MHG-LR MODULAR TURBO REFRIGERATING® ICE MACHINE

Manual Part Number 12A4171M12

Service Manual

$50^{00}

8/28/00

NOTICE

This manual is the property of the owner of this particular Tube-Ice® machine.

Model #_____ Serial #_____.

It is to be left on the premises with this machine at all times. After start-up, it should be stored in a safe place where it can be readily available when needed for future reference in maintaining troubleshooting or servicing.

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

This manual is intended as an informational tool for the installation, operation, maintenance, troubleshooting, and servicing of this equipment. If an existing situation calls for additional information not found herein, we suggest that you contact your distributor first. If further assistance or information is needed, please feel free to contact the factory at 502-635-3000 or FAX at 502-635-3024.

IMPORTANT: The Warranty Registration/Start-Up Report found in the front of this manual is to be completed and returned to the factory promptly after the official start-up.

Please return to: VOGT ICE®, LLC
1000 W. Ormsby Ave.
Louisville, KY 40210

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 _____

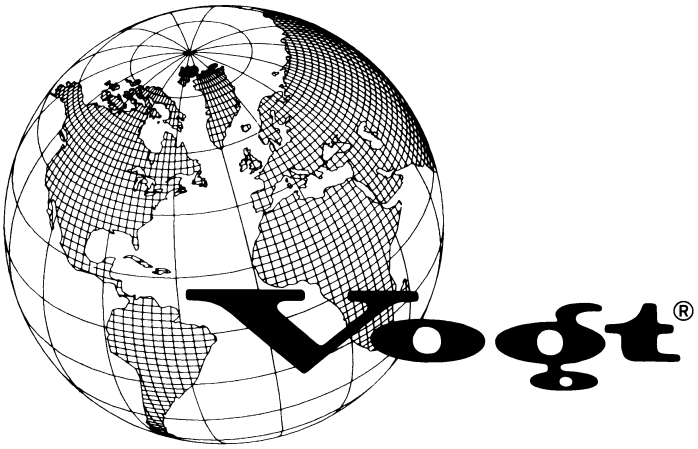
Test Cycle	Make-up Water Temp	Freeze Time Min/Sec	Harvest Time Min/Sec	First Ice Out Min/Sec	All Ice Out Min/Sec	Avg. Hole Size	Ice Lb. Per Harvest	Ice Lb. Per Day
#1								
#2								
#3								
#4								

Note: Ice lb. per day can be found by: $\frac{\text{ice lb. per harvest}}{\text{(freeze time + harvest time)}} \times \mathbf{1440}$

Remarks:

Technician Signature: _____ **End User Signature:** _____

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



VOGT ICE®, LLC, located in

Louisville, Kentucky since 1880.

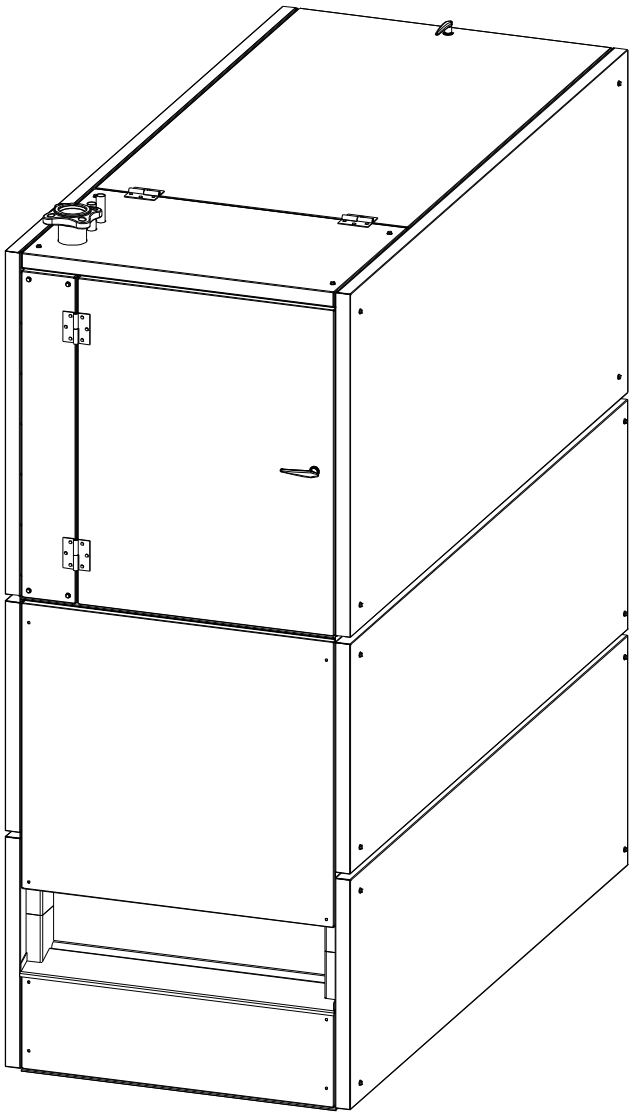
Sales - (800) 853-8648

Parts and Service - (502) 635-3000

Since 1880, Manufacturers of Quality
Tube-Ice® Machines

Vogt®

Turbo Refrigerating® Ice Machines



Installation, Service Manual and Parts Catalog #12A4171M12

Modular Lowside Model

TABLE OF CONTENTS

Vogt® TUBE-ICE® MACHINES
MHG-LR Modular Model

TABLE OF CONTENTS

Page No

TABLE OF CONTENTS

1. Introduction

TURBO REFRIGERATION CO.

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.

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

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. Since Vogt Ice introduced Tube-Ice® machines in 1938, the process of making Tube-Ice® ice has been widely recognized as the most economical means of production. The machine's economic and reliable operations have been proven over and over again in a network of varied types of installations throughout the world.

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**.

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 anhydrous ammonia 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 R-717 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.

! 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 !

Always store cylinders containing refrigerant 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.

! CAUTION !
It is not recommended that refrigerant be transferred from a refrigeration system directly into a cylinder. If such a transfer is made, the refrigerant cylinder must be an approved, CLEAN cylinder--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.
! CAUTION !

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.

! DANGER !
Indicates an immediate hazard and that special precautions are necessary to avoid severe personal injury or death.
! DANGER !

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

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

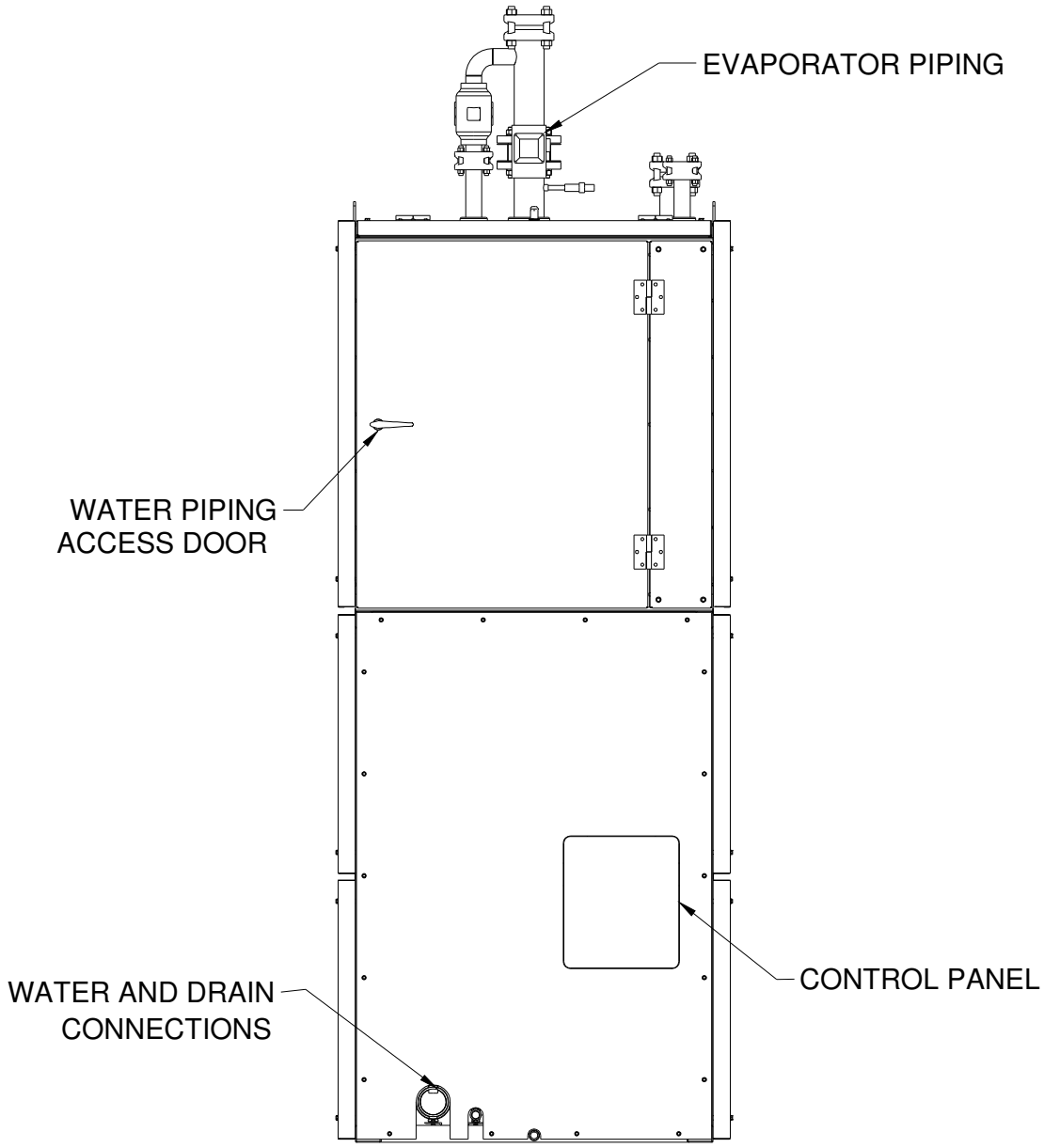


FIGURE 1-1
Modular Flooded Front View

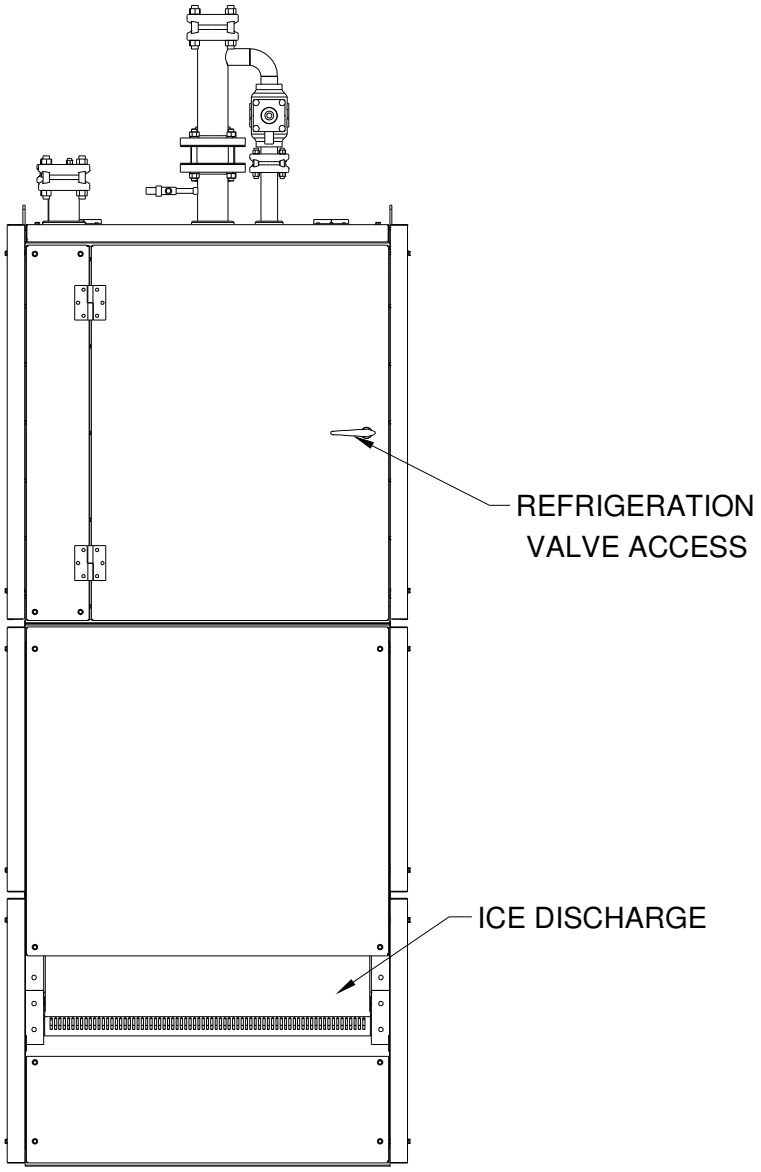


FIGURE 1-2
Modular Flooded Back View

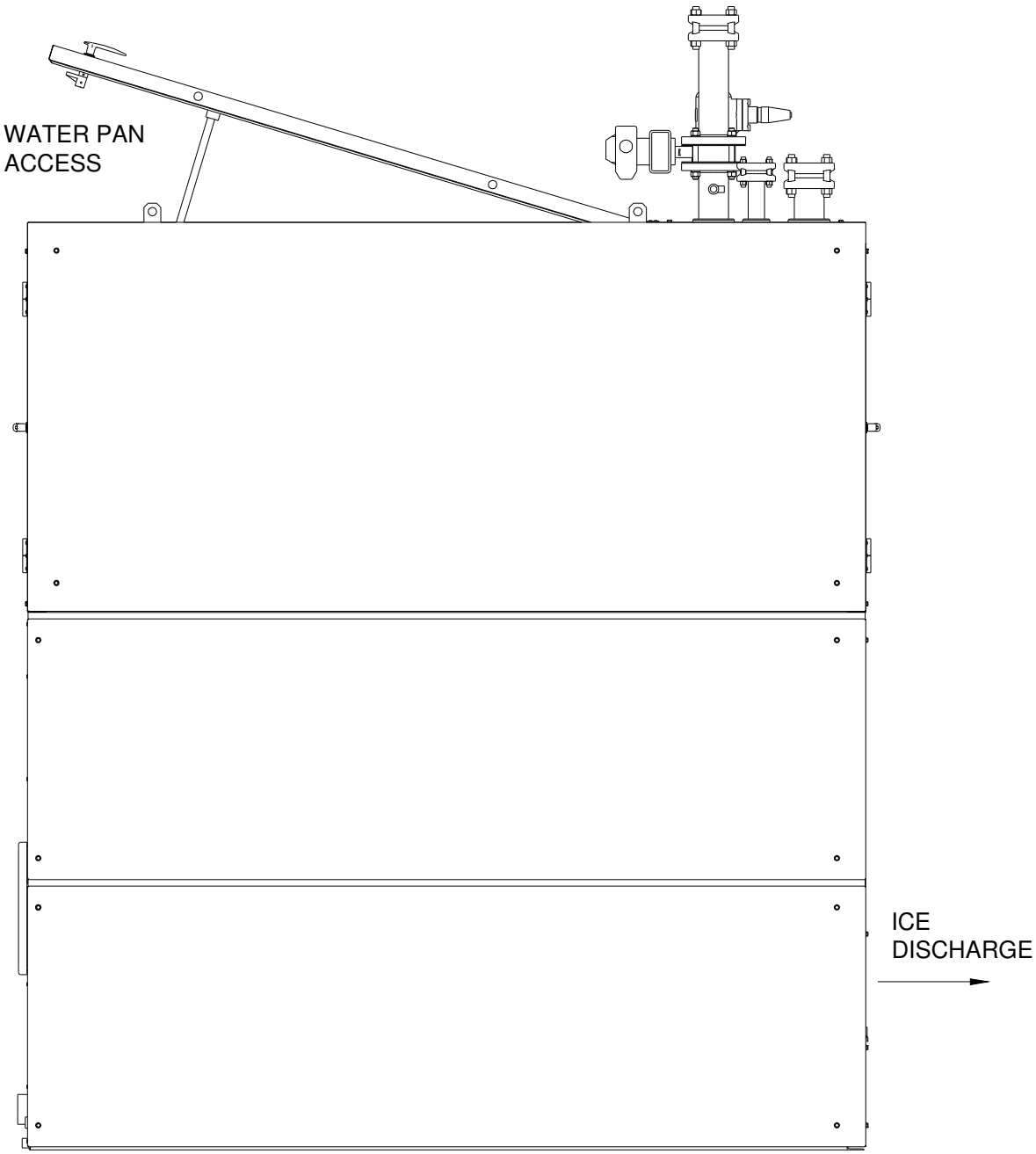


FIGURE 1-3
Modular Flooded Right View

2. Receipt Of Your Vogt Ice Machine

! CAUTION !
Only service personnel experienced in ammonia refrigeration 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 anhydrous ammonia.** **An approved ammonia mask should be readily available for use in an emergency and all personnel should be aware of its location and proper use.**
! CAUTION !

