls the entire Modular Ice making System. "On" will the system to run if conditions permit. "Off" will stop the modules or prevent the unit from starting.
27	Module Control	Changes the screen to individual module control
28	Quick Look	Allows seeing in a single view 10 modules online and Auto status.
29	Stop	Instantly Stops the selected Module regardless of the freeze or defrost cycle. This is the same function that occurs if the Mode Switch on the Module is pushed in for 5 times in 3 seconds as described earlier in this chapter.
30	Off	Prevents the Module indicated from starting. If the indicated module is already in an active ice making cycle, it will complete its cycle and then stop. This is the same function that occurs if the Mode Switch on the Module is pushed in for 3 seconds as described earlier in this chapter.

31	Auto	Allow the Module indicated to start as needed by the Master Panel. This is the same function that occurs if the Mode Switch on the Module is pushed 2 times within 3 seconds as described earlier in this chapter.
32	Manual Defrost, then Off	Begins a manual defrost cycle for the indicated module. Once complete, that Module will also turn Off.
33	Manual Defrost, then Auto	Begins a manual defrost cycle for the indicated module. Once complete, that Module will also turn to Auto.
34	Conveyor Purge	Causes the screw conveyor relay to energize for purging of the screw conveyor downstream of the Modules.
35	Module Pump Control	Allow the water pump for individual modules to be run in automatic or manual.
36	Clear (Present Failure)	This resets the failure indicated on the operator interface. Personnel authorized and trained in operation of the rake should only do this.
37	History (Failure)	Displays the last three failures.
38	Inputs	Displays the status of the inputs wired to the PLC in the Master Panel.
39	Outputs	Displays the status of the outputs wired to the PLC in the Master Panel.
40	Modules	Displays the status of the Modules connected to the Master Panel.
41	Hour Meter	Displays the run hours of each Module connected to the Master Panel.
99	Password Protection	Contact the factory for assistance with password protected items.

**Table 6-7 Interface Menu Definitions**

## 6.5: Operator Interface Item Descriptions

Review the items on the Settings Menu screens (items 1 through 25 shown above) and make any adjustments you feel necessary. The PLC has been programmed with factory defaults that should work as a starting point in most circumstances. To access the settings, go to the Main Menu, select Settings, and then select Icemaker. From that point, scroll through the settings one at a time and make any necessary changes.(NOTE: all previous settings will be lost if you restore to factory defaults).

## 6.6: Starting the Modular System

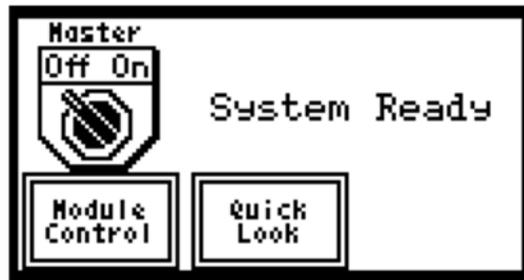


Figure 6-9 Interface MCS Screen

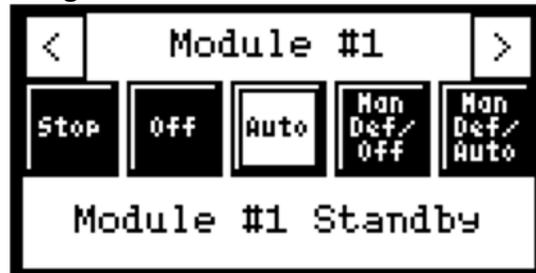


Figure 6-10 Interface Module Control

To start the system, any modules you want to operate need to be put in the Auto mode via the pushbutton on the Modular unit, or with the operator interface as shown by pressing the Auto button. Once the desired modules are in the Auto mode, go to the MCS screen and press the Master button. The PLC will sequentially start each Module in a harvest cycle after which it will go into a freezing cycle. The modules start sequentially in the order determined by the ID switches in the “Configuring a New System or Module” section. The Modules will now continuously freeze/harvest until the Master switch is turned off, the Bin Level Switch (see wiring diagram) signals the system to stop, or the individual module is turned off via the interface on the Master Panel or the Mode Switch on the Module. Once Off is selected, the Module(s) will continue to run until it(s) freezing cycle and harvest cycle is complete. If it is necessary to stop the machine immediately, push the red emergency stop button (see wiring diagram).

## Chapter 7: Maintenance

### 7.1: Preventive Maintenance

A careful inspection of the Vogt Ice machines refrigeration system for leaks and correct operational functions at time of installation will start its long satisfactory life of service. In order to insure this degree of dependability, a systematic maintenance program is recommended. Therefore, the following schedule is suggested as a minimum.

- A. Daily
  - 1) Check operating pressures (suction, discharge, oil).
  - 2) Check ice quality.
  - 3) Check "ice out" time (maintain 15 seconds of continued harvest after last ice is out).
  - 4) Check compressor oil level.
  - 5) Check refrigerant operation level.
  - 6) Check frost pattern on freezer plates and oil trap.
  - 7) Check make-up water float valve adjustment.
- B. Weekly (in addition to daily checks)
  - 1) Check for leaks after 400 hours or four weeks of operation
- C. Monthly (in addition to weekly checks)
  - 1) Check calibration and operation of all controls (high and low pressure switches, oil pressure switch, etc.)
  - 2) Check cooling tower spray nozzles and pump suction screen for scaling and algae (consult water treatment suppliers for corrective measures).
  - 3) Check water distribution and freezer plates for scale accumulation.
  - 4) Check water tank for solids to be removed.
  - 5) Check all motor drive units (compressor, pump motors, cooling tower fan, and pump, etc.) for abnormal noise and/or vibrations.
  - 6) Check one complete freeze/thaw cycle, record data and compare with production check of Registration/Start-up Report.
- D. Yearly (in addition to weekly and monthly)
  - 1) Check entire system for leaks.
  - 2) Drain water from condenser and cooling tower and check condenser tubes. Check closely for damage by corrosion or scale.
  - 3) Remove all rust from all equipment, clean, and paint.
  - 4) Check all motors for shaft wear and end play.
  - 5) Check operation and general condition of all electrical controls, relays, motor starters, and solenoid valves.
  - 6) Check freezing time, ice release time, and ice out time.
  - 7) Lubricate compressor motor bearings.

## 7.2: Preventative Maintenance Form

This form can be removed and duplicated for record keeping.

Date: \_\_\_\_\_ Model #: \_\_\_\_\_ Serial #: \_\_\_\_\_

The following service performed and checked:

- Hour meter reading \_\_\_\_\_, Ambient temperature (inside) \_\_\_\_\_ °F
- Make-Up water float valve adjusted properly
- Water distribution clean and in place
- All drains freely draining
- Cleaned and flushed water tank
- Compressor oil changed
- Cleaned and inspected inside compressor crankcase
- Changed compressor oil filter
- Checked/adjusted compressor belt tension or alignment
- Lubricate compressor motor bearings
- Leak check entire system
- Check liquid refrigerant level in receiver
- Drained oil from oil trap
- Compressor crankcase heater working
- Compressor net oil pressure (gage reading less suction)

Compressor Motor amps: \_\_\_\_\_ Discharge Pressure \_\_\_\_\_ Defrost Pressure \_\_\_\_\_

Module 1

Water Pump Amps \_\_\_\_\_  
Suction Pressure (end of freeze) \_\_\_\_\_  
Defrost Bypass Valve Turns Open \_\_\_\_\_  
Full Sheets of Ice During Freeze \_\_\_\_\_ Ice Thickness \_\_\_\_\_

Module 2

Water Pump Amps \_\_\_\_\_  
Suction Pressure (end of freeze) \_\_\_\_\_  
Defrost Bypass Valve Turns Open \_\_\_\_\_  
Full Sheets of Ice During Freeze \_\_\_\_\_ Ice Thickness \_\_\_\_\_

Repeat for all modules

Tower fan cycles \_\_\_ On \_\_\_ Off

Comments: \_\_\_\_\_

Name: \_\_\_\_\_

## 7.3: General Cleaning

The ice-making section of the Vogt-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 water pump is used to circulate the cleaner through the system by manually operating it with the operator interface located at the Master Panel. Set the water pump to “Manual” operation from the “Module Pump Control” screen to start the water pump and to “Auto” when you are done to stop the water pump. For complete instructions, refer to the “Cleaning Procedure” attached to the equipment and duplicated here.

