

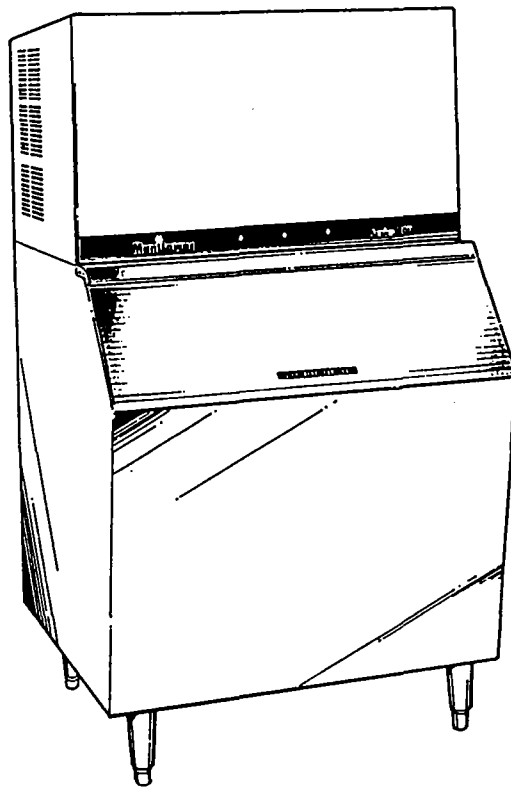


# Manitowoc<sup>®</sup>

## ICE MACHINES

**Series  
G1700**

### SERVICE MANUAL



G6SVCVR

This product qualifies for the following listings:



We reserve the right to make product improvements at any time. Specifications and design are subject to change without notice.



Part No. 80-0847-3  
Rev 1 (8-92)



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# GENERAL SPECIFICATIONS

This section is not intended to be a guideline to install the ice machine. Refer to Installation Manual for installation procedures.

**Ambient Air Temperature:** 35°F minimum, 110°F maximum (minimum five-inch clearance rear and sides)

**Ice Making Water Supply:**

Pressure — 20 psi minimum, 80 psi maximum  
 Supply Line — 3/8 inch  
 Drain Line — 3/4 inch  
 Water Temperature — 33°F minimum, 90°F maximum

**Water-Cooled Condenser Water Supply:**

Water Regulating Valve Setting — 220 psig ± 5 (Factory preset)  
 Pressure — 20 psi minimum, 150 psi maximum  
 Supply Line — 1/2 inch  
 Drain Line — 1/2 inch  
 Temperature — 33°F minimum, 90° maximum

**Heat of Rejection (BTU/Hr):**

Average 25,000, Peak 40,500

**Refrigerant R-502:**

Water-Cooled — 50 oz., 62 oz. with accumulator  
 Remote — 22 lb.

## ELECTRICAL REQUIREMENTS

Voltage Phase Cycle	WATER		REMOTE	
	Maximum Fuse/Circuit Breaker	Minimum Circuit Ampacity	Maximum Fuse/Circuit Breaker	Minimum Circuit Ampacity
208-230/1/60	35	29.5	40	33.2
208-230/3/60	25	17.5	25	20.0
220-240/1/50	40	23.1	40	25.3
380-415/3/50	10	8.7	15	11.3

Numbers Listed Are Amps

**MANITOWOC ICE MACHINES ARE AIR CONDITIONING REFRIGERATION INSTITUTE (ARI) CERTIFIED AND RATED IN ACCORDANCE WITH AIR CONDITIONING REFRIGERATION INSTITUTE STANDARD 810-87**

**NOTE**

Test conditions for standard ratings at 90°F air, 70°F water, and 30 ± 2 psig water inlet pressure.

Model Designation	Capacity (Lb. per 24 Hr.)		Potable Water Used (Gal. per 100 Lb. of Ice)	Condenser Water Used (Gal. per 100 Lb. of Ice)	Power Input (kW/Hr. 100 Lb. of Ice)
GR-1701W	1404		20.3	172	5.3
GD-1703W	1510		20.3	172	4.9
GY-1705W	1510		20.3	172	4.9
GR-1790N	1423*	1390#	20.3	--	6.0
GD-1792N	1530*	1500#	20.3	--	5.6
GY-1794N	1530*	1500#	20.3	--	5.6

\* With AC1795A Remote Condenser

# With AC1796B Remote Condenser

# WARRANTY INFORMATION

## IMPORTANT

Read this section very carefully for warranty explanation. (Refer to Warranty Bond for complete details.)

## OWNER WARRANTY REGISTRATION CARD

Warranty coverage begins the day the ice machine is installed.

## IMPORTANT

To validate the installation date, the OWNER WARRANTY REGISTRATION CARD must be mailed in.

If the card was not returned, Manitowoc will use the date of sale to the Manitowoc Distributor as the first day of warranty coverage for your new ice machine.

## About Your Warranty

Contact your local Manitowoc representative or our Wisconsin factory for further warranty information.

## WARRANTY COVERAGE

**(Effective for Ice Machines Installed after January 1, 1991)**

### Parts

1. The ice machine is warranted against defects in materials and workmanship under normal use and service for three (3) years from the date of the original installation. It is important to send in the warranty registration card so Manitowoc can begin your warranty on the installation date.
2. An additional two (2) years (five years total) warranty is provided on evaporator and compressor from the date of original installation.

### Labor

1. Labor to repair or replace defective components is warranted for three (3) years from the date of original installation.
2. An additional two (2) years (**five (5) years total**) labor warranty is provided on the evaporator from the date of original installation.

### Exclusions from Warranty Coverage

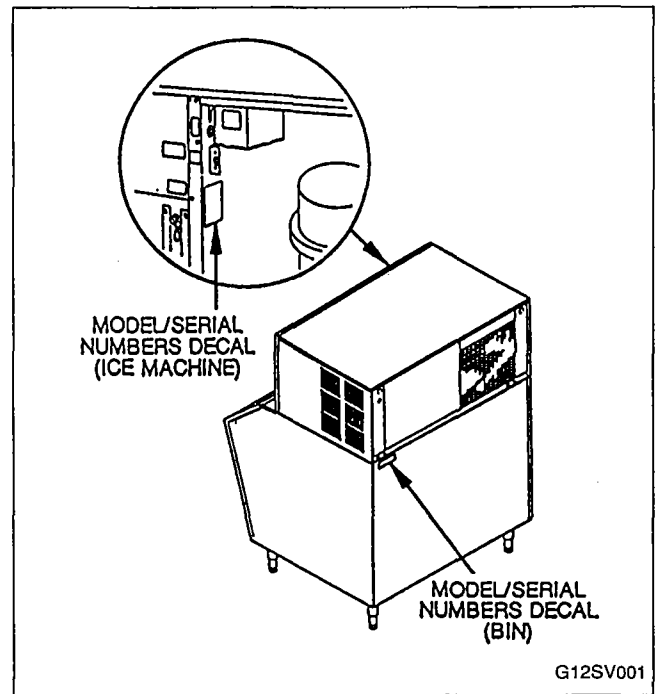
The following items are not included in the warranty coverage of the ice machine.

1. Normal maintenance, adjustments and cleaning as outlined in the Use and Care Guide.
2. Repairs due to unauthorized modifications to the ice machine or the use of nonapproved parts without written approval from Manitowoc Ice, Inc.
3. Damage from improper installation as outlined in the Installation Instructions, improper electrical supply, water supply or drainage; flood, storms, or other acts of God.
4. Premium labor rates due to holidays, overtime, etc. Travel time, flat rate service call charges, mileage and miscellaneous tools and material charges not listed on the payment schedule are excluded as well as additional labor charges resulting from inaccessibility of the ice machine.
5. Parts or assemblies subjected to misuse, abuse, neglect or accidents.
6. When the ice machine has been installed, cleaned and/or maintained inconsistent with the technical instructions provided in the Owner/Operator Use and Care Guide and the Installation Manual.

### Authorized Warranty Service

To comply with the provisions of the warranty a refrigeration service company qualified and authorized by a Manitowoc distributor or a Contracted Service Representative must perform the warranty repair.

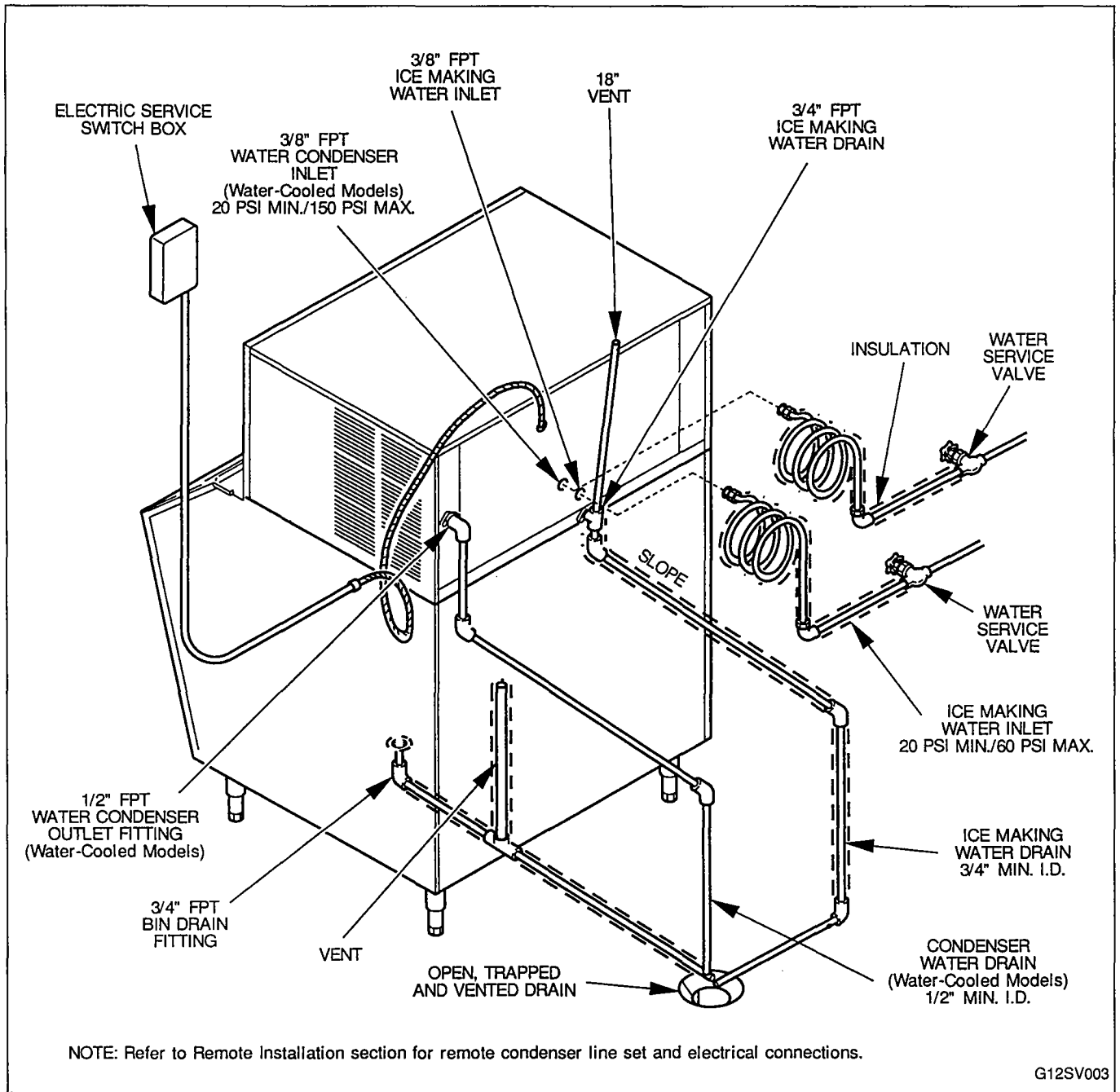
Please contact your local Manitowoc Distributor or Manitowoc Ice, Inc. for further information regarding warranty coverage. (NOTE: Have model and serial numbers of ice machine available when calling. See Figure 1 for location of model and serial numbers.)



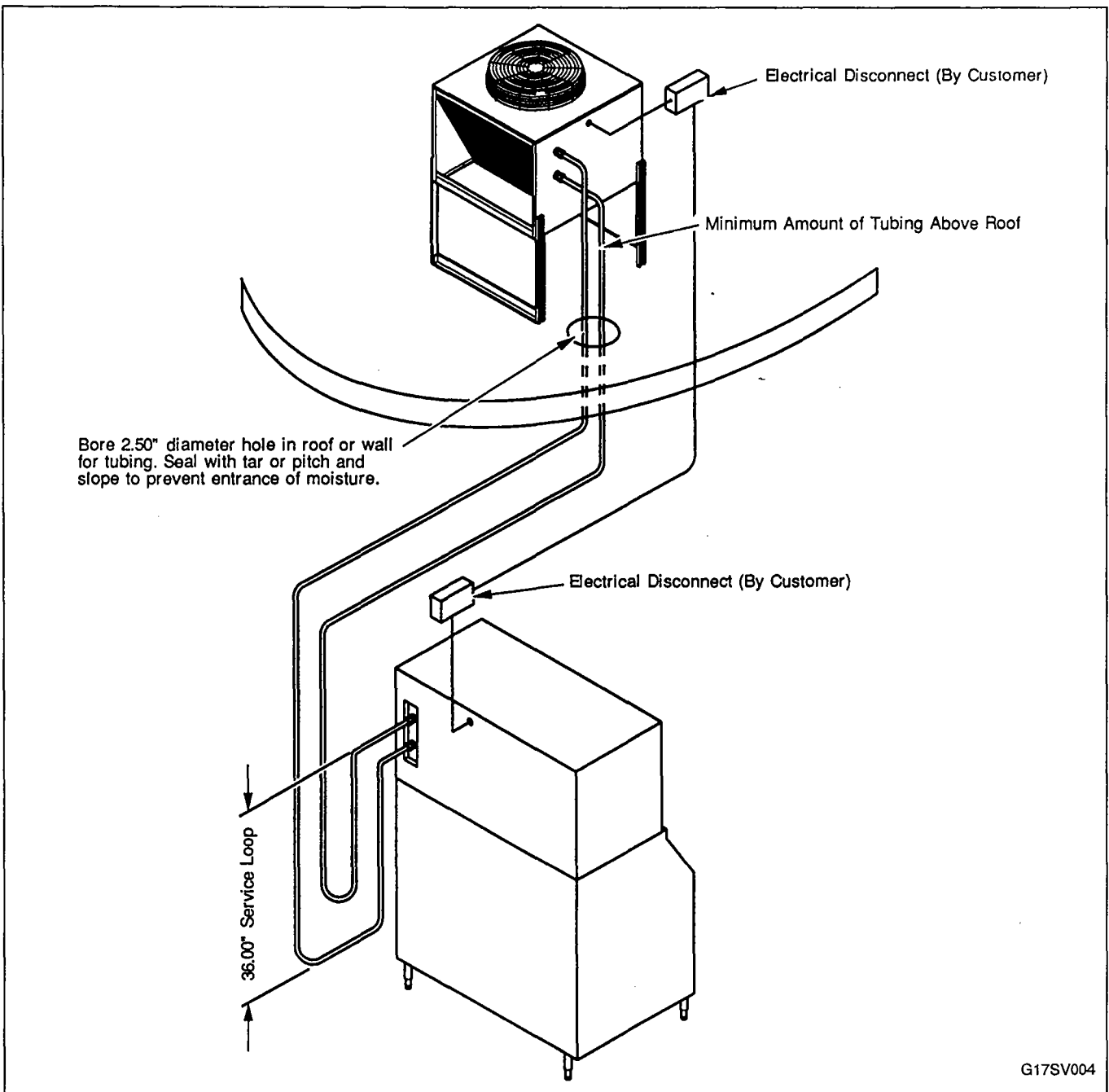
**FIGURE 1. MODEL/SERIAL NUMBERS LOCATION**

The model/serial decal may be on the left side of the electrical box.



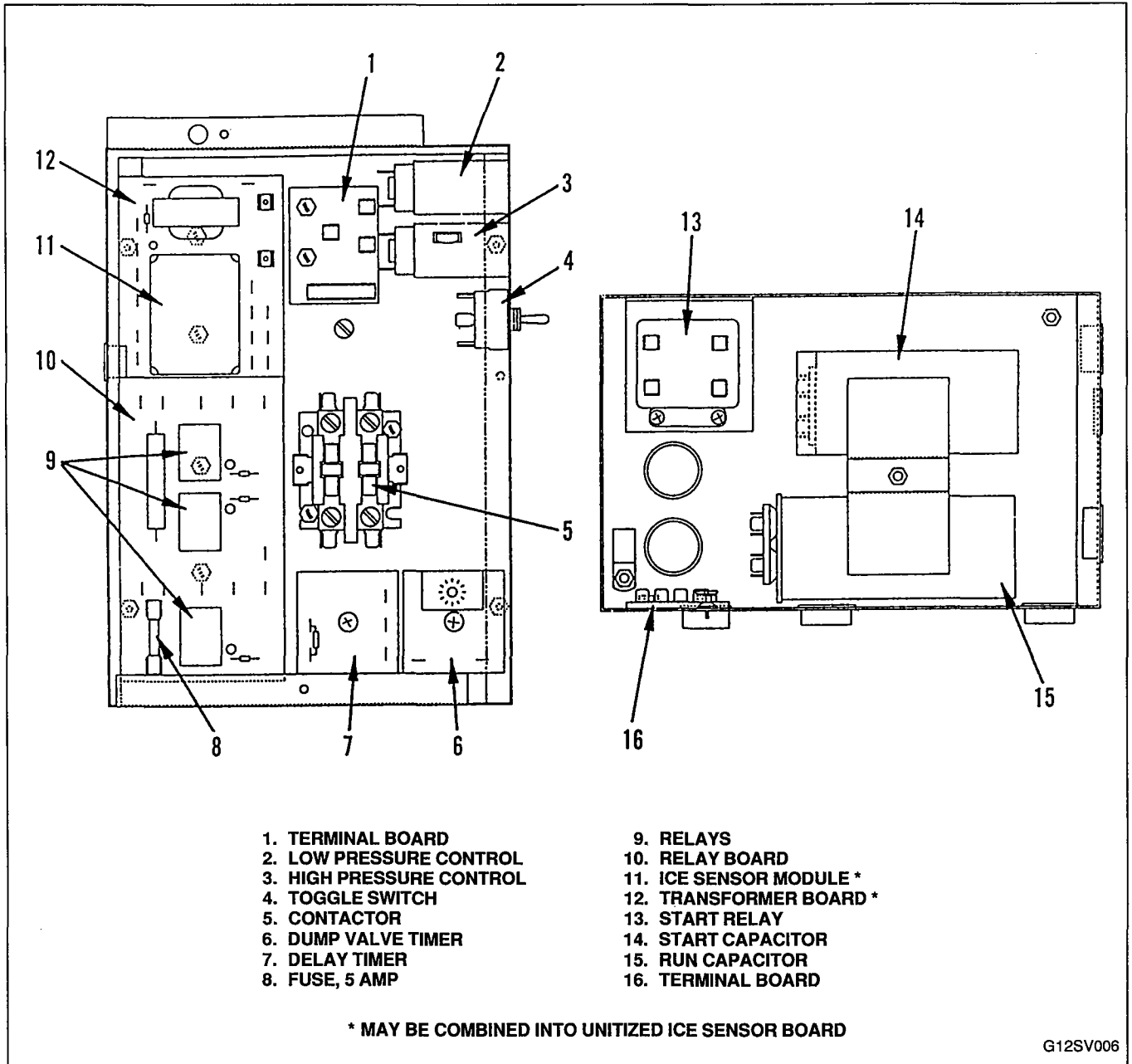


**FIGURE 3. TYPICAL SELF-CONTAINED INSTALLATION**



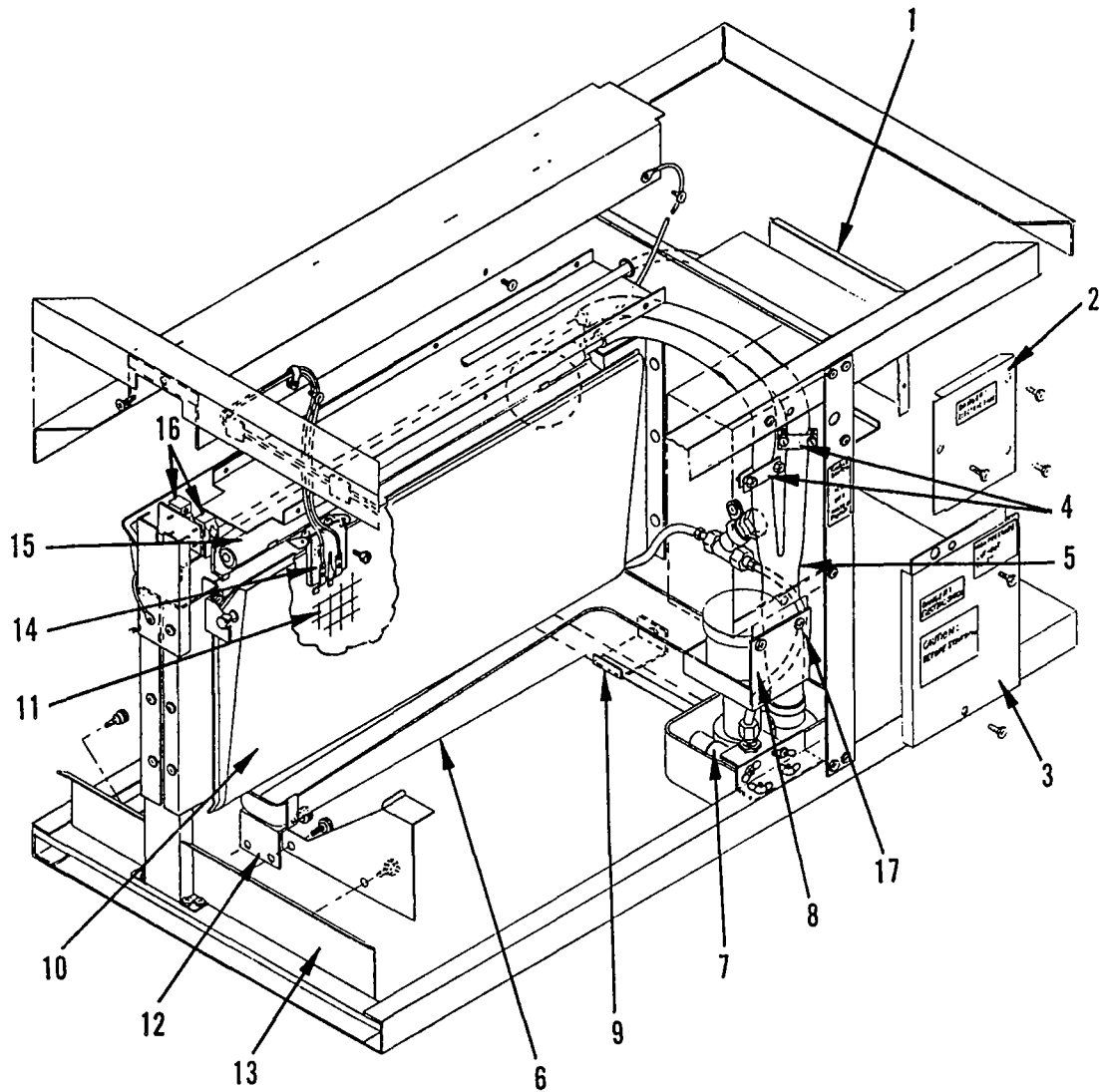
**FIGURE 4. TYPICAL REMOTE CONDENSER LINE SET INSTALLATION**

