Vogt®

P-42AL

TUBE-ICE® MACHINE

Service Manual

$50^{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 or 502-634-0479.

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: Tube Ice, LLC
1000 W. Ormsby, Suite 19
Louisville, KY 40210
Att. Tube-Ice Service Department

Vogt® Tube-Ice® Machine

MID & LARGE MACHINE WARRANTY REGISTRATION/START-UP REPORT

MUST COMPLETE AND RETURN TO INITIATE WARRANTY

Machine Model No. _____ Serial No. _____

Installed at: _____( )_____
Company Name Phone

_____
Address City State Zip

_____

Installed by: _____( )_____/____/_____
Company Name Phone Date

_____
Address City State Zip

Describe any damage to machine/repairs made: _____

_____

_____

Start up by: _____( )_____/____/_____
Company Name Phone Date

_____
Address

Name of person starting up machine: _____

PRE START-UP CHECK

CHECK

- ☐ Service Manual on hand
- ☐ Machine room suitable 50°F minimum, 110°F maximum
- ☐ Proper power supply, actual voltage _____, _____, _____ (machine not running)
- ☐ Compressor crankcase heater on 12 hour minimum
- ☐ Necessary hand valves opened as required
- ☐ Solenoid valve stems in auto position
- ☐ System leak checked/tight
- ☐ Auxiliary equipment overloads wired into control circuit
- ☐ Compressor oil level _____ (1/4 glass min.)
- ☐ All water distributors in place (visually inspected)
- ☐ Water supply and drain lines installed and connected properly
- ☐ Compressor, pump, cutter and other motor direction of rotation correct
- ☐ Make-up water float valve adjusted properly
- ☐ Hour meter in control panel connected

OPERATION CHECK

Machine charged with refrigerant lbs._____ Actual voltage _____ , _____, _____(machine running)
Ambient temp. _____ °F Fan cycles On _____ Off _____ Tower water in _____°F out _____ °F
Comp motor RLA _____, _____, _____, Actual _____, _____, _____,
Pump RLA _____, _____, _____, Actual _____, _____, _____
Cutter motor RLA _____, _____, _____, Actual _____, _____, _____
Suction pressure end of freezing _____, end of harvest _____ Discharge pressure end of freezing _____, end of harvest _____
Evaporator/suction line frost _____ Receiver liquid level operating _____

Test Cycle	Water Temp	FreezeTime 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: $\frac{\text{ice lb. per harvest}}{\text{(freeze time + harvest time)}}$ x 1440

The machine operated satisfactorily for ___ continuous hours. Date _____

Comments_____

_____

Installer signature _____ End user signature _____

Please return to: Tube Ice LLC, 1000 W. Ormsby, Suite #19, Louisville, KY 40210

VOGT®
TUBE-ICE® MACHINES
P42AL Model

Tube Ice, LLC
1000 W. Ormsby Avenue, Suite 19
Louisville, Kentucky, 40210
800-853-8648 • 502-635-3000
Fax: 502-634-0479

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Model P42AL

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1. Introduction

Henry Vogt Machine Co.

A Brief History Of Our Company. Henry Vogt Machine Co. was founded as a small machine shop in Louisville, Kentucky in 1880. Today, it is one of the world's leading producers of ice-making equipment.

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 hard labor and large amounts of floor space for freezing, cutting, and crushing ice by hand.

Vogt Energy-Saving Tube-Ice Machines Are Cost Effective. Today, Vogt Tube-Ice® machines enjoy a well-earned reputation as the most energy efficient, dependable ice-making equipment in the world.

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

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

Preview. All the skill in engineering and fabrication that we've learned in over a century of experience is reflected in every Tube-Ice® machine. Since Vogt introduced Tube-Ice® machines in 1938, the process of making Tube-Ice® ice has been widely recognized as the most economical means of production. The machine's economic and reliable operation has been proven over and over again, in a network of varied types of installations throughout the world.

This manual is designed to assist you in the installation, start-up, and maintenance of your unit. Your Tube-Ice® machine will give you a lifetime of service provided you install, maintain, and service it properly. It is evidence of our desire to deliver to you "the finest ice-making unit ever made."

Please read your manual carefully before attempting installation, operation, or servicing of this professionally-designed piece of equipment. Also, make sure the Warranty Registration/Start-up Report is completed and returned.

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

Important Safety Notice. This information is intended for use by individuals possessing adequate backgrounds in electrical, refrigeration and mechanical experience. Any attempt to repair major equipment may result in personal injury and/or 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. It is important that personnel understand the properties of this refrigerant and that they be thoroughly trained in safe practices for its use and handling. Refer to the enclosed "Anhydrous Ammonia Safety" in Appendix A.

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 them.

! 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 !

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 (R-717) refrigerant. See "Material Safety Data Sheet", MSDS Code No. 5B81-83.

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, excessive or 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 brought on by an increase in temperature.
! 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 weighed continuously to assure contents do not exceed net weight specified by cylinder manufacturer or any applicable code requirements.
! CAUTION !

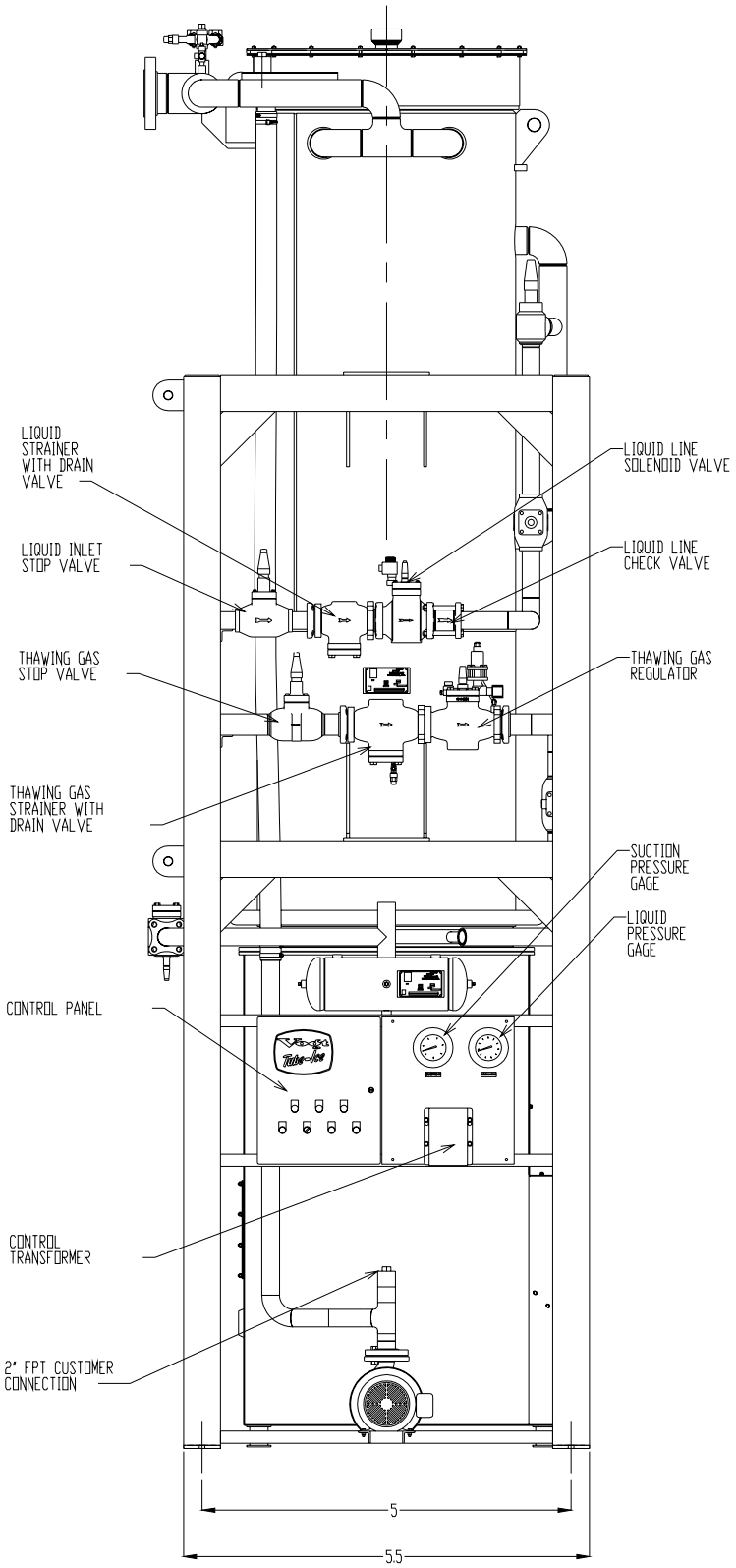


FIGURE 1-1
P42AL Front Side (Control Panel)

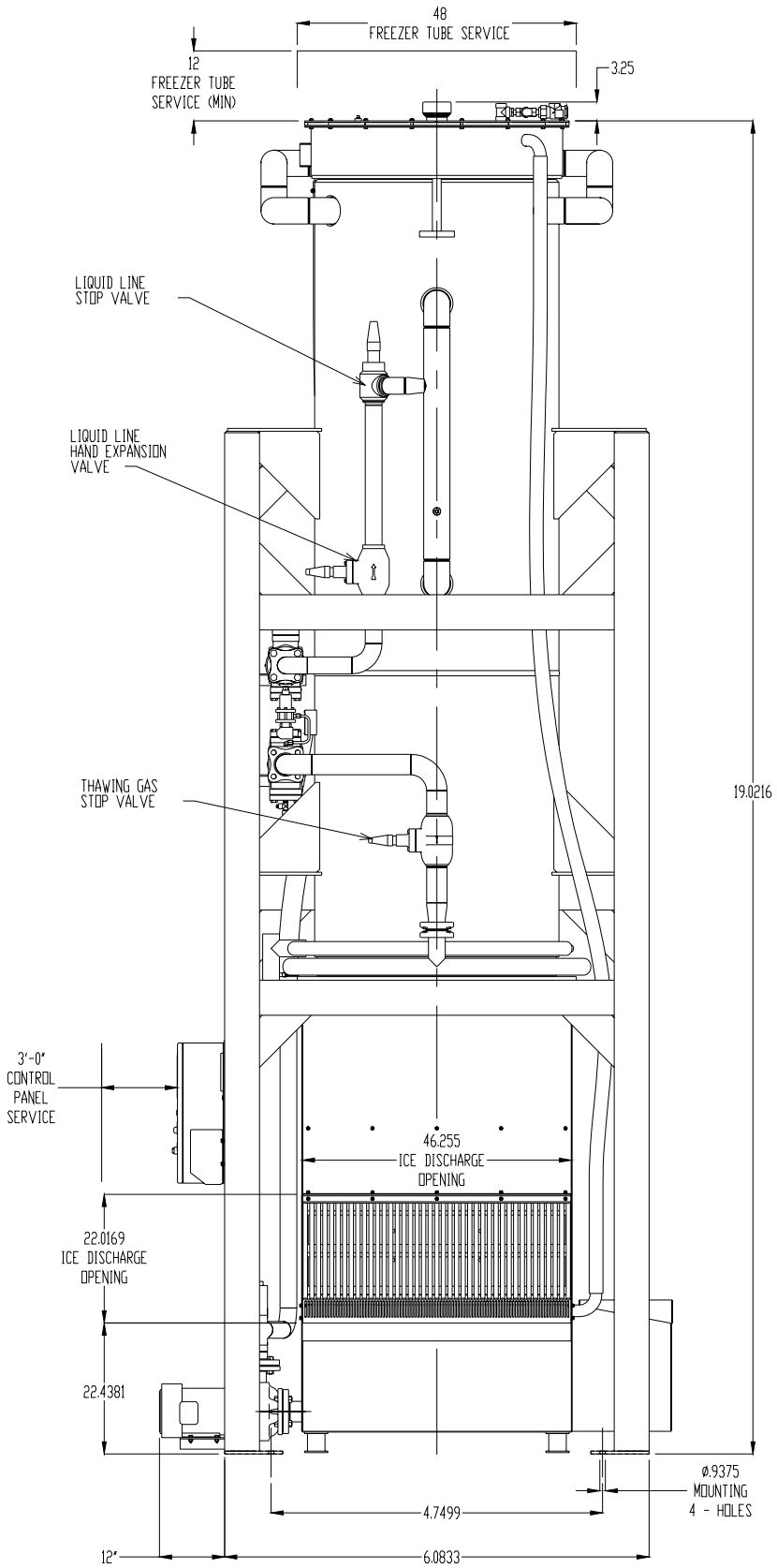


FIGURE 1-2
P42AL Right Side

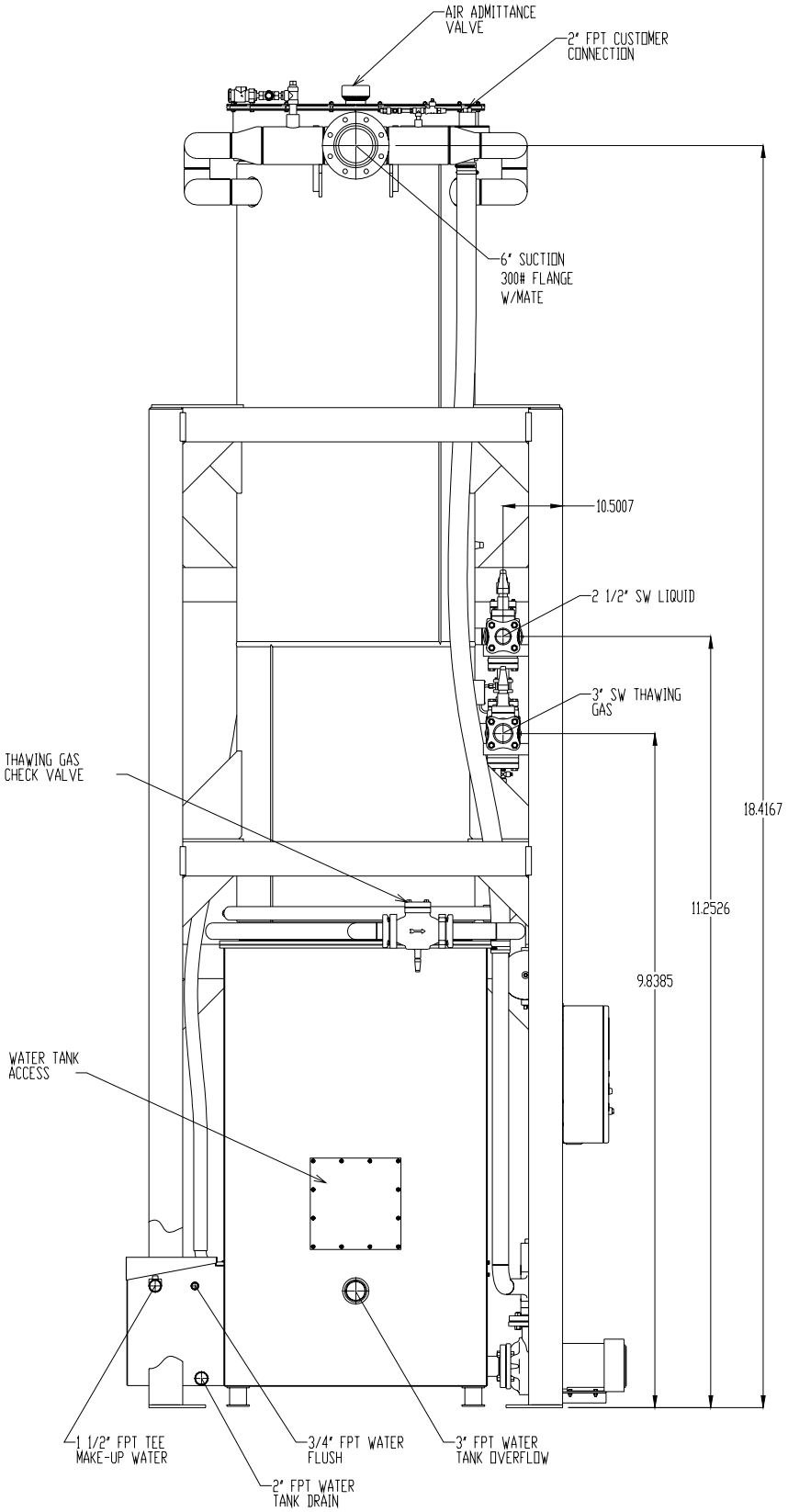


FIGURE 1-3
P42AL Left Side

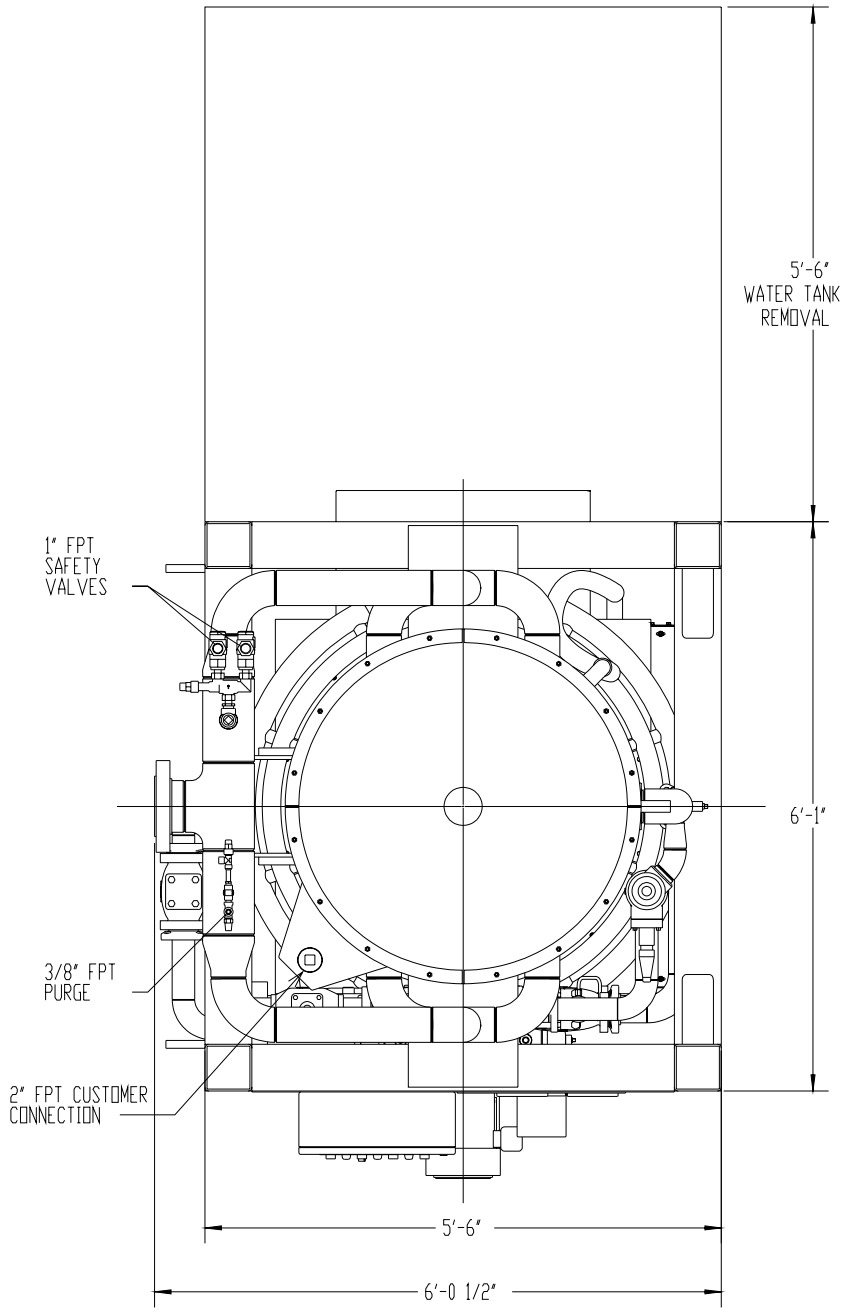


FIGURE 1-4
P42AL Top

2. Receipt Of Your Tube-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 Tube-Ice® machine. **Eye protection should be worn by all personnel working on or around the Tube-Ice® 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 Henry Vogt Machine Co. can void the machine's warranty. You should also notify your Vogt distributor or the factory.