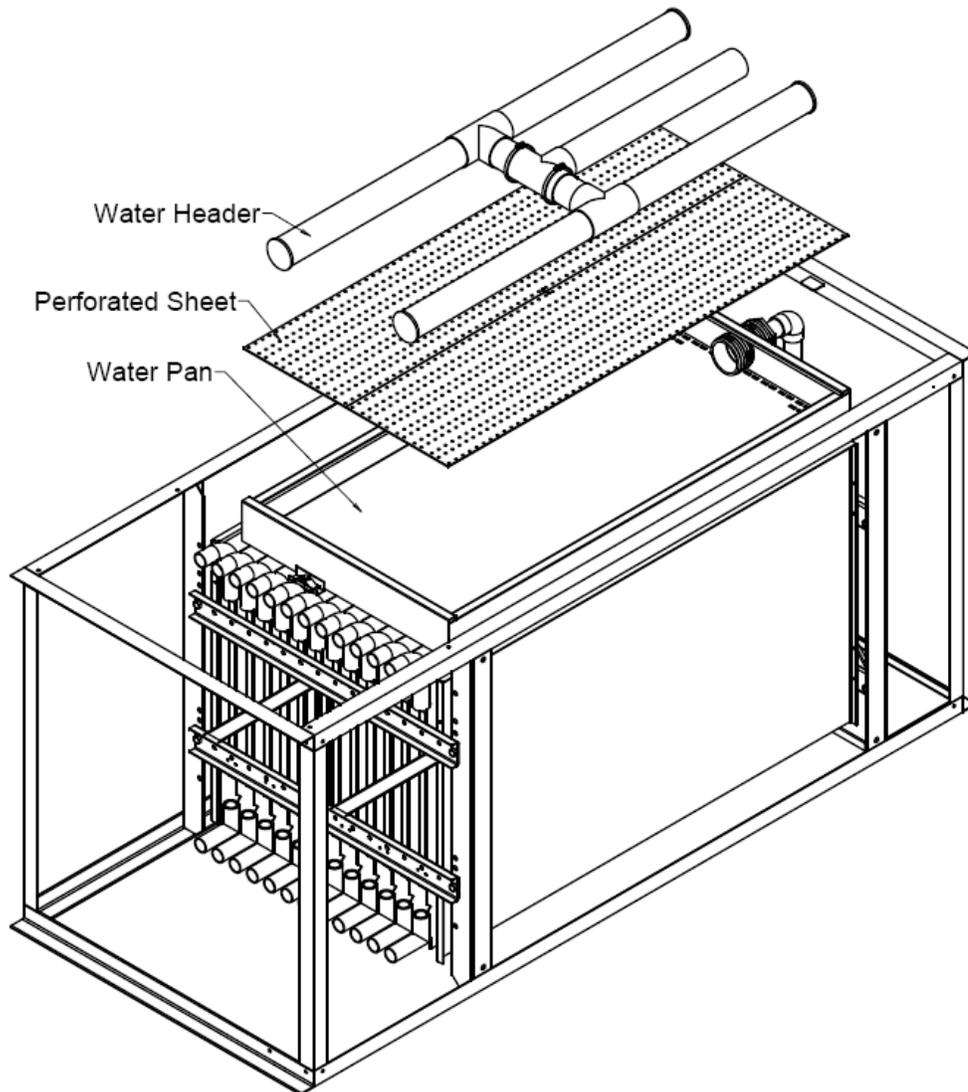
### 7.3.1: Procedure

1. Before cleaning any Tube-Ice machine make sure the crankcase heater is working properly. When the crankcase heater is not working there is a possibility for refrigerant evaporated by warm circulating water to migrate to the compressor during the cleaning operation
2. Turn the Module to “Off” with the Operator Interface. If the machine is running, it will shut down on completion of the next ice harvest period.
3. Remove ice from storage area or cover ice discharge opening to prevent water from splashing out and contaminating stored ice.
4. Shut off water supply and drain water tank by removing the over flow tube. Remove any loose sediment from tank.
5. Return the overflow piping and fill water tank (approximately 25 gallons) with warm water.
6. Add 72 ounces (8 ounces per 3 gallons) of Calgon™ ice machine cleaner (a food grade liquid phosphoric acid) to water tank during the refill period.
7. Inspect the water pan.
8. Set the water pump to “Manual” operation from the “Module Pump Control” screen to start the water pump.
9. Circulate cleaning solution until deposits are dissolved or solution is neutralized. Repeat cleaning if necessary.
10. To stop the water pump, set the water pump to “Auto” operation from the “Module Pump Control” screen. Then drain and flush water tank with fresh water. Open water supply to machine.
11. Drain and flush tank and then refill with fresh water.
12. Clean inside of ice storage area and remove any solution that entered during the cleaning process. Remove cover if one was installed over opening into storage area.
13. Start ice making cycle by selecting “Auto” setting from the “Module Control” screen and then selecting “On” from the MCS screen.

### 7.3.2: Water Distribution System

The water distribution pan and perforated sheet is located under the top panel at the top of the plates. This pan may require occasional or periodic cleaning to remove solids and foreign particles accumulated from the make-up water. The frequency of this cleaning operation will depend on the characteristics of the water supply. The cleaning operation is needed when the distribution pan holes become partially clogged and disrupt normal water flow onto the evaporator plates. See Figure 7-1 Water Distribution System. To clean water pan, stop the unit and remove the water header on top of the plates. Note the orientation of the PVC perforated sheet and match mark it

prior to removal. Use a wet/dry shop vacuum to remove any loose debris in the pan. If scale is present in the pan, it may become necessary to remove the pan for cleaning. NOTE that while removing the pan is fairly simple, re-installing the pan can be difficult due to plate/pan alignment. Improper installation of the water pan will result in poor water distribution and freeze up problems. The distribution pan can be soaked in ice machine cleaner to remove mineral buildup. Rinse distribution pan thoroughly before reinstalling.



**Figure 7-1 Water Distribution System**

### **7.3.3: Water Tank.**

The production of opaque ice can indicate that the water in the water tank contains a concentrated amount of solids or salts. Remove cover plate. Remove the overflow pipe. Clean tank thoroughly by flushing out with a hose and scrubbing with a stiff brush. After cleaning, close drain and fill the water tank with fresh water. When restarting the machine, be sure that the water pump is circulating water. It is possible that air may have collected in the pump impeller housing and the pump may have to be stopped and started several times to expel the air.

<b>! CAUTION !</b>
<b>The water distribution system is critical to proper machine operation. Failure to maintain and clean water distribution components can result in improper machine operation and compressor failure.</b>
<b>! CAUTION !</b>

<b>! DANGER !</b>
<b>Follow all lock-out and tag-out procedures before servicing any electrical equipment.</b>
<b>! DANGER !</b>

## 7.4: Other Maintenance Operations

The following sections outline some general guidelines for service of auxiliary equipment. Always follow the instructions provided by equipment manufacturers when performing service operations or scheduled maintenance.

### 7.4.1: Water Cooled Condenser Cleaning

As water evaporates from a cooling tower, the solid impurities remain and must be flushed from the system to prevent a scale build-up in the condenser and cooling tower. This can be accomplished by a continuous bleed off valve located in the pump discharge line. The valve should be adjusted to bleed off an equal amount of water that is evaporated. If water hardness is very high, a higher bleed off rate or chemical treatment may be required. Consult your local water treatment company for recommendations. If after a period of time, scale has formed inside the tubes, mechanical cleaning may be necessary. See "Servicing Section--Condenser".

### 7.4.2: Cooling Tower/Evaporative Condenser

1. Bleed off valve. The bleed off valve should be checked monthly to assure that is not blocked and that water is flowing as required. If the unit is controlled by a water treatment system, the bleed off valve may not be required.
2. Strainer. The pan or sump strainer is located in the bottom of the sump at the suction connection to the pump. The strainer should be inspected monthly and kept clean. Do not operate the unit without the strainer in place.
3. Make-up water float valve. This valve should be checked monthly for proper operation and adjustment. It should be adjusted to maintain a water level below the overflow and high enough to prevent the pump from cavitating when the system is in operation.
4. Spray nozzles. The spray nozzles should be checked monthly to make sure none are restricted and the spray pattern is complete and even.
5. Pump motor and fan motor. The motors should be checked and/or lubricated every six months according to the motor manufacturer's recommendations.

6. Fan bearings. The fan bearings should be lubricated every six months. Make sure the proper grade of grease is used (normally conforms to NLCI-Grade 2) and it is best to use a hand grease gun.
7. Fan belts. The fan belt tension should be checked weekly for the first two weeks of operation, then monthly during continuous use. The best tension for a V-belt is the lowest tension at which the belt will not slip under its full load. Never use dressing on V-belts. Keep belts and grooves clean and free of oil, grease, and foreign material. Clean with non-flammable, non-toxic degreasing agent or commercial detergent and water.

**! CAUTION !**

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

**! CAUTION !**

Maintenance Operation	Start-Up	Monthly	Six Months	Shutdown
Clean debris from unit	X	X		X
Clean strainer and flush sump	X	X		X
Check fan and pump rotation	X			
Clean spray nozzles	X	X		
Check belt tension	X	X		
Check for noise/vibration	X	X		
Check/adjust make-up water valve	X	X		
Check/adjust bleed rate	X	X		
Check/lubricate fan bearings	X		X	
Lubricate motor base adj. Screw	X		X	X
Drain sump and piping				X

**Table 7-1 Cooling Tower Maintenance Schedule**

### 7.4.3: Compressor

This section is only a guide; consult the compressor manual for manufacturers recommended maintenance.

In starting and charging the unit, the oil sight glass should be continually checked to make sure an adequate oil level is maintained. The oil level should be 1/4-3/4 of the sight glass. If the oil level drops below 1/4 of the glass, add refrigeration oil as per the compressor manufacturer recommendations. Never allow the oil level to be out of sight, above or below the sight glass when the compressor is operating.

**! CAUTION !**

**The crankcase heater should be energized for a minimum of four hours and the oil temperature should be 100°-110°F before attempting to start the compressor.**

**! CAUTION !**

<b>! DANGER !</b>
<b>Follow all lock-out and tag-out procedures before servicing any electrical equipment.</b>
<b>! DANGER !</b>

During operation, the specified net oil pressure should be maintained for proper lubrication and operation of the cylinder unloader mechanism.

Mycom N&W Series net oil pressure: 17-28 psig

Vilter 450 Series net oil pressure: 35-50 psig

Note: Net oil pressure is calculated by subtracting the compressor suction pressure from the oil pressure gage reading while the compressor is running.

Example:	Oil pressure gage reading:	65 psig
	Suction pressure gage reading:	40 psig
	Net Oil Pressure:	25 psig

The compressor oil should be changed at close intervals during initial break-in operation and up to the first 1000 hours (see Table 7-4 below).

Note: It is the owner's responsibility to make sure normal maintenance is initiated to insure that the compressor is not subjected to premature wear or failure due to neglect or lack of sufficient maintenance and care.

Maintenance Operation	Frequency				
	1st	2nd	3 <sup>rd</sup>	4th	Thereafter
Change oil	200 hr.	500 hr.	1500 hr.	4000 hr.	Every 4000 hrs.
Clean suction strainer cloth	200 hr.	500 hr.	Remove if clogging is minimal		

**Table 7-2 Suggested Compressor Oil Change Interval**

The above maintenance is only a guide. The compressor should be inspected anytime there is unusual noise, damage is suspected or the oil becomes discolored. The oil should be changed any time the compressor is opened. For specific recommendations and instructions, refer to the particular compressor manufacturer's manual.