# COMPONENT IDENTIFICATION



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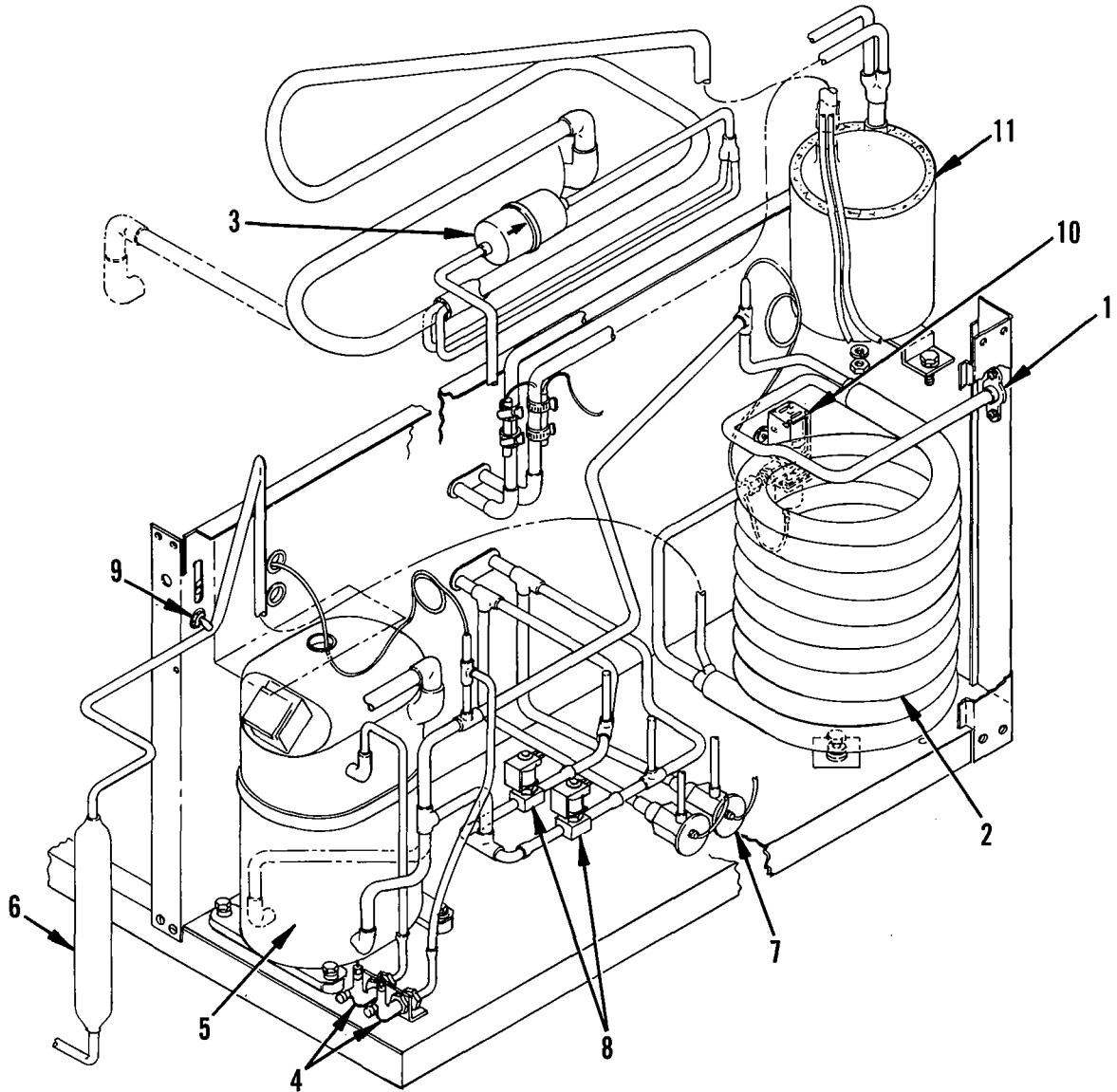
FIGURE 5. ELECTRICAL CONTROL BOXES



- |  |                                     |
|--|-------------------------------------|
| 1. SIDE COVER (COMPRESSOR START COMPONENTS BOX)  | 9. DRAIN TUBE BRACKET               |
| 2. FRONT COVER (COMPRESSOR START COMPONENTS BOX) | 10. WATER CURTAIN (TWO REQUIRED)    |
| 3. CONTROL BOX COVER                             | 11. EVAPORATOR                      |
| 4. WATER FLOW CLAMPS (REGULAR SIZED CUBES ONLY)  | 12. LH SUMP TROUGH SUPPORT          |
| 5. WATER DISCHARGE TUBE WITH DUMP VALVE)         | 13. SPLASH SHIELD                   |
| 6. SUMP TROUGH                                   | 14. ICE THICKNESS CONTROL           |
| 7. FLOAT VALVE                                   | 15. WATER DISTRIBUTOR TUBE          |
| 8. WATER PUMP (WITH BRACKET AND COVER)           | 16. BIN SWITCH (TWO REQUIRED)       |
|  | 17. SOLENOID DUMP VALVE (NOT SHOWN) |

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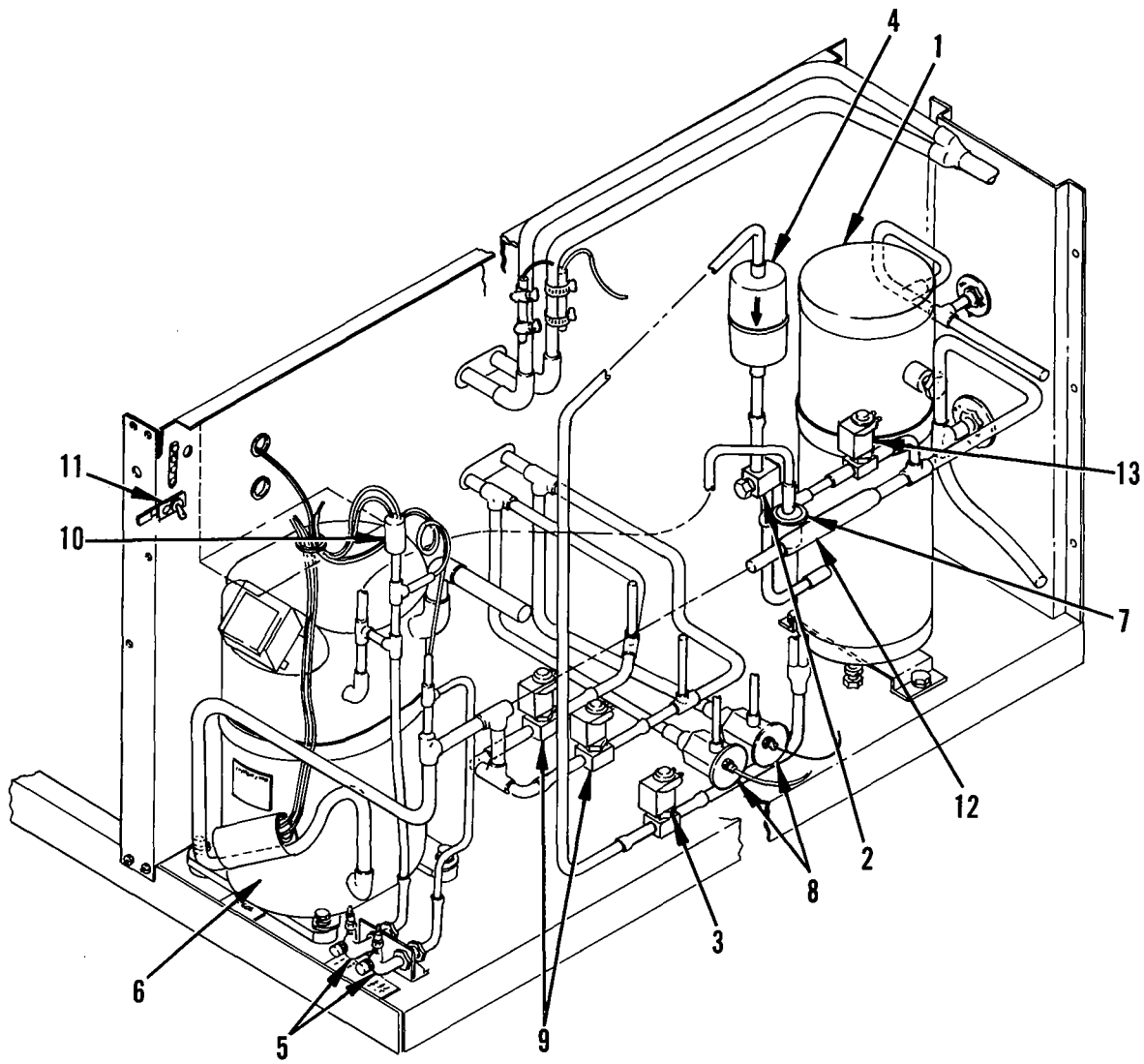
**FIGURE 6. EVAPORATOR COMPARTMENT**



- |                                     |                           |
|-------------------------------------|---------------------------|
| 1. CONDENSER WATER DRAIN            | 6. RECEIVER               |
| 2. WATER-COOLED CONDENSER           | 7. EXPANSION VALVES       |
| 3. DRIER                            | 8. HOT GAS VALVES         |
| 4. HIGH AND LOW SIDE PROCESS VALVES | 9. TOGGLE SWITCH          |
| 5. COMPRESSOR                       | 10. WATER REGULATOR VALVE |
|                                     | 11. ACCUMULATOR           |

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**FIGURE 7. WATER-COOLED COMPRESSOR COMPARTMENT**



- |   |  |
|---|--|
| 1. RECEIVER                             | 8. EXPANSION VALVES                                  |
| 2. SERVICE VALVE                        | 9. HOT GAS VALVES                                    |
| 3. LIQUID LINE PUMP<br>DOWN SOLENOID    | 10. SUCTION PRESSURE SWITCH                          |
| 4. DRIER                                | 11. TOGGLE SWITCH                                    |
| 5. HIGH AND LOW SIDE<br>PROCESS VALVES  | 12. MAGNI-CHECK VALVE                                |
| 6. COMPRESSOR                           | 13. HARVEST PRESSURE<br>REGULATING SOLENOID<br>VALVE |
| 7. HARVEST PRESSURE<br>REGULATING VALVE |  |

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**FIGURE 8. REMOTE MACHINE COMPRESSOR COMPARTMENT**

# INTERIOR CLEANING

For efficient operation, clean and sanitize ice machine every six months.

## IMPORTANT

Do not use hot water. If ice machine requires cleaning and sanitizing more frequently, consult a qualified service company to test the water quality and recommend appropriate water treatment.

Before cleaning, check water dump valve for proper operation (see Cleaning Water Dump Valve, page 16). Deposits may accumulate in the valve causing leakage or restriction of water flow.

## REMOVAL OF PARTS FOR CLEANING

1. Loosen two screws holding front panel in place and remove front panel.
2. Set ICE/OFF/WATER PUMP switch at OFF after ice falls from evaporator at completion of harvest cycle, or set switch at OFF and allow ice to melt off evaporator.



## CAUTION

Never use any type of object to force ice from evaporator as damage may result.

3. Turn off water to the ice machine at water service valve(s).
4. Stacked ice machines: remove ice chutes.
5. Remove all ice from bin.
6. Remove water curtain.
7. Remove drain plug from water trough and allow water to drain into bin.

## REMOVE WATER PUMP (Figure 9)

1. Disconnect water pump power cord.

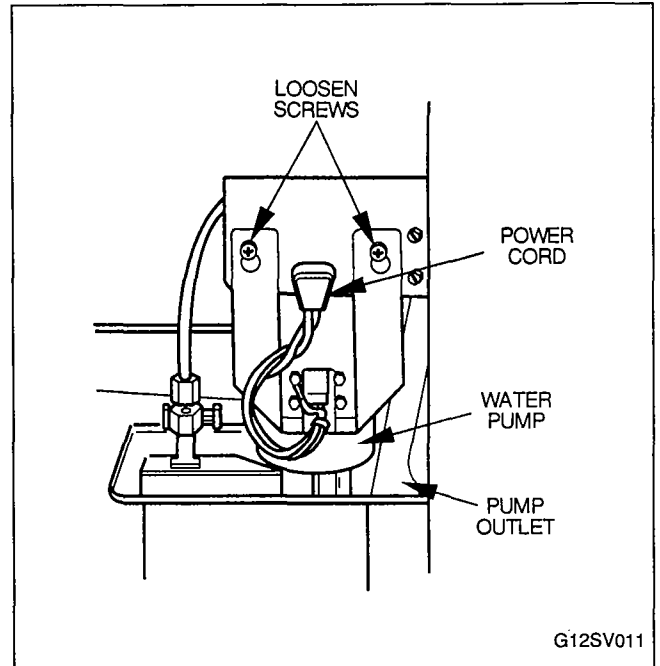


FIGURE 9. WATER PUMP REMOVAL

2. Disconnect hose from pump outlet.
3. Remove two screws holding pump mounting bracket to rear bulkhead.
4. Lift pump and bracket assembly off screws.

## REMOVE FLOAT VALVE (Figure 10)

1. Remove wing nuts from bracket and pull bracket from water trough.
2. Disconnect the water inlet tube from the float valve at the compression fitting.
3. Remove filter screen and cap.

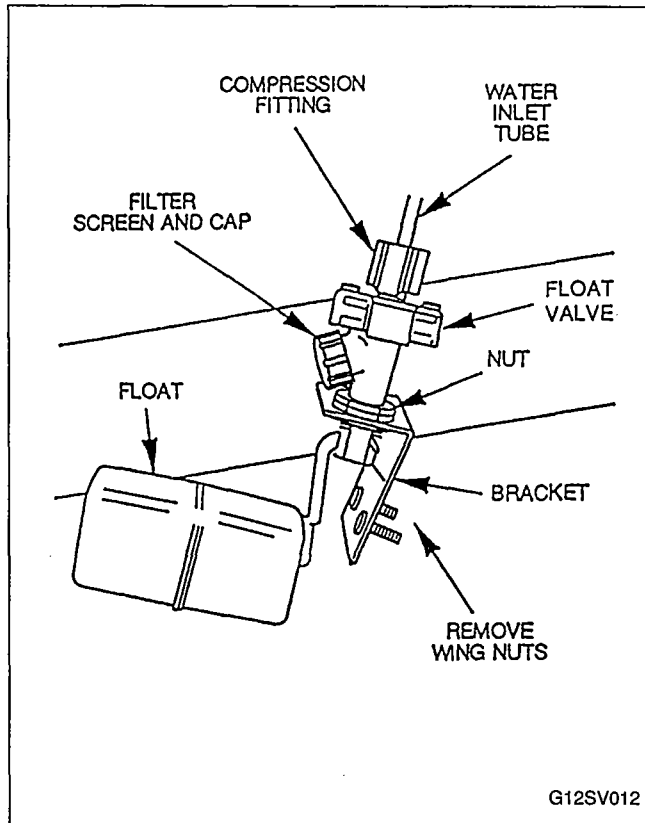


FIGURE 10. FLOAT VALVE REMOVAL

## REMOVE DISTRIBUTION TUBE (Figure 11)

1. Remove distribution tube from the two spring clips holding it in place.
2. Disconnect the hose from the distribution tube.

### NOTE

To reinstall distribution tube, align locating pin on top extrusion with hole in distribution tube.

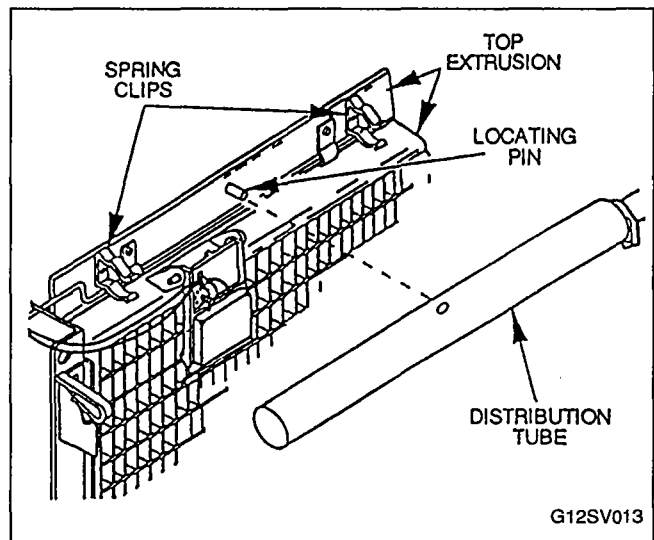


FIGURE 11. DISTRIBUTION TUBE REMOVAL

## DISASSEMBLE DISTRIBUTION TUBE (Figure 12)

### NOTE

Disassembly of the distribution tube is not usually necessary as normal cleaning of the ice machine will clean the tube. The distribution tube should only be disassembled if, after normal cleaning procedures, there is inadequate water flow from the distribution tube.

1. Heat rubber end plugs on distribution tube in warm water to soften them.
2. Remove end plugs and inner distribution tube.
3. Reheat rubber plugs in warm water after cleaning is complete and reassemble distribution tube.