Inspection As soon as you receive your machine, inspect it for any damage. If damage is suspected, 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 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.

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.

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.

Safety Valves This equipment is provided as a component of a larger refrigeration system. As such, pressure safety valves are not provided from the factory. The end user bears the responsibility of the proper sizing, selection, installation, and maintenance of pressure safety devices. Sizing must be to the appropriate industry, local, and national codes, and must not allow the pressure in the equipment to exceed 110% of MAWP. Vent the pressure relief valves to the atmosphere in such a manner as to comply with industry, local, and national codes.

RECEIPT OF YOUR TURBO REFRIGERATING MACHINE

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.

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.

Turbo Modular Machines
Unified Model Number Structure

(example is for MT12A, aluminum exterior panels,460/3/60 power, 110/1/60 controls, Galvanized construction, and single point power)

MT12A – LN1 – 63G - ACE

Number of Plates
"MT12" – Hot Gas Defrost
"MC12" – Hot Water Defrost

Refrigerant
"A" - Ammonia
"F" - R-22
"H" - R-404a

Basic Configuration
"D" - DX (Halocarbon only)
"F" - Flooded
"L" – Liquid Overfeed
"H" - Highside

Condenser
"R" - Remote condenser
"S" - Self-contained
"M" - Marine condenser
"N" - condenser not included

Exterior Panels
"1" - Aluminum panels
"2" - Stainless steel panels

Electrical Codes

First Digit (3-phase)	Second Digit (Ctrl)
"1" - 200-3-50	"1" - 110/1/50
"2" - 220-3-50	"2" - 220/1/50
"3" - 380-3-50	"3" - 110/1/60
"3" - 415-3-60	"4" - 220/1/60
"4" - 208-3-60	
"5" - 240-3-60	
"6" - 460-3-60	
"7" - 575-3-60	

Frame Material
"G" – Galvanazised Frame
"S" – Sanitary Construction

Option/Product Variation Codes
See following page

3. Installing Your Turbo Refrigerating Ice Machine

! 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 !

Important Notice.

The Warranty Registration / Start-Up Form must be completed and returned to Vogt Turbo Refrigerating® to initiate and assure a full warranty. A postage paid envelope is provided or you may fax the report to 800-770-8648.

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 3-1.

Lifting Procedures

! CAUTION !
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.**
! CAUTION !

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. If a forklift is used, make sure its capacity is sufficient. Avoid using forks that do no extend completely under the frame. Do not lift the units using the drain pan as the support.

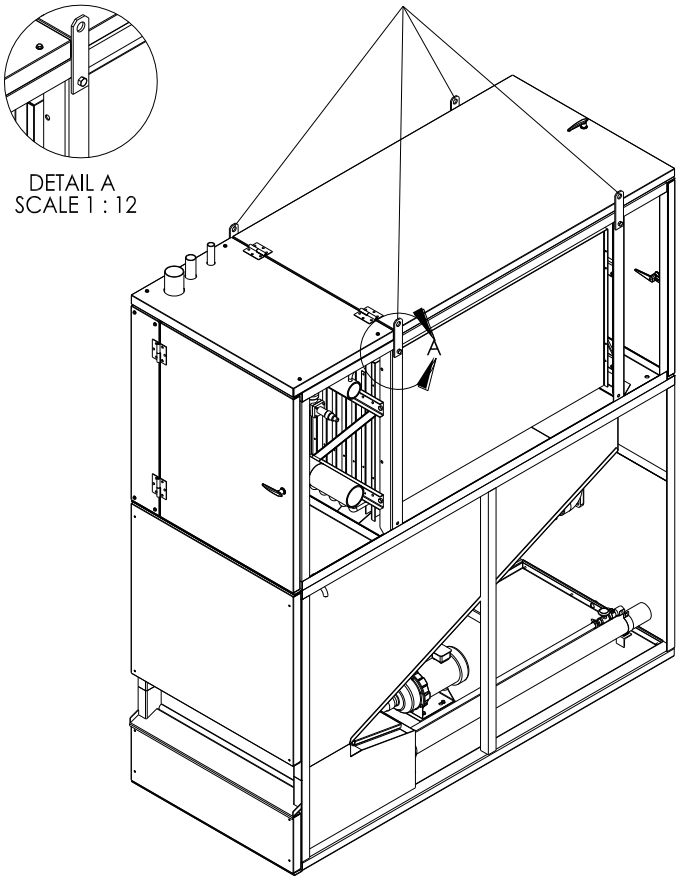
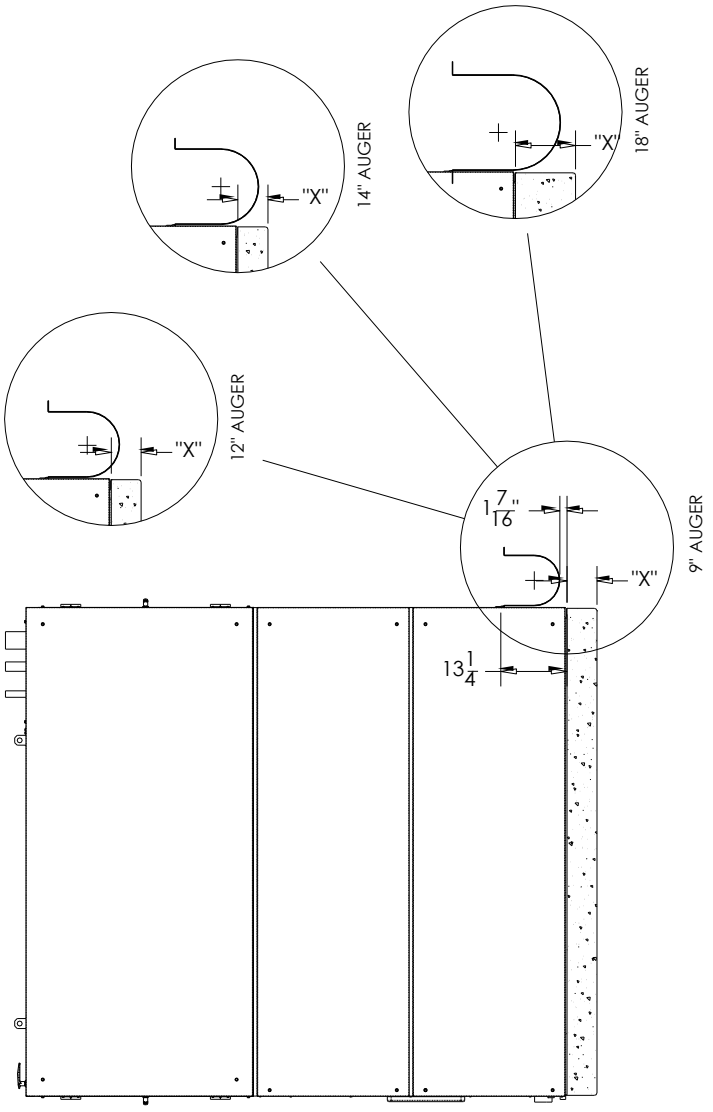


FIGURE 3-1
Lifting Procedure- Modular Unit

Foundation Layout

! CAUTION !
The approximate machine operating weight is 3,400 pounds.
! CAUTION !

The machine foundation should be constructed from concrete or similar material in accordance with all local and federal OSHA codes and building regulations. The minimum required foundation size is shown in Figure 3-2. The foundations height will vary depending on the auxiliary equipment selected by the customer to transport ice to a bin or hopper. Adequate space should be allowed for servicing operations such as cleaning and auger repair.



Auger Size	"X"
9	2
12	5
14	7
18	11

FIGURE 3-2
Foundation Height- Modular Unit

Figure 3-3 indicates minimum mounting requirements. Contact your local distributor 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.

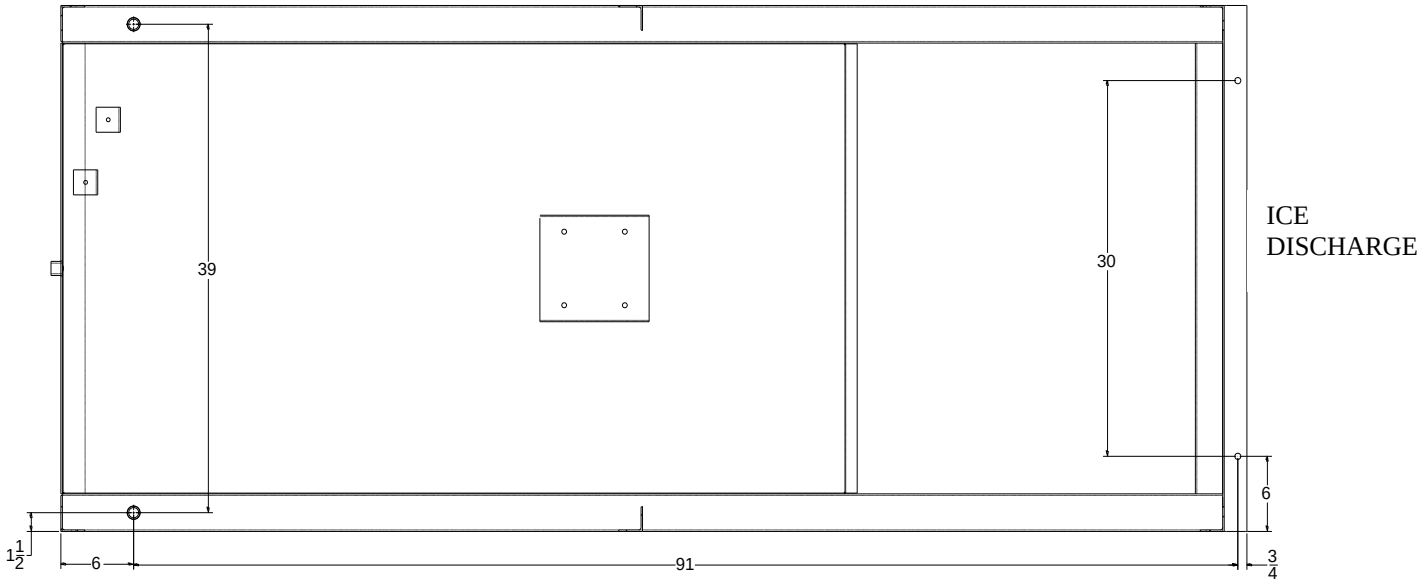


FIGURE 3-3
Mounting Detail- Modular Unit

Piping and Drain Connections

Figure 3-5 (Water Connections and Refrigerant Connections) shows locations and sizes for all connections on lowside.

! CAUTION !
External shut-off valves must be provided in the water inlet lines. The minimum inlet water pressure for satisfactory operation of the machine is 30 psig. The maximum allowable pressure is 100 psig.
! CAUTION !

Make-up Water In	Water Tank Drain*	Water Tank Overflow	Water Tank Flush Valve	Wet Suction Connection**	Liquid Connection**	Thaw Gas Connection***
3/4” FPT	1” FPT	3” FPT	3/4” FPT	3” Flange	1” Flange	1 1/2” Flange

***** The water tank drain connection must be extended to an open drain or sump, arranged for visible discharge.
****** Mating 4 bolt flange supplied with machine.
******* Mating 2 bolt flange supplied with machine.

TABLE 3-1
Water Supply, Drain and Refrigerant Line Sizes

! CAUTION !
The drain lines must NOT be connected into a pressure tight common header due to the possibility that warm condenser water may back up into the water tank. The condenser water outlet MUST be piped separately to the drain.
! CAUTION !

Make-Up Water In. The water 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 and flushing water lines 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.

Water Tank Drain. This valve and 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. A 3" FPT connection on the rear of 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 flushing 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.

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.

Blowdown Valve. Additional blowdown may be necessary to melt ice fines and 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, this blowdown can be reduced by installing a smaller orifice in the flushing outlet elbow. Make sure there is enough flushing water to prevent the accumulation of excessive ice fines in the tank.

If overflow and flushing water can be connected by a common drain line to the machine.

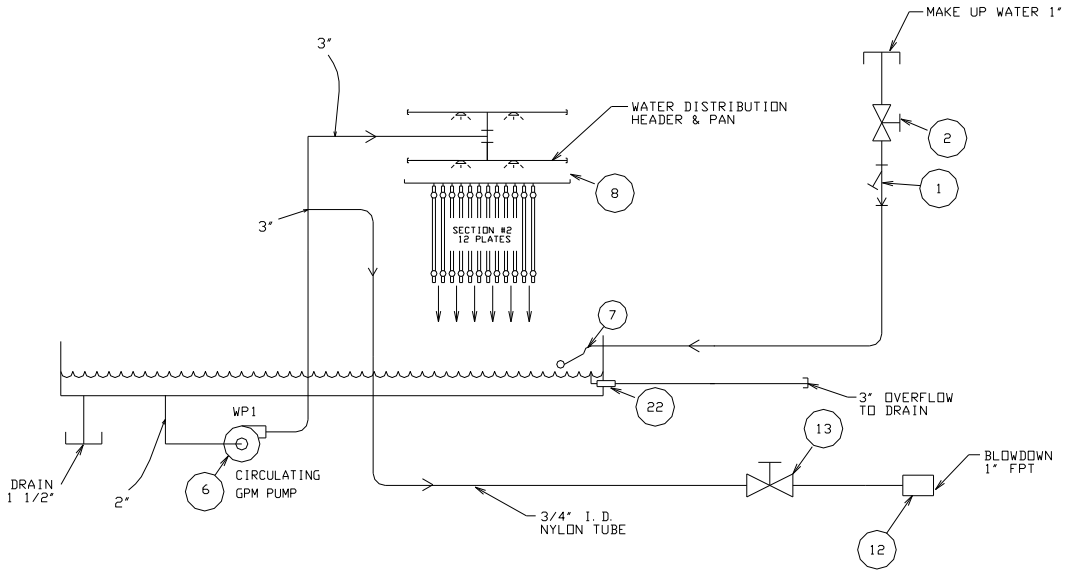


FIGURE 3-4
Water Piping

Wet Suction and Liquid Stop Valve **The MHG-LR is supplied with a stop valves on the suction and liquid connections.** These stop valves are stainless steel soleniod valves. This type valve is a normally closed valve and required power to open. These valves are equipped with a manually opening feature.