## Chapter 8: Troubleshooting

<b>! WARNING !</b>
<b>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 Turbo Refrigerating® machine.</b>
<b>! WARNING !</b>

<b>! CAUTION !</b>
<b>Follow all lock-out and tag-out procedures before servicing any electrical equipment.</b>
<b>! CAUTION !</b>

Note: 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 incorporate safety and overload circuits and protect all related equipment.

When the machine stops, it must be manually restarted by putting the Module in Auto and pushing the MCS button on the Master Panel operator interface. The machine will restart in a harvest to clear any ice from the plates before beginning another cycle.

Always check the machine operation thoroughly after remedying the problem. Be sure to correct the source or cause of the problem to prevent the problem from occurring again.

Contact your distributor first for technical service assistance about operation problems not covered in this manual. Also feel free to contact the factory for additional service (502) 635-3000.

## 8.1: Symptom: Machine Stopped

Possible Cause	Possible Remedy
Power failure or interruption	Check fused disconnect or circuit breaker supplying power to the machine. If power has been off, make sure the crankcase heater is energized and there is no liquid refrigerant in the compressor crankcase prior to restarting the compressor. If ice is on the freezer plates, initiate a manual harvest.
Control fuse (FU1) for control circuit tripped	Check coils of relays, contactors, starters, solenoid valves, and PLC for a ground. Repair or replace any defective part and replace fuse. Make sure there is no liquid refrigerant in the compressor crankcase prior to restarting the machine.
Compressor motor starter overload tripped	Check for a loose connection on all motor starter and motor terminals that could cause excessive amp draw. Reset overload and restart the machine, check amperage, power supply, and head pressure. (Check delay timer in part wind starts only).
Water pump, conveyor motor, overload tripped	Check for loose connection on all terminals that could cause excessive amp draw. Reset the overload and manually run that particular motor to check actual voltage and amperage against motor rating.
Freezer water pump motor overload (WP) tripped	Check for loose terminal connections and/or blown fuse, reset the overload and restart by pushing the start push button (PB1). Machine will start in a harvest. Check voltage and amperage against motor rating during freeze. Confirm proper rotation.
Screw Conveyor 1 or Screw Conveyor 2 (Take Away Conveyors)	In some cases the motor starter for the conveyors may be supplied by Vogt. Check for loose terminal connections and/or blown fuse. Clear all ice that may have jammed the conveyor. Reset the overload and test by pushing the "Purge" push button on the operator interface "Screw Purge" screen. Check voltage and amps against motor rating. If tripping repeats but ice is not jammed, check the conveyor for worn bearings/liners, and reducer motor for defect or single phasing.
Bin level control open	The Bin Level Switch is installed in your ice storage bin and wires into the Master Panel. Adjust or replace control as required. If bin level control is not used, make sure jumper

	wire from #L1 to #20 is installed at the terminal block.
High/Low pressure safety switch tripped (optional)	If the machine stops by low pressure cutout, the switch will reset automatically when the pressure rises to the “cut-in” setting. Check thaw gas valve (18) to make sure it opens during harvest time. Check Liquid feed valve (25) to make sure it is feeding during a freeze. If the machine stops by high pressure cutout, the switch will have to be manually reset after the pressure drops below the “cut-in” setting. Check the head pressure during the next freeze cycle.
Low oil pressure tripped (OPS) located on compressor	Manually reset the switch after the switch heater cools. Check the crankcase oil level (1/4-3/4 full). Add oil if below 1/4 glass before attempting to restart the machine. Restart the machine and check net oil pressure (net oil pressure = oil pump line pressure minus crankcase suction pressure). Net oil pressure range: Mycom= 17-28 psig Vilter= 35-50 psig
Defective control panel component such as ETH1, LVR, SVR, PLC, WP	Check for open circuit. Refer to FIGURES 6-1 and 6-2, Control Panel to identify parts. Check for loose wires. Replace defective part, restart machine, check power supply, and current draw.
Main Three Phase power fused disconnect (option) for Module(s) blown.	Check for loose connection on all terminals, replace fuse and check amp draw against fuse rating. Check voltage and current unbalance, Section 3. Replace fuse if blown.

## 8.2: Symptom: Freeze-up due to extended freeze period

Possible Cause	Possible Remedy
Refrigeration timer set to long.	Adjust timer set-point in the settings screen.
Water tank drain valve, make-up water float valve or flushing valve opened too far.	Close, repair, or replace valve as needed. The float valve should be adjusted low enough that water should not run out the tank overflow during the freeze cycle.
Compressor running unloaded.	If the compressor is running unloaded, the motor amp draw will only be 60%-70% of the normal amp draw of a loaded compressor. Refer to the compressor manual for normal oil pressure needed to load the compressor cylinders and any further procedures to check the mechanical function of the unloader mechanism

### 8.3: Symptom: Freeze-up due to ice failing to discharge

Possible Cause	Possible Remedy
Refrigeration timer set to long	Adjust timer set-point in the settings screen.
Defrost time too short	Adjust defrost timer in the settings screen to allow all ice to clear the plates ice discharge opening with at least 15 seconds to spare. See pressure regulating valve adjustment.
Defrost pressure to low	The defrost gas regulator should be adjusted to increase the pressure in the plates to 80-90 psi during a harvest. Isolate and repair or replace the valve as needed.
Insufficient heat for defrost due to low condensing pressure	The head pressure should be maintained form 175-190 psi (maximum 200) usually by a water regulating valve or fan cycling switch. Check to make sure these controls are working properly. Cold prevailing wind can also be a factor.
Insufficient heat due to non-condensable gas (usually air) in the system	If non-condensable gas are present with the refrigerant, the saturated temperature will not relate to the pressure reading at the receiver and the refrigerant will be cooler, although pressure will be high.
Auger does not turn, backing ice up to freezer	Check gear reducer and drive motor for proper operation and alignment. Check for broken belts or sheared shaft key. Replace defective parts.
Excessive concentration of solids in the water tank usually indicated by a build-up of mineral deposit on the freezer plates.	Perform a cleaning procedure as well as removing the freezer cover and cleaning the water distributors. Make sure the flushing valve (27) is functioning and the tank overflow piping is not restricted.
Compressor not running unloaded during thaw cycle.(for single section Module with dedicated high side only)	Check compressor motor Amp draw. During the thaw cycle, the compressor motor Amp draw should be 60 - 70% of normal amp draw during the freeze cycle. Check compressor unloader solenoid coil to make sure it is energized and the valve is opening during the thaw cycle.

## 8.4: Symptom: Low ice capacity.

Suspensions of low ice capacity should be confirmed by accurate calculations of actual ice product. Significant losses can occur due to melting and off fall through augers and other ice handling equipment.

Possible Cause	Possible Remedy
Inadequate water for ice making	Water pressure of 30 psig minimum is required to assure proper water supply. Check water pressure. Check for a restriction in the incoming line or at the make-up water float valve.
Water distribution may be stopped up	Check pan and clean orifices as needed.
Water pump failure	Check water pump rotation, amp draw and water level in distribution pan (minimum 1 inch).
Refrigeration timer or defrost timer out of adjustment	Check ice thickness. Industrial ice should be 3/16"-1/4" thick. Check and adjust defrost time. Defrost time should be 15 seconds longer than it takes for all the ice to clear the plates.
Excessive ice chips in the water tank, causing short cycling	Check incoming water temperature (45°F minimum). Check flushing valve to make sure ice chips are being melted and flowing out the tank overflow during the harvest cycle.
Compressor running unloaded or not pumping full volume	Check compressor motor amp draw. Check for belt slippage and tighten as needed. Check for leaking compressor suction or discharge valves. Refer to your compressor manual. See other related symptoms.
Restriction in the refrigerant liquid line or expansion device not operating properly	Check for a partially closed valve or an obstruction at the strainer, solenoid valve, or hand/automatic expansion valve. The liquid line will normally have frost on the downstream side of a restriction, especially as the suction pressure decreases.
Low refrigerant charge	Check the receiver gage for the proper level. Check for and repair leaks. Add refrigerant.
Warm make-up water for ice making	Capacity of the machine is proportional to ice making water temperature. Warmer water will reduce the ice making capacity. Check float adjustment and water tank drain valve.
Excessively high head pressure	Check cooling tower or evaporative condenser to make sure sufficient water is provided for cooling and the equipment is operational to cool the water. Also see "Symptom High Head Pressure".
Suction regulator out of adjustment or defective (optional)	Check the freezer pressure and compare to the main suction pressure. The suction regulator

	should regulate the freezer pressure and create a 2 psi pressure drop across the valve. Adjust pressure regulator. Repair or replace defective valve.
Thawing gas solenoid valve leaking through during freeze cycle	Check the manual opening stem to make sure it is in the automatic position (stem screwed in). Check for leak by sound, temperature difference and frost during a freeze cycle. Close the stop valve to confirm suspicion of leakage. Repair or replace the valve.

### 8.5: Symptom: Poor ice quality

Possible Cause	Possible Remedy
Excessive concentration of solids in the water tank usually indicated by a build-up of mineral deposit on the sides and bottom of the tank and opaque ice production. Also, water distributors restricted.	Perform a cleaning procedure as well as removing the freezer cover and cleaning the water distributors. Make sure the flushing valve (13) is functioning and the tank overflow piping is not restricted.
Insufficient water supply indicated by a low level in the tank	Check water pressure, 30 psig is recommended minimum. Check for a water line restriction, partially closed valve, or defective make-up water float valve. Make sure the water tank drain is closed.
Water pump rotation wrong direction	Check rotation in relation with arrow on pump housing and reverse two wires at the motor if necessary.
Low refrigerant charge.	Check refrigerant level mark on the receiver
Suction Pressure to low	Adjust suction regulator valve
Restriction in liquid line, starving evaporator	Check for closed valve, defective butterfly valve, or strainer restricted. The liquid line will normally have frost on the down-stream side of a restriction, especially as the suction pressure decreases.