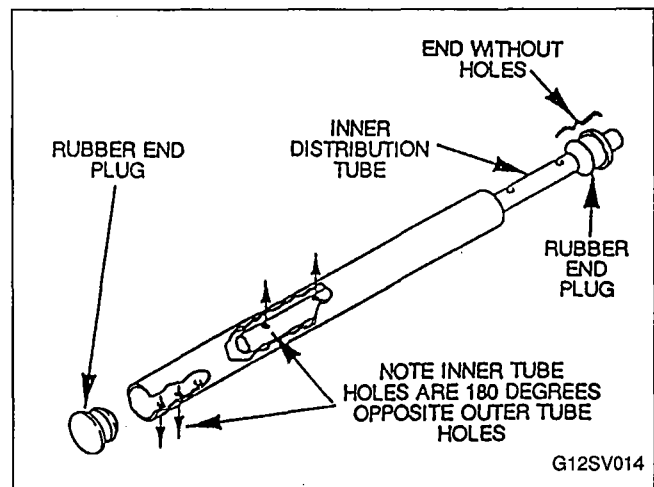


FIGURE 12. DISTRIBUTION TUBE DISASSEMBLY

## REMOVE ICE THICKNESS PROBE (Figure 13)

1. Disconnect wire leads from ice sensor in control box. Be sure electrical power is disconnected.
2. Compress side of probe at top near hinge pin and disengage it from the bracket.

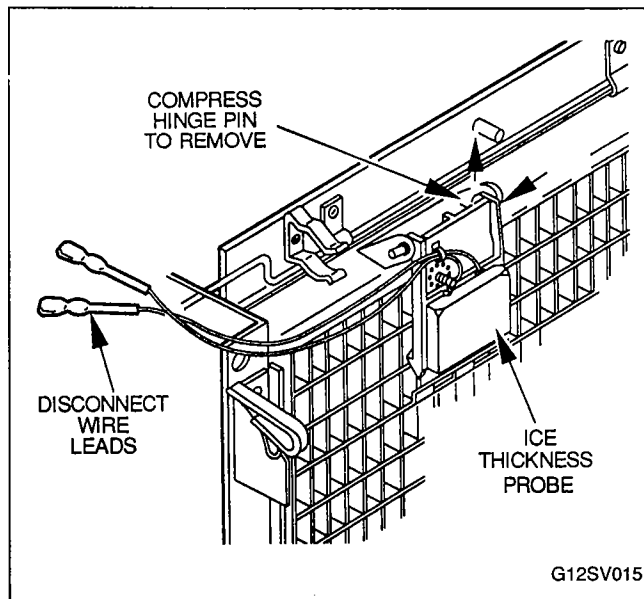


FIGURE 13. ICE THICKNESS PROBE REMOVAL

## REMOVE WATER TROUGH

1. Remove float valve and water pump.
2. Disconnect water outlet hose (Figure 14).
3. Remove thumb screws and remove water trough (Figure 15).

## CLEANING PROCEDURES

Ice Machine Cleaner is for removal of lime scale or other mineral deposits. It is not used for removal of algae or slime. Refer to Sanitizing for removal of algae and slime.

### CAUTION

Use only Manitowoc Ice Machine Cleaner, Part No. 94-0546-3, in recommended concentration as this is compatible with materials used in the manufacture of Manitowoc Ice Machines.

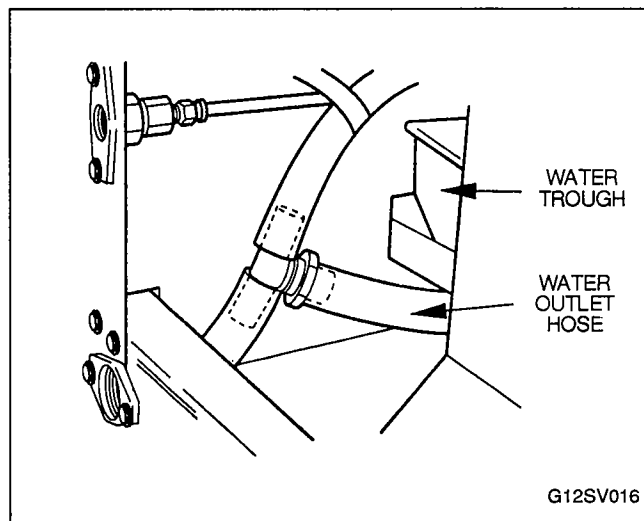


FIGURE 14. DISCONNECT WATER OUTLET HOSE

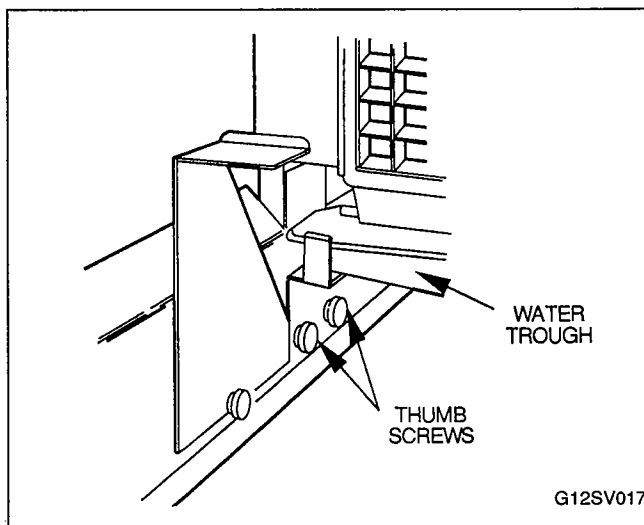


FIGURE 15. REMOVE WATER TROUGH

1. Soak parts in a solution of no more than 16 ounces of cleaner to one gallon of warm water. Use a brush (**DO NOT USE A WIRE BRUSH**) or a sponge to clean the parts, taking care not to damage them.

### CAUTION

*Do not* immerse the water pump motor in the cleaning solution. Also, use care when cleaning the ice thickness probe so as not to move the adjusting screw.

2. Use the cleaning solution and a brush or sponge to remove scale build-up from the top, sides and bottom extrusions, the inside of the ice machine panels, and the entire inside of the ice bin.

A dirty top extrusion, Figure 11, could result in uneven water flow over the evaporator. Ensure all scale and dirt are removed.

3. Thoroughly rinse with clean water all parts and surfaces washed with the cleaning solution.

**NOTE**

Incomplete rinsing of the ice thickness probe could leave residue which could cause the ice machine to go into premature harvest. For best results, brush or wipe off while rinsing and then wipe dry.

4. Reinstall all parts removed for cleaning except front panel and top chute (if stacked).

## **CLEANING THE EVAPORATOR**

**NOTE**

Failure to clean other parts prior to cleaning evaporator may result in poor cleaning of the evaporator surface.

1. Turn on water to ice machine at water service valve and verify float valve is open, Figure 10.
2. Allow trough to fill to proper operating level, Figure 50, page 45.
3. Set ICE/OFF/WATER PUMP switch at WATER PUMP.

4. Add four ounces of cleaner to water trough and allow solution to circulate a maximum of 10 minutes.

**NOTE**

Use a soft brush on excessively dirty evaporator to help remove deposits. Ensure connecting holes in back corners of cube molds are open.

5. Set ICE/OFF/WATER PUMP switch at OFF.
6. Shut off water at float valve. See Figure 10.
7. Drain water trough by removing drain plug.
8. Thoroughly rinse trough with clean water, then reinstall drain plug.
9. Turn on water at float valve.
10. Set ICE/OFF/WATER PUMP switch at WATER PUMP and allow water trough to fill to proper operating level.
11. Sanitize ice machine after cleaning.

# SANITIZING

Sanitizer is used for removal of algae or slime AND AFTER USE OF MANITOWOC ICE MACHINE CLEANER. It is not used for removal of lime scale or other mineral deposits.

1. Loosen two screws holding front panel in place and remove front panel.
2. Set ICE/OFF/WATER PUMP switch at OFF after ice falls from evaporator at completion of harvest cycle or set switch at OFF and allow ice to melt off evaporator.



## CAUTION

Never use any type of object to force ice from evaporator as damage may result.

3. Stacked ice machines: Remove ice chute as described under Removal of Parts for Cleaning, page 11.
4. Remove water curtain, Figure 53.
5. Remove all ice from bin.
6. Set ICE/OFF/WATER PUMP switch at WATER PUMP.
7. Add one ounce of sanitizer to water trough and allow solution to circulate a minimum of one minute.
8. Drain solution from trough by removing drain plug, Figure 50.
9. Thoroughly rinse trough with clean water, then reinstall drain plug.
10. Wash all surfaces requiring sanitizing (ice machine and bin) with a solution of one ounce of sanitizer to up to four gallons of water.
11. Thoroughly rinse all sanitized surfaces with clean water.
12. Set ICE/OFF/WATER PUMP switch at ICE.

# CHECKING AND CLEANING THE WATER DUMP VALVE

## OPERATION CHECK

1. Remove front panel.
2. Set ICE/OFF/WATER PUMP switch at ICE.
3. Check clear plastic outlet drain hose of dump valve, Figure 16, for leakage while the ice machine is in the freeze cycle.
4. If the dump valve is leaking or restricted, remove, disassemble and clean.

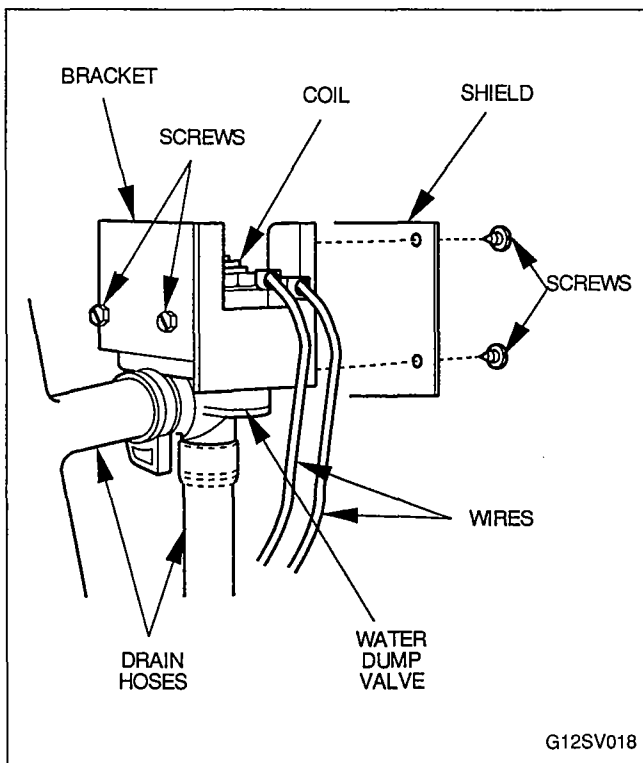
## REMOVE WATER DUMP VALVE (Figure 16)



### WARNING

Disconnect electric power to the ice machine at the electric service switch box.

1. Drain water trough by removing drain plug.
2. Remove two screws from water dump valve mounting bracket.



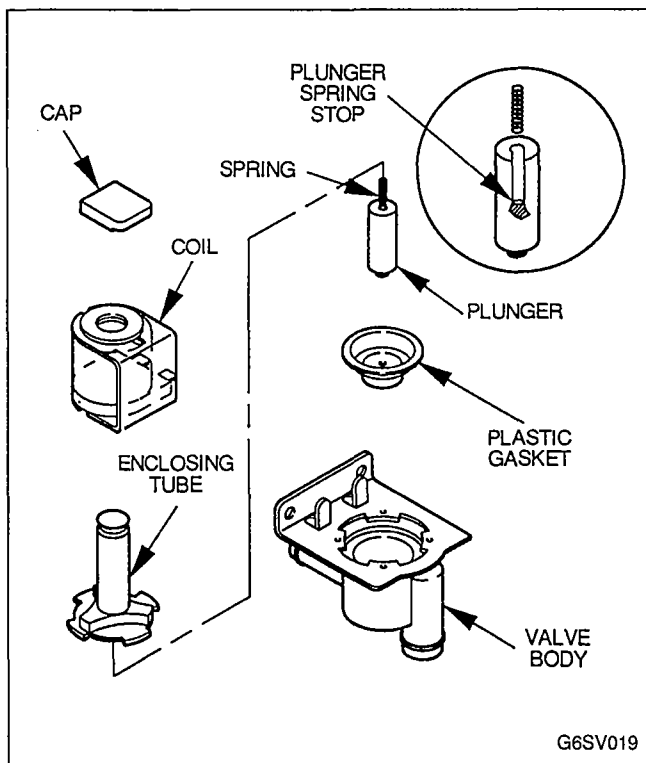
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FIGURE 16. WATER DUMP VALVE REMOVAL

3. Disconnect wires from dump valve coil.
4. Remove drain hose clamp and carefully remove both drain hoses from valve.
5. Remove two screws securing dump valve to mounting bracket.

## DISASSEMBLE PLASTIC BODY WATER DUMP VALVE (Figure 17)

1. Lift cap and slide coil retainer cap from top of coil.
2. Lift coil assembly off valve body. Note position of coil assembly on valve before removing. When reassembling valve, ensure coil is in same position.
3. Press down on enclosing tube plastic nut and rotate nut 1/4 turn and remove nut and enclosing tube from dump valve.
4. Remove enclosing tube, plunger and plastic gasket from valve body.

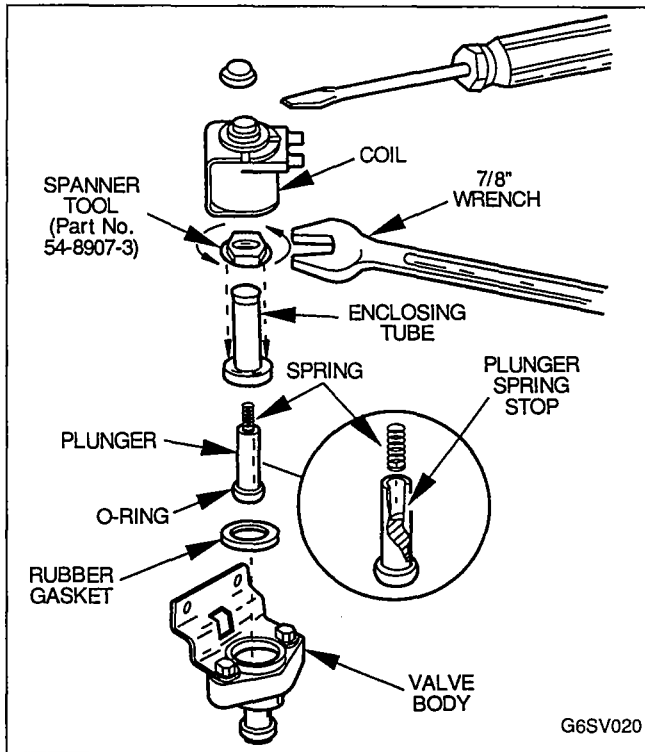


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FIGURE 17. PLASTIC BODY WATER DUMP  
VALVE DISASSEMBLY

## DISASSEMBLE BRASS BODY WATER DUMP VALVE (Figure 18)

1. Pry off retainer on top of dump valve coil with flat tip screwdriver.



**FIGURE 18. BRASS BODY WATER DUMP VALVE DISASSEMBLY**

2. Lift coil assembly off valve body. Note position of coil assembly on valve before removing. When reassembling valve, ensure coil is in same position.

3. Place spanner tool (Manitowoc Part No. 54-8907-3, available through your local Maniowoc Distributor) over enclosing tube and insert pins on spanner tool into holes on bottom of tube.
4. Turn spanner tool counterclockwise with 7/8" wrench and remove enclosing tube, plunger and rubber gasket from valve body.

## CLEANING WATER DUMP VALVE

### NOTE

It is not necessary to remove spring from plunger when cleaning. If spring is removed, insert *flared* end of spring into slotted opening in top of plunger until spring comes in contact with plunger spring stop. Use care not to stretch or damage spring in plunger when cleaning.

1. Soak components in cleaning solution (refer to Cleaning Procedures, page 13). Remove heavy scale deposits with a stiff-bristle brush. Use a small bottle brush to clean inside the enclosure tube. Wipe off rubber gasket with soft cloth.



### CAUTION

Do not soak coil assembly.

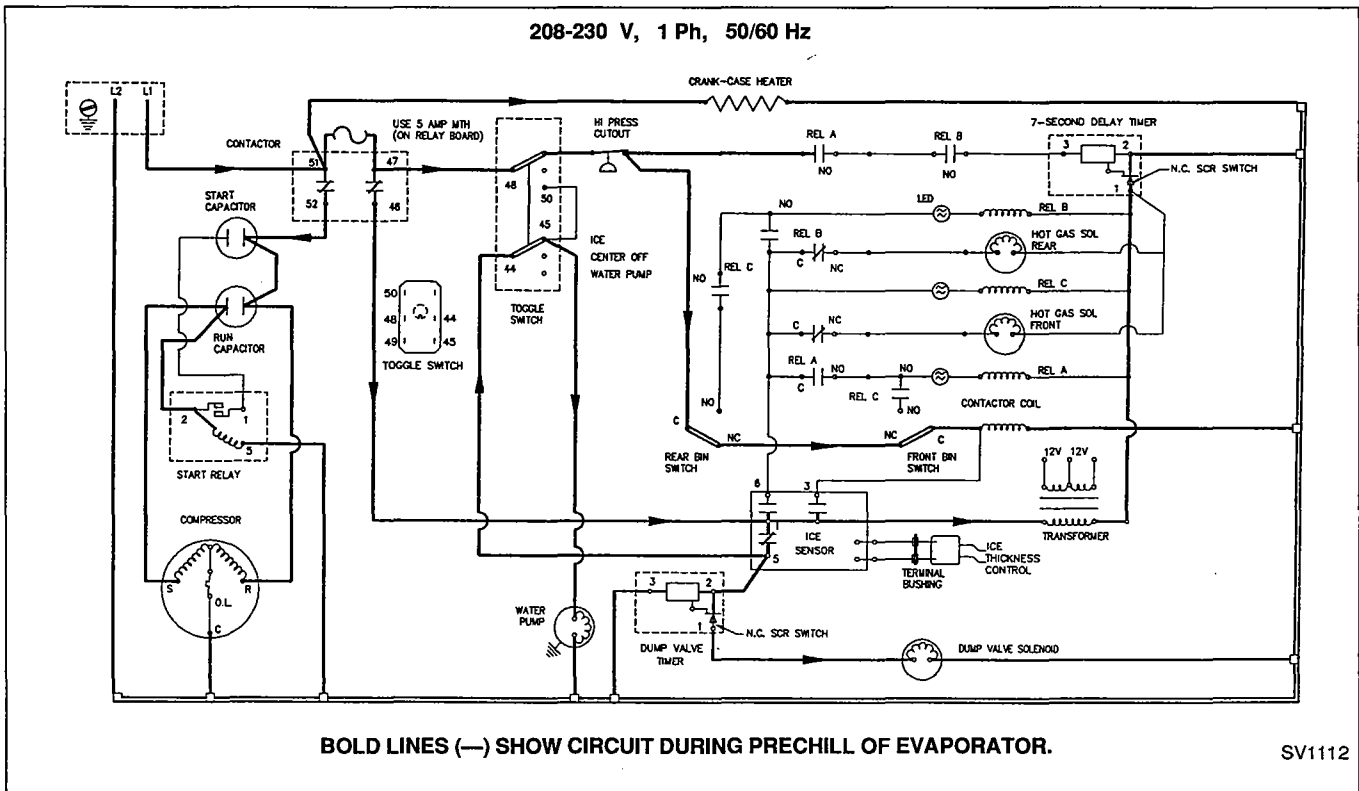
2. Thoroughly rinse components with clean water.
3. Reassemble water dump valve and reinstall in ice machine.

# ELECTRICAL SEQUENCE OF OPERATION SELF-CONTAINED WATER COOLED

## **FREEZE CYCLE (Prechill of Evaporator/Water Dump)**

With the toggle switch in the ice position, the current will flow through the high pressure cut-out and rear and front bin switches energizing the contactor coil. With the contactor energized the compressor will start. Voltage is supplied through the primary of the transformer,

through the contactor and normally closed (n.c.) 7-second delay timer switch. The current flow through normally closed ice sensor relay contact #5 energizes the water pump, dump valve and dump valve timer. Water flows through the energized dump valve and down the drain. This prechills the evaporators while water is flushed from the sump trough.