Compressor Unloading When a single MHG is attached to a dedicated compressor system unloading of the compressor will be required. A minimum compressor unloading during the harvest cycle is 66%. If the compressor can not be unloaded then a hot gas bypass to the suction line must be installed.

Safety Valves This equipment is provided as a component of a larger refrigeration system. As such, pressure safety valves are not provided from the factory. The end user bears the responsibility of the proper sizing, selection, installation, and maintenance of pressure safety devices. Sizing must be to the appropriate industry, local, and national codes, and must not allow the pressure in the equipment to exceed 110% of MAWP. Vent the pressure relief valves to the atmosphere in such a manner as to comply with industry, local, and national codes.

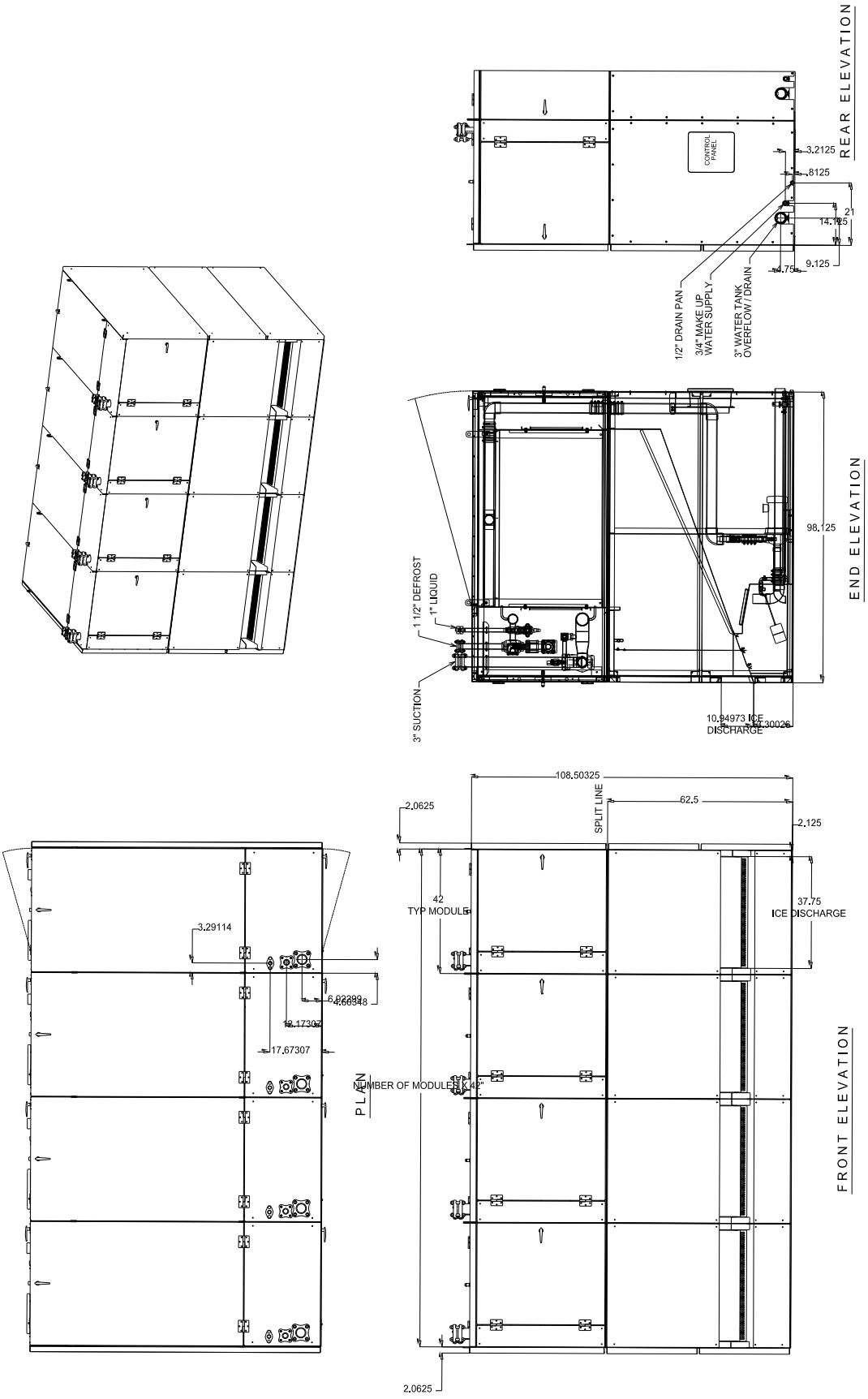
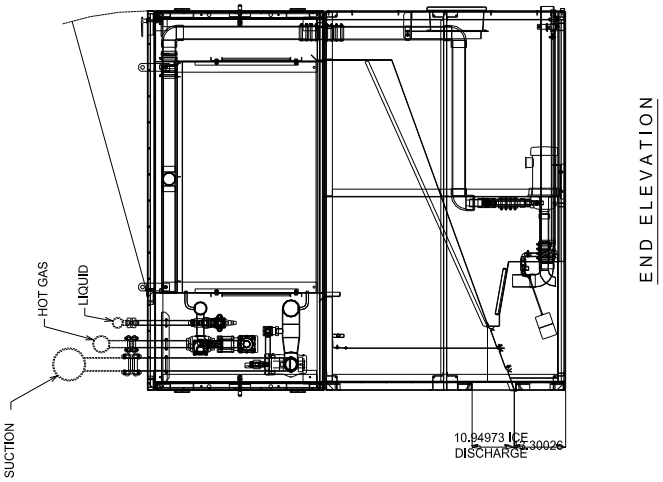
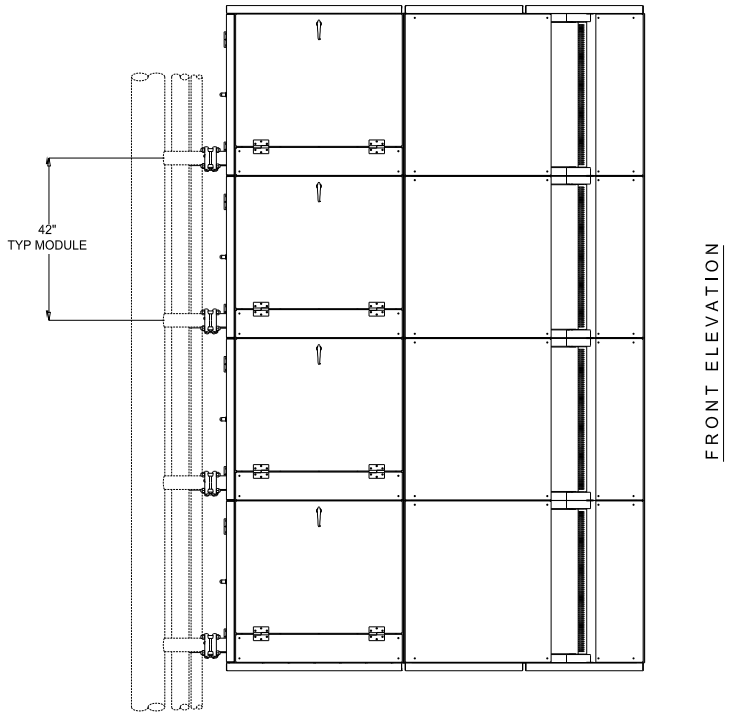


FIGURE 3-5
Spacing and Connection Diagram – LR





NUMBER OF MODULES	SUCTION LINE SIZE (OD INCHES)	LIQUID LINE SIZE (OD INCHES)	HOT GAS LINE SIZE (OD INCHES)	MAKE-UP WATER SUPPLY (OD INCHES)
1	3	1 1/4	2	3/4
2	4	1 1/2	2	1
3	5	2	2	1 1/4
4	5	2	3	1 1/2
5	6	2 1/2	4	2
6	8	2 1/2	4	2

FIGURE 3-6
Customer Piping – LR

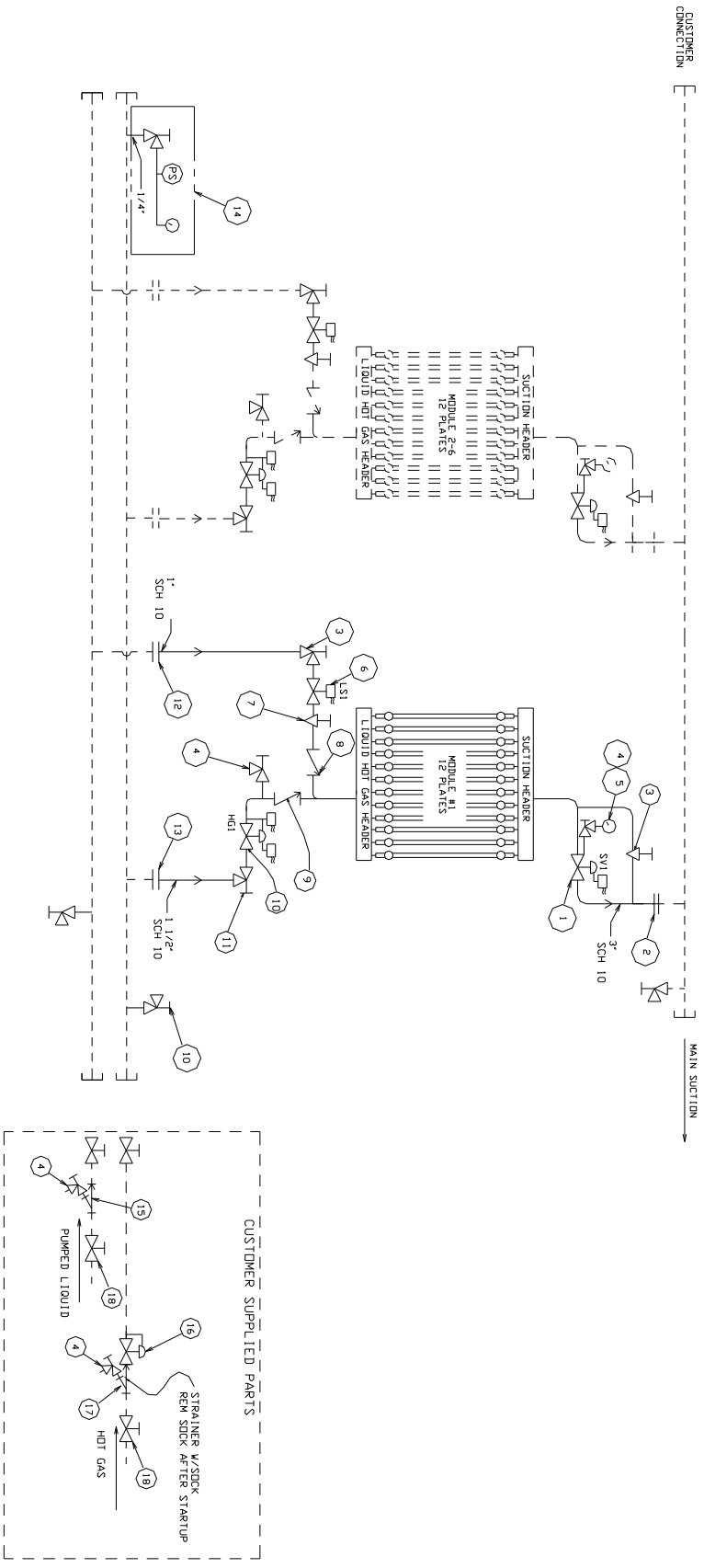


FIGURE 3-7
Piping Schematic LR

INSTALLING YOUR TURBO REFRIGERATING® MACHINE

Wiring and Electrical Connection

! WARNING !
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.
! WARNING !

Refer to TABLE 3-2 to properly size wiring connections. A fused disconnect must be provided near the Turbo Refrigerating® machine. Connect 3 phase power to terminals L1A, L2A, L3A in each Modular Panel for operation of the Turbo Refrigerating® machine. Connect 120 VAC control power to the Master Panel and each Modular unit as shown in the wiring diagrams. A typical wiring example is shown below. Rotation checking of the water pump is required (see following section). Also, if one leg of the 3 phase power is higher or lower ("Wild"), then it should be connected to terminal #L2. Connect the "Ground" wire to the "Ground" lug provided.