### 8.6: Symptom: High discharge pressure (check gage accuracy)

Possible Cause	Possible Remedy
Insufficient water flow through the cooling tower or condenser	Check the condenser water pump to make sure it is pumping enough water. Check sump strainer screen and clean. Check condenser pump direction of rotation.
Fan control out of adjustment	Check adjustment. Replace if defective.
Non-condensable in system.	If non-condensable gas are present with the refrigerant, the saturated temperature will not relate to the pressure reading at the receiver.

	The refrigerant will be cooler, although the pressure will be high. It may be necessary to recover the refrigerant, pull a good vacuum on the system, and recharge with non-contaminated refrigerant.
Cooling tower or evaporative condenser requires maintenance	Check fan motor and fan belts for proper operation and tension. Check spray nozzles, tubes, sump, and sump screen, for accumulation of mineral deposit and clean as required. Check tower blow-down and chemical treatment if applicable.
Dirty condenser tubes	Visually inspect the condenser tubes to see if there is any build-up of mineral deposits which would reduce the cooling effect of the tubes and water. Clean chemically or mechanically as applicable.

### 8.7: Symptom: Low discharge pressure (check gage accuracy)

Possible Cause	Possible Remedy
Fan cycling switch out of adjustment or defective	Check adjustment. Replace if defective.
Compressor running unloaded or not pumping efficiently	Check compressor motor amp. If the compressor is running unloaded, the amperage will only be approximately 60% of normal amp draw (FLA). Refer to the compressor manual.
Ambient temperature low and prevailing winds blowing through tower	Shield tower from prevailing winds to prevent excessive cooling. Install an indoor sump.
Too much cold water circulating through condenser	Install a water regulating valve in the water line form the condenser and control flow by receiver pressure.
Defrost gas valve leaking through	Make sure manual opening stem is in the automatic (screwed in) position. Repair or replace defective parts.

### 8.8: Symptom: High suction pressure (check gage accuracy)

Possible Cause	Possible Remedy
Compressor running unloaded or not pumping efficiently	Check compressor motor amp. If the compressor is running unloaded, the amperage will only be approximately 60% of normal amp draw. Refer to the compressor manual.
Defrost gas valve leaking through	Make sure manual opening stem is in the automatic (screwed in) position. Repair or replace defective parts.
Suction Pressure too low	Adjust suction regulator valve
Defective gage	Check pressure with accurate gage and replace as necessary.

### 8.9: Symptom: Compressor running unloaded during freeze (dedicated compressor only)

Possible Cause	Possible Remedy
Low oil pressure	Check compressor net oil pressure. Net oil pressure = oil pressure gage reading less suction pressure. Mycom = 17-28 psig Vilter = 35-50 psig. Refer to the compressor manual for "Oil Pressure Adjustment".
Unloader solenoid valve open	Check solenoid coil to make sure it is not energized. If valve is stuck open, replace valve.
Unloader mechanism not working properly	Refer to compressor manual. Mycom compressor can be loaded manually.

## 8.10: Symptom: Compressor oil pressure low (check gages)

See Section 7, for compressor oil pressure requirements.

Possible Cause	Possible Remedy
Oil diluted with refrigerant	Oil will be very foamy. Check liquid feed control for overfeed problem.
Oil pressure regulating valve out of adjustment	Adjust valve to increase oil pressure. Turn stem in to increase, out to decrease.
Compressor rotation incorrect	Check rotation direction by arrow indication. Reverse rotation, if necessary.
Restriction strainer, oil filter, pick-up tube or oil passage	Clean strainer or restriction in passage or replace filter.
Compressor thrust bearing installed upside down	The Mycom compressor thrust bearing on the shaft seal end has an oil passage hole that has to be in the proper position when installing the thrust bearing. Hole up for "WA" and "WB" series Mycom compressor. Refer to your compressor manual.

## 8.11: Symptom: Compressor loosing oil excessively

Possible Cause	Possible Remedy
Non-effective oil separator or float	The oil separator will normally return a good portion of oil leaving the compressor, if it is working properly. Check the oil float and return line to see it is not restricted.
Liquid refrigerant in crankcase	Check liquid feed to make sure it is not overfeeding and that the solenoid valve (25) is not leaking through when the machine is stopped.
Compressor piston rings seized or broken	Check compressor efficiency. If rings are seized or broken, replace defective parts.
Leaking shaft seal	A few drops per hour is okay. If refrigerant is leaking, replace the seal.

### 8.12: Symptom: High compressor discharge temperature

Possible Cause	Possible Remedy
High head pressure	Check gage accuracy and “High discharge pressure”.
Defective suction or discharge valves	Feel the compressor heads for hot spots or one head running hot. Replace worn or leaking valves.
Restriction in the discharge gas line	Check all hand and check valves to make sure they are fully opened and not stuck. Repair or replace as needed.
Internal relief valve leaking	Check the compressor manual to see if your compressor is so equipped. Replace accordingly.

### 8.13: Symptom: Suction line frosting to compressor

Possible Cause	Possible Remedy
Liquid refrigerant overfeed	Check float switch to make sure it is functioning properly. Replace if defective. Check solenoid valve (25) to make sure it is not leaking through. Repair or replace if defective.
Refrigerant contaminated with water	Test refrigerant or oil for water contamination. Completely pump the freezer out (pump down) and blow excess water out through the oil trap drain valve. Refer to Service, Section 9 “Removing Excess Water”.

## Chapter 9: Service Operations

### 9.1: Pump-down Procedure

To perform a pump-down, follow this procedure:

- 1) With the machine running, close the liquid feed stop valve nearest the receiver
- 2) Put the water pumps in manual operation.
- 3) Open the water tank drain valve partially to allow a continuous flow of warm make-up water into the water tank and still maintain a good level in the tank. An auxiliary supply of warm water (not to exceed 100°F) may be used if available. Warmer water affords a more complete pump-down.
- 4) Allow the machine to operate and eventually it will shut down on low pressure
- 5) When the suction pressure increases to 70 psig or higher, start the compressor and allow the machine to stop automatically by the low pressure switch at approximately 15 psig. (Lower pressure can be obtained by jumping out the pressure switch.) Remove all power from the machine before opening the control panel cover. With the pressure switch jumped out, the machine can be manually started and stopped. Do not operate the machine below 2 psig.
- 6) When the desired pump-down is obtained, close the hot gas stop valve, and the compressor discharge line stop valve. Other valves may also be closed to isolate a particular area that may require attention.

### 9.2: Removal of Refrigerant from the Machine

Refrigerant can be removed from the machine using an approved refrigerant recovery unit. Refer to a qualified technician to perform this operation. Follow local and federal guidelines. Make sure you are familiar with and technically qualified to handle liquid refrigerant.

<b>! WARNING !</b>
<b>Approved recovery equipment, hoses, gages, and refrigerant containers must be used to comply with all local and federal EPA regulations.</b>
<b>! WARNING !</b>

<b>! WARNING !</b>
<b>Follow these instructions carefully. Severe personal injury can result from improper discharge of refrigerant.</b>
<b>! WARNING !</b>

**! WARNING !**

**It is not recommended that refrigerant be transferred from a refrigeration system into a cylinder. If such a transfer is made, the refrigerant cylinder must be an approved CLEAN cylinder-- free of any contaminants or foreign materials--and must be weighed continuously to assure contents do not exceed net weight specified by cylinder manufacturer or any applicable code requirements.**

**! WARNING !**

### 9.3: Refrigerant Leaks

Refrigerant leaks can be detected by soap solution, electronic detection equipment, or sulfur sticks. Soap solution can be purchased from your refrigeration supply house or it can be made by mixing four parts water, one part liquid soap, and a few drops of Glycerin for better capillary attraction.

Apply soap solutions with a narrow brush or spray bottle to all joints, welds, or areas of suspicion. The solution will form bubbles if there is a leak.

### 9.4: Non-condensable Gases

Satisfactory operation of the machine is not possible if non-condensable gases (usually air) are present in the system. Excessive condensing pressure is an indication of such gases. Excessive condensing pressure in water cooled condensers may also be due to the accumulation of scale in the cooling coil or due to insufficient cooling water or excessive water temperature. See "Water Cooled Condensers", Section 7.

Non-condensable gas effects are:

- Higher condensing pressure than desired.
- Greater electrical power consumption.
- Reduced refrigeration capacity.
- Longer than normal compressor running time.
- Slow ice release and long defrost cycle.

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

Note: whenever excessive water is present in the system, the source should be identified and corrections made prior to further operation.

## **Appendix A**

2/15/96

**SECTION 1: CHEMICAL PRODUCT & COMPANY IDENTIFICATION**

**CHEMICAL NAME:** Anhydrous Ammonia      **TRADE NAMES/SYNONYMS** Ammonia  
**PRODUCT CODE:** 5B81-83  
**MANUFACTURER AND/OR DISTRIBUTOR:** **EMERGENCY TELEPHONE NUMBERS:**  
 LaRoche Industries Inc.      Transportation (CHEMTREC): (800) 424-9300  
 1100 Johnson Ferry Rd., NE      Environmental/Health/Safety: (800) 528-4963  
 Atlanta, Ga. 30342      Customer Service: (800) 491-7987

**SECTION 2: COMPOSITION/INFORMATION ON INGREDIENTS**

CHEMICAL	FORMULA	% BY WEIGHT		CAS	OSHA PEL	NIOSH REL / ACGIH TLV		IDLH
		C-grade	P-grade					
Ammonia	NH <sub>3</sub>	99.5	99.995	7664-41-7	50 ppm (TWA)	25 ppm (TWA)	35 ppm (STEL)	300 ppm
Water	H <sub>2</sub> O	0.4	33 ppm	7732-18-5	None	None	None	
Oil	----	0.1	2 ppm	-----	None	None	None	

**SECTION 3: HAZARDS IDENTIFICATION**

**EMERGENCY OVERVIEW:** 1) Colorless gas or compressed liquid with extremely pungent odor 2) Liquid ammonia reacts violently with water. Vapor cloud is produced 3) Avoid contact with liquid and vapor 4) Stay upwind and use water spray to absorb vapor 5) Not flammable under conditions likely to be encountered outdoors 6) Stop discharge if possible

**POTENTIAL HEALTH EFFECTS:**

**ROUTES OF ENTRY:** Inhalation, Skin Contact, Eye Contact, Ingestion **TARGET ORGANS:** Eyes, skin and respiratory system

**EYE CONTACT:** Exposure to liquid or high concentrations of vapor can cause painful, instant and possibly irreversible damage to tissue such as the conjunctiva, cornea and lens.

