3. Installing Your Tube-Ice Machine

Note: A video production is available through your distributor.

Installation Without Bin. Machine must be installed on a drainable condensate drip pan.

Bin Installation. Set the bin on solid, level footing. Inside the bin you will find the four legs. Screw these legs to the bottom of the bin. You can make MINOR leveling adjustments by using these legs as leveling screws, as outlined in the manufacturer's instructions.

Once the ice storage bin is level, the Tube-Ice® machine can be elevated and placed inside the condensate drip pan on the top of the bin.

FIGURES 3-1 and 3-2 illustrate two methods of lifting & setting Tube-Ice® machine on a level ice storage bin.

! CAUTION !
The approximate weight of the machine is 1360 pounds. Always use equipment with adequate load-carrying capacity.
! CAUTION !

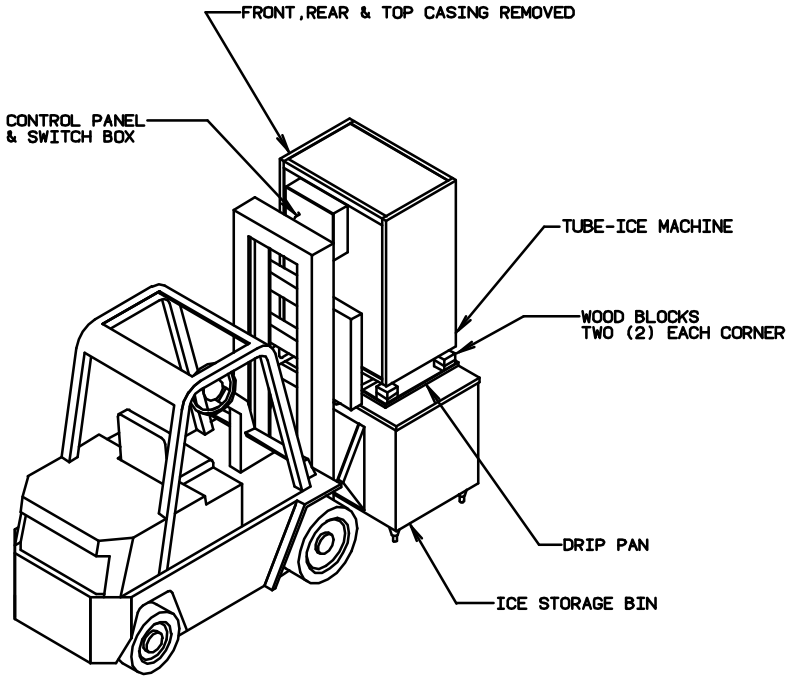


FIGURE 3-1
Forklift-&-Blocks Method

You need:
+ forklift truck with adequate load and height capacities
+ (8) 2X4 wood blocks 8 in. long
+ (2) wooden 2X4's measuring 3-ft. long
+ pry bar

Step 1. Position Tube-Ice® machine on forks.

! CAUTION !
The Tube-Ice® machine may be somewhat top heavy on the rear.
! CAUTION !

Step 2. Stack wood blocks in each corner of the drip pan on top of the ice storage bin.
Step 3. Lift and set Tube-Ice® machine on wood blocks.
Step 4. Remove forklift.
Step 5. Stack 3-ft. long 2X4's beside drip pan, overlapping front and back of bin.
Step 6. Using a pry bar with fulcrum on 2X4's, raise side of machine enough to remove the TOP wood blocks.

! CAUTION !
Do not remove top AND bottom blocks at the same time.
! CAUTION !

Step 7. Repeat steps 5 and 6 on other side.
Step 8. With machine sitting on one (1) block under each corner, repeat steps 5, 6, and 7 remove remaining blocks. Drip pan flanges may bend slightly.
Step 9. Straighten bent drip pan flanges.
Step 10. Check alignment of ice chute to bin opening.

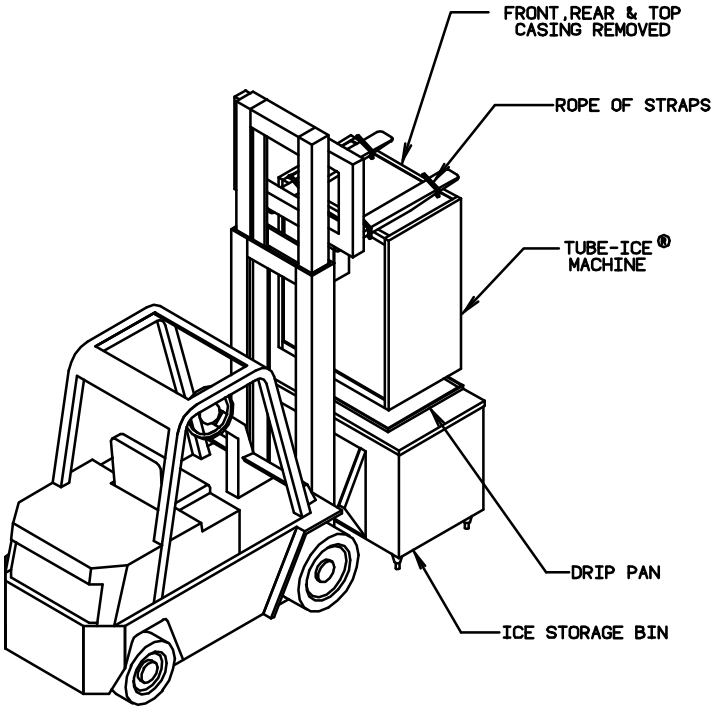


FIGURE 3-2
Forklift-&-Rope or Lifting Straps Method

You need:
+ extra head room
+ forklift with adequate load and height capacities
+ 1/2” rope or four lifting straps to bind forks to top angles

Step 1. Remove front, rear, and top access panels.

Step 2. Position fork truck so that forks are resting flat on top angles of Tube-Ice® machine.

Step 3. Use the rope or straps to securely bind forks to the top angles.

! CAUTION !
Be sure the bin is level and is set in its proper location. See the space diagrams, FIGURE 3-4 and 3-5.
! CAUTION !

Step 4. Lift Tube-Ice® machine and set into drip pan of bin.

Step 5. Remove rope or straps and fork truck.

Step 6. Install front, rear and top access panels.

Step 7. Check alignment of ice chute to bin opening.

Wiring And Electrical Connection.

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

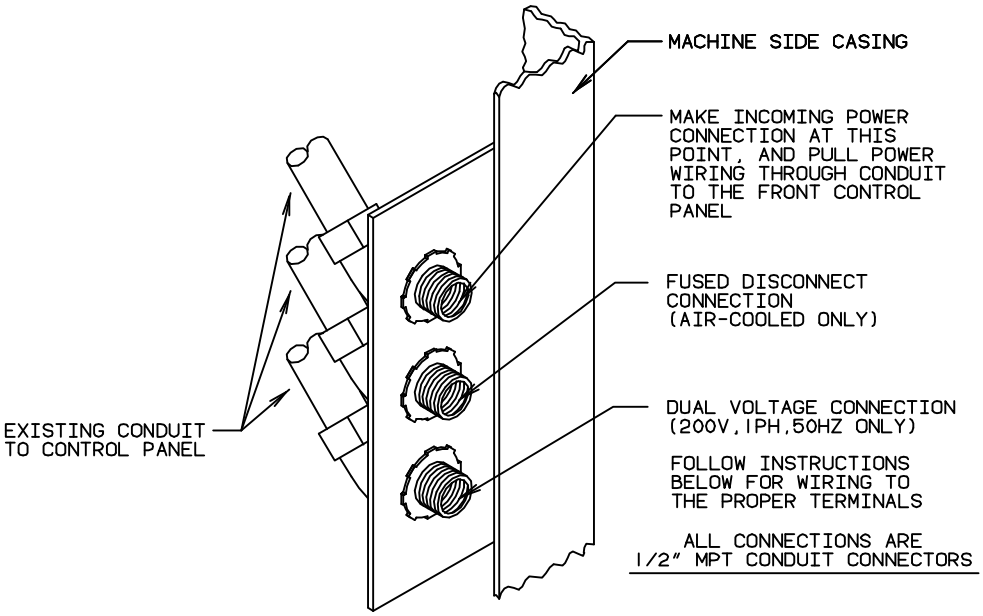


FIGURE 3-3
Electrical Connections for Machine Power & AC Connections

A fused disconnect must be provided near the Tube-Ice® machine. Connect 3 phase power to terminals L1, L2, L3 for operation of the Tube-Ice® machine and its controls. Rotation checking of compressor is not required for **reciprocating** compressors. Also, if one leg of the 3 phase power is higher or lower ("Wild"), then it should be connected to terminal #L2. Connect the "Ground" wire to the "Ground" terminal provided. See "Initial Start-up and Operation", Section 5.

Scroll compressor rotation must be checked and confirmed to be correct. Attach pressure gages to the suction & discharge service valves to make sure there is an immediate decrease in the suction pressure and increase in discharge pressure upon start up. If not, reverse two (2) compressor wires (L1, L2, L3) at the control panel terminal block to change direction of rotation, and check suction and discharge pressure on start up again.

Do not switch leads directly at the compressor. Terminals L4 and L5 are for connection of single phase 208/230 electrical supply for split voltage applications such as 460 volt, 3 phase for compressor.

! CAUTION !
Do not attempt to start machine prior to connecting water lines and making the following NECESSARY provisions. Refer to FIGURES 3-4 & 3-5 (space diagrams) for correct installation.
! CAUTION !

Piping and Drain Connections. All connections are located at the rear of the machine. Look for four water connections on the freezing unit of each water cooled machine. See Space Diagram, FIGURE 3-4 for correct utility connections.

! 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 30 psig. The maximum allowable pressure is 100 psig.
! CAUTION !

Model	**HEC-10**	**HEC-20**	**HEC-30**	**HEC-40**
Make Up Water In	3/8” FPT	3/8” FPT	3/8” FPT	3/8” FPT
Water Tank Drain	3/4” FPT	3/4” FPT	3/4” FPT	3/4” FPT
Condenser Water In	3/4” FPT	3/4” FPT	3/4” FPT	1” FPT
Condenser Water Out	3/4” FPT	3/4” FPT	3/4” FPT	1” FPT

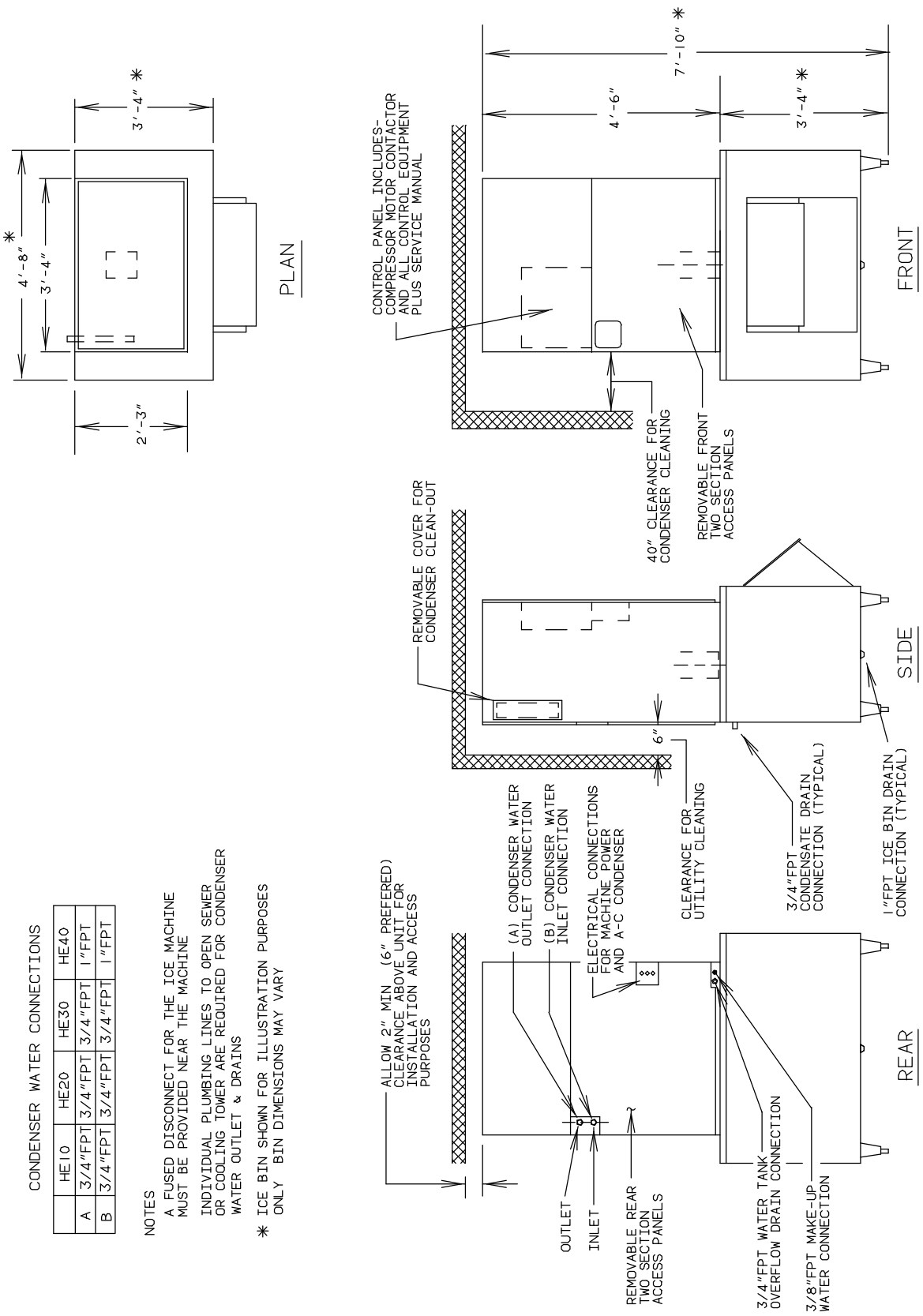
TABLE 3-1
Water Supply and Drains

When the ice machine sits on a storage bin, the bin must be provided with a drip pan for catching the condensate from the ice machine. Separate drains for the condensate and for the bin are necessary. See FIGURE 3-4 or 3-5 (space diagram drawings for typical water and drain connections).

Condensate drain **must not** run through the ice compartment of the bin.

The condenser water outlet, water pan drain, condensate drain and ice storage bin drain connections must be extended to an open drain or sump and arranged for visible discharge.

! CAUTION !
These lines must NOT be connected into a pressure tight common header due to the possibility that warm condenser water may back up into the water pan, drip pan or the ice storage bin. The condenser water outlet MUST be piped separately to the drain.
! CAUTION !



CONDENSER WATER CONNECTIONS

	HE10	HE20	HE30	HE40
A	3/4"FPT	3/4"FPT	3/4"FPT	1"FPT
B	3/4"FPT	3/4"FPT	3/4"FPT	1"FPT

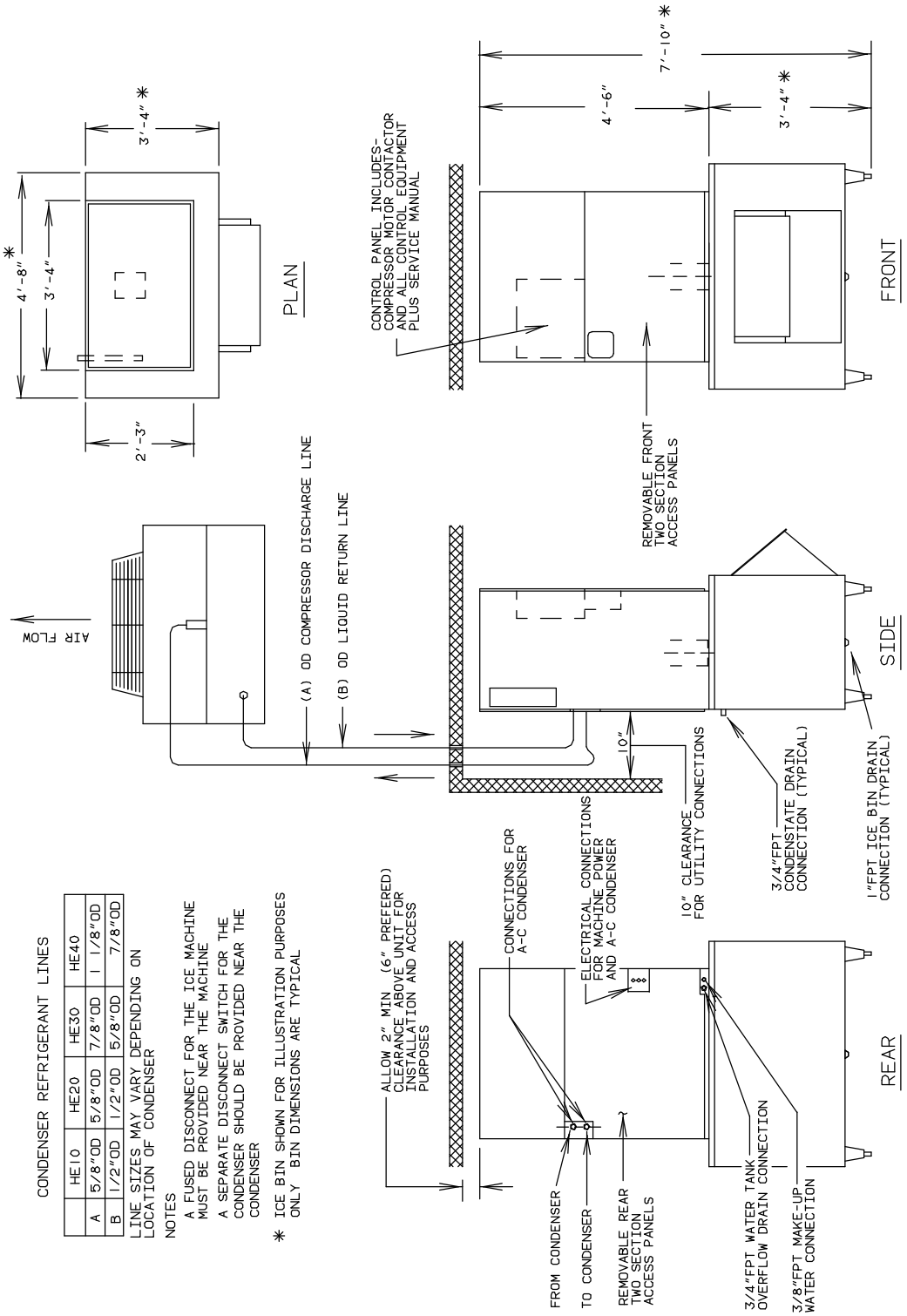
NOTES

A FUSED DISCONNECT FOR THE ICE MACHINE MUST BE PROVIDED NEAR THE MACHINE

INDIVIDUAL PLUMBING LINES TO OPEN SEWER OR COOLING TOWER ARE REQUIRED FOR CONDENSER WATER OUTLET & DRAINS

* ICE BIN SHOWN FOR ILLUSTRATION PURPOSES ONLY BIN DIMENSIONS MAY VARY

FIGURE 3-4
Space Diagram Water Cooled Machine



	HE10	HE20	HE30	HE40
A	5/8"OD	5/8"OD	7/8"OD	1 1/8"OD
B	1/2"OD	1/2"OD	5/8"OD	7/8"OD

FIGURE 3-5
Space Diagram Air-Cooled Machine

Air-Cooled Condenser Installation Instructions.

! WARNING !
Using a non-Vogt condenser will void the compressor warranty.
! WARNING !

Certain installation guidelines must be followed to obtain reliable operation from air-cooled ice machines. If these guidelines are not followed, the compressor warranty will not be honored. Any exceptions to this policy must be obtained in writing prior to installation and operation of the ice machine.

1. Outdoor condensers **must** be installed with vertical air flow. Indoor condensers used for heat recovery may be installed with either horizontal or vertical air flow.

2. The preferred condenser location is above the ice machine, with liquid refrigerant from the condenser outlet draining freely (1/4" per foot slope) in the direction of normal operating flow (back to the ice machine) with no traps in the liquid line.

3. If it is absolutely necessary to install the condenser below the ice machine, certain conditions MUST be met. The refrigerant connections on the condenser must be no more than 6 feet below the refrigerant connections on the ice machine. The return liquid line from the condenser must rise no more than 12 feet before dropping back down to the elevation of the ice machine. When the condenser is located below the ice machine, expect a 16 psig increase in head pressure and at least 3% reduction in capacity.

4. Flooding head pressure controls such as Alco Headmaster are **not** to be used, since they cause excessive subcooling of the returned liquid refrigerant and interfere with reliable ice harvest.

5. The discharge and liquid lines must be insulated with 1/2" thick Armaflex insulation or equal.

6. **Horizontal runs in the discharge** line should slope 1/4" per foot in the normal direction of flow (away from the ice machine).

7. Traps must be installed in discharge lines at the base of all vertical risers. There should be no intentional traps in liquid lines. Trap volume should be kept to a minimum. Typical details are shown in FIGURE 3-8.

8. Use only ACR grade copper pipe, Type L. Recommended line sizes are shown in TABLE 3-2.

9. Distance between ice machine and condenser must not exceed 150 equivalent feet. Refer to Condenser Equivalent Line Size worksheet.

10. Condensers must be provided with a cold weather valve kit per FIGURE 3-7. These valves allow one-half of the condenser to be disabled in cold weather. Running the ice machine with one half the condenser in cold weather makes it easier to maintain minimum necessary condensing pressure, particularly in windy conditions.

11. Condensers with multiple fans must be provided with a thermostat to turn off unneeded fans in cold weather, per FIGURE 3-9. Turning off unneeded fans reduces on-off cycling of the fan(s) and allows for a steadier condensing pressure.

12. When extreme cold conditions are expected or encountered (temperatures below 0°F and wind greater than 15 MPH), it may be necessary to install a protective enclosure around the condenser. A typical enclosure is shown in FIGURE 3-12. Other apparatuses such as louvers may be used. Contact the factory for suggestions.

13. After installation, the field-installed lines are to be evacuated to a vacuum of 500 microns or less and held for at least one hour. After the vacuum pump is removed, vacuum should hold at 500 microns or less for at least 5 minutes and the lines pressurized with R-22 to 25 psig minimum.

14. The volume of refrigerant supplied with the machine is sufficient to fill the condenser and condenser lines when length of pipe (one way) is 75 feet or less. When the length of lines is longer than 75 feet, additional refrigerant must be added as follows:

Liquid Line Size	75 ft.	100 ft.	125 ft.	150 ft.
1/2”	none	none	none	2
5/8”	none	2	4	6
7/8”	none	4	8	12
1-1/8”	none	6	12	18

Table 3-2
Pounds R-22 to Add Vs. Liquid Line Length

15. All piping must be done in accordance with applicable local and national codes. Such codes may include “The Safety Code for Mechanical Refrigeration (ANSI B9.1), and “The Code for Refrigerant Piping” (ANSI B31.5).

The following installation guidelines are strongly suggested. While they do not affect the machine warranty, they may be required for safe operation, and to comply with all applicable electrical and mechanical codes.

16. Local electrical code must be checked for wiring method.

17. The installer must provide a lockable, fused disconnect switch(s) adjacent to the condenser.

18. Electrical connections between the condenser and the Tube-Ice® machine require minimum 12 ga. wire.

19. All electrical fittings and components exposed to the weather must be suitable for outdoor installation.

The design total heat rejection for each Tube-Ice® machine, the recommended air-cooled condenser, and condenser physical and electrical data are shown in TABLE 3-3. Only the condensers shown are UL listed with the ice machines. Other condensers may be individually UL listed, but are not UL listed with the Tube-Ice® machines, and cannot be recommended by the Henry Vogt Machine Co.

Catalog energy efficiency ratings of the ice machines are based on use of the recommended condenser.

Condensers supplied by Vogt must be utilized. The use of non-Vogt condensers will void the compressor warranty. For continuous operation at ambients above 105°F, consult the factory about using a larger condenser.

Ice Machine Model	HEC-10	HEC-20	HEC-30	HEC-40
Electrical Frequency, Hz	60/50	60/50	60/50	60/50
Recommended Condenser	DD-61	DD-61	DD-101	DD-131
Total Heat Rejection:				
BTU/hr at 60 hz.	28,700	28,700	44,500	80,400
BTU/hr at 50 hz.	23,900	23,900	37,100	67,000
Fans:				
Number	1	1	2	2
HP, Each	.333	.333	.5	.5
Total, CFM	5000	5,000	9,800	9,800
Full Load Amps:				
1 ph., 208/230V, 60 hz.	2.5	2.5	5.0	5.0
3 ph., 208/230V, 60 hz.	N/A	N/A	N/A	N/A
3 ph., 460V, 60 hz.	N/A	N/A	N/A	N/A
1 ph., 230V., 50 hz.	3.0	3.0	5.8	5.8
3 ph., 230V., 50 hz.	N/A	N/A	N/A	N/A
3 ph., 400V., 50 hz.	N/A	N/A	N/A	N/A
Locked Rotor Amps:				
1 ph., 208/230V., 60 hz.	7	7	15	15
3 ph., 208/230V., 60 hz.	N/A	N/A	N/A	N/A
3 ph., 460V., 60 hz.	N/A	N/A	N/A	N/A
1 ph., 230V., 50 hz.	8.2	8.2	17.5	17.5
3 ph., 230V., 50 hz.	N/A	N/A	N/A	N/A
3 ph., 400V., 50 hz.	N/A	N/A	N/A	N/A
Weight, lbs.:				
Net	150	150	250	265
Shipping	195	195	310	325
Operating (maximum flooded)	167	167	276	301
Condenser dimensions (see FIG. 3-6), inches:				
A (Width)	39”	39”	42”	42”
B (Length)	46”	46”	66”	66”
C (Height)	36”	36”	36”	36”
D (Leg centerline)	37-7/8”	37-7/8”	40-3/8”	40-3/8”
E (Leg centerline)	37”	37”	54”	54”
F (Clearance below)	16”	16”	16”	14”
Recommended Line Sizes, OD:				
Liquid				
All lengths and orientations	1/2”	1/2”	5/8”	7/8”
Discharge Gas				
Vertical Up, All lengths	5/8”	5/8”	7/8”	1-1/8”
Horiz. Or Down, < 75 ft.	5/8”	5/8”	7/8”	1-1/8”
Horiz. Or Down, > 75 ft.	7/8’	7/8”	1-1/8”	1-3/8”
Connections (Cond. & Ice Mach.):				
Liquid (ODF)	1/2”	1/2”	5/8”	7/8”
Discharge Gas (ODF)	5/8”	5/8”	7/8”	1-1/8”

TABLE 3-3
Air-Cooled Condenser Data

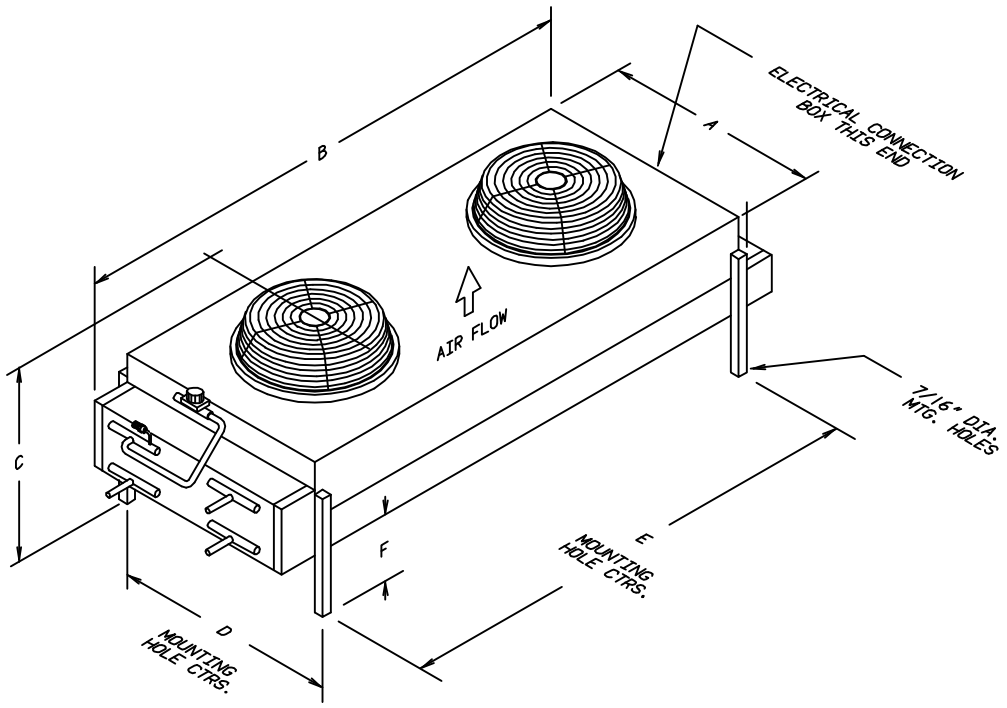
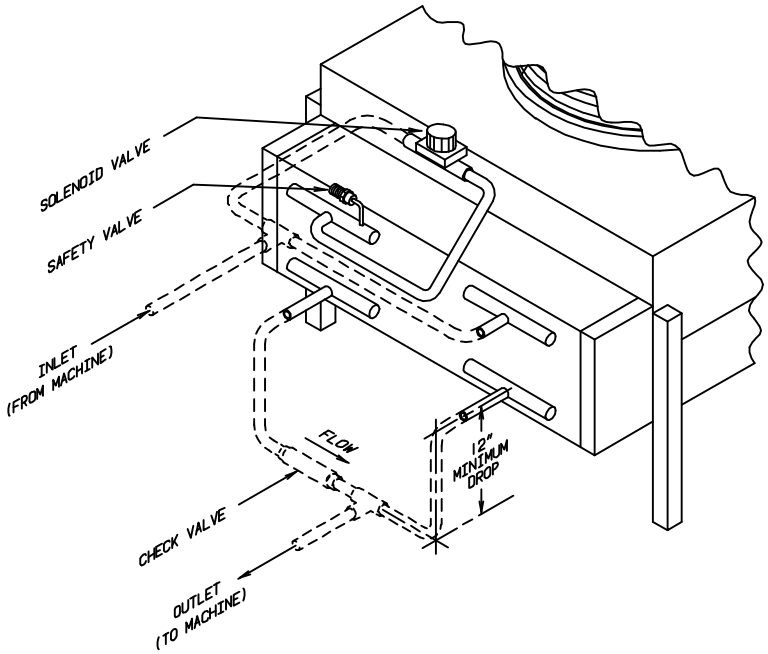


FIGURE 3-6
Condenser Dimensions (Condenser pictured: DD-101 or DD-131)



Note: Dash lines indicate customer supplied piping. The Check Valve in the return line (labeled "Output To Machine") is supplied with the condenser.