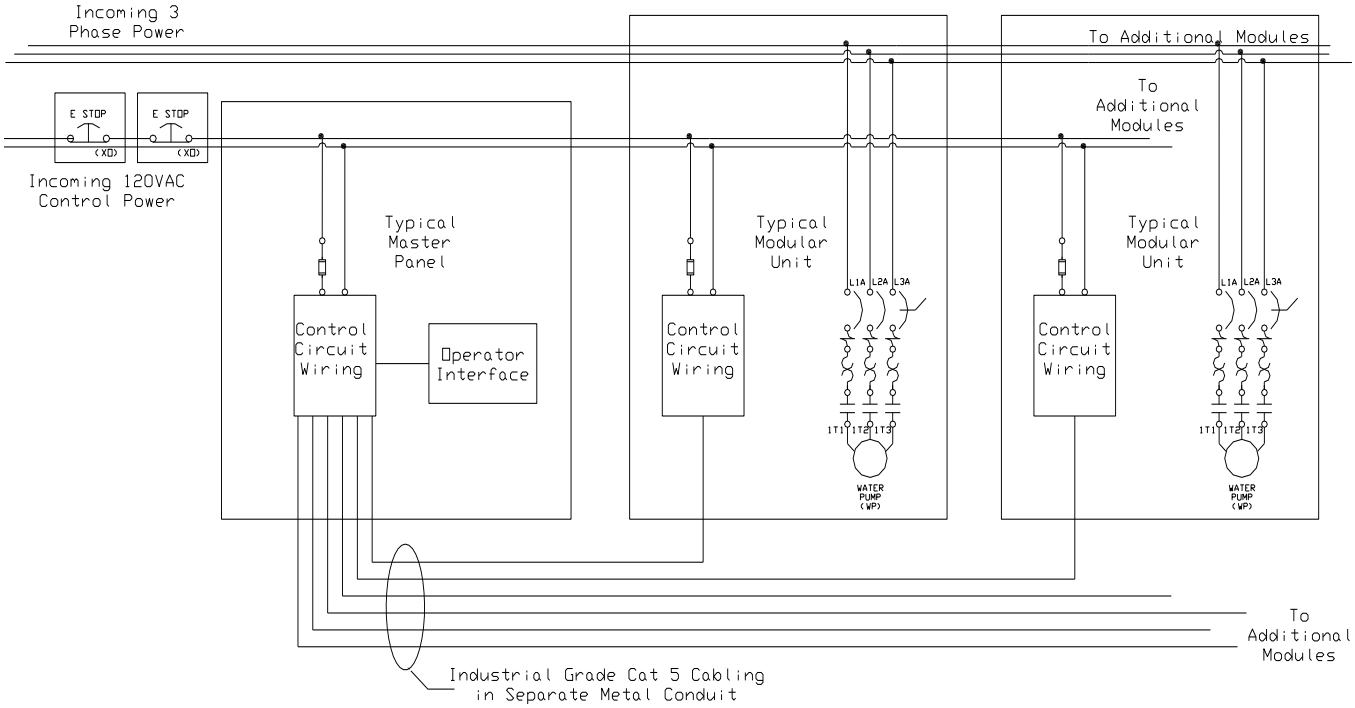


FIGURE 3-8
Typical Master Panel and Module Connection Scheme

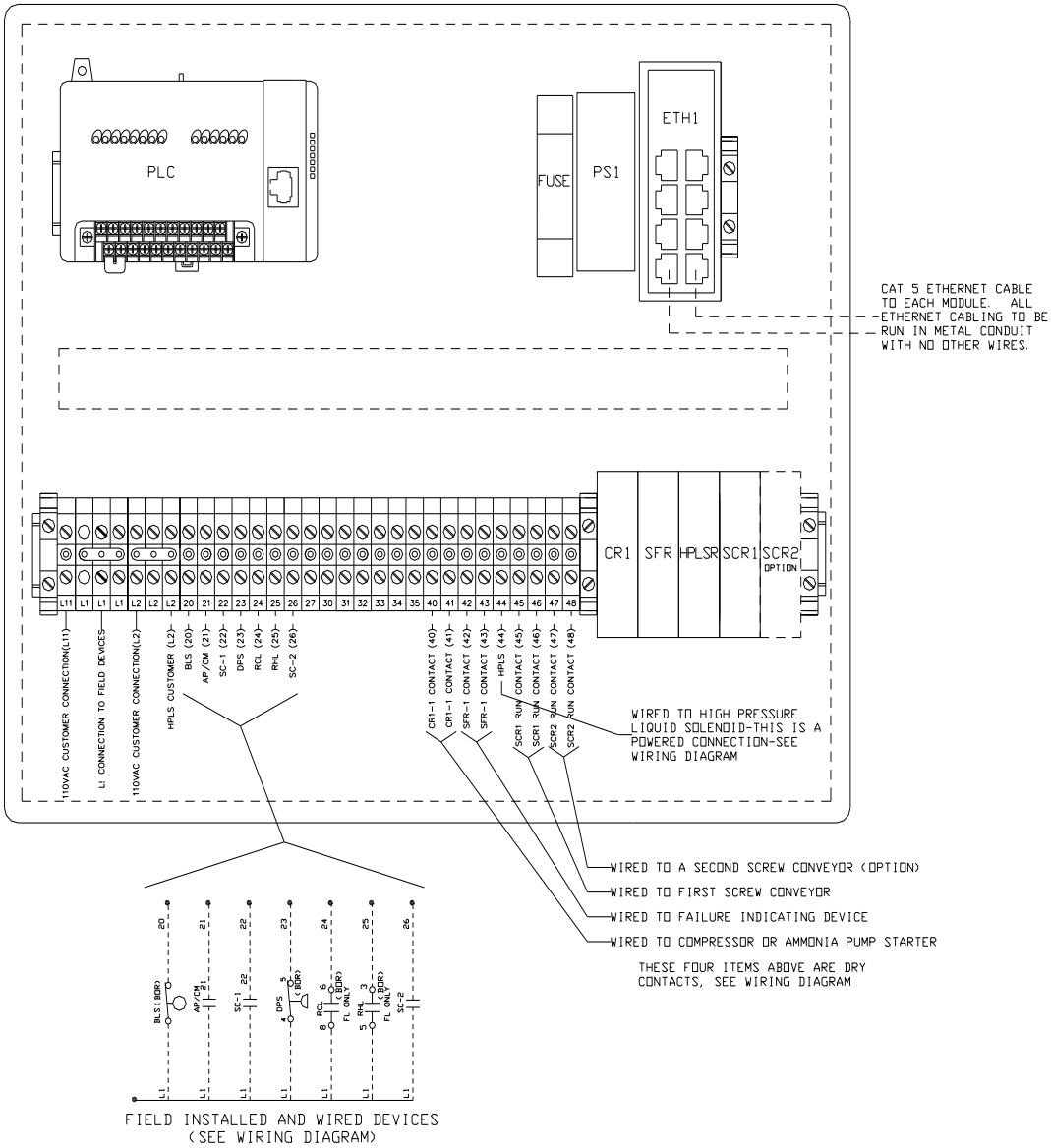


FIGURE 3-9
Master Panel Field Connections

AP/CM	AMMONIA PUMP/COMPRESSOR
BLS	BIN LEVEL SWITCH
CR1	CONTROL RELAY #1
DPS	DEFROST PRESSURE SWITCH
ETH1	ETHERNET SWITCH
FU1	FUSE
HPLSR	HIGH PRESSURE LIQUID SOLENOID RELAY (FL)
LT-1	INDICATOR LAMP
PS1	POWER SUPPLY
RCL	REFRIGERANT CONTROL LEVEL (FL ONLY)
RHL	REFRIGERANT HIGH LEVEL (FL ONLY)
SC-1	SCREW CONVEYOR #1
SC-2	SCREW CONVEYOR #2 (OPTION)
SCR1	SCREW CONVEYOR RELAY #1
SCR2	SCREW CONVEYOR RELAY #2
SFR	SAFETY FAILURE RELAY

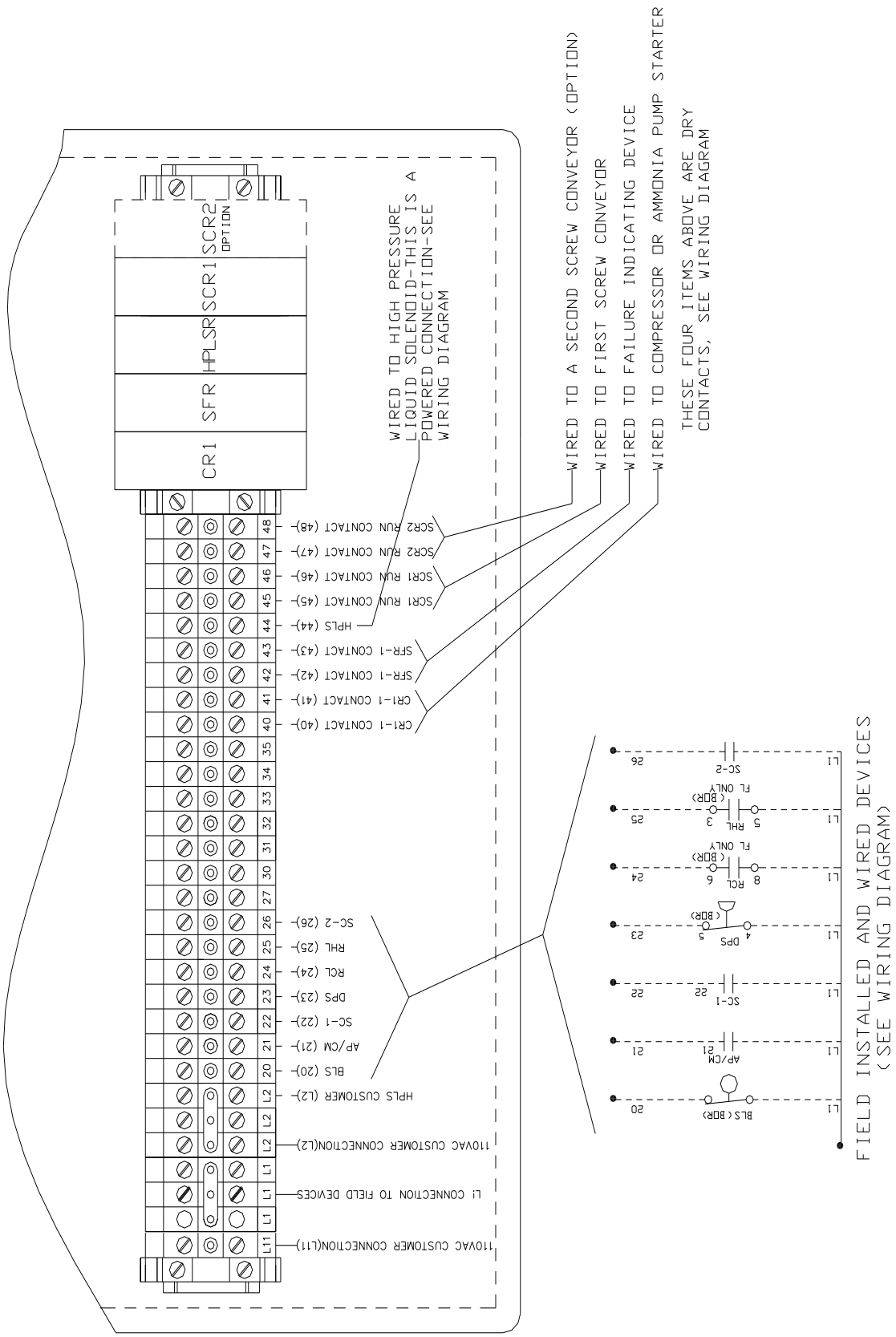


FIGURE 3-10
Master Panel Field Connections (Detail)

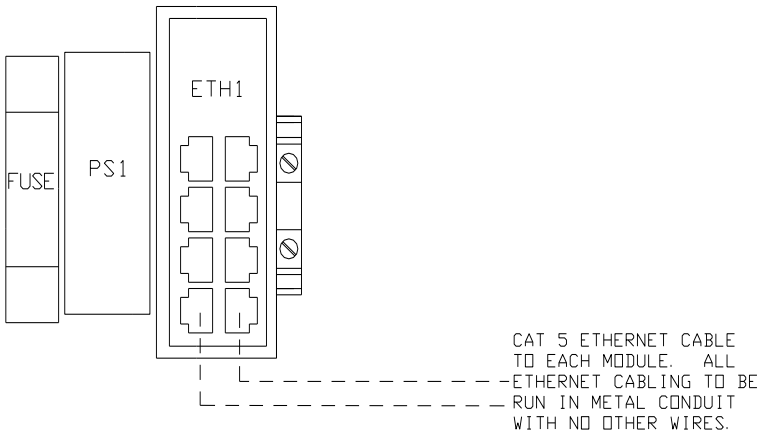


FIGURE 3-11
Master Panel Field Ethernet Connections (Detail)

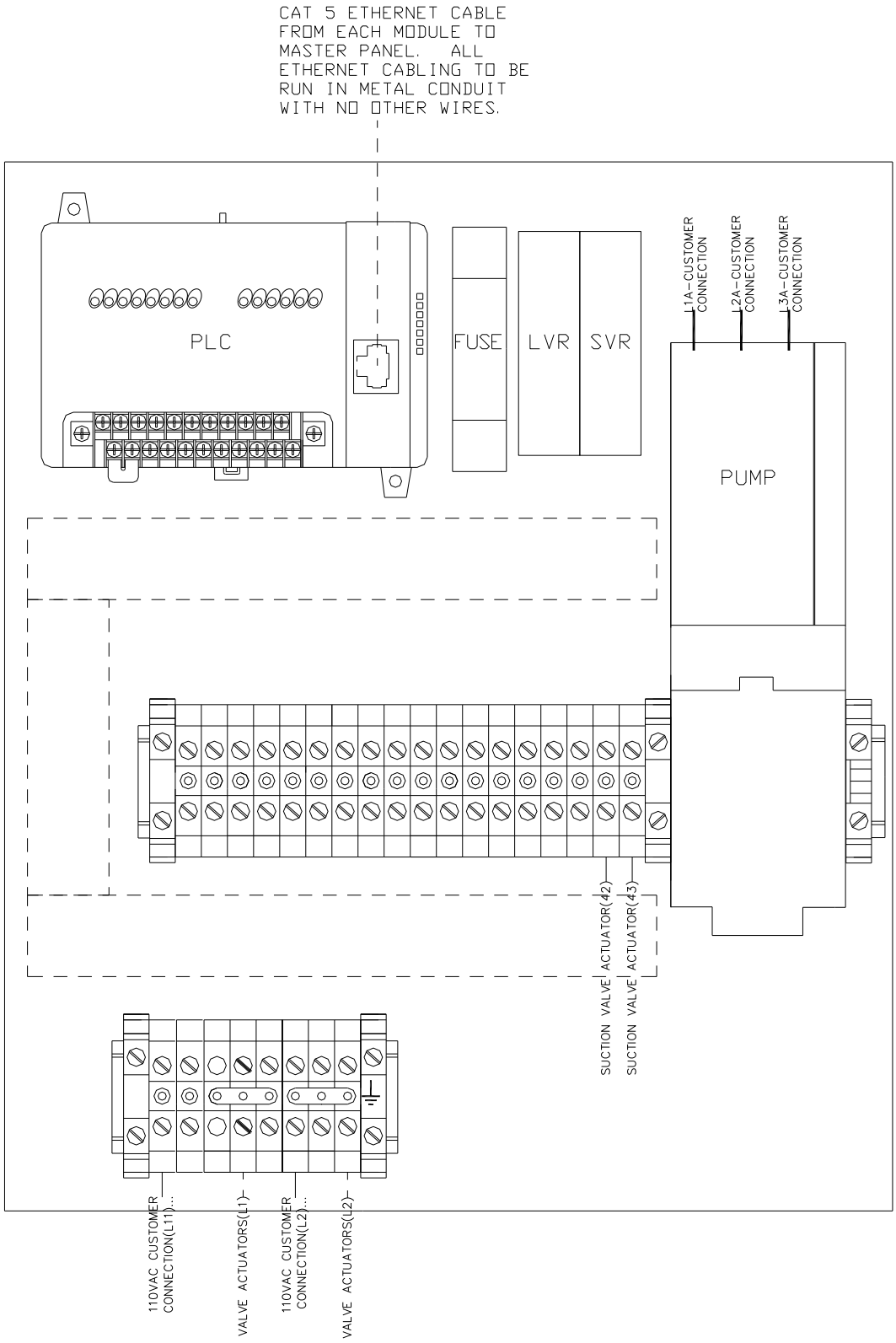


FIGURE 3-12
Modular Panel Field Connections

Standard Voltages	F.L.A.	Minimum Ampacity	Maximum Fuse
208/230, 3ph, 60 Hz	9.2	10.4	10
460, 3ph, 60 Hz	4.6	5.2	5
220, 3ph, 50 Hz	11.6	13.3	10
400, 3ph, 50 Hz	6.0	6.9	10

TABLE 3-2
3 Phase Electrical Specifications for Each Module

Note: Refer to Chapter 6 for electrical component layout and description.