**SKIN CONTACT:** Prolonged contact with high concentrations can cause painful tissue damage, frostbite and serious chemical burns.

**INHALATION:** Depending on exposure concentration and duration, effects can vary from none or only mild irritation, to obstruction of breathing from laryngeal and bronchial spasm, to edema and severe damage of the mucous membranes of the respiratory tract with possible fatal results. Latent edema and residual reduction in pulmonary function may occur.

**INGESTION:** Tissue damage, chemical burns, nausea and vomiting can occur. Ammonia is a gas under normal atmospheric conditions and ingestion is unlikely.

**CARCINOGENICITY:** NTP? No      IARC? No      OSHA? No

**SECTION 4: FIRST AID MEASURES**

**EYE CONTACT:** Flush with large amount of water for at least 15 minutes then immediately seek medical aid.

**SKIN CONTACT:** Immediately flush with large quantities of water for at least 15 minutes while removing clothing. Clothing frozen to the skin should be thawed with water before removal. Seek immediate medical aid.

**INHALATION:** Remove from exposure. If breathing has stopped or is difficult, administer artificial respiration or oxygen as needed. Seek immediate medical aid.

**INGESTION:** Do not induce vomiting. Have the victim drink large quantities of water if conscious. Immediately seek medical aid. Never give anything by mouth to an unconscious person.

**SECTION 5: FIRE FIGHTING MEASURES**

**FLASH POINT(method used):** Not Applicable **FLAMMABLE LIMITS:** 16-25% in air

**EXTINGUISHING MEDIA:** With a source of ignition, ammonia will burn in the range of 16-25% in air. Stop flow of gas or liquid.

**SPECIAL FIRE FIGHTING PROCEDURES:** Move containers from fire zone if possible; if not, use water to cool fire exposed containers. Use water spray to control vapors. Do not put water directly on liquid ammonia. Personnel must be equipped with appropriate protective clothing and respiratory protection.

**NFPA HAZARD CLASSIFICATION:** **Health: 3**      **Flammability: 1**      **Reactivity: 0** (least-0 ↔ 4-highest)

**SECTION 6: ACCIDENTAL RELEASE MEASURES**

Release of 100 lbs. or more of ammonia within 24 hours must be immediately (within minutes) reported to the National Response Center at 1-800-424-8802, as well as appropriate local and state agencies. **Suggested Local Action:** Stop leak if feasible. Avoid breathing ammonia. Evacuate personnel not equipped with protective clothing and equipment. Use copious amounts of water spray or fog to absorb ammonia vapor. DO NOT put water on liquid ammonia. Contain run-off to prevent ammonia from entering a stream, lake, sewer, or ditch. Any release of this material, during the course of loading, transporting, unloading or temporary storage, must be reported to U.S. D.O.T. as required by CFR 171.15 and 171.16.

**SECTION 7: HANDLING AND STORAGE**

Refer to the ANSI K61.1 standard for storage and handling information. Protect containers from physical damage and temperatures exceeding 120°F. Use only approved storage systems. Zinc, copper, silver, cadmium and their alloys must not be used in ammonia systems since they can be rapidly corroded by it. Avoid hydrostatic pressure, which can cause equipment rupture, by adhering to proper filling procedures and the use of hydrostatic pressure relief valves where appropriate.

## SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

**RESPIRATORY PROTECTION:** Respiratory protection approved by NIOSH/MSHA for ammonia must be used when exposure limits are exceeded. Whether a chemical cartridge respirator or a self-contained breathing apparatus is sufficient for effective respiratory protection depends on the type and magnitude of exposure.

**EYE PROTECTION:** Chemical splash goggles, approved for use with ammonia, must be worn to prevent eye contact with liquid or vapor. A face shield should be used for increased protection from contact with liquid.

**VENTILATION:** Local positive pressure and/or exhaust ventilation should be used to reduce vapor concentrations in confined spaces. Ammonia vapor, being lighter than air, can be expected to dissipate to the upper atmosphere. Ammonia concentrations may also be reduced by the use of an appropriate absorbent or reactant material.

**OTHER EQUIPMENT:** Emergency eye wash stations and deluge safety showers must be available in the work area. Post a list of emergency response contacts and telephone numbers.

## SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

**Boiling Point:** -28.1°F

**Vapor Pressure:** 4802.9 mm Hg @60°F

**Vapor Density:** 0.60 @ 32°F (Air=1)

**Solubility In Water:** High

**Percent Volatile By Volume:** 100%

**pH:** Approx. 11.6 for 1 N Soln. in water

**Melting Point:** -107.9°F

**Specific Gravity:** 0.62 @ 60°F (water=1)

**Appearance:** Colorless (pungent) gas

## SECTION 10: STABILITY AND REACTIVITY

**STABILITY:** Material generally considered stable. However, heating above ambient temperatures causes the vapor pressure of ammonia to increase rapidly.

**INCOMPATIBILITY (Materials to Avoid):** Ammonia can react violently with strong acids. Under certain conditions, ammonia reacts with bromine, chlorine, fluorine or iodine to form compounds which explode spontaneously. Reactions of ammonia with gold, silver or mercury to form explosive fulminate-like compounds have been reported.

**HAZARDOUS DECOMPOSITION PRODUCTS:** Hydrogen on heating to over 850°F. The decomposition temperature may be lowered to 575°F by contact with certain metals such as nickel.

**HAZARDOUS POLYMERIZATION:** Will not occur. **CONDITIONS TO AVOID:** Not applicable.

## SECTION 11: TOXICOLOGICAL INFORMATION

Ammonia is a strong alkali and readily damages all body tissues. Ammonia is not a cumulative metabolic poison.

## SECTION 12: ECOLOGICAL INFORMATION

Aquatic Toxicity: 2.0-2.5 ppm/1-4 days/goldfish & yellow perch/LC; 60-80 ppm/3 days/crawfish/LC<sub>100</sub>; 8.2 ppm/96hr/fatheadminnow/TLM

Waterfowl Toxicity: 120 ppm

Biochemical Oxygen Demand: Not pertinent

Food Chain Concentration Potential: None

## SECTION 13: DISPOSAL CONSIDERATIONS

Recover ammonia if feasible. Otherwise, let ammonia evaporate if appropriate. Only personnel experienced in ammonia spills should add water to liquid ammonia. Dispose of diluted ammonia as a fertilizer or in an industrial process. For Hazardous Waste Regulations call 1-800-424-9346, the RCRA Hotline.

## SECTION 14: TRANSPORT INFORMATION

	Domestic Shipments	International Shipments
Proper shipping name:	Ammonia, Anhydrous, Liquefied	Ammonia, Anhydrous, Liquefied
DOT Hazard Class:	2.2 (nonflammable gas)	2.3 (poison gas)
Identification Number:	UN1005	UN1005
Packing Group:	None	None

## SECTION 15: REGULATORY INFORMATION

**NOTICE:** This product is subject to the reporting requirements of SARA (1986, Section 313 of Title III) and 40 CFR Part 370.

**OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200:** Ammonia is considered a hazardous chemical.

**OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200:** Ammonia is considered a hazardous chemical.

**EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT (SARA, TITLE III):** Section 302

Extremely Hazardous Substance: Yes; Section 311/312 Hazardous Categories: Immediate (acute) health hazards;

Section 313 Toxic Chemical: Yes

**CERCLA/SUPERFUND, 40 CFR 117,302:** This product contains ammonia which if released to the environment in quantities of 100 lbs. or more requires notification to the National Response Center in Washington, DC at 1-800-424-8802.

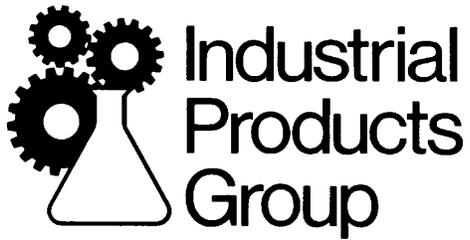
**WHMIS:** One Percent (1%) **CALIFORNIA PROPOSITION 65:** Reproductive: No Carcinogen: No

**OSHA PROCESS SAFETY MANAGEMENT, 29 CFR 1910.119:** This product is subject to the Process Safety Management requirements of 29 CFR 1910.119 if maintained on-site in quantities of 10,000 lbs. or greater.

**EPA CHEMICAL ACCIDENT RELEASE PREVENTION, 40 CFR PART 68:** This product is subject to the Risk Management Plan requirements of 40 CFR Part 68 if maintained on-site in quantities of 10,000 lbs. or greater.

**DRINKING WATER:** Maximum use dosage in potable water is 5 mg/l.





## **Anhydrous Ammonia Safety**

**LaRoche** INDUSTRIES INC.

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# FOREWORD

Ammonia (frequently called anhydrous ammonia) is one of the most valuable and versatile chemical compounds in today's modern world. For example, it finds wide application in food production and processing, textile and chemical manufacturing, refrigeration, metal treating and pollution abatement.