Description Of Machine. A Vogt low side Tube-Ice® 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.

After factory pressure testing of the machine, 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 control panel gages 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.

The machine is available in three different tube sizes for producing ice 7/8" OD x 1" long, 1 1/8" OD x 1" long, or 1 3/8" OD x 1" long. The ice is cut to length by a rotating breaker type cutter. Ice can be produced up to 1 1/2" long by modifying the spacers under the adapter plates (see Chapter 10, "Ice Length" for modifying instructions). Crushed ice is also available by modifying the cutter and making minor adjustments to the machine (see Chapter 10, "Crushed Ice").

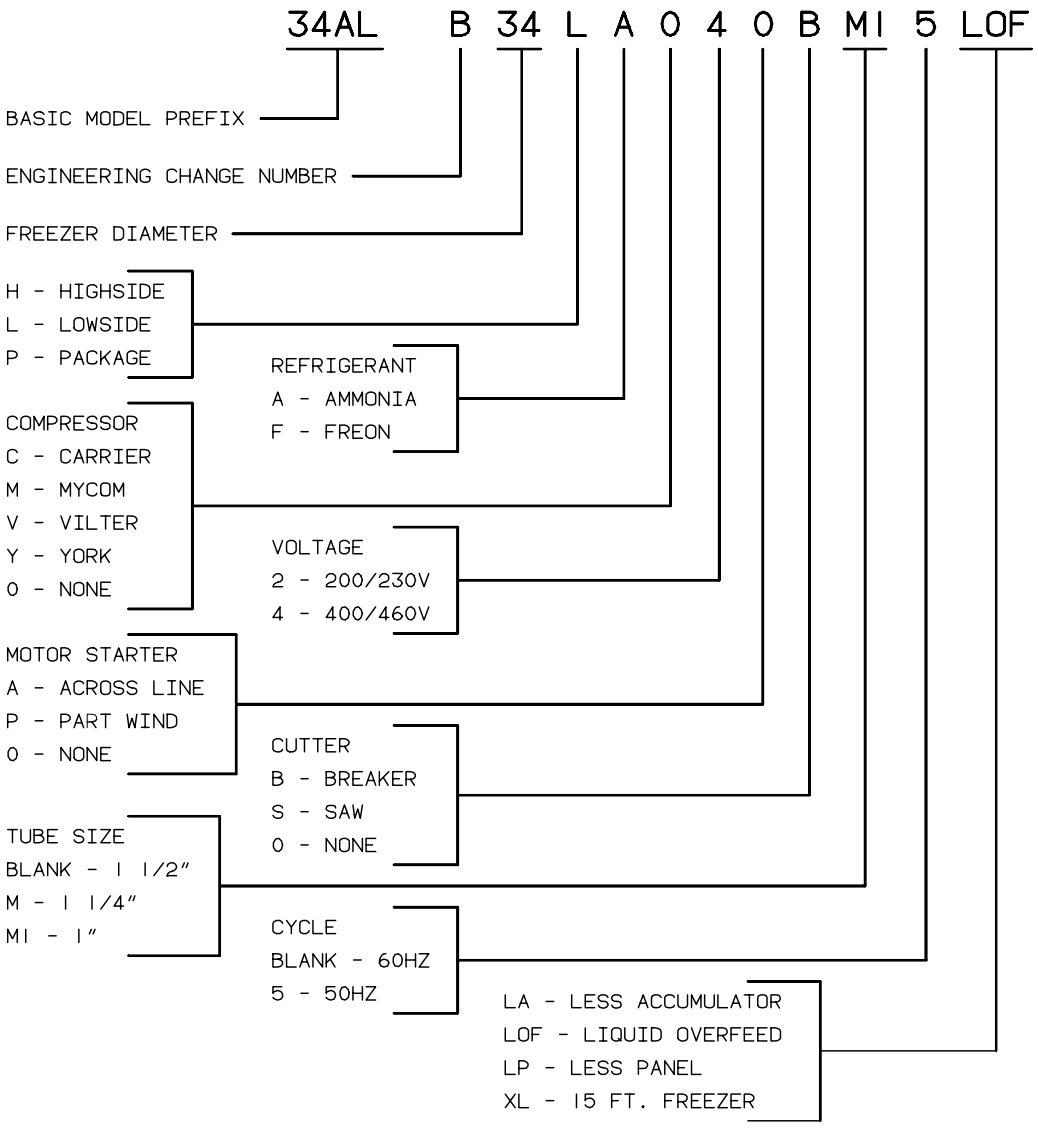


FIGURE 2-1
Model Designation for P-Series Ice Machines

Rated Capacity. The Tube-Ice® machine is rated to produce a given amount of ice when operating under the proper conditions as specified in this manual (see Section 11 for the operating specifications). 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.

Storage (prior to installation or start-up). The machine must not be stored or installed in an area that is subject to reach temperatures at or above 110°F (43.3°C).

3. Installing Your Tube-Ice Machine

Your machine will be shipped to you as one package. You will need to arrange for the handling of the package as soon as it arrives, see the machine specifications Section 11 for shipping and operating weight. Before you remove the unit from the truck, be certain that any sign of damage, however slight, is noted on the carrier's papers.

Note: See "Lifting Procedure" drawing furnished with this manual, Fig 3-5 and 3-6.

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 radiation 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 Tube-Ice® machine are rated NEMA 1. Therefore, 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.

Space Requirements. Refer to the space diagrams, Figures 1-2 and 1-4, for recommended minimum clearance around the machine for ease of servicing and observation. Pay particular attention to the additional space required. If it ever becomes necessary to mechanically clean the freezer tubes, extra space will be required.

Foundation. Refer to the space diagrams, Figures 1-2,1-3 and 1-4, for recommended minimum foundation requirements. The figures show anchor bolt details and machine anchor hole details. Contact your local distributor for seismic anchoring requirements in your area.

! WARNING !
Lifting or moving heavy equipment should only be attempted by competent rigging and hoisting contractors. Never allow personnel near or under heavy equipment when it is being moved or lifted. Failure to comply could result in personal injury or loss of life.
! WARNING !

Lifting Procedures. Your Tube-Ice® machine is provided with lifting lugs for the purpose of unloading and moving the machine to its operation location. Refer to the enclosed drawings for instructions and illustrations of their use.

P42AL - Machine weight 13,200 lbs.

These figures are intended as a guide to unloading and lifting the P42AL Tube-Ice® machine. **The Vogt Tube-Ice LLC is not responsible for product damage or personnel injury or loss of life during the loading or lifting procedure.**

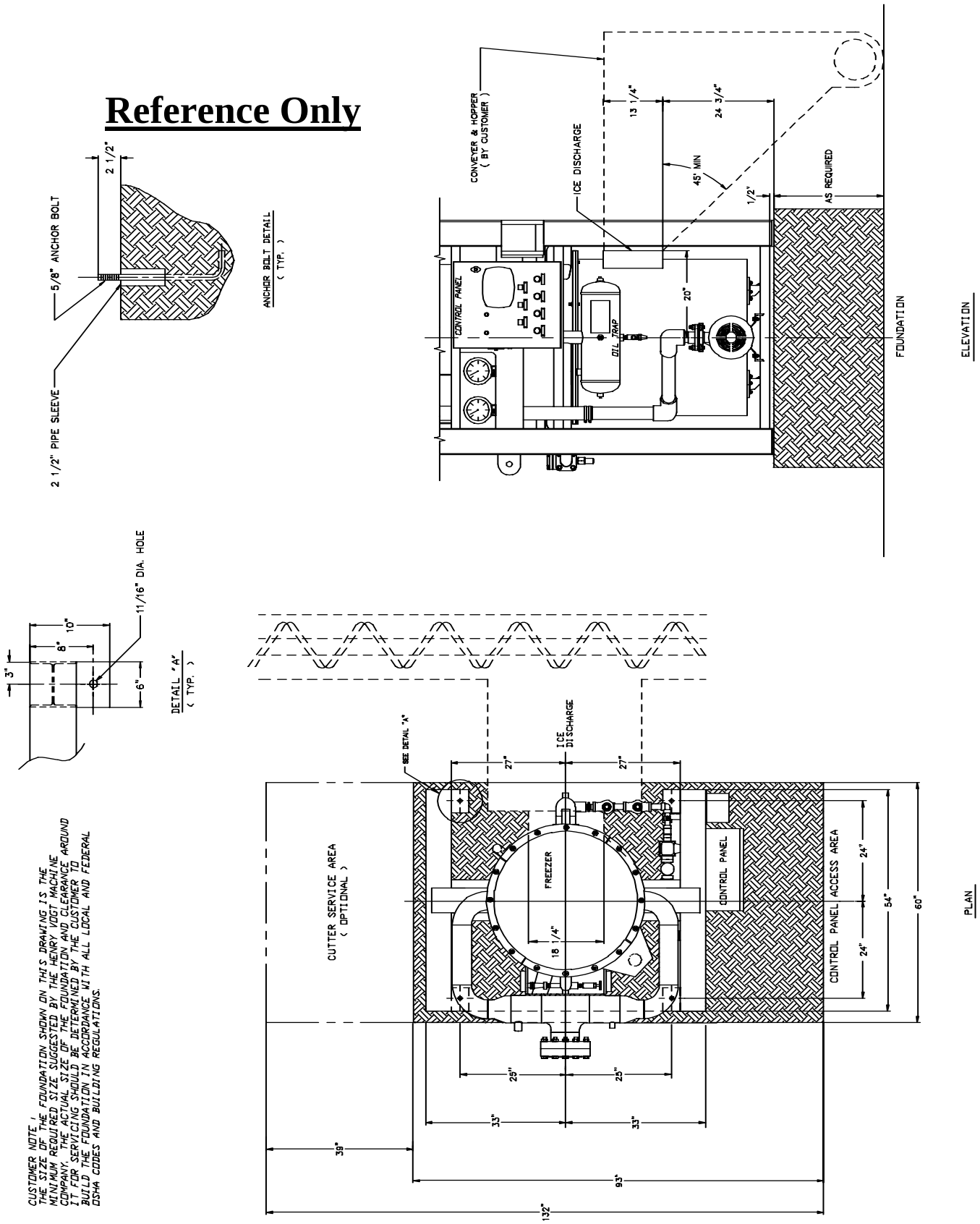


FIGURE 3-1
P42AL Foundation Layout

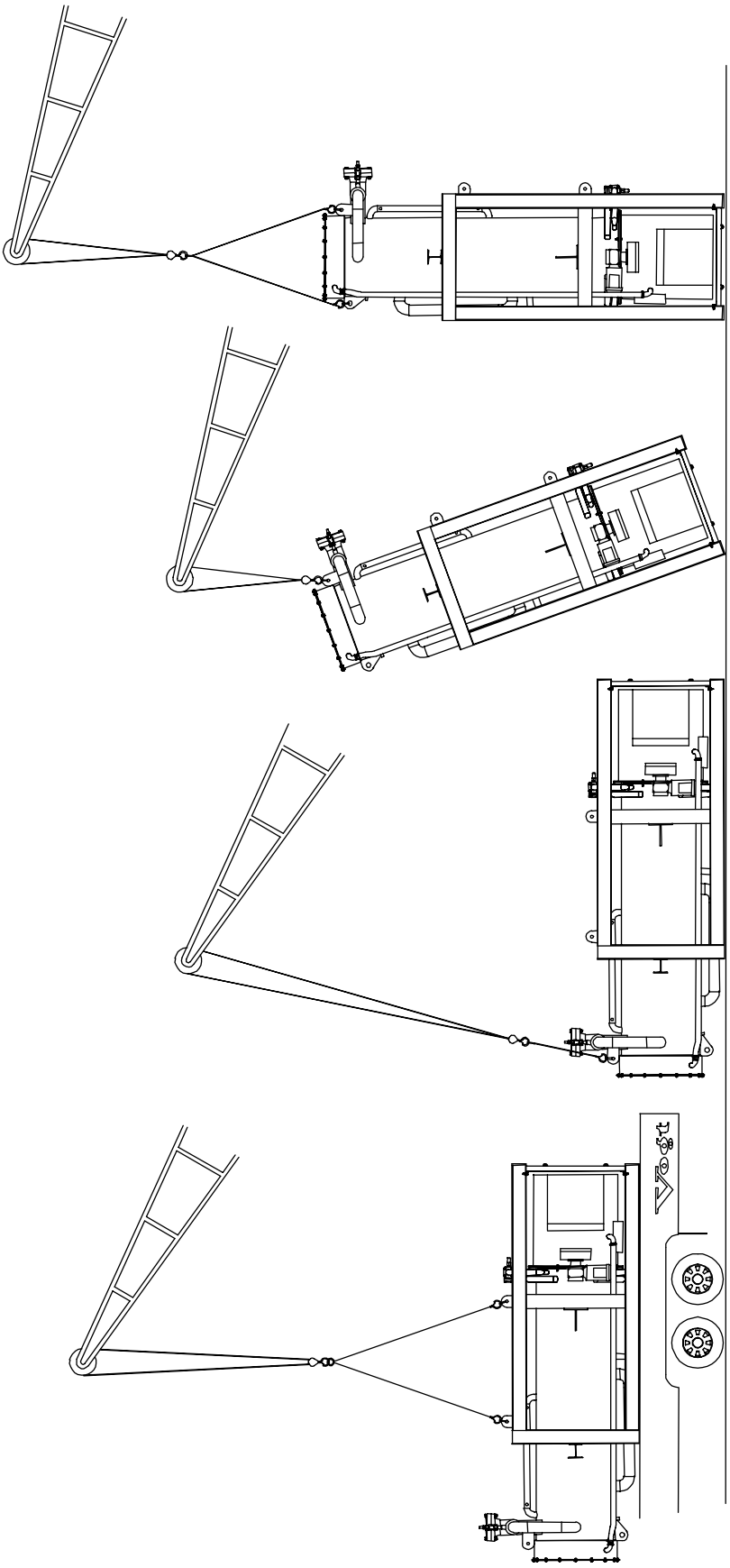


FIGURE 3-2
Lifting Procedure for P42AL

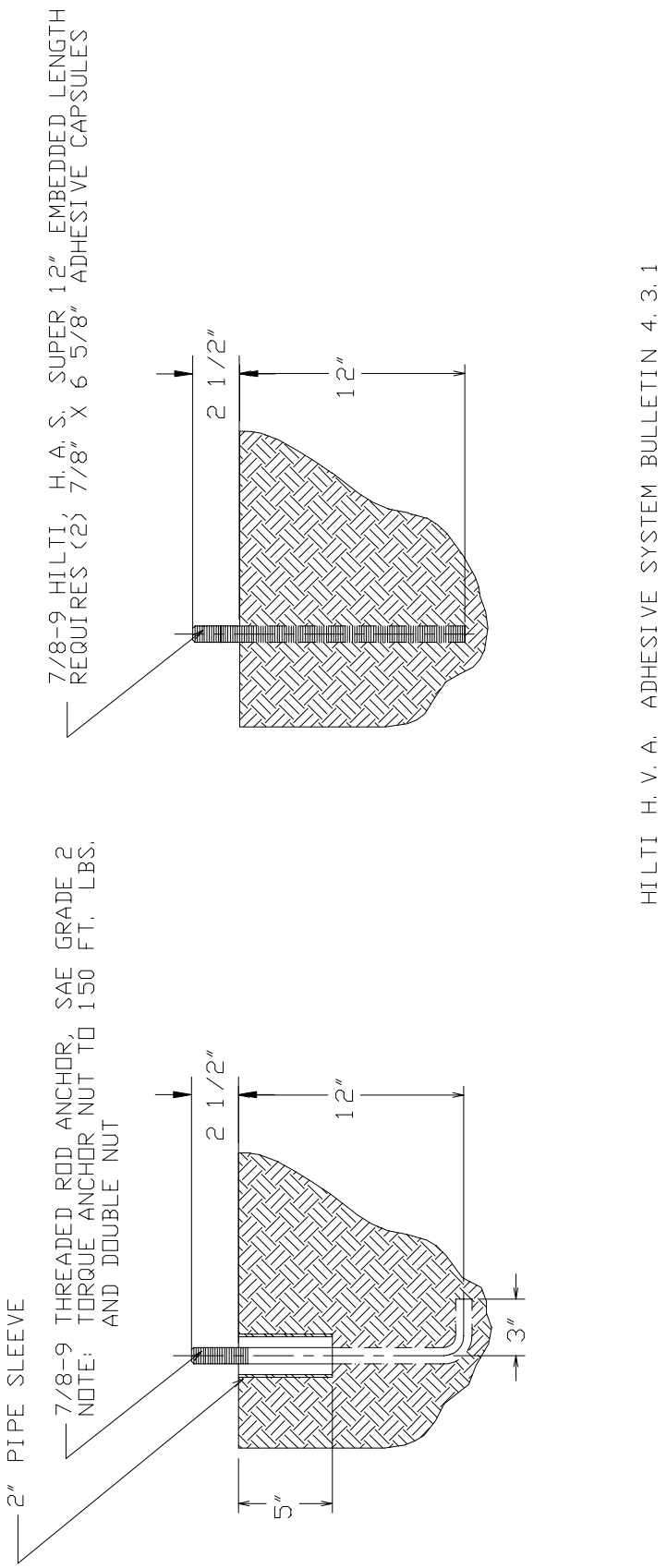


FIGURE 3-3
Seismic Anchoring Detail for P42AL Tube-Ice Machine

Piping and Drain Connections. See Figure 1-1 to 1-8 and 3-11 to 3-17 for connection locations.

When connecting refrigeration piping, you must follow and adhere to all ANSI/ASHRAE 15 " Safety Code for Mechanical Refrigeration" and ANSI Standard B-31.5 " Refrigeration Piping Code". Also, all piping must conform to all state and local codes. Make sure all piping is kept clean, dry and contaminate free. All piping should be supported properly.

! CAUTION !
Exterior shut-off valves must be provided in the water inlet lines. The minimum inlet water pressure for satisfactory operation of the machine is 40 psig. The maximum allowable pressure is 100 psig.
! CAUTION !

Model	**Make-up Water In**	**Flushing Water In**	**Water Tank Drain**	**Water Tank Overflow**	**Low Side Suction Connection***	**Low Side Liquid Connection** **	**Low Side Thaw Gas Connection**
P42AL	11/2" FPT	3/4" FPT 104gal/3 min.	2" FPT	3" FPT	6" SW Flange	2 1/2" FPT or SW	3" SW Flange

* Mating 4 bolt flange supplied with machine.
** Liquid connection is all purpose coupling.

TABLE 3-1
Water Supply, Drain and Refrigeration Connections
(See FIGURE 1-1 through 1-4 for locations)

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 15 GPM (peak flow), allowing for a restriction through the filter as it traps these particles. The inlet water pressure should be a minimum of 40 psi. Refer to TABLE 3-1 for line size and Section 11 for average flow rate at various water temperatures.

Flushing Water In. Flushing water (blowdown) is necessary to melt ice fines and flush dissolved solids from the water tank during the thawing (harvest) cycle. This function is important and helps to maintain good ice quality. If water quality is superior, installing a smaller orifice in the flushing outlet elbow can reduce this blowdown. Make sure there is enough flushing water to prevent the accumulation of excessive ice fines in the tank.