**FIGURE 19. PRECHILL ELECTRICAL SEQUENCE**

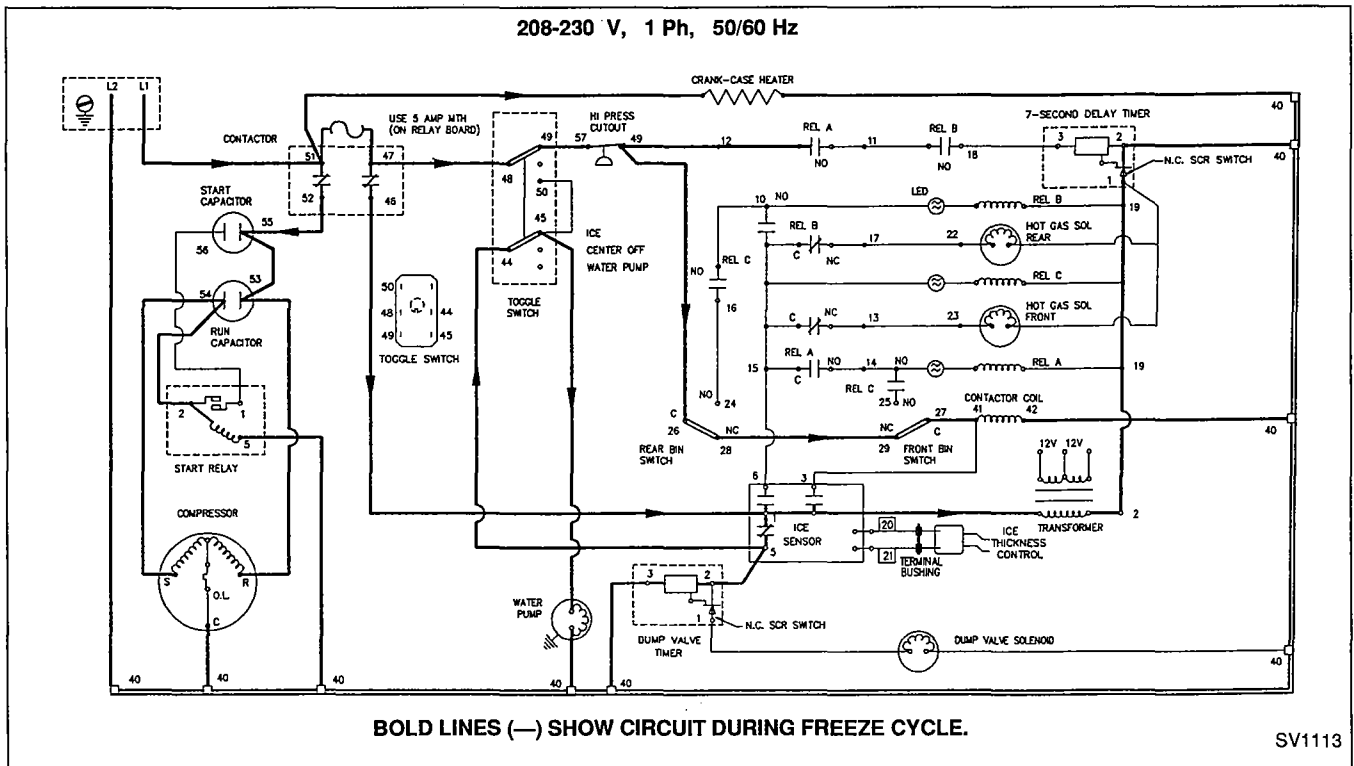
### **Prechill Electrical Sequence**

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Toggle switch ..... ice position</li> <li>2. High pressure cut-out ..... closed</li> <li>3. Rear bin switch ..... closed</li> <li>4. Front bin switch ..... closed</li> <li>5. Contactor ..... energized</li> <li>6. Compressor ..... energized</li> <li>7. 7-second delay timer ..... not energized<br/>Timer switch ..... closed</li> <li>8. Power at transformer primary ..... yes</li> <li>9. Ice sensor relay ..... not energized             <ol style="list-style-type: none"> <li>A. Ice sensor relay contact #3 ..... open</li> <li>B. Ice sensor relay contact #5 ..... closed</li> </ol> </li> </ol> | <ol style="list-style-type: none"> <li>1. Water pump ..... energized</li> <li>2. Dump valve timer ..... energized<br/>Timer switch ..... closed</li> <li>3. Dump valve solenoid ..... energized</li> <li>C. Ice sensor relay contact #6 ..... open</li> <li>10. Harvest relays A, B, C             <ol style="list-style-type: none"> <li>A. Relay A ..... not energized<br/>Front hot gas valve ..... not energized</li> <li>B. Relay B ..... not energized<br/>Rear hot gas valve ..... not energized</li> <li>C. Relay C ..... not energized</li> </ol> </li> </ol> |
|---|--|

## FREEZE CYCLE (Self-Contained Water Cooled)

The normally closed (n.c.) dump valve timer switch will open after the dump valve timer is energized continually for 20 seconds. The opening of the dump valve timer

switch will de-energize the dump valve and water will begin to flow over the evaporators, forming ice. The freeze cycle will last approximately 10-15 minutes, depending on air and water temperatures entering the ice machine. (Refer to Cycle Time Chart, page 62.)



**FIGURE 20. FREEZE CYCLE ELECTRICAL SEQUENCE**

### Freeze Cycle Electrical Sequence

1. Toggle switch ..... ice position
2. High pressure cut-out ..... closed
3. Rear bin switch ..... closed
4. Front bin switch ..... closed
5. Contactor ..... energized
6. Compressor ..... energized
7. 7-second delay timer ..... not energized  
Timer switch ..... closed
8. Power at transformer primary ..... yes
9. Ice sensor relay ..... not energized
  - A. Ice sensor relay contact #3 ..... open
  - B. Ice sensor relay contact #5 ..... closed

1. Water pump ..... energized
2. Dump valve timer ..... energized  
Timer switch ..... open
3. Dump valve solenoid ..... not energized
- C. Ice sensor relay contact #6 ..... open
10. Harvest relays A, B, C
  - A. Relay A ..... not energized  
Front hot gas valve ..... not energized
  - B. Relay B ..... not energized  
Rear hot gas valve ..... not energized
  - C. Relay C ..... not energized



**HARVEST CYCLE (NO. 2)  
(Self-Contained Water Cooled)  
(Ice Falling off Front Evaporator,  
Tripping Front Bin Switch/  
Ice on Rear Evaporator)**

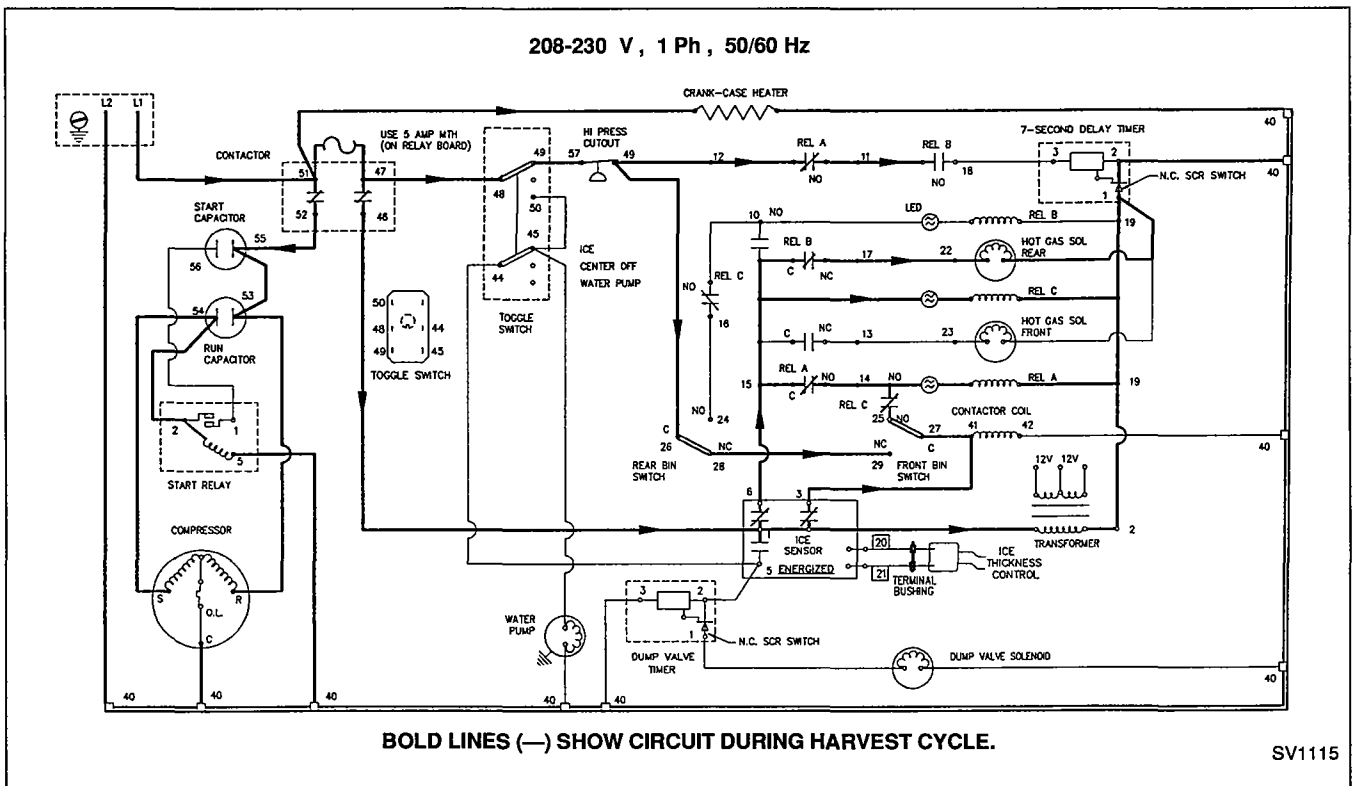
During the harvest mode, the hot gas raises the evaporator temperatures, causing the release of the ice from the evaporators. The ice may drop from the front, Figure 22, or rear, Figure 23, in any order or at the same time.

Figure 22 shows the ice as it is falling off the front evaporator (before the rear), pushing out on the front water curtain. The front water curtain movement will momentarily change the front bin switch from the normally closed (n.c.) position to the normally open

(n.o.) position. The bin switch movement to the open position will energize the relay A coil.

The normally closed (n.c.) contact of relay A will open and de-energize the front hot gas valve. Both normally open (n.o.) contacts of relay A will close. One of the n.o. contacts closes, acting as a holding circuit to keep relay A coil energized. This is required because the power supply to relay A coil is lost through the bin switch after ice falls into the bin and the water curtain falls back toward the evaporator.

The normally open (n.o.) contact of relay A, in series with the 7-second delay timer, closes. Timer will not energize until both normally open (n.o.) contacts of relay A and B are closed.



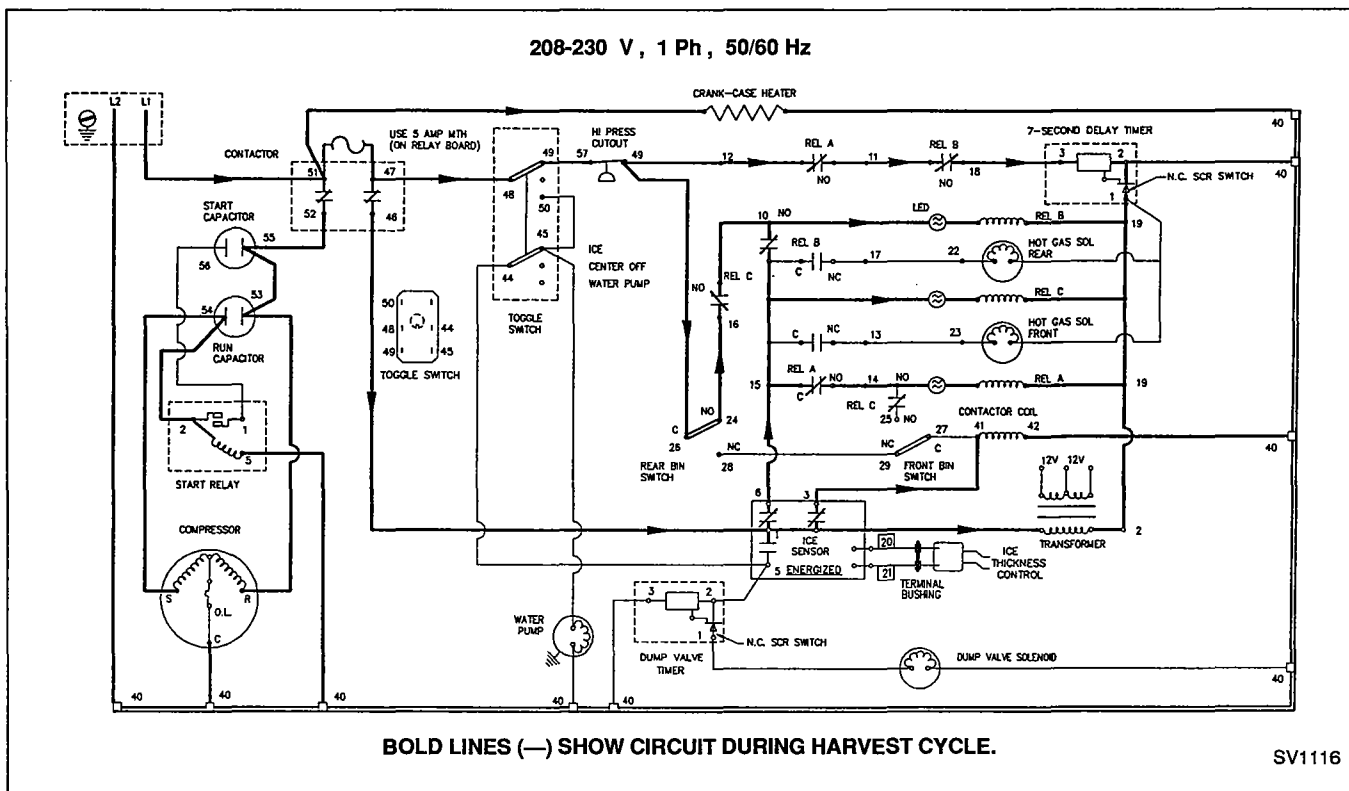
**FIGURE 22. HARVEST CYCLE ELECTRICAL SEQUENCE**

**HARVEST CYCLE (NO. 3)  
 (Self-Contained Water Cooled)  
 (Ice from Front Evaporator in Bin/  
 Ice on Evaporator Falling off,  
 Tripping Rear Bin Switch)**

During the harvest mode, the hot gas raises the evaporator temperatures, causing the release of the ice from the evaporators. The ice may drop from the front, Figure 22, or rear, Figure 23, in any order or at the same time.

Figure 23 shows the ice as it is falling off the rear evaporator (after ice has fallen off the front), pushing out

on the rear water curtain. The rear water curtain movement will momentarily change the rear bin switch from the normally closed (n.c.) position to the open position. The rear bin switch movement to the open position will energize the relay B coil. The normally closed (n.c.) contact of relay B will open and de-energize the rear hot gas valve. Both normally open (n.o) contacts of relay B will close. One of the n.o. contacts will close, acting as a holding circuit to energize relay B coil. This is required because the power supply to relay coil B is lost after ice falls into the bin and the water curtain falls back toward the evaporator. The other normally open (n.o.) contact closes to energize the 7-second delay timer.

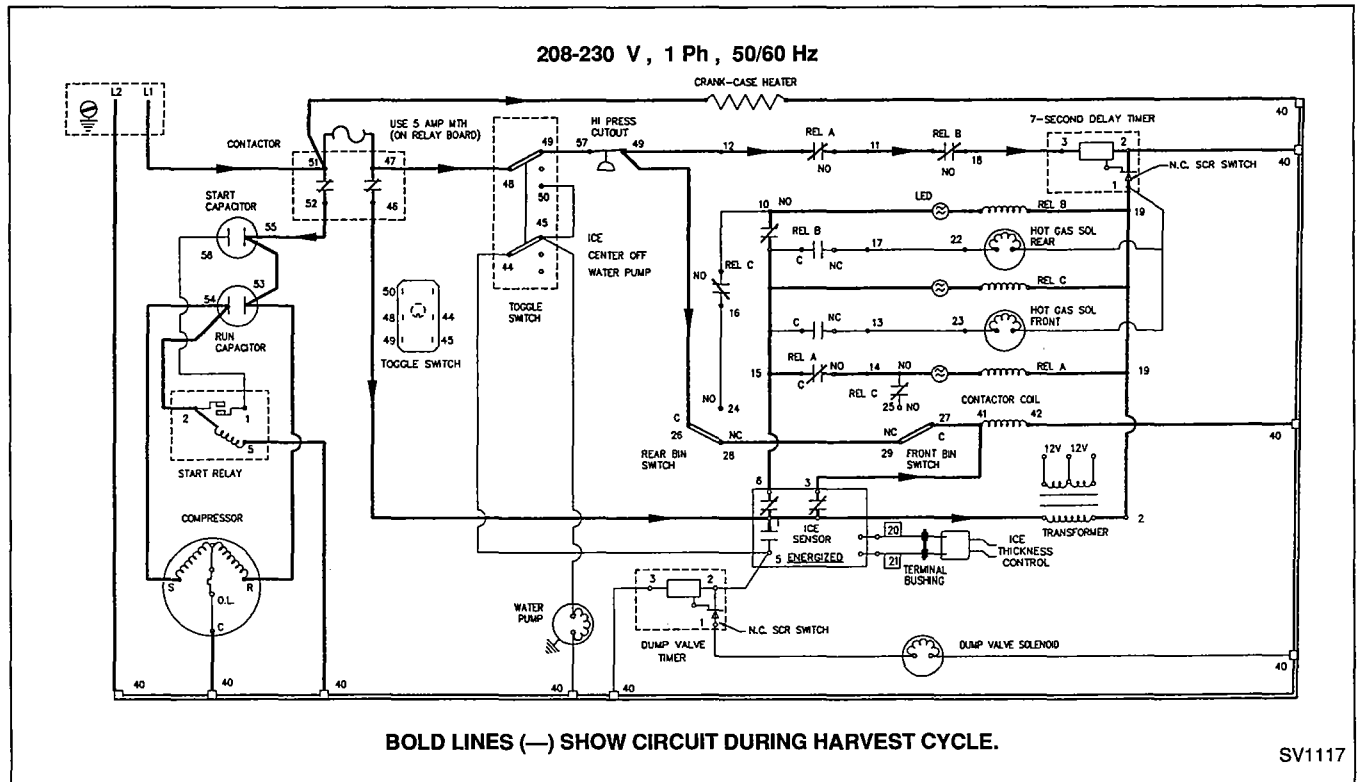


**FIGURE 23. HARVEST CYCLE ELECTRICAL SEQUENCE**

# HARVEST CYCLE (NO.4) (Self-Contained Water Cooled) (Ice from Both Evaporators Has Fallen into Bin)

Relays A and B are both energized after ice falls off both evaporators. With the normally open (n.o.) contacts of relays A and B closed, the 7-second delay timer relay is energized.

After the timer is "energized" continually for 7 seconds, the timer switch will open. This interrupts the primary power supply at the transformer, de-energizing the ice sensor relay on the unitized board. The ice sensor relay contacts #3, #5, and #6 change position. The ice machine will cycle back into the freeze cycle prechill.



**FIGURE 24. HARVEST CYCLE ELECTRICAL SEQUENCE**

### Harvest Cycle Electrical Sequence

(Switch positions shown just after ice has fallen off both evaporators and the 7-second delay timer is energized.)