An ever increasing use of ammonia has been accompanied by a corresponding growth in the need for the dissemination of knowledge regarding ammonia safety among persons working with ammonia under either normal or emergency conditions. Recognizing this need, LaRoche Industries has prepared this booklet which contains a selected collection of helpful information and suggestions for the ammonia user and for safety personnel. The suggestions may be employed as an aid in the preparation of the ammonia user's own comprehensive safety program and should be altered or augmented in accordance with individual requirements.

Anyone working with ammonia, either directly or indirectly, whether at a supervisory or non-supervisory level, has a responsibility not only to be thoroughly familiar with basic ammonia safety principles, but also to observe faithfully all necessary precautions and to react promptly and appropriately should an emergency arise. Readers of this booklet will find answers to questions most often asked regarding general properties, potential hazards, exposure effects, personal protective and safety equipment, first aid procedures and methods of dealing with emergencies involving ammonia. Information as to the manufacture, transportation, storage or application of ammonia is not detailed.

Persons requiring any information regarding ammonia not covered in this booklet are urged to consult with LaRoche Industries or with the Compressed Gas Association, Inc., Arlington, VA or The Fertilizer Institute, Washington, DC for assistance.

## PLEASE NOTE

The information and suggestions compiled in this booklet are derived from sources believed to be reputable and reliable. HOWEVER, LAROCHE INDUSTRIES SUPPLIES THIS BOOKLET MERELY AS A GRATUITOUS SERVICE AND MAKES NO WARRANTY OR GUARANTEE OF RESULTS, EXPRESSED OR IMPLIED, AND ASSUMES NO LIABILITY IN CONNECTION WITH THE INFORMATION AND SUGGESTIONS HEREIN. No assumption shall be made as to the absolute correctness or sufficiency of any representation in the booklet or that certain circumstances may not warrant or require modified or additional precautions or actions.

This booklet should not be confused with federal, state or municipal regulations, insurance requirements or national safety codes, although some statements may be similar or identical.

# ANHYDROUS AMMONIA SAFETY

## GENERAL

The term "anhydrous ammonia" appearing in the title of this booklet refers to the compound having the formula  $\text{NH}_3$ , formed by the chemical combination of nitrogen and hydrogen. Whenever the term "ammonia" appears in this booklet, it should be understood as meaning anhydrous ammonia and not aqua ammonia, aqueous ammonia or ammonium hydroxide which are solutions of ammonia in water. Ammonium hydroxide solutions generally range in concentrations of ammonia from about 30% down to the 2 to 4% found in the well known household ammonia. These solutions are all commonly known as ammonia, but should never be confused with liquid anhydrous ammonia which has a much greater hazard potential. "Anhydrous" means "free from water".

At room temperature and atmospheric pressure, ammonia is a pungent, colorless gas approximately 40% lighter than air. Compressed and cooled, ammonia gas condenses to a colorless liquid about 68% as heavy as water. At atmospheric pressure, the liquid boils at -28F.

In a container, ammonia in the liquid form normally coexists with vapor. Temperature affects both the vapor pressure and volume of liquid ammonia.

As the temperature of the liquid rises, the vapor

above the liquid phase exerts increased pressure. It should be noted that the pressure observed within a container is NOT a measure of the quantity of the liquid present.

With increasing temperature, ammonia in the liquid phase expands. For example, in an ammonia cylinder at 65F loaded to its maximum allowable limit in accordance with Federal regulations, the vapor phase occupies about 12% of the total cylinder volume. This vapor space would be completely filled with liquid ammonia if its temperature were permitted to reach 145F. Upon further temperature rise, the cylinder will bulge and could rupture due to the internal hydrostatic pressure caused by the expanding liquid.

Because of these characteristics, ammonia containers should not be exposed to excessive heat. (See THERMAL EXPANSION and FIRE EXPOSURE.)

Under equilibrium conditions, the vapor pressure and volume of liquid ammonia vary with temperature as shown in Table 1.

TABLE 1. VAPOR PRESSURE AND VOLUME OF LIQUID AMMONIA AT VARIOUS TEMPERATURES

Temperature Degrees F	Vapor Pressure psig	Volume Gal./CWT
-28	0.0	17.57
0	15.7	18.10
30	45.0	18.72
60	92.9	19.43
90	165.9	20.25
115	251.5	21.04
130	315.6	21.58

(Data derived from U.S. Bureau of Standards Circular No. 142.)

Ammonia is most frequently shipped by highway and rail and stored in pressure containers as a liquefied compressed gas at ambient temperatures. Ammonia in very large quantities is transported in high pressure pipelines at ambient temperatures and is shipped by barge or tanker as refrigerated liquid at - 28F and atmospheric pressure. When stored in large quantities, such as at a terminal, ammonia is generally refrigerated and kept in insulated tanks at - 28F.

## PRIMARY HAZARDS

Ammonia acts as an irritant to human tissue in varying degrees depending upon concentration and exposure.

The pungent and distinctive odor of the vapor, even at low concentrations, provides adequate warning so that no person will voluntarily remain in concentrations which are hazardous. (See HUMAN PHYSIOLOGICAL EFFECTS.)

At the time of this printing ammonia is classified by the U.S. Department of Transportation as a NONFLAMMABLE GAS. Conditions favorable for ignition are seldom encountered in normal handling due to its narrow range of susceptibility to ignition. In the presence of a flame or spark at about 1200F, ammonia vapor will ignite, but only within the limited range of 16-25% of ammonia in air by volume. The heat generated by combustion is insufficient to maintain a flame which therefore will extinguish upon ignition source removal.

## OTHER HAZARDS

*CHEMICAL* - As a chemical compound, ammonia is highly associated and stable at ordinary temperatures. At about 840F ammonia begins to dissociate with the formation of nitrogen and highly flammable hydrogen.

Ammonia will not corrode most of the common metals, but in the presence of water, ammonia will attack copper, zinc and alloys containing these elements. For this reason, materials of construction used for ammonia containers, fittings, piping and equipment are limited to steel and iron or certain non-ferrous alloys resistant to attack by ammonia.

Ammonia is a highly reactive chemical, forming salts with many inorganic and organic acids, usually with the release of heat. Under certain conditions, ammonia is known to react with bromine, chlorine, fluorine or iodine, to form compounds which explode spontaneously. Ammonia has been reported as reacting with gold, silver or mercury to form fulminate-like compounds which are explosive.

*THERMAL EXPANSION* - Liquid ammonia exhibits a high coefficient of cubical expansion. A given quantity of liquid ammonia therefore expands considerably in volume with a rise in temperature. (See Table 1.) For this reason, appropriate measures must be taken to avoid hydrostatic rupture of containers, piping or other equipment as could be caused by such expansion.

## HUMAN PHYSIOLOGICAL EFFECTS

Ammonia is NOT a cumulative metabolic poison; ammonium ions are actually important constituents of living systems. Depending upon concentration and time, the effects of exposure to ammonia vapor vary from none or only mild irritation, to obstruction of breathing from laryngeal and bronchial spasm, to edema and severe damage of the mucous membranes of the respiratory tract with possible fatal results.

Ammonia in the presence of water is highly alkaline. Contact of the skin or mucosa with liquid ammonia or a high concentration of vapor can result in a caustic burn. Due to the great attraction of water to ammonia, water may be absorbed simultaneously from the tissue resulting in dehydration of the affected area.

Liquid ammonia boils at -28F under atmospheric conditions, acting as a refrigerant to remove heat from any warmer object it may be contacting. Accordingly, liquid ammonia in contact with the skin can cause frostbite.

Exposure levels of ammonia vapor which are tolerated by some persons may produce adverse reactions in others. Persons having chronic respiratory disease or persons who have shown evidence of undue sensitivity to ammonia should not be exposed to ammonia. Table 2 indicates human physiological response to various concentrations of ammonia in air upon inhalation.

**TABLE 2. PHYSIOLOGICAL EFFECTS OF AMMONIA VAPOR**

Effect	PPM Ammonia in Air by Volume
Least perceptible odor	5 ppm
Readily detectable odor	20-50 ppm
No discomfort or impairment of health for prolonged exposure	50-100 ppm
General discomfort and eye tearing; no lasting effect on short exposure	150-200 ppm
Severe irritation of eyes, ears, nose and throat; no lasting effect on short exposure	400-700 ppm
Coughing, bronchial spasms	1,700 ppm
Dangerous, less than 1/2 hour exposure may be fatal	2,000-3,000 ppm
Serious edema, strangulation, asphyxia; rapidly fatal	5,000-10,000 ppm
Immediately fatal	over 10,000 ppm

(From "Anhydrous Ammonia", Pamphlet G-2 Seventh Edition, Compressed Gas Association, Inc.)

## EXPOSURE LIMITS

Occupational Safety and Health Administration (OSHA) regulations require that an employee's short term exposure limit (STEL) for ammonia not exceed a time-weighted average of 35 ppm ammonia in air by volume in any 15 minute period.

The American Conference of Government and Industrial Hygienists (ACGIH) has established an exposure limit of 25 ppm ammonia in air by volume as an 8 hour time weighted average (TWA).

## PERSONAL PROTECTIVE EQUIPMENT

Persons working with ammonia under routine circumstances of operation and maintenance should wear flexible fitting, hooded ventilation goggles and rubber or plastic gauntlet gloves impervious to ammonia so as to protect critical body areas which are most vulnerable to contact with ammonia should a minor leak occur. A full face shield may be worn over the goggles for additional protection, but not as a substitute for the goggles.

## EMERGENCY PROTECTIVE AND SAFETY EQUIPMENT

Each location having an ammonia installation should have readily available and freely accessible, emergency protective and safety equipment as may be required by federal, state, and local governmental regulations. The location of such protective and safety equipment should be well identified by appropriate signs.

Depending upon the size and nature of the installation, emergency protective and safety equipment may include one or more of the following:

**SAFETY SHOWER** - Parts of the body injured by contact with ammonia must be flooded immediately with large quantities of water. An emergency safety shower, eye wash fountain, or other source of clean water can be used for this purpose. Such a source should be protected from freezing in cold weather.