FIGURE 3-7
Condenser Field Piping

CONDENSER EQUIVALENT LINE SIZE WORKSHEET

Discharge Gas Line O.D. _____

Fitting Type	Number Used	Factor	Total
Globe Valve (open)			
Angle Valve (open)			
45° Elbow			
90° Elbow			

Feet of Straight Copper Used	
Total Fitting Factor	
Total Equivalent Feet	

Fitting Factors

Copper Tube O.D. Type "L"	1/2"	5/8"	7/8"	1 1/8"
Globe Valve (open)	14	16	22	28
Angle Valve (open)	7	9	12	15
45° Elbow	.5	1	1	1.5
90° Elbow	1	2	2	3

TABLE 3-4

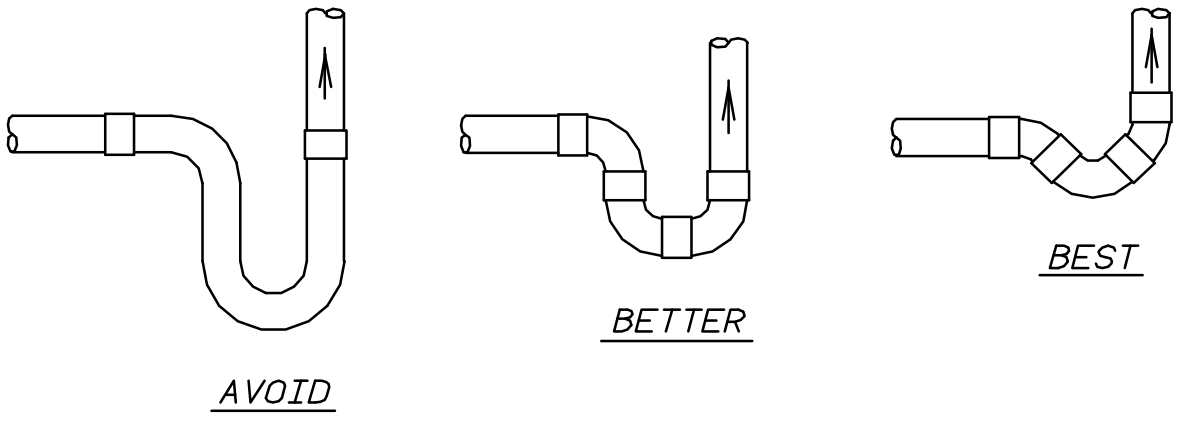
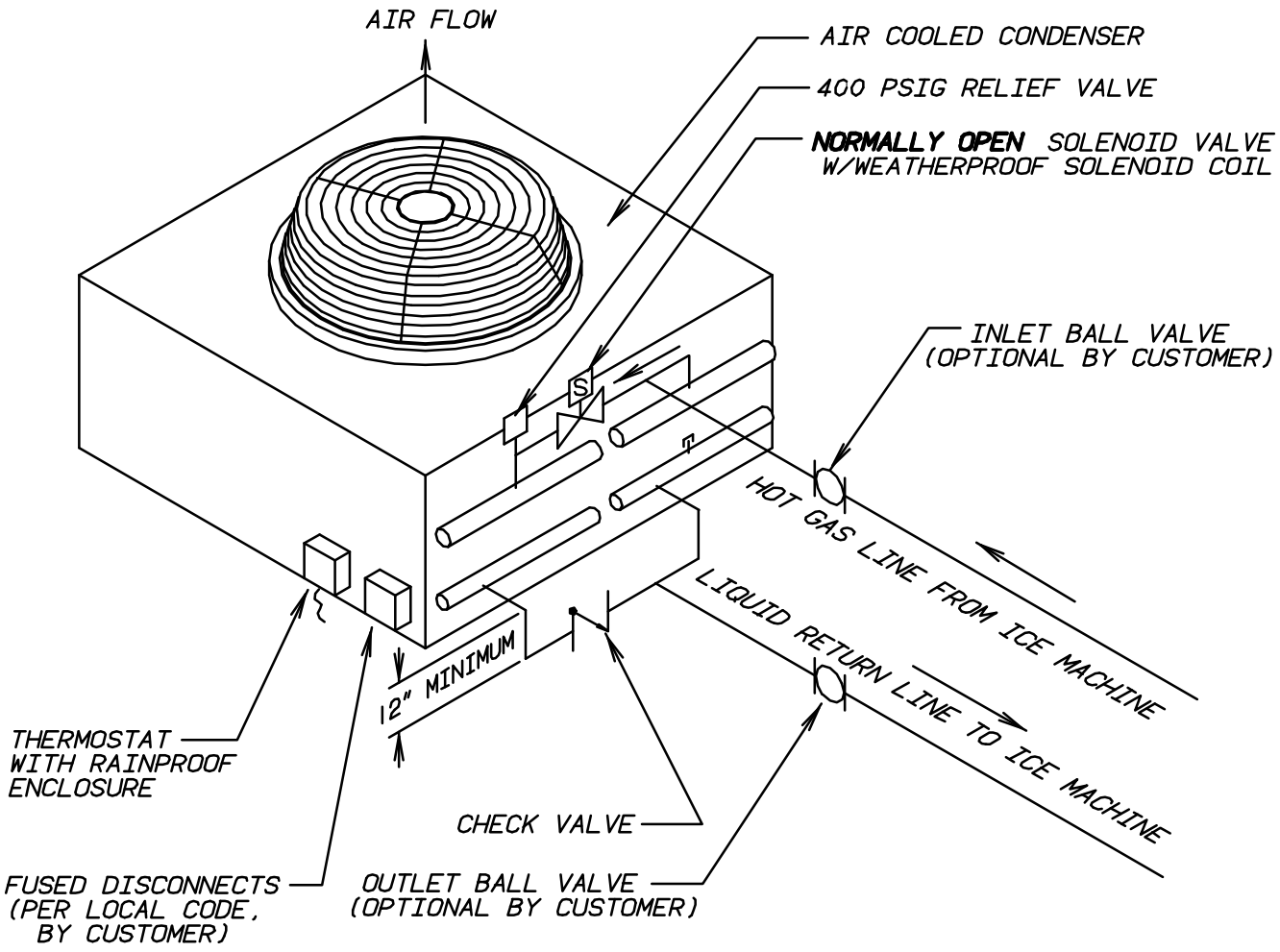


FIGURE 3-8
Minimum Traps for Discharge Lines



NOTES

1 THE INLET MANIFOLD IS FACTORY MOUNTED AND WIRED AND INCLUDES A NORMALLY OPEN SOLENOID VALVE WITH WEATHERPROOF COIL, PRESSURE RELIEF VALVE, THERMOSTAT(S) IN A WEATHER PROOF ENCLOSURE, AND SCHRAEDER FITTINGS

2 THE OUTLET MANIFOLD IS SHIPPED LOOSE AND INCLUDES A 12" DROP LEG AND CHECK VALVE THIS OUTLET MANIFOLD MUST BE SOLDERED OR BRAZED TO THE CONDENSER AT THE TIME OF INSTALLATION

3 THE REQUIRED FUSED FIELD DISCONNECTS, AND OPTIONAL ISOLATION BALL VALVES, ARE NOT INCLUDED IN THE FACTORY SCOPE OF SUPPLY

FIGURE 3-9
Condenser Piping With Cold Weather Valve Kit

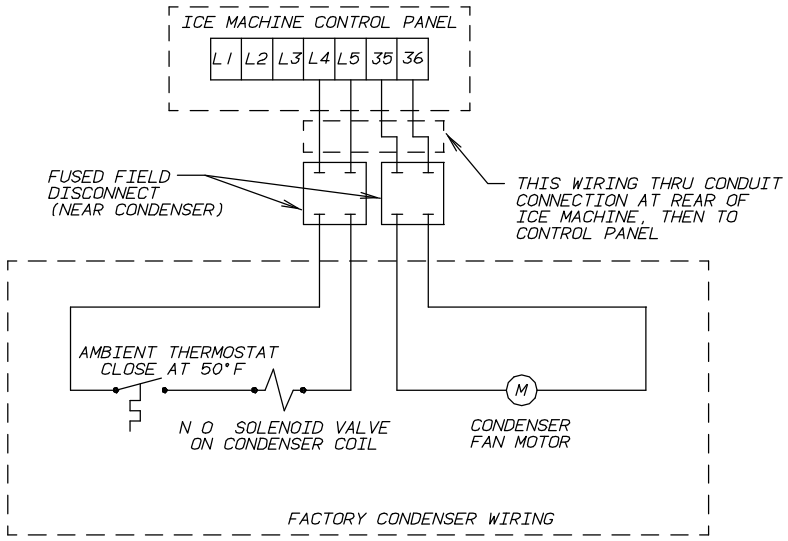


FIGURE 3-10
Wiring For DD-61 With Cold Weather Valve and Single Fan

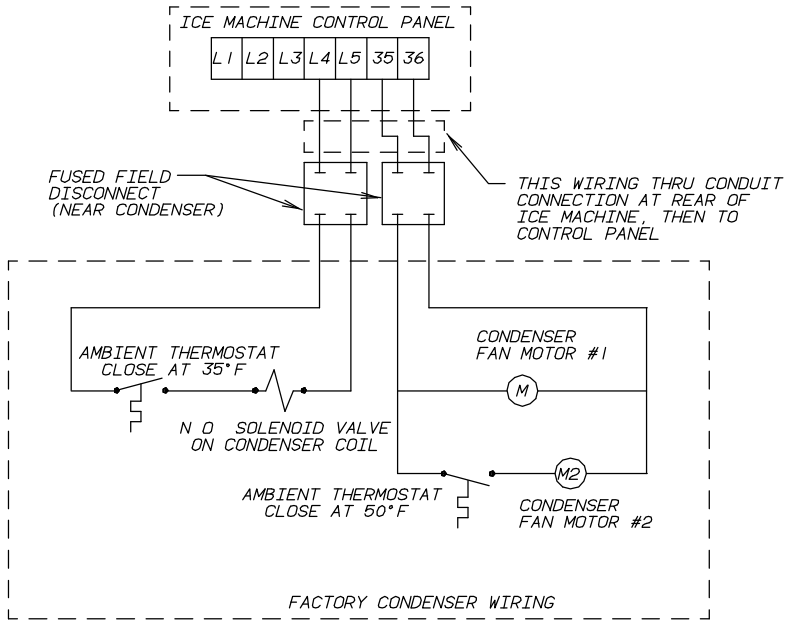


FIGURE 3-11
Wiring For DD-101 & DD-131 With Cold Weather Valve And Dual Fans

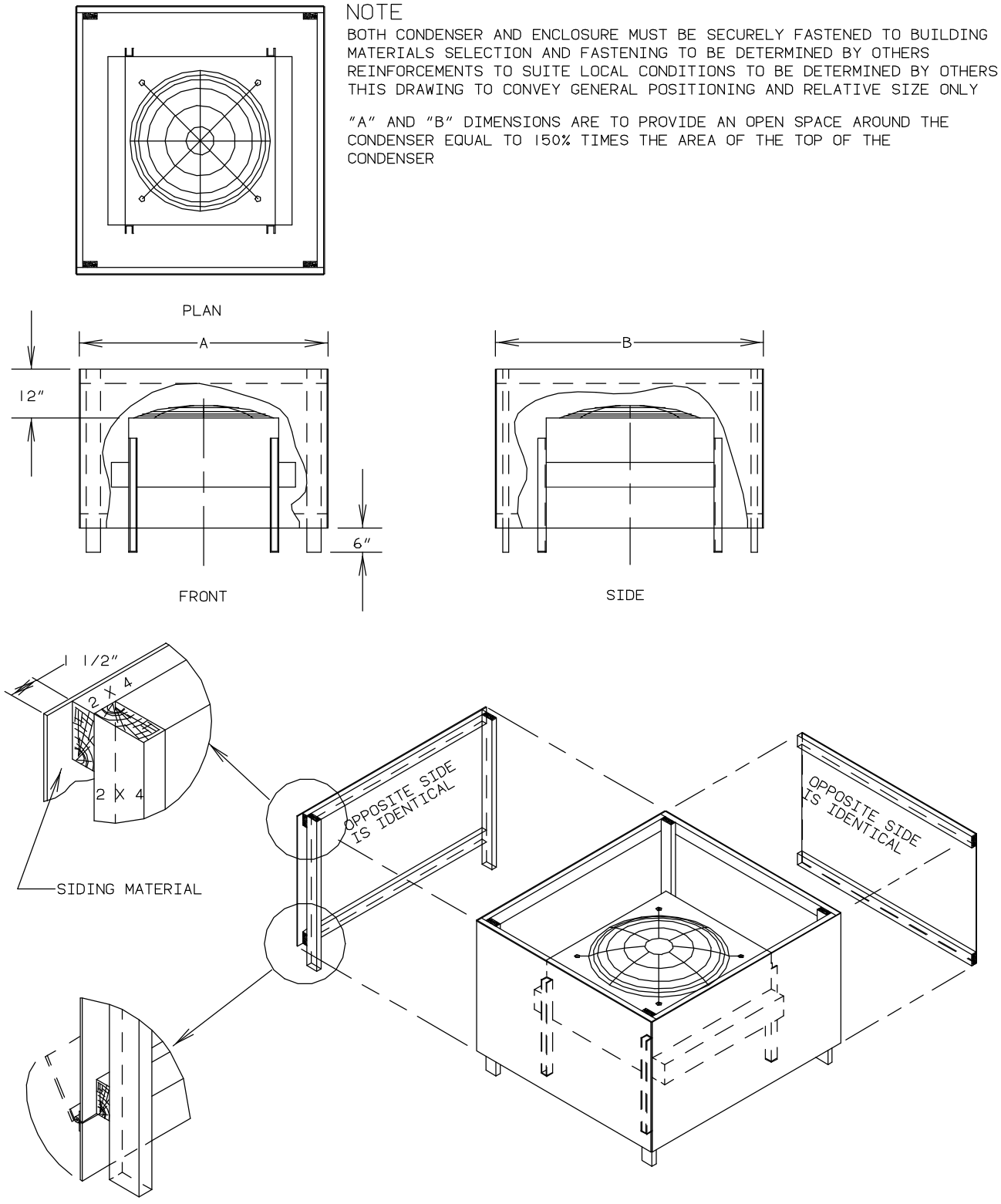
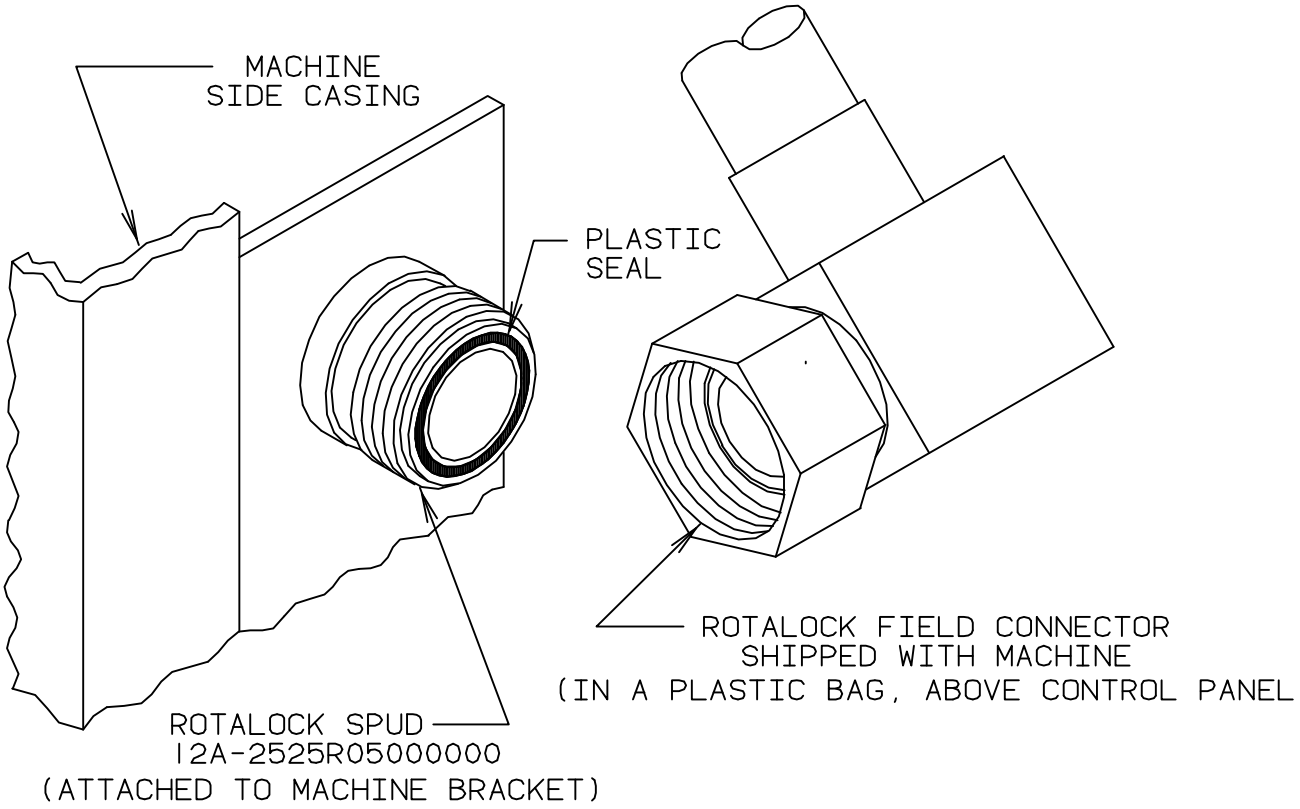


FIGURE 3-12
Air-Cooled Condenser Enclosure



FOLLOW THESE PROCEDURES TO MAKE A TIGHT JOINT

1. SOLDER OR BRAZE CONDENSER TUBING ENDS TO THE FEMALE ROTALOCK CONNECTORS
2. REMOVE DUST CAPS IF USED, MAKING SURE THAT COMPONENT PLASTIC SEALS ARE INTACT
3. WIPE OFF CONNECTOR AND SPUD THREADED SURFACES WITH A CLEAN CLOTH TO PREVENT THE INCLUSION OF DIRT, OR ANY FOREIGN MATERIAL IN THE SYSTEM
4. CONNECTOR COUPLING NUT SHOULD BE SCREWED ONTO ROTALOCK SPUD USING THE PROPER AMOUNT OF TORQUE

SPUD SIZE	AMOUNT OF TORQUE
1/2" - 5/8"	30-40 FT LBS
7/8"	50-60 FT LBS
1 1/8"	80-100 FT LBS

FIGURE 3-13
Field Attachment, Air Cooled Condenser Refrigerant Tubing

Ice Bin Thermostat Bulb Installation. Each machine is equipped with an ice bin thermostat. To assure proper protection for the machine, the control bulb of the ice bin thermostat must be located so that ice will contact it when the bin is full. For a divided bin, locate the control bulbs as illustrated in FIGURE 3-14. This allows space for the machine to make an additional discharge of ice AFTER the ice contacts the bulb WITHOUT the ice building up into the discharge opening of the chute.

Note: As an option, the PLC can be programmed for your machine to produce a specified amount of ice during a certain time each day. Consult the factory for more details.

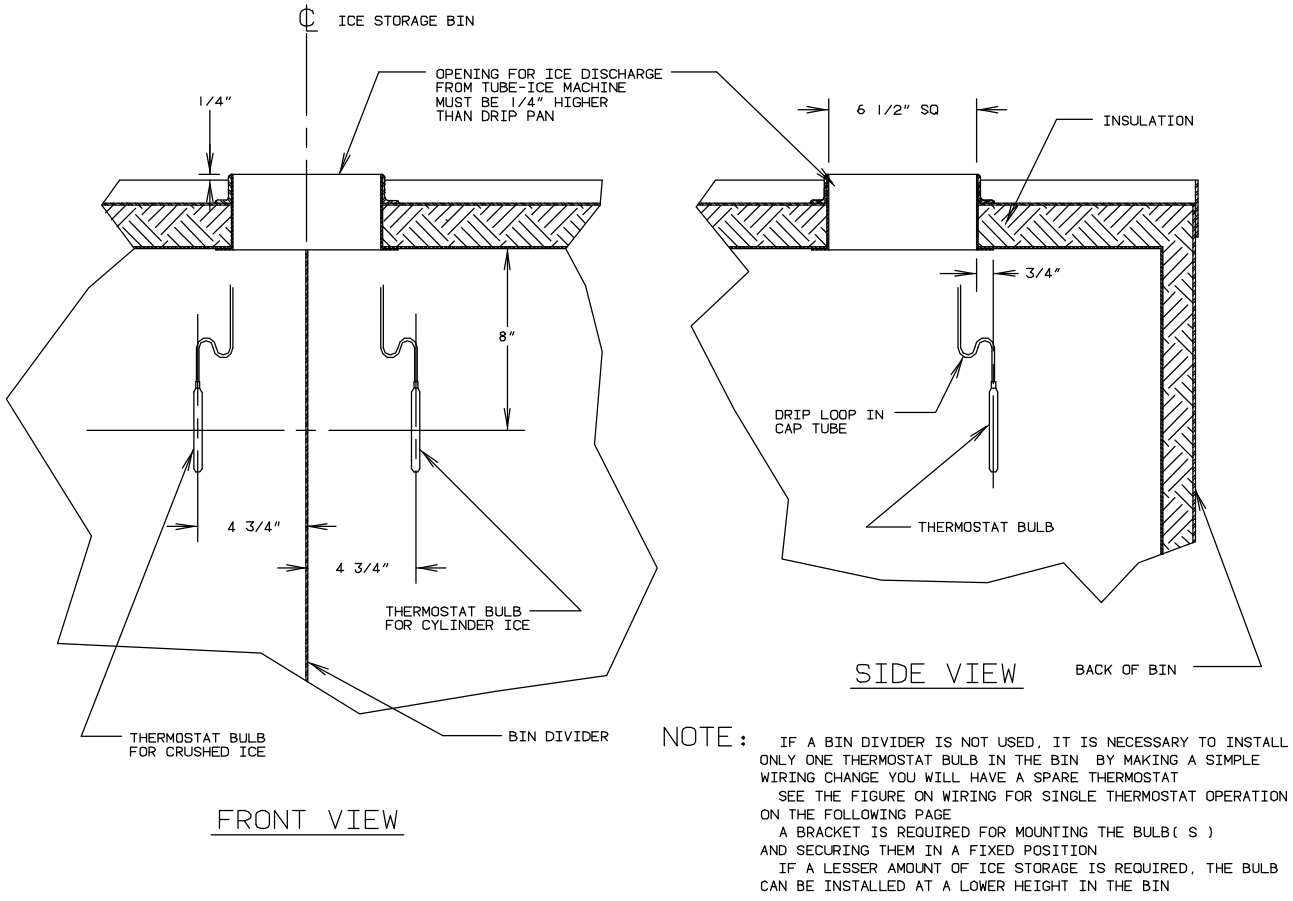


FIGURE 3-14
Location Of Thermostat Bulbs In Ice Storage Bin

The control panel is electrically connected so that the bin thermostat will stop the machine only upon the completion of a harvest period.

When both cylinder and crushed ice are produced and separately stored in a divided bin, the control bulb of thermostat BT1 is placed in the crushed ice section of the storage bin (left side) and the control bulb of thermostat BT2 is placed in the cylinder ice section (right side of bin).

When the bin does not have a divider, only one thermostat is necessary. The wiring may be modified to use only one thermostat and bulb (See "With No Divider in Bin", Section 4 and FIGURE 3-14). Or install both bulbs--so that the ice contacts both bulbs when the bin is full.

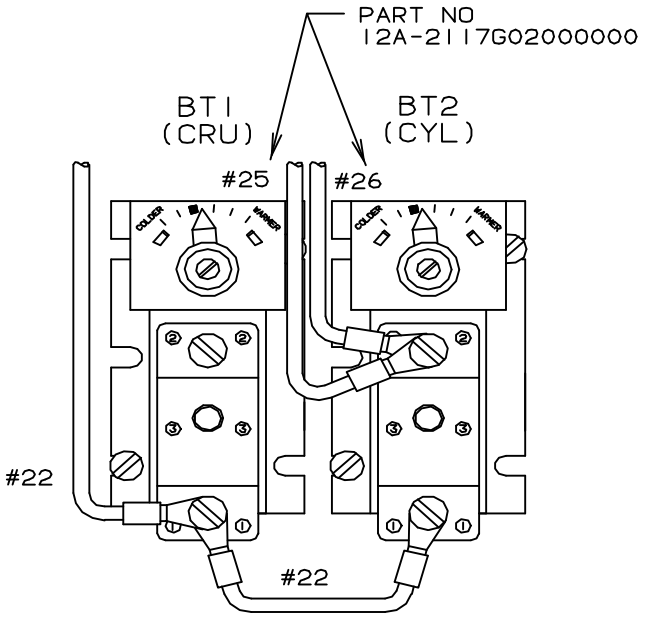


FIGURE 3-15
Wiring for Single Thermostat Operation (Dual Ice Type Only)
(follow instructions below)

1. Turn power off to the machine and check with volt meter to make sure panel is dead.

2. Select the thermostat which will not be used (either CRU or CYL) and disconnect wire #25 or #26 from that thermostat.

3. Connect wires #25 & #26 to the same terminal of the thermostat to be used and extend that thermostat bulb into the bin, mounting it as illustrated in FIGURE 3-14.

4. Turn power on to the machine and restart the machine according to instructions.

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 required charge of Refrigerant 22 has been isolated in the Receiver (15R).}

CHECK: _____ All water supply and drain connections for conformity to requirements stipulated in this manual. See FIGURES 3-4, 3-5, and TABLE 3-1.

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 (air-cooled condenser, ice storage bin, ice spreader, etc.) for proper installation.

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

CHECK: _____ The position of all push button switches to assure they will or will not start automatically as desired.

NOTE: This machine is controlled by a PLC and can automatically start with power to the machine after a two hour time lapse if the ice switch is in the on position and all other requirements are met.

4. How Your Tube-Ice Machine Works

Principle Of Operation. The manual operation of the machine is controlled by the "Ice" and "Start" switches located in the switch box of the freezing unit. The automatic operation is controlled by the PLC and ice bin thermostats which will automatically stop and start the freezing unit by the level of the ice in the storage bin (NOTE: See "Ice Bin Thermostat Bulb Installation" for instructions on installation of the control bulb of the ice bin thermostats FIGURE 3-14). The type ice produced (cylinder or crushed) is determined by the position of the ice selector switch located in the switch box. The control wiring is arranged so that the unit will stop only upon the completion of a thawing period and partial pumpdown cycle whether by action of the "Ice" switch or the ice bin thermostats.

The "Clean" switch must always be set in the "Off" position (not illuminated) during normal ice-making operation. It is set on the "Clean" (illuminated) position only when the equipment is to be cleaned or pumped down as outlined in the "Cleaning Procedure," and "Total Pump-Down Procedure", Section 9, and instructions attached to the machine.

If it should become necessary to instantly stop the machine, either the external disconnect switch, cutter overload switch, or pump overload switch must be turned off.

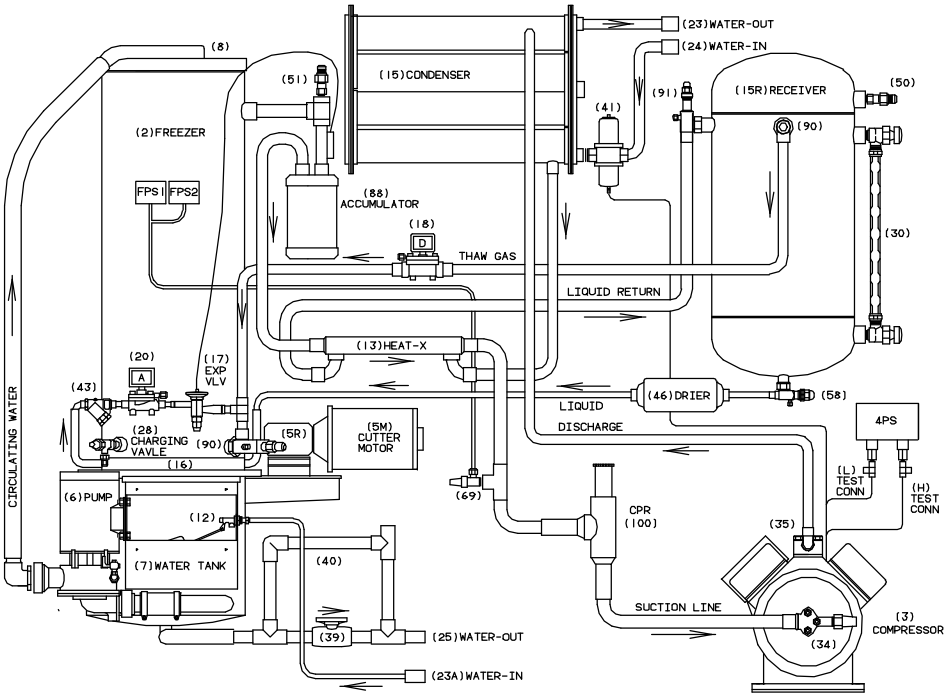
FIGURES 4-1, 5-2, & 5-3 illustrate the piping diagram of the refrigerant and water circuits of the Tube-Ice® machines with numbers for easy reference. Throughout this manual the numbers you see in parentheses refer to the numbers in this piping schematic.

The freezer (2) is a shell and tube-type vessel. During the freezing period, 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). Solenoid valve (20), sometimes referred to as the "A" valve, is open and solenoid valve (18), sometimes referred to as the "D" valve, is closed.

Refrigerant gas from the top of the freezer (2) passes through the accumulator (88), the heat exchanger (13), the CPR valve (100), and to the compressor (3) which discharges it into the condenser (15). Condensed liquid refrigerant from the condenser flows through the liquid side of the heat exchanger and into the receiver (15R). Liquid refrigerant from the receiver flows through the filter/drier (46), the thawing chamber (16) of the freezer, the strainer (43), "A" valve (20), expansion valve (17), and into the freezer, thereby completing the freezing circuit.

At the completion of the freezing period, thawing is started by action of the freezer pressure switch in the control panel. The water pump is stopped and solenoid valve "A" (20) is closed. After a time lapse of seven seconds, solenoid valve "D" (18) is opened, the cutter motor (5M) is started and the harvest (thaw) timer (FIGURE 9-6) is activated. Warm gas from the receiver is discharged into the freezer through valve (18), thereby slightly thawing the ice which drops on the rotating cutter for sizing. Cylinder ice will be discharged through the right half-section of the ice discharge chute when viewing the Tube-Ice® machine from the front. Crushed ice will be discharged through the left half-section of the ice discharge chute.

Air-cooled machines have a solenoid valve (53), sometimes referred as the "X" valve, in the compressor discharge line, and a check valve (101) in the liquid return line to the receiver. These valves prevent the migration of refrigerant to the condenser when the machine is not operating.