Phase Check

! CAUTION !
DO NOT attempt to start machine without priming pump and insuring proper rotation of both cutter and pump.
! CAUTION !

Auger and pump motor rotation are factory synchronized but **must** be checked at installation. The pump rotation should match the marking on the pump housing. The pump will need to be primed by starting the machine in the clean mode and allowing it to run for several minutes. To change direction of rotation for both, cutter and pump, disconnect power and reverse L1 and L3 (incoming power wires) at the compressor motor contactor.

Voltage Unbalance Voltage unbalance can cause motors to overheat and fail.

The maximum voltage unbalance between any two legs should be no greater than 2%.

Example: Supply Voltage = 230-3-60
Voltage Readings: **AB = 220 Volts**
BC = 225 Volts **Average = (220 + 225 + 227)/3 = 224 Volts**
AC = 227 Volts

(AB) 224-220 = 4 Volts (Highest Deviation)
(BC) 225-224 = 1 Volts **% Voltage Unbalance = 100 x (4/224) = 1.78% "Acceptable"**
(AC) 227-224 = 3 Volts

Important: If the supply voltage phase unbalance is more the 2%, contact your local electric utility company.

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 = 95Amps

(L1) 96-95 = 1 Amps
(L2) 95-91 = 4 Amps (Highest Deviation)
(L3) 98-95 = 3 Amps

% Current Unbalance = 100 x (4/95) = 4.2% "Acceptable"

Screw Conveyor

The size of the screw conveyor and its speed are determined by the actual delivery requirements of the modular system. In most installations, 9", 12" or 16" screw conveyors are typically used. The screw conveyor is typically sized to run 90-100% full. The tables below list delivery capacities for 9", 12" and 16" screws at various speeds. The final conveyor size and selection is the responsibility of the supplier of the components. The tables are provided as guidelines only. Standard helicoids screw conveyors with standard pitch, single flight configurations are recommended for all applications. With this design, the pitch equals the diameter of the screw conveyor.

Although the maximum speed may vary from supplier to supplier, 100-150 RPM is generally the maximum recommended speed. Regardless of the recommended maximum, higher speeds result in more snow as well as increased conveyor component wear and maintenance. For your final selection, determine all factors including:

Screw conveyors connected to the floor screw will normally be operated at 30-45 percent loading versus the 90-100 percent used for the floor screw. Incline screws are normally increased 10-15 RPM while horizontal screw can be increased by 5-10 RPM since they do not have to overcome the effects of gravity. The use of vertical screws in not recommended for this reason. Vertical screw typically would have to be operated at double the speed of horizontal or incline screw due to the vertical lift required. In the previous example a 12" vertical screw used in place of the incline would have to operate at approximately 130 RPM instead of the 65 required for the incline. High speeds required for vertical screws results in high snow levels and should be avoided if possible.

Consult the supplier for recommendations for your complete conveying system.

	Screw Conveyor Diameter, inches		
	9"	12"	16"
Delivery, cubic feet / hour / revolution	16.4	38.4	93.4
Percent Loading	90		

Fragmented Ice - TURBO TIG / TIGAR (Random non-sized fragments).

	Screw Conveyor Speed, RPM			
Delivery Rate, tons of ice per hour	9" Dia. Screw	12" Dia. Screw	16" Dia. Screw	Recommended
10	**30**	**13**	**5**	9"
15	**46**	**20**	**8**	9" or 12"
20	61	**26**	**11**	12"
25	76	**33**	**13**	12"
30	*91*	**39**	**16**	12"
35	*107*	**46**	**19**	12"
40	*122*	52	**21**	16"

Ice density = 36 pounds per cubic foot (sized fragmented ice)

Shaded areas can be used

Selections in italics are not recommended.

Startup Checklist

! IMPORTANT !
Be sure to follow the wiring schematic when incorporating overloads. This is necessary to provide proper protection for the Turbo Refrigerating machine and its component parts.
! IMPORTANT !

Installation Review: A 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.

CHECK: ____ Auger gear reducer oil level oil should run out of side pipe plug when removed.

CHECK: ____ The water distribution at top of freezer to make sure they are in position

! CAUTION !
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.
! CAUTION !

INSTALLING YOUR TURBO REFRIGERATING® MACHINE

4. How Your Ice Machine Works

Principle Of Operation

For a detailed description of the functions of each control panel component, see Section 6. The Mode Switch on each Module and the operator interface at the Master Panel controls operation of the machine. Automatic operation is controlled by a (BLS) bin level switch, which will automatically stop and start the icemaker by the level of the ice in the storage bin. The program is written so that the unit will stop only upon the completion of a defrost cycle whether by action of the "Off" position of the Master switch on the operator interface, or by the bin level switch

The MCS "On" position during normal ice-making operation and the water pump selection to "Auto". The pump should only be set to the "Manual" position only when the equipment is to be cleaned as outlined in the "Cleaning Procedure", Section 7 and instructions attached to the machine.

If it should become necessary to instantly stop the machine, push the emergency "Stop" button. To restart the machine, use the MCS on the operator interface.

FIGURES 4-1 & 4-2 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 freezer (1) is a plate bank assembly of 12 plates. During the freezing period, water is constantly recirculated on the exterior of the plates by a centrifugal pump (11). Make-up water is maintained by a float valve (15) in the water tank. The electrical circuit opens and closes the liquid line solenoid valve (2), the defrost solenoid valve (3), sometimes referred to as the "D" valve, the wet suction solenoid valve (20) and the high pressure liquid feed valve (51).

Refrigerant gas from the freezer (1) passes through the suction accumulator, and 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 feeds to the low pressure receiver (32) through the hand expansion valve (52) to be circulated back to the freezer (1). The cold liquid is pumped to the Freezer through the liquid line solenoid valve (2). The cold liquid refrigerant enters the freezer where it absorbs heat from the circulating water. This cool gas is pulled out of the freezer at the suction outlet thereby completing the circuit.

The freezing period is completed by action of the freeze timer in the control panel. The water pump (11) is stopped and solenoid valves (2 and 20) are closed. The thawing period then begins. The thaw gas solenoid valve (3), sometimes referred to as the "D" valve, is partially opened and the harvest timer (T) is activated. After a brief period the thaw gas valve completely opens. Warm gas from the compressor is discharged into the freezer through valve (3), thereby slightly thawing the outer edge of the ice which drops on the ice slide for discharging. See "Freezer Period and Harvest Period" for more detailed description of operation.

Freeze Period. The Modular Plate Ice machine is frozen on the outside the stainless steel plates in the freezer (1) by the direct application of refrigerant to the inside of the plate. The ice is produced

from constantly recirculating water during the freeze period. As the ice thickness increases, the freezer suction pressure decreases. At a set time, the PLC initiates the harvest period.

Dry Out Period. At the end of freeze, there is an optional brief period where the water pump is stopped, but the refrigeration circuit still remains in freeze. This is used to slightly dry the ice prior to harvest.

Harvest Period. When the freeze time is reached, the water pump stops (optional). The solenoid valve (2 and 20) close, the "D" solenoid valve (3) opens and the defrost time begins. As the ice releases and drops through the ice slide, it is discharged through the side opening. 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.

! CAUTION !
Make sure all the ice clears the freezer with at least 20 seconds to spare before the next freeze period begins. This is to prevent refreezing.
! CAUTION !

1	Freezer Section	31	Hot Gas Strainer
2	Liquid Solenoid Valve	32	Regulator
3	2-Position Hot Gas Valve		
4	Hot Gas Shut Off Valve		
5	Service Valve		
6	Gage		
7	Thaw Gas Pressure Switch		
8	Freezer plate		
10	Check Valve		
11	Water Pump		
12	Blowdown Connection		
13	Globe Valve		
14	Overflow and Tank drain		
15	Float Valve		
16	Water Distribution Pan		
17	Strainer		
18	Gate Valve		
20	Suction Solenoid Valve		
21	Suction By-pass		
22	Flange Union		
23			
24	Service valve		

Piping Nomenclature
TABLE 4-1

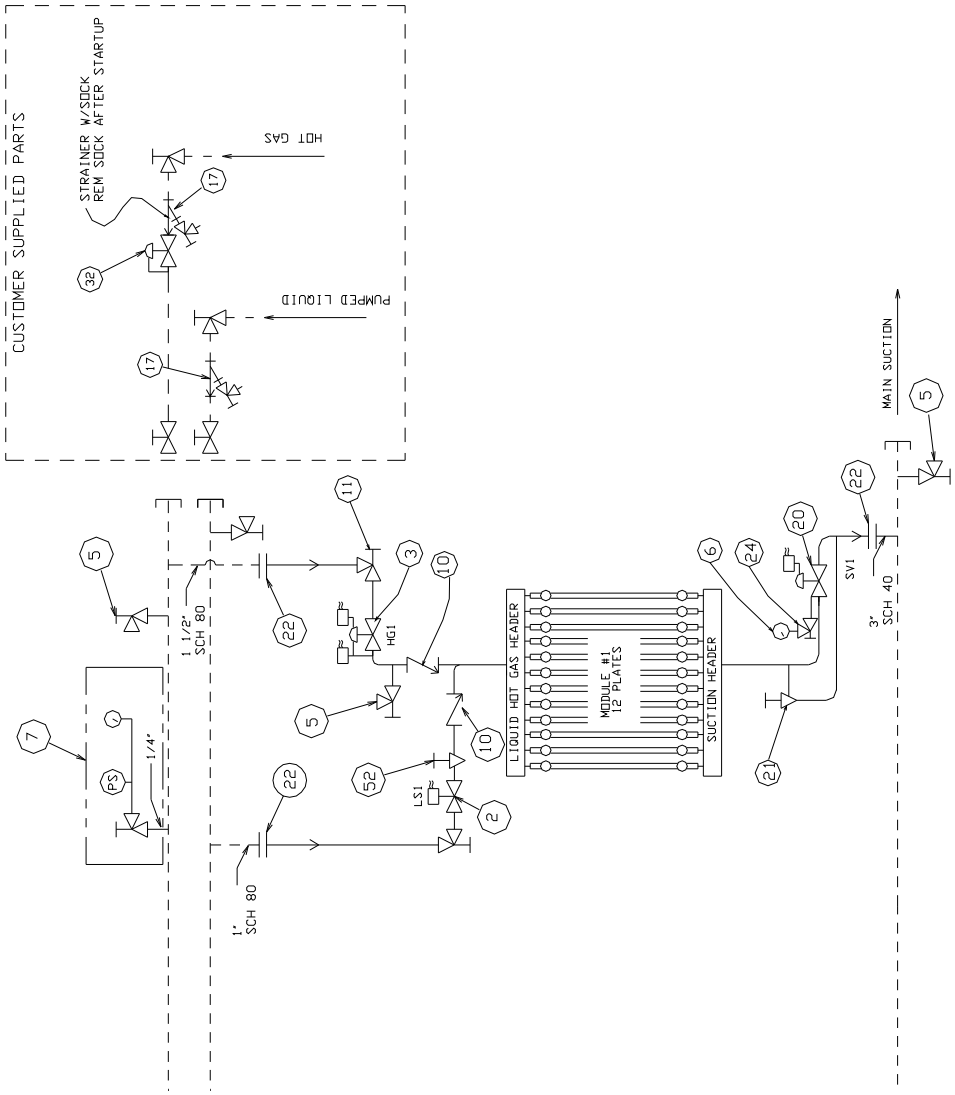


FIGURE 4-1
Piping Schematic

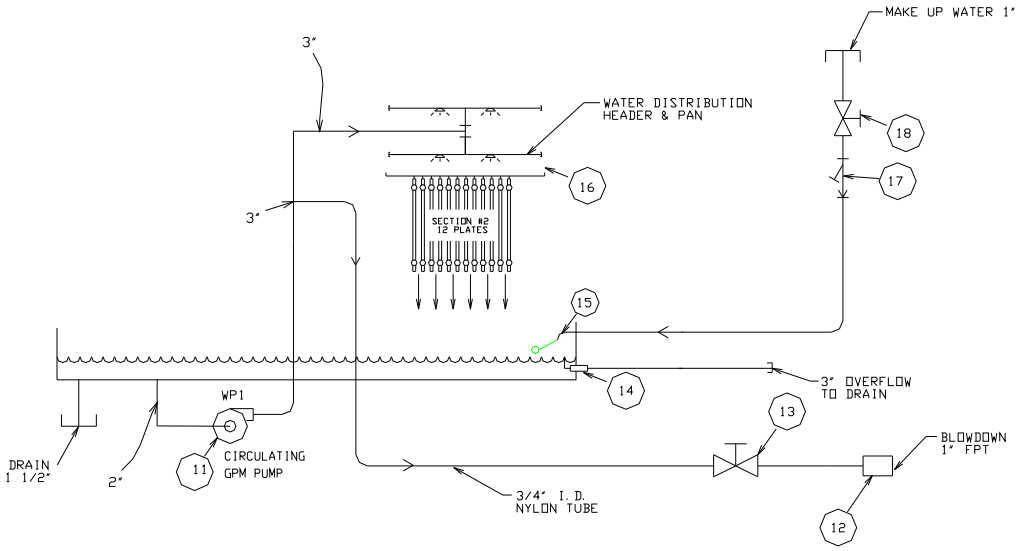


FIGURE 4-2
Water Piping Schematic

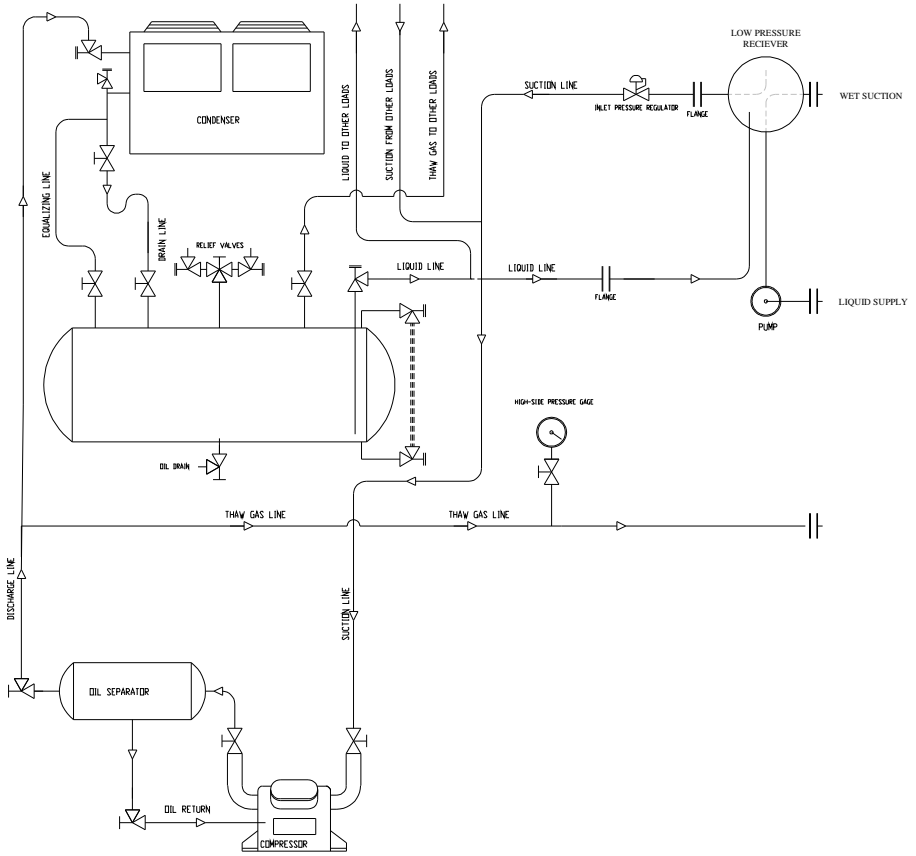


FIGURE 4-3
Typical High Side Layout

5. Start-Up and Operation

Refrigeration System Review The refrigeration system uses anhydrous ammonia (R-717) refrigerant. Following the piping schematic (Figure 4-1, 4-2 and 4-3), you will see that during the machine's freeze cycle, the compressor discharge gas goes through the oil separator to remove any oil present in the discharge gas and return the oil to the compressor crankcase. It is then discharged into the condenser and condensed into a liquid by the removal of heat by water passing through the condenser tubes. A reservoir of liquid R-717 is accumulated in the receiver. Liquid from the receiver flows through the strainer to the solenoid valve (51) which opens and closes by action of the level column level control (46). The liquid is then expanded through the hand expansion valve (52) and into the low pressure receiver (LPR). The cold wet R-717 refrigerant floods the evaporator through the liquid solenoid valve (2) and is in contact with the outside of the ice making plates which water is being circulated over. 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 long sheet of ice that adheres to the outside of freezer 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 flushing valve helps to rid the water tank of increased dissolved solids by flushing them out the overflow during the harvest (thawing) period.