- |                                 |              |                                |               |
|---------------------------------|--------------|--------------------------------|---------------|
| 1. Toggle switch                | ice position | 1. Water pump                  | not energized |
| 2. High pressure cut-out        | closed       | 2. Dump valve timer            | not energized |
| 3. Rear bin switch              | closed       | Timer switch                   | closed        |
| 4. Front bin switch             | closed       | 3. Dump valve solenoid         | not energized |
| 5. Contactor                    | energized    | C. Ice sensor relay contact #6 | closed        |
| 6. Compressor                   | energized    | 10. Harvest relays A, B, C     |               |
| 7. 7-second delay timer         | energized    | A. Relay A                     | energized     |
| Timer switch                    | closed       | Front hot gas valve            | not energized |
| (will open in 7 seconds)        |              | B. Relay B                     | energized     |
| 8. Power at transformer primary | yes          | Rear hot gas valve             | not energized |
| 9. Ice sensor relay             | energized    | C. Relay C                     | energized     |
| A. Ice sensor relay contact #3  | closed       |                                |               |
| B. Ice sensor relay contact #5  | open         |                                |               |

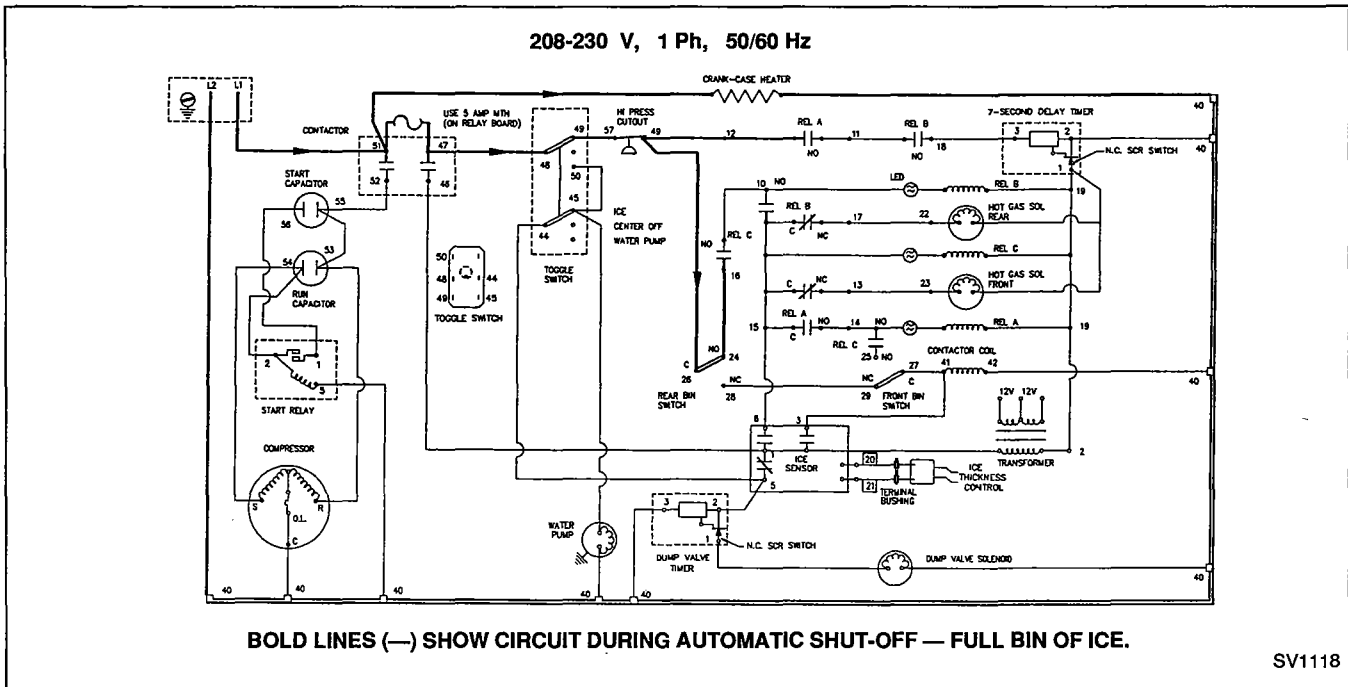
**AUTOMATIC SHUT-OFF  
(Self-Contained Water Cooled)  
(Full Bin of Ice)  
(Ice from Front Evaporator in Bin/  
Ice from Rear Evaporator Holding  
Rear Curtain Open)**

When ice storage bin becomes full, the last harvesting of ice cubes will not completely clear either the front or rear water curtain, holding it open. This will shut the ice machine off when it cycles back into the freeze mode. In the example below, ice has fallen off the front evaporator and cleared the front water curtain. This may have occurred before or after ice falls off the rear evaporator. The ice fell from the rear evaporator and did not completely clear the water curtain. This holds the rear bin switch in the open position.

At this point the main power supply through the bin switches to the contactor is lost. The contactor is being energized through ice sensor contact #3 which is closed during the harvest cycle only. (The ice machine will not shut off until a complete harvest cycle occurs). As the ice machine cycles back into the freeze cycle, the ice sensor contact #3 will open. The contactor will de-energize and the ice machine shuts off. The ice machine remains off until sufficient ice is removed from the bin allowing ice to clear the water curtain and close the bin switch.

**NOTE**

Relay C prevents the front hot gas valve from energizing when the ice machine is shut off on a rear bin switch.



**FIGURE 25. AUTOMATIC SHUT-OFF ELECTRICAL SEQUENCE**

**Automatic Shut-Off Electrical Sequence**

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Toggle switch . . . . . ice position</li> <li>2. High pressure cut-out . . . . . closed</li> <li>3. Rear bin switch . . . . . open</li> <li>4. Front bin switch . . . . . closed</li> <li>5. Contactor . . . . . not energized</li> <li>6. Compressor . . . . . not energized</li> <li>7. 7-second delay timer . . . . . not energized</li> <li>Timer switch . . . . . closed</li> <li>8. Power at transformer primary . . . . . no</li> <li>9. Ice sensor relay . . . . . not energized             <ol style="list-style-type: none"> <li>A. Ice sensor relay contact #3 . . . . . open</li> <li>B. Ice sensor relay contact #5 . . . . . closed</li> </ol> </li> </ol> | <ol style="list-style-type: none"> <li>1. Water pump . . . . . not energized</li> <li>2. Dump valve timer . . . . . not energized</li> <li>Timer switch . . . . . closed</li> <li>3. Dump valve solenoid . . . . . not energized</li> <li>C. Ice sensor relay contact #6 . . . . . open</li> <li>10. Harvest relays A, B, C             <ol style="list-style-type: none"> <li>A. Relay A . . . . . not energized</li> <li>Front hot gas valve . . . . . not energized</li> <li>B. Relay B . . . . . not energized</li> <li>Rear hot gas valve . . . . . not energized</li> <li>C. Relay C . . . . . not energized</li> </ol> </li> </ol> |
|---|---|

# ELECTRICAL SEQUENCE OF OPERATION REMOTE ICE MACHINES

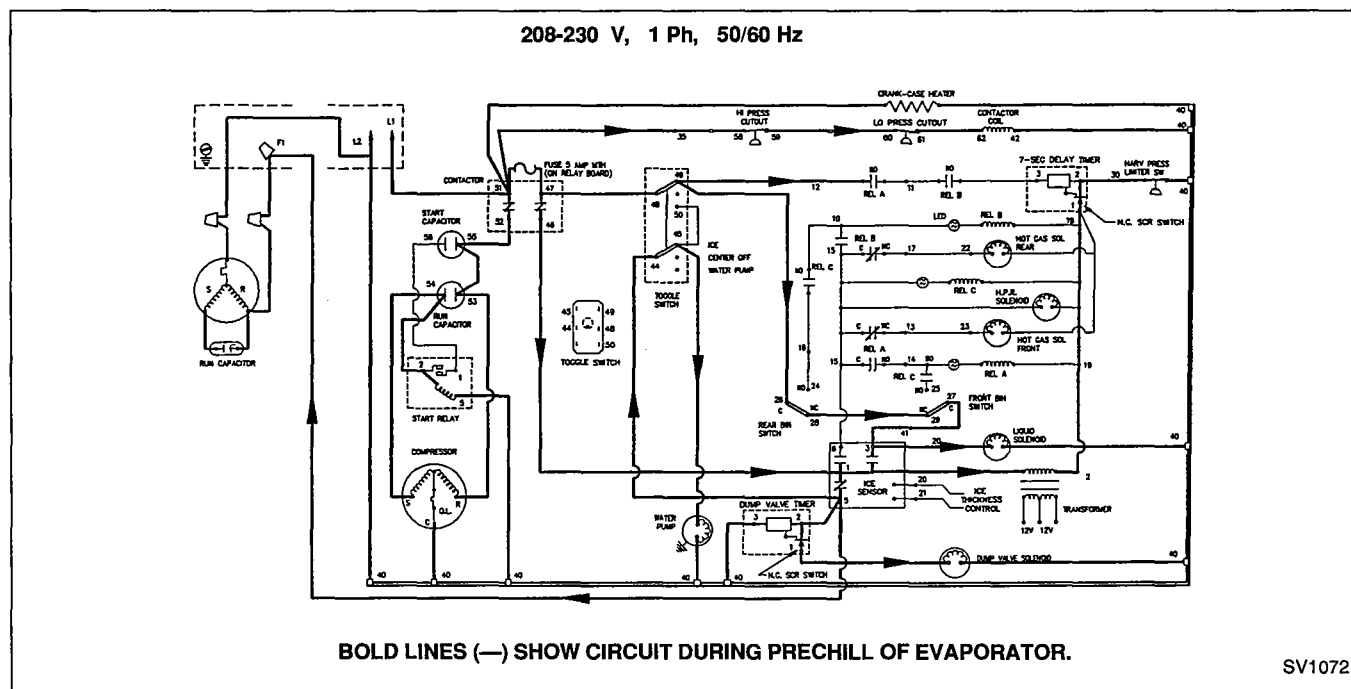
## **FREEZE CYCLE (Prechill of Evaporator/Water Dump)**

### **Initial Start-Up**

With the toggle switch in the ice position, current will flow through the rear and front bin switches to energize the liquid line solenoid. The low pressure will rise, closing the low pressure cut-out (approximately 40 psig) to energize the contactor coil which starts the compressor and the prechill.

### **Freeze Cycle Prechill**

Voltage is supplied to the primary of the transformer through the contactor, normally closed (n.c.) switch of the 7-second delay timer and the harvest pressure limit cut-out. The current flow through normally closed (n.c.) ice sensor relay contact #5 energizes the remote condenser, fan motor, water pump, dump valve, and dump valve timer. Water flows through the energized dump valve and down the drain. This prechills the evaporators while water is flushed from the sump trough.



**FIGURE 26. PRECHILL ELECTRICAL SEQUENCE**

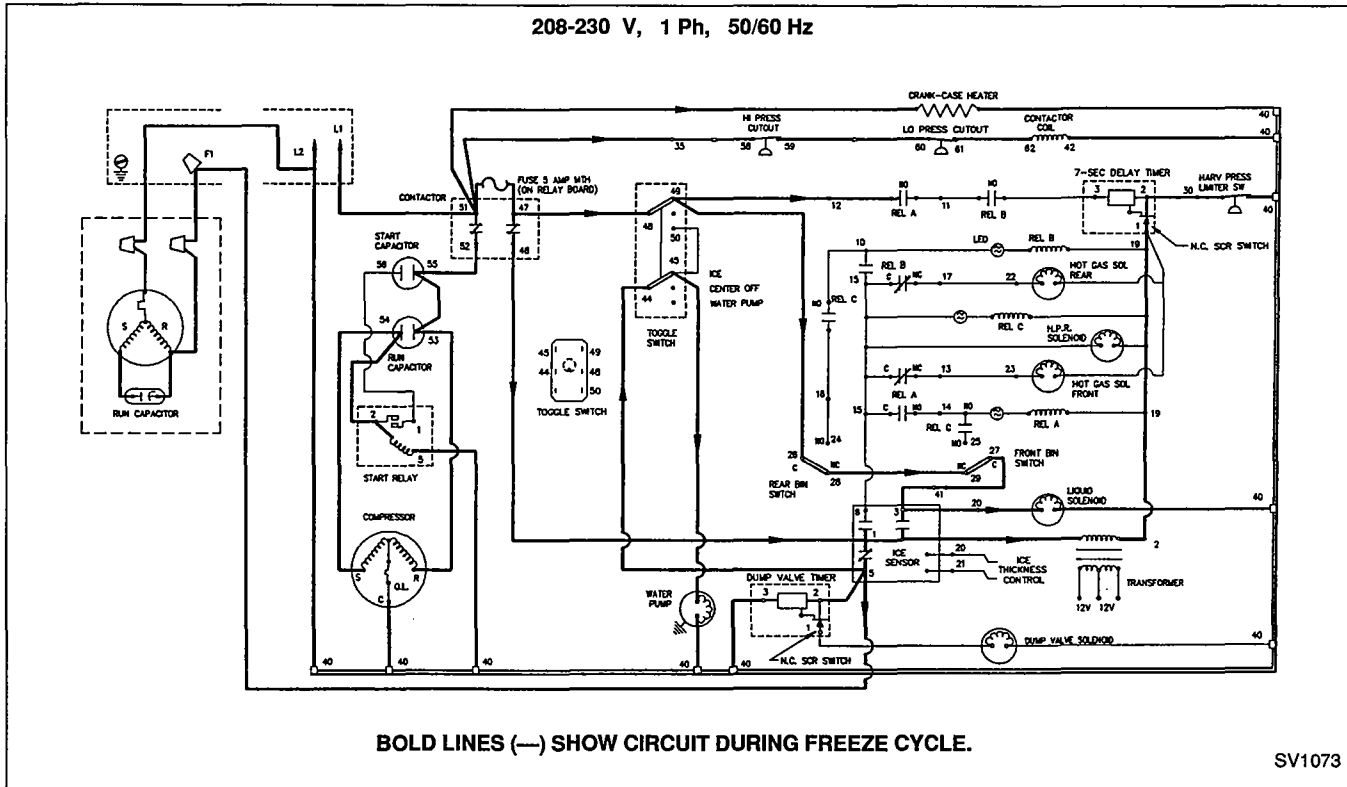
### **Prechill Electrical Sequence**

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Toggle switch . . . . . ice position</li> <li>2. Rear bin switch . . . . . closed</li> <li>3. Front bin switch . . . . . closed</li> <li>4. Liquid line solenoid valve . . . . . energized</li> <li>5. High pressure cut-out . . . . . closed</li> <li>6. Low pressure cut-out . . . . . closed</li> <li>7. Contactor . . . . . energized</li> <li>8. Compressor . . . . . energized</li> <li>9. 7-second delay timer . . . . . not energized<br/>Timer switch . . . . . closed</li> <li>10. Harvest pressure limiter . . . . . closed</li> <li>11. Power at transformer primary . . . . . yes</li> <li>12. Ice sensor relay . . . . . not energized             <ol style="list-style-type: none"> <li>A. Ice sensor relay contact #3 . . . . . open</li> <li>B. Ice sensor relay contact #5 . . . . . closed</li> </ol> </li> </ol> | <ol style="list-style-type: none"> <li>1. Remote condenser<br/>fan motor . . . . . energized</li> <li>2. Water pump . . . . . energized</li> <li>3. Dump valve timer . . . . . energized<br/>Timer switch . . . . . closed</li> <li>4. Dump valve solenoid . . . . . energized</li> <li>C. Ice sensor relay contact #6 . . . . . open</li> <li>D. Harvest pressure regulating<br/>(HPR) solenoid . . . . . not energized</li> <li>13. Harvest relays A, B, C             <ol style="list-style-type: none"> <li>A. Relay A . . . . . not energized<br/>Front hot gas valve . . . . . not energized</li> <li>B. Relay B . . . . . not energized<br/>Rear hot gas valve . . . . . not energized</li> <li>C. Relay C . . . . . not energized</li> </ol> </li> </ol> |
|---|--|

## FREEZE CYCLE (Remote Machines)

The normally closed (n.c.) dump valve timer switch will open after the dump valve timer is energized continually for 20 seconds. The opening of the dump valve timer

switch will de-energize the dump valve and water will begin to flow over the evaporators, forming ice. The freeze cycle will last approximately 10-16 minutes, depending on air and water temperatures entering the ice machine. (Refer to Cycle Time Chart, page 62.)



**FIGURE 27. FREEZE CYCLE ELECTRICAL SEQUENCE**

### Freeze Cycle Electrical Sequence

- |                                  |               |   |               |
|----------------------------------|---------------|---|---------------|
| 1. Toggle switch                 | ice position  | 1. Remote condenser fan motor                 | energized     |
| 2. Rear bin switch               | closed        | 2. Water pump                                 | energized     |
| 3. Front bin switch              | closed        | 3. Dump valve timer                           | energized     |
| 4. Liquid line solenoid          | energized     | Timer switch                                  | open          |
| 5. High pressure cut-out         | closed        | 4. Dump valve solenoid                        | not energized |
| 6. Low pressure cut-out          | closed        | C. Ice sensor relay contact #6                | open          |
| 7. Contactor                     | energized     | D. Harvest pressure regulating (HPR) solenoid | not energized |
| 8. Compressor                    | energized     | 13. Harvest relays A, B, C                    |               |
| 9. 7-second delay timer          | not energized | A. Relay A                                    | not energized |
| Timer switch                     | closed        | Front hot gas valve                           | not energized |
| 10. Harvest pressure limiter     | closed        | B. Relay B                                    | not energized |
| 11. Power at transformer primary | yes           | Rear hot gas valve                            | not energized |
| 12. Ice sensor relay             | not energized | C. Relay C                                    | not energized |
| A. Ice sensor relay contact #3   | open          |   |               |
| B. Ice sensor relay contact #5   | closed        |   |               |

## HARVEST CYCLE (NO. 1) (Remote Machines) (Ice on Front and Rear Evaporators)

The harvest cycle begins when water flowing over the ice on the front evaporator contacts the probes on the ice thickness control. After a constant 6-10 seconds of water contact, the relay on the ice sensor board is energized, changing contacts #3, #5 and #6.

Contact #3 — Closes to supply a secondary power to the liquid line solenoid during the entire harvest cycle. This is needed to prevent the liquid line solenoid from de-energizing, as the power supply through the bin switches to the liquid line solenoid will be interrupted as

the bin switches open momentarily during the harvest cycle.

Contact #5 — Opens to de-energize the remote condenser fan motor, water pump and dump valve timer.

Contact #6 — Closes to energize the front hot gas valve, rear hot gas valve, harvest pressure regulating (HPR) valve, and relay C. Relay C closed two sets of contacts.

### NOTE

Relay C is used to isolate components from voltage supply during the automatic shut-off mode, thus has no specific function while the ice machine is running.

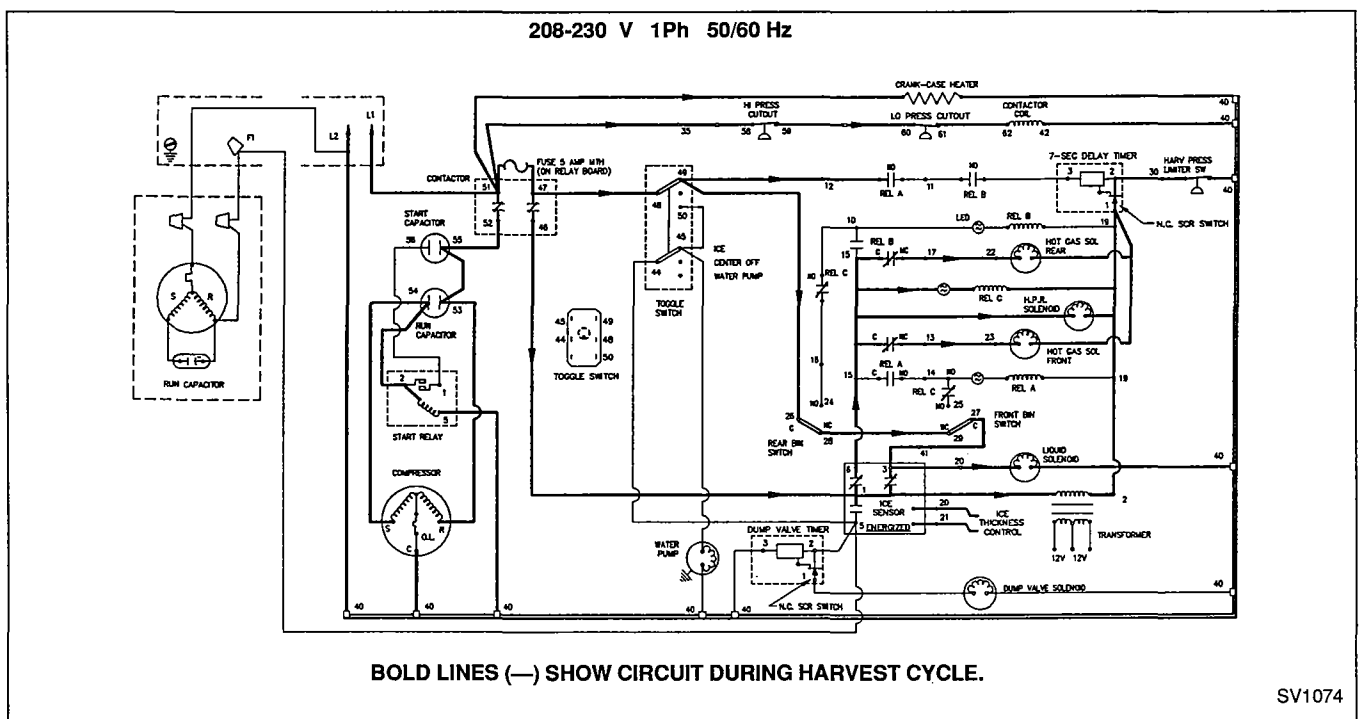


FIGURE 28. HARVEST CYCLE ELECTRICAL SEQUENCE

### Harvest Cycle Electrical Sequence

- |                                  |               |   |               |
|----------------------------------|---------------|---|---------------|
| 1. Toggle switch                 | ice position  | 1. Remote condenser fan motor                 | not energized |
| 2. Rear bin switch               | closed        | 2. Water pump                                 | not energized |
| 3. Front bin switch              | closed        | 3. Dump valve timer                           | not energized |
| 4. Liquid line solenoid valve    | energized     | Timer switch                                  | closed        |
| 5. High pressure cut-out         | closed        | 4. Dump valve solenoid                        | not energized |
| 6. Low pressure cut-out          | closed        | C. Ice sensor relay contact #6                | closed        |
| 7. Contactor                     | energized     | D. Harvest pressure regulating (HPR) solenoid | energized     |
| 8. Compressor                    | energized     | 13. Harvest relays A, B, C                    |               |
| 9. 7-second delay timer          | not energized | A. Relay A                                    | not energized |
| Timer switch                     | closed        | Front hot gas valve                           | energized     |
| 10. Harvest pressure limiter     | closed        | B. Relay B                                    | not energized |
| 11. Power at transformer primary | yes           | Rear hot gas valve                            | energized     |
| 12. Ice sensor relay             | energized     | C. Relay C                                    | energized     |
| A. Ice sensor relay contact #3   | closed        |   |               |
| B. Ice sensor relay contact #5   | open          |   |               |