### RESPIRATORY DEVICES -

1. A full-face GAS MASK with an ammonia (green) or a universal (red) industrial size canister approved by MSHA/NIOSH (formerly U.S. Bureau of Mines). OSHA regulations require at least two gas masks to be maintained at a stationary ammonia storage installation.

It should be noted these canisters are limited to brief periods of use not exceeding 15 minutes and in

concentrations of ammonia not exceeding 3% (30,000 ppm) in air by volume. Spare canisters, within usable date limitations as marked, should be kept on hand. Replacement of over-age canisters, even though not used, is recommended.

A person wearing a mask must leave a contaminated area immediately on detecting an odor of ammonia or experiencing difficulty in breathing. These are indications that the mask or canister is not functioning properly, that the ammonia concentration is excessive, or that adequate oxygen is not available.

2. For protection where ammonia concentrations are unknown or may exceed 3%, or in oxygen deficient atmospheres, SELF-CONTAINED AIR BREATHING APPARATUS of an approved pressure demand type should be used. This apparatus, which consists of a full face piece, a pressure and flow control and a high pressure cylinder of air, provides protection for a period of time which varies with the amount of air carried and the extent of exertion by the user.

Any respiratory device must be used and maintained in accordance with the manufacturer's instructions. Because the device is normally used in an emergency, where there is tension and excitement, a person who uses it should have received thorough training and practice.

**PROTECTIVE CLOTHING** - Emergency or rescue personnel required to work in high ammonia concentrations should wear protective gloves, boots, pants and jacket, or slicker impervious to ammonia. A hard hat should be worn as required by plant practice or dictated by special hazards.

**RESCUE HARNESS** - A safety belt and lifeline should be worn by an individual using respiratory equipment and entering contaminated air in a confined location. Another person also wearing respiratory equipment and protective clothing should be located outside the contaminated area to act in case of emergency.

**WATER SYSTEM** - At a large installation, a high capacity water system should be available not only for fire fighting, but also for controlling ammonia leaks.

**STRETCHER AND BLANKETS** - Inadequate facilities for transporting a seriously injured person from the scene of an accident to a first aid station can add to the seriousness of the injury. A stretcher provides the most acceptable method of hand transportation and it may be used as a temporary cot at the first aid station or during transit in a vehicle.

## FIRST AID PROCEDURES

Ammonia is one of the most water soluble of all gases. Accordingly, the best means of providing first aid for an injury caused by ammonia contact with the eyes or skin is to flush immediately the injury area with large quantities of clean water. Promptness in initiating treatment, using adequate quantities of water and continuing its application for at least fifteen minutes, or longer if necessary, are all essential in successful first aid management of an eye or skin injury resulting from contact with ammonia. Cool coffee, tea and even a fruit flavored beverage are all reported as having been used with good effect in starting first aid treatment when water was not immediately available. A physician must be called promptly for any person who has been burned severely or overcome by ammonia. The physician should be given a complete account of the cause of injury. Speedy removal of the patient from the contaminated location is important to avoid aggravation of the injury.

*PRIOR TO MEDICAL AID BY THE PHYSICIAN, FIRST AID PROCEDURES SHOULD BE EMPLOYED. THOSE PRESENTED HEREIN ARE BASED UPON WHAT IS BELIEVED TO BE COMMON PRACTICE IN INDUSTRY. THEIR ADOPTION IN ANY SPECIFIC CASE SHOULD, OF COURSE, BE SUBJECT TO PRIOR ENDORSEMENT BY A COMPETENT MEDICAL ADVISOR.*

As a guide in case of injury caused by ammonia, the following first aid procedures are suggested:

**INHALATION** - Any conscious person who has incurred irritation due to inhalation of ammonia vapor should proceed at once to a location free of ammonia and breathe fresh air. If exposure has been minimal, usually no other treatment will be necessary.

A person overcome by ammonia must be carried to a location free of ammonia and the services of a physician obtained promptly. Successful resuscitation requires SPEED and EFFICIENCY. DELAY AND INEXPERIENCE MAY RESULT IN A FATALITY.

If there is an obstruction to the patient's breathing, the airway must be cleared by appropriate methods which may include proper positioning of the patient's head, pulling the tongue forward and clearing any blockage from the mouth such as dentures or vomitus. If spontaneous breathing does not resume after the airway has been cleared, artificial respiration should be started immediately by mouth-to-mouth resuscitation (expired-air ventilation, rescue breathing), preferably by an individual trained in the procedure.

Oxygen therapy may be indicated once the patient's breathing has been restored or if it continues to be labored. Such therapy should not replace immediate mouth-to-mouth resuscitation and should only be applied during a sustained resuscitation period or if the patient is to be moved. CAUTION: It may not be advisable to administer oxygen under positive pressure if the patient is in shock or there is impending or existing cardiovascular failure. Oxygen therapy equipment should be used only by qualified and experienced personnel.

Treatment with oxygen may be discontinued if breathing becomes easy, the color is good and there are no signs of lung congestion. During treatment, the patient should be placed in a reclining position, or if he prefers, in a sitting position. He should be kept quiet, at rest and comfortably warm, but not hot. The patient

should be examined by a physician and not allowed to return to work until found free of injury.

**EYES** - If contacted by ammonia, the eyes must be flooded immediately with copious quantities of clean water. Speed is essential. If contact lenses are worn, they must be removed, otherwise ammonia may be trapped underneath causing a severe burn. In isolated areas, water in a squeeze bottle which can be carried in the pocket is helpful for emergency irrigation purposes. An eye fountain should be used, but if not available, clean water from any source may be poured over the eyes. In any case, the eyelids MUST BE HELD OPEN and irrigation continued for at least 15 minutes. Repeat this procedure every ten minutes for an hour, each time irrigating for a period of five minutes until medical attention can be obtained. Such attention must be received promptly from a physician, preferably an ophthalmologist. No oils or any medication should be placed in the eyes unless ordered BY A PHYSICIAN. If prescribed BY A PHYSICIAN, 2 to 3 drops of topical anesthetic such as 1/2% tetracaine hydrochloride (Pontocaine) may be instilled to relieve pain and to permit more thorough flushing of the eyes with water.

**SKIN AND MUCOSA** - If contacted by liquid ammonia, the body area affected should be immediately flooded with water. If no safety shower is available, utilize any available water source. Water will have the effect of thawing out clothing which may be frozen to the skin. Such clothing should be removed and flooding of the skin with water continued for at least 15 minutes.

Do not apply salves or ointments to skin or mucous membrane burns during the 24 hour period following injury. Subsequent medical treatment is otherwise the same as for thermal burns.

**INTERNAL** - Swallowing of liquid ammonia is very unlikely. However, if ammonia has been taken internally and if the patient is CONSCIOUS and able, have him drink large quantities of water immediately. NEVER GIVE ANYTHING BY MOUTH TO AN

**UNCONSCIOUS PERSON.** Should the patient vomit, place his face down with head lower than hips to prevent vomitus from entering lungs. Transport patient to a physician promptly and apply other first aid treatment as he may prescribe.

## **EMERGENCY MEASURES**

Every plant, warehouse, office or other facility is susceptible to emergency situations which can result in property damage and/or bodily harm to employees, visitors or even neighbors. Management bears responsibility within its own organization for the development and implementation of comprehensive and effective plans designed to meet these situations in a manner as will protect the safety of human life, physical assets and the environment to the greatest degree practicable within the constraints of governmental regulations and prudent business practice.

No one plan will serve the needs of all companies and each organization must assess the various potential emergency conditions that might occur and develop a program to suit its own requirements. Where ammonia is stored and used, the following procedures and actions are suggested for incorporation into an emergency response plan.

When an ammonia leak occurs, personnel trained for and authorized to handle such situations should take immediate steps to locate and control the condition. Respiratory equipment and protective clothing as may be necessary and suitable for ammonia must be worn. All other persons must be kept away from the affected area until the leak has been stopped. Keep on the windward side of the leak when possible.

If ammonia vapor is released, the irritating effect of the vapor will generally force personnel to leave the area before they are overcome by harmful concentrations. Sufficient, well marked and readily accessible exits must be provided to facilitate rapid

evacuation from a building. Should an individual become trapped in an ammonia contaminated atmosphere, breathing should be held to a minimum and eyes opened only as necessary. Because ammonia vapor is lighter than air, a trapped person should remain close to the floor to take advantage of lower vapor concentrations while seeking an escape route, unless liquid ammonia has been spilled. If respiratory equipment is not available, some temporary protection may be afforded by holding a wet cloth over the nose and mouth.

Should a leak occur which is extensive, such as might be involved with a spill of liquid ammonia, all persons in the path of the vapor should be warned. If necessary, local emergency authorities should be contacted to control evacuation. The evacuation area should be adjusted according to wind changes and observed effects on population. Suggested evacuation distances are given in Table 3, starting with the circle as shown in the accompanying diagram.

With good ventilation or rapidly moving air currents, ammonia vapor, being lighter than air, can be expected to dissipate readily to the upper atmosphere. Further action may not be required other than to stop the leak. If necessary, the concentration of ammonia vapor in the air can be reduced effectively by the use of an adequate volume of water applied through a spray or fog nozzle.

Under some conditions, ammonia in a container may be colder than the available water supply. At such times, water must not be applied to the container walls since heat would be transferred to the ammonia thus causing increased pressure within the container resulting in aggravation of any leakage or relief valve discharge.

Water should not be applied to a liquid spill unless at least 100 parts of water to one part of ammonia are available. Runoff of a liquid spill should be diverted if the direction of flow will create an additional problem. **UNDER NO CIRCUMSTANCES**

**SHOULD AN ATTEMPT BE MADE TO NEUTRALIZE AN AMMONIA SPILL WITH AN ACID.**

It is recommended that an up-to-date telephone listing of various emergency, rescue, medical and regulatory agencies be maintained for use by designated personnel should it become necessary to call for sources of outside help to cope with a situation which is beyond the self-sufficiency of local plant employees. Included in the listing should be numbers for fire and police departments, ambulance, rescue or paramedical services, doctors, hospitals, governmental authorities, material and equipment suppliers. Also listed should be the names and numbers for selected company supervisory and management personnel (such as foreman, superintendent, safety and public relations directors, etc.) who are to be notified of an

emergency situation. Where appropriate, both day and night or alternate numbers should be shown.