The wet suction gas leaves the freezer and passes through the LPR, where liquid droplets are removed, and allowing dry gas to enter the suction side of the compressor. The suction gas is then compressed and discharged once again, completing the cycle. As ice continues to form in the freezer plates, the suction pressure steadily decreases, when the freeze timer times out the contact closes, initiating the thaw (harvest) cycle.

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

During the harvest period, the "D" thawing gas valve (3) opens in two stages to prevent shock to the plates .The compressor unloads (when required), allowing the warm high pressure gas from the compressor to enter the freezer section. 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 discharging out. Harvesting requires about 1 1/2 minutes, but can vary depending on ice thickness, suction pressure, discharge pressure (thawing gas temperature) and distance from the compressor to the freezer.

! IMPORTANT !
It is a good idea and will be profitable for you to observe and become familiar with the proper operating characteristics of your Tube-Ice® 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 !

Refrigerant Charge Prior to charging the machine with anhydrous ammonia (R-717) make sure the system is leak tight and free of non-condensables or other contaminants.

The machine will require a full charge of pure anhydrous ammonia. Make sure it is from a reputable supplier who can and will furnish quality ammonia of Refrigeration or Federal Technical grade.

Grade	Minimum Ammonia Content	Maximum Water Content	Maximum Oil Content	Maximum Non-condensable
Fertilizer	99.50%	5000 PPM	5 PPM	N/A
Refrigeration	99.98%	150 PPM	3 PPM	.2 ml/g
Federal Technical	99.98%	200 PPM	5 PPM	None
Metallurgical	99.99%	33 PPM	2 PPM	10 ml/g
Research	99.999%	5 PPM	1 PPM	7 PPM

(Reference IIAR Ammonia Data Book Chapter 1, General Information)

NOTE: Do not use Fertilizer grade ammonia.

TABLE 5-1
Ammonia Specification By Grade

Total ammonia (R-717) charge required: Evaporator only - 100 lbs.
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 of anhydrous ammonia 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 ammonia (R717) refrigerants. See "Material Safety Data Sheet", MSDS Code5B81-83, for detailed information.

Charging From Tank Truck (dedicated high side only). The system may be charged by bulk from a tank truck and be pumped directly into the receiver through the drain valve.

Follow these instructions with caution:

1. Using a ammonia approved charging hose, connect one end to the drain/charging valve in the bottom of the high pressure receiver.
2. Connect the other end of the charging hose to the tank truck. It is best to have a gage in this line to indicate pressure.
3. Open the drain/charging valve and the fill valve from the tank truck.
4. While observing the sight glass on the high pressure receiver, fill the receiver to the proper volume.
5. 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 ammonia and should be disposed of in accordance with local, state and federal safety and environmental rules.

! CAUTION !
Do NOT attempt to bulk charge the machine through the freezer charging valve (30). The freezer will not hold the full charge without exposing the compressor to serious damage.
! CAUTION !

Charging From Cylinders (dedicated high side only). The machine may also be charged from refrigerant cylinders. To charge from cylinders, the compressor will have to operate to transfer the ammonia from the freezer to the receiver. 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:

1. Using a approved for ammonia charging hose, connect one end to the charging valve (5) located on the freezer liquid line.
2. Lay a full cylinder of anhydrous ammonia horizontally with the cylinder valve outlet pointing up to withdraw liquid and the bottom end raised about 2" higher than the top end.
3. 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.
4. Close the liquid line stop valve (50) or the receiver liquid feed valve.
5. Open charging valve (5) and carefully purge air from the charging hose.
6. 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.
7. Set the freeze timer to maximum setting.
8. Check compressor rotation by starting and stopping the compressor momentarily. Jog the compressor by using the green "Start" push button (PB2) and the red "Stop" push button (PB1) in sequence. Correct compressor rotation is indicated by an arrow on the outer rim of the oil pump assembly (opposite the shaft end of the compressor).
9. Set the water pump on one or modules to the "Manual" position via the operator interface allowing the circulating water pump to circulate water through the freezer.
10. As the pressure continues to rise in the freezer, start the compressor and pump the ammonia into the receiver. Make sure water is circulating through the condenser and water distribution pan.
11. The machine will make ice during the process and care should be taken not to freeze the ice solid. If necessary harvest the ice and repeat the process.

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 R-717 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 hose from the cylinder. Loosen the union in the refrigerant charging line--carefully to avoid liquid ammonia release into the atmosphere.

! 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:

a) Discharge pressure - 175 psi to 200 psi maximum
b) Compressor oil pressure - Mycom W-Series, 18-27 psi, Vilter 450-Series, 35-50 psi. Other models will vary (check manufacturer's specifications).
c) Liquid level in receiver
d) 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. Loosen the union in the charging line gradually to relieve the ammonia pressure slowly.

When charging is complete, stop the machine, disconnect and lockout the power. Open liquid line stop valve (50) and/or receiver liquid feed valve and you will hear liquid refrigerant flowing through to the liquid solenoid valve (52). Turn main power disconnect to the on position and the machine is ready for start-up and ice production.

Start-up

! CAUTION !
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.
! CAUTION !

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

1. Make sure the crankcase oil temperature is approximately 100 ^{o}F and there is no liquid ammonia in the crankcase.

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

3. 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.

4. Push the MCS button to "ON" via the operator interface at the Master Panel.

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

6. 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.

7. Set the defrost gas pressure regulator. See "Defrost Gas Regulator" on page 5-7 for instructions.

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

9. Complete the remaining part of the "Warranty Registration/Start-Up Report" and return it to the TUBE ICE®, LLC.

Thaw Gas Regulating and Suction By-pass Valve. The following is the procedure for regulating valve adjustment. On dedicated compressor systems, the suction regulating valve is not required. However the compressor must unload by 50% or greater during the harvest or a hot gas bypass must be installed.

1. Install gauge and gauge valve in gauge port of regulator.

2. Turn high pressure stem (down stream pressure) on suction regulator into the milled flats, do not turn milled flats into packing nut.

3. Start the machine and initiate a harvest.

4. Adjust thaw gas regulator to build pressure to 80 - 85 psig (1 turn is approximately 13 psig).

5. Adjust (downstream) by-pass valve 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.

Shut-down

! CAUTION !
The red "Stop" button should only be used for emergency shutdown. For normal shutdown use the Master switch on the operator interface.
! CAUTION !

1. 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.

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

3. 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 freezer to prevent refreeze when the machine is restarted.

4. If in a harvest, the machine will complete the harvest and stop.

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.

6. Electrical Controls-Description

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 20 modules. 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 a 3" 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 2 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 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.

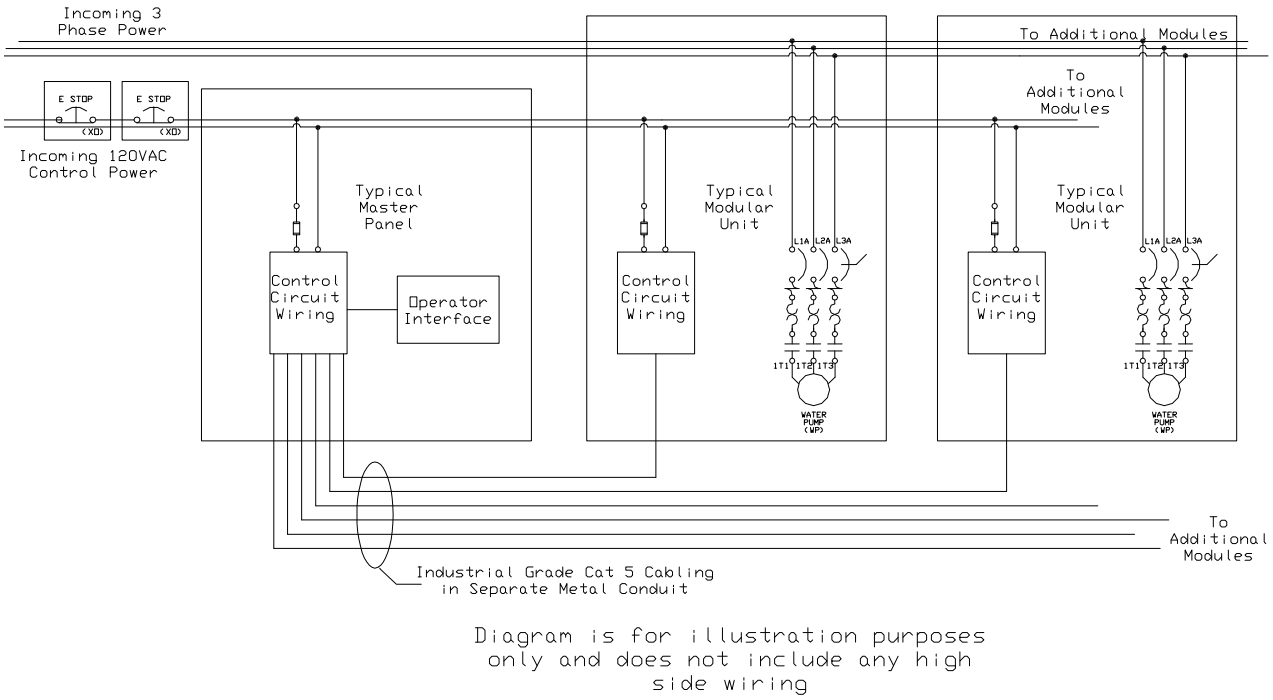


FIGURE 6-1
Diagram depicting a typical Master/Modular set up.

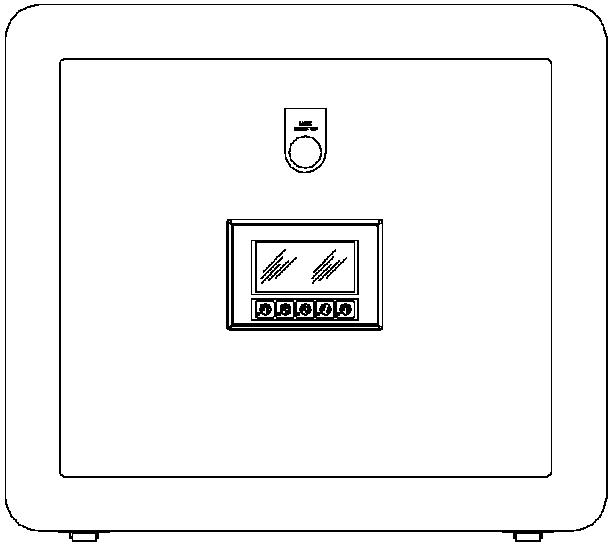


FIGURE 6-2
Exterior view of Master Panel showing the operator interface and an indicator light.

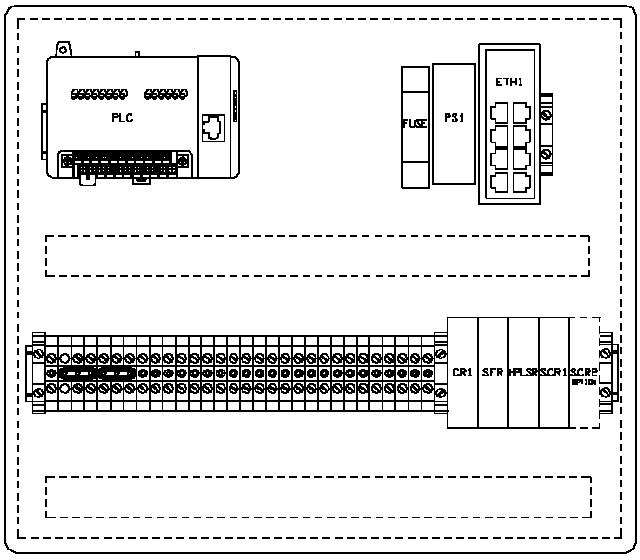


FIGURE 6-3
Internal view of Master Panel

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

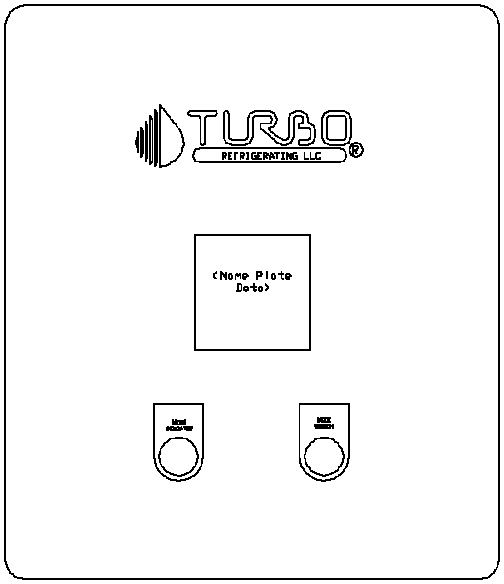


Figure 6-4
External view of Modular Panel showing the mode pushbutton and the mode indicator light.