If make-up and flushing water are from the same source, a common line to the machine can connect them.

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 side of the water tank 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.

Receiver. The receiver used to supply hot thaw gas must be sized adequately to provide suffecient thaw gas. Table 3-2 shows the volume required to hold the refrigeration charge of the freezer and the hot gas required for the thaw cycle. It is recommended that a heating coil be installed in the receiver to assure that the liquid ammonia is at saturated temperature at the start of each thaw period.

Note: Additional storage volume may be required for the interconnecting piping. Add volume of interconnecting piping to the values shown in Table 3-2

RECEIVER VOLUME (Cubic Feet)		
MODEL	With Heating Coil	With out Heating Coil
P42AL	70	100

TABLE 3-2
Receiver Volume Requirements

Thaw Gas Pressure Regulator. The thaw gas pressure regulator is a 2" solenoid operated pressure combination regulator and shut-off valve (see figures 1-2 and 1-5 for locations). **Do not reduce the size of this line**. This valve is deigned to carry the proper amount of thaw gas to the evaporator during the harvest cycle. See section 5-7 for operating instructions.

Suction Pressure Regulator. When a P42AL is attached to a central system a n evaporator pressure regulator will be required (see Figures 3-15 through 3-16 for location). This regulator (usually furnished by the purchaser) must be a combination back-pressure regulating and open type valve. The usual minimum pressure drop across this type valve is 2 psig, therefore the valve must be set to maintain a freezer pressure at least 2 psi above the maximum general suction pressure. A throttling by-pass line with a solenoid shut-off and hand valve for regulating flow should accompany this valve.

Compressor Unloading. When multiple P42AL are attached to a dedicated compressor system unloading of the compressor may be required. A minimum compressor unloading during the harvest cycle is 50%. If the compressor can't be unloaded then a hot gas bypass to the suction line must be installed.

Wiring and Electrical Connections.

! WARNING !
Only service personnel experienced in refrigeration and qualified to work with high voltage electrical equipment should be allowed to install or work with the Tube-Ice® machine.
! WARNING !

A fused disconnect must be provided near the Tube-Ice® machine. The control panel and transformer (if required) are attached to the structurals on the front of the Tube-Ice® machine (see FIGURE 3-11). Incoming 3-phase power will be connected at the cutter motor circuit breaker (CB3). Terminals L1, L2, L3 for operation of the Tube-Ice® machine and its controls. Rotation checking of the, cutter motor, and water pump and auxiliary equipment is required (see rotation check). Also, if one leg of the 3-phase power is higher or lower ("wild"), then it should be connected to terminal L3. Connect the ground wire to the "ground" terminal provided.

Make sure wires #22 and #27 are connected to the elapse time (ET) indicator in the control panel.

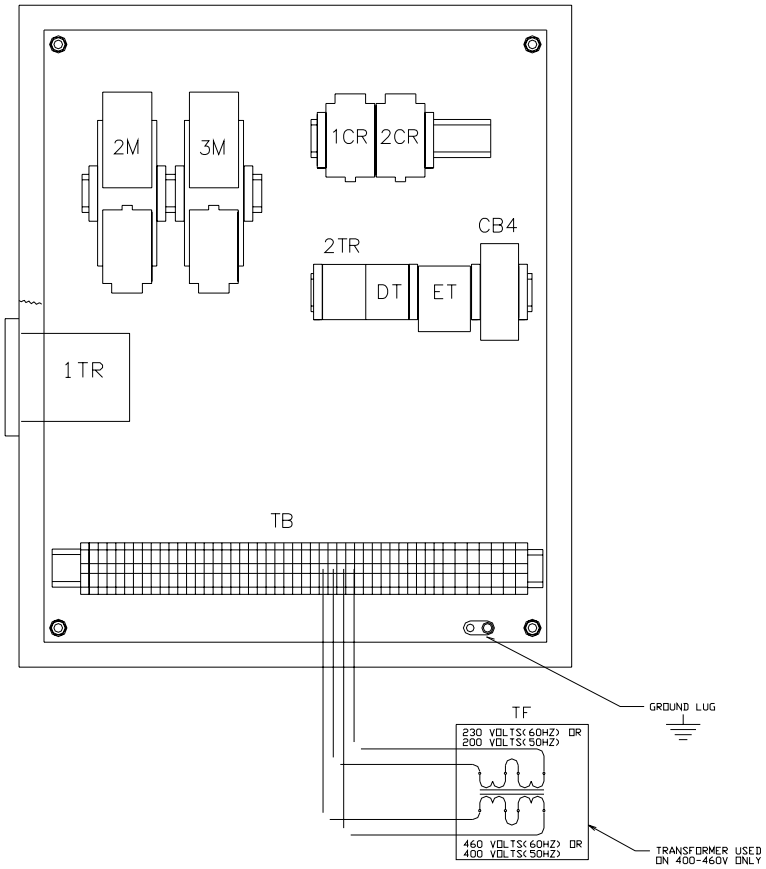


FIGURE 3-4
Power Supply Connections

Voltage Unbalance Voltage unbalance can cause motors to overheat and fail. Voltage imbalance 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
(AC) 227-224 = 3 Volts

% Voltage Unbalance = 100 x (4/224) = 1.78% "Acceptable"

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 Average = (96 + 91 + 98)/3 = 95Amps
L3 = 98 Amps

(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"

Rotation Check. The compressor, cutter, and pump motor rotation are factory synchronized, but must be checked at installation. For cylinder ice production, the cutter disc as viewed at the ice discharge opening should turn from left to right.

Check rotation by the following procedure:

1. Turn the power to the machine on and check voltages.
2. Make sure the water tank is full of clean water.
3. Turn the Hand-Auto switch (ISS) to HAND position. The water pump will start and the freezing (1LT) and the liquid feed (2LT) pilot lights will illuminate. Check pump rotation.

4. Push the MANUAL HARVEST button. The water pump will stop, the "Freezing and Liquid Feed" lights will go out, and after 20-30 seconds, the cutter motor will start. The thawing gas solenoid valve will open and the "Thawing" pilot light (3LT) will illuminate.
5. Check the cutter disc rotation. It should be turning from left to right (CCW looking from the top).
6. Turn the HAND-AUTO switch to AUTO to stop the cutter.

To change rotation, follow this procedure:

1. Disconnect power to the machine and lock it out to make sure it can't be turned back on.
2. Check for power at L1, L2, L3 with a volt meter to make sure it is off.
3. At the cutter motor circuit breaker (CB3) or at the power disconnect, reverse wires L1 and L2.
4. Make sure these terminals are tight and restore power to the machine.
5. Perform rotation check again to confirm that it is correct.

! CAUTION !
Do not attempt to start the machine until first making sure all conditions listed in the Installation Review Checklist and all necessary valves have been opened for operation.
! CAUTION !

Auxiliary Controls or Equipment. When connecting other equipment such as high/low pressure swith, conveyor motors, bin level control, etc., refer to the control panel wiring drawing for the proper connecting terminals and instructions. See Figure 6-3.

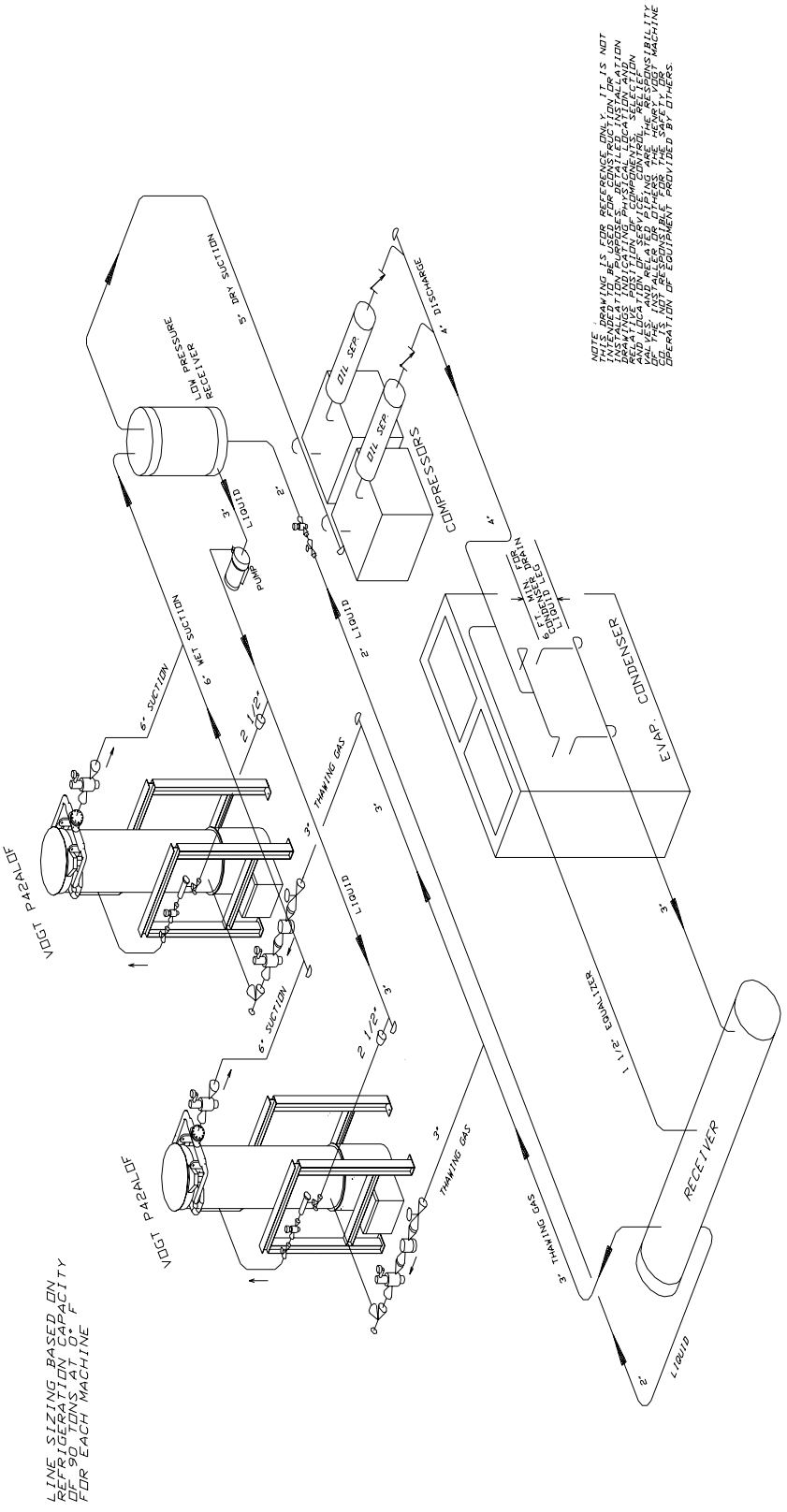


FIGURE 3-5
Interconnecting Piping for 2-Vogt P42AL and Central High Side

! IMPORTANT !
Be sure to follow the wiring schematic when incorporating overloads of conveyor (5 MOL). Also remove jumpers as instructed. This is necessary to provide proper protection for the Tube-Ice® 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, which should be indicated on the suction and discharge gages.)

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: _____ Cutter gear reducer oil level oil should run out of side pipe plug when removed.

CHECK: _____ The water distributors at top of freezer to make sure they are all in position (one seated firmly in each tube with a vent tube in each distributor).

! 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 !

4. How Your Tube-Ice Machine Works

Operating Features. Your Vogt low side Tube-Ice® machine is an efficient ice producing plant. If installed and maintained properly, it will give many years of operation with a minimum amount of repairs. Refer to piping schematics, FIGURE 4-1 and 4-2 to identify component parts while following the information and instructions in this manual.

The machine is manually started and stopped by the START and STOP push buttons. The machine will automatically stop by safeties such as, cutter and pump overloads, as well as other auxiliary motor overloads. It will also stop automatically by high head pressure, low suction pressure (if field wired to the high side). The circulating water pump can be operated independently for chemically cleaning the freezer tubes and water tank by use of the HAND/AUTO selector switch. The machine can be manually forced into a harvest cycle with the manual harvest push button.

Liquid Overfeed Principle of Operation. The freezer (2) is a shell and tube-type vessel designed to operate on a liquid overfeed refrigeration system. During the freezing period (cycle), water is constantly recirculated through the vertical tubes of the freezer by a centrifugal pump (6). Make-up water is maintained by a float valve (12) in the water tank (7). The refrigerant is pumped or recirculated through the liquid feed "A" solenoid valve (20) and maintains the desired refrigerant flow in the freezer (2) (evaporator). The refrigerant flow rate (overfeed) is 3:1.
The evaporated refrigerant gas and liquid mixture from the top of the freezer (2) passes through the suction connection to the wet suction header and back to the low-pressure receiver (overfeed tank). After separation the cool gas from the low-pressure receiver, passing through the dry suction header, is compressed to a high temperature, high pressure gas which discharges through the oil separator (then through the heat coil of the receiver, when installed) and to the condenser. In the condenser, heat is removed and the gas is condensed to a high temperature, high-pressure liquid. The high-pressure liquid passes through the liquid line through a strainer, liquid solenoid valve, check valve, and hand expansion valve to the low-pressure receiver. At the hand expansion valve, the refrigerant expands from a saturated high-pressure liquid state to a low pressure, low temperature liquid. This cold liquid enters the low-pressure receiver where it is pumped to the freezer. Cool gas and liquid mixture is again pulled out of the freezer through the suction outlet, thereby completing the circuit.

The freezing period is completed by action of the freeze timer (1TR) in the control panel. The water pump (6) stops and the "A" solenoid valve (20) closes. After a delay of 20-30 seconds, the cutter motor starts, the thawing gas "D" solenoid valve (18R) opens, and the harvest (thawing) timer (2TR) is activated. Warm gas from the receiver is discharged through the thawing chamber (16), check valve (101), and into the freezer. There it warms the refrigerant and the outer surface of the freezer tubes, allowing the ice to release on the inside of the tubes and drop down onto the rotating cutter for sizing. After sizing, the ice drops on the tines cutter disc and is discharged through the ice discharge opening.

See "Freeze Period" and "Harvest Period" for more detailed description of machine.

Freeze Period. The Tube-Ice® is frozen inside the stainless steel tubes of the freezer (2) by the direct application of refrigerant to the outside shell side of the tubes. Ice is produced from constantly recirculating water down each tube. Overfeed of the liquid refrigerant to the freezer enhances heat transfer, therefore reducing freeze times. At a set time the freeze timer (1TR) energizes the relay (1CR), which stops the water pump, closes the "A" liquid feed solenoid valve (20), de-energizes the

suction regulator (when installed), turns out the two pilot lights, ammonia feed and freezing. Note: the liquid feed should be delayed for approximately 30 seconds at the beginning of the freeze cycle.

Harvest Period. About 20-30 seconds after the 1CR relay is energized, the thaw gas valve (18) opens, the "H" water flush solenoid valve (63) opens, the compressor unloads (when required), the cutter motor starts, the thaw timer (2TR) is energized, the red thawing gas light illuminates, and auxiliary equipment such as conveyors etc. start. When the refrigerant in the freezer is warmed sufficiently, approximately 40°F / 5°C, to allow the ice in the tubes to release and fall to the cutter for sizing. The ice is then discharged into the customers' ice handling equipment. See "Ice Handling" for more information on this subject. **The thaw timer (2TR) is adjustable and should be set for the time required for all the ice to clear the freezer plus 30 seconds more**.

! CAUTION !
Make sure all the ice clears the freezer with at least 30 seconds to spare before the next freezer period begins. This is to prevent refreezing and to allow the ice moving augers etc. to clear.
! CAUTION !

1	Control Panel
1PG	Suction Pressure Gauge
2PG	Discharge Pressure Gauge
2	Freezer
5M	Cutter Motor
5R	Gear Reducer
6	Water Pump
7	Water Tank (includes cutter assembly)
8	Water Distributing Chamber
9	Water Tank Overflow (3" FPT)
12	Make-Up Water Float Valve
16	Thawing Chamber
17	Hand Expansion Valve
18	Thawing Gas Regulator/Solenoid Valve "D"
20	Liquid Feed Solenoid Valve "A1"
28	Refrigerant Charging Valve
29	Liquid Line Stop Valve
30	Sight Glass
31	Gage Glass Stop Valve
36	Oil Trap
39	Water Tank Drain Valve
43	Strainer
44	Receiver Drain Valve
46	Filter Drier
49	Freezer Suction Stop Valve or Regulator
51	Freezer Safety Valve
52	3-Way Valve
61	Freezer Oil/Ammonia Drain Valve
62	Make-up Water Inlet Valve
63	Water Flush Solenoid Valve
69	Low Suction Pressure Stop Valve
75	Strainer Purge Valve
76	Freezer Purge Valve
82	Thaw Gas Pressure Gage Stop Valve
90	Thawing Gas Stop Valve
101	Check Valve

Piping Nomenclature

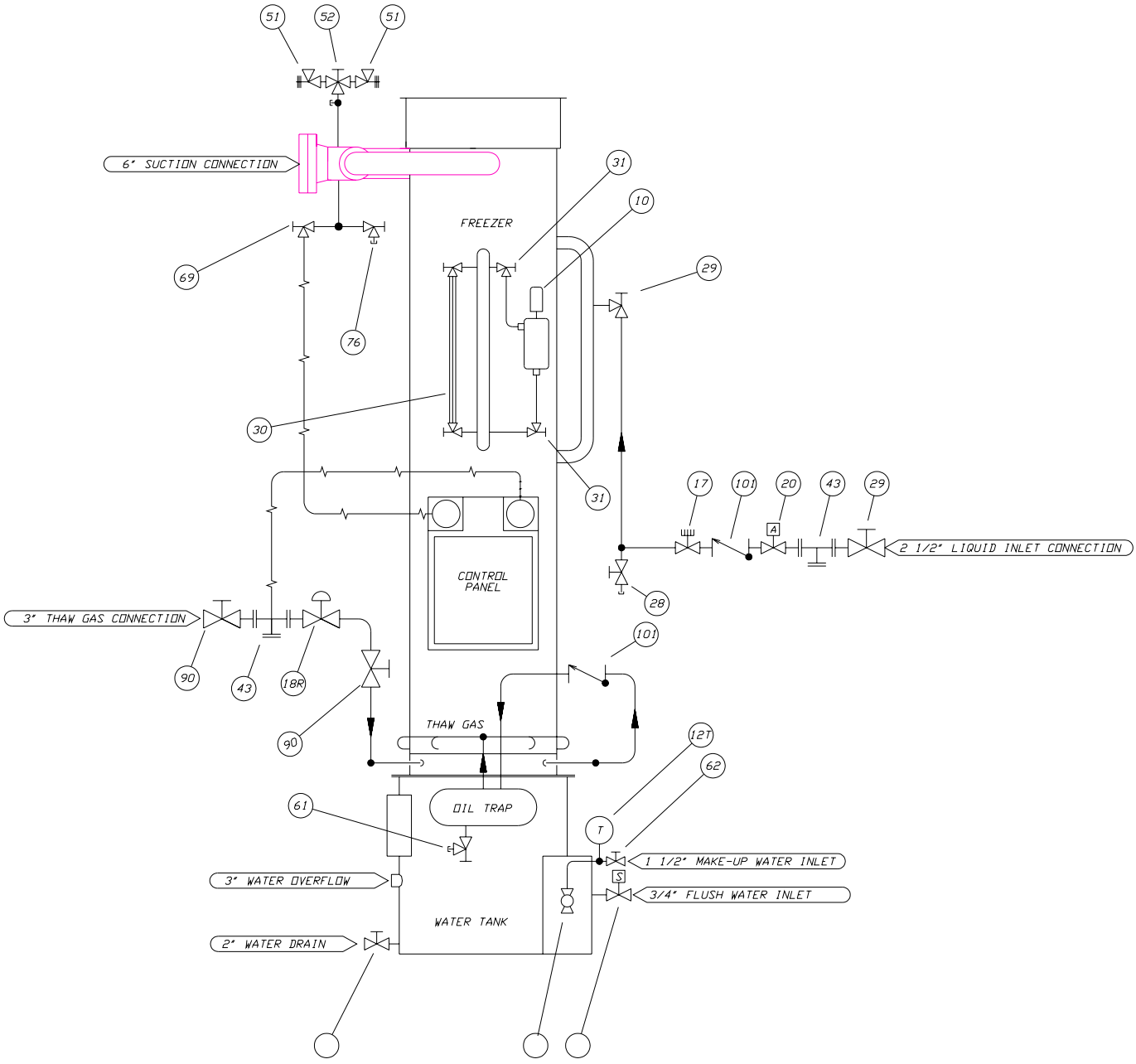


FIGURE 4-1
Piping Schematic for P42AL

HOW YOUR TUBE-ICE MACHINE WORKS

5.Start-Up & Operation

Refrigeration System Review. The refrigeration system uses recirculated anhydrous ammonia (R-717) refrigerant. Following the piping schematic (Figure 3-12 to 3-16 and 4-1 or 4-2), you will see that a recirculated or overfeed refrigeration system is actually two systems. One can be described as a standard refrigeration system where the low-pressure receiver acts as the evaporator and the other is a refrigerant pumping system. A liquid overfeed system can only be applied to two or more evaporators or one evaporator attached with other base loads (i.e. production cooling loads).
During all cycles 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 passing water through the condenser tubes. A reservoir of liquid R-717 (approximate 325 lbs. for P42AL and 944 lbs. for P34ALOF) is accumulated in the high pressure receiver and is required for thawing purposes (see Table 3-2). Liquid from the high-pressure receiver flows through the strainer to the solenoid valve, which opens and closes by action of the float switch on the low-pressure receiver (the float switch should be positioned to maintain suitable head on the liquid pump and a high level cutout should be installed). The liquid is then expanded through the hand expansion valve and into the low-pressure receiver. The cold wet R-717 refrigerant is now pumped to the evaporator and comes in contact with the outside of the ice making tubes which water is being circulated through. The heat contained in the water passes through the wall of the tubes, lowering the temperature of the water causing it to freeze and form a long tube of ice that adheres to the inside of freezer tubes. 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 low-pressure receiver, where liquid droplets are removed, 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 tubes, the suction pressure steadily decreases, when the freeze timer (1TR) times out the contact closes, initiating the thaw (harvest) cycle. Freezing requires about 12 minutes, but can vary depending on ice thickness, suction pressure, discharge pressure and distance from the LPR to the freezer.