HEC, Water Cooled -- Piping Schematic

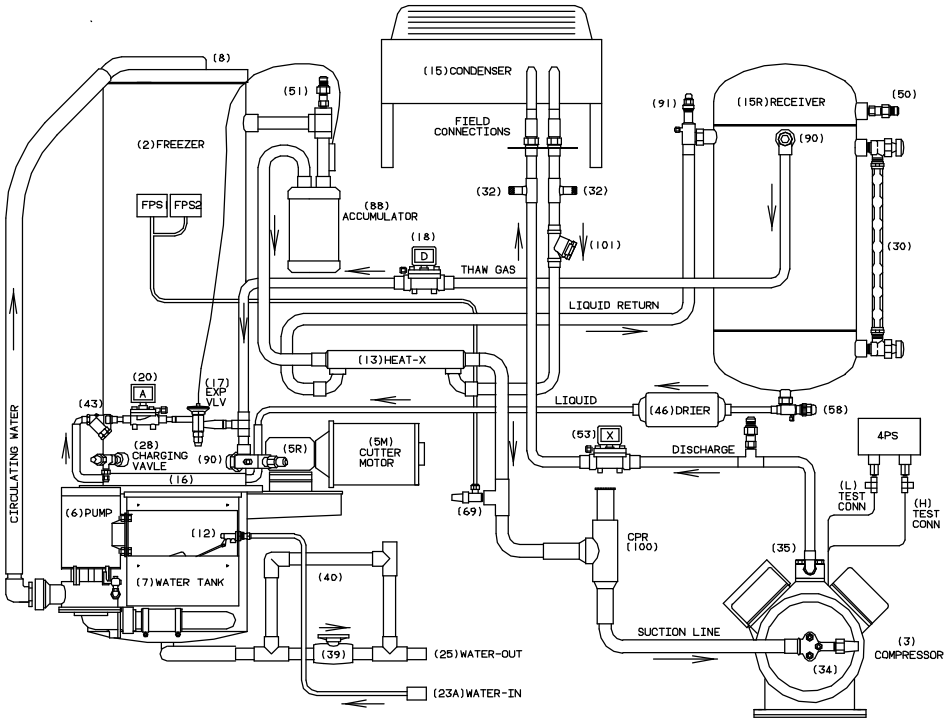


FIGURE 4-1
HEC, Air Cooled -- Piping Schematic

Dual ice type (crushed and cylinder).

Divider in bin (cylinder and crushed ice separately stored). With the selector switch on "Auto", the machine will automatically produce cylinder ice until the cylinder-ice bin is filled. This action will open the cylinder ice thermostat switch in the cylinder ice bin and will automatically change the machine over to crushed ice production--PROVIDED THE CRUSHED ICE BIN IS NOT FULL. When the crushed ice bin is filled, its thermostat switch opens and stops the machine upon completion of the harvest cycle and partial pumpdown cycle.

If cylinder ice is removed--during the freeze cycle of the crushed ice operation and the cylinder ice bin thermostat switch closes within five minutes of that cycle, the machine will revert immediately to cylinder ice production.

If, when producing cylinder ice, the thermostat switch for cylinder ice should open within the first five minutes of that cycle, the machine will immediately revert to crushed ice production. The selection of cylinder or crushed ice can be changed for that cycle only within the first five minutes of the freezing cycle. Note that the "R" (reversing relay) is not energized when making cylinder ice.

The machine will never stop by action of the bin thermostat during any freezing operation. It will always complete the evacuation and discharge of all the ice and completion of a partial pumpdown cycle regardless of the causes which open either thermostat switch.

See FIGURE 3-14, "Illustration of the Bin Thermostat Bulb Installation".

With no divider in bin (producing only ONE type ice). When there is no partition in the bin for separating cylinder and crushed ice, you need use only one bin thermostat and bulb. By connecting wires #25 and #26 together on the same thermostat terminal and installing that thermostat bulb in the bin, you will have the other thermostat as a spare. You will still be able to produce cylinder or crushed ice, whichever is desired. The deflector door assembly and chute deflector may be removed if the bin has no divider (see FIGURE 9-14).

See FIGURE 3-15, "Wiring for Single Thermostat Operation".

Ice Selector Switch, FIGURES 6-2 & 9-7. When the selector switch is set on either "Auto" or "Cyl", the machine will produce cylinder ice until the bin is filled and the thermostat switch opens, shutting down production at the completion of the thaw mode and partial pumpdown cycle. If the selector switch is changed to "Cru" after the unit has started a cylinder ice freeze and five minutes has lapsed, it will complete the freeze and evacuation of the cylinder ice BEFORE changing to the production of crushed ice. If five minutes has not lapsed, it will revert to crushed ice immediately.

With the selector switch set on "Cru", the machine will produce crushed ice until the bin is filled and the thermostat switch opens. It will then shut down at the completion of the thawing period and partial pumpdown cycle. If the switch is changed to "Auto" or "Cyl" within five minutes of the machine starting crushed ice freeze, it will switch immediately to the production of cylinder ice.

When ice bin thermostats are NOT used. With the selector switch set on either "Auto" or "Cyl", the machine will produce cylinder ice. If the switch is changed to "Cru" while the unit is producing cylinder ice, after the first 5 minutes of a cycle, it will complete the freeze and evacuation of the cylinder ice before changing to the production of crushed ice. The next cycle will produce crushed ice.

With the switch set on "Cru" the machine will produce crushed ice. If the switch is changed to "Auto" or "Cyl" within the first 5 minutes of a cycle, the unit will revert immediately to the production of cylinder ice.

The selector switch will function as stated above (see FIGURES 6-2 & 9-7).

Starting and stopping of the machine must be controlled by the "Ice" switch (see FIGURE 6-2).

If an alternate bin level control is used, it must be located in a position to stop the machine prior to ice backing up into the ice chute and jamming cutter.

Crushed Ice Preferred. A special customized PLC can be programmed and furnished as an option to produce crushed ice first when the selector switch is in the "Auto" position. This option will still allow the operator to select "Cyl" or "Cru" ice as desired, but will produce crushed ice and satisfy that thermostat first then revert to making cylinder ice. Contact your distributor for details.

Single Ice Type. The machine will contain only one freezer pressure switch (FPS2) and one bin thermostat (BT2). A selector switch (SS) and reversing relay (R) are not included. The machine will also be supplied with an ice chute without an ice deflector door assembly (FIGURE 9-12).

Cylinder Ice. The single ice type machine will be factory adjusted to produce cylinder ice.

Crushed Ice. To convert a single ice type machine from cylinder ice to crushed ice, only small modifications need to be made.

- Move jumper in control panel
- Adjust freezer pressure switch (FPS2)

See "Converting from cylinder ice to crushed ice", Section 9, "Service Operations" for details.

Ice Bin Capacity. Crushed or cylinder ice weighs approximately 35 pounds per cubic ft. (35 lb/ft^3). As ice drops into a bin, it will pile up and slope naturally at about a 45° angle. This natural slope should be taken into account when locating the bin thermostat bulb (or other bin level control) and when calculating the normal bin capacity. If the ice is spread out by hand in the bin for maximum storage capacity, make sure a hazard is not created by allowing ice to back up into the chute and jamming the cutter. Always allow enough room below the chute for at least one harvest (approx. 40 lbs. of ice).

If a two-way defector is installed below the ice chute, care should be taken to make sure it is located directly in the center of the stream of ice as it falls to give even distribution of the ice.

Refrigeration System (Review Before Starting Machine). The refrigeration system uses HCFC-22 refrigerant, a compressor, a thermal expansion valve, a flooded evaporator (freezer), and warm gas defrost. Following the schematic, you see that during the freeze period of the machine's cycle, the compressor discharge gas leaves the compressor and goes to the condenser where it is condensed into a liquid by the removal of heat by either air or water passing through the condenser. A reservoir of liquid is accumulated in the receiver and flows as required, passing through the filter/drier, then the thawing chamber, (a lower separate section of the freezer). The liquid solenoid valve (the "A" valve) being open during the operation allows the liquid to be metered by the thermal expansion valve that opens and closes (modulates) as the temperature of the suction line dictates. The evaporator floods with wet refrigerant that is in contact with the outside of the tubes that the ice-making water is being circulated through. The heat contained in this water is conducted 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 each of the freezer tubes. The flowing water keeps the accumulated ice clear by washing separated solids down into the sump area of the water tank.

The wet suction gas leaves the freezer, passes through the accumulator, and has any remaining liquid droplets removed by the heat contained in the high side liquid passing through the heat exchanger. The dry gas enters the compressor and is compressed then discharged to the condenser, the condensed liquid flows through the liquid side of the heat exchanger and to the receiver completing the cycle.

As the ice is formed in the freezer, the suction pressure steadily reduces until it causes one of the freezer pressure switches to close and switch the machine to a harvest period.

During the harvest period, the thawing gas solenoid valve, (The "D" valve), is open allowing the warm high pressure gas to enter the freezer. This heat melts a thin film from the outside of the ice, reducing the diameter and letting it fall free from the freezer tubes. The flow of thaw gas through the freezer is controlled by the CPR (crankcase pressure regulator) valve. This valve should be set as recommended in TABLE 9-2, "CPR Valve Setting".

For additional information and familiarization, see "How Your Tube-Ice Machine Works," Page 4-1, and Piping Schematics, FIGURES 4-1, 5-7, & 5-3.

5. Initial Start-Up & Operation

Start-Up Checklist

Be sure to complete and return the Warranty Registration/Start-Up report located at the front of the manual.

In order to prepare the machine for start-up, it will be necessary to remove the front panels for access to the various valves and for observation.

_____ 1. See that water-inlet connections are attached to the proper couplings (water cooled units) and to water for ice making. The inlet shutoff valves should be open. The water level in the water pan should be at a height where the make-up water float valve will be closed when the machine is idle.

_____ 2. See that the cutter motor gear reducer is lubricated (see "Lubrication" for instructions).

_____ 3. See that compressor crankcase oil level is at proper height of 1/4 to 3/4 of the sight glass. (no sight glass on Carlyle scroll compressor.)

_____ 4. See that "Cutter" and "Pump" circuit breakers are in the "On" position.

_____ 5. See that the "Ice" push button switch is in the "Off" position (Button Out).

_____ 6. See that the "Clean" push button switch is set to "Off" position (Button Out).

NOTE: All valves are tagged with instructions.

_____ 7. Open compressor service valves (34 and 35), the two hand-stop valves (90) in the thawing gas line, (91) in the condenser return line, and the hand-stop valve (58) in the liquid line and hand-stop valve (69) to the freezer pressure switch. These valves are tagged to indicate that they were closed for shipping purposes.

_____ 8. IMPORTANT! CHECK TO SEE that all stop valves in the various refrigerant lines are open except charging valve (28), according to the attached tags.

_____ 9. Immediately after opening all valves, entire machine should be checked for refrigerant leaks with electronic leak detector.

_____ 10. Close exterior disconnect switch to energize crankcase heater and power the PLC.

! CAUTION !
The crankcase heater should be energized for a MINIMUM of 2 HOURS before attempting to operate the compressor.
! CAUTION !

_____ 11. Connect a suction gage to the low pressure test connection and a high pressure gage to the high pressure test connection. After TWO HOURS, push the "Ice" button and the "Start" button. The machine will not operate until the low pressure raises sufficiently (to approximately 40 psig) to close the low pressure switch (4PS) & open the cylinder ice freezer pressure switch (FPS2).

If the machine does not start, put the “Ice” button in the “Off” position. Put the “Clean” button in the “On” position and push the “Start” button. This will put the machine in the clean mode and tell the PLC that the machine is pumped down. Now put the “Clean” button in the “Off” position, shutting off the water pump, and the “Ice” button in the “On” position. When the “Start” button is pushed, the “A” valve will open and feed liquid for 2 minutes then go to the freeze cycle.

Note: Be sure to check compressor rotation of machines with scroll compressor.

Suction pressure must decrease and discharge pressure increase immediately. To change rotation, reverse two (2) of the three (3) compressor wires L1, L2, and L3 at the control panel terminal block.

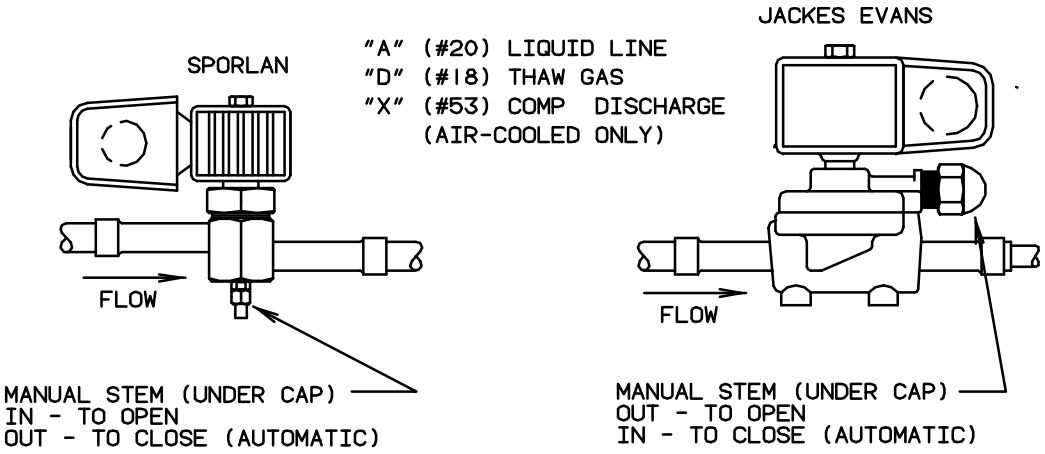


FIGURE 5-1
Solenoid Valves

_____ 12. When the machine starts, check water level in water pan (7) to determine whether or not water pump (6) is pumping water. It may be necessary to stop and start the machine several times to expel air from the water pump impeller housing.

Note: Use one of the circuit breakers, “Cutter” or “Pump” to stop--for approximately 10 seconds--and start button to start the machine, if necessary to prime the pump.

! CAUTION !
If it should ever become necessary to add refrigerant to the system, charging valve (28) is provided for this purpose. **Be sure to follow all local and federal regulations regarding the handling of refrigerants and their illegal emission into the atmosphere.**
! CAUTION !

Refrigerant Charge. Check the refrigerant level after the machine has operated for a few cycles. It should be slightly above the operating level, as indicated on the receiver, a few minutes prior to start of a thawing period. If this level is low at this time, sufficient refrigerant should be added to the system to raise the level above this point. One inch (1") is equivalent to 5 lbs. in the receiver. Add only a small quantity (5 lbs. or less) at a time, and operate the machine several cycles to check the level before adding additional refrigerant. Refrigerant may be added as a liquid through the charging valve (28) only while the machine is operating. It is important that no air or other non-condensable gases enter the system when charging refrigerant into the unit.

When adding refrigerant to the system, it may also be necessary to add lubricating oil. See "Lubrication Compressor", Section 7, "Maintenance".

In order to check the total charge in the system, it is necessary to transfer all of the refrigerant to the receiver. A total pumpdown procedure should be performed.

Total Pumpdown Mode. The function of the total pumpdown mode is to transfer all the liquid refrigerant from the freezer (evaporator) into the receiver. Total pumpdown is initiated as the first phase of and prior to entering the clean mode. It should only be performed when the freezer is clear of ice.

Its main purpose is to clear the freezer of liquid refrigerant and prevent possible refrigerant migration to the compressor while running the clean cycle. It also can be used to check the units total refrigerant charge.

Total pumpdown is initiated by setting the selector switch to the "Cyl" position, turn "Ice" switch to the "Off" position (allow the machine to harvest if running in a freeze cycle), press the "Clean" button to the "On" position. At this time the compressor and water pump will run, the "A" (liquid feed) solenoid valve will close and the freezer will begin to pump down. As the suction pressure decreases, the freezer pressure switch will initiate a harvest cycle to clear the partially formed ice cylinders from the freezer. This harvest cycle will end after one minute and the total pumpdown will resume, continuing until the compressor cycles off by the low pressure switch. At this time, only the water pump will be running. The "Clean" push button must then be pushed to the "Off" position and the machine will go to the standby mode.

To restart the machine after a total pumpdown:

1. Set the selector switch to the position desired (dual ice type machines only).
2. See that the "Clean" switch is in the "Off" position.
3. Push the "Ice" button to the "On" position.
4. Push the "Start" button.

At this time, the "A" (liquid feed) solenoid valve will open for 2 minutes and the machine will start in a freeze cycle.

! CAUTION !
If the power has been turned off to the machine, make sure the compressor crankcase is warm and there is no liquid refrigerant in with the oil before restarting the unit.
! CAUTION !

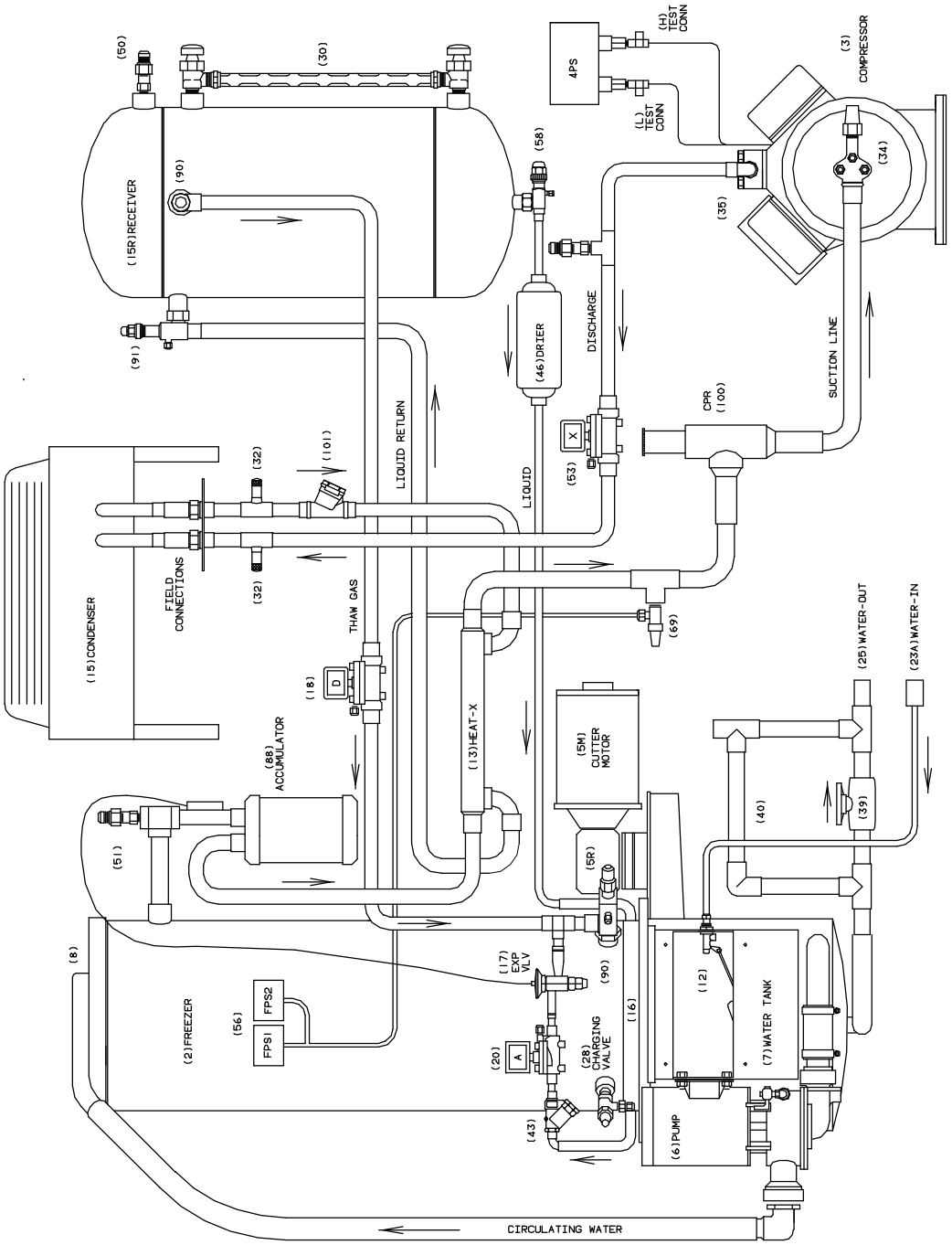


FIGURE 5-2
Piping Schematic, Air-Cooled

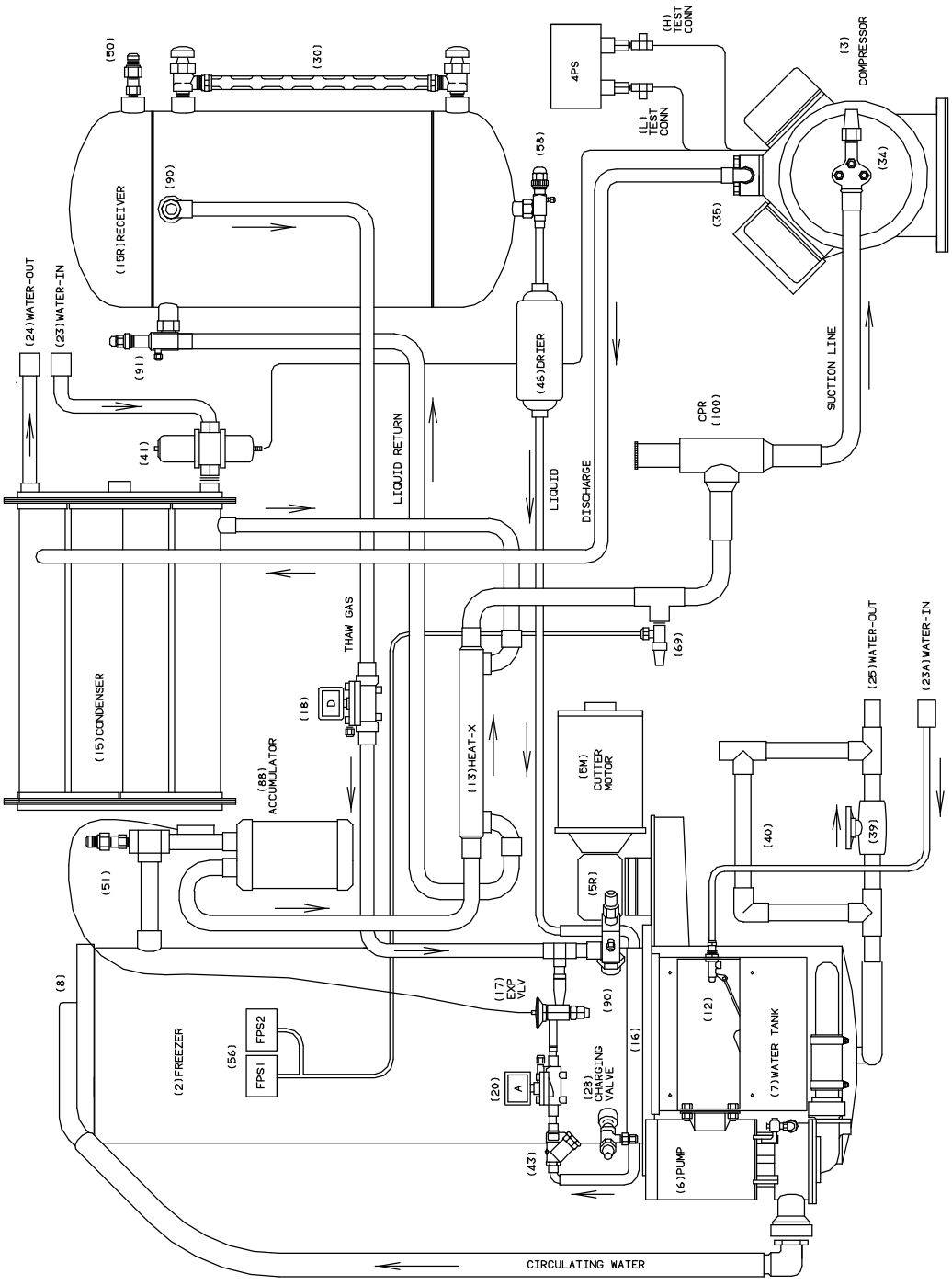
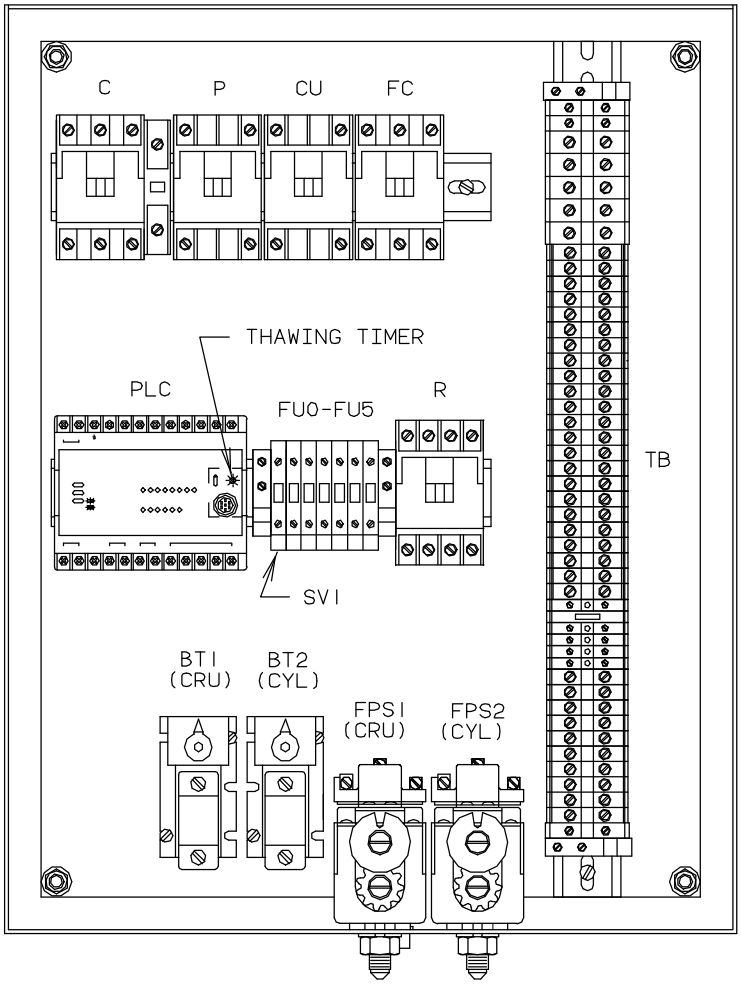


FIGURE 5-3
Piping Schematic, Water Cooled

6. Electrical Controls & Their Functions



Control Panel Parts

***BT1**	12A 2117G02000000-Bin Thermostat (Crushed)	***FPS1**	12A 2117E04000000-Freezer Pressure Switch (Crushed)
BT2	12A 2117G02000000-Bin Thermostat (Cylinder)	**FPS2**	12A 2117E04000000-Freezer Pressure Switch (Cylinder)
C	12A 7516E13000000-Compressor Contractor	**P**	12A 7516E09000000-Pump Contactor
	12A 7518E2000000 - Auxiliary Contact	**CU**	12A 7516E09000000 - Cutter Contactor
PLC	12A 7536M01000000 - Programmable Controller	**FC**	12A 7516E11000000 Fan Contactor (Air-cooled only)
***R**	12A 7517E18000000 - Reversing Relay	**FU0-FU5**	PLC Protection Fuses (part of fuse block assembly)
TB	12A 7501E30000000 - Terminal Block Assembly	**Fuses (FU0-FU5)**	12A 7504E23000000 - 2 amp fuses
SVI	Service Indicator Switch (part of fuse block assembly)		

***Note: Components used in dual ice type machines only**

FIGURE 6-1
Control Panel (Cover Removed)

ELECTRICAL CONTROLS & THEIR FUNCTIONS

Description of Control Panel Parts.

***BT1 and BT2. Bin Thermostats.** Ice bin thermostats for automatically stopping and starting the machine based on the ice level in the storage bin. BT1 (Crushed Ice). BT2 (Cylinder Ice).

C. Compressor Motor Contactor. Provides power to the compressor motor. Energized during freezing and thawing. Normally closed contact provides power to the compressor crankcase heater when the machine is off.

P. Pump Contactor. For making and breaking contacts to start and stop the circulating water pump. Energized during the freeze, pumpdown, and clean modes.

CU. Cutter Contactor. For making and breaking contacts to start and stop the cutter. Energized during the harvest mode.

PLC. Programmable Logic Controller. For monitoring, sequencing, and controlling various functions of the Tube-Ice® operation. Also has a built in thaw timer for controlling the time of the thawing period. Thawing time is adjustable from 1 1/2 to 5 minutes.

***FPS1 and FPS2. Freezer Pressure Switches.** For regulating the ice thickness by sensing the freezer pressure and initiating the thaw period. FPS1 (Crushed Ice). FPS2 (Cylinder Ice).

***R. Reversing Relay.** Switches machine to either cylinder or crushed ice by making or breaking various circuits concerning cylinder or crushed ice production. Energized during crushed ice production only.

FC. Fan Contactor. Cycles the fan motor(s) of air-cooled condenser "On" and "Off". Activated by the condenser pressure switch. (Air-cooled machines only).

SVI. Service Indicator Switch. For disabling the machine and entering a troubleshoot mode to identify a machine "fault". Opened for entering a troubleshoot mode, closed for normal machine operation.

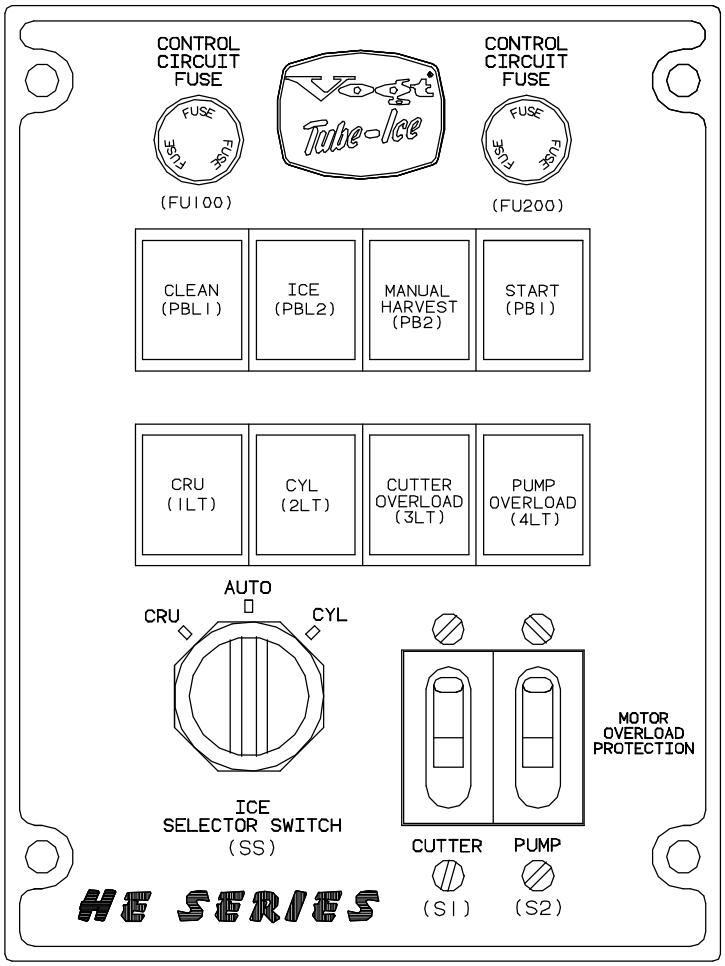
FU0 through FU5. Overload and short circuit protection of the components controlled by the PLC output. See Wiring Schematics.

CD-OL. Compressor Motor Overload. HEC-30 and HEC-40 only. Stops the machine in the event of a mechanical or electrical malfunction of the compressor motor, causing excessive amperage. Is automatically reset, but the machine must be manually restarted by the "Start" push button or will automatically restart after two hours.

CD-TS. Compressor Motor Thermal Overload. HEC-30 and HEC-40 only. Stops the machine in the event of excessive temperature in the compressor motor windings. Will reset when motor cools sufficiently. The machine can be manually restarted by the "Start" push button or will restart automatically after the compressor stops when this overload trips and restarts. The machine will stop by long freeze cycle "fault" after repeated overload trips.

HEC-10 and HEC-20 have built in motor overload protection with automatic reset.