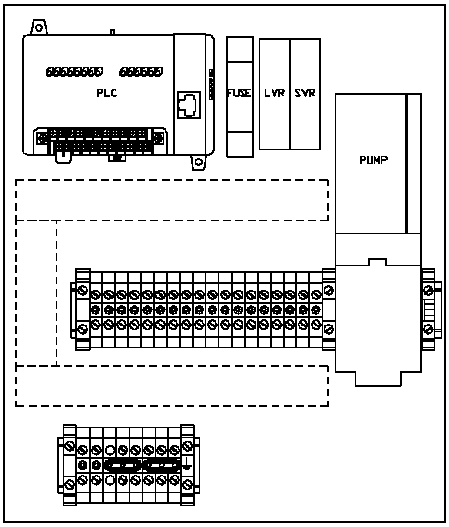


FIGURE 6-5
Internal view of Modular Panel

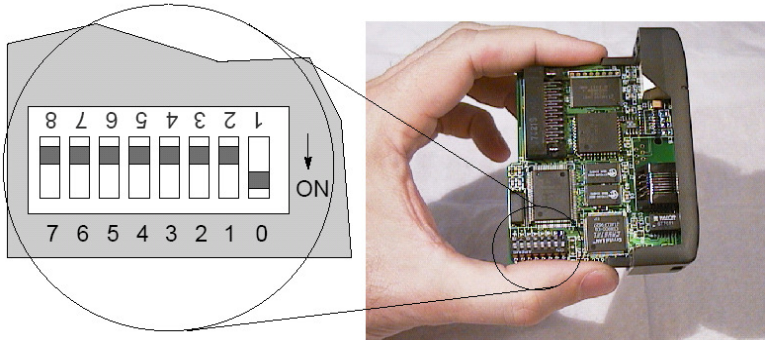
PLC	Programmable Logic Controller-controls the various valves and relays wired to the panel and contains the program.
FUSE	Fuse-protects the control circuit inside the control panel
LVR	Liquid Valve Relay-provides open and close control for motorized liquid valve.
SVR	Suction Valve Relay-provides open 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
Modular Control Panel Components

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. These cards must be properly configured to allow communication between the various panels. 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.



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 do not 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									
				16	8	4	2	1	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 settings for ECOM

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/Reset	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. If the Module has a failure, this will clear the failure for this module only.
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.

TABLE 6-4
Functions of the 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.

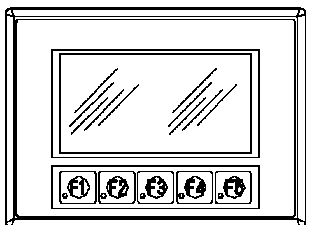
Mode Indicator Flashes	Description
One Flash	Module has shifted to the Off mode
Two Flashes	Module has shifted to the Auto mode
Three Flashes	Module has shifted to the Manual Defrost mode. Once defrost is complete, the module will turn off.
Four Flashes	Module has shifted to the Manual Defrost mode. 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.

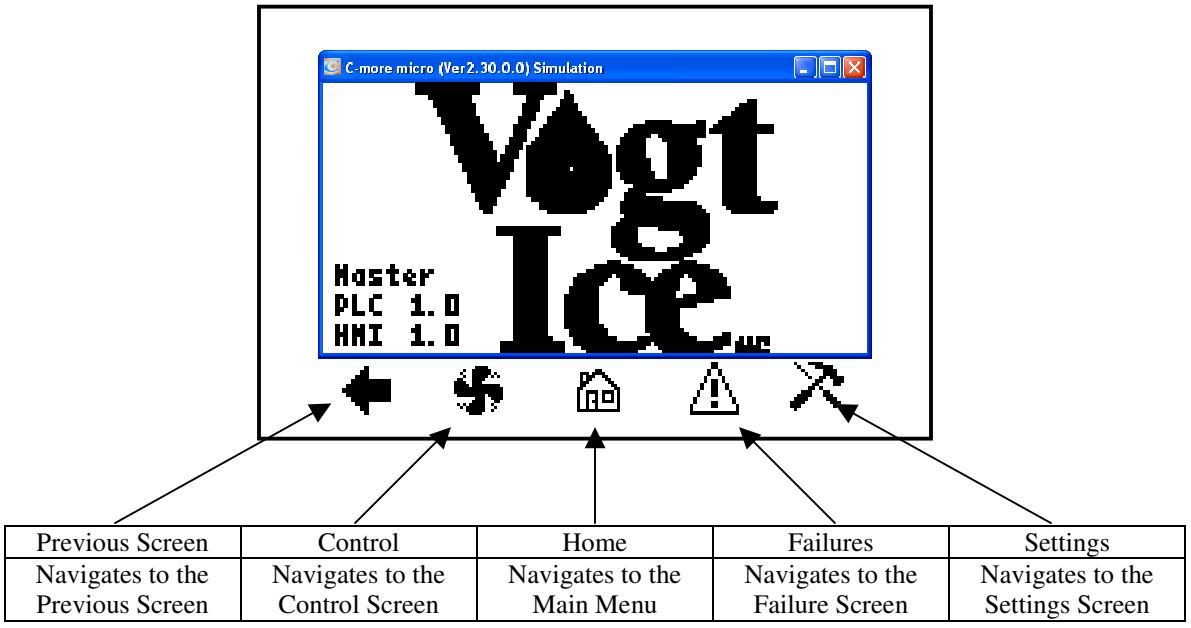
TABLE 6-5
Failure Indicators

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.

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 20 ice making modules. 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 and several screens for the input of set points and timer presets. These screens are organized into groups. See the tables/figures below for a list of these groups and a description of what they control.



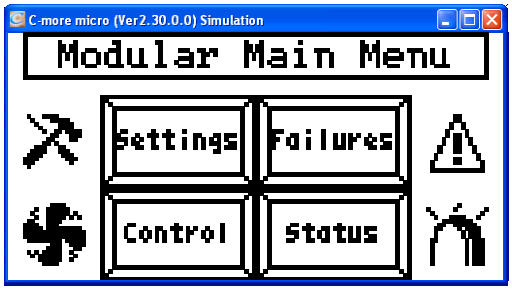


Previous Screen	Control	Home	Failures	Settings
Navigates to the Previous Screen	Navigates to the Control Screen	Navigates to the Main Menu	Navigates to the Failure Screen	Navigates to the Settings Screen

FIGURE 6-6
Operator Interface Function Buttons

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.



- Settings: The Settings Menu will present you with two more choices, Ice Maker settings and Screw Conveyor settings.
- Control: The Control Menu will present you with four choices, MCS Screen, Module Modes, 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 three choices: Inputs, Outputs, and Modules.

Note: a description is located in the next table for those items with ( )			
Main Menu	Settings	Ice Maker	Cycle Time (1)
			Normal Defrost Time (2)
			Dry Time (3)
			Liquid Valve Control (4)
			Hot Gas Main Valve Delay 5)
			Manual Defrost Time (6)
			Extended Defrost Time (7)
			Cycle Extend Count (8)
			Water Pump Setting (9)
		Screw Conveyor	Screw Run Time (15)
	Control	MCS Screen	Master On/Off (20)
			Module Control (21)
		Module Modes	Off (22)
			Auto (23)
			Manual Defrost, then Off (24)
			Manual Defrost, then Auto (25)
		Conveyor Purge	Purge (30)
		Module Pump Control	Manual Pump Control (32)
	Failures	Present Failure	Silence (40)
			Clear (41)
		Failure History (42)	
	Status	Inputs (43)	
		Outputs (44)	
		Modules (45)	

TABLE 6-6
Operator Interface Menu Map

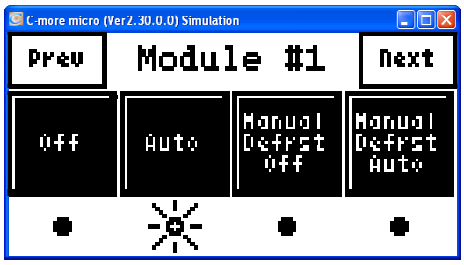
Menu Item		Description
1	Cycle Time	Length of the entire cycle for any given Module. To make thicker ice, increase this value. Entered in minutes and seconds. (mm:ss)
2	Normal Defrost Time	Length of a normal defrost cycle entered in seconds.
3	Dry Time	If the water pump is set to stop during defrost, this determines how long before defrost begins that the pump will stop. Entered ins seconds.
4	Liquid Valve Control	Determines how long before defrost that the liquid feed valve should close for that module. Entered in seconds.
5	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.
6	Manual Defrost Time	Determines how long a manual defrost cycle will last. Entered in seconds.
7	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.
8	Cycle Extend Count	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.
9	Water Pump Setting	This setting determines if the water pump runs or stops during defrost. ***Caution***-harvest time will be longer if the water pump stops during defrost. You may need to adjust the normal defrost time.
15	Screw Run Time	Determines how long the screw conveyor continues to run after defrost is complete. Entered in seconds.
20	Master On/Off	Controls the entire Modular Ice making System. “On” will the system to run if conditions permit. “Off” will stop the unit or prevent it from starting.
21	Module Control	Changes the screen to individual module control
22	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.
23	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.
24	Manual Defrost, then Off	Begins a manual defrost cycle for the indicated module. Once complete, that Module will also turn Off.
25	Manual Defrost, then Auto	Begins a manual defrost cycle for the indicated module. Once complete, that Module will also turn to Auto.
30	Conveyor Purge	Causes the screw conveyor relay to energize for purging of the screw conveyor downstream of the Modules.
32	Module Pump Control	Allow the water pump for individual modules to be run in automatic or manual.
40	Silence (Present Failure)	This silences the audible alarm created by the operator interface while a failure is present. It does not reset the failure.
41	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.
42	History (Failure)	Displays the last three failures.
43	Inputs	Displays the status of the inputs wired to the PLC in the Master Panel.
44	Outputs	Displays the status of the outputs wired to the PLC in the Master Panel.
45	Modules	Displays the status of the Modules connected to the Master Panel.

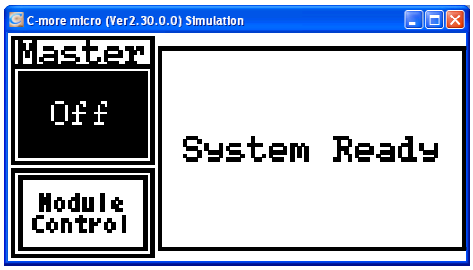
TABLE 6-7
Operator Interface Item Descriptions

Review the items on the Settings Menu screens (items 1 through 15 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. The very last screen in this string of screens will allow you to restore the original factory settings (NOTE: all previous settings will be lost if you restore to factory defaults).

Starting the Modular System

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).

7. Maintenance

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.

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)

Motor amps: Compressor _____ Cutter _____ Pump _____

Suction psig (end of freeze) _____ Discharge psig (end of freeze)_____
Suction psig (end of thaw) _____ Discharge psig (end of thaw) _____

Compressor water out ____°F Tower fan cycles ___ On ___ Off

Ice Production Check

Test Cycle	Make-up Water Temp	Freezing Time Min/Sec	Harvest Time Min/Sec	First Ice Out Min/Sec	All Ice Out Min/Sec	Avg. Hole Size	Ice lb. Per Harvest (estimated)	Ice lb. Per Day (estimated)
#1								
#2								
#3								
#4								

Comments: _____
_____
_____

Name: _____

Ice Making Section 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.

Cleaning 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 (14). 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.

Water Distribution System

Water Distribution. The water distribution pan is located under the top cover at the top of the freezer. This distributors 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 inside diameter of a large proportion of the ice becomes irregular (due to channeling of water), or if some of the ice is opaque, or if there is a noticeable decrease in ice capacity.

To clean distributors, stop the unit and remove the distribution pan on top of the freezer.. Use care when cleaning distributors to avoid distorting orifice holes or the body of the distributor. The distribution pan can be soaked in ice machine cleaner to remove mineral buildup. Rinse distribution pan thoroughly before reinstalling.

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 (14). 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.

! CAUTION !
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.
! CAUTION !

Other Maintenance Operations

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

Oil Trap. Although the compressor is equipped with an oil separator, which has an automatic return, some oil will pass through the separator and eventually settle in the oil trap (40), which is offset from the base of the freezer. This oil trap will have evidence of frost on its surface during the freeze cycle and may be more pronounced at the end of a normal freeze cycle just before the harvest. Where there is oil in the trap, there will not be frost. Where there is frost, there will not be oil. When the trap is 1/2 to 3/4 full of oil, it should be drained.

The machine should be shutdown for at least 12 hours before attempting to drain oil from the trap. Follow the procedure outlined in the service section, “Draining Oil Trap”.

! CAUTION !
Only qualified refrigeration service personnel familiar and experienced in the handling and use of anhydrous ammonia (R717) should be authorized to perform the "Draining Oil Trap" procedure.
! CAUTION !

Optional 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.

Water Cooled Condenser Cleaning (optional). 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 you 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".

Cooling Tower/Evaporative Condenser (optional).

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 7-3
Cooling Tower Maintenance Schedule

Compressor (optional). 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 !

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	3rd	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 7-4
Compressor Maintenance

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.

8.Troubleshooting

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

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

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 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 freezer 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.

TROUBLESHOOTING

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.

Symptom: Freeze-up due to extended freeze period

Possible Cause	Possible Remedy
Refrigeration timer set to long	Adjust timer setpoint 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.

Symptom: Freeze-up due to ice failing to discharge

Possible Cause	Possible Remedy
Refrigeration timer set to long	Adjust timer setpoint 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-condensables (usually air) in the system	If non-condensables 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. Air can be purged from the system by following the procedure in the Section 9, “Purging Non-Condensables”.
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.

TROUBLESHOOTING

Symptom: Low ice capacity.

Suspicions 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.

1. Time the total cycle (freeze time + thaw time).
2. Catch all the ice at the ice discharge opening of the machine for that cycle.
3. Weight the total amount of ice caught.

Lbs. ice per cycle
Cycle time minutes X 1440 = _____ lbs. production per 24 hours (Note: divide seconds by 60 to get decimal equivalent)

More than one cycle should be caught and weighed to get an accurate average.

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 (See TABLE 7-2). 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 glass mark 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.

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 and on the painted portion of the gage glass guard. Be sure to keep the gage glass cocks closed when finished checking the level.
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.

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-condensables 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. Air can be purged from the system by following instructions in Section 9, “Purging Non-Condensables”.
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 blowdown 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.

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.
Thaw gas valve (18) leaking through	Make sure manual opening stem is in the automatic (screwed in) position. Repair or replace defective parts.

TROUBLESHOOTING

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.
Thaw gas valve (18) leaking through	Make sure manual opening stem is in the automatic (screwed in) position. Repair or replace defective parts.
Suction Pressure to low	Adjust suction regulator valve
Defective gage	Check pressure with accurate gage and replace as necessary.

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.

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.

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 minute is okay. If ammonia is leaking, replace the seal.

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.

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 (pumpdown) and blow excess water out through the oil trap drain valve. Refer to Service, Section 9 "Removing Excess Water".

9. Service Operations

Total Cycle Time. The freezing time period for the production of ice on the plates is controlled by the Total Cycle Time. This setting is located in the Settings Menu via the Icemaker option on the operator interface. This controls how often defrost occurs on a specific Module regardless of how many Modules may be connected. The timer was set at the factory to a default of 15 minutes. The cycle time can be adjusted to compensate for water temperature and refrigeration system conditions. Do not make adjustments until several ice-discharging cycles have been made.