Note: Freezing time will vary, depending on make-up water temperature, suction pressure and thickness of ice produced. The freeze timer (1TR) 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 (18) opens and the compressor unloads (when required), allowing the warm high-pressure gas from the receiver to enter the freezer. As the tubes warm up to slightly above freezing (approximately 40°F / 5°C), the ice inside the tubes releases and falls down onto the rotating cutter for sizing and discharging. Harvesting requires about three minutes, but can vary depending on ice thickness, suction pressure, discharge pressure (thawing gas temperature) and distance from the receiver to the freezer.

Note: Only one evaporator should harvest at a time. If multiple machines harvest during the same period, the high-pressure receiver may not supply enough hot gas to harvest either machine, causing a freeze-up situation. The pressure in the high-pressure receiver should be allowed to recover before another machine is allowed to harvest.

! 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 !

Start-up Checklist. Be sure to complete and return the "Warranty Registration/Start-up Report" located in the front of the manual.

1. See that the water-inlet connections are attached properly. The water inlet shutoff valve (62) for the water tank should be open. The water level in the water tank should be at a height where the make-up float valve will be closed when the machine is idle and water is not running out of the overflow (9).

2. Fill the cooling tower sump and check the tower manufacturer's installation and operation instructions to make sure it is ready to run.
3. Check condenser cooling water pump and refrigerant pump rotation.
4. Check rotation of augers or ice handling equipment to make sure they are rotating the proper direction.
5. Check all tagged valves and make sure they are in their correct operational position (opened, closed, or automatic).
6. See that the electrical disconnect is closed and the proper power is supplied to the machine.
7. See that the compressor oil temperature is 100-110°F and there is no liquid ammonia in the crankcase. The oil level should be 1/2-3/4 of the sight glass.
8. Check the elapsed time indicator (ET) and make sure wire #22 and #27 are attached.
9. Reconfirm "Rotation Check" for cutter and water pump (See Section 3).

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

TABLE 5-1
Ammonia Specification By Grade
(Reference IIAR Ammonia Data Book Chapter 1, General Information)
NOTE: Do not use Fertilizer grade ammonia.

Total ammonia (R717) charge required is approximately;
Evaporator only - P42AL = 1503 lbs.

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, located in the Appendix A.

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 (28). 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 for four hours.

Follow these instructions with caution:

1. Using a approved for ammonia charging hose, connect one end to the charging valve (28) in the liquid line near the freezer.
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 (29) or at the receiver.
5. Open charging valve (28) 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 (1TR) to maximum seting. If the machine contains a pressure switch (2PS) in place of the freeze timer, disconnect and locked out the power, open the control panel door and disconnect wire #24 from the freezer pressure switch (2PS), then turn the power back on.
8. Check compressor rotation by starting and stopping the compressor momentarily. If the compressor starter is wired to (3CR)then jog the compressor by using the green "Start" push button (2PB) and the red "Stop" push button (1PB). 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 Hand/Auto switch (1SS) to the "Hand" position 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 freezer tubes.

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.
c) Liquid level in both receivers
d) Compressor oil level

While charging the machine, the low-pressure switch will stop operation of the compressor at 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 in the tubes 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 push the manual harvest push button (3PB) while the compressor is running. As soon as all the ice clears the cutter area, turn the Hand/Auto switch to “Hand” and then back to “Auto”. This will stop the harvest and start another freeze to continue the charging procedure. When the liquid level in the receiver is near the pumpdown level and the freezer is down to 15 psi suction with little of no frost on the 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 lock-out the power. If the machine contains a pressure switch (2PS), open the control panel door and reconnect wire #24 to the freezer pressure switch. Open valve #29 and/or receiver liquid feed valve and you will hear liquid refrigerant flowing through to the liquid solenoid valve #20. Turn main power disconnect to the on position and the machine is ready for start-up and ice production.

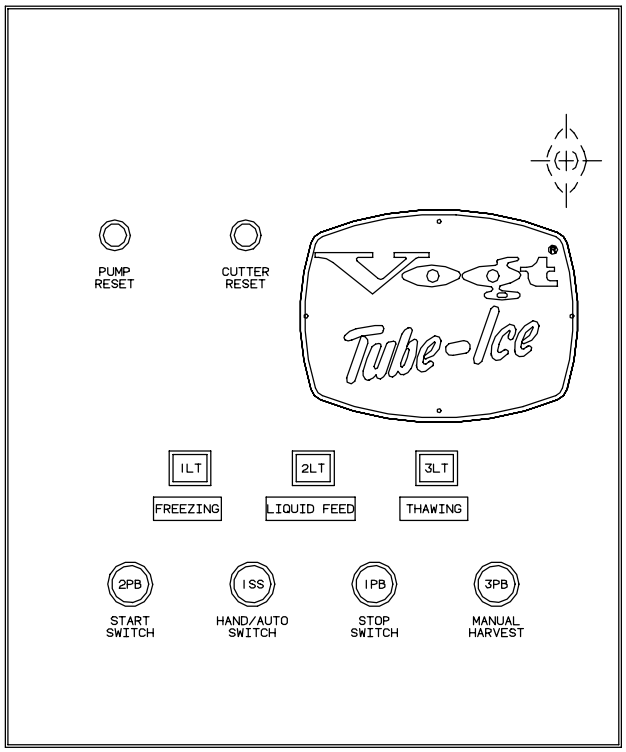


FIGURE 5-1.
Control Panel

Start-Up. Starting the machine in a freezing cycle can be accomplished as follows:

1. Make sure the crankcase oil temperature is approximately 100°F and there is no liquid ammonia in the compressor crankcase.
2. Turn the Hand/Auto switch (1SS) to the "Hand" position and allow the water tank to refill. MAKE SURE THE DRAIN VALVE IS CLOSED.
3. If the compressor motor starter is wired to the control relay (3CR) then push the green "Start" push button to start the compressor and immediately observe the oil pressure, the oil level, the discharge pressure, and listen for any unusual sounds. The compressor should start unloaded and will load automatically after several seconds of operation. Make sure the refrigerant pump is operating.
4. Turn the Hand/Auto switch to the "Auto" position.
5. When the discharge pressure increases to about 170 psi, push the "Manual Harvest" button to initiate the harvest cycle. See "Harvest Period".
6. Set the thaw gas pressure regulator (18R) and the suction regulator (if used). See "Thaw Gas Regulator" and "Suction Regulator" for instructions.
7. When the suction pressure raises to 50-55 psig, any ice made should release and discharge. After all of the ice clears the cutter and auger, turn the Hand/Auto switch to "Hand" and back to "Auto". This will interrupt the harvest cycle and start another freeze cycle. See "Freeze Cycle".

As the machine continues its freezing cycle, the liquid ammonia will feed into the freezer until the freeze timer (1TR) has timed out. When the freeze timer (1TR) times out the switch will close and initiate the harvest cycle.

Be sure to observe several complete cycles of ice production to confirm the satisfactory operation of the machine.

! IMPORTANT !
Complete the remaining part of the "Warranty/Registration Start-Up Report" and return it to the Henry Vogt Machine Co.
! IMPORTANT !

Check the refrigerant level at the receiver liquid gage glass to make sure it is near the operating level mark.

Adding Refrigerant. Add refrigerant while the machine is running by the following procedure:

1. With a cylinder of anhydrous ammonia laying on its side, cylinder valve outlet pointing up and bottom end raised two inches higher than the valve end, connect an "approved for ammonia" charging hose between the freezer charging valve (28) and the cylinder valve.
2. Purge all air from the charging hose and open the cylinder valve gradually to check for possible leaks around the packing nut or hose fittings. Then open the cylinder valve fully.
3. While the "ammonia feed light is not illuminated, open the charging valve (28) and ammonia will flow from the cylinder to the freezer.
4. Close the cylinder valve immediately when the ammonia feed light comes on and reopen it when the light goes out. Repeat until properly charged.

! CAUTION !
Do not leave a refrigerant cylinder attached to the machine unattended. Disconnect it immediately when the machine is charged or the cylinder is empty.
! CAUTION !

Operating Tips.

- Make sure the machine is left running in the "Auto" position. This will assure a complete shutdown if a safety or overload is tripped.
- To initiate a harvest cycle, simply push the Manual Harvest push button (3PB).
- To interrupt the harvest cycle (harvest timer #2TR) and revert to a freeze cycle, turn the Hand/Auto switch to "Hand" and back to "Auto".
- The circulating water overflow tubing will show that water is being slightly lifted up the tubing near the end of the freezing cycle. If this action ceases and water begins overflowing from the top water box, it is an indication that the tubes are freezing solid and the machine should begin a harvest cycle. It is best not to freeze the ice solid with no hole.
- To cease ice production manually, allow the machine to complete the harvest period and start the freeze period. When the "liquid feed" light comes on at the beginning of the freeze period, push the "Stop" button to cease ice production.

Thaw Gas Regulating and Suction Regulating Valve Adjustment. 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 the thaw gas regulator to build pressure of 60 - 65 psig. (1 turn is approximately 13 psig)
5. Adjust (downstream) high-pressure stem on suction regulator to begin regulating at 59-64 psig. (slightly below the thaw gas regulator)
6. After the machine has completed the harvest cycle and returned to the freeze cycle, adjust the low pressure (upstream pressure) on the suction regulator to maintain the required freezer pressure. For clear ice a minimum of 20 psig freezer pressure is required.

6. Electrical Controls

Your packaged Tube-Ice® machine is equipped with a compressor motor starter contact (3CR) and a transformer (if required) for the control circuit power. The control panel and transformer are mounted on the machine front side (see Figures 1-1 or 1-8).

The control panel wiring schematic, FIGURE 6-3, illustrates these components as well as provisions for auxiliary equipment which may be incorporated by the customer such as:

(FU1) Main power disconnect
(5M) Conveyor motor starters and overload (5MOL)
(C-SOL) Suction regulating valve
(RF) Refrigerant recirculating pump

When adding motor starters for auxiliary equipment, be sure to incorporate the overload protection as indicated between terminals #12-#13 and remove the jumper wire. This will assure that the machine will shutdown when any auxiliary equipment fails.

Bin Level Control. Included in the wiring schematic is provision for a bin level control (BLC). The NC contract of your control should be wired between terminals #8-#9 and the jumper wire removed as indicated. Installation in this manner will allow the machine to finish the harvest period before shutdown. However, the machine will still need to be manually started to resume production.

Safety Switches. The machine is not equipped with the following safeties and control switches, however they can be wired into the control circuit. Refer to the wiring schematic FIGURE 6-3 for their circuitry.

- High/Low dual pressure switch (1PS) to stop the machine if the compressor suction pressure goes too low (15-20 psi) or the compressor discharge pressure goes too high (225-250 psi). See “High/Low Pressure Switch”.

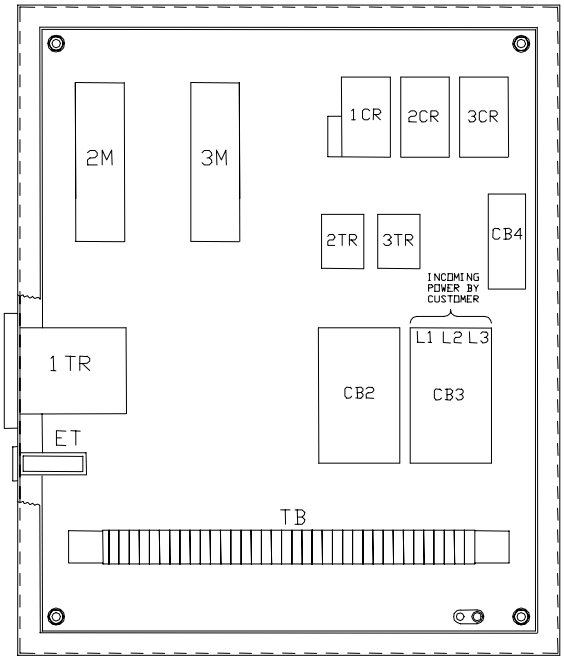


FIGURE 6-1
Control Panel (Door Opened)

(3CR)	Compressor Motor Starter contact and holding relay	Holding relay for safety and bin level control. Auxiliary contact provides control power to the compressor motor starter. Continuously energized during freezing and thawing.
(2M)	Pump Motor Starter	Provides power to the circulating water pump during the freezer period or when the Hand/Auto switch is in the "Hand" position to circulate water or ice machine cleaner, etc.
(3M)	Cutter Motor Starter	Provides power to the cutter during the harvest period.
(1CR)	Control Relay With Pneumatic Timer	For making and breaking various circuits during freezing and thawing period with pneumatic timer to delay the actual thawing process. Energized during thawing.
(2CR)	Control Relay	For making and breaking circuits during freezing and thawing. Energized during freezing, thawing, and hand. Momentarily de-energized at the end of the harvest.
(3TR)	Liquid Feed Delay	Delays opening of liquid feed valve at the beginning of the freeze.
(2TR)	Thawing Timer	Controls the time of the harvest (thawing) period. Energized during the harvest period.
(1TR)	Freeze Timer	Controls the length of time the machine is in the freeze cycle. When timed out initiates the harvest cycle.
(2PS) optional for dedicated high side	Freezer Pressure Switch	Controls the desired ice thickness (hole size) by sensing the freezer suction pressure and initiating the harvest period.
(ET)	Elapsed Time Indicator	Indicates total hours of machine operation. Is powered when the compressor is running.
(CB4)	Circuit Breaker	Overload and short circuit protection for crankcase heater and the control circuit.
(CB2)	Circuit Breaker	Secondary protection for the circulating water pump motor.
(CB3)	Circuit Breaker	Secondary short circuit protection for the cutter motor.
(TB)	Terminal Block	Numbered for multiple wire connections and ease of troubleshooting.

TABLE 6-1
Description of Control Panel Parts (Inside)

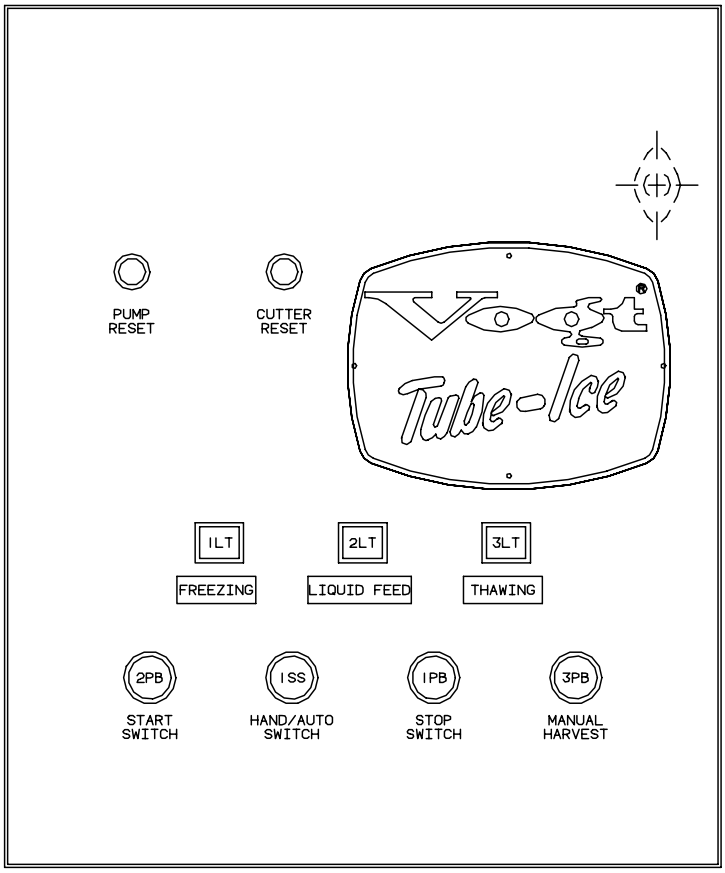


FIGURE 6-2
Control Panel (Hinged Door)

(1LT)	Amber Pilot Light - Freezing	Illuminated during the freeze period or whenever the circulating water pump is running.
(2LT)	Clear Pilot Light - Liquid Feed	Illuminated when the circulating water pump is running and the float switch (10) is closed. Indicates that the liquid line solenoid valve (20) is opened.
(3LT)	Red Pilot Light - Thawing	Illuminated when the machine is in a harvest period.
(2PB)	Green Push Button - Start	For starting the compressor motor and ice production. (NO)
(1PB)	Red Push Button - Stop	For stopping the compressor motor and ice production. (NC)
(3PB)	White Push Button - Manual Harvest	For manually initiating a harvest cycle. (NO)
(1SS)	Selector Switch - Hand/Auto	"Hand" position for running the circulating water pump independently at start-up or for cleaning the freezer tubes and water tank. "Auto" position for provision of automatic system shutdown if there is a control circuit power interruption.