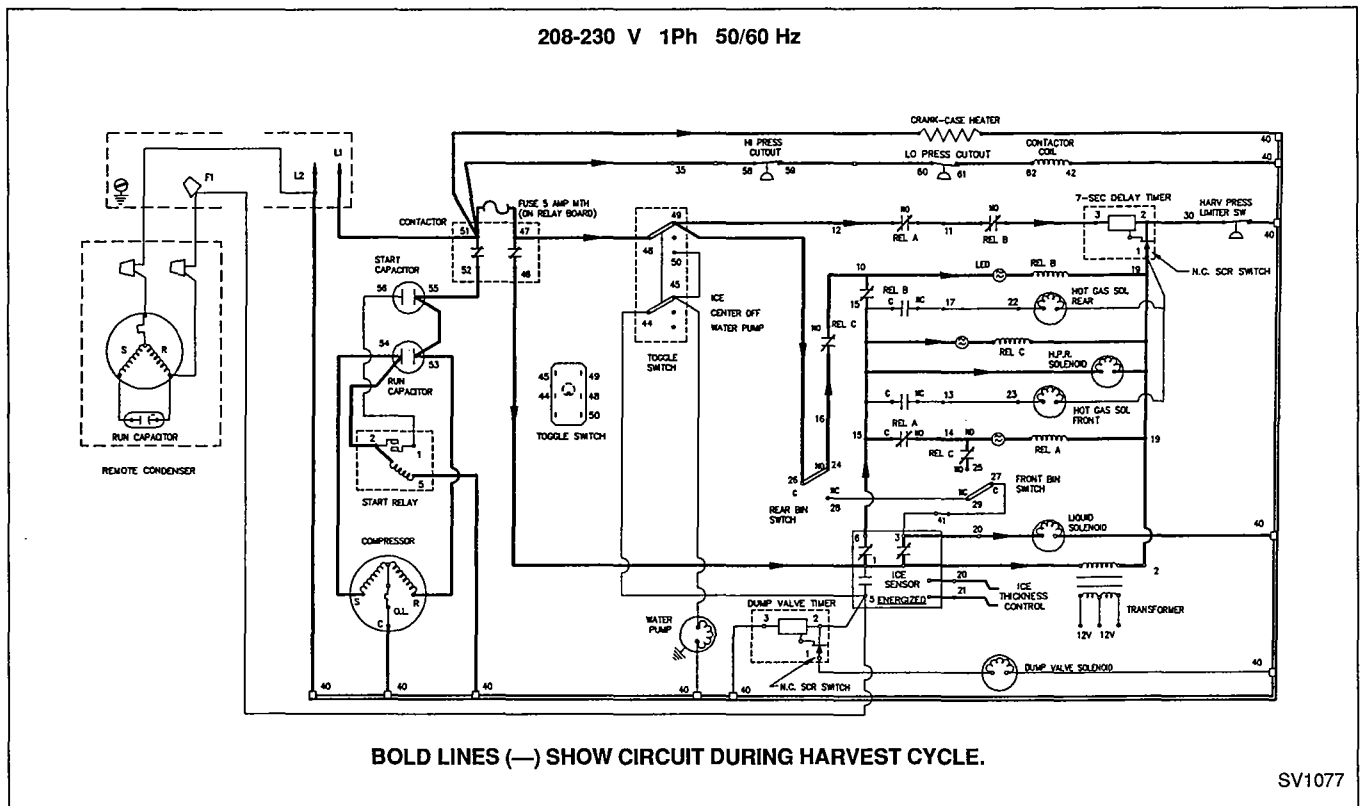
**HARVEST CYCLE (NO. 3)  
(Remote Machines)  
(Ice from Front Evaporator in Bin/  
Ice on Rear Evaporator Falling off,  
Tripping Rear Bin Switch)**

During the harvest mode, the hot gas raises the evaporator temperatures, causing the release of the ice from the evaporators. The ice may drop from the front, Figure 29, or the rear, Figure 30, in any order or at the same time.

Figure 30 shows the ice as it is falling off the rear evaporator (after ice has fallen off the front), pushing out on the rear water curtain. The rear water curtain movement will momentarily change the rear bin switch

from the normally closed (n.c.) position to the open position. The rear bin switch movement to the n.o. position will energize the relay B coil. The normally closed (n.c.) contact of relay B will open and de-energize the rear hot gas valve. Both normally open (n.o.) contacts of relay B will close. One of the n.o. contacts closes, acting as a holding circuit to keep relay B coil energized. This is needed because the power supply to relay B coil is lost through the rear bin switch after ice falls into the bin and the water curtain falls back toward the evaporator.

The other normally open (n.o.) contact of relay B closes to energize the 7-second delay timer.

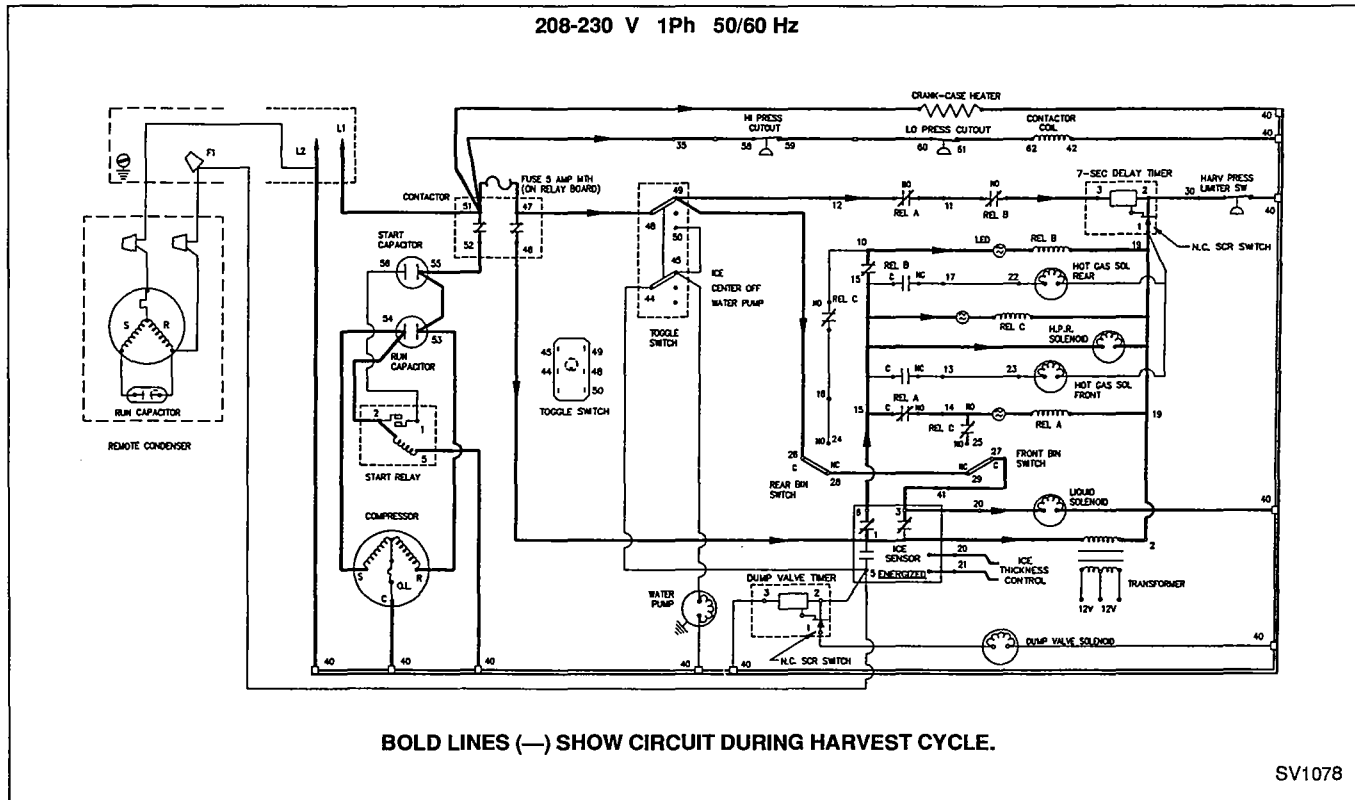


**FIGURE 30. HARVEST CYCLE ELECTRICAL SEQUENCE**

**HARVEST CYCLE (NO. 4)  
(Remote Machines)  
(Ice from Both Evaporators Has  
Fallen into Bin)**

Relays A and B are both energized after ice falls off both evaporators. With the normally open (n.o.) contacts of relays A and B closed, the 7-second delay relay is

energized. After the timer is "energized" continually for 7 seconds, the timer switch will open. This interrupts the primary power supply at the transformer, de-energizing the ice sensor relay on the unitized board. The ice sensor relay contacts #3, #5, and #6 change position. The ice machine will cycle back into the freeze cycle prechill.



**FIGURE 31. HARVEST CYCLE ELECTRICAL SEQUENCE**

**Harvest Cycle Electrical Sequence**

(Switch positions shown just after ice has fallen off both evaporators and the 7-second delay timer is energized.)

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Toggle switch . . . . . ice position</li> <li>2. Rear bin switch . . . . . closed</li> <li>3. Front bin switch . . . . . closed</li> <li>4. Liquid line solenoid valve . . . . . energized</li> <li>5. High pressure cut-out . . . . . closed</li> <li>6. Low pressure cut-out . . . . . closed</li> <li>7. Contactor . . . . . energized</li> <li>8. Compressor . . . . . energized</li> <li>9. 7-second delay timer . . . . . energized</li> <li style="padding-left: 20px;">Timer switch . . . . . closed</li> <li style="padding-left: 40px;">(will open in 7 seconds)</li> <li>10. Harvest pressure limiter . . . . . closed</li> <li>11. Power at transformer primary . . . . . yes</li> <li>12. Ice sensor relay . . . . . energized</li> <li style="padding-left: 20px;">A. Ice sensor relay contact #3 . . . . . closed</li> <li style="padding-left: 20px;">B. Ice sensor relay contact #5 . . . . . open</li> </ol> | <ol style="list-style-type: none"> <li>1. Remote condenser fan motor . . . . . not energized</li> <li>2. Water pump . . . . . not energized</li> <li>3. Dump valve timer . . . . . not energized</li> <li style="padding-left: 20px;">Timer switch . . . . . closed</li> <li>4. Dump valve solenoid . . . . . not energized</li> <li>C. Ice sensor relay contact #6 . . . . . closed</li> <li>D. Harvest pressure regulating (HPR) solenoid . . . . . energized</li> <li>13. Harvest relays A, B, C</li> <li style="padding-left: 20px;">A. Relay A . . . . . energized</li> <li style="padding-left: 40px;">Front hot gas valve . . . . . not energized</li> <li style="padding-left: 20px;">B. Relay B . . . . . energized</li> <li style="padding-left: 40px;">Rear hot gas valve . . . . . not energized</li> <li style="padding-left: 20px;">C. Relay C . . . . . energized</li> </ol> |
|--|---|

**AUTOMATIC SHUT-OFF  
(Remote Machines)  
(Full Bin of Ice)  
(Ice from Front Evaporator in Bin/  
Ice from Rear Evaporator Holding  
Rear Curtain Open)**

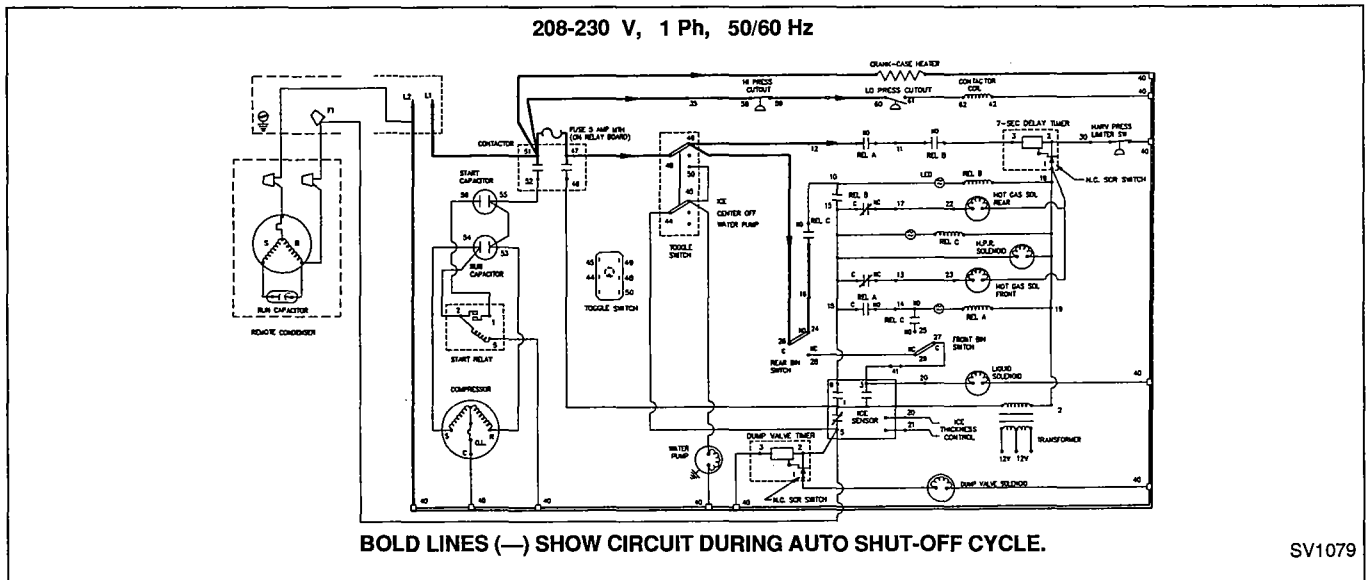
When the ice storage bin becomes full, the last harvesting of ice cubes will not completely clear either the front or rear water curtain, holding it open. This will shut the ice machine off when it cycles back into the freeze mode. In this example, ice has fallen off the front evaporator and cleared the front water curtain. This may have occurred before or after ice falls off the rear evaporator. The ice fell from the rear evaporator and did not completely clear the water curtain. This holds the rear bin switch in the open position.

At this point the main power supply through the bin switches to the liquid line solenoid is lost. The liquid

line solenoid is being energized through ice sensor contact #3 which is closed during the harvest cycle only. (The ice machine will not shut off until a complete harvest cycle occurs.) As the ice machine cycles back into the freeze cycle, the ice sensor contact #3 will open. The liquid line solenoid will de-energize. The compressor will continue to run and pump down the low side of the ice machine. When the suction pressure reaches approximately 15 psig, the low pressure cut-out control opens and de-energizes the contactor, shutting the ice machine off.

**NOTE**  
Relay C prevents the front hot gas valve and HPR valve from energizing when the machine is shut off by a rear bin switch.

The ice machine remains off until sufficient ice is removed from the bin allowing ice to clear the water curtain and close the bin switch.



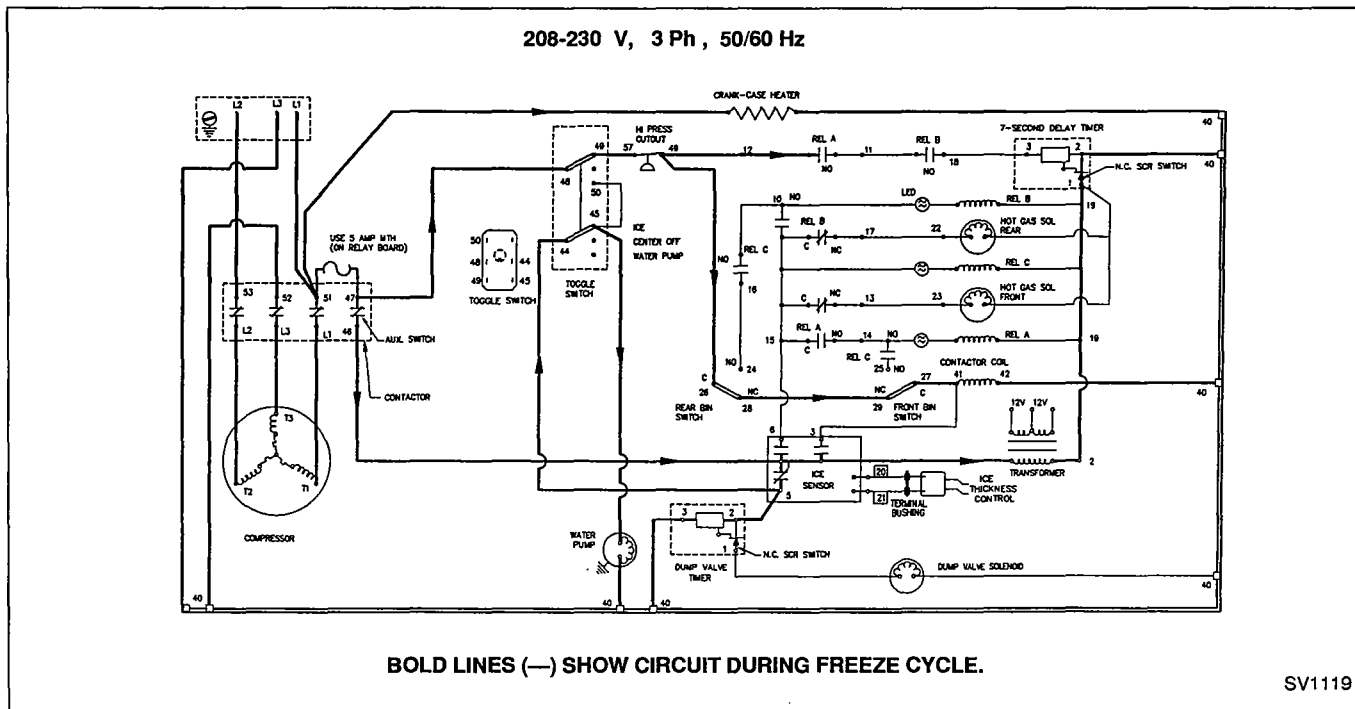
**FIGURE 32. AUTOMATIC SHUT-OFF ELECTRICAL SEQUENCE**