Standard Defrost Time. The defrost timer governs the ice harvesting period. This setting is located in the Settings Menu via the Icemaker option on the operator interface. This timer is set prior to shipment for approximately a two-minute period. Set the defrost time for at least 30 seconds longer than the time required to harvest the entire discharge of ice. Check defrost time after each adjustment.

Dry Time. The Dry Time is the amount of time prior to defrost that stops the water pump to allow the ice to sub-cool and dry prior to the harvest cycle. This is an optional setting that works only when the "Water Pump On/Off during Defrost" is set to "Off". If this option is selected, a longer harvest will result, make sure the harvest time is adequate if this option is selected.

Liquid Shut Off. This setting controls the time period before defrost that closes the liquid solenoid. This is used to improve harvest time.

Manual Defrost Time. This setting controls the length of a user initiated manual defrost. This setting is changed via the operator interface. Manual Defrost can be initiated via the interface or the mode selection button on the Module.

Extended Defrost Time. As an added feature of your machine, you have an extended defrost time setting that will extend defrost under either of two conditions: 1) if the Defrost Pressure Switch detects a low pressure condition, this time is added to the Standard Defrost Time, 2) the second condition is listed below.

Defrost Extend Count. Every time defrost occurs on a module, a counter is incremented. When that counter reaches the set point of this setting, the defrost is extended by the setting of the Extended Defrost Setting.

Conveyor Timer. This setting controls how long the screw conveyor runs after defrost ends.

Make-up Water Float Valve (37A). The make-up float valve maintains the proper level in the water tank for ice making. The valve should be set to maintain a water level in the water tank during the freezing period so that there will be a quantity of blowdown only during the thaw mode. The water level during the freeze mode should always be below the overflow piping to prevent excessive waste of cold water, resulting in loss of ice capacity.

If it should become necessary to clean the float valve, close the stop valve in the make-up water line to the machine and remove the float valve. After the valve has been cleaned and reinstalled, check to

ascertain if the proper water level is being maintained. After the machine is stopped and the water in the tank seeks its normal level, there should be no water flow through the float valve or overflow.

It is advisable to install a large area strainer in the water supply line to protect the float valve from dirt or solids in the water that would necessitate frequent cleaning. A strainer of 40-mesh screen is usually satisfactory.

Refrigerant Float Switch (23). The float switch is installed on a header assembly that is attached to the surge drum. Valves are provided for isolation of the float switch assembly if replacement or servicing is necessary. The float switch opens as the level of refrigerant in the drum rises and closes as the level falls.

The float switch is connected to the "A" solenoid valve coil. This is the solenoid valve directly before the hand expansion valve. Therefore when the refrigerant level in the freezer drops, the float switch closes, thereby energizing and opening the "A" liquid feed solenoid until sufficient level has been reached to open the float switch. The float switch has a fixed 1/2" differential.

Hand Expansion Valve (9). The hand expansion valve is located directly after the "A" solenoid valve. This valve should be set at a point where the float switch is open for a length of time approximately equal to the time it is closed.

Solenoid Valves (18,25). All solenoid valves are pilot operated with "floating" type diaphragms. For satisfactory operation be sure that the manual opening stem is in the closed or automatic position. This means the stem is backed all the way out. Correct direction of stem rotation should be labeled on the stem seal nut.

Control Circuit Fuse (FU1). The electrical control circuit of the Master Panel and any Module Panel is protected by a fuse. If fuse should open, the machine will immediately stop. Before replacing the fuse, check power to the machine. Once repowered, the machine will default to the off position. If the machine was off for an extended time the crankcase heater must be energized for a minimum of two hours before restarting the machine. When ready to restart the machine, depress the "MCS" button on the Master Panel and put any desired modules in the Auto mode. The machine will automatically return to a freeze cycle upon completion of a harvest cycle.

Circulating Water Pump Motor (5). The motor bearings are prelubricated and sealed. They require no further lubrication. The pump should operate with the water level above the impeller housing to prevent cavitation or loss of prime. The pump is equipped with a mechanical seal which is self-adjusting and requires no lubrication. However, the pump should not be operated unless circulating water. The pump manufacturer recommends that a mechanical seal be kept as a spare. When ordering a seal, specify pump size, type, serial number, and manufacturer's name as indicated on the nameplate.

Pumpdown. The function of the pumpdown is to transfer the entire liquid refrigerant from the freezer (evaporator) into the receiver. Pump-down should only be performed when the freezer is clear of ice. Its main purposes are:

1. To check the total refrigerant charge.
2. To perform service or repair work on the machine.
3. To winterize the machine.

4. To prepare the machine for disconnecting and moving.
5. Before cleaning

Pumpdown Procedure To perform a pumpdown, 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 pumpdown.

4. Allow the machine to operate and eventually it will shutdown 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 pumpdown is obtained, close the thawing 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.

7. To perform a total pumpdown, it may be necessary to apply heat directly to the oil trap in order to boil off the liquid ammonia and oil mixture.

Removal of Ammonia Refrigerant from the Machine. Liquid ammonia can be removed from the machine through the receiver drain valve. Refer to Sections 1, 2 and Appendix A for special warnings and instructions regarding the handling of ammonia. Make sure you are familiar with and technically qualified to handle anhydrous-ammonia refrigerant.

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

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

! 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 !

If ammonia vapor is released from the machine, it may be purged into water, which will absorb it. Follow the purging instructions. See "Purging Non-condensables".

Refrigerant Leaks. Anhydrous ammonia leaks can be detected by odor, sulfur stick, soap solution, or test paper. The odor is normally noticed first and the location of the leak is found with soap or sulfur stick. 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.

- Light the end of the sulfur stick and pass it around suspected points of leakage. A white cloud will form where a leak is, even if it is very small.

- Moisten a strip of test paper and pass it around the suspected area. If the paper comes in contact with ammonia, it will turn red. Coils submerged in water, or condenser cooling water may be tested by dipping a strip directly in the water. If ammonia is present, the paper will turn red. Always remove refrigerant pressure from the vessel, tubing, or component part before repairs are attempted.
  Note: Sulfur sticks and test paper can be obtained from your ammonia supplier.

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.

Purging Non-Condensables. Air and other non-condensable gases in a refrigeration system are not desirable. Purging air from your Tube-Ice® machine will greatly improve system performance and save money.

Non-condensable gas effects are:
1. Higher condensing pressure than desired.
2. Greater electrical power consumption.
3. Reduced refrigeration capacity.
4. Longer than normal compressor running time.
5. Slow ice release and long thaw 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. Evaporative condensers usually have purge points at the top of the outlet header of each circuit. Receivers usually have a purge point at the top, away from the inlet, where it is coolest and the gas velocity is the lowest.

The freezer can be purged through the valve at the top of the suction line, but should be done only during the thaw cycle or after the system has been idle at least two hours.

Purging Procedure Follow this procedure when purging:

1. Connect a suitable hose to the purge valve and place the other end in water.

2. Open (slightly) the purge valve and allow air to escape.

3. Air will appear as bubbles in the water rising to the surface.

4. The larger the bubbles, the more air is escaping.

5. DO NOT leave the purge hose unattended.

6. When air bubbles are reduced to a minute size (smaller than 1/16), it can be considered that most of the air has escaped and purging can be ceased at this point.

7. Additional purging can be done at other purge points.

8. When purging is completed, close the valve, disconnect the hose, and install a plug in the purge valve.

Draining the Oil Trap. After many hours of operation, the oil which escapes the oil separator will pass through the receiver and to the freezer where it will settle in the oil trap (22). Indication of oil in the trap will be evident by the frost line. At the end of a freeze cycle, frost (or ice) will form on that part of the oil trap where oil is not present. When frost is seen only on the top 1/4 to 1/2 of the oil trap, the oil trap should be drained. Do not allow the oil trap to fill completely with oil, or it will cause loss of ice production and possible refrigerant floodback to the compressor.

Oil Trap Draining Procedure

1. Stop the machine and wait 12 hours or more.

2. Attach a suitable hose to the oil trap drain valve #61. Make sure there are no kinks or restrictions in the hose.

3. Open the valve slightly until oil begins to drain.

4. Continually observe the oil flow, being ready to close the valve quickly.

! DANGER !
Do not leave the oil trap drain valve opened or unattended--severe injury may result
! DANGER !

5. When a small amount of liquid ammonia begins to spew out, immediately close the valve.

6. Remove the hose and install a plug in the valve. DO NOT attempt to reuse any oil taken from the system unless it is properly reclaimed and meets the proper specifications.

Removing Excess Water from Ammonia

If excessive water is in the ammonia, it will cause frost on the suction line to the compressor, and dilution of the oil. This condition should not go uncorrected and the water needs to be removed.

Water Removal Procedure

1. Perform a total pumpdown of the freezer. See "Pumpdown" page 9-4.

2. A total pumpdown is accomplished when there is no frost or ice on the freezer or oil trap and the freezer pressure is below that pressure relative to the surrounding temperature. Refer to the Temperature-Pressure chart for ammonia.

3. With the freezer pressure below 25 PSIG, attach a hose to the oil trap drain valve and extend the other end into a container (5 gallon bucket, etc.).

4. Open the drain valve a little and drain out the oil and water that is present.

5. Continue to drain oil/water, and purge the freezer and compressor to 0 PSIG.

6. Close the compressor discharge stop valve and the oil return valve. Make sure the power is disconnected and locked-out.

7. Drain the compressor oil, remove the compressor side cover and clean the inside of all oil and foreign matter, and reinstall the side cover.

8. Connect a vacuum pump, or pumps to the freezer and compressor, and evacuate them to 2000 microns or below while maintaining 60°F (10°c) or higher room temperature. A 5 CFM or larger vacuum pump is best.

9. During evacuation, add new oil to the compressor. Also purge the receiver for non-condensables.

10. After evacuation, break the vacuum by manually opening the liquid line solenoid valve and gradually opening the liquid line stop valve (24) or at the receiver, letting liquid ammonia enter the freezer and raise the pressure.

11. When the freezer (suction) pressure is up to at least 60 PSI, manually close the liquid line solenoid valve and restore power to the machine.

12. Open the compressor discharge valve, oil return valve, and all other valves that should be opened for normal operation.

13. When the receiver liquid level is near its normal operating level or the pressures are near equal and the compressor crankcase has warmed, the compressor can be started and ice production resumed.

14. After several cycles, check the system for symptoms of excessive water, and if necessary, repeat the pumpdown and evacuation procedure.

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

Appendix A

Material Safety Data Sheet # 4001

LAROCHE INDUSTRIES INC.

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:

LaRoche Industries Inc.
1100 Johnson Ferry Rd., NE
Atlanta, Ga. 30342

EMERGENCY TELEPHONE NUMBERS:

Transportation (CHEMTREC): (800) 424-9300
Environmental/Health/Safety: (800) 528-4963
Customer Service: (800) 491-7987

SECTION 2: COMPOSITION/INFORMATION ON INGREDIENTS

CHEMICAL	FORMULA	% BY WEIGHT C-grade	% BY WEIGHT P-grade	CAS	OSHA PEL	NIOSH REL / ACGIH TLV		IDLH
Ammonia	NH_3	99.5	99.995	7664-41-7	50 ppm (TWA)	25 ppm (TWA)	35 ppm (STEL)	300 ppm
Water	H_2O	0.4	33 ppm	7732-18-5	None	None	None	
Oil	-----	0.1	2 ppm	----------	None	None	None	

SECTION 3: HAZARDS INDENTIFICATION

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 durationís, 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_{100}; 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

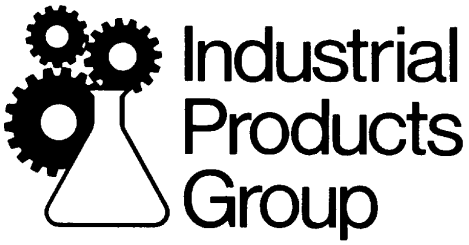
CERCLA/SUPERFUND, 40 CFR 117,302: This product contains ammonia which if released to the environment in quantities of 100 lbs. or more requires notification to the National Response Center in Washington, DC at 1-800-424-8802.

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.

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.

CONTENTS

TABLES

ANHYDROUS AMMONIA SAFETY

GENERAL

The term "anhydrous ammonia" appearing in the title of this booklet refers to the compound having the formula 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 procedures 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 opthalmologist. 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

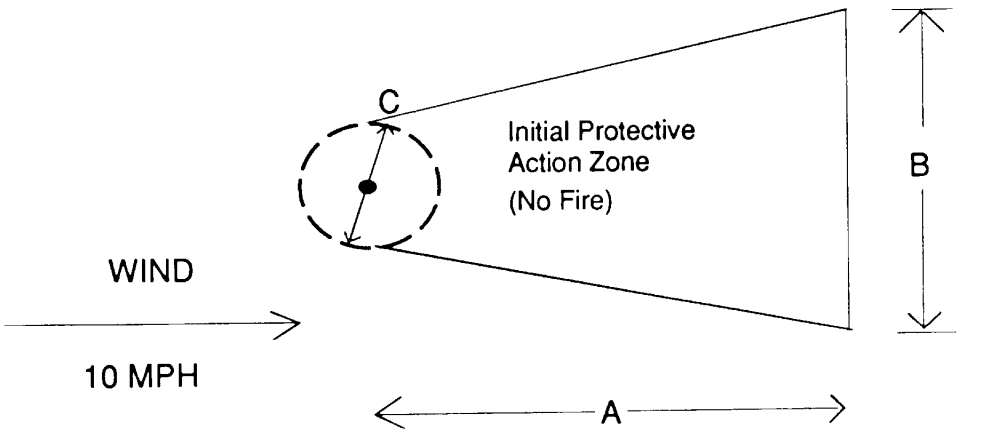
Table of Initial Isolation and Protective Action Distances

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 reseat. If reseating 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 on ly 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

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

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

Western
15116 Canary Avenue
LaMirada, CA 90638
213/691-0596

Industrial Products Group

LAROCHE INDUSTRIES INC.
1100 JOHNSON FERRY ROAD, N.E.
ATLANTA, GEORGIA 30342
(404) 851-0300

SELECTED AMMONIA SAFETY REFERENCES AND TRAINING AIDS

1. *Safety Requirements for the Storage and Handling of Anhydrous Ammonia, ANSI-K61.1*
   American National Standards Institute, Inc. (ANSI)
   1430 Broadway
   New York, New York 10018
   212/354-3300

2. *Anhydrous Ammonia, Pamphlet G-2*
   Compressed Gas Association, Inc. (CGA)
   1235 Jefferson Davis Hwy.
   Arlington, VA 22202
   703/979-0900

3. *Agricultural Ammonia Safety, Booklet P15*
   The Fertilizer Institute (TFI)
   1015 18th Street, NW
   Washington, DC 20036
   202/861-4900

4. *Safe Handling of Anhydrous Ammonia, Rural Accident Protection Bulletin*
   National Safety Council
   Farm Department
   444 North Michigan Avenue
   Chicago, Illinois 6061155D
   312/527-4800

5. *For the Rest of Your Life,* 16mm color sound film
   National Society for the Prevention of Blindness, Inc.
   79 Madison Avenue
   New York, New York 10016
   212/684-3222