TABLE 6-2
Description of Control Panel Parts (Outer Door)

ELECTRICAL CONTROLS

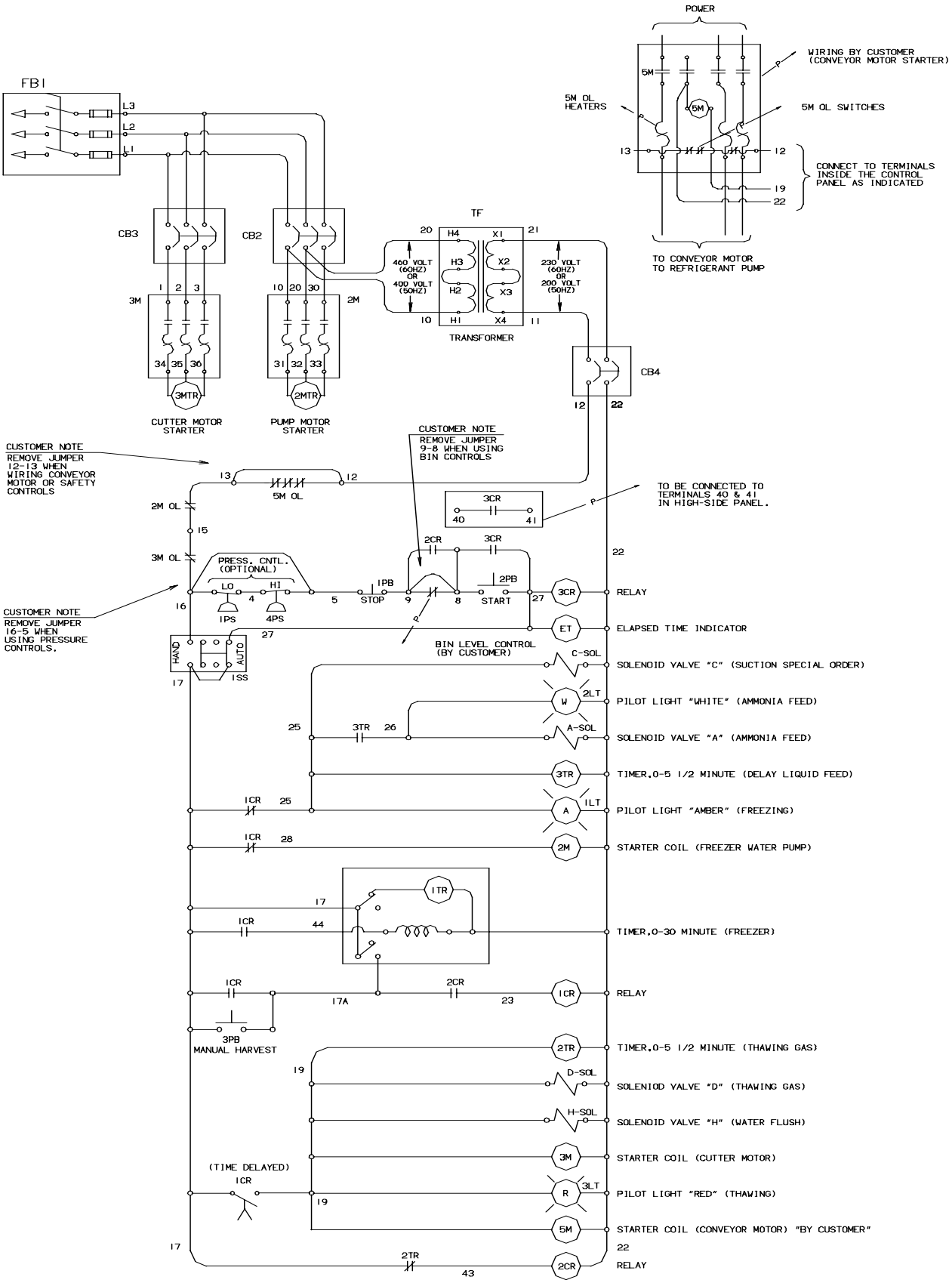


FIGURE 6-3
Electrical Schematic for P42AL all Voltages, 50-60 Hz.

7. Maintenance

Preventative Maintenance. A careful inspection of the Tube-Ice® machine for leaks and correct operational functions at the time of installation and start-up will begin its long satisfactory life of service. In order to insure this degree of dependability, a systematic maintenance program is necessary. Therefore, the following schedule is suggested as a minimum.

A. Daily
   1) Check operating pressures (suction, discharge, pumped refrigerant, oil).
   2) Check ice quality.
   3) Check "ice out" time (maintain 30 seconds of continued harvest after last ice is out).
   4) Check compressor oil level.
   5) Check refrigerant operating level and pump pressures.
   6) Check frost pattern on freezer shell 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 distributors in freezer for scale accumulation.
   4) Check water tank for solids to be removed.
   5) Check all motor drive units (compressor, cutter, pump motors, cooling tower fan, etc) for abnormal noise and/or vibrations.
   6) Check oil level in gear reducer.
   7) 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) Change oil in gear reducer box once a year.
   8) Lubricate compressor motor and refrigerant pump bearings.
   9) Check bearings in refrigerant pump.

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 distributors 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
- ☐ Check/change cutter gear reducer oil
- ☐ Check/adjust cutter drive gear meshing
- ☐ 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

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 (est)	Ice lb. Per Day (est)
#1								
#2								
#3								
#4								

Comments: _____
_____
_____

Name: _____

Ice Making Section. The ice making section of the Tube-Ice® machine should be cleaned at least twice a year (more often if water conditions cause mineral build up). Use an approved food-grade ice machine cleaner. The water pump is used to circulate the cleaner through the system. For complete instructions, follow the "Cleaning Procedure" below.

Cleaning Procedure.

1. Stop the machine at the end of harvest.
2. Shut off make-up water supply.
3. Drain the water tank, flushing out any loose sediment.
4. Close the drain valve and fill the tank with warm water. Warm water promotes faster cleaning.
5. Cover the ice discharge opening to prevent water from splashing out and contaminating any stored ice.
6. Add sufficient ice machine cleaner to the water tank.
   P42 tank = 9.2 gallons water per inch of water height in tank, 13" = 120 gallons
   Mix cleaning solution according to manufacturer's recommendations.
7. Remove top water box cover, inspect distributors, remove any hard particles from orifices, and make sure all distributors are in place. Replace cover.
8. Turn Hand/Auto switch to "Hand" position and circulate the cleaning solution until deposits are dissolved or the solution is neutralized. After draining, the pump may have to be stopped and restarted to dispel air.
9. Turn switch to "Auto" position to stop the pump. Drain and flush the water tank. Repeat cleaning as necessary.
10. After cleaning, fill the tank with fresh water, start the pump again, and circulate for 15 minutes.
11. Stop the pump, drain and flush the tank and again refill with fresh water.
12. Remove the cover from the ice discharge opening, and clean any area that may have been splashed with solution during cleaning.
13. Make sure the make-up water float valve is adjusted properly and the drain valve is closed.
14. Start and stop the pump again to make sure it is circulating water and it is not air bound.

You are now ready to produce ice.

Water Distributors. The water distributors are located under the top freezer cover. These distributors are similar in design to those used in mid-size and small machines (i.e. P18F, P118, etc.) except they have a small vent tube. It is important that this plastic vent tube remain in place in each distributor. The distributors may require occasional or periodic cleaning to remove solids, foreign particles, or mineral deposit accumulated from the circulating make-up (ice making) water. The frequency of cleaning operation will depend on the characteristics of the water supply. The distributors need inspection when the inside diameter of a large portion of the ice becomes irregular (due to channeling of water), if some of the ice is opaque or if there is a noticeable decrease in ice capacity and quality.

Tube Size	1 1/2”	1 1/4”	1”
Model	Number of Distributors		
P42AL	492	660	906

TABLE 7-1
Water Distributors

You may look through the plastic freezer cover to inspect the water distributors if the view is clear. For a closer inspection you should stop the unit, remove the nuts and retaining ring sections and lift off the top cover. Make sure the two orifices in the side of each distributor are open, the vent tubes are in place, and a distributor and vent tube assembly is installed firmly in each tube.

To remove the water distributors for cleaning:

1. Grip the top of the distributor body (not at the vent tube) with adjustable pliers.
2. Hold and twist the distributor while pulling upward.
3. Lift the distributor out of the hole.

To install the distributors:

1. Insert one in each tube hole and seat firmly by using a short piece of pipe or conduit.
2. Slide the pipe or conduit down over the vent tube and gently tap the distributor in place.
3. Do not allow the distributor to be recessed below the top of the tube sheet.

To replace the cover:

1. Replace water distributor box cover gasket.
2. Install the cover over the bolt studs.
3. Install the four (4) cover retaining rings sections and nuts.
4. Tighten the wing nuts firmly to prevent foreign materials from entering the water box.

Note: The freezer cover and gasket are not intended to hold the pressure of the circulating water in the event of a freeze up. Therefore every effort should be made to prevent the Tube-Ice® from freezing solid (with no hole).

Tube Size	1 1/2”	1 1/4”	1”
Hole Size	1/4”-3/8” Avg.	1/8”-3/16” Avg.	1/16”-1/8” Avg.

TABLE 7-2
Average Hole Size In Tube-Ice®

Water Tank. The production of opaque ice can indicate that the water in the water tank contains a concentrated amount of solids or salts. See Troubleshooting, “Poor Ice Quality”.

To clean the water tank:

1. Stop the machine at the end of harvest.
2. Shut off the make-up water supply.
3. Open the drain valve and drain the tank.
4. Remove the water box cover and flush out any loose sediment from the tank. The wire mesh screen can be removed if necessary.
5. If further cleaning is needed, follow “Cleaning Procedure”.
6. If further cleaning is not needed, close the drain valve and refill the tank with fresh water.
7. Make sure the float valve is adjusted properly and install the water box cover.
8. Start and stop the pump again to make sure it is circulating water and is not air bound.

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/Evap 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 !

Service/Frequency	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, please 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.

	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. See "Compressor Oil Changing and Inspection"

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 (36), 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 !

Cutter Gear Reducer. The oil level of the gear reducer should be checked monthly or when there is any evidence of leakage. The correct level is indicated by the pipe plug in the side of the gear housing. The oil should run out of the hole when the plug is taken out. If low, add oil through one of the top plugged holes. A high grade lubricant such as Mobil 600W or SAE 140 gear oil should be used. The oil should be changed annually. Drain the oil and flush the gear case with mineral spirits. Drain the mineral spirits completely and refill with the proper oil.

Note: If a USDA high food grade lubricant is desired, use Chevron FM Lubricating Oil 460X.

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

8. Troubleshooting

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 pushing the "Start" button. If it stopped while in a freeze cycle, it should be manually harvested to remove all ice from the freezer. This is done by pushing the white "Manual Harvest" button.

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) 635-3510.

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 in the freezer, initiate a manual harvest.
Circuit breaker (CB4) for control circuit tripped	Check compressor crankcase heater, coils of relays, contactors, starters, solenoid valves, and thawing timer for a ground. Repair or replace any defective part and reset circuit breaker. 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, which 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, cutter motor, conveyor motor, overload tripped	Check for loose connection on all terminals, which 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 (2MOL) tripped	Check for loose terminal connections and/or defective breaker (CB2), reset the overload and start the pump by turning the selector switch (1SS) to “Hand”. Check voltage and amperage against motor rating. Confirm proper rotation.
Cutter motor overload (3MOL) tripped	Check for loose terminal connections and blown fuse, reset the overload. Clear all ice that may have jammed cutter. Turn the selector switch (1SS) to “Hand” and push the “Manual Harvest” button. Check voltage and amps against motor rating. If tripping repeats but ice is not jammed, check the gear reducer for resistance, cutter bearings for wear, drive gear and ring gear for proper engagement, and reducer motor for defect or single phasing.
Bin level control (optional) open	Adjust or replace control as required. If bin level control is not used, make sure jumper wire #8 and #9is installed at of the terminal block.

Symptom: Machine Stopped (con't)

Possible Cause	Possible Remedy
High/Low pressure safety switch (1PS or 4PS) tripped (optional)	If the machine stops by low pressure cutout, the switch will reset automatically when the pressure raises to the "cut-in" setting. Check thaw gas valve (18) to make sure it opens during harvest time. Check Liquid feed valve (20) 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 1PB, 1SS, 1M contact, 2CR contact, 2TR	See FIGURE 6-3, Wiring Schematic, and 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.
Refrigerant pump motor overload tripped	Check for loose terminal connections and/or defective breaker, reset the overload and start the pump. Check voltage and amperage against motor rating. Confirm proper rotation.
Circuit breaker (CB2 or CB3) for pump or cutter motor tripped.	Check for loose connection on all terminals, reset breaker and check amp draw against breaker rating. Check voltage and current unbalance, Section 3. Replace breaker if defective.

Symptom: Freeze-up due to extended freeze period

Possible Cause	Possible Remedy
Freeze timer (1TR) set to long	Adjust timer or replace if defective. See FIGURE 9-1.
Water tank drain valve, make-up water float valve or flushing valve stuck or opened (if 2PS is used)	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.
Thaw gas solenoid valve (18) leaking through during freeze(if 2PS is used)	Check the manual opening stem to make sure it is in the automatic position (stem screwed in). Check for leakage by sound, temperature difference and frost during the freeze cycle. Leakage should stop by closing the hand stop valve downstream of thaw gas valve. Isolate and repair or replace the valve as needed.
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. Check the load delay timer electrical circuit to make sure the “UR-SOL” coil is not energized. 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
Freeze timer (1TR) set to long	Adjust timer or replace if defective. See FIGURE 9-1.
Extended freeze period (if 2PS is used)	Check freezer pressure switch (2PS) adjustment. See FIGURE 9-1 for adjustment and TABLE 7-2 for average hole size. Make sure all water distributors are in place (one in each tube).
Thaw time too short (2TR)	Adjust thaw timer (2TR) to allow all ice to clear the cutter and ice discharge opening with at least 30 seconds to spare. Replace defective timer. See pressure regulating valve adj.
Thaw pressure to low	The thaw gas regulator should be adjusted to increase the pressure in the freezer to 60-65 psi during a harvest. Isolate and repair or replace the valve as needed.
Liquid feed valve leaking through	Check liquid feed valve for positive shut-off.
Insufficient heat for thawing 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”.
Insufficient heat due to low refrigerant charge	The refrigerant level in the receiver should be near the operating mark at the end of a freezing cycle to provide enough volume of warm gas for harvesting. DO NOT OVERFILL RECEIVER. See Table 3-2
Cutter or cutter disc does not turn	Check cutter gear reducer and drive gear for proper operation and alignment. Check for broken gear teeth or sheared shaft key. Replace defective parts.
Compressor not running unloaded during thaw cycle. (for 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 (UR) to make sure it is energized and the valve opening during the thaw cycle.

Symptom: Low ice capacity.

Suspicions of low ice capacity should be confirmed by accurate calculations of actual ice product. Much weight can be lost by melting and off fall through augers and other ice handling equipment.

1. Time the total freeze and thaw cycle for the cycle which is to be caught and weighed.
2. Catch all the ice at the ice discharge opening of the machine.
3. Weight the total amount of ice caught.

Lbs. ice per cycle
Cycle time minutes X 1440 = _____ lbs. production per 24 hours

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 40-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 distributors may be stopped up	Check distributors and clean orifices as needed.
Freeze timer, Freezer pressure switch or thaw timer out of adjustment	Check hole size in Tube-Ice (See TABLE 7-2). Crushed ice should be 3/16”-1/4” thick. Check and adjust thawing time. Thawing should be 30 seconds longer than it takes for all the ice to clear the freezer.
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 Refrigerant pump malfunctioning.	Check for a partially closed valve or an obstruction at the strainer, solenoid valve, or hand expansion valve. The liquid line will normally have frost on the cold sections. Check the rotation and proper operation of the refrigerant pump.
Low refrigerant charge, causing re-freeze	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. Refer to Section 10, Capacity Table. Check float adjustment and water tank drain valve.

Symptom: Low ice capacity (cont.)

Possible Cause	Possible Remedy
Excessively high head pressure	Check cooling tower or evap 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 (18) 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 (90) 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 (63) is functioning and the tank overflow piping is not restricted.
Insufficient water supply indicated by a low level in the tank	Check water pressure, 40 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, causing an ice out problem and re-freeze	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 the refrigerant liquid line or Refrigerant pump malfunctioning.	Check for a partially closed valve or an obstruction at the strainer, solenoid valve, or hand expansion valve. The liquid line will normally have frost on the cold sections. Check the rotation and proper operation of the refrigerant pump.

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 as specified in TABLE 3-2. 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 evap condenser in need of 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 deposit which would reduce the cooling effect of the tubes and water. Clean chemically or mechanically as applicable.
Too much liquid in condenser covering tubes causing inefficiency	Remove refrigerant so all tubes will be above liquid refrigerant level.

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.

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 which 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 #20 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: Machine short cycles (using freeze pressure switch (2PS) only)

Possible Cause	Possible Remedy
Freeze-up	See “Freeze-up due to extended freezer period” and “Freeze-up due to ice failing to discharge”.
Clogged water distributors	Clean water distributors.
Lack of water for making ice	Check water tank for sufficient water level. Check for restriction in water line, defective float valve, open drain valve, excessive ice chips or low water pressure.
Lack of sufficient liquid refrigerant feed	Check for a partially closed valve or an obstruction at the strainer, solenoid valve, or hand expansion valve. Check the rotation and proper operation of the refrigerant pump. Check proper operating level of low pressure receiver.
Water pump rotation incorrect or pump defective	Check pump motor rotation. Check for leaking pump seal or defective motor and repair or replace as needed.

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 to low-pressure receiver.	Check float switch to make sure it is functioning properly. Replace if defective. Check solenoid valve 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 #61. Refer to Service, Section 9 “Removing Excess Water”.

9. Servicing Operations

Automatic Blowdown (harvest cycle). A feature of this machine is a solenoid activated flushing valve (63) which is provided to eliminate or reduce the necessity for frequent flushing or cleaning of the water tank. This flushing during the harvest cycle helps to remove salts or solids accumulated in the water as a result of the freezing action. It also helps melt ice chips which fall into the water tank during harvest. The flushing valve is opened (energized) during each thaw cycle when the water pump stops and the water in the freezer tubes returns to the water tank. If water quality is superior, installing a smaller reducer bushing in the outlet elbow can reduce this blowdown.

The flushing action carries accumulated salts, solids, and ice chips (fines) out through the water tank overflow pipe. This overflow should be kept open at all times to allow the water to drain freely and keep the water level below the cutter disc and ice discharge opening. If the flushing solenoid valve leaks through during the freeze cycle, it can be disassembled and cleaned, then reassembled.

Cleaning Ice Making Section. Refer to Section 7, Maintenance for instructions for cleaning the circulating water tubes, water distributors, and water tank.

Float valve (make-up water). The make-up water float valve (12) maintains the proper pumping 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 out the 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, which would necessitate frequent cleaning. A strainer of 40 mesh screen is usually satisfactory.

Hand Expansion Valve. The hand expansion valve is located directly after the “A1” solenoid valve. This valve should be set at a point to allow proper flow through the freezer.

Freeze Timer. The freezing time period for producing ice of a desired thickness is controlled by the freeze timer (1TR), Figure 9-2, located inside the control panel. This timer is a microprocessor based timer housed in a standard 15 terminal CYCL-FLEX® plug-in case. Time set points are entered into the unit using a sealed membrane keypad on the front of the unit. Each digit in the setpoint is individually increased or decreased by pressing the appropriate keypad switch. There is a mode annunciator in the display area on the front of the unit. The mode annunciator will flash when the unit is timing. Table 9-2 shows the miniature rocker switch settings for the unit. This enables the unit to pulse output, reverse start, minute/second display and battery back-up setpoints and timing.

Switch	#1	#2	#3	#4	#5	#6	#7
ON	X	X	X			X	X
OFF				X	X		

TABLE 9-2
Minature Rocker Switch Settings for Freeze Timer

Entering and Displaying Setpoints. Whenever the freeze timer unit is powered up and the previous setpoint has been lost, the digit display indicates four hyphens. The unit will not operate until it has been provided with a setpoint, clearing the display of hyphens.