*Note: Components used in dual ice type machines only.



Switch Box Parts

FU100	12A 7504E10000000	Fuse 2.5 amp
FU200	12A 7504E10000000	Fuse 2.5 amp
PBL1	12A 7500E36000000	Clean Lighted Push Switch
PBL2	12A 7500E36000000	On/Off Lighted Push Switch
PB1	12A 7500E03000000	Start Push Button
PB2	12A 7500E02000000	Manual Harvest Push Switch
***SS**	12A 7500E07000000	Selector Switch
S1	12A 7515E01000000	Cutter Overload Switch
S2	12A 7515E07000000	Pump Overload Switch
***1LT**	12A 7520E10000000	Cylinder Light
***2LT**	12A 7520E10000000	Crushed Light
3LT	12A 7520E09000000	Cutter Overload Light
4LT	12A 7520E09000000	Pump Overload Light

*Note: Components used in dual ice type machines only.

FIGURE 6-2
Switch Box. Most functions of the machine can be controlled from the switch box.

FU100 and FU200, 2.5 Amp Fuses. Overload and short circuit protection for crankcase heater and the control circuit.

PB1, Start Push Button. For starting the machine in the ice making mode. (Momentary contact). Will also bypass the built in 120 minute start-up mode. Will also terminate a harvest mode.

PB2, Manual Harvest Push Button. Initiates a thaw period immediately when manually depressed. (Momentary contact)

PBL1, Clean/Off Lighted Push Button. "Clean" illuminated in the "On" position (button in). Not illuminated in the "Off" position (button out) for ice making.

PBL2, Ice/Off Lighted Push Switch. "Ice" illuminated in the "On" position (button in) for ice making. Not illuminated in the "Off" position (button out).

***1 LT, Crushed Light.** "Cru" illuminated when set to produce crushed ice.

***2 LT, Cylinder Light.** "Cyl" illuminated when set to produce cylinder ice.

Both 1 LT and 2 LT are illuminated when selector switch set in "Auto" position.

3 LT, Cutter Overload. Illuminated when cutter overload switch (S1) has tripped.

4 LT, Pump Overload. Illuminated when pump overload switch (S2) has tripped.

***SS, Selector Switch.** For the purpose of selecting the type of ice to be made, either crushed (Cru) or cylinder (Cyl). Note: Use "Auto" position only when using divided bin.

S1, Cutter Overload Switch. Stops machine operation in the event of a mechanical or electrical malfunction of the cutter motor, resulting in excessive motor amperes.

S2, Pump Overload Switch. Stops machine operation in the event of a mechanical or electrical malfunction of the pump motor, resulting in excessive motor amperes.

If machine is turned off by either S1 or S2, the machine stops immediately and advances to the start-up mode when the switch is put back in the "On" position. The machine will automatically restart after two hours in the start-up mode if the switch has been reset. The machine can be restarted also by resetting the overload switch and pushing the "Start" button. It will restart in a freeze cycle.

*Note: Components used in dual ice type machines only.

PLC Features & Functions
(Condensed Description)

The PLC provides many beneficial features as follows:

1. Identifies machines faults and stores the identity of the last fault.
2. Automated total pump down prior to a clean mode.
3. Performs partial pump down when machine cycles off by “Bin Stat” or “Ice” switch.
4. Provides fault identification:
   a. Short cycle fault
   b. Long freeze cycle fault
   c. High/low pressure fault during freeze
   d. High/low pressure fault during thaw
   e. High/low pressure fault during partial pump down
   f. High/low pressure fault during total pump down
5. Automatic (2-hour delayed) restart after being off from:
   a. Power failure
   b. Power interruption
   c. Compressor overload cutout
   d. Low pressure fault
   e. Long freeze fault
   f. Short cycle fault
6. Built in adjustable thaw timer (range 1 1/2-5 minutes).
7. Closes “A” (liquid feed) solenoid valve and stops the water pump seven seconds before the harvest begins providing a slight pump out of the freezer and accumulator and allowing the water level to stabilize before the cutter turns.
8. Sequences the machine functions to assure the highest product capacity with the least amount of personal attention.

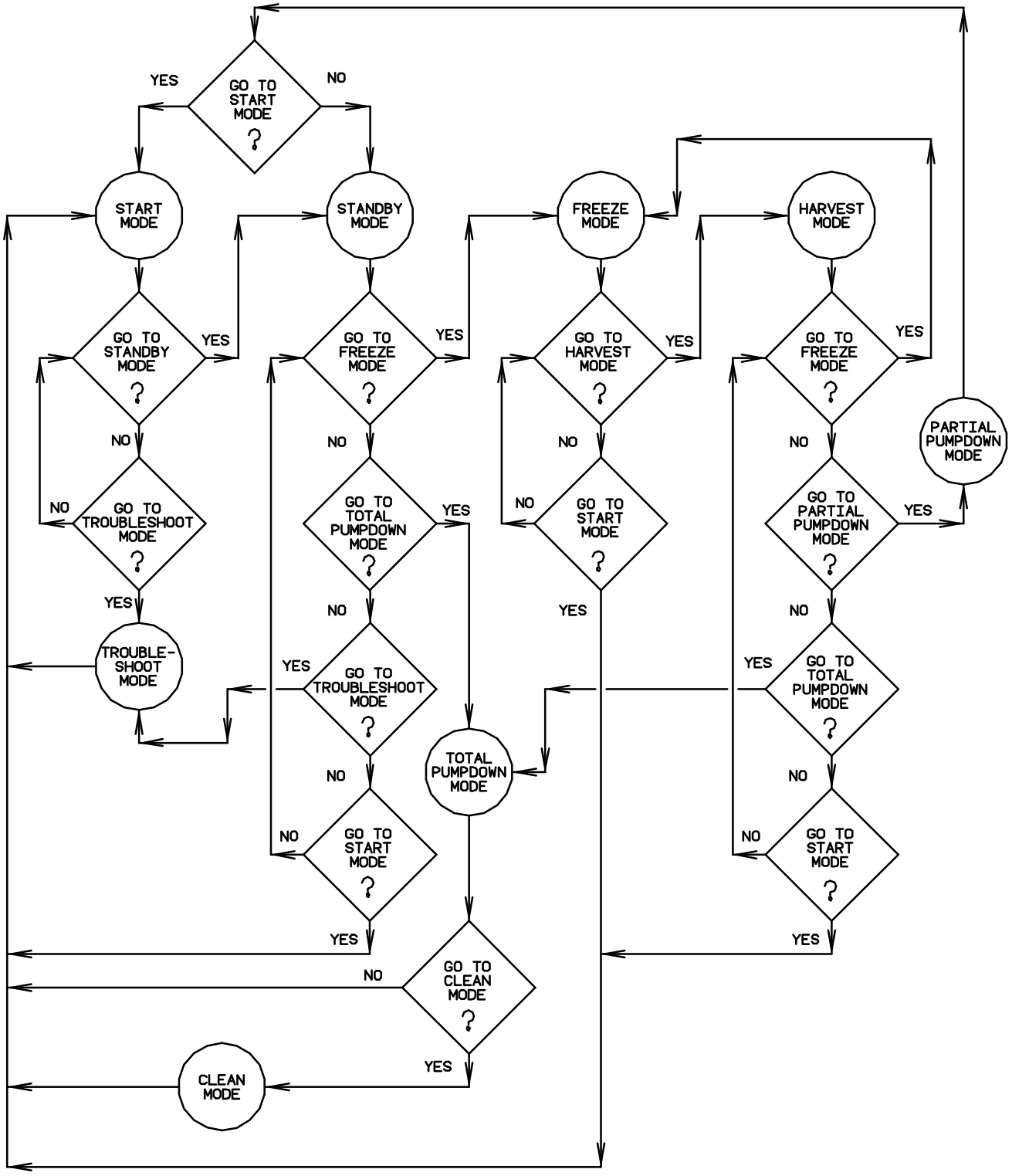


FIGURE 6-3
Control Sequence Flow Chart

"PLC" (Programmable Logic Controller)
Sequence Of Controller & Machine Operation

Explanation. The HEC-Series Tube-Ice® machine is controlled by a PLC (Programmable Logic Controller). The PLC controls the sequence of events and monitors the ice machine functions. The operational sequences of the HEC-Series Tube-Ice® machine can be best described as a series of eight different modes. Each mode identifies and defines a sequence of events that occur while in that mode and thereby cause it to move to the next mode. Only one mode is active at a time. Refer to the PLC Flow Chart (FIGURE 6-3) in this section for sequencing and various mode paths.

Start-Up Mode. The start-up mode is a function which prevents the premature automatic starting of the machine at the time of installation, after a power interruption, or after a safety trip. Its normal time period is two hours.

Initiated by the following:

1. Initial power up at the time of installation
2. Power restored after a power interruption or power failure
3. After running a "Troubleshoot" mode
4. After running a "Clean" mode
5. After running a "Total Pumpdown" mode
6. Machine faults such as:
    a) Cutter overload trip (manual reset)
    b) Pump overload trip (manual reset)
    c) High pressure cutout trip (manual reset)
    d) Control circuit fuse failure (manual replacement)
    e) Compressor overload trip (automatic reset) - HEC-30 & 40 only
    f) Low pressure cutout trip (automatic reset)
7. If both the "Clean" and "Ice" buttons are in the "On" position (and the harvest cycle is complete).

If all safeties in the control circuit are closed, the machine will remain in the start-up mode for a period of two hours (120 minutes) before automatically advancing to the standby mode. The start-up mode may be bypassed at any time by pressing the "Start" button to immediately advance to the standby mode. Make sure the compressor crankcase is warm and there is no liquid refrigerant in with the oil before pushing the "Start" button.

Standby Mode. The standby mode is a decision making mode. It monitors the position of all the various switches in the control circuitry and at the proper time decides which mode to advance to next.

Initiated by the following action:

1. After the two hour period in the start-up mode.

2. After pushing the “Start” button.

3. After pushing the “Ice” button to the “Off” (and the harvest cycle and partial pumpdown cycles are complete).

4. After the bin thermostat contact opens (and the harvest cycle and partial pumpdown cycles are complete).

Freeze Mode (Freeze Cycle). The freeze mode is active during the normal ice making cycle. During this time, the circulating water pump and compressor are running and the “A” (liquid feed) solenoid valve and “X” solenoid valve compressor discharge (AC units only) are open.

Initiated by the following:

1. After the start-up and standby modes are satisfied in sequence.

2. At the termination of the harvest mode.

Harvest Mode (Thaw Cycle). The harvest mode is normally initiated at the termination of the freeze mode. At this time, the circulating water pump stops and the “A” (liquid feed) solenoid valve closes for a time period of seven seconds. After seven seconds, the “D” (thaw gas) solenoid valve opens, the cutter motor starts and the thaw timer is activated.

Initiated by the following:

1. Action of the freezer pressure switch.

2. Pushing the manual harvest button.

The harvest mode is terminated by the thaw (harvest) timer at which time the machine will begin another freeze cycle. If the “Ice” switch is “Off” or the bin thermostat is satisfied the machine will advance through the partial pumpdown mode then standby. The harvest mode can be terminated manually by pushing in the “Start” button. The machine will end the harvest and start a freeze or go to standby if the “Ice” switch is “Off”.

Partial Pumpdown Mode. The partial pumpdown modes precedes the normal off or standby mode. Its purpose is to transfer a portion of the liquid from the suction accumulator and freezer into the receiver prior to shutdown of the machine (standby mode). This will discourage any migration of liquid refrigerant to the compressor during the off or standby mode. It is also intended to help prevent any liquid refrigerant slugging to the compressor when the machine restarts in a freeze mode.

When partial pumpdown is initiated, the "A" (liquid feed) solenoid valve is closed and the water pump and compressor run for a set time. After this set time the compressor stops and the machine is in the standby mode.

Model	HEC-10	HEC-20	HEC-30	HEC-40
Time	7 minutes	7 minutes	5 minutes	3 minutes

TABLE 6-1
Partial Pumpdown Time

NOTE: The PLC uses the cylinder ice pressure switch (FPS2) as a partial pumpdown safety. Do not remove this pressure switch from the machine.

Initiated by the following:

1. At the end of a harvest cycle with the bin thermostat satisfied.

2. At the end of a harvest cycle with the "Ice" switch in the "Off" position.

Total Pumpdown Mode. The function of the total pumpdown mode is to transfer all the liquid refrigerant from the freezer (evaporator) into the receiver. Total pumpdown is initiated as the first phase of and prior to entering the "Clean" mode.

Its main purpose is to clear the freezer of liquid refrigerant and prevent possible refrigerant migration to the compressor while running the "Clean" cycle. It can also be used to check the units total refrigerant charge, isolate the refrigerant in the receiver while making repairs, or prepare the machine for disconnecting and moving.

Initiated by the following:

1. Set the "Selector" switch to the "Cyl" position (dual ice type machines only).

2. Turn the "Ice" switch to the "Off" position (allow the machine to harvest if it is operating).

3. Push the "Clean" button into the "On" position. At this time the compressor and water pump will run, the "A" (liquid feed) solenoid valve will close and the freezer will begin to pumpdown. As the suction pressure decreases, the freezer pressure switch will initiate a harvest cycle to clear the partially formed ice cylinders from the freezer. This harvest cycle will end after one minute and the total pumpdown will resume continuing until the compressor cycles off by the low pressure switch. At this time, only the water pump will be running. The "Clean" button must then be pushed to the "Off" position and the machine will be in the standby mode.

To restart the machine after a total pumpdown:

1. Set the “Ice Selector” switch to the position desired.
2. See that the “Clean” switch is in the “Off” position.
3. Push the “Ice” button to the “On” position.
4. Push the “Start” button. (Make sure the compressor crankcase is warm and there is no liquid refrigerant in with the oil before pushing the “Start” button.)

At this time the “A” (liquid feed) solenoid valve will open for two minutes, allowing the freezer pressure to raise to the cut-in setting of the low pressure switch. Then the machine will start in a freeze cycle.

Clean Mode. The “Clean” mode is considered to be a maintenance or servicing function of the machine. It should only be initiated when the freezer is clear of ice.

The first phase of the “Clean” mode is a total pumpdown.

! CAUTION !
Do not attempt to bypass the total pumpdown phase of the “Clean” mode. If a clean cycle is performed without first completing a total pumpdown, the warm water being circulated through the freezer tubes can force refrigerant to migrate to the suction accumulator and compressor. This could create an unfavorable condition and possible cause damage to the compressor when returning to the freeze mode.
! CAUTION !

After the total pumpdown and pushing the “Start” button, the water pump can be started and stopped by simply pushing the “Clean” button on and off. (Note: If the freezer and compressor suction pressure have come up enough to open the freezer pressure switch FPS2 and close low pressure safety switch 4PS, the compressor will come and on and pump down the freezer again.) Ice machine cleaning solution can be circulated though the tubes to accomplish the cleaning procedure. If the water pump is left to run in the clean mode. The clean mode can be resumed by pushing the “Start” button.

At the termination of the clean mode, the machine can be returned to ice making mode by pushing the “Clean” button to the “Off” position; the “Ice” button to the “On” position; and the “Start” button. See “Maintenance--Ice Making”, Section 7, for complete cleaning procedure.

Troubleshoot Mode. If the machine has stopped due to a “fault” during normal operation, a troubleshoot mode can be used to identify this “fault”. This mode can be entered from a start-up or standby mode.

To enter the troubleshoot mode, the SVI (service indicator) switch located inside the control panel (FIGURE 6-1) must be opened. This will disable the machine and its components.

Initiated by the following:

1. Open the SVI switch.

2. Set the “Clean” button to the “On” position.

3. Set the “Ice” button to the “On” position.

4. Push both the “Harvest” and “Start” buttons simultaneously.

At this point, the machine “fault” can be identified and necessary corrections or adjustments can be made for returning the machine to good working order. A “fault” will be identified by illumination of specific numbered PLC output indicator lights on the PLC. See “Fault Identity”, TABLE 6-2.

To exit the troubleshoot mode, follow this sequence:

1. Set the “Clean” button to the “Off” position.

2. Set the “Ice” button to the “Off” position.

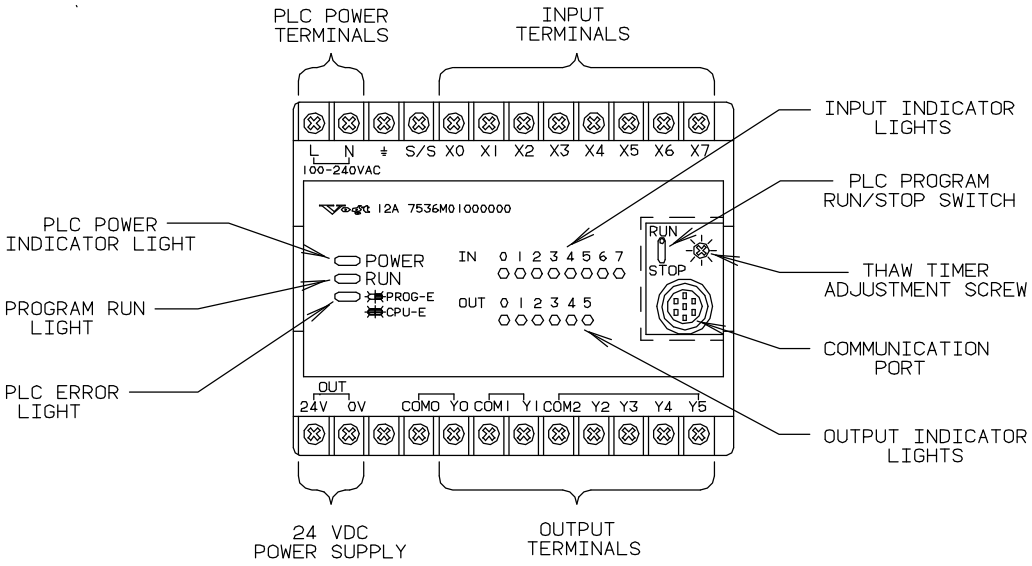
3. Close the SVI switch.

4. This will return the machine to the “Start-Up” mode.

Output Light	Fault #	Fault Description
●●✶●✶●	#10	High or low pressure cutout during freeze cycle
●●✶●✶✶	#11	High or low pressure cutout during harvest cycle
●●✶✶●●	#12	High or low pressure cutout during partial pumpdown
●●✶✶●✶	#13	High or low pressure cutout during total pumpdown
●●✶✶✶●	#14	Short Cycle Fault: Three Harvests Within A Specified Time As Noted: HEC-10 --- 10 Minutes HEC-20 --- 10 Minutes HEC-30 --- 5 Minutes HEC-40 --- 5 Minutes
●●✶✶✶✶	#15	Long Freeze Cycle Fault: One Freeze Cycle Longer Than A Specified Time As Noted: HEC-10 --- 120 Minutes HEC-20 --- 120 Minutes HEC-30 --- 80 Minutes HEC-40 --- 60 Minutes
●✶●●●●	#16	Power failure/compressor O/L

Note: ✶ indicates light is “On”

TABLE 6-2
Fault Identity



NOTE: Part #12A-7536M01000000. PLC must be pre-programmed for specific model.

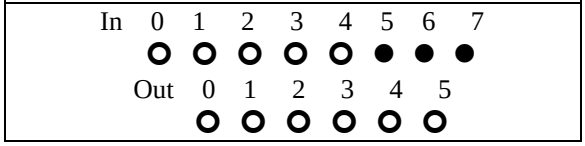
FIGURE 6-4
PLC Display

Input	Description
0	Cylinder Ice Bin Stat / Selector Switch
1	Crushed Ice Bin Stat / Selector Switch
2	Freezer Pressure Switch / Manual Harvest
3	Start Switch
4	Clean Switch
5	Ice Switch
6	High / Low Pressure Safety Switch
7	Service Indicator Switch

Output	Description
0	Flush Valve (Special Order Only)
1	A-valve
2	Compressor (X-valve / air cooled machine)
3	Reversing Relay
4	Water Pump
5	Cutter / D-valve

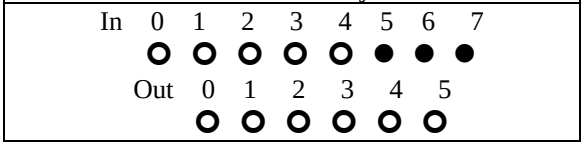
TABLE 6-3
PLC Inputs & Outputs

S10 - Start



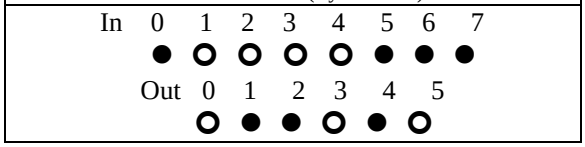
Note: Inputs # 0 or # 1 may be "on". If machine has shut off due to a High pressure fault, input 6 will be "off".

S11 - Standby



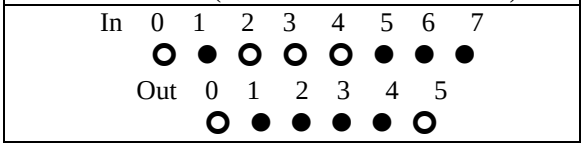
Note: If Ice button, Input # 5 is "off", Input # 0 or # 1 may be "on".

S12 - Freeze (Cylinder Ice)



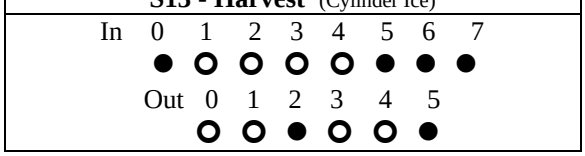
Note: Input # 2 will come "on" to initiate the harvest cycle.

S12 - Freeze (Crushed Ice - 5 minutes into freeze)



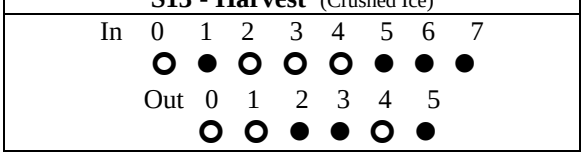
Note: Input # 2 will come "on" to initiate the harvest.

S13 - Harvest (Cylinder Ice)



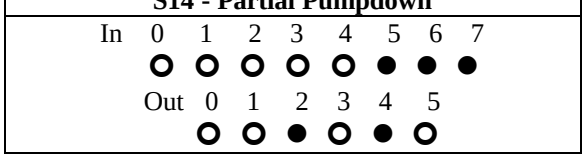
Note: Input # 2 will be "on" at the start of the Harvest, but will turn "off" as thaw gas pressure rises.

S13 - Harvest (Crushed Ice)



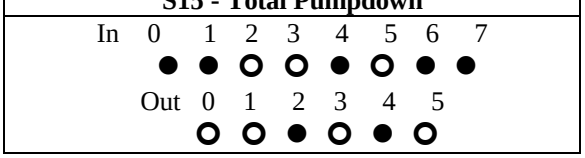
Note: Input # 2 will be "on" at the start of the Harvest, but will turn "off" as thaw gas pressure rises.

S14 - Partial Pumpdown



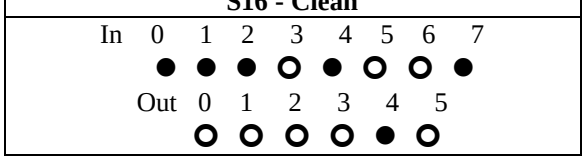
Note: If Ice button, Input # 5 is "off", Input # 0 or # 1 may be "on".

S15 - Total Pumpdown



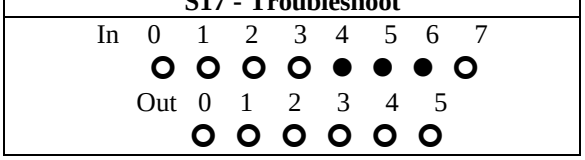
Note: Input # 0 and # 1 may be "off".

S16 - Clean



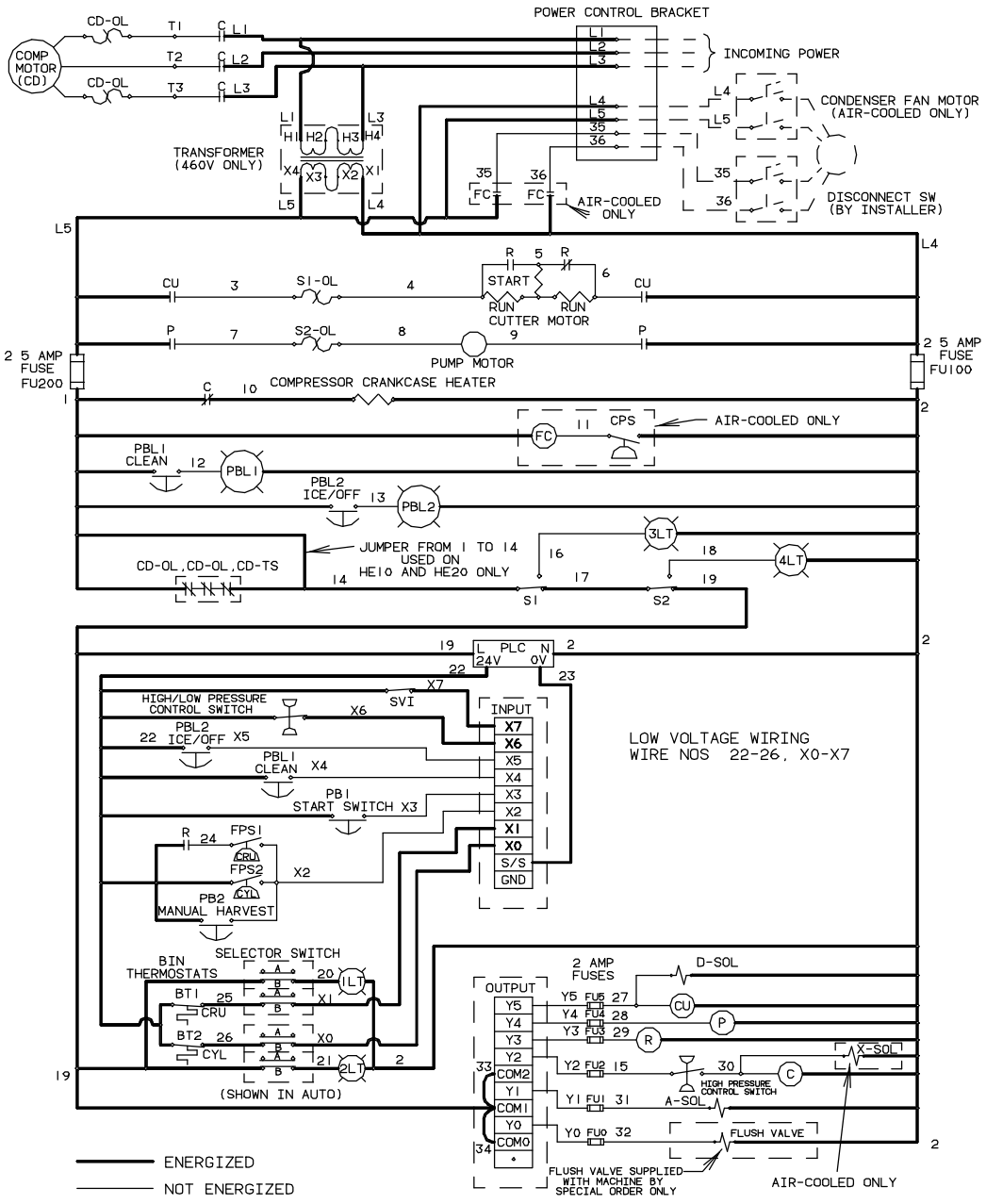
Note: As pressure builds in the freezer and at the compressor, Input # 2 may turn "off" and Input # 6 turn "on".

S17 - Troubleshoot



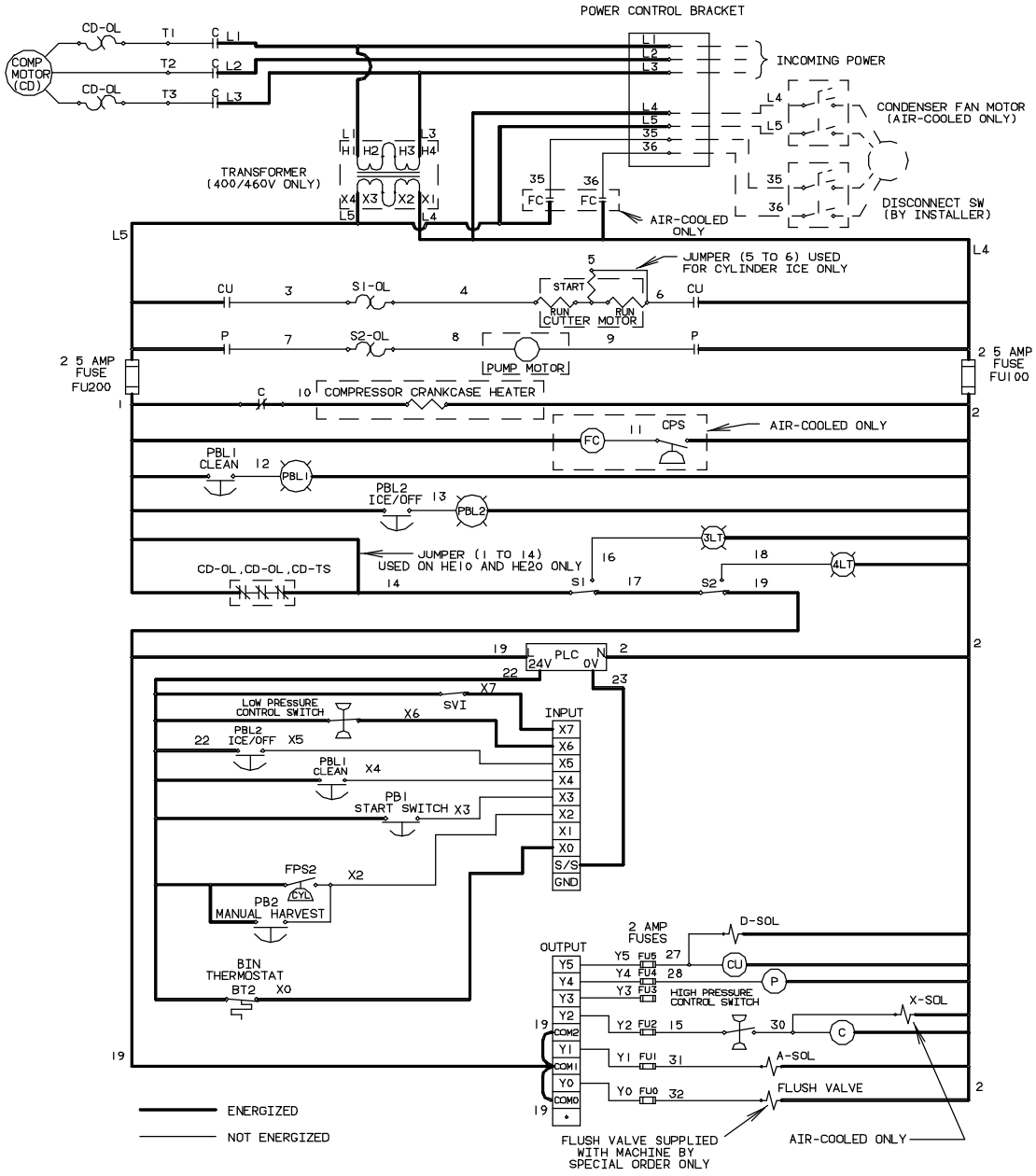
Note: Input's # 0 and # 1 may be "on". Output lights will indicate the previous machine fault.