**Automatic Shut-Off Electrical Sequence**

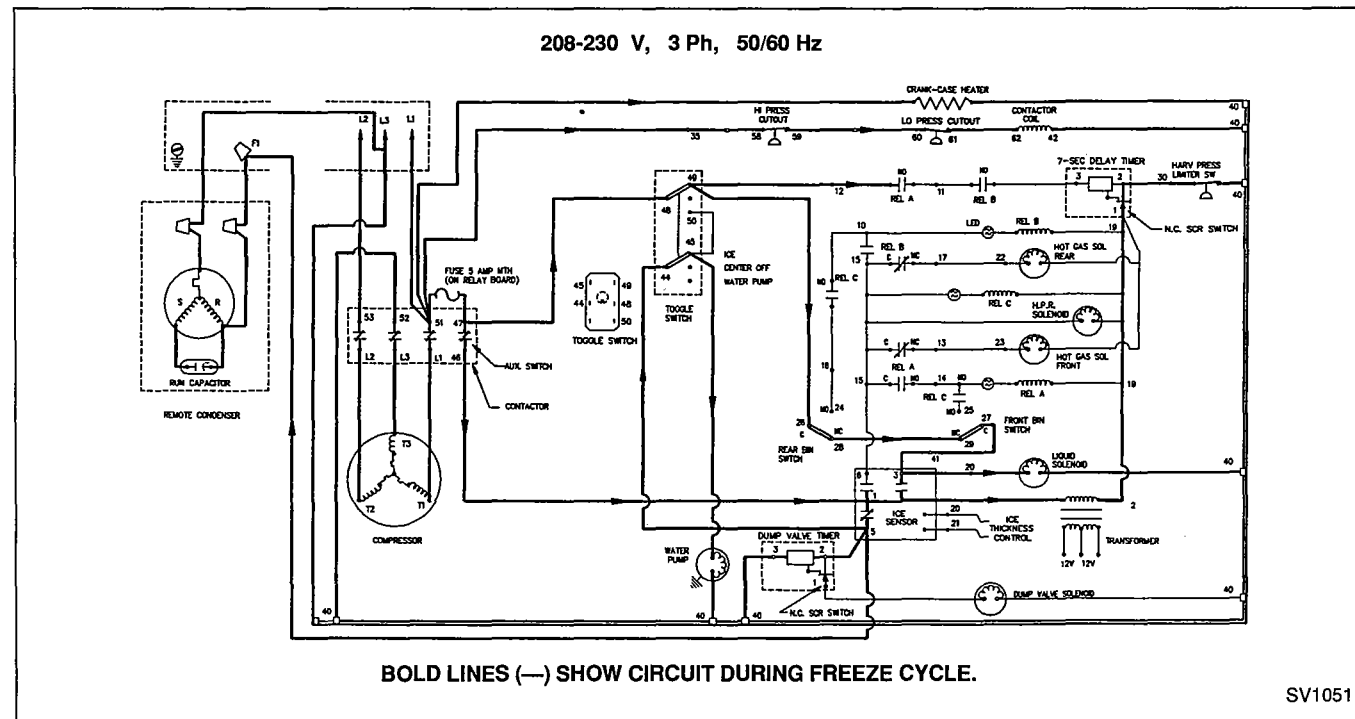
1. Toggle switch ..... ice position
2. Rear bin switch ..... open
3. Front bin switch ..... closed
4. Liquid line solenoid valve ..... not energized
5. High pressure cut-out ..... closed
6. Low pressure cut-out ..... open
7. Contactor ..... not energized
8. Compressor ..... not energized
9. 7-second delay timer ..... not energized  
Timer switch ..... closed
10. Harvest pressure limiter ..... closed
11. Power at transformer primary ..... no
12. Ice sensor relay ..... not energized
  - A. Ice sensor relay contact #3 ..... open
  - B. Ice sensor relay contact #5 ..... closed

1. Remote condenser fan motor ..... not energized
2. Water pump ..... not energized
3. Dump valve timer ..... not energized  
Timer switch ..... closed
4. Dump valve solenoid ..... not energized
- C. Ice sensor relay contact #6 ..... open
- D. Harvest pressure regulating (HPR) solenoid ..... not energized
13. Harvest relays A, B, C
  - A. Relay A ..... not energized  
Front hot gas valve ..... not energized
  - B. Relay B ..... not energized  
Rear hot gas valve ..... not energized
  - C. Relay C ..... not energized

# 3-PHASE WIRING DIAGRAMS (208/230 V, 3 Ph, 50/60 Hz)



**FIGURE 33. SELF-CONTAINED WATER COOLED WIRING DIAGRAM**



**FIGURE 34. REMOTE MACHINES WIRING DIAGRAM**

# 3-PHASE WIRING DIAGRAMS (380/220 V, 3 Ph, 50 Hz)

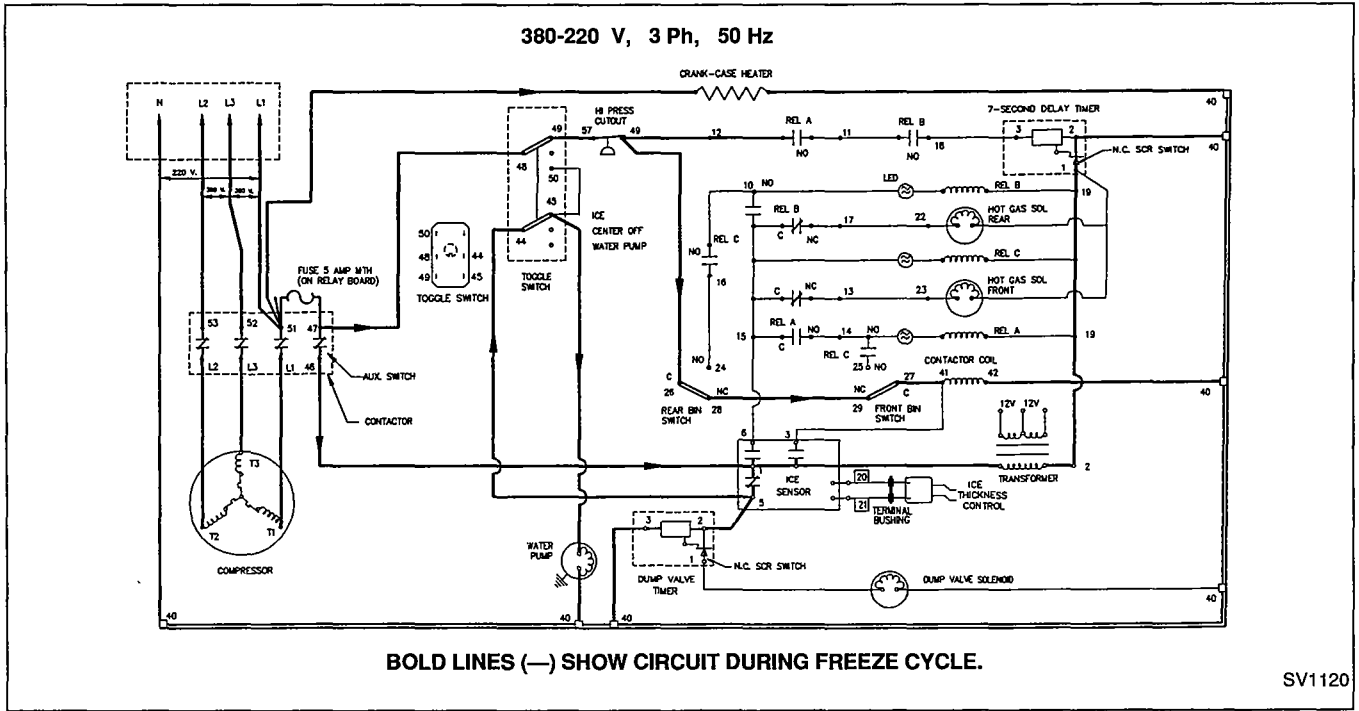


FIGURE 35. SELF-CONTAINED WATER COOLED WIRING DIAGRAM

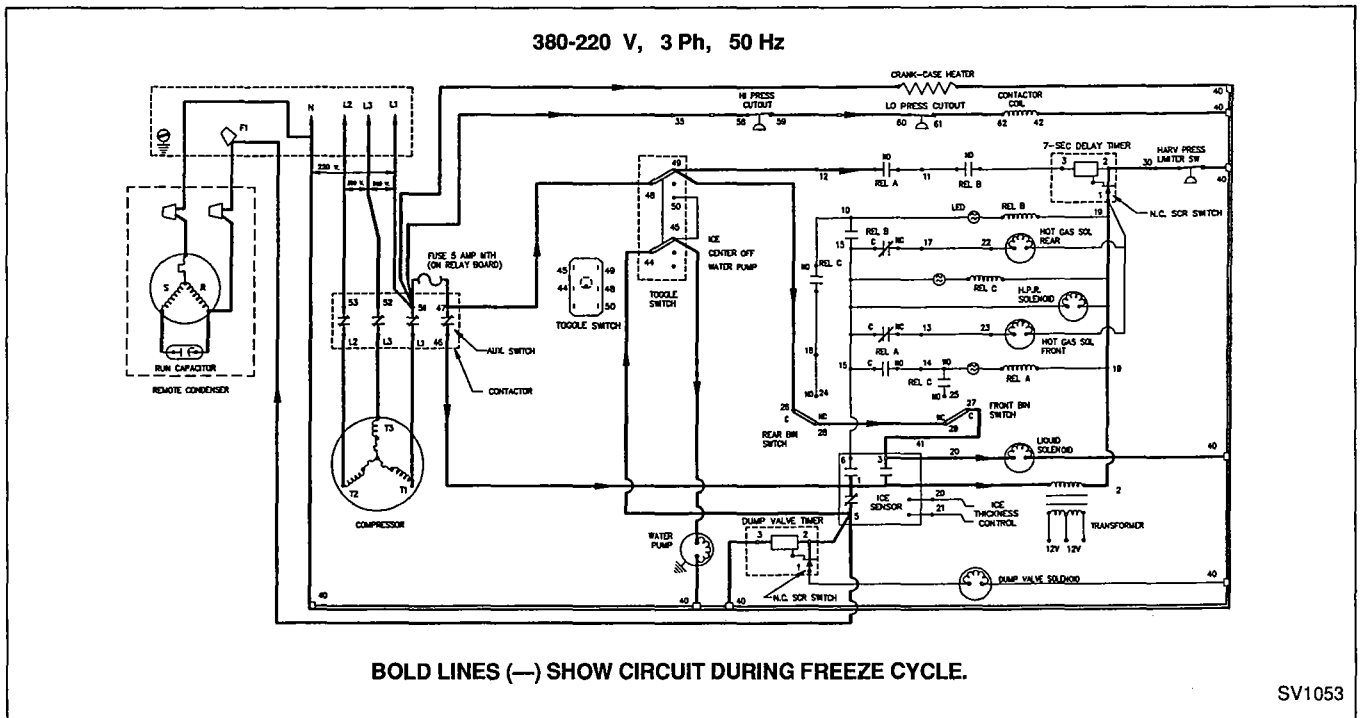
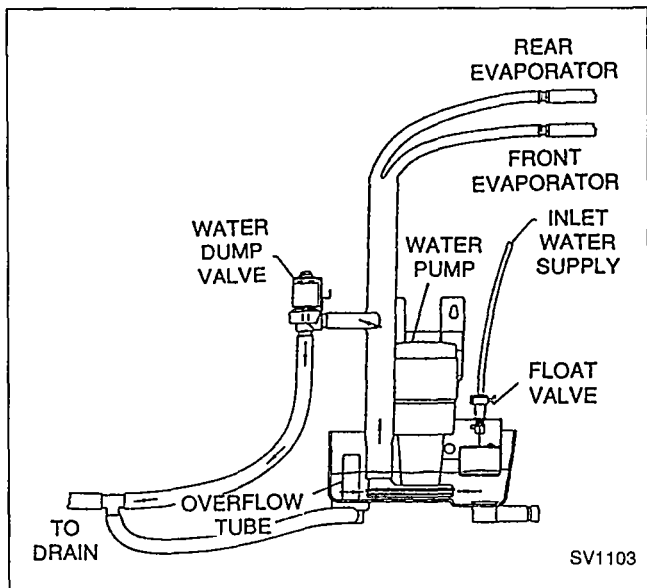


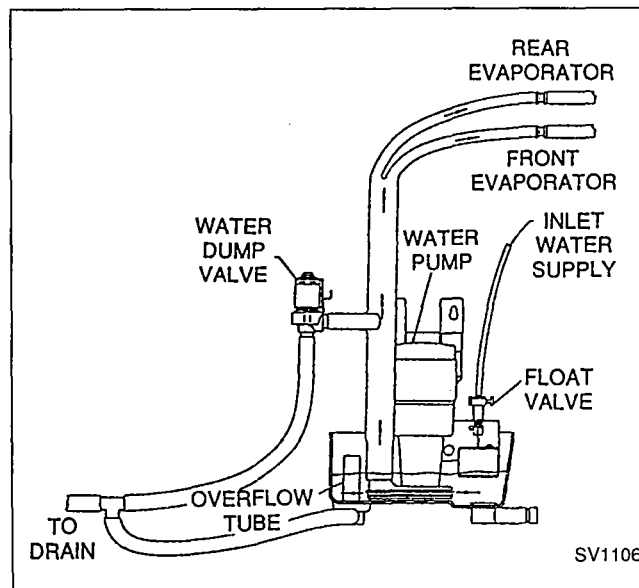
FIGURE 36. REMOTE MACHINES WIRING DIAGRAM

# WATER SYSTEM SEQUENCE OF OPERATION SELF-CONTAINED OR REMOTE MACHINES

## WATER SYSTEM



**FIGURE 37. PRECHILL WATER FLOW SEQUENCE**



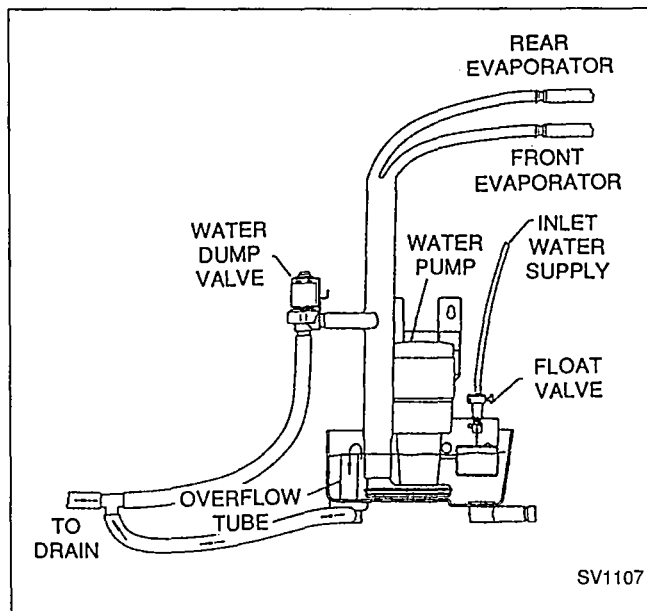
**FIGURE 38. FREEZE CYCLE WATER FLOW SEQUENCE**

### Prechill Water Flow Sequence

The water from the sump trough is pumped through the energized dump valve and down the drain. The flushing helps to keep the cubes clear and reduces the frequency of the ice machine cleanings.

### Freeze Cycle Water Flow Sequence

Water from the sump trough is pumped to the distribution tubes above the evaporators. The float valve maintains proper water level in the sump trough.



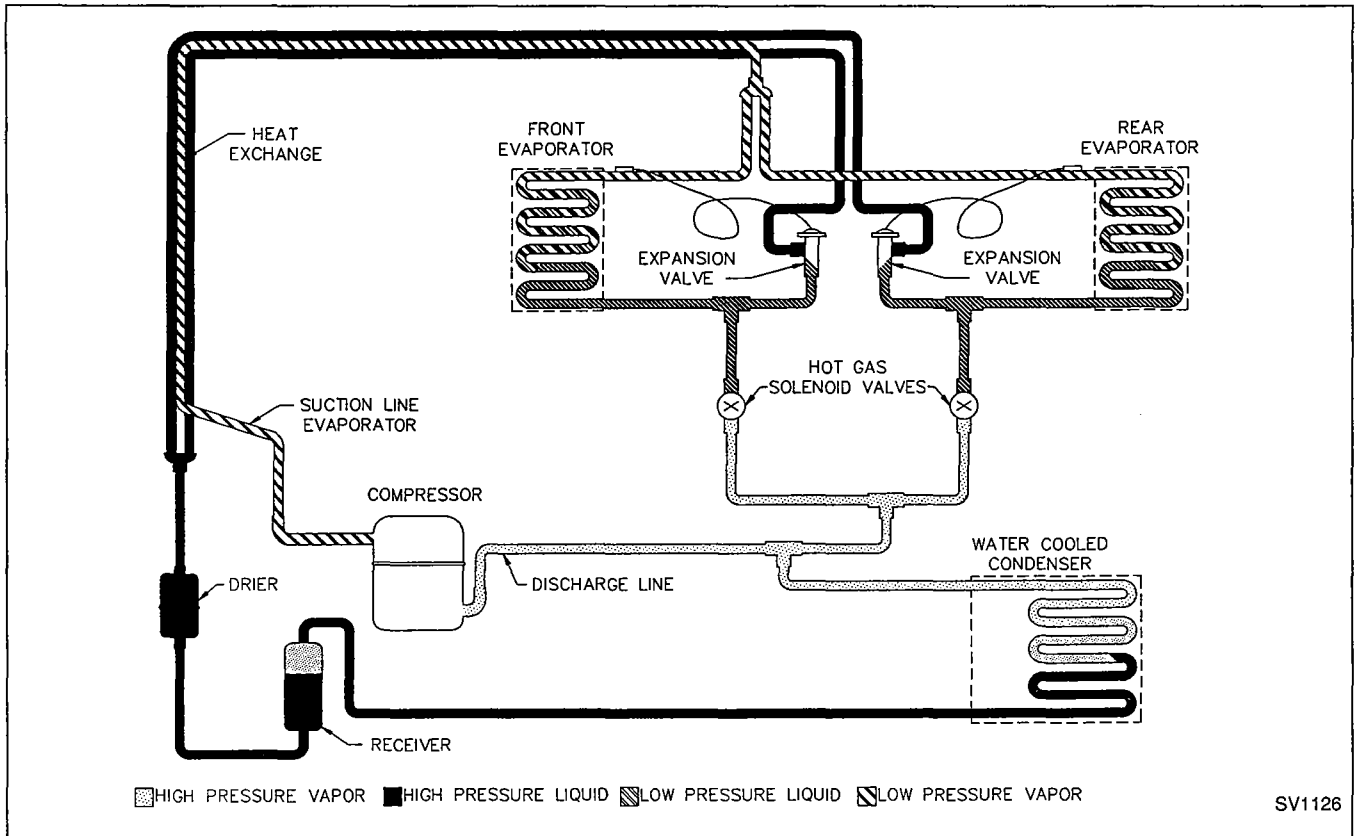
**FIGURE 39. HARVEST CYCLE WATER FLOW SEQUENCE**

### Harvest Cycle Water Flow Sequence

The water pump does not operate during the harvest cycle. Some water may run out overflow tube and down drain.

# REFRIGERATION SYSTEM SEQUENCE OF OPERATION SELF-CONTAINED WATER COOLED

## PRECHILL AND FREEZE CYCLE



**FIGURE 40. PRECHILL AND FREEZE CYCLE SEQUENCE**

### Prechill Refrigeration Sequence

There is no water flow over the evaporator during the prechill. The refrigerant absorbs heat (picked up during the harvest cycle) from the evaporators. The suction pressure decreases during prechill.

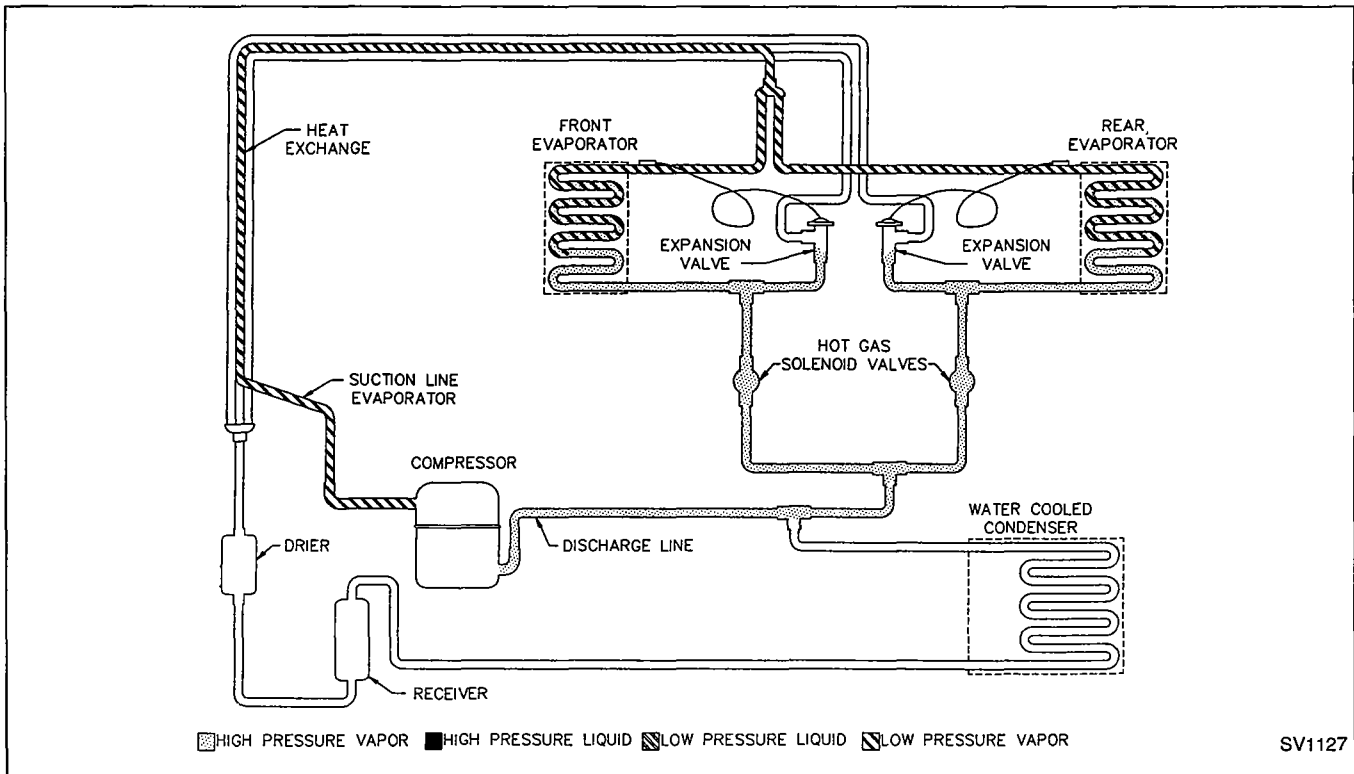
### Freeze Cycle Refrigeration Sequence

The refrigerant is absorbing heat from water running over the evaporator surface. The suction pressure gradually drops as ice forms.