To create or change a setpoint, press the SET key. The setpoint if any, is displayed and the panel key pads become active. The operation of the timing or counting function and the output loads are not affected. For setpoint changes, the SET indicator appears on the graphics panel. The setpoint is changed by pressing appropriate Δ or ∇ keypads. Pressing a Δ key increments the setpoint digit located above the key; the ∇ key decrements the digit located above the key. If the pad is continually depressed, the digit will change every .5 second until the pad is released. The display will carry to the digit on the left on the 9 to 0 transitions when using the Δ pads. The display will borrow from the digits on the left on the 0 to 9 transitions when using the ∇ pads. On ranges 6 and 7, the display will carry on the 59 to 00 transition and borrow on the 00 to 59 transition of the two least significant digits.

When the desired setpoint is displayed, touch the ENT key. The new setpoint is entered, all Δ and ∇ keys become inoperable and “SET” disappears from the graphics panel. New setpoints can be entered while the unit is timing or counting, but they will not take effect until the next reset.

The setpoint may be displayed at any time without disturbing the timing or counting cycle by pressing SET. The actual value is returned by pressing ENT. If the unit is set at 0000, the load is always ON if programmed for OOX, and always OFF if programmed OXO.

A keypad “lock” is provided on the freeze timer to prevent unauthorized tampering. To initiate the keypad lock, press the word “SIGNAL” in the Eagle Signal logo for 8 seconds. To disable the lock to change setpoints, remove power from the unit and turn the battery off (miniature rocker switch #6) and then on. The unit will lose all setpoints and they must be re-entered for further operation.

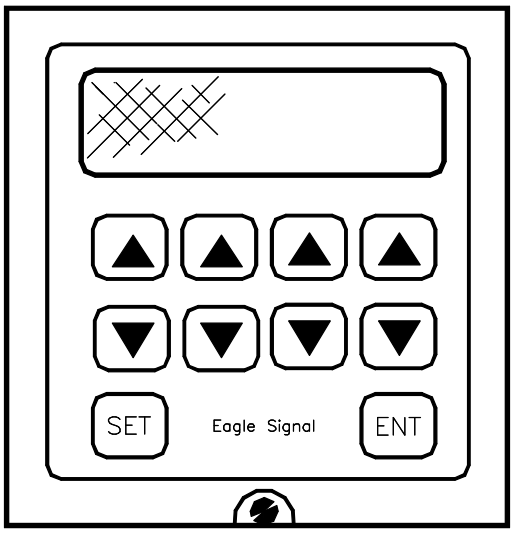


FIGURE 9-1
Freeze Timer (1TR)

Control Circuit Protection. The electrical control circuit of the machine is protected by a 6 amp circuit breaker (CB4). If this breaker should open, the machine will immediately stop. Before resetting the circuit breaker, open the disconnect switch and lock-out all power to the control panel. Reset CB4 and restore power. Check circuitry with a volt meter. If the machine was off for an extended time, the crankcase heater must be energized for a minimum of four (4) hours and no liquid refrigerant in the crankcase before restarting the machine. When ready to restart the machine, depress the "Start" button. As usual, initiate a harvest cycle if there is ice remaining in the freezer. Check Amp draw through the breaker for excessive load or unbalance.

Thawing Timer. The thawing timer (2TR), Figure 9-4, governs the ice thawing period. It is located inside the control panel (FIGURE 6-1). It is started by action of the freeze timer (2TR) or freezer pressure switch (2PS) which energized the "1CR" relay. This timer is set prior to shipment for approximately a three minute period. To replace the timer, simply pull the timer from its base and plug in another, set to "X1" and "Min" and set the thawing period for at least 30 seconds longer than the time required to harvest the entire discharge of ice. If it should be necessary to change the setting of the timer, turn the adjustment dial clockwise to increase the time or counter-clockwise to decrease the time. Check thaw time after each adjustment.

Note: Thicker ice may require a longer thaw period, due to slower ice release time.

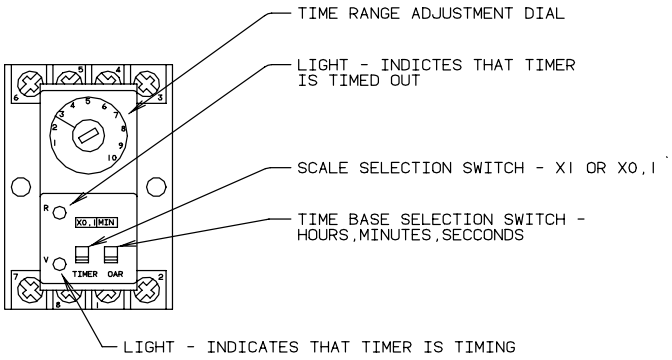


FIGURE 9-2
Thawing Timer (2TR)

Suggested Condenser Cleaning. Any brush or cleaning tool should be sized accordingly so as not to damage the tubes during cleaning. The cleaning tools should be rotated at the specified speed for the particular tool used. The tubes should be kept wet during cleaning After cleaning the tubes should be flushed thoroughly and all foreign material removed. Contact your distributor or Vogt's Service Department to obtain the proper cleaning tools.

The following is the condenser cleaning procedure:

1. Make sure ample room is provided for removing the condenser heads and using the mechanical cleaning equipment.
2. Order replacement cover gaskets for use at the time of reassembly.
3. Disconnect and lock-out power to the ice machine, compressor and auxiliary equipment.
4. Disconnect water piping and drain the condenser. Generally additional water can be drained by loosening the cover (heads) and separating the covers from the condenser end.
5. Remove the heads bolts and gasket completely.
6. Inspect the tubes for excessive corrosion and possible ammonia leaks to determine whether or not further cleaning is feasible.
7. Clean the inside of each tube as well as possible, being careful not to damage the tube. Follow the instructions for the particular tool being used.
8. Flush each tube with water to remove all loose material to prevent contamination of the cooling tower and sump.
9. Clean the ends of the tube sheets, so the new gasket will seal properly.
10. Install the replacement gasket. Make sure the gasket does not cover the tube ends.
11. Install the end covers (heads) and fasten securely in place with the head bolts. It is recommended that a anti-seize compound be applied to the bolt and nut threads to prevent rusting and ensure ease of removal at the next cleaning.
12. Reconnect the water piping, turn on the power. Check for leaks by turning the power on to the condenser pump allowing it to run.
13. Turn the power ON to the compressor and wait for the crankcase heater to warm-up the compressor before starting the machine.

Cutter Gear Reducer. (Cutter units only) The cutter motor and gear reducer (54), Figure 9-5B, drive the ring gear of the cutter assembly. It is important that the teeth of the drive gear and the ring gear mesh properly both vertically and horizontally. The drive gear and hub can be raised or lowered on the gear reducer shaft to obtain maximum vertical tooth engagement and the reducer assembly can be moved in or out horizontally to obtain the proper tooth depth for maximum gear life.

Note: The motor and gear reducer are an integral unit. Only qualified personnel should attempt to disassemble and repair this unit.

Drive Gear Replacement. (Cutter units only)

1. Disconnect and lock-out all power to the machine.

2. Remove the top and side bolts holding the mounting plate to the support bracket. Lift the plate and gear reducer from the bracket and rest the assembly on a stable work table sitting next to the tank. Leave the electrical conduit connected to the gear reducer motor.

3. Inspect the drive gear teeth for proper vertical alignment and wear pattern.

4. If the wear pattern indicates less than a full width of tooth engagement, measure the difference and make a note to correct at the time of reassembly.

5. Measure and record the dimension from the drive gear to the bottom side of the mounting plate.

6. Remove the three or four cap screws holding the drive gear to the split taper bushing.

7. Using two of the same cap screws in the threaded holes of the bushing, jack the gear off the bushing and remove both from the gear reducer shaft.

8. Clean the split bushing and tapered hole of the new drive gear and insert the bushing into the drive gear making sure the tapers match.

9. Slide the split hub and gear onto the keyed shaft with the key in place, positioning the hub (by measurement previously recorded) so the full width of the gear teeth will engage when assembled and tightened.

10. Tighten the cap screws (three or four) progressively and uniformly around the hub and recheck the location measurement. If it is not correct, loosen the cap screws, hub and gear assembly and make correction. Then retighten the cap screws.

11. Install the reducer and mounting plate assembly on the water tank bracket and fasten in place with the side and top cap screws.

12. Rotate the cutter and disc assembly by hand and stop at the point where you feel the least amount of backlash between the gear teeth.

    NOTE: There should be only a slight amount of backlash (more specifically “tooth tip clearance”). Too much clearance will cause premature wear and possible tooth damage. When the cutter runs under a no load condition, it should have a smooth uniform sound. For

lubrication, see Section 7, Maintenance.

13. If the tooth tip clearance needs adjusting, loosen the four hex nuts holding the reducer to the mounting plate and move the reducer as required for proper tooth engagement. Tighten the hex nuts securely and recheck backlash.

Gear Reducer Replacement. (Cutter units only)

1. Disconnect and lock out all power to the machine.

2. Disconnect electrical wires and conduit from the motor.

3. Remove the top and side bolts holding the mounting plate to the support bracket and lift the plate and gear reducer assembly from the tank bracket.

4. Inspect the drive gear teeth for proper vertical alignment and wear pattern. If the wear pattern indicates less than a full width of tooth engagement, measure the distance so correction can be made at the time of reassembly.

5. Measure and record either the distance of the drive gear from the mounting plate or the split hub from the shaft end for future reference when reassembling.

6. Remove the three or four cap screws from the split taper bushing.

7. Use two of the cap screws in the threaded holes of the busing as jacking screws for pushing the drive gear from the hub.

8. Drive a wedge in the split of the hub (bushing) and slide both the hub and gear from the shaft.

9. Remove the four hex nuts and lock washers from the carriage bolts around the reducer base and mounting plate and separate the plate and reducer.

10. Install the replacement gear reducer and motor onto the mounting plate using the carriage bolts, lock washers, and hex nuts. Tighten the nuts snug only for later adjustment.

11. Clean the split hub and drive gear, insert the hub into the gear, making sure the tapers of the two match and slide the hub and gear onto the shaft.

12. Position the hub on the shaft (note measurements previously taken) so the full width of the gear teeth will engage when assembled and tightened.

13. Tighten the cap screws (three or four) progressively and uniformly around the hub, checking the measurements and adjusting as necessary.

14. Install the reducer and mounting plate assembly on the water tank bracket and fasten in place with the side and top cap screws.

15. Rotate the cutter and disc assembly by hand and stop at the point where you feel the least amount of backlash between the gear teeth.

16. If the gear tooth tip clearance needs adjusting, loosen the four hex nuts around the reducer base and move the reducer as required for proper tooth clearance. Tighten the hex nuts securely and recheck for backlash.

17. Reconnect the electrical wires and conduit to the motor.

18. Check cutter rotation and correct as necessary.

    NOTE: When the cutter runs under a “no-load” condition, it should have a smooth uniform sound.

To inspect the cutter assembly and make repairs or replace parts, it will be necessary to lower and remove the water tank from its mounting to the bottom of the freezer. The water tank has metal casters allowing it to be rolled out from under the freezer for inspection and servicing.

Water Tank Removal

1. Disconnect and lock-out all power to the machine.

2. There should be ample space to roll the water tank from under the machine. It may be necessary to provide a flat level surface such as a sheet of plywood sufficiently supported to hold the weight of the tank and cutter assembly.

3. Turn off water supply, drain water, and disconnect water and drain lines from the tank.

4. Remove the overflow tubing from the water tank and remove the circulating water tubing from the pump.

5. P42A only - the water pump is mounted to the structural frame of the machine and will have to be disconnected from the tank at the pump inlet bolted flange before moving the water tank.

6. Disconnect the ice discharge chute or hopper from the ice discharge opening of the water tank, making sure the tank is free to be moved.

7. Remove the mounting bolts from around the flange of the tank, allowing the tank to be lowered to rest on its casters.

8. P42A only - the channel support at the right side base of the machine (opposite from the pump side) will have to be removed for the tank to be rolled out from under the freezer.

9. Roll the water tank from under the freezer, turning it as you go to clear the gear reducer and motor. It is now accessible for inspecting and/or repair of the cutter assembly.

Cutter Assembly Removal and Installation.

1. Follow water tank removal instructions, Steps 1-9.

2. Remove the socket head cap screw from the center of the cutter shaft and lift out the retainer and gasket.

3. Lift the cutter straight up and off the shaft, taking care to catch the shaft key as it is removed.

4. To install the cutter, lower it down onto the shaft, allowing the ring gear to mesh with the drive gear.

5. Rotate the cutter, aligning the shaft and hub key way and inserting the key to its full depth.

6. Install the gasket, the retainer, and the socket head cap screw and tighten to approximately 15 ft. lb. torque.

7. Check and adjust the cutter height per “Cutter Height Adjustment” instructions.

Bearing Bracket and Cutter Disc Removal.

1. Remove the cutter assembly per instructions.

2. Match mark the bearing bracket support arms with the water tank for reassembly reference.

3. Remove the splash shield and ice deflector plate from the ice discharge opening.

4. Support the bearing bracket to keep it from falling in the tank. Loosen and remove the four cap screws and lock washers from the ends of the bearing bracket support arms.

5. Lift the bracket and cutter disc from the tank. Be sure the support arms are match marked for reassembly. You may have to gently drive the support arms up or down to release them from the tank walls.

6. With the bracket and disc assembly turned upside down, remove the cotter pin from the shaft.

7. Loosen and remove the slotted hex nut, spring washer, and spacer.

8. Lift the cutter disc from the keyed shaft, being careful not to loose the shaft key.

The cutter shaft and bearings are sealed in the bearing bracket assembly. The cavity between the bearings has been filled with a food-grade grease to prevent the presence of moisture and prolong the life of the unit. If there is any vertical or side movement of the shaft or if the bearings feel rough or tight when turning the shaft, the assembly should be dismantled and rebuilt. Refer to the cutter tank assembly drawing, Figure 9-3B, for parts location and identification.

Cutter Shaft and Bearing Removal.

Note: Use only a soft mallet or other soft tool for fitting all parts into place.

1. With the bearing bracket assembly removed from the tank, press the shaft out of the housing from the bottom up.

   Note: The two top bearings may come out with the shaft along with the upper seal and excluder.

2. Turn the bracket over and press the bottom bearing out the bottom, along with the lower seal.

3. There are three spacers on the shaft which should be removed and labeled as to their location. Remove them as they are made accessible.

4. Clean and inspect all parts for wear or damage. Discard all parts showing any indication of damage.

Cutter Shaft and Bearing Installation.

1. Clean the inside of the bearing housing of grease or foreign matter. Further clean the top bearing housing with pro-lock cleaner and primer (or a suitable substitute) and remove the pipe plugs from the side of the housing.

2. Apply a thin coat of Loctite® RC/609 retainer (or a suitable substitute) to the inner surface and bearing shoulder of the top of the bearing bracket.

3. Insert a bearing in the top housing and set it in place.

4. Clean the cutter shaft and press the top bearing onto the shaft.

5. Slide the upper bearing spacer on the shaft and begin driving the shaft down through the middle bearing of the housing. Do not start the top shaft bearing in the housing.

6. Partially fill the housing with grease (MPG-2 or a USDA approved grease). Use enough to fill the area between the two upper bearings, forcing some out the pipe plug hole when the shaft and top bearing are seated.

7. Finish driving the shaft and bearing into the housing until it is firmly seated.

8. Turn the bracket and shaft upside down and fill the housing around the shaft with MPG-2 (or suitable substitute) grease.

9. Slide the lower bearing spacer over the shaft and into the housing.

10. With the top end of the shaft supported, install the lower bearing on the shaft driving it down into the housing firmly against the housing shoulder.

11. Slide the seal spacer (ridged end in, flat end out) and seal (open face out) onto the shaft together.

12. Uniformly tap the seal into the housing against its shoulder.

    NOTE: The purpose of the seals and excluders are to prevent moisture from entering the housing area not to hold the grease in.

13. Wipe off excess grease and install the two pipe plugs.

14. Install the largest excluder on the bracket as illustrated by the assembly drawing.

15. Install the tines disc, the 1/4 x 1/4 key, spacer, spring washer, castle nut, and cotter pin.

16. Turn the assembly right side up and install it in the water tank, locating the support arms as they were match marked when removed and secure in place using the 5/8" stainless steel cap screw and lock washer maximum torque should be 90 ft. lbs.

17. Install the top seal (open side facing out*), tapping it uniformly into the housing until it seats.

18. Install the top water excluder.

19. Install the splash shield and ice deflector plate in the ice discharge opening.

20. Install the cutter assembly, using the 1/4" X 1/4" X 3 3/16" lg. stainless steel key to align the key ways and lock the cutter and shaft together.

21. Install the red rubber gasket, retainer, and 3/8" stainless steel socket head cap screw. Tighten to approximately 15 ft. lbs.

22. Check and adjust the cutter height per "Cutter Height Adjustment" instructions.

Cutter Height Adjustment. The height of the cutter can be adjusted by the four bolts holding the bearing bracket assembly in place. These bolts are threaded into holes in the end of each arm through holes in the water tank. The current design has these washers welded in place after the cutter height is properly adjusted. This helps to insure proper adjustment during servicing. Using a true straight edge long enough to reach across the top flange of the water tank (30" for P24 and 40" for P34), the top of the cutter rim and blade should be 1/8" ± 1/16" below the top of the water tank flange.

Keep one end of the straight edge at the same point and swing the other end across the tank at various points to check the clearance.

Also, rotate the cutter to check all points. If adjustment is necessary, loosen the four side bolts and raise or lower each arm as needed. Tighten the bolts securely to approximately 90 ft. lb.

Water Tank Installation.

1. Place the 3/16" thick gum rubber gasket on the top of the tank flange. It can be held in place with narrow strips of tape through the bolt holes.

2. Push the water tank in and under the freezer aligning the bolt holes and installing the mounting bolts around the flange and tightening the nuts securely.

3. Reconnect the discharge chute or hopper to the ice discharge opening.

4. Mount the water pump (P4 only) and attach the circulating water tubing and overflow tubing.

5. Reconnect all water piping such as drain, overflow, and make-up water lines. Turn water on and check for leaks.

6. Fill the water tank with water and make sure the drain valve is closed.

When ready, turn the power "On" to the machine, but don't operate the compressor until the oil is warm and there is no liquid refrigerant in the crankcase.

Pumpdown. The function of the pumpdown is to transfer all the liquid refrigerant from the freezer (evaporator) into the receiver. Pumpdown 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 remove excess water from the ammonia.
5. To prepare the machine for disconnection or moving.

To perform a pumpdown, follow this procedure:

1. With the machine running, close the liquid feed stop valve nearest the low-pressure receiver.

2. 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.

3. Allow the machine to operate and complete two freeze and harvest cycles.

4. After the second harvest cycle, stop the machine, throw the electrical disconnect, and lock-out all power to the machine.

5. Remove wire #17 from the freezer pressure switch (2PS) and insulate the end to prevent a short circuit.

6. Restore power to the machine and start the water pump only, to circulate warm water through the freezer.

7. 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 or timer jumped out, the machine can be manually started and stopped. Do not operate the machine below 2 psig.

8. When the desirable pumpdown is obtained, close the thawing gas stop valve, #90, and the compressor discharge line stop valve. Other valves may also be closed to isolate a particular area which may require attention.

9. To perform a total pumpdown, it may be necessary to apply heat directly to the oil trap and low pressure receiver 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 !
It is not recommended that refrigerant to 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 weighed continuously to assure contents do not exceed net weight specified by cylinder manufacturer of 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”.