If company or security personnel are not present at a facility during off-hours, the name(s) and telephone number(s) of a responsible individual(s) should be posted at a gate or entrance for purposes of notification by local authorities should an emergency arise.

**LEAK DETECTION**

An ammonia leak is readily detectable by its characteristically pungent odor.

**TABLE 3**

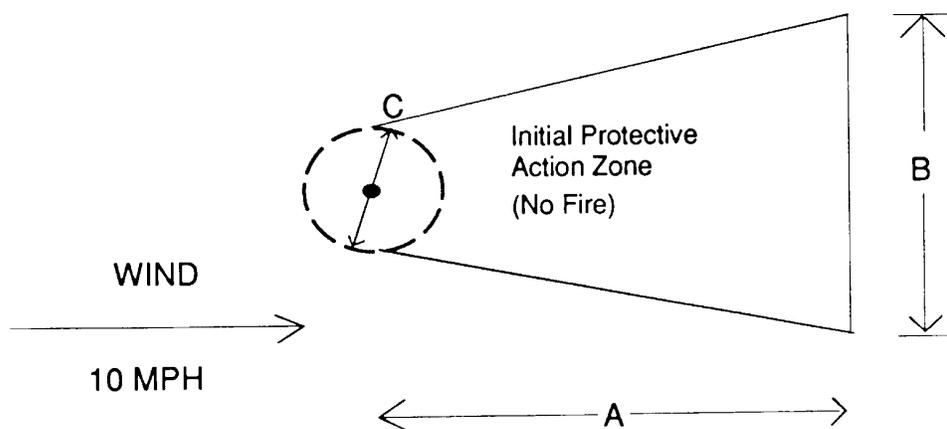
**Table of Initial Isolation and Protective Action Distances**

**Small Spill**

- A) Downwind Distance: 0.2mi
- B) Crosswind Distance: 0.2mi
- C) Isolation Zone Diameter: 150 ft.

**Large Spill**

- A) Downwind Distance: 1 mi.
- B) Crosswind Distance: 1 mi.
- C) Isolation Zone Diameter: 300 ft.



*(Derived from "Guidebook for First Reponse to Hazardous Materials Incidents" - 1990, U.S. Department of Transportation P5800.5)*

The location of a small leak may often be determined by holding a moist strip of phenolphthalein or red litmus paper near the suspected leak source. The rapidity and intensity of the color change in the paper will give some indication of leak proximity or size. In the presence of ammonia, phenolphthalein paper will turn from white to pink or deep red, whereas the red litmus will become blue.

Sulfur dioxide vapor reacts with ammonia to form a dense white cloud and may be used for leak detection. Care must be exercised to avoid breathing sulfur dioxide vapor as it is also highly irritating. It should be noted that a gas mask canister which is specific for ammonia will not offer protection against sulfur dioxide. If there is an appreciable quantity of ammonia in the air, it may be difficult to pinpoint the leak source.

Various types of devices are available to detect and measure the concentration of ammonia vapor in air. One such device employs a colorimetric detector tube through which air to be tested is drawn by a special hand or battery operated pump. A comparison of the length of the color stain produced in the tube is made with a calibrated chart which gives an indication of the concentration.

## **LEAK CONTROL**

*EQUIPMENT OR PIPING* - If a leak occurs in equipment or piping, shut off the ammonia supply and carefully vent all ammonia from the system before attempting to dismantle any part or make repairs. The appearance of frost on an external surface indicates the presence of liquid ammonia vaporizing in the system. Accordingly, the frost should be allowed to dissipate before breaking any connection. If welding is required, the system should be thoroughly purged until all ammonia and any oil residue has been removed. Welding must conform with applicable codes.

*VALVE* - A leak at a valve stem can usually be stopped by tightening the packing gland nut. A leak at a valve bonnet may be stopped by tightening the bonnet threads or the bolts holding the bonnet to the valve body. All tightening should be performed slowly and without application of excessive force. Packing gland nut and bonnet threads on some ammonia valves are left-handed. If tightening procedures fail to stop the leak, the valve should be closed. If the valve should fail to close completely, it should be plugged.

*PRESSURE RELIEF DEVICE* - A leak or discharge through a pressure relief device, such as a pressure relief valve or hydrostatic relief valve, may occur if the pressure within the equipment, piping, tank or container exceeds the rated pressure setting of the device or if the device is faulty. Reducing the pressure within the system by removing ammonia as a vapor to process or cooling the container with a water spray may permit the device to reseal. If resealing does not take place, it most often will be necessary to replace the device with one approved for ammonia service and of the proper pressure rating and capacity.

No attempt should be made to plug, cap or otherwise tamper with a pressure relief device under any circumstances. However, a pressure relief valve may sometimes be provided with a shut-off valve in an arrangement whereby the leaking device can be isolated for removal purposes while another pressure relief valve(s) provides not less than the full rate of discharge capacity required for safety. Unless returned to the manufacturer, a pressure relief device should not be repaired or adjusted in any manner. Pressure relief valves should be replaced at regular intervals as suggested by the manufacturer. Failure to observe these precautions could result in a serious weakening or catastrophic rupture of the equipment, piping, tank or container which was being protected by the device.

*STORAGE TANK* - A leak at a threaded or flanged storage tank opening may often be stopped by

a careful tightening of threads or bolts. Should such efforts fail, it will be necessary to empty the tank of all ammonia before attempting further repair. If the leak is small, the tank can frequently be emptied by removing the ammonia as a vapor or liquid to process. If necessary to remove the ammonia promptly, or if the tank is equipped with a vaporizer, your supplier should be contacted for advice and assistance.

Occasionally, a storage tank will develop a leak in a plate, weld or coupling. No attempt to peen such a leak should be made. Instead, call your tank or ammonia supplier promptly. Welding on an ammonia storage tank must be performed in accordance with ASME code procedures and only after complete purging.

**SHIPPING CONTAINER** - Ammonia is shipped in special containers which are fabricated, transported and maintained in accordance with U.S. Department of Transportation regulations. Shipping containers include cylinders, portable tanks, tank trucks, rail tank cars, barges and tankers. If an ammonia leak occurs in a shipping container while at the user's facility, these actions should be taken to limit and control the escape of ammonia:

- (1) If liquid is leaking from a cylinder, position it if possible so that vapor instead of liquid escapes. The quantity of ammonia released from a vapor leak is considerably less than from a liquid leak through an opening of the same size.
- (2) If possible, move the container to an area of reduced hazard.
- (3) If no risk is entailed, attempt to reduce the pressure in the container by removing the ammonia to process as a vapor.
- 4) Reduce the quantity of vapor in the atmosphere with a water spray applied to the leak area.
- (5) Aside from trying to stop a leak from a shipping container by tightening a valve packing

nut, closing a valve or possibly tightening a flange bolt, no other repairs should be attempted or authorized by the user.

(6) It is a violation of federal regulations to transport an ammonia shipping container which is leaking or damaged. If a shipping container is damaged or is leaking in a manner which cannot be handled by personnel at the site, the nearest office of the producer or supplier should be called for assistance. If the producer or supplier cannot be reached, contact the Chemical Transportation Emergency Center (CHEMTREC) by telephoning the toll free number, 800/424-9300, (add long-distance access number if required) for advice and help day or night.

When calling for assistance, be prepared to provide the following information:

- (a) Nature of emergency, when, where and extent.
- (b) Type and condition of container.
- (c) Name of shipper or supplier.
- (d) Extent of injuries or property damage, if any.
- (e) Description of surrounding area and prevailing weather conditions.
- (f) Corrective measures being applied.
- (g) Name of caller and location now and where telephone contact may be re-established with caller or other responsible party at the emergency site.

Environmental protection and/or other regulatory authorities should be notified of an ammonia spill as may be appropriate and required by statute.

## **FIRE EXPOSURE**

If possible, an ammonia container should be disconnected and removed immediately from the fire zone. If, for any reason, a container cannot be moved,

it should be kept cool with water spray until well after the fire is extinguished. Firefighting personnel should be equipped properly with protective clothing and respiratory equipment.

## **EMPLOYEE SAFETY TRAINING**

Safety in working with ammonia depends on more than just the availability of personal or emergency protective equipment and clothing. Employee training in safe operation procedures, in first-aid measures and in the use of suitable operating and protective equipment, properly maintained, must also be included as an essential element in any comprehensive safety program.

Such safety training is the responsibility of management and should be given to new and old employees at periodic intervals as needed to maintain high proficiency levels. Included should be written and oral instructions followed by drills regarding the

location, purpose and use of personal and emergency protective clothing, equipment, emergency alarms, fire fighting equipment, safety showers or other water sources, first aid supplies and shut-down equipment such as valves and switches.

Training should also stress the avoidance of body contact with liquid ammonia or inhalation of gas and the reporting of equipment failures to appropriate supervisory authority.

This material has been reviewed by experienced safety, medical and other technical personnel competent to evaluate its accuracy and practicability.

*Additional copies of this booklet are available by forwarding a request to LaRoche Industries at any of the office locations shown below.*

*Material Safety Data Sheets are also available by similar request.*

## **REGIONAL OFFICES**

### **Eastern**

20 Meta Lane  
Lodi, NJ 07644  
201/472-8008

### **Central**

1900 Spring Road  
OakBrook, IL 60521  
708/571-4950

### **Southern**

1990 Lakeside Parkway, Suite 130  
Tucker, GA 30084  
404/691-0596

### **Western**

15116 Canary Avenue  
LaMirada, CA 90638  
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