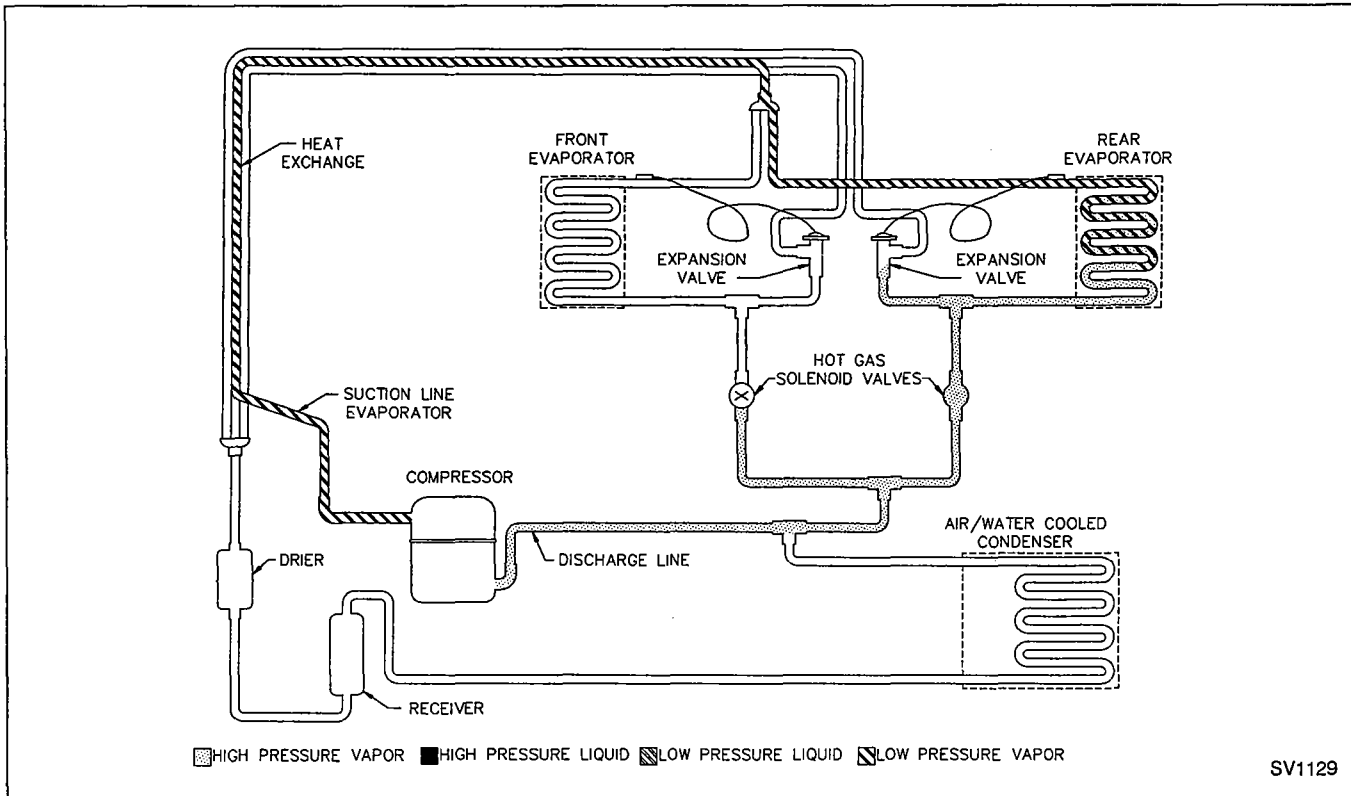
### WATER COOLED FREEZE CYCLE PRESSURES

Ambient Temp. °F	Head Pressure PSIG	Suction Pressure PSIG
50	210-230	40-26
70	210-230	40-26
80	210-230	42-28
90	210-230	42-28
100	210-230	42-28

# HARVEST CYCLE (Self-Contained Water Cooled)

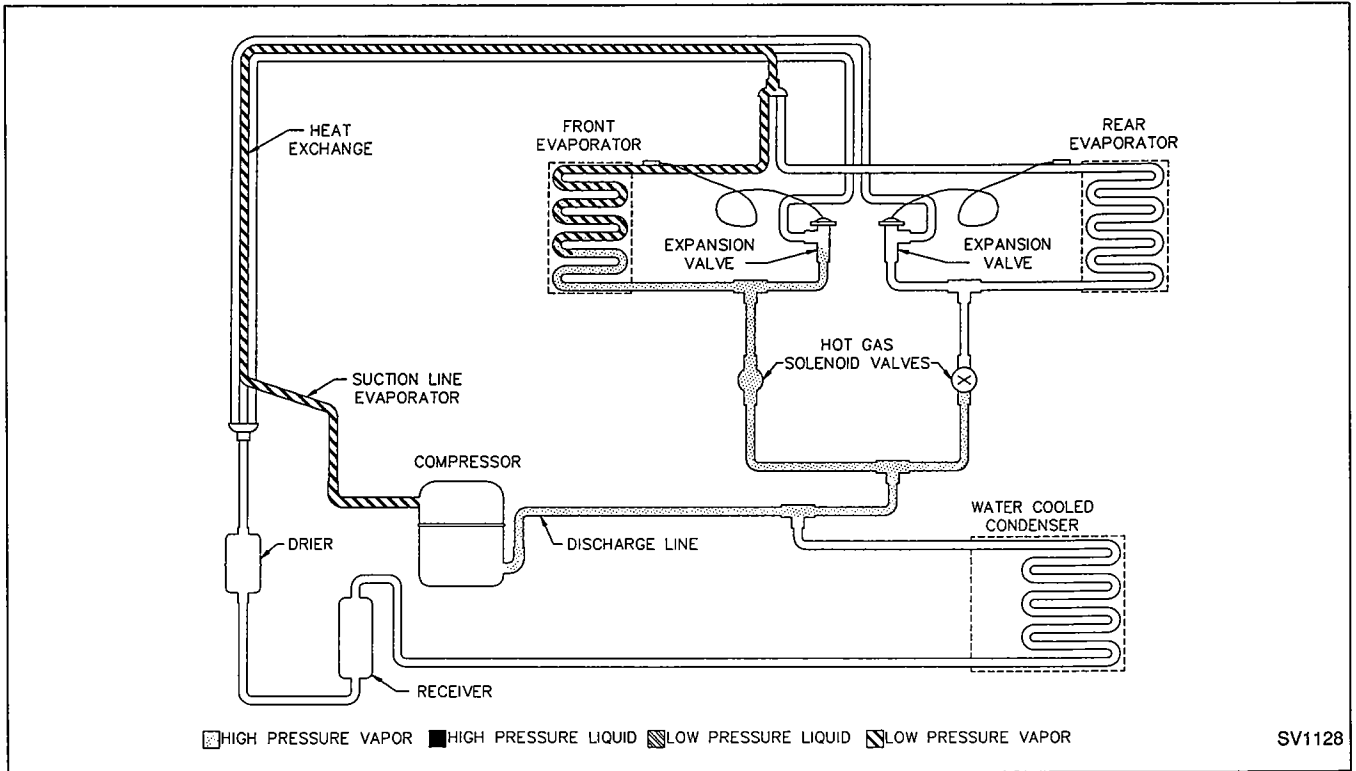


**FIGURE 41. HARVEST CYCLE — ICE ON BOTH EVAPORATORS**



**FIGURE 42. HARVEST CYCLE — ICE OFF FRONT EVAPORATOR BEFORE REAR EVAPORATOR**

# HARVEST CYCLE (Self-Contained Water Cooled)



**FIGURE 43. HARVEST CYCLE — ICE OFF REAR EVAPORATOR BEFORE FRONT EVAPORATOR**

### Harvest Cycle Refrigeration Sequence

The harvest cycle begins with hot gas flowing through both energized hot gas valves to heat the evaporators (Figure 41). The hot gas valves are sized to allow the proper amount of hot gas into the evaporators. This specific sizing assures proper heat transfer without the hot gas condensing to liquid and slugging the compressor.

The ice may drop from the front evaporator or the rear evaporator in any order. Figure 44 shows ice off the front evaporator before the rear. After the ice falls off the front evaporator, the front hot gas valve de-energizes. Figure 45 shows ice off the rear evaporator before the front. After the ice falls off the rear evaporator, the rear hot gas valve de-energizes.

### WATER COOLED HARVEST CYCLE PRESSURES

Ambient Temp. °F	Head Pressure PSIG	Suction Pressure PSIG
50	110-150	65-80
70	110-150	65-80
80	120-160	70-85
90	120-160	70-85
100	120-160	75-90

#### NOTE

The refrigeration system does not operate during the automatic shutoff (a full bin of ice).

# REFRIGERATION SYSTEM SEQUENCE OF OPERATION REMOTE ICE MACHINES

## PRECHILL AND FREEZE CYCLE

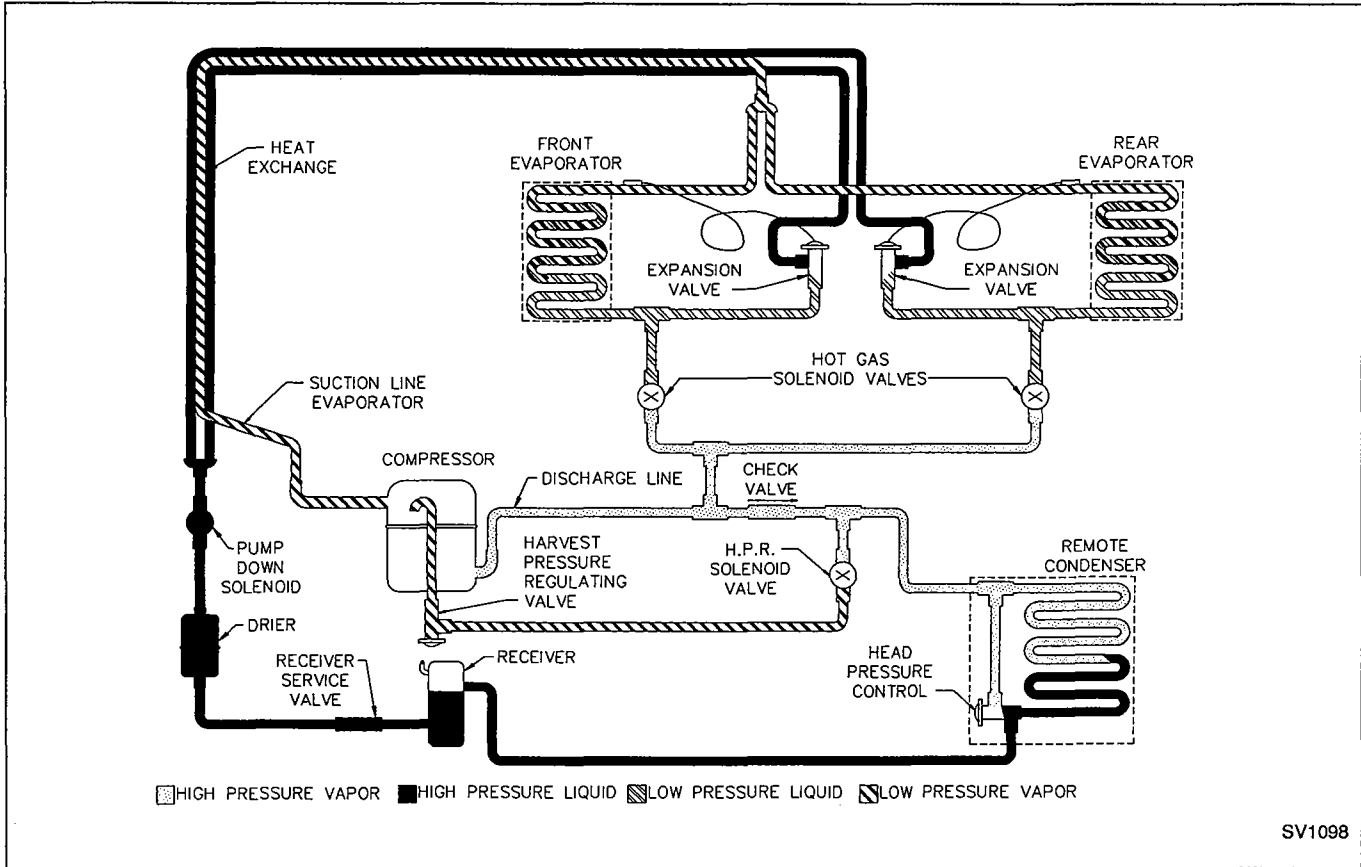


FIGURE 44. PRECHILL AND FREEZE CYCLE SEQUENCE

### Prechill Refrigeration Sequence

There is no water flow over the evaporator during the prechill. The refrigerant absorbs heat (picked up during the harvest cycle) from the evaporators. The suction pressure decreases during prechill.

### Freeze Cycle Refrigeration Sequence

The refrigerant is absorbing heat from water running over the evaporator surface. The suction pressure gradually drops as ice forms.

### REMOTE FREEZE CYCLE PRESSURES

Ambient Temp. °F	Head Pressure PSIG	Suction Pressure PSIG
-20 to 50	170-190	40-25
70	175-200	40-25
90	220-250	42-26
100	250-330	44-28
110	290-330	46-30

# HARVEST CYCLE (Remote Machines)

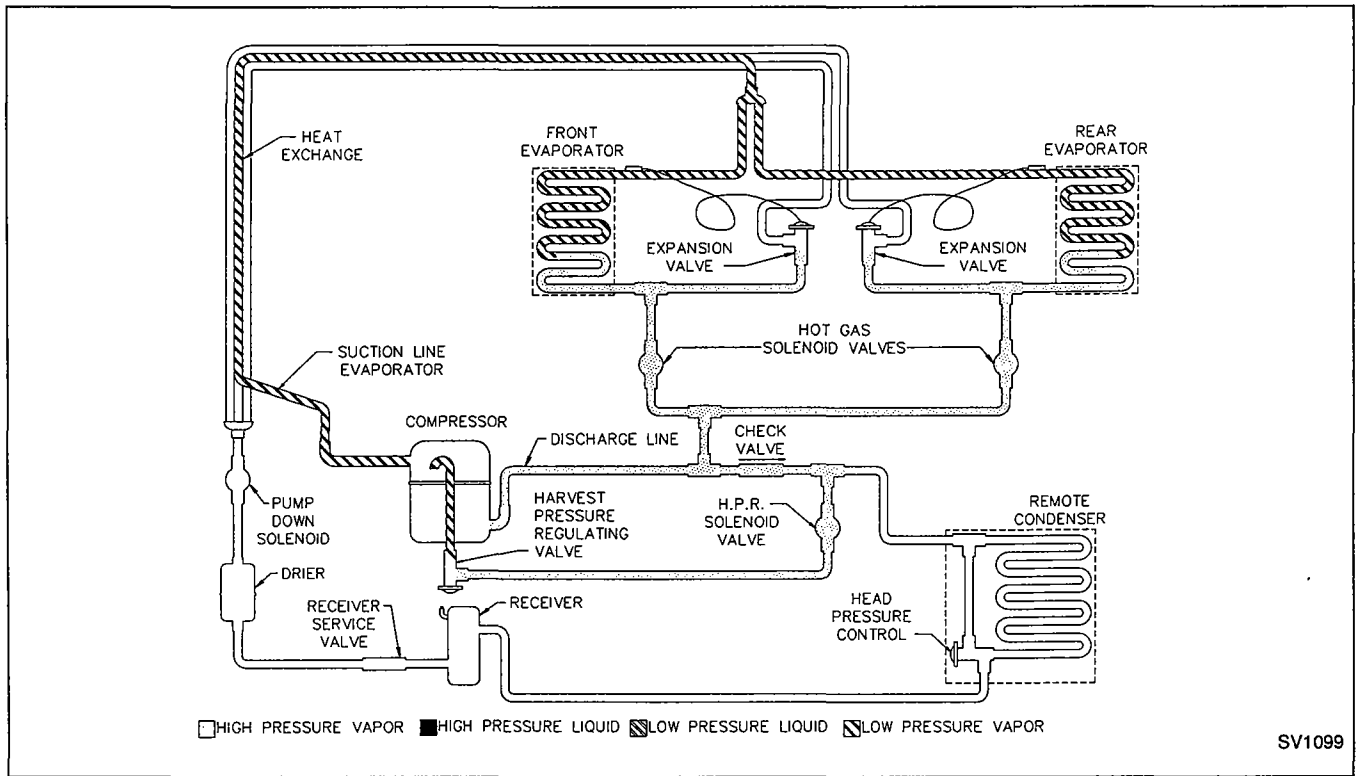


FIGURE 45. HARVEST CYCLE — ICE ON BOTH EVAPORATORS

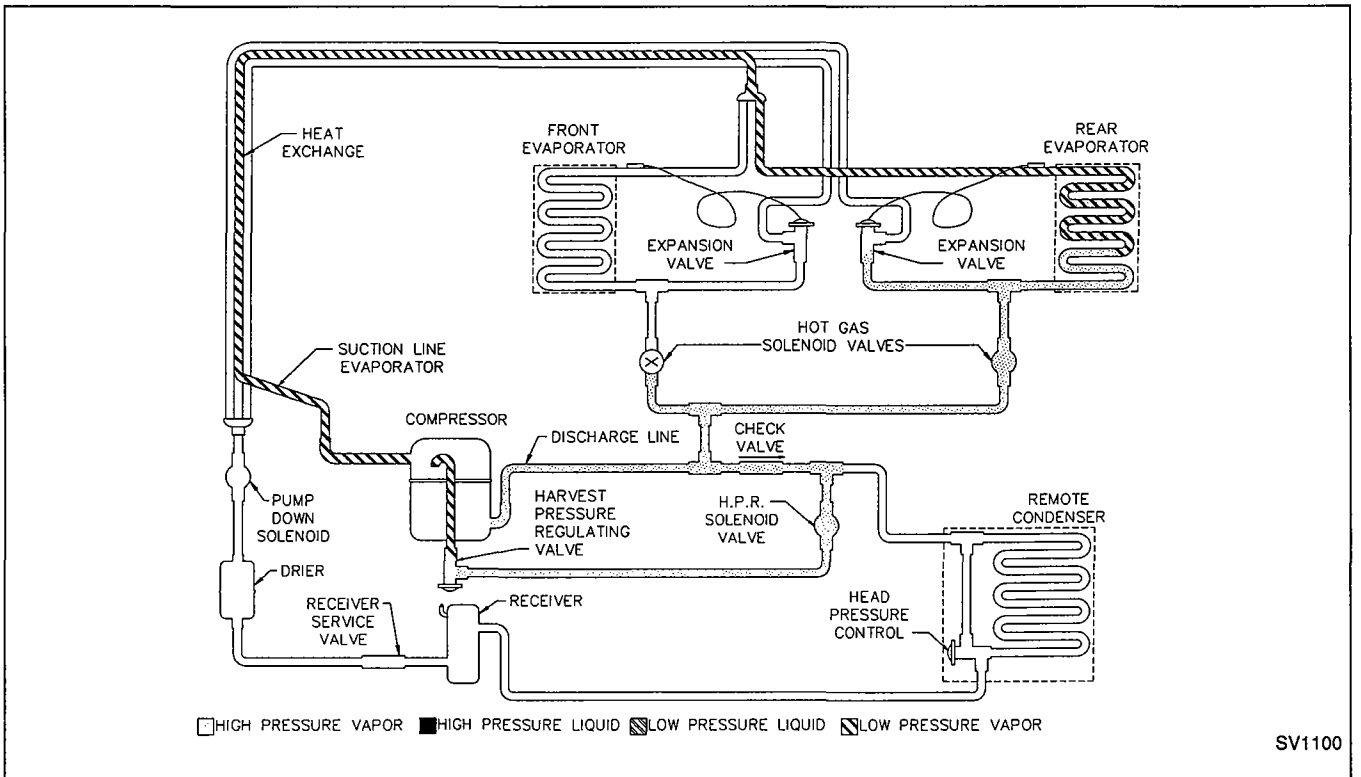