Note: Observe all local codes when handling and discharging anhydrous-ammonia refrigerant.

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.

Sulfur sticks and test paper can be obtained from your ammonia supplier.

- 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.

Non-condensable Gasses. 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.and Section 9 "Condenser Cleaning".

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 accumulator, but should be done only during the thaw cycle or after the system has been idle at least two hours.

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.

Note: Repeat above procedure for low-pressure receiver.

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, #36. 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.

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.

1. Perform a total pumpdown of the freezer. See “PUMPDOWN”.

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, #61 and extend the other end into a container (5 gallon bucket, etc.).

4. Open the hot gas check valve (101).

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

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

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

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

9. 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.

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

11. After evacuation, break the vacuum by manually opening the liquid line solenoid valve and gradually opening the liquid line stop valve (29 or at the receiver), letting liquid ammonia enter the freezer and raise the pressure.

12. 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.

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

14. Turn the “HAND/AUTO” switch to “HAND”. 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.

15. 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.

Circulating Water Pump Motor. The motor bearings are prelubricated and sealed. They require no further lubrication. The pump should operate with the water level above the impeller housing.

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.

Solenoid Valves. The P24 and P34 are equipped with several solenoid valves to perform various functions for proper operation and good ice production.

The Thaw Gas Solenoid Valve (18), Figure 9-3, is opened during the thaw cycle to allow warm gas to pass from the receiver to the freezer. Repair or replace as follows:

1. With the receiver pressure higher than the freezer pressure, manually open the valve by turning the manual stem out until you hear gas passing through the valve.

2. Close the two hand stop valves (#90) tight on either side of solenoid valve when there is vapor only in that part of the line.

3. Loosen the 1/4" tubing compression nut at the strainer slightly to purge that section of the thaw gas line and continue to purge until all pressure is relieved.

4. Repair or replace the valve as needed making sure all connections are tight.

5. With the valve manually opened (stem out), open slightly only one stop valve #90 and purge air from the line through the 1/4" tubing compression nut at the strainer. Then close that valve #90 and open the other #90 valve to purge air from that section of the line.

6. When purging is complete, tighten the compression nut, manually close the solenoid valve (stem in until it protrudes about 1/8" out from the housing).

7. Reopen stop valves #90 and check for leaks.

8. Adjust the regulating valve to approximately 60-65 psig to the freezer pressure during harvest.

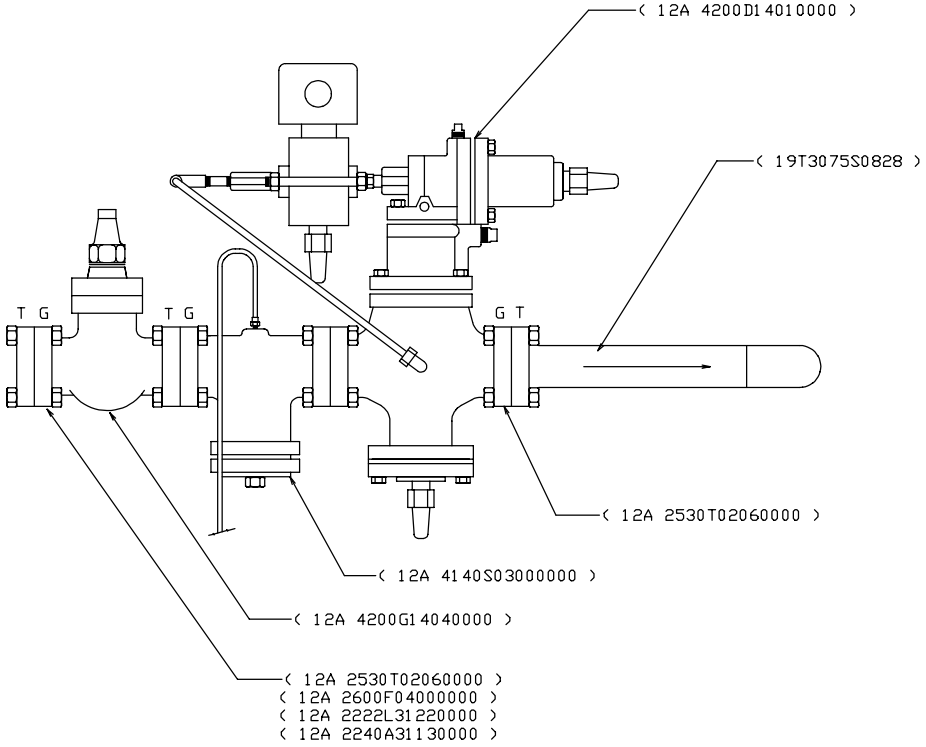


FIGURE 9-3
Thaw Gas Solenoid Valve Assembly

The Liquid Feed Solenoid Valve (20), Figure 9-4, is opened and closed during the freezer cycle by the float switch #10, in order to maintain the proper freezer refrigerant level. It is closed when the machine is off to prevent liquid flow from the receiver to the freezer.

Repair or replace as follows:

1. With the receiver pressure higher than the freezer pressure close the hand stop valve #58 and #29 (upstream and downstream) in the liquid line between the receiver and liquid feed solenoid valve.

2. Manually open (screw stem in until only 1/8" protrudes) and allow the liquid to flow to the freezer and clear this part of the line of liquid, leaving only vapor.

3. Close the other hand stop valve #29 (downstream). This will isolate the solenoid valve.

4. Purge the remaining ammonia from this line through the strainer purge valve #75.

5. Repair or replace the valve as needed, making sure all connections are tight.

6. Evacuate or purge air from this isolated part of the liquid line through the strainer purge valve.

7. After purging, manually close (screw stem out) the solenoid valve and open stop valves #29 and #58,check for leaks.

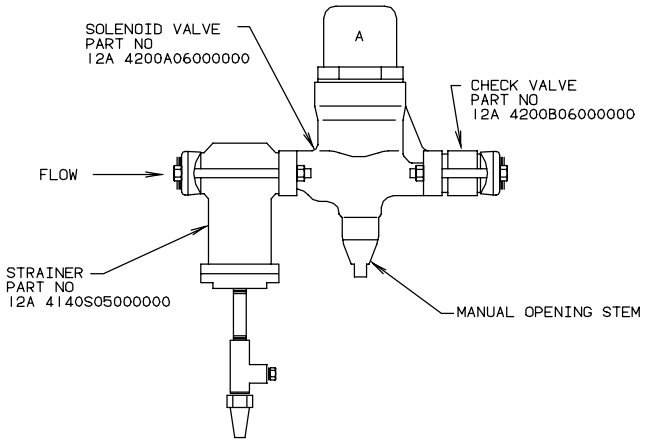


FIGURE 9-4
Liquid Line Solenoid Valve

Thaw Chamber Check Valve. This valve is closed during the freeze cycle to keep the thaw chamber from filling with liquid ammonia. To manually open simply turn the manually opening stem inward. Repair or replace as follows:

1. Pump the machine completely down with check valve in the manually open.
2. Shut the thaw gas hand valve (90).
3. Vent additional ammonia vapors from oil trap drain valve (61).
4. Replace or repair valve.
5. Shut oil trap drain valve and open thaw gas hand valve.
6. start machine in normal operating condition.

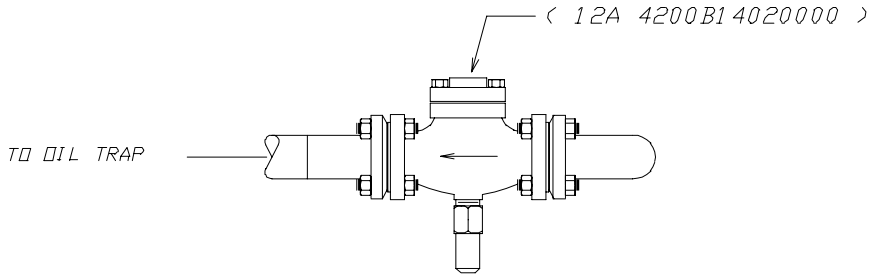


FIGURE 9-5
Thaw Gas Check Valve

Water Flush Solenoid Valve (63) is opened during the thaw (harvest) cycle, to flush out some of the impurities form the water in the tank, thereby improving the ice quality. Repair or replace as follows:

1. Turn off the water supply to this valve.
2. Dismantle the valve and inspect for dirt, etc., and wear. Reverse osmosis water can cause premature wear and erosion of the brass parts of this valve, you may want to consider replacing the valve with a stainless steel valve.
3. Repair or replace the valve as needed.
4. Turn on the water supply and check for leaks.

Compressor Cooling Solenoid Valve (64) is opened all the time the compressor is running. It provides water for cooling the compressor oil and heads. There should be no water flow through the compressor heads when the compressor is not running. Water through the heads (water jackets) during off times could cause liquid ammonia condensing in the crankcase and dilute the oil or slug

the compressor at start up. Repair or replace this valve by following the same procedure outlined for the Water Flush Valve, #63.

Compressor Oil Changing (optional)

See Table 7-4 for frequency recommendations.

1. Turn off power to the machine and make sure the compressor crankcase heater is not energized.
2. Drain the oil through the oil drain valve located at the base of the compressor.
3. When all oil is drained, new oil of the required specifications can be pumped into the crankcase to the proper level.
4. Turn the power on and allow the crankcase heater to warm the oil prior to start-up. Be sure to confirm sufficient oil pressure at start-up.
5. Restore power to the crankcase heater allowing time to warm the oil. Be sure to confirm sufficient oil pressure at start-up.

Compressor Inspection (optional)

1. Close the compressor suction valve and allow the machine to stop by low pressure cut-out.
2. Close the compressor discharge valve, oil return stop valve. Disconnect and lock-out all power to the machine.
3. Drain the oil through the oil drain valve located at the base of the compressor and purge the compressor until all pressure is relieved.
4. Remove the compressor side cover(handhole cover) being careful to protect the gasket and surface from damage.
5. Inspect the crankcase inside for foreign material such as sludge, metal flakes, burrs, or anything which may look unusual, indicating excessive wear or damage.
6. Remove all remaining oil and wipe out the compressor with a lint-free cloth. The extent of internal inspection should be dependent on the degree of evidence of wear.
7. Inspect and clean the oil strainer. Cleaning can be accomplished with light oil, diesel fuel or mineral spirits. Make sure excess cleaning agents are removed prior to closing the crankcase.
8. Clean the oil sight glass and install the side cover plate using a new gasket if necessary and torqueing bolts tot he correct specification.
9. Evacuate the compressor and add new oil to the crankcase.
10. Restore power to the crankcase heater allowing time to warm the oil.

11. Open the suction valve, discharge valve, oil return valve, and any other valves which may have been closed for servicing and check for leaks.

12. Check and confirm sufficient oil pressure as you witness at least one complete cycle when operation is resumed.

Belt Tension. New belts should be checked after the first day running, after the first week for tension, then at regular intervals for tension, alignment, and wear

1. Always use matched sets or banded belts for multiple belt applications.

2. Too much tension shortens belt life and motor bearing life.

3. Never use a petroleum base belt dressing.

4. The proper tension is just enough to prevent slipping.

Reasons for premature wear.
1. Pulley misalignment
2. Belts not matched
3. Dirt or foreign material present
4. Excessive slipping (loose tension)

Belt Replacement. Belts which are worn, cracked, frayed, or over stretched should be replaced.

1. Remove the belt guard and loosen motor hold-down bolts.

2. Move the motor and sheave closer to the compressor until there is enough slack to remove the old belts.

3. Remove the old belts and clean the sheave grove if necessary with non-flammable, non-toxic degreasing agent or commercial detergent.

4. Install new belts by rotating the belt and sheaves to obtain seating in the grooves.

   Note: on drives having more belt grooves in the sheaves than needed, use the grooves closest to the motor and compressor. Make sure that the belts are all slack on the same side of the drive, preferably the bottom, prior to tightening.

5. Move the sheaves apart until the belts are snug.

6. Check the motor and compressor shafts to make sure they are parallel, and check the flywheel and motor sheave with a straight edge, string, or wire to make sure they are parallel and in the same plain. Make adjustment as required.

7. Adjust tension following these guidelines:

a) Best tension is the lowest tension at which the belts will not slip under the highest load condition.

b) Check tension after the first two to four hours and again after 24 to 48 hours of operation, then periodically thereafter.

c) If a belt slips, tighten it.

8. Retighten motor hold-down bolts after each adjustment.

Compressor Servicing. Refer to your compressor manual for specific instructions regarding repair and servicing of internal parts. It is important to be familiar with the operation and function of your equipment so you can provide the best possible service.

10. Options and Accessories

Length of Ice. Ice length can be changed by increasing or decreasing the length of the spacer under the adapter plates. The water tank assembly must be removed for making this modification. When installing the adapter plates, make sure the horizontal dimension from the cutter blade edge to the edge of the adapter plate is as follows:

7/8” space for 1” tubes
1 1/8” space for 1 1/4” tubes
1 3/8” space for 1 1/2” tubes

See Figure 9-6 for illustration of this critical adjustment.

! CAUTION !
Always witness several ice making cycles after making conversions or modifications to make sure all ice clearing during the set thawing time and adjust timer accordingly.
! CAUTION !

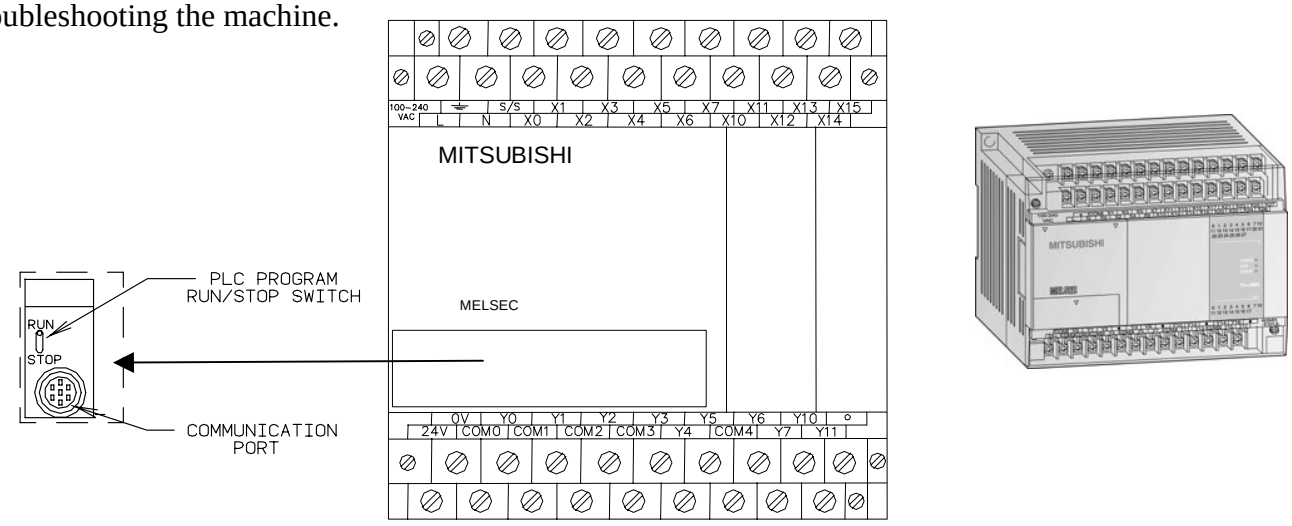
Large Machine PLC (Programmable Logic Controller)

Tube-Ice® machines are available with a Mitsubishi Fx_{1n} 24MR programmable controller and a 10DUE operator interface. The PLC version of the Tube-Ice® enhances the operation of the standard version by providing: Selectable automatic restart after a power failure, choice of timed or pressure switch controlled freeze cycles, programmable blowdown adjustment, programmable in cutter delay, programmable conveyor control contacts (delay and run time), freezer pumpdown and a total cycle counter. The PLC also provides fault indication with an alarm relay. Faults include compressor high discharge pressure, compressor low suction pressure, compressor oil pressure, compressor motor overload, cutter motor overload, water pump motor overload, long cycle, short cycle (when using pressure switch) and power failure.

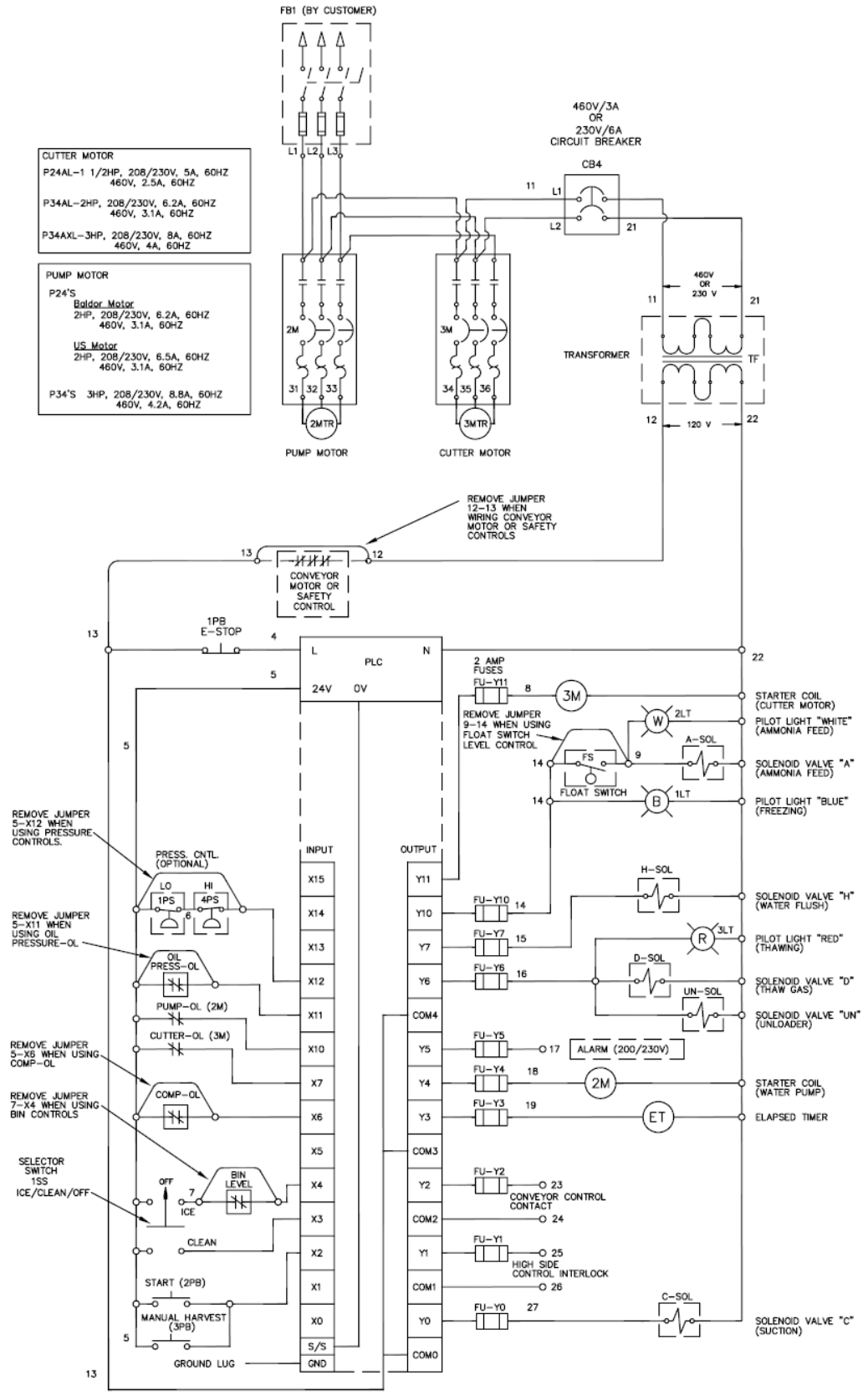
MITSUBISHI PLC

The Mitsubishi Programmable controller contains 14 inputs and 10 outputs. The power supply for the unit can be 100-240VAC, 50/60 Hz and is internally fused for 3A. The inputs are 24VDC internally fused for 5-7mA and supplied by the PLC. All 24VDC control wiring is blue in color and is distinguished from the red 240VAC control wiring. The outputs are externally fused for 2A. Outputs 1 and 2 are dry contacts used for high side control interlock and conveyor control. Outputs 0, 3-11 are relay type with 120V or 200/240 V connections.