FIGURE 6-5
PLC Input/Output Display



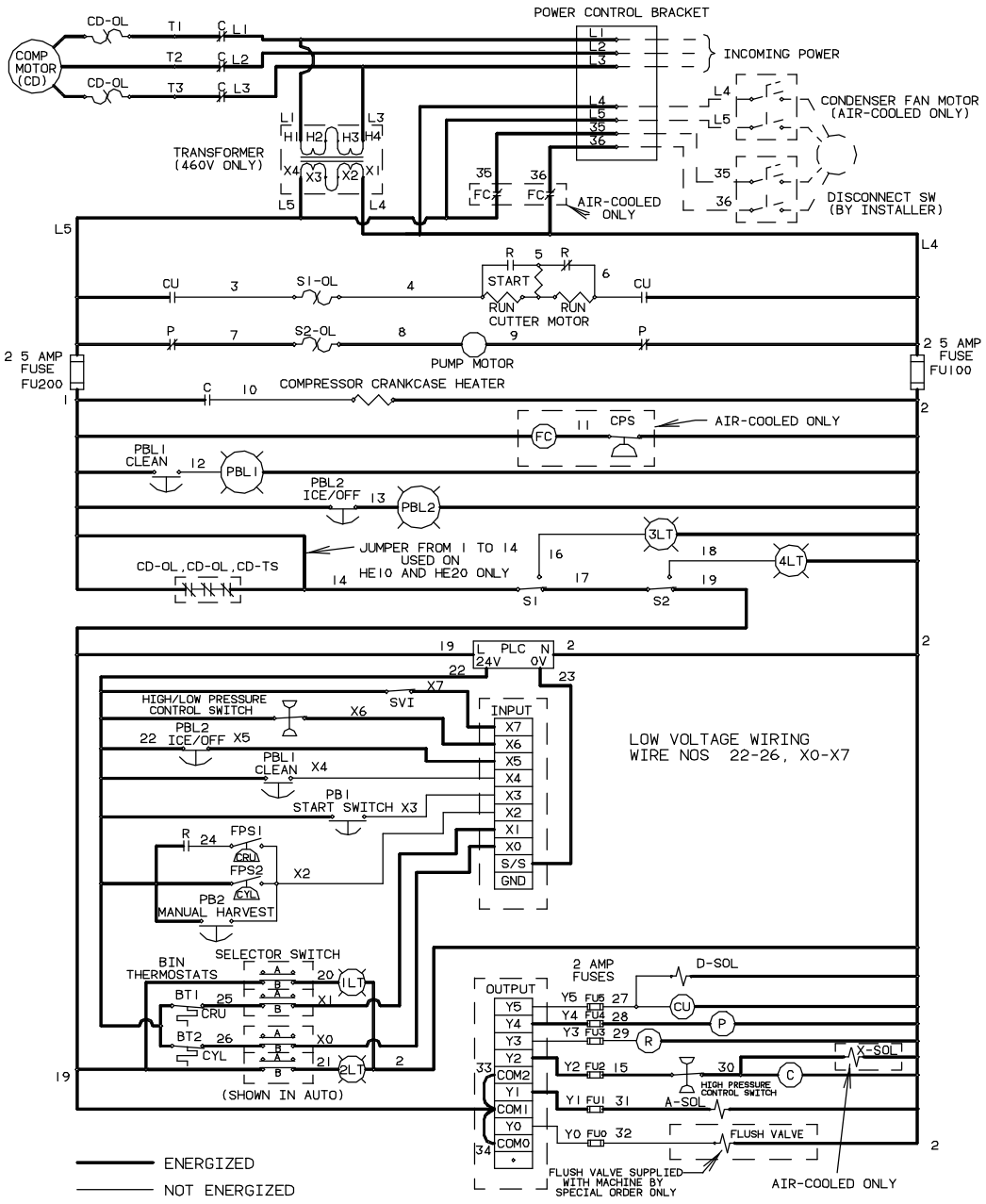
Use Copper Conductors Only. Protected against primary single phase failure.

FIGURE 6-6
Dual Ice Type--Machine Off



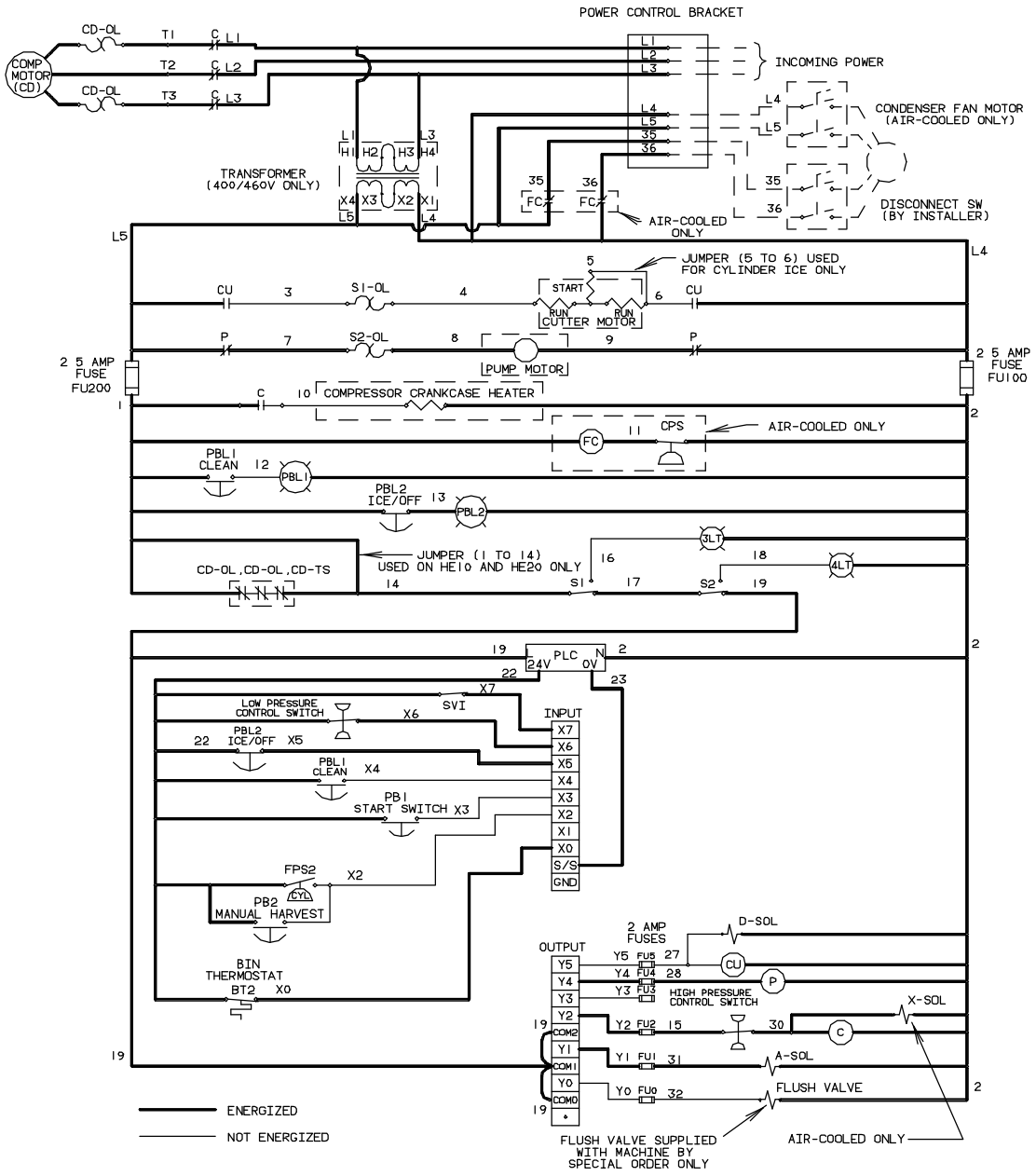
Use Copper Conductors Only. Protected against primary single phase failure.

FIGURE 6-6A
Single Ice Type--Machine Off



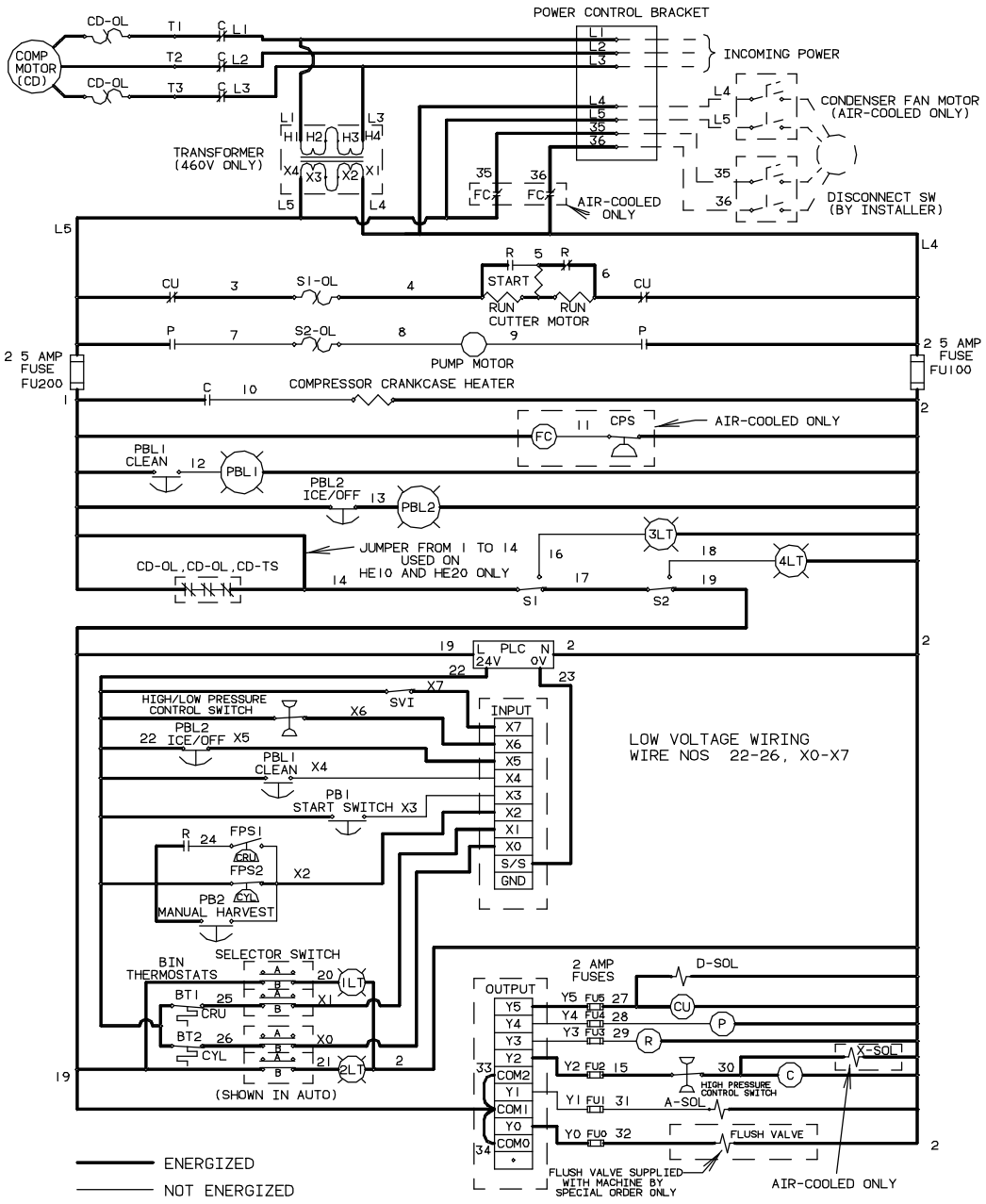
Use Copper Conductors Only. Protected against primary single phase failure.

FIGURE 6-7
Dual Ice Type--Freeze Cycle (Cylinder Ice)



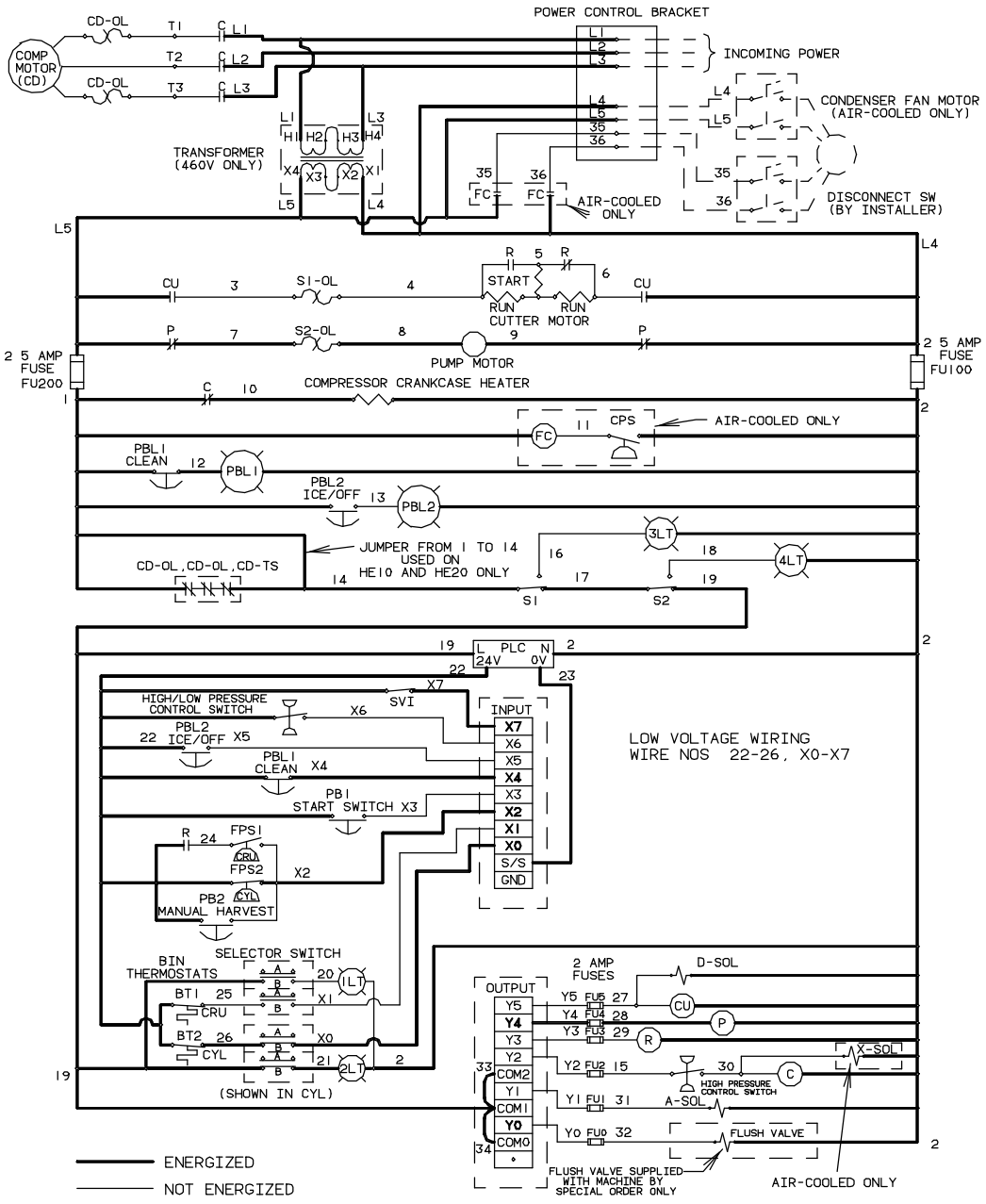
Use Copper Conductors Only. Protected against primary single phase failure.

FIGURE 6-7A
Single Ice Type--Freeze Cycle



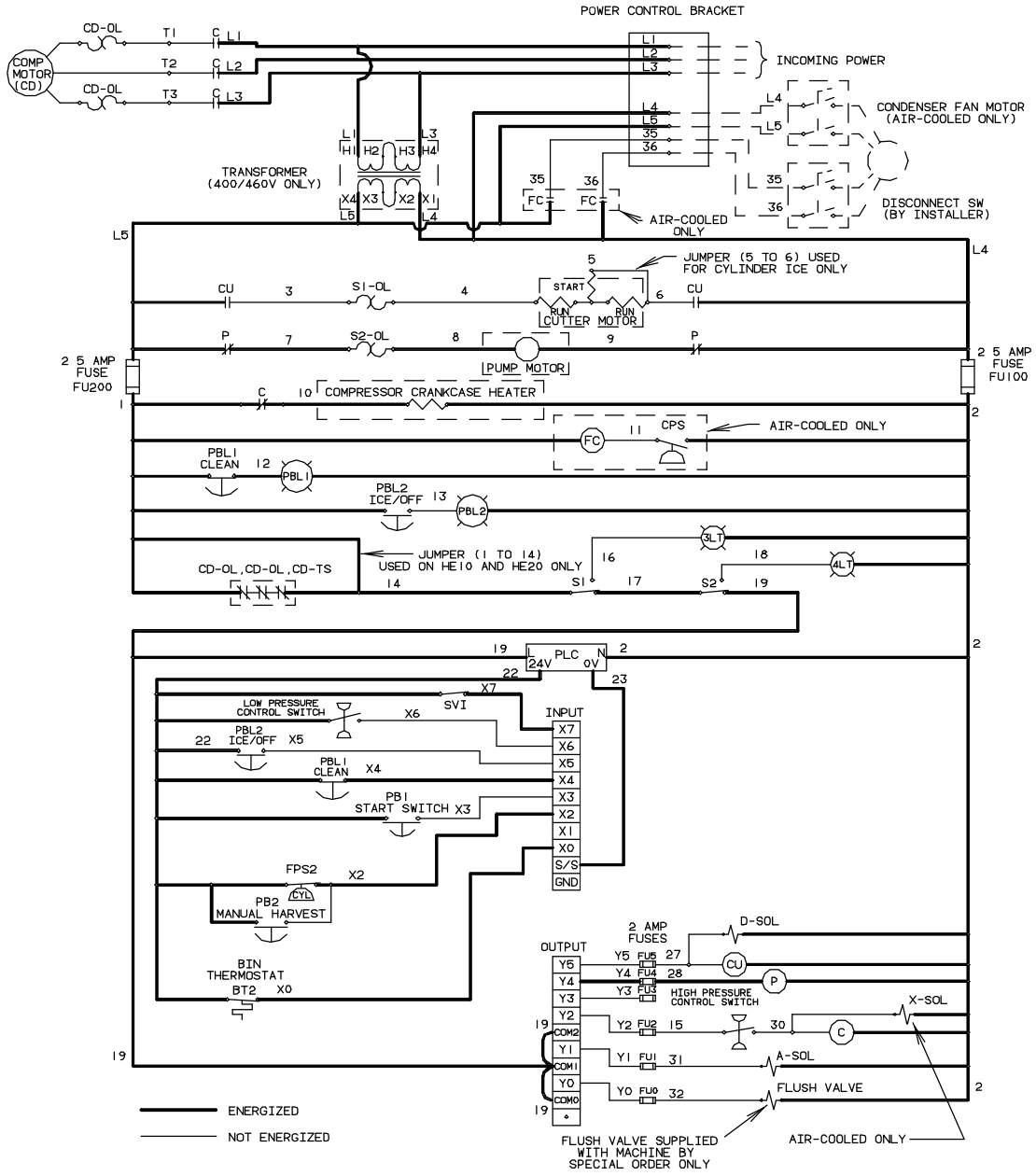
Use Copper Conductors Only. Protected against primary single phase failure.

FIGURE 6-8
Dual Ice Type--Harvest Cycle (Cylinder Ice)



Use Copper Conductors Only. Protected against primary single phase failure.

FIGURE 6-9
Dual Ice Type--Clean Cycle (A Maintenance Operation)



Use Copper Conductors Only. Protected against primary single phase failure.

FIGURE 6-9A
Single Ice Type--Clean Cycle

7. Maintenance

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) using an approved food-grade ice machine cleaner. The water pump is used to circulate the cleaner through the system by setting the "Clean" push button switch to the "On" position (button in) and starting and stopping the pump by this push button switch and the start button. For complete instructions, refer to the "Cleaning Procedure" attached to the equipment and duplicated here.

Cleaning Procedure

1. Set "Ice" switch to "Off" position. If the machine is running, it will shut down on the completion of the harvest period and partial pumpdown cycle. Remove the freezer cover to inspect and clean the water distributors as necessary. Replace the freezer cover with the distributors installed.

2. Remove ice from storage area or cover opening to prevent ice contamination.

3. Set the "Selector" switch to "Cyl" position (dual ice type machines only).

4. Push the "Clean" button to the "On" position. The machine will begin a total pumpdown. After total pumpdown, the compressor will stop and only the water pump will be running.

5. Push the "Clean" button to the "Off" position and the pump will stop.

6. Shut off the water supply and drain the water tank flushing loose scale in the process.

7. Close the water tank drain valve and fill tank with approximately six gallons of tap water. Warm water can be used but should not exceed 115°F (46°C).

8. Add a measured portion of a food-grade ice machine cleaner (nickel safe preferred) to the water tank in accordance with cleaner instructions and insert the plastic tubing and petcock valve (discharge end) of the adjustable blowdown into the water tank and adjust the petcock to full open.

9. Push the "Clean" button to the "On" position and push the "Start" button to run the pump only and circulate cleaner solution. Clean until deposits are dissolved by changing solution as necessary.

10. When the system is considered clean, stop the pump, drain the tank, turn on the water supply, and flush the system thoroughly with clean water (at least twice) as necessary to remove chemical residue.

11. Clean inside the ice storage area and remove any solution that may have entered during the cleaning process. Remove cover from over the opening into the storage area.

12. Make sure the water tank drain valve is closed, the adjustable blowdown petcock is adjusted properly, the adjustable blowdown tubing is inserted into the drain bypass line, the "Clean" button is in the "Off" position, and the selector switch is in the desired ice making position.

13. Push the "Ice" button to the "On" position and push the "Start" button for immediate start-up in the ice production mode.

Water Distributors. The water distributors are located under the freezer cover (8) at the top of the freezer. There are 78 distributors used in the models having an "S" suffix (i.e., Models HEC-10S, HEC-20S, HEC-30S, and HEC-40S); 48 distributors are used in the models having an "M" suffix (i.e., Models HEC-10M, HEC-20M, HEC-30M, and HEC-40M). These distributors may require occasional or periodic cleaning to remove solids and foreign particles accumulated from the make-up water. The frequency of this cleaning operation will depend on the characteristics of the water supply.

The cleaning operation is indicated when the inside diameter of a large proportion of the ice becomes irregular (due to channeling of water), or if some of the ice is opaque, or if there is a noticeable decrease in ice capacity.

To clean distributors, stop the unit and remove the freezer cover (8) on top of the freezer. The water distributors (one in each tube) may then be removed with pliers for cleaning. Grasp the top of the distributor gently with pliers, twist, and pull up to remove the distributor. After cleaning, reinstall distributors firmly in each tube.

Water Tank. The production of opaque ice usually indicates that the water in the water tank contains a concentrated amount of solids or salts or the adjustable blowdown is not opened enough. See "Adjustable Blowdown", Section 9.

Remove cover plate. Open drain valve (39). Clean tank thoroughly by flushing out with a hose and scrubbing with a stiff brush. Fill the water tank with fresh water.

When restarting the machine, be sure that the water pump is circulating water. It is possible that air may have collected in the pump impeller housing and the pump may have to be stopped and started several times to expel the air. This procedure can be done by use of "Pump" or "Cutter" circuit breaker switches and "Start" push button.

Drip Pan. If the machine is installed on a bin with a drip pan, it is important to keep the drip pan free of any foreign materials and to keep the drain for this pan open. This drain **must not** run through the ice compartment of the bin.

Water Cooled Condensers. Checking operation. How often condensers need cleaning depends on so many variables that it is impossible to recommend a schedule. Some will seldom need cleaning, other perhaps need cleaning once a year. In rare cases, cleaning is required several times a year.

Proper operation of cooling towers will increase the interval between cleaning considerably. The tower overflow rate should be checked frequently. If a tower is operated with insufficient overflow, nominal 1-1/2 to 3 GPH bleed depending on water quality, the resulting mineral concentration in the water can cause rapid and heavy flooding inside the condenser tubes, requiring excessively frequent cleaning. Also, these conditions often lead to severe corrosion.

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

It is advisable to double check the system to make sure that fouling is actually causing the trouble. High head pressure alone does not mean a fouled condenser. The following possibilities should always be checked before cleaning is undertaken:

1. Non-condensables in system or faulty head pressure gauge? Check standby pressures against refrigerant tables.
2. Incorrectly set or defective water regulator valve? Check its setting and operation.
3. Partly closed compressor discharge service valve? Check its setting. Stem should be backseated.
4. High water temperatures entering condenser? Check tower fan and system.

After the above possibilities have been eliminated, determine the temperature difference between the water leaving the condenser and the refrigerant condensing temperature (saturation temperature, from pressure-temperature chart, corresponding to head pressure). If this difference is more than 10°F, cleaning is indicated because this difference indicates a good heat exchange is not being made. If this difference is less than 8°F, something other than a fouled condenser may be causing the high head pressure. In normal operation, this difference will stay between 5°F and 10°F regardless of water inlet temperature when the water flow is regulated by a pressure operated water valve. If this difference is less than 5°F, restricted water flow or a low supply pressure is indicated. A restriction can occur with foreign matter in the condenser, but it is also likely to be somewhere else in the system.

Draining. Draining of water cooled condensers is recommended in preparation for the winter cold where units may be left exposed to ambients below 32°F. Theoretically, it is easy to drain a condenser. In practice, the problem can be complex.

Despite the fact that a condenser my have vent and drain fittings, the opening of these fittings is not sufficient for a natural gravity flow. Water will be retained in a tube due to (1) surface tension and (2) the normal curvature between tube supports. Our experience shows that as much as 20% of the water in the condenser can be retained. To break the surface tension on the tubes and to drain all tubes completely, it is necessary to remove the back plate and actually tilt the condenser a minimum of 5 degrees. Whether water left in the tubes will cause damage during a freeze-up will be dependent upon how quickly the freeze occurs and the location of the water inside the condenser.

In the field it is recommended that the tubes be blown out individually with air. Alternatively, a minimum of 25% ethylene glycol in the system will also prevent a freeze which can rupture the tubes.

Chemical Cleaning. The Henry Vogt Machine Co. makes no recommendation for any particular chemical preparation. The same chemical may not be effective for all situations.

! CAUTION !
The following directions and precautions should be observed when cleaning is undertaken. The warranty on condensers is void if they are damaged by improper cleaning tools or methods. If harsh chemicals are used, be sure to follow the manufacturer's recommendations regarding safety in handling those solutions.
! CAUTION !

a) Use only preparations from an established, reliable source.
b) Follow directions exactly, particularly regarding amounts to use, and flushing or neutralizing procedure after cleaning.
c) Close the water supply stop valve. Remove the condenser water regulating valve (41).
d) Circulate the solution through the condenser until it is considered clean.
e) Flush the condenser according to directions.
f) Install the water regulating valve and connecting piping.
Open the water supply stop valve and check for leaks.

Mechanical cleaning.

Part I.

a) Close the stop valve in the water supply line.

b) Drain the water from the condenser.

c) Remove water regulating valve (41) and attached piping to the condenser.

d) Remove the cover plate on the side of the frame to expose the condenser end plate.

e) Remove the nuts, water plates, and gaskets from both ends of the condenser. If the gasket does not lift off with the end plate, do not try to pry it off. The seal surface may be damaged, which would cause a water leak. To free a sticking gasket, replace the water plate and tap it on the outside face with a mallet or a block of wood. After a few taps, the gasket will spring free and will then slip off with the water end plate.

f) Gaskets need only be rinsed in running water: rust, scale or dirt will not stick to gasket material. A rag or soft brush is all that is required to remove any foreign matter.

Part II.

The inside of the water end plates and the outer tube sheet surfaces should be cleaned only with clear water and a rag or a soft bristle brush. A worn paint brush is excellent.

These surfaces have been coated with a special material which will give years of protection against corrosion unless damaged. Never use a wire brush or a strong caustic on these surfaces.

Flush condenser tubes clear with air, water, or a piece of rag on a stick or wire. In many cases this is all that is required. If the inside surfaces are smooth, even though discolored, further cleaning is not necessary. It is useless to try and get a bright copper surface on the inside of the tubes. They will discolor almost immediately in service and the condenser has been designed with an adequate reserve for moderate fouling on these surfaces.

If, however, a rough coating remains inside the tubes after flushing and wiping, further cleaning is desirable. The color of this coating varies with water conditions, but roughness indicates cleaning tools should be used.

Any type tool to be considered should be tried first on a piece of copper tubing held in a vise or flare block. Nylon, brass, or copper brushes are recommended. If any flakes of copper appear or if score marks are made inside the tube, the tool should not be used. Never use anything with sharp or rigid edges which could cut into the copper tubing.

A cleaning tool is available from Vogt® through your distributor. Ask for Part #12A-2055B01.

When using a cleaning tool, keep the inside of the tube wet and move the tool slowly from one end to the other while rotating it at a moderate speed. A hand drill brace is recommended. If an electric drill is used, a low speed attachment on a 1/4" size drill is preferred. Larger units are powerful enough to damage a tube, if for any reason, the cleaning tool should stick. After one or two passes in each tube, they should be flushed and inspected. Often this is enough, although some deposits require more. In any case, stop when a few places begin to show a copper color.

After cleaning, wipe all foreign matter from the tube sheets and studs. Reassemble as outlined on gasket installation instructions.

If the gasket seal ridge was damaged and a replacement is not immediately available, water leaks can be stopped by removing the gasket, drying it, and apply a thin film of a non-hardening gasket sealer, such as Permatex #2, around the seal ridge. This film should be no thicker than the height of the ridge itself and about 3/16" wide. Then re-assemble.

If a new gasket is put on later, be sure to remove any grit or particles that stick to the sealer film on the tube sheet. It is not necessary to remove all traces of the sealer before installing a new gasket, as long as no particles that cut into the new gasket remain on the surface.

Air-Cooled Condenser Cleaning. Visual inspection will indicate if dirt is accumulating and clogging the fin face of the condenser. A vacuum cleaner, compressed air, or a brush may be used to remove any accumulation of loose direct from the fin section of the condenser.

For the removal of more severe accumulations of dirt or foreign materials, a detergent-type cleaner can be used. This cleaning agent can be supplied by your local refrigeration supply house. Follow the manufacturer's instructions when using a liquid cleaner.

If fins have been damaged, they should be straightened with the proper fin comb.

Lubrication

Compressor. In starting and charging the unit, the oil sight glass (33) in the crankcase of the compressor should be watched carefully for the first hour to make certain the proper lubrication is being maintained. The oil may become low in the crankcase on an initial start-up if the electrical current has been interrupted to the machine, thus de-energizing the compressor crankcase heater.

Before starting the machine again, the heater should be energized for a time period of at least two hours to evaporate refrigerant that may have condensed in the crankcase during the shutdown period. If level is low after start-up, it should begin to return after a short period of operation.

The oil level should be checked frequently, particularly during the start-up operation, to see that a sufficient amount of oil remains in the crankcase. While it is important to observe the oil splash during operation, the true level can be obtained only when the compressor is stopped. With the compressor idle, the oil level should be at a height of 1/4 to 1/2 of the sight glass but never out of sight above it.

Although the machine was shipped with the oil charge, which was originally added for the test operation, it may be necessary to add some oil when or if new refrigerant is added to the system.

An oil pump should be used to force any oil that may be required into the system. Oil may be added to the compressor of all units through the low pressure test connection adjacent to the high/low pressure switch or through the compressor suction service valve. The compressor suction service valve should be "backseated" to shut off pressure to the gauge port when connecting the oil pump. Air should be purged from the oil pump discharge line by forcing some oil through the line before tightening the charging connection.

For HEC-10, HEC-20 (with Copeland scroll), HEC-30, and HEC-40 use "Dual Inhibited Sunisco 3GS" (Viscosity 150) or equal. **Do not use a synthetic substitute.** For HEC-20 with Carlyle Scroll compressor use Zerol 150 oil.

Cutter Gear Reducer. The oil level for the gear reducer should be checked if there is evidence of a leak. It should be level with the plugged opening in the side of the gear housing. Use Mobile 600W cylinder oil or equal. Change oil once a year.

Preventive Maintenance

For The Manager Who Depends Upon This Machine For Efficient Operation.

"Preventive Maintenance" simply means that you or a delegated employee makes a daily visual check of your Tube-Ice® machine. Here is what to look for and why:

Daily checklist:

1. Is the machine running or is the bin full
2. Bin doors kept closed
3. Thermostat bulb in bracket
4. Ice quality (clarity and uniformity)
5. Does all ice discharge during harvest
6. Cleanliness
7. Unusual noises

Why? When you make these simple observations on a daily basis, you insure the smooth production of ice for your facility. When you are aware of the proper operating conditions and observe them on a daily basis, changes in these conditions can alert you to changes in the operation of the machine which may require maintenance--long before a service situation arises.

"An ounce of prevention is worth a pound of cure!"

Note To Manager or Owner:

The following page is a complete Preventative Maintenance Schedule that should be performed each 90 days. The Preventative Maintenance page may be copied and given to your service person. It should be signed, dated, and returned to you for permanent record.

Preventive Maintenance Program

Model # _____ Serial # _____ Date _____

Customer/Address _____

_____

Mgr. Name _____ Service Tech Name _____

The following service performed and checked:

- ☐ Last maintenance performed (approx. date) ___/___/___
- ☐ Scale condition of water tank & tubes (good - fair - poor)
- ☐ All drains freely draining (water tank, drip pan, ice bin)
- ☐ Water distributors cleaned
- ☐ Ice machine cleaner circulated through system
- ☐ AC condenser clean (if applicable)
- ☐ Voltage at machine (actual reading) L1-L2 _____, L2-L3_____, L1-L3_____
- ☐ Compressor amps (halfway through the freeze cycle) L1_____ L2_____ L3_____
- ☐ Cutter motor amps (cutting ice) _____
- ☐ Water pump amps _____
- ☐ AC condenser motor amps (if applicable) _____
- ☐ Crankcase heater heating
- ☐ Refrigerant leak (okay - high - low)
- ☐ Leak checked system _____ leaks found & repaired
- ☐ Compressor oil level (i.e, 1/4 - 1/2 - 3/4 - low - high)
- ☐ Gear reducer oil (okay - low)
- ☐ PSIG, low pressure switch set @ 20 psi
- ☐ PSIG, high pressure switch set @ 300 psi
- ☐ Bin stat(s) installed and operate properly
- ☐ Make-up water float valve adjusted okay
- ☐ Adjustable blowdown adjusted for clear ice
- ☐ °F suction line superheat at TXV (after at least two minutes into the freeze) _____°F

CYL_____ CRU_____ Suction PSIG at end of freeze

CYL_____/____ CRU____/____ Suction PSIG during harvest (high/low)

_____ PSIG, CPR valve adjustment

CYL_____ CRU_____ Discharge PSIG at end of freeze

_____°F/°C at machine _____ °F/°C outside ambient (at condenser if applicable)

_____ °F/°C make-up water temperature

CYL _____ CRU _____ Freeze cycle time (minutes)

CYL _____ CRU _____ Harvest cycle time (minutes)

CYL _____ CRU _____ First ice out (seconds)

CYL _____ CRU _____ All ice out (seconds)

CYL _____ CRU _____ Pounds of ice per cycle

Capacity check: $\frac{\text{ice \# per cycle}}{\text{total cycle time (min) \_\_\_\_\_}} \times 1440 =$ _____ lbs. (24 hr. capacity)

Remarks:_____

_____

8. Troubleshooting

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

Symptom: Machine won't run. (See Fault Identity, Section 6, TABLE 6-2)

Possible Cause	Possible Remedy
Intermittent power interruptions or power failure. Fault #16	If there is a power failure or a power interruption, the machine will advance to a start-up mode when power is restored. After a two hour period, the machine will restart automatically if there is no other problem. See Fault Identity, Section 6, TABLE 6-2.
A machine fault has occurred and the machine has tried to restart unsuccessfully.	Enter the "Troubleshoot" mode and identify the last occurring fault. See Fault Identity, Section 6, TABLE 6-2.
High/Low safety pressure switch stopped machine. A machine fault #10, #11, #12, or #13 has occurred.	See High/Low Pressure Switch, Section 9, FIGURE 9-2. If the machine stops by low pressure cutout, the switch will reset automatically when the pressure raises to the "cut-in" setting. If it stops by high pressure cutout, the switch will have to be reset manually. Upon tripping, the PLC will initiate the start-up mode for two hours. The machine will restart automatically at the end of two hours if the switch is reset, or the machine can be started immediately by pushing the "Start" button.
Cutter or pump motor overload trips (circuit breaker switches).	See Section 6, FIGURE 6-2, (switch box), reset switch, push "Start" button to restart the machine and check motor amps.
Bin thermostat contacts open.	Adjust or replace bin stat. See Section 9, FIGURE 9-5. Make sure bin stat bulb is in the proper location. See Section 3, FIGURE 3-12.
SVI switch open. (Input X7 light not on)	Make sure all switches are in their proper setting, close switch, and push "Start" button.
Defective PLC.	Check power supply, fuses, and possible loose connections before determining PLC defective. Replace PLC.
Defective contactor, ice switch, selector switch, control circuit fuse, etc.	See Wiring Schematic, Section 6, FIGURE 6-5 and check for open circuit. Refer to Section 6, FIGURES 6-1 and 6-2 for control panel and switch box parts.
A machine fault has occurred.	Enter the "Troubleshoot" mode and identify the last occurring fault. See Fault Identity Section 6, TABLE 6-2.

Symptom: Freeze up due to extended freezing period.

Check for Fault #15, Long Freeze Cycle (see note below)

Possible Cause	Possible Remedy
Freezer pressure switch setting too low.	See Freezer Pressure Switches, Section 9 FIGURE 9-1, and Operating Vitals, Section 11, TABLE 11-2.
Warm condenser water entering water tank (7) through overflow connection (40). WATER COOLED UNITS	Pipe water outlet (24) and drain (25) separately to floor drain. See Section 3, Water Supply and Drains.
Drain valve (39) from water pan open or leaking.	Close valve or repair.
Solenoid valve (18) may be by-passing hot refrigerant gas into freezer (2) during the freeze mode.	Clean or replace solenoid valve. Check manual opening stem which should be at "All In" position. See Solenoid Valve, Section 9, FIGURE 9-13.
Make-up water float valve (12) stuck open or adjusted too high.	Check operation of float valve and replace if necessary. See Float Valve (Make-Up Water), Section 9.
Low refrigerant charge (usually insufficient warm gas for harvesting).	See Refrigerant Charge. Check system for leaks before adding refrigerant, Section 9.
Expansion valve (17) overfeeding.	See Expansion Valve, Section 9.
PLC malfunction	Check PLC power supply and fuses. Also check for loose wire connections. Replace PLC if defective.
A machine Fault #15 has occurred.	Enter the troubleshoot mode and identify the last occurring "fault". See Fault Identity, Section 6, TABLE 6-2.

Symptom: Freeze-up due to ice failing to discharge.

Check for Fault #14 Short Cycle (see note below)

Possible Cause	Possible Remedy
Low condensing pressure during freezing resulting in insufficient heat for thawing.	See Head Pressure, Section 9.
Thawing timer setting too short to allow ice to clear freezer.	Check PLC thaw timer setting. See PLC Thawing Timer, Section 9.
Insufficient heat for thawing due to low refrigerant charge.	See Refrigerant Charge, Section 6.
Non-condensable gases (usually air) in system.	See Non-Condensable Gases, Section 9.
Cutter does not turn.	Check cutter drive for proper operation. See that drive gear is tight on cutter motor shaft. Check circuit breaker. Replace breaker if defective. Check PLC output fuse (FU5). Replace if blown and check operation.
Ice backs up into cutter, jamming it.	If machine discharges into an ice chute, check angle of chute (30° minimum angle for cylinder ice; 45° for crushed ice). Ice may not contact bin thermostat control bulb to stop machine when bin is filled. See Ice Bin Thermostat, Section 9, and Bulb Installation, Section 3, FIGURE 3-12.
Ice fails to discharge from cutter area properly.	Ice mushy due to concentration of solids in water pan. Drain and clean water tank. Check "blowdown" during thawing. See Float Valve (make-up water), Section 9.
Inadequate flow of refrigerant through thawing chamber (16) to provide sufficient heat to prevent ice freezing at lower freezer tube head.	Irregular operation of expansion valve (liquid line should stay frosted on outlet side during freezing). Check expansion valve bulb and re-insulate if necessary. Check for restriction in liquid line at drier (46) or solenoid valve (20).
Broken cutter disc or drive pin.	Replace disc or pin.
CPR valve pressure set too low.	Adjust valve, see Section 9, FIGURE 9-14 and TABLE 9-2.
A machine Fault #14 has occurred.	Enter the troubleshoot mode and identify the last occurring fault. See Fault Identity, Section 6, TABLE 6-2.

Symptom: Low ice capacity.

Possible Cause	Possible Remedy
Low refrigerant charge in freezer.	Add refrigerant and check for leaks.
Restriction in liquid line.	Check for obstruction at filter drier (46), strainer (43), solenoid valve (20) or TXV (17). The liquid line will normally have frost on the downstream side of a severe restriction.
Solenoid valve (18) may be leaking warm refrigerant gas into freezer (2) during the freezing period.	Repair or replace solenoid valve. Check manual opening stem which should be at "All-In" position. See Solenoid Valve, FIGURE 9-13.
Water distributors at top of freezer may be stopped up.	See Water Distributors, Section 7 & 9.
Make-up water float valve (12) provides inadequate quantity of water for ice making.	See Float Valve (make-up water), Section 9. Check water pressure at machine (30 psig minimum recommended).
Warm make-up water for ice making.	Capacity of machine is proportional to ice making water temperature. Warmer water will reduce the ice making capacity. See Ice Capacity Table, Section 11, TABLE 11-1.
Make-up water float valve (12) stuck open.	See Float Valve (make-up water), Section 9.
Water tank drain valve (39) open or leaking.	Close valve.
Warm condenser water entering water tank (7) through overflow connection (40).	Pipe water outlet (24) and drain (25) separately to floor drain. See Water Supply and Drain, Section 3.
Controls for regulating freezing and thawing cycles improperly set.	See Freezer Pressure Switch and Thawing Timer, Section 9, FIGURE 9-1, and 9-6.
Excessive head pressure.	See Head Pressure, Section 9.
Extended thawing period.	Check setting of thawing timer. See Thawing Timer, Section 9, FIGURE 9-6.
Expansion valve not operating properly.	Check setting of expansion valve (17). See Expansion Valve, Section 9. Also check for restriction in liquid line at expansion valve, drier (46) or solenoid valve (20).
Intermittent power interruptions or power failure.	If there is a power failure or a power interruption, the machine will advance to a start-up mode when power is restored. After a two hour period, the machine will restart automatically if there is no other problem. See Fault Identity, Section 6, TABLE 6-2.
A machine fault has occurred and the machine has tried to restart unsuccessfully.	Enter the "Troubleshoot" mode and identify the last occurring fault. See Fault Identity, Section 6, TABLE 6-2.

Symptom: Safety pressure switches stop machine.

Possible Cause	Possible Remedy
Low pressure switch opens.	Compressor suction service valve (34) may be either closed or partially closed. Open valve wide. Check switch for improper setting (too high opening pressure). See Section 9, FIGURE 9-2.
High pressure switch opens.	Compressor discharge service valve (35) closed or partially closed. Open valve wide. Check cleanliness of condenser. Check water supply to condenser. See Head Pressure, Section 9.
A machine fault #10, 11, 12, or 13 has occurred.	Enter the troubleshoot mode and identify the last occurring fault. See Fault Identity, Section 6. Check High/Low Pressure Switch, Section 9, FIGURE 9-2 for improper setting (too low opening pressure). See Head Pressure, Section 9. "X" (discharge line) solenoid valve not opening (air-cooled units only). If the machine stops by low pressure cut-out, the switch will reset automatically when the pressure raises to the "cut-in" setting. If it stops by high pressure cut-out, the switch will have to be manually reset. After the switch is reset (low pressure or high pressure), the PLC will initiate the start-up mode for a two hour "time delayed" automatic restart or the machine can be started immediately by pushing the "Start" button.

Symptom: Motor overload protectors stop machine.

Possible Cause	Possible Remedy
Compressor motor overload (CD-OL) stops machines. NOTE: Overloads are automatic-reset type, located in junction box of compressor, Models HEC-30 & HEC-40 only.	Motor overloaded due to excessive condensing pressure or combination of high heat pressure and low/high voltage check power supply, see Head Pressure, Section 9. Motor overload due to a high suction pressure, warm water in water pan and warm inlet water to condenser during start-up after a prolonged shutdown period. Machine should operate satisfactorily after temperature of water in water pan is reduced sufficiently so that the suction pressure is less than 60 psig. Check items under "Freeze-up due to extended freezing period." Compressor binding, or stuck--repair or replace compressor. Check fuses in disconnect switch. One fuse may be burnt out resulting in single phasing compressor motor.
Compressor internal temperature thermal switch (CD-TS) stops machine. HEC-30 & HEC-40 will reset automatically after the motor has cooled sufficiently. The machine can be manually restarted by pushing the "Start" button or it will restart automatically after two hours.	Excessive temperature may be caused by gas leakage between suction and discharge valves of compressor valve plate. Check for broken valve plate gaskets or valves. High freezer superheat or high discharge rpessure can cause excessive heat.
HEC-10 and HEC-20 have built-in motor overload and thermal protection with automatic reset. If compressor shuts off, machine will continue to run and eventually shut-off on long freeze cycle, fault #15.	See motor overload and internal temperature thermal switch above for possible remedy.
Cutter motor circuit breaker or pump motor circuit breaker stops machines.	Crushed ice too thick, overloading cutter motor. Check setting of freezer pressure switch. See Freezer Pressure Switches, FIGURE 9-1, Section 9. Crushed ice mush, fails to discharge properly, overloading cutter motor. See Float Valve, Section 9. Cutter bearing worn in cutter hub, overload cutter motor. Replace bearing, if defective. Gear reducer worn or binding, overloading cutter motor--install gear reducer, if necessary. Pump fails to rotate due to mineral build up or foreign materials in impeller housing--dismantle and clean pump. See Switch Box, Section 6, FIGURE 6-12. Reset switch, push "Start" button to restart the machine, and check motor amps.

Symptom: Motor overload protectors stop machine. (Cont.)

One of the 2.5 amp fuses in the switch box stops machine.	Check compressor crankcase heater, coil of fan contactor and PLC for a ground. Repair or replace defective part. Replace fuse. Make sure the compressor crankcase heater is energized for at least two hours and there is no liquid refrigerant in the crankcase prior to running the machine.
A machine fault #16 has occurred. NOTE: If cutter motor circuit breaker, pump motor circuit breaker, compressor motor overload, or thermal protection shuts the machine off (HEC-30 and HEC-40 only), the PLC will lose power and a power failure, fault #16, will be indicated.	Enter the troubleshoot mode and identify the last occurring fault. See Fault Identity, Section 6.

9. Service Operations

Adjustable Blowdown (for clearer ice). A petcock is installed on the overflow from water pump to provide means for obtaining blowdown from the water tank during the freezing period. This supplements the blowdown that is discharged during the thawing period through the bypass piping connected to the drain of the water tank. (See "Automatic Blowdown" below).

The petcock was set at the factory to discharge enough water during the freeze cycle to produce clear ice. After installation it should be adjusted to the minimum rate required to maintain production of clear ice and checked after a few days of ice making.

Automatic Blowdown (harvest cycle). A patented feature of this machine is the automatic blowdown (40) which is provided to eliminate or reduce the necessity for frequent flushing or cleaning of the water tank (7) to remove accumulated salts or solids in the water as a result of the freezing action.

A principle feature of the blowdown arrangement is a drain by-pass effect which is initiated during each thawing period when the water pump is stopped and the water in the freezer tubes returns to the water tank thereby raising the water level higher than the by-pass piping (40) and causing a portion of the water to drain from the bottom of the tank (approximately 1 gal/cycle).

The water level, controlled by the float valve (12), regulates the quantity of blowdown during the thawing period. An optional solenoid valve can be furnished in place of the drain valve to permit additional if required.

Float Valve (make-up water). The make-up 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 by-pass or blowdown only during the thaw mode. The water level during the freeze mode should always be below the by-pass 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.

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.

Expansion Valve. The expansion valve was adjusted before shipment and it is rarely necessary to change this setting.

If considerably less ice than shown in TABLE 11-1 is being produced per discharge, check the water supply, circulating water pump, water distributors, liquid line valves, refrigerant level, freezer pressure switch and all other avenues BEFORE changing the factory setting of the expansion valve.

TXV Adjustment By Superheat. Superheat is the difference between the refrigerant vapor temperature and its saturation temperature. (Translate the pressure reading to saturated temperature and subtract it from the actual temperature reading.)

Follow this procedure:

1. Attach an accurate pressure gage to the low pressure test connection.

2. Using a digital thermometer, attach the thermocouple to the suction line directly below and in-line with the existing TXV sensing bulb.

3. Hold the thermocouple in place with tape and insulation to assure good contact and a true reading.

4. Set the selector switch to make crushed ice.

5. Operate the machine and monitor the superheat during the freeze cycle after the first four minutes and at two minute intervals for at least two cycles. Refer to the chart below for recommended superheat ranges.

6. Adjust the valve only 1/4 turn at a time. Close (turn stem in) to raise superheat. Open (turn stem out) to lower superheat. Monitor at least two cycles after each adjustment before adjust further.

Model	Minimum	Target	Maximum
HEC-10	7	8	10
HEC-20	5	6	8
HEC-30	7	8	10
HEC-40	8	10	11

TABLE 9-1
Recommended Superheat Range

If the valve cannot be adjusted satisfactorily, check the bulb insulation as follows:

1. Remove the insulation from the sensing bulb.

2. Loosen the bulb clamps and remove the bulb.

3. Clean and polish the sensing bulb and suction line to assure maximum contact between them.

4. Install the bulb in the same place tightening the clamps securely.

5. Replace the insulation around the bulb making sure it is well sealed. Repeat the adjustment procedure and if you are still unable to accomplish the proper superheat setting, the valve must be replaced.

When installing a new valve, be sure to use the proper soldering techniques to prevent overheating the valve body which could damage the superheat spring and result in flood back problems.

When soldering:

1. Wrap a wet cloth around the valve body and element.

2. Direct the flame away from the valve body.

3. Apply only enough heat to flow the alloy material into all the joint areas. Do not overheat.

4. After the brazing alloy has set, quench or apply a wet brush or swab to remove the flux residue. Use Emery cloth or a wire brush if necessary.

Freezer Pressure Switches. The freezing time period for the production of crushed ice is controlled by the freezer pressure switch (FPS1) located inside the control panel. The freezing time period for cylinder ice is controlled likewise by the second switch (FPS2).

These switches were set at the factory to produce ice of recommended thickness. Look at the "Certificate of Test" which was provided with the machine for a sample set of pressure readings with corresponding time periods and water temperatures. Also see TABLE 11-2 for typical settings. Do not make adjustments until several ice discharging cycles have been made.

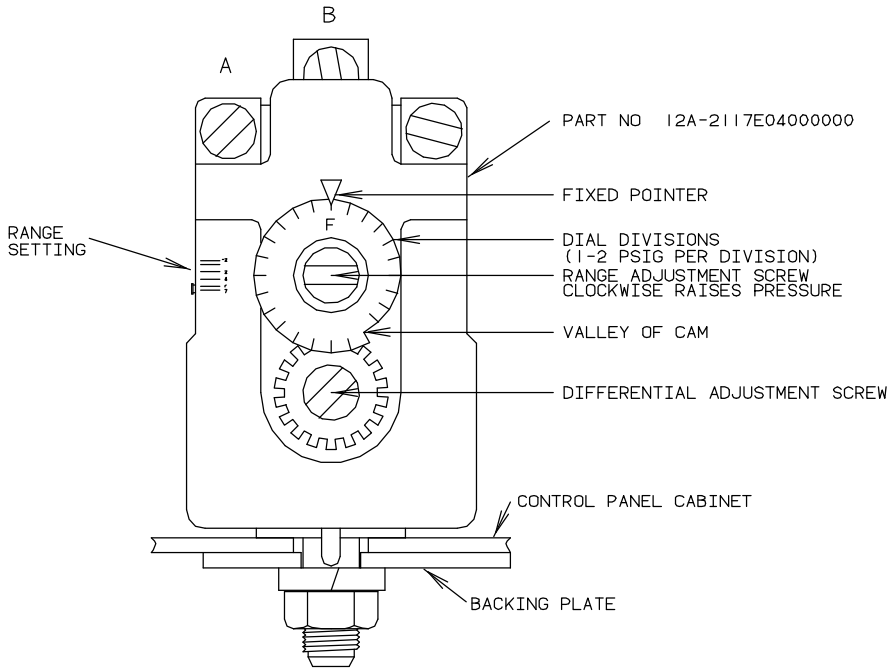


FIGURE 9-1
(Allen Bradley)

Allen Bradley Switch. The following procedure is recommended for initially setting an AB pressure switch which has **not** been previously adjusted:

1. Turn the bottom screw (differential) approximately 1/2 turn to the left (counter clockwise). The pointer arrow, which is at the top middle of the switch, will be at the "F" setting. See FIGURE 9-1.

2. Turn the top screw (range adjustment) approximately 4 1/2 turns to the left (counter clockwise). The pointer on the range setting will be between 40 psi and 50 psi. See FIGURE 9-1.

3. After the machine is running, the range adjustment (top screw) will have to be fine tuned to get the proper ice thickness. (Clockwise = Thinner Ice) (Counter Clockwise = Thicker Ice)

The freezing time can be such that a small percentage of the ice is frozen solid. If so, some ice from the top and bottom of the freezer should have a small hole in the center to insure that the freezing time has not been extended to where a loss in capacity would result.

It is preferable that the freezing cycle be such that a small diameter hole remain in the center of the ice cylinder. (1/16" diameter for 7/8" diameter ice, and 1/8" diameter for 1 1/8" diameter ice.) This insures that the freezing cycle is not extended unnecessarily and eliminates a possible opaque core in the center of the ice.

When crushed ice is produced, the freezer pressure switch (FPS1) (FIGURES 6-1 & 9-1) should be set to produce ice having a wall thickness of approximately 3/16".

Note: While making crushed ice, if machine harvests after running a five minute freeze cycle, the crushed ice pressure switch (FPS1) is set too high. Lower pressure setting by turning the range adjustment (top screw) counter clockwise.

High-Low Pressure Switch. The high-low pressure switch (4PS) (FIGURES 1-2A, 1-3A, & 9-2) is a two pole dual function switch. Located in the machine outside the control panel, it protects the machine from possible damage due to abnormal pressure during operation.

! CAUTION !
When this switch causes the machine to stop, the cause should be identified and corrected before resuming normal operation. See Fault Identity, Section 6, Table 6-2.
! CAUTION !

The **LOW** pressure cut-in should be set at 40 psig and the cut-out set at 20 psig. After tripping at the cut-out setting, the switch will reset automatically when the pressure rises to the cut-in setting.

The **HIGH** pressure cut-out should be set at 300 psig. After tripping, reset the switch manually.

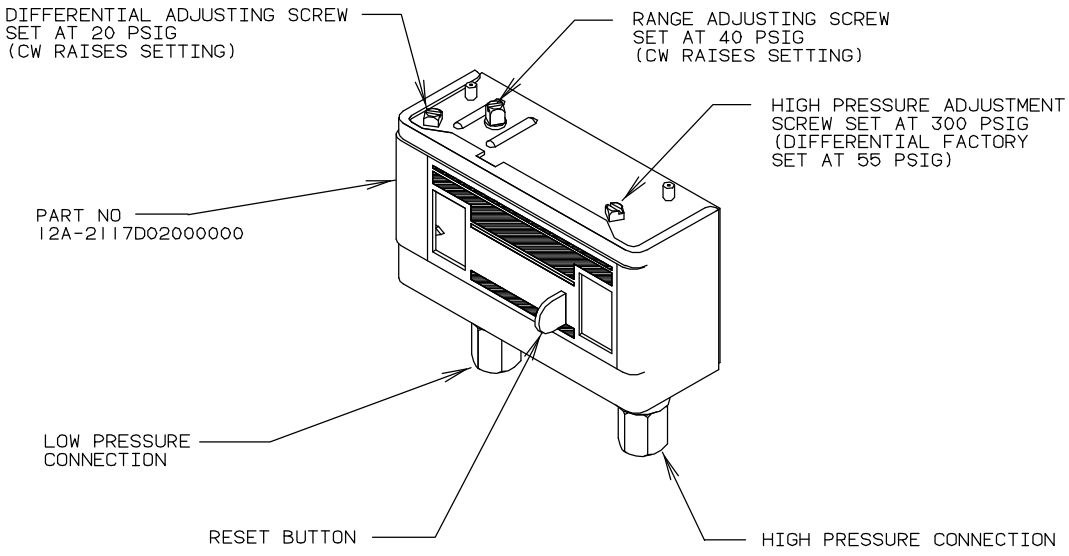


FIGURE 9-2
High-Low Pressure Switch

NOTE: High-low pressure switch contains both high and low voltage circuits. Line numbers 22 and X6 supply a low voltage signal to the PLC. Line numbers 15 and 30 supply power to the compressor contactor coil.

If it becomes necessary to install a new high/low pressure switch, the following procedure is recommended for its adjustment:

Turn the adjusting screws clockwise to raise the pressure setting. Turn counter-clockwise to lower the setting. Adjust the switch to the indicated pressure settings and test with an accurate gage to be sure the switch functions properly before installation.

Head Pressure. The head pressure should be maintained at 190-210 psig during the freeze cycle. This pressure can be checked at the test connection in the high pressure line near the high-low pressure switch.

Air-Cooled Units. The condenser fan switch (FIGURES 1-2A & 9-4) (CPS) is used to regulate the head pressure. This is an adjustable pressure switch located on the right-hand front of machine. It controls the operation of the condenser fan motor(s) through a contactor (FC) located in the control panel. The switch is set to cycle the fan motor(s) “On” at 210 psig and “Off” at 190 psig.

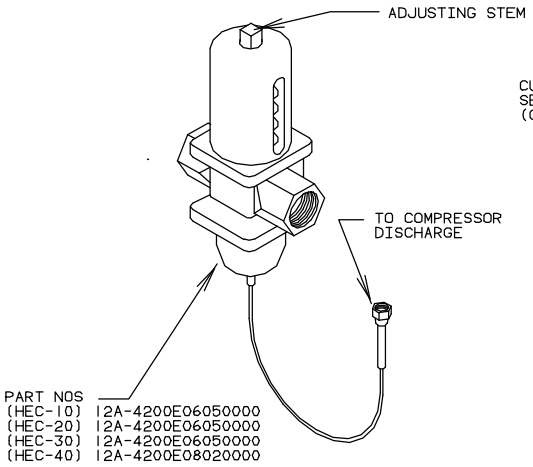


FIGURE 9-3. Water Regulating Valve.

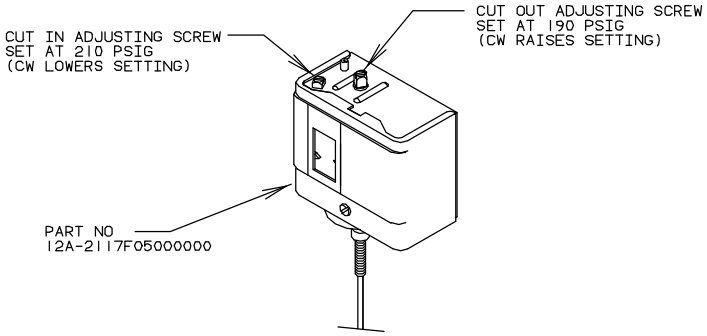


FIGURE 9-4. Condenser Fan Switch.

Water-Cooled Units. A water regulating valve (FIGURES 1-3B & 9-3) located in the condenser water inlet line is used to control the water flow through the condenser. This valve should be adjusted to maintain a head pressure of 190-210 psig. Increasing the water flow lowers the head pressure and decreasing the water flow raises the head pressure. The valve is adjusted during the factory test.

Compressor Crankcase Heater. When electrical power is supplied to terminals L1, L2 & L3 of the control panel, the crankcase heater is energized when the machine is not operating.

PLC Fuses. Six PLC output fuses located in the control panel provide the PLC with short circuit protection. If any of the 2 amp (PLC output) fuses FU0-FU5 are blown, they must be replaced for that component to function. Fuse Part #12A-7504E23000000.

! CAUTION !
In case of a power interruption or outage, be sure the compressor crankcase is warm and there is no liquid refrigerant in the crankcase prior to restarting the machine manually (except for Scroll compressor)
! CAUTION !

Two control circuit fuses (FU100 and FU200) located in the switch box (FIGURE 6-2) protects the compressor crankcase heater as well as the control circuit.

If either of these two fuses “blow” for any reason, they must be replaced before the crankcase heater is energized and the machine will operate. Fuse Part #12A-7504E10000000.

Ice Bin Thermostat(s) Adjustments. The ice bin thermostats (FIGURES 6-1 & 9-5) are set prior to shipment. However, a MINOR adjustment may be necessary after installation due to local conditions. The following procedure should be followed for initially setting or maintaining adjustments to the ice bin thermostat.

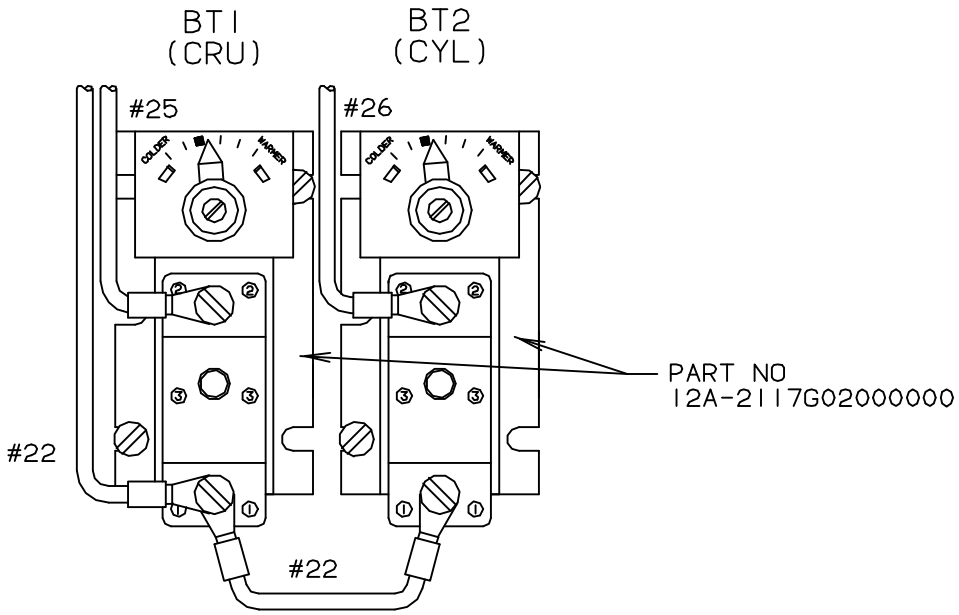


FIGURE 9-5
Ice Bin Thermostat (Dual Ice Type)

1. Cover bulb with ice. Use a continuity tester to see if the contacts are open. It should take approximately 10-15 seconds for the contacts to open.

2. Remove bulb from ice. Check the time it takes for the contacts to close. It should take a minimum of 3 minutes (4 to 5 minutes preferred) for the contacts to close when the bulb hangs free in a bin approximately 1/2 full of ice with the bin doors closed.

3. Turning the adjustment screw clockwise raises the setting. This adjustment makes the contacts open quicker at a higher temperature.

4. Turn the adjustment screw counter-clockwise lowers the setting. This adjustment makes the contacts open slower at a lower temperature.

5. Make sure the bulb is mounted firmly in the bin bracket after adjustment.

6. Form a “drip loop” in capillary tubing to thermostat bulb. See FIGURE 3-12, Thermostat Bulb Installation.

If it becomes necessary to install a new bin thermostat, the above procedure should be followed for making the adjustment.

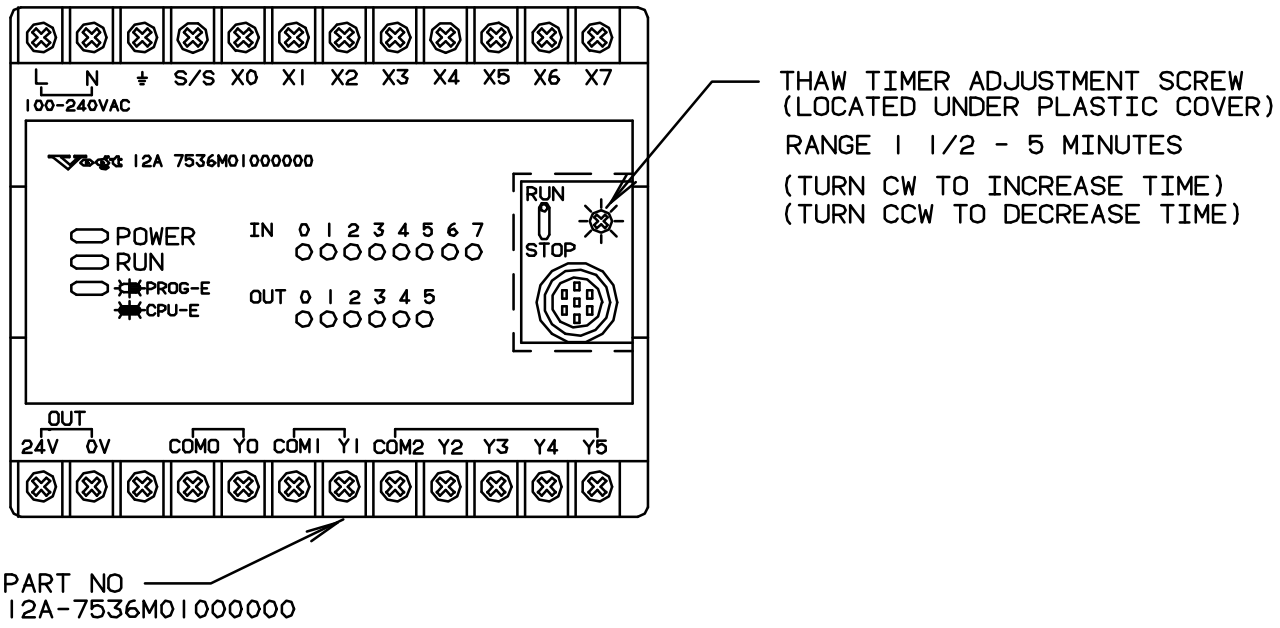


FIGURE 9-6
Thawing Timer. (Part of PLC)

Thawing Timer. The thawing timer governs the ice thawing period. It is built into the PLC located inside the control panel. It is started by action of one of the freezer pressure switches (FPS1 or FPS2) or the manual harvest button. This timer is set prior to shipment for approximately a 90 second period.

Set the thawing period for at least 20 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 screw clockwise to increase the time or counter-clockwise to decrease the time. Check thaw time after each adjustment FIGURES 6-1 & 9-6.

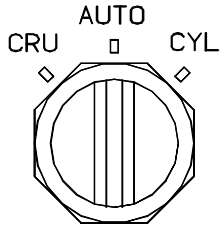


FIGURE 9-7
Ice Selector Switch (Dual Ice Type Only)

Ice Selector Switch. A 3-position rotary-type switch marked “Cru-Auto-Cyl” is located in the switch box (FIGURE 6-2). Set this switch on “Auto” to produce and store both cylinder and crushed ice in a divided bin with two thermostats. To continuously produce either type of ice, set switch to “Cru” for crushed ice only or to “Cyl” for cylinder ice only.

Control Circuit Protection. The electrical control circuit of the machine is protected by two 2.5 amp fuses (FU100 & FU200). If either of these fuses should blow, the machine will immediately stop. Before replacing a fuse, open the disconnect switch to machine and set the "Ice" push button to the "Off" position. If the machine was off for an extended time, the crankcase heater must be energized for a minimum of two hours before restarting the machine. Make sure there is no liquid refrigerant in the compressor crankcase before attempting to restart the machine. When ready to restart the machine, depress the "Ice" button, then the "Start" button. Allow the machine to operate for approximately two minutes and then depress the "Manual Harvest" button to clear the freezer of any ice. The machine will automatically return to a freeze cycle upon completion of the harvest cycle.

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

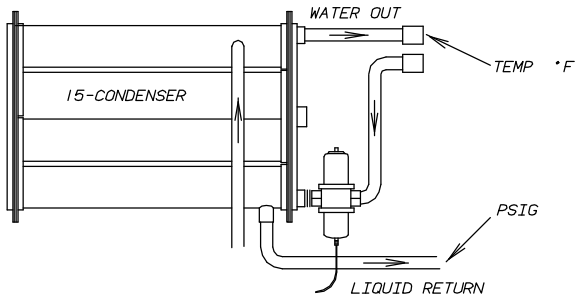
The pump is equipped with a mechanical seal which is self-addressing and requires no lubrication. However, the pump should not be operated unless circulating water. The pump manufacturer recommends that a mechanical seal be kept as a spare. When ordering a seal, specify pump size, type, serial number, and manufacturer's name as indicated on the nameplate.

Condenser Cleaning. See Maintenance, Section 7, "Water Cooled Condensers".

WC Condenser Service. High head pressure due to fouled condenser.

Eliminate other possible causes:

- Non-condensables
- Faulty gauge
- Refrigerant restriction
- Water regulating valve
- High inlet water temperature
- Insufficient water supply



Example
Liquid return (RCVR) Psig = 200 = 102°F (SAT)
Water outlet temperature = 95°F
Difference = 7°F

If difference is more than 10°F, cleaning is indicated. For cleaning procedure see, "Water Cooled Condenser Cleaning", Section 7.

Air-Cooled Condenser. Visual inspection will indicate if dirt is accumulating and clogging the fin face of the condenser. A vacuum cleaner, compressor air or a brush may be used to remove an accumulation of dirt from the fin section of the condenser. See Section 7.

Cutter Gear Reducer. The oil level for the gear reducer should be checked if there is evidence of a leak. It should be level with the plugged opening in the side of the gear housing. Use Mobile 600W cylinder oil or equal. Change oil once a year.

The motor bearings are prelubricated and require no further lubrication. For additional information, refer to manufacturer's instructions.

Gear Reducer Replacement.

1. Stop the machine and lockout its power.

2. Remove four cap screws holding the motor to the reducer housing.

3. Separate the motor from the reducer by pulling the motor and shaft out of the reducer sleeve. Be sure to catch and save shaft key for later reassembly.

4. Remove bolts holding gear box mounting plate to the drive gear enclosure and lift out gear reducer and plate assembly.

5. Remove drive gear from the reducer output shaft. Two 1/4"-20 x 1 1/2" long (all thread) bolts can be used for jacking screws in the two threaded holes of the drive gear.

6. Remove the split hub (bushing) from the reducer shaft and remove the gear reducer from the mounting plate.

7. Reassemble in the reverse order.

8. After assembly of the drive gear on the gear reducer, set the assembly in place in the enclosure, and check vertical alignment of the drive gear and cutter ring gear. Turn the gears by hand a full turn to make sure they engage the full width of the teeth. Adjust the hub accordingly.

9. Adjust the horizontal engagement of the gear teeth by the four bolts holding the reducer to the mounting. There should be only a slight amount of tooth clearance at the closest engagement spot.

10. After complete assembly, test operation and check for unusual noise and normal motor amperage.

Cutter Bearing. The cutter bearing is of the sleeve type and is made of UHMW plastic requiring no lubrication. If necessary to replace this bearing, follow instructions under heading "Cutter and Gear Drive".

Cutter and Gear Drive. To remove the ice cutter (21), when and if necessary, proceed as follows:

1. Turn machine off.

2. Close the stop valve in the make-up water line to water pan.

3. Drain the tank, disconnect the make-up water line and drain line from the water tank.

4. Separate motor from the cutter drive reducer by removing four cap screws. Watch for shaft key when separating unit which must be installed in motor keyway when unit is reassembled. It is not necessary to remove the reducer from its mounting plate on the water pan.

5. Remove the water pump which is attached to the side of the tank by four bolts and nuts.

6. Remove ice discharge chute which is attached to the water tank by four hex nuts.

7. Remove the water tank assembly which contains the cutter by removing four bolts and nuts from around the top edge of the tank.

Assembly may then be taken to a work bench for removal of cutter.

To remove the cutter from the water tank assembly, perform the following:

1. Remove the ice deflector by removing the hinge pin at the hub end.

2. Remove the cutter disc assembly which is held onto the shaft by a roll pin. The cutter can now be removed.

3. Remove the cutter bearing bracket which is held in place by three 1/4" cap screws holding cutter support to side of the water tank.

If the bearing requires replacement, perform the following:

1. Remove the worn bearing by driving the 3/16" lock pin located in the side of bronze hub through the bearing wall with a 3/16" punch. Drive or press the bearing from hub.

2. The new bearing may be driven into hub using old bearing as a driver.

3. When bearing is fully seated, drill a 3/16" hole through bearing wall using original hole in hub as a pilot.

4. Lock new bearing in place with 3/16" lock pin. Insert the pin flush with outside of hub, check that pin does not extend beyond inner surface of the bearing.

The parts should be reassembled reversing the procedure described for removal.

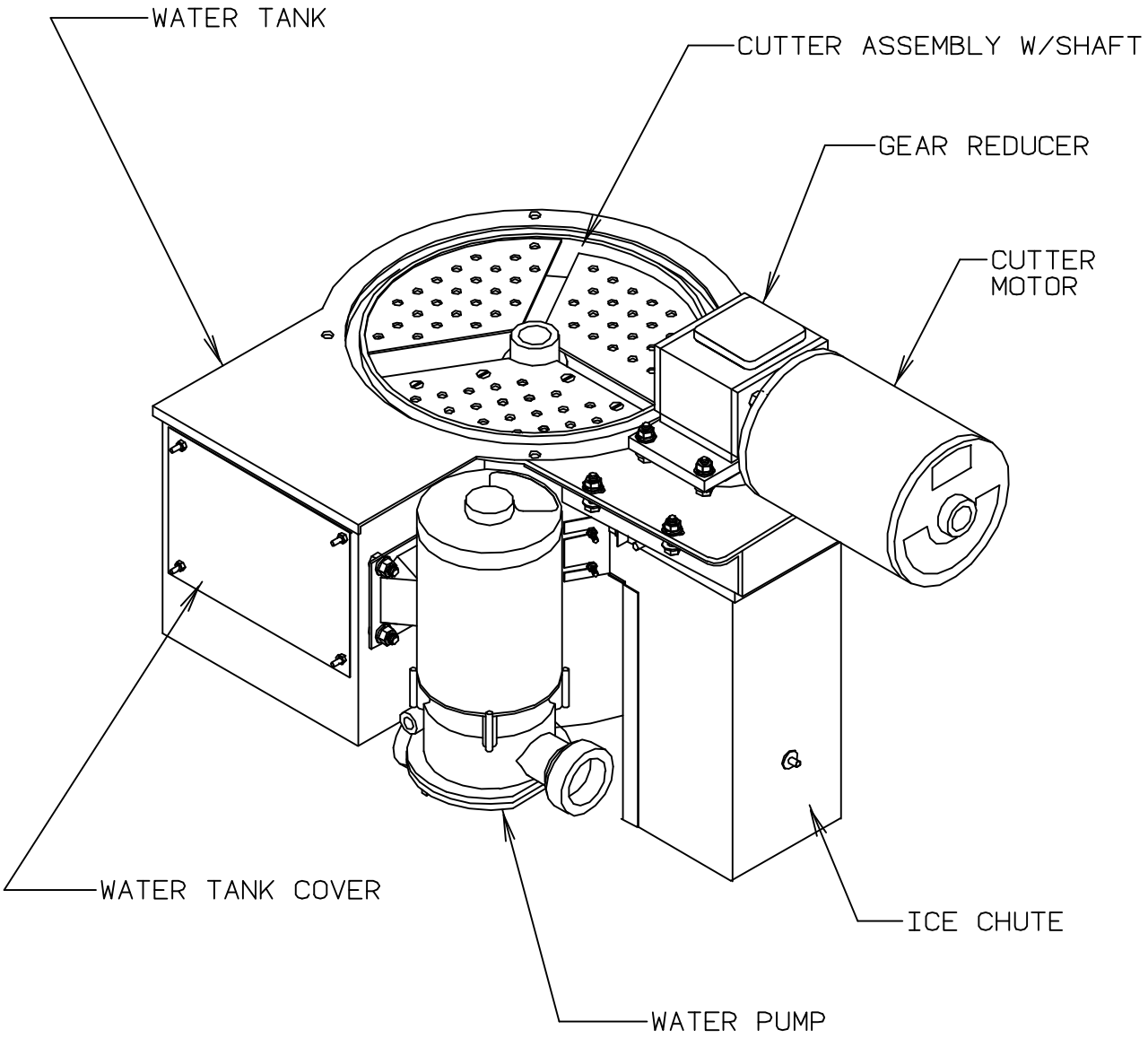


FIGURE 9-8
Cutter/Water Tank Assembly With Water Pump and Cutter Motor

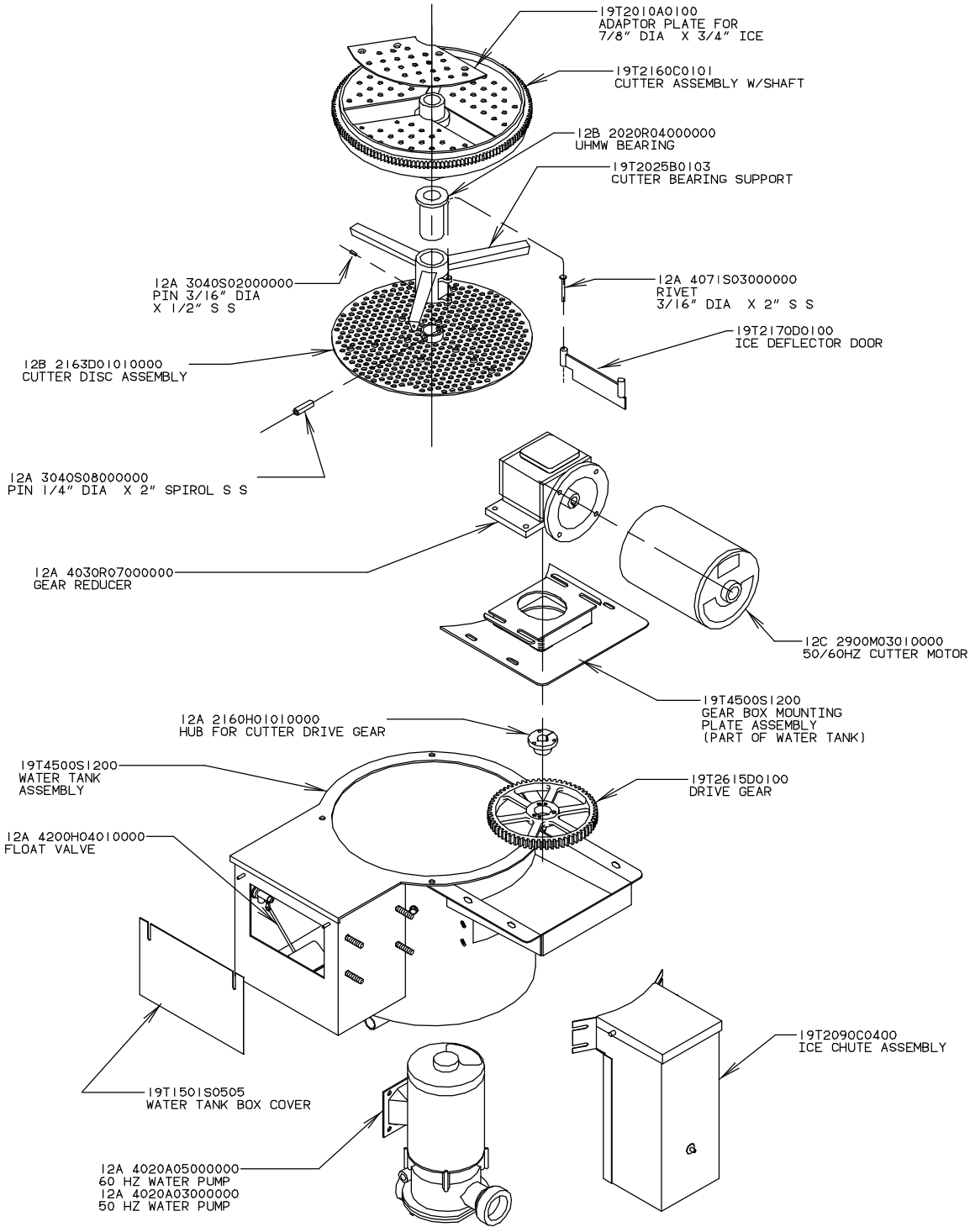


FIGURE 9-9
Cutter/Water Tank Parts

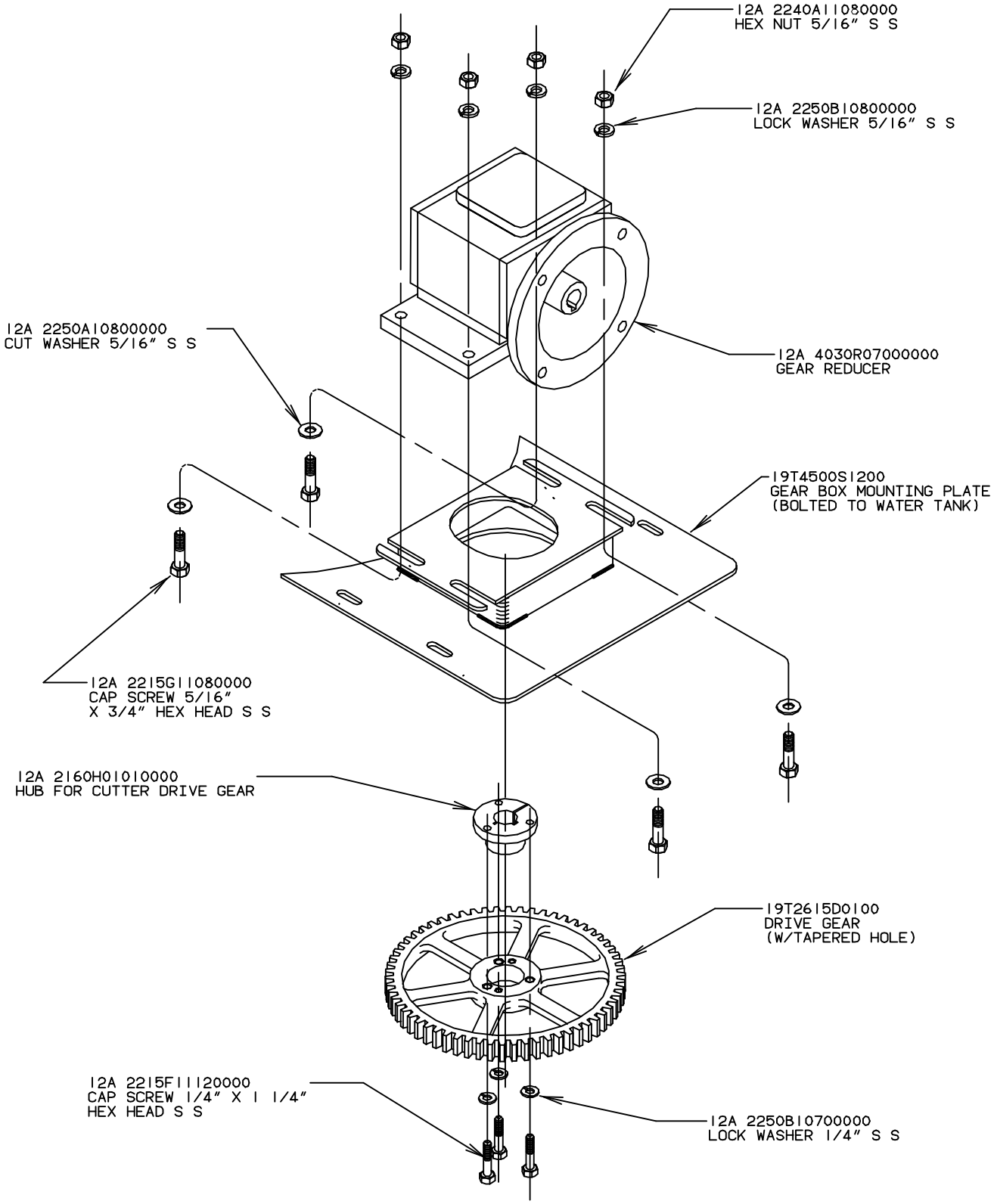


FIGURE 9-10
Cutter Drive Parts

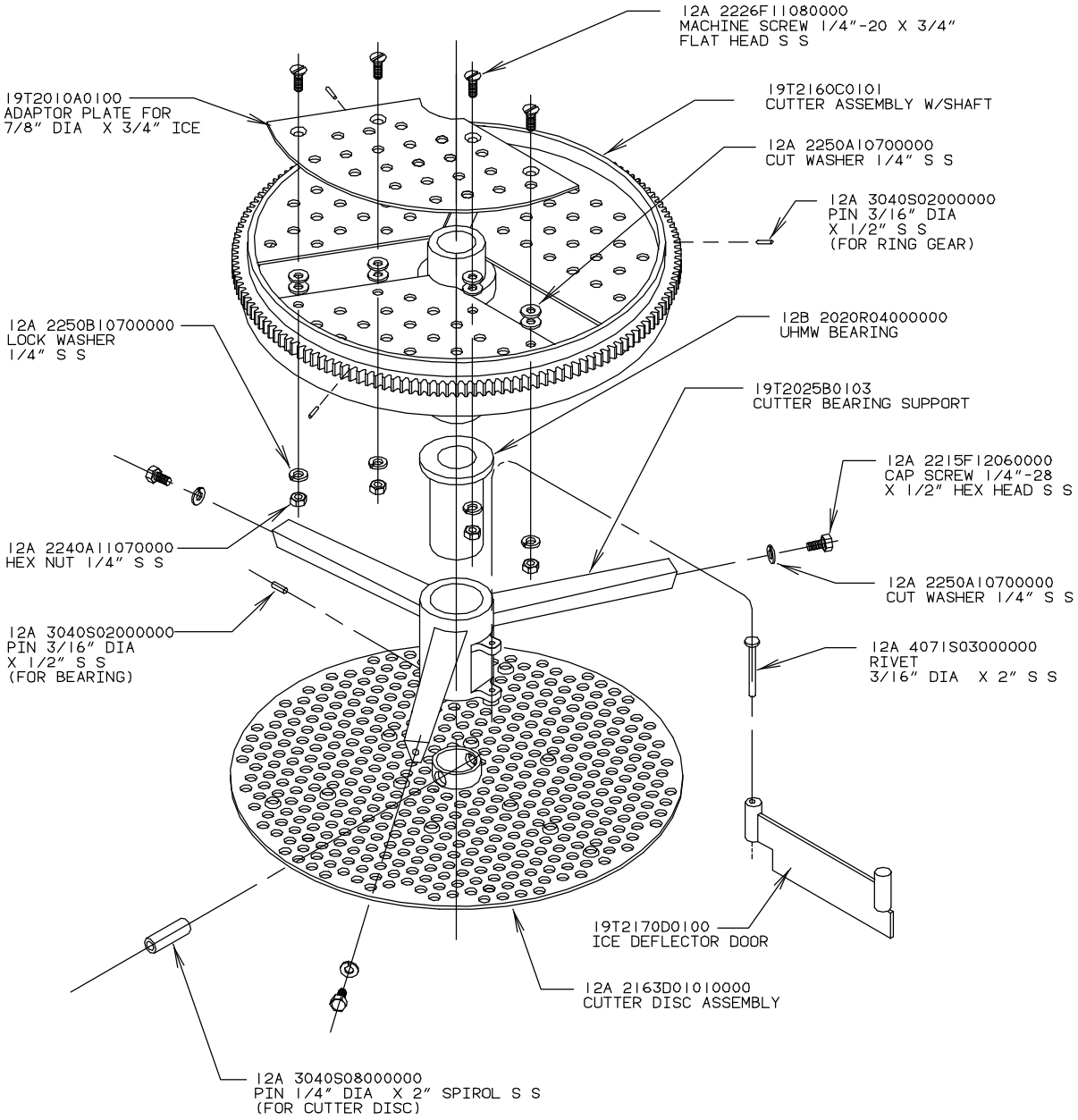
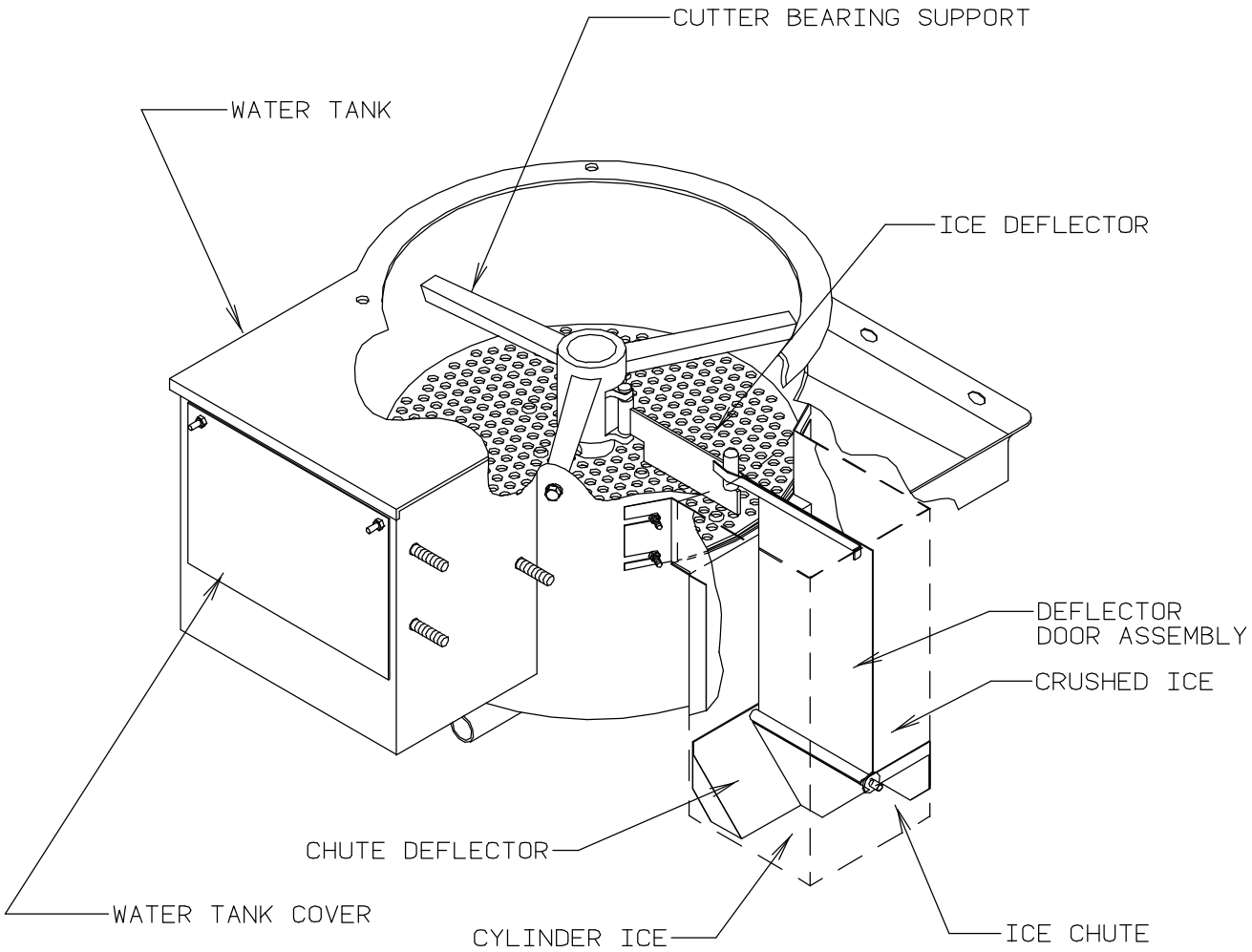


FIGURE 9-11
Cutter Parts



NOTE: Deflector door assembly and chute deflector may be removed if there is no divider in the bin, see "How Ice Is Stored", Section 4.

FIGURE 9-12
Ice Discharge Arrangement

Pumping Down Freezer. If it should become necessary to pump the refrigerant out of the freezer, sufficient vapor should be retained to hold one pound of pressure in the freezer so that air will not enter if the system is opened.

A total pumpdown is the first phase of the clean mode. Refer to Section 6, Total Pumpdown Mode to perform this function. After the pumpdown is accomplished, push the "Clean" button to "Off" to stop the water pump.

Note: After completing the total pumpdown cycle, the liquid line will remain full of liquid refrigerant from the receiver "king" valve (58) to the liquid feed "A" solenoid valve (20).

If it becomes necessary to open freezer to the atmosphere, you will need to remove the remaining refrigerant by using an approved refrigerant recovery unit. Isolate that part of the system by closing the necessary hand stop valves at the receiver, condenser, compressor, etc. before using the recovery unit and opening the system.

Pumping Down Entire System. If it should become necessary to pumpdown the entire system, including the liquid line, the following should be performed. Manually open the liquid feed "A" solenoid valve (20) by backing the stem out. Close liquid outlet "king" valve (58) on the receiver (15R). Put machine into total pumpdown as described above.

Removal Of Refrigerant From The Machine. To transfer the refrigerant charge from the machine into a separate container, proceed as instructed above under pumping down freezer. This will isolate most of the refrigerant in the receiver and the recovery unit can be connected to the access port (44) of the liquid outlet "king" valve (58) at the bottom of the receiver. Open the valve access port by turning the valve stem in (front seat) and operate the recovery unit until the system is considered empty.

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

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

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

Refrigerant Leaks. In addition to testing the machine for leaks as instructed under "Refrigerant Charge", it is advisable to again make a leak test after the unit has been in operation approximately one week. Any noticeable change in operating conditions, other than shown on the "Certificate of Test" may indicate a loss of refrigerant due to a leak. Always remove the refrigerant pressure from the vessel or tubing before repairs are attempted.

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

Compressor Motor Burnout. There are several causes of compressor motor burnout. Some of these are described below.

1. Low Line Voltage. A compressor motor is designed to operate within the range of plus or minus 10% of its nameplate voltage. Low voltage or excessively high voltage requires the motor windings to carry more current at the same compressor load. When this current gets too high or is applied for an extended period, the motor windings overheat, resulting in a failure or burnout.

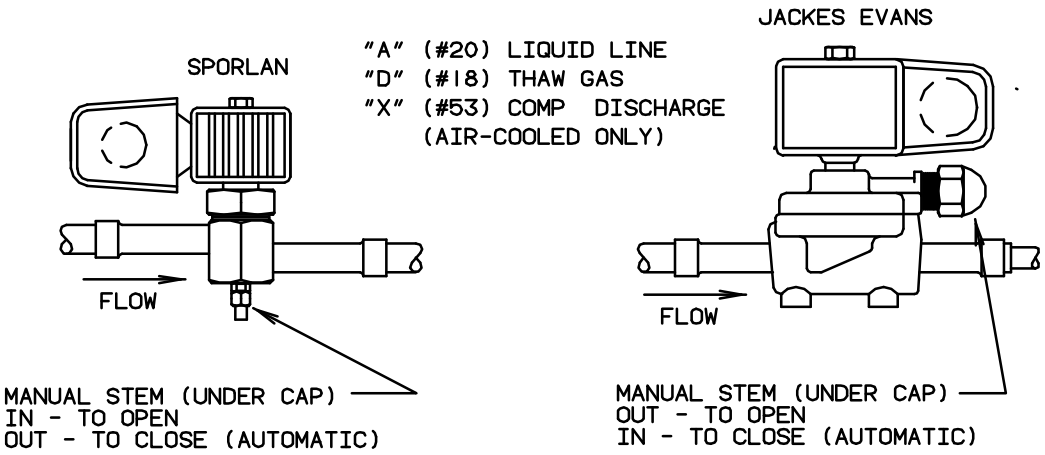
2. Loss of Refrigerant. The hermetic compressor motor is maintained at proper operating temperature by passing cool suction gas over the motor windings. A loss of refrigerant can cause the winding to overheat resulting in a failure or burnout.

3. High Head Pressure. The system is designed to operate at 200 psig. Excessive head pressure adds refrigerating load on the compressor which can cause the windings to overheat and result in a failure or burnout.

4. Moisture. Moisture in contact with refrigerant oil and the presence of heat will form hydrochloric or hydrofluoric acid. The acid will destroy the insulation on the motor winding causing a short circuit which can increase motor temperature in excess of 3000°F. This extreme temperature will also create a sludge or black residue in the system.

5. Mechanical Failure. Mechanical failure has been determined as a major cause of motor burnout. Bearing wear or wipe-out may allow rotor to drag--overheating the windings and burnout.

Whenever there is a compressor failure due to a motor burnout, it is important that the system be thoroughly cleaned before replacing the damaged compressor or otherwise the new compressor may also be damaged. A suction line filter should be installed and filter cores replaced until system is cleaned. Also replace the liquid line filter drier.



Note: "X" Valve #53 (air-cooled units only)
FIGURE 9-13
Solenoid Valves

Solenoid Valves. The solenoid valves (#18, #20 and #53) are pilot-operated with "floating" type diaphragm. For satisfactory operation, be sure that the manual opening stem, which is located in the valve bonnet on the outlet side of the Jackes-Evans valve and on the bottom of the Sporlan valve, is in the "automatic" or "closed" position. These valves require only a quarter turn of the manual stem to cause valve to remain open.

These valves will operate on voltages within 10% of rating but dirt or sludge will affect the operation. Care should be taken to assure the enclosing tube is not bent or dented so as to cause the plunger to stick and prevent proper operation.

Valves should be dismantled (or wrapped with wet rags if valve ends are the extended type) before applying heat for brazing.

Water Distributors. The water distributors are located in the distributing head (8) at the top of the freezer. There are 78 distributors used in models having an "S" suffix (i.e., Models HEC-10S, HEC-20S, HEC-30S, and HEC-40S); 48 distributors are used in models having an "M" suffix (i.e., Models HEC-10M, HEC-20M, HEC-30M, and HEC-40M). These may require occasional or periodical cleaning to remove suspended solids and foreign particles accumulated from the make-up water. The frequency of this cleaning operation will depend on the characteristics of the water supply.

The cleaning operation is indicated when the inside diameter of a large proportion of the ice becomes irregular (due to channeling of the water) or if some of the ice is opaque. Or if there is a noticeable decrease in ice capacity.

To clean distributors, stop the unit and remove the freezer cover (8) on top of the freezer. The water distributors may then be removed with pliers for cleaning by soaking in a solution of ice machine cleaner or 10% muratic acid and water. Grasp the top of the distributor gently with pliers, twist, pull up and out of the tube. After cleaning, reinstall distributors firmly in each tube.

! WARNING !
Acid can cause serious burns or blindness. Always add the acid to the water for dilution. Wear eye and body protection.
! WARNING !

Water Tank. The production of opaque ice usually indicates that the water in the water tank contains a concentrated amount of solids or salts.

Remove cover plate, open drain valve (39) and clean tank thoroughly by flushing out with a hose and scrubbing with a stiff brush. Close the drain valve and refill tank with fresh water. Also see "Ice Making--Cleaning Procedure", Section 7.

When restarting the machine after filling the water tank, be sure that the water pump is circulating water. It is possible that air may have collected in the pump impeller housing and the unit may have to be stopped and started several times to expel the air.

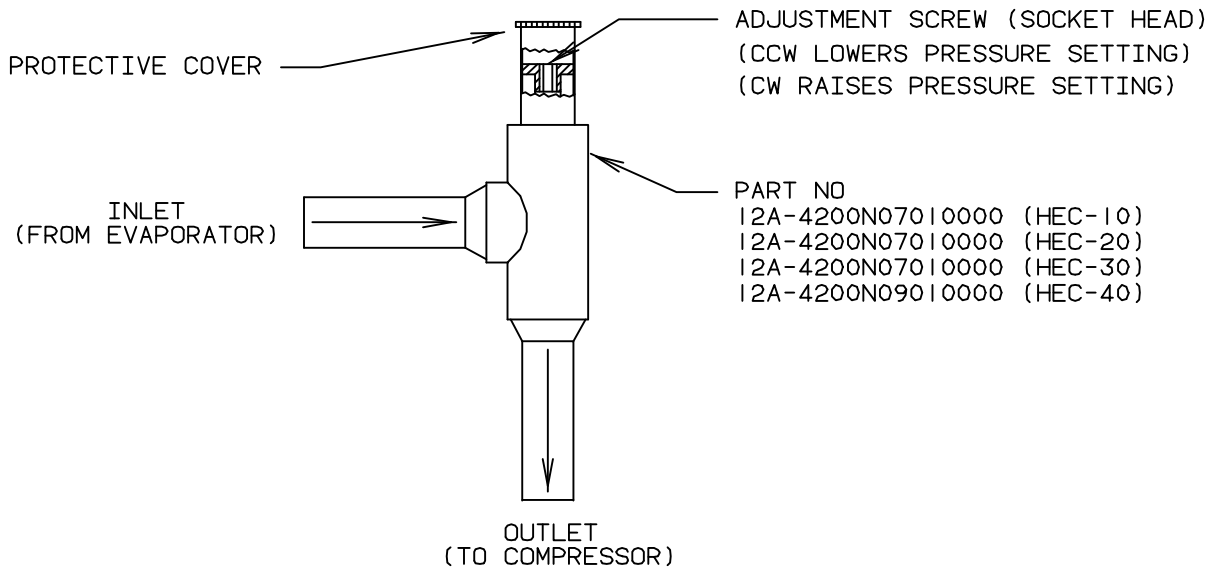


FIGURE 9-14
CPR (Crankcase Pressure Regulating) Valve

CPR (Crankcase Pressure Regulating) Valve. The CPR valve is designed to prevent overloading and liquid slugging of the compressor. It limits the crankcase pressure to a predetermined maximum value during and after a harvest (thawing) cycle. The valve automatically throttles the vapor flow from the evaporator until the compressor can handle the load.

When installing the CPR valve with solder type connections, the internal parts must be protected by wrapping the valve with a wet cloth.

Adjustment instructions:

1. Connect an accurate pressure gage to the low pressure test connection.

2. Remove the protective cover from over the CPR adjustment screw.

3. While the machine is in a harvest cycle, turn the adjustment screw CW to raise the gage pressure to 58-60 psig. Then turn the screw CCW (out) gradually until the pressure reaches the recommended setting (TABLE 9-2) and remains constant during the harvest.

4. Replace the protective cover.

If there is sufficient refrigerant in the receiver, a discharge pressure of 200 psig is maintained during the freeze and the system is free of noncondensables, ice will release and be cleared from the freezer within 1 1/2 minutes. Check several cycles after making adjustments.

HEC-10	HEC-20	HEC-30	HEC-40
55psig	55psig	55psig	50psig

TABLE 9-2
CPR Valve Setting

Converting from Cylinder Ice to Crushed Ice (Single Ice Type Machines).

- Remove jumper from #5 and #6 on terminal block and put on #5 and #4. This will reverse the rotation of the cutter motor.

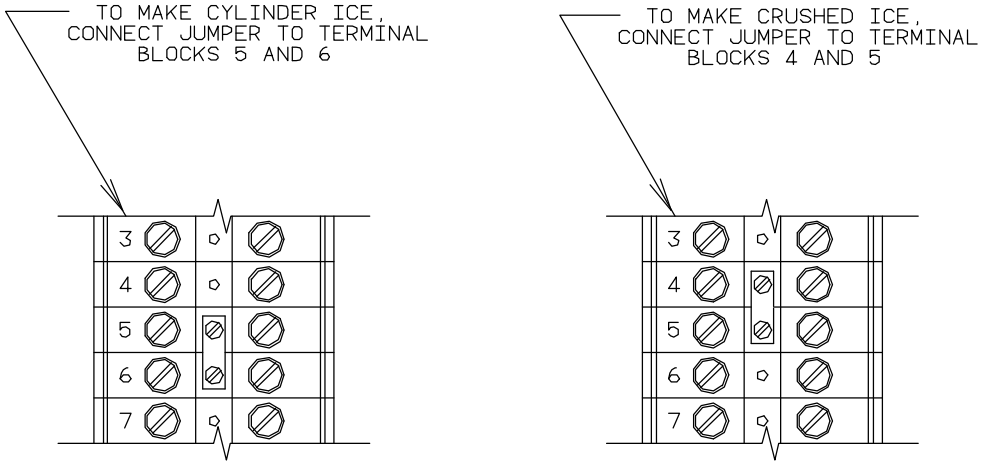


FIGURE 9-15
Terminal Block Jumper Locations

- Adjust Freezer Pressure switch (FPS2) – See table below for recommended pressure settings

Machine	Cylinder Ice (psig)	Crushed Ice (psig)
HEC-10S	42 - 44	45 - 47
HEC-10M	39 - 41	43 - 45
HEC-20S	43 - 45	46 - 48
HEC-20M	38 - 40	41 - 43
HEC-30S	38 - 40	41 - 43
HEC-30M	35 - 37	39 - 41
HEC-40S	31 - 33	36 - 38
HEC-40M	25 - 27	31 - 33

TABLE 9-3
Recommended Freezer Pressure Settings

Turn top screw to adjust the pressure setting (also referred to as the Range)

Clockwise = increase pressure setting
Counterclockwise = decrease pressure setting

The bottom screw is used to set the Differential – **DO NOT ADJUST**

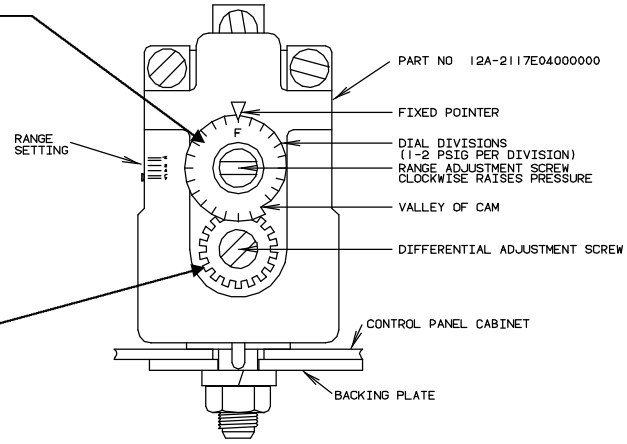


FIGURE 9-16
Freezer Pressure Switch

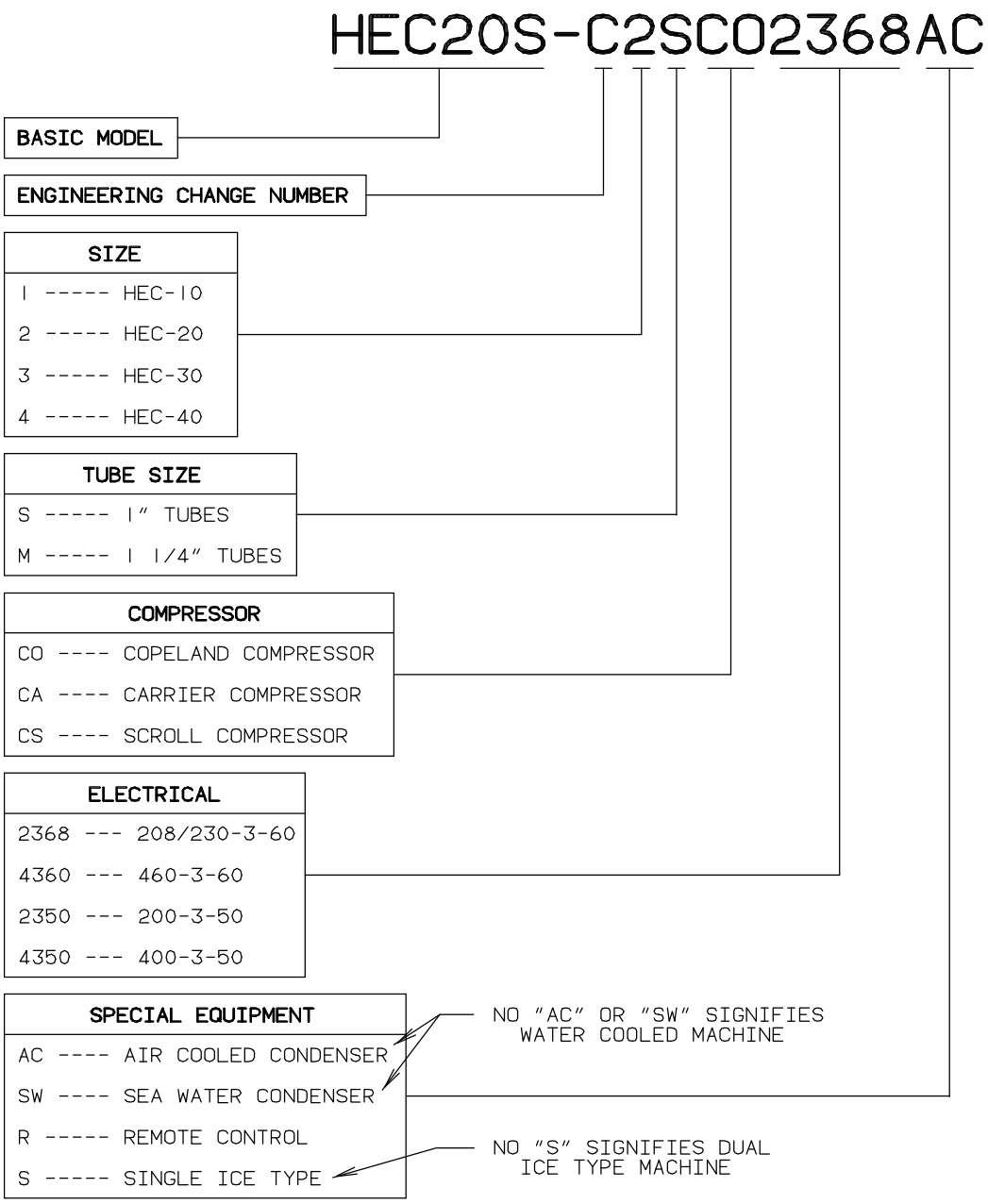
- The pressure switch should be adjusted until the desired ice thickness is obtained--See table below for recommended ice weights

Machine	**Cylinder Ice** (lbs.)	**Crushed Ice** (lbs.)
HEC-10S	39 - 41	29 - 31
HEC-10M	37 - 39	27 - 29
HEC-20S	39 - 41	29 - 31
HEC-20M	37 - 39	27 - 29
HEC-30S	38 - 40	28 - 30
HEC-30M	36 - 38	26 - 28
HEC-40S	38 - 40	28 - 30
HEC-40M	36 - 38	26 - 28

TABLE 9-4
Recommended Ice Weights per cycle

Single To Dual Ice Conversion. Converting from single type to dual type ice consist of adding components, rewiring, and machine adjustments. Consult factory for single to dual ice conversion kit information.

10. Model Number Structure



11. Tables and Charts

Capacity Table

Pounds of Ice Per 24 Hours

Model	90°F/32°C	80°F/26°C	70°F/21°C	60°F/15°C	50°F/10°C	40°F/4°C
HEC-10S	1300	1400	1450	1550	1600	1700
HEC-10M	1100	1200	1250	1300	1400	1450
HEC-20S	1500	1700	1800	1750	2100	2200
HEC-20M	1300	1400	1550	1650	1750	1850
HEC-30S	1900	2100	2250	2400	2500	2600
HEC-30M	1600	1750	1900	2050	2150	2250
HEC-40S	3300	3500	3700	3950	4200	4450
HEC-40M	2800	3000	3150	3350	3550	3750

ICE CAPACITIES ARE BASED ON 60 HZ. OPERATING CURRENT AND AN AMBIENT TEMPERATURE NOT EXCEEDING 85°F (29°C). REDUCE CAPACITY 17% FOR 50 HZ. OPERATION.

TABLE 11-1

		Suction Press (psig)		Discharge Press (psig)		Suction Superheat Deg. F	Freeze Time (Min)	Thaw Time (Min)	Ice Per Cycle (lbs.)	Condenser Water (gpm) Temp Deg. F				
		End of Freeze	End of Thaw	End of Freeze	End of Thaw					90°	80°	70°	60°	50°
C	HEC-10S	43	80	200	110	8	40	1.5	39	4.8	2.7	1.5	1.1	0.9
Y	HEC-10M	40	80	200	110	8	54	1.5	39	4.6	2.6	1.4	1.0	0.8
L	HEC-20S	44	80	200	100	8	33	1.5	39	7.2	4.0	2.2	1.6	1.3
I	HEC-20M	39	80	200	100	8	37	1.5	39	6.9	3.9	2.1	1.5	1.2
N	HEC-30S	39	80	200	100	8	21	1.5	39	14.7	8.4	5.9	4.7	3.8
D	HEC-30M	36	80	200	100	8	23	1.5	39	14.3	8.2	5.7	4.4	3.6
E	HEC-40S	32	80	200	100	10	14	1.5	39	25.1	14.7	9.5	7.4	5.9
R	HEC-40M	26	80	200	100	8	17	1.5	39	24.1	14.1	9.1	7.2	5.7
C	HEC-10S	46	85	200	100	8	26	1.5	29	4.8	2.5	1.5	1.1	0.9
R	HEC-10M	44	85	200	100	8	38	1.5	29	4.6	2.6	1.4	1.0	0.8
U	HEC-20S	47	85	200	100	8	23	1.5	29	7.2	4.0	2.2	1.6	1.3
S	HEC-20M	42	85	200	100	8	26	1.5	29	6.9	3.9	2.1	1.5	1.2
H	HEC-30S	42	85	200	100	8	15	1.5	29	14.7	8.4	5.9	4.7	3.8
E	HEC-30M	40	85	200	100	8	18	1.5	29	14.3	8.2	5.7	4.4	3.6
D	HEC-40S	37	85	200	100	10	11	1.5	29	25.1	14.7	9.5	7.4	5.9
	HEC-40M	32	85	200	100	9	13	1.5	29	24.1	14.1	9.1	7.2	5.7

First Ice Out: within 15 seconds
All Ice Out: within 90 seconds

*Based on 70° make-up water

TABLE 11-2
Normal Operating Vitals

TEMPERATURE - PRESSURE CHART
FOR COMMON REFRIGERANTS

DegF	R-12	R-22	R-502	R-134a	MP-39	HP-62	HP-80
-50	-7.6	-3.0	0.2	-9.0	-9.1	0.0	1.2
-48	-7.2	-2.4	0.7	-8.7	-8.7	0.8	2.1
-46	-6.8	-1.7	1.5	-8.3	-8.3	1.6	2.9
-44	-6.3	-1.0	2.3	-8.0	-7.9	2.5	3.9
-42	-5.8	-0.2	3.2	-7.6	-7.4	3.4	4.9
-40	-5.4	0.5	4.1	-7.1	-7.1	5.5	5.9
-38	-4.9	1.3	5.0	-6.7	-6.6	6.5	6.9
-36	-4.4	2.2	6.0	-6.3	-6.1	7.5	8.0
-34	-3.8	3.0	7.0	-5.8	-5.6	8.6	9.2
-32	-3.3	4.0	8.1	-5.3	-5.2	9.7	10.3
-30	-2.7	4.9	9.2	-4.8	-4.4	10.8	11.6
-28	-2.1	5.9	10.3	-4.2	-4.1	12.0	12.8
-26	-1.5	6.9	11.5	-3.8	-3.4	13.2	14.1
-24	-0.8	7.9	12.7	-3.0	-2.9	14.5	15.5
-22	-0.1	9.0	14.0	-2.4	-2.2	15.8	16.9
-20	0.6	10.1	15.3	-1.8	-1.7	17.1	18.4
-18	1.3	11.3	16.7	-1.1	-1.0	18.5	19.9
-16	2.1	12.5	18.1	-0.4	-0.2	20.0	21.5
-14	2.8	13.8	19.5	0.3	0.4	21.5	23.1
-12	3.7	15.1	21.0	1.1	1.4	23.0	24.8
-10	4.5	16.5	22.6	1.9	2.2	24.6	26.5
-8	5.4	17.9	24.2	2.8	3.1	26.3	28.3
-6	6.3	19.3	25.8	3.6	3.9	28.0	30.2
-4	7.2	20.8	27.5	4.5	4.8	29.8	32.1
-2	8.2	22.4	29.3	5.5	5.7	31.6	34.1
0	9.2	24.0	31.1	6.5	6.7	33.5	36.1
2	10.2	25.6	32.9	7.5	7.7	35.6	38.1
4	11.2	27.3	34.9	8.5	8.8	37.4	40.4
6	12.3	29.1	36.9	9.6	9.9	39.4	42.6
8	13.5	30.9	38.9	10.8	11.0	41.6	44.9
10	14.6	32.8	41.0	12.0	12.2	43.9	47.3
12	15.8	34.7	43.2	13.1	13.4	46.0	49.7
14	17.1	36.7	45.4	14.4	14.6	48.3	52.2
16	18.4	38.7	47.7	15.7	15.9	50.7	54.8
18	19.7	40.9	50.0	17.0	17.2	53.1	57.5
20	21.0	43.0	52.5	18.4	18.6	55.6	60.2
22	22.4	45.3	54.9	19.9	20.0	58.2	63.0
24	23.9	47.6	57.5	21.4	21.5	59.9	65.9
26	25.4	49.9	60.1	22.9	23.0	63.6	68.9
28	26.9	52.4	62.8	24.5	24.6	66.5	72.0
30	28.5	54.9	65.6	26.1	26.2	69.4	75.1
32	30.1	57.5	68.4	27.8	27.9	72.3	78.3
34	31.7	60.1	71.3	29.5	29.6	75.4	81.6
36	33.4	62.8	74.3	31.3	31.3	78.5	85.0
38	35.2	65.6	77.4	33.2	33.2	81.8	88.5
40	36.9	68.5	80.5	35.1	35.0	85.1	92.1
42	38.8	71.5	83.8	37.0	37.0	88.5	95.7
44	40.7	74.5	87.0	39.1	39.0	91.9	99.5
46	42.7	77.6	90.4	42.0	41.0	95.5	103.4
48	44.7	80.7	93.9	43.3	43.1	99.2	107.3
50	46.7	84.0	97.4	45.5	45.3	102.9	111.4

DegF	R-12	R-22	R-502	R-134a	MP-39	HP-62	HP-80
50	46.7	84.0	97.4	45.5	45.3	102.9	111.4
52	48.8	87.3	101.0	47.7	60.0	109.0	120.0
54	51.0	90.8	104.8	50.1	62.0	113.0	124.0
56	53.2	94.3	108.6	52.3	65.0	117.0	129.0
58	55.4	97.9	112.4	55.0	68.0	121.0	133.0
60	57.7	101.6	116.4	57.5	70.0	125.0	138.0
62	60.1	105.4	120.4	60.1	73.0	130.0	142.0
64	62.5	109.3	124.6	62.7	76.0	134.0	147.0
66	65.0	113.2	128.8	65.5	79.0	139.0	152.0
68	67.6	117.3	133.2	68.3	82.0	144.0	157.0
70	70.2	121.4	137.6	71.2	85.0	148.0	162.0
72	72.9	125.7	142.2	74.2	89.0	153.0	168.0
74	75.6	130.0	146.8	77.2	92.0	158.0	173.0
76	78.4	134.5	151.5	80.3	95.0	164.0	179.0
78	81.3	139.0	156.3	83.5	99.0	169.0	184.0
80	84.2	143.6	161.2	86.8	102.0	174.0	190.0
82	87.2	148.4	166.2	90.2	106.0	180.0	196.0
84	90.2	153.2	171.4	93.6	109.0	185.0	202.0
86	93.3	158.2	176.6	97.1	113.0	191.0	208.0
88	96.5	163.2	181.9	100.7	117.0	197.0	214.0
90	99.8	168.4	187.4	104.4	121.0	203.0	220.0
92	103.1	173.7	192.9	108.2	125.0	209.9	227.0
94	106.5	179.1	198.6	112.1	129.0	215.0	234.0
96	110.0	184.6	204.3	116.1	133.0	222.0	240.0
98	113.5	190.2	210.2	120.1	138.0	229.0	247.0
100	117.2	195.9	216.2	124.3	142.0	235.0	254.0
102	120.9	201.8	222.3	128.5	146.0	242.0	261.0
104	124.7	207.7	228.5	132.9	151.0	249.0	269.0
106	128.5	213.8	234.9	137.3	156.0	256.0	276.0
108	132.4	220.0	241.3	142.8	160.0	264.0	284.0
110	136.4	226.4	247.9	146.5	165.0	271.0	292.0
112	140.5	232.8	254.6	151.3	170.0	279.0	299.0
114	144.7	239.4	261.5	156.1	175.0	286.0	307.0
116	148.9	246.1	268.4	161.1	180.0	294.0	316.0
118	153.2	252.9	275.5	166.1	185.0	302.0	324.0
120	157.7	259.9	282.7	171.3	191.0	311.0	332.0
122	162.2	267.0	290.1	176.6	196.0	319.0	341.0
124	166.7	274.3	297.6	182.0	202.0	328.0	350.0
126	171.4	281.6	305.2	187.5	207.0	336.0	359.0
128	176.2	289.1	312.9	193.1	213.0	345.0	368.0
130	181.0	296.8	320.8	198.9	219.0	354.0	377.0
132	185.9	304.6	328.9	204.7	225.0	364.0	387.0
134	191.0	312.5	337.1	210.7	231.0	373.0	396.0
136	196.2	320.6	345.4	216.8	237.0	383.0	406.0
138	201.3	328.9	353.9	223.0	243.0	392.0	416.0
140	206.6	337.3	362.6	229.4	250.0	402.0	426.0
142	212.0	345.8	371.4	235.8	256.0	412.0	436.0
144	217.5	354.5	380.4	242.4	263.0	423.0	447.0
146	223.1	363.4	389.5	249.2	269.0	434.0	458.0
148	228.8	372.3	398.9	256.0	277.0	444.0	468.0
150	234.6	381.5	408.4	263.0	283.0	449.0	479.0

TABLE 11-3

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 11-4

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
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 11-5

12. Technical Service Bulletins

No. 88-5

All Models

Subject: Water Conditioning For Ice Cube Machines

The quality of the ice produced by a commercial ice cube machine can only be as high as the quality of the water which is used. Water which contains turbidity or sediment or which has a high concentration of dissolved minerals or gases will produce cloudy or opaque ice.

Ion exchange (zeolite) softening is used to advantage in many cases, as the softener removes iron and most forms of turbidity, and also prevents scale formation in the ice machines. However, softening the water by ion exchange does not reduce the concentration of minerals. In addition, most machines require a considerable blowdown to waste to prevent the buildup of the total dissolved solids and thus a considerable amount of softened water will be wasted.

All the sulfates, chlorides, and the sodium carbonate (listed below) have in general the same effect on the appearance of raw water ice and therefore, in this rough tabulation, can be grouped together.

Generally, the sodium carbonates can be considered 1 1/4 times as objectionable as the sulfates, and the chlorides about 3/4 as objectionable as the sulfates. Therefore, total the sulfates and chlorides separately and apply the factors:

Calcium Sulfate	Calcium Chloride
Magnesium Sulfate	Magnesium Chloride
Sodium Sulfate	Sodium Chloride
Sodium Carbonate	

Total Sulfates x 1.0 = _____

Total Chlorides x 0.75= _____

Sodium Carbonate x 1.25 = _____

Sum Total = _____

Dissolved solids below 171 ppm (10 grains per gallon) produces first quality ice, 256 ppm (15 g.p.g.) good quality ice, and 342 ppm (20 g.p.g.) an ice that is still marketable. If dissolved solids are between 342 ppm and 684 ppm (40 g.p.g.), acceptable ice quality ice is questionable, over 684 ppm, marketable ice cannot be expected.

When cloudy or opaque is produced because of the water quality, it is suggested that the water be analyzed by a reputable laboratory and their advice be followed.

Henry Vogt Machine Co.
Louisville, KY

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