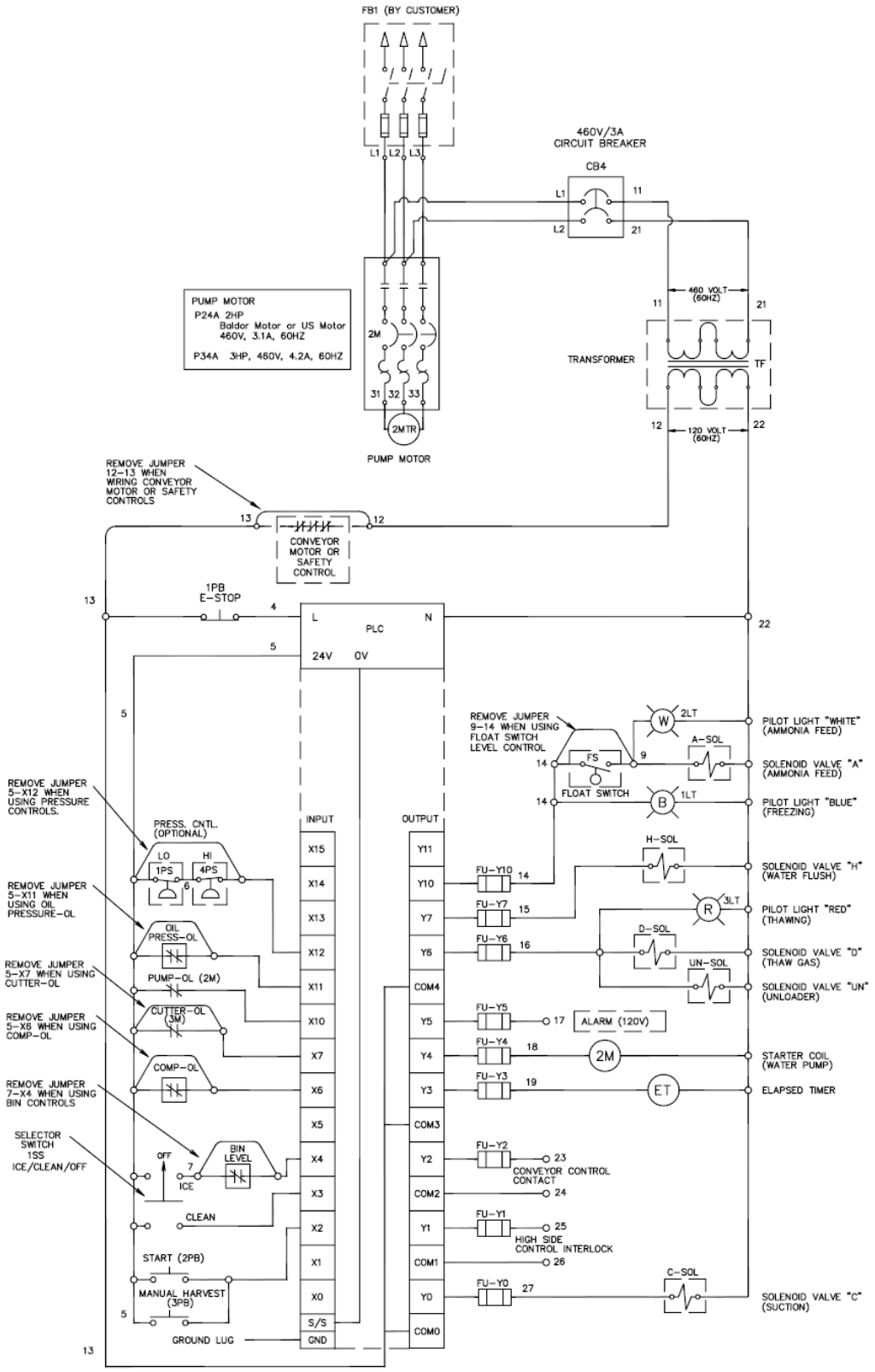
The LED indicators on the right hand side of the Mitsubishi PLC indicate the power, run and error status of the PLC. When power is on to the PLC and the run/stop switch is in the run position the power and run indicators will be illuminated. A solid or flashing error light indicates a processor or program error. The LED indicators on the upper right hand side of the PLC, indicates the input status and LED indicators on the lower right hand side of the PLC indicate the output status. If the input (X#) indicator is illuminated, then the PLC is receiving the input. If the output (Y#) indicator is illuminated, then the PLC is sending the output. Use of these LED's will be helpful in troubleshooting the machine.



Mitsubishi Programmable Logic Controller



Wiring Schematic (Standard Unit)



Wiring Schematic (Cutterless Unit)

PLC Input & Output Descriptions

Inputs	Description	Use
0	Not used	N/A
1	Not used	N/A
2	Start / Manual Harvest Button (in parallel)	Initiates harvest or start of machine
3	Selector Switch (Clean position)	Clean switch
4	Selector Switch (Ice position) is series w/Bin control	Ice switch
5	Freezer Pressure switch (package machines only)	Initiates harvest cycle (optional)
6	Compressor overload	High side safety (optional)
7	Cutter Motor overload	Cutter motor safety
10	Pump Motor overload	Pump motor safety
11	Oil Pressure safety	High side safety (optional)
12	High / Low pressure safety	High side safety (optional)
13	Not used	N/A
14	Not used	N/A
15	Not used	N/A

Outputs	Description	
0	C-sol (Suction solenoid valve)	On during freeze cycle and pumpdown
1	High Side Control Interlock	Signals high side that ice machine is running (when in Freeze, harvest or pumpdown)
2	Conveyor Control Contact	On during harvest (comes on at start of harvest and runs 30-60 sec after end of harvest)
3	ET - Elapsed Timer	On when in Freeze or Harvest cycle
4	2M – Water Pump motor starter	On when in a Freeze Cycle or Clean cycle
5	Alarm	For external alarm after fault occurs
6	Harvest Light D-sol (defrost solenoid valve) UN-sol (compressor unloader) – for dedicated compressor	On during Harvest cycle
7	H-sol (water tank flush valve)	On during Harvest cycle
10	Freeze light Float switch / A-sol (liquid feed valve) & Liquid Feed light	On during Freeze cycle
11	3M – Cutter motor starter	On during Harvest cycle (comes on after a 15-30 sec delay)

11. Tables & Charts

P42AL SPECIFICATIONS, 400/460 Volt-3 Phase- 50/60Hz

Tube Size	**inches** (cm)	**1** (2.54)	**1 1/4** (3.17)	**1 1/2** (3.18)
Nominal Capacity(1)	**Tons/day** (M Tons/day)	75.9 (68.8)	67.0 (60.78)	52.5 (47.6)
Ice per Harvest	**lbs** (Kg)	1,537 (697)	2,044 (927)	1987 (901)
Overall Dimensions (LxWxH)	**Feet** (meters)			
Shipping Weight	**lbs** (Kg)	13,200 (5987)	13,200 (5987)	13,200 (5987)
Operating Weight	**lbs** (Kg)	17,200 (7802)	17,700 (8,028)	17,300 (7,847)
Refrigerant Charge (R-717)(2)	**lbs** (Kg)	1656 (751)	1407 (683)	1286 (583)
Total FLA (3)		**27**	**27**	**27**
Maximum Fuse		**50**	**50**	**50**
Minimum Ampacity		**7.9**	**7.9**	**7.9**
System Requirements				
- Dedicated Compressor(4)	**Tons** (KW)	171	136	95
- Average Refrigeration(4)	**Tons** (KW)	130	107	82.5
- Peak refrigeration(4)	**Tons** (KW)	NA	NA	NA
-makeup(5)	**gpm** (m^3/ Hr)	22.4 (5.1)	21.3 (4.9)	17.2 (3.9)
- blowdown per harvest	**Galllons** (L)	60 (22.7)	60 (22.7	60 (22.7
Connection Sizes				
-makeup water	**FPT**	**1 ½”**	**1 ½”**	**1 ½”**
-tank drain	**FPT**	**2”**	**2”**	**2”**
-flush water	**FPT**	**3/4”**	**3/4”**	**3/4”**
-tank overflow	**FPT**	**3”**	**3”**	**3”**
-suction	**Bw**	**5”**	**5”**	**5”**
-liquid feed	**Flanged**	**2 ½”**	**2 ½”**	**2 ½”**
-thaw gas	**Flanged**	**3”**	**3”**	**3’**
Compressor -HP-KW-FLA	Dedicated	**N/A**	**N/A**	**N/A**
Water Pump - HP-KW-FLA		**3-2.1-4.3**	**3-2.1-4.3**	**3-2.1-4.3**
Cutter Motor - HP-KW-FLA		**N/A**	**N/A**	**N/A**
THR	**Btu/hr** (kW)			

(1) Nominal capacity is based on 70°F makeup water, 16°F suction temperature,100°F condensing temperature, 70°F ambient, and 25% blowdown.

(2) For evaporator only. Dedicated system charge is 1,000 lbs., (454Kgs).

(3) FLA for 460 volt models is approximately 1/2 that of 230 volt models. Total FLA does not include cooling tower or auxiliary equipment.

(4) Compressor Requirements is based on 16°F suction temperature,100°F condensing temperature, 70°F ambient, and 25% blowdown.

(5) Makeup water is maximum value and includes 25% blowdown. each cycle.

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

Table 11-1

TEMPERATURE - PRESSURE CHART
FOR COMMON REFRIGERANTS (°F-psig)

DegF	R-12	R-22	R-502	R-134a	R-404A	R-717	MP-39	DegF	R-12	R-22	R-502	R-134a	R-404A	R-717	MP-39
-50	-7.6	-3.0	0.2	-9.0	0.0	-7.0	-9.1	**50**	46.7	84.0	97.4	45.5	102.9	74.2	45.3
-48	-7.2	-2.4	0.7	-8.7	0.8	-6.5	-8.7	**52**	48.8	87.3	101.0	47.7	109.0	77.7	60.0
-46	-6.8	-1.7	1.5	-8.3	1.6	-6.0	-8.3	**54**	51.0	90.8	104.8	50.1	113.0	81.3	62.0
-44	-6.3	-1.0	2.3	-8.0	2.5	-5.4	-7.9	**56**	53.2	94.3	108.6	52.3	117.0	84.9	65.0
-42	-5.8	-0.2	3.2	-7.6	3.4	-4.9	-7.4	**58**	55.4	97.9	112.4	55.0	121.0	88.7	68.0
-40	-5.4	0.5	4.1	-7.1	5.5	-4.3	-7.1	**60**	57.7	101.6	116.4	57.5	125.0	92.6	70.0
-38	-4.9	1.3	5.0	-6.7	6.5	-3.6	-6.6	**62**	60.1	105.4	120.4	60.1	130.0	96.6	73.0
-36	-4.4	2.2	6.0	-6.3	7.5	-3.0	-6.1	**64**	62.5	109.3	124.6	62.7	134.0	100.7	76.0
-34	-3.8	3.0	7.0	-5.8	8.6	-2.3	-5.6	**66**	65.0	113.2	128.8	65.5	139.0	104.9	79.0
-32	-3.3	4.0	8.1	-5.3	9.7	-1.6	-5.2	**68**	67.6	117.3	133.2	68.3	144.0	109.3	82.0
-30	-2.7	4.9	9.2	-4.8	10.8	-0.8	-4.4	**70**	70.2	121.4	137.6	71.2	148.0	113.7	85.0
-28	-2.1	5.9	10.3	-4.2	12.0	0.0	-4.1	**72**	72.9	125.7	142.2	74.2	153.0	118.3	89.0
-26	-1.5	6.9	11.5	-3.8	13.2	0.8	-3.4	**74**	75.6	130.0	146.8	77.2	158.0	123.1	92.0
-24	-0.8	7.9	12.7	-3.0	14.5	1.7	-2.9	**76**	78.4	134.5	151.5	80.3	164.0	127.9	95.0
-22	-0.1	9.0	14.0	-2.4	15.8	2.6	-2.2	**78**	81.3	139.0	156.3	83.5	169.0	132.8	99.0
-20	0.6	10.1	15.3	-1.8	17.1	3.5	-1.7	**80**	84.2	143.6	161.2	86.8	174.0	137.9	102.0
-18	1.3	11.3	16.7	-1.1	18.5	4.5	-1.0	**82**	87.2	148.4	166.2	90.2	180.0	143.2	106.0
-16	2.1	12.5	18.1	-0.4	20.0	5.6	-0.2	**84**	90.2	153.2	171.4	93.6	185.0	148.5	109.0
-14	2.8	13.8	19.5	0.3	21.5	6.7	0.4	**86**	93.3	158.2	176.6	97.1	191.0	154.1	113.0
-12	3.7	15.1	21.0	1.1	23.0	7.8	1.4	**88**	96.5	163.2	181.9	100.7	197.0	159.7	117.0
-10	4.5	16.5	22.6	1.9	24.6	8.9	2.2	**90**	99.8	168.4	187.4	104.4	203.0	165.5	121.0
-8	5.4	17.9	24.2	2.8	26.3	10.2	3.1	**92**	103.1	173.7	192.9	108.2	209.9	171.4	125.0
-6	6.3	19.3	25.8	3.6	28.0	11.4	3.9	**94**	106.5	179.1	198.6	112.1	215.0	177.5	129.0
-4	7.2	20.8	27.5	4.5	29.8	12.8	4.8	**96**	110.0	184.6	204.3	116.1	222.0	183.7	133.0
-2	8.2	22.4	29.3	5.5	31.6	14.2	5.7	**98**	113.5	190.2	210.2	120.1	229.0	190.1	138.0
0	9.2	24.0	31.1	6.5	33.5	15.6	6.7	**100**	117.2	195.9	216.2	124.3	235.0	196.1	142.0
2	10.2	25.6	32.9	7.5	35.6	17.1	7.7	**102**	120.9	201.8	222.3	128.5	242.0	203.3	146.0
4	11.2	27.3	34.9	8.5	37.4	18.6	8.8	**104**	124.7	207.7	228.5	132.9	249.0	210.2	151.0
6	12.3	29.1	36.9	9.6	39.4	20.3	9.9	**106**	128.5	213.8	234.9	137.3	256.0	217.2	156.0
8	13.5	30.9	38.9	10.8	41.6	21.9	11.0	**108**	132.4	220.0	241.3	142.8	264.0	224.4	160.0
10	14.6	32.8	41.0	12.0	43.9	23.7	12.2	**110**	136.4	226.4	247.9	146.5	271.0	231.7	165.0
12	15.8	34.7	43.2	13.1	46.0	25.4	13.4	**112**	140.5	232.8	254.6	151.3	279.0	239.2	170.0
14	17.1	36.7	45.4	14.4	48.3	27.4	14.6	**114**	144.7	239.4	261.5	156.1	286.0	246.9	175.0
16	18.4	38.7	47.7	15.7	50.7	29.3	15.9	**116**	148.9	246.1	268.4	161.1	294.0	254.8	180.0
18	19.7	40.9	50.0	17.0	53.1	31.3	17.2	**118**	153.2	252.9	275.5	166.1	302.0	262.8	185.0
20	21.0	43.0	52.5	18.4	55.6	33.3	18.6	**120**	157.7	259.9	282.7	171.3	311.0	271.0	191.0
22	22.4	45.3	54.9	19.9	58.2	35.5	20.0	**122**	162.2	267.0	290.1	176.6	319.0	279.4	196.0
24	23.9	47.6	57.5	21.4	59.9	37.7	21.5	**124**	166.7	274.3	297.6	182.0	328.0	288.0	202.0
26	25.4	49.9	60.1	22.9	63.6	40.0	23.0	**126**	171.4	281.6	305.2	187.5	336.0	296.7	207.0
28	26.9	52.4	62.8	24.5	66.5	42.4	24.6	**128**	176.2	289.1	312.9	193.1	345.0	305.7	213.0
30	28.5	54.9	65.6	26.1	69.4	44.8	26.2	**130**	181.0	296.8	320.8	198.9	354.0	314.8	219.0
32	30.1	57.5	68.4	27.8	72.3	47.4	27.9	**132**	185.9	304.6	328.9	204.7	364.0	324.2	225.0
34	31.7	60.1	71.3	29.5	75.4	50.0	29.6	**134**	191.0	312.5	337.1	210.7	373.0	333.7	231.0
36	33.4	62.8	74.3	31.3	78.5	52.7	31.3	**136**	196.2	320.6	345.4	216.8	383.0	343.4	237.0
38	35.2	65.6	77.4	33.2	81.8	55.5	33.2	**138**	201.3	328.9	353.9	223.0	392.0	353.4	243.0
40	36.9	68.5	80.5	35.1	85.1	58.4	35.0	**140**	206.6	337.3	362.6	229.4	402.0	363.5	250.0
42	38.8	71.5	83.8	37.0	88.5	61.3	37.0	**142**	212.0	345.8	371.4	235.8	412.0	373.8	256.0
44	40.7	74.5	87.0	39.1	91.9	64.4	39.0	**144**	217.5	354.5	380.4	242.4	423.0	384.4	263.0
46	42.7	77.6	90.4	42.0	95.5	67.6	41.0	**146**	223.1	363.4	389.5	249.2	434.0	395.2	269.0
48	44.7	80.7	93.9	43.3	99.2	70.8	43.1	**148**	228.8	372.3	398.9	256.0	444.0	406.1	277.0
50	46.7	84.0	97.4	45.5	102.9	74.2	45.3	**150**	234.6	381.5	408.4	263.0	449.0	432.0	283.0

TABLE 11-2

All pressures are in lbs/in^2 gage (psig).

REFERENCE INFORMATION

CONVERSION FACTORS: English to Metric

To Convert	From	To	Multiply by
Area	ft^2 in^2	m^2 m^2	9.2903e-2 6.416 e-4
Energy	BTU hp kW	Joule (J) BTU/Hr hp	1054.48 2546.2 1.34
Length	ft. in.	m. m.	0.3048 0.0254
Pressure	lbf/ft^2 lbf/in^2 (psi) in. Hg in H_2O	Paschals Paschals psi psi	47.88 6894.76 0.491 0.03612
Temperature	°F °C	°C °F	$T_C=5/9*(T_F - 32)$ $T_F=(9/5*T_C) + 32$
Volume	ft^3 gal(U.S.) ft^3	m^3 m^3 gal(U.S.)	2.8317e-2 3.7854e-3 7.48

TABLE 11-3

CONSTANTS

Specific heat of Water	1 BTU/(lbm °F)
Specific heat of Air	4.19 kJ/(kg °C) 0.24 BTU/(lbm °F)
Tube-Ice Density	32-35 lbs/ft^3
Ice Latent Heat	144 BTU/hr
Water Sensible Heat	1 BTU/(lb °F)
Ice Melting Effect (IME) 1 Ton Refrigeration	12,000 BTU/hr
Atmospheric pressure	14.7 psia
Weight of Water	62.4 lbs/ft^3 8.33 lbs/gal
1 gpm water	12013 lb/day
Weight of air	0.0749 lbs/ft^3 0.0100 lbs/gal
1 Horsepower	2545.6 BTU/hr
1 Kilowatt	1.34 horsepower
Gravitational accel.	9.81 m^2/sec

TABLE 11-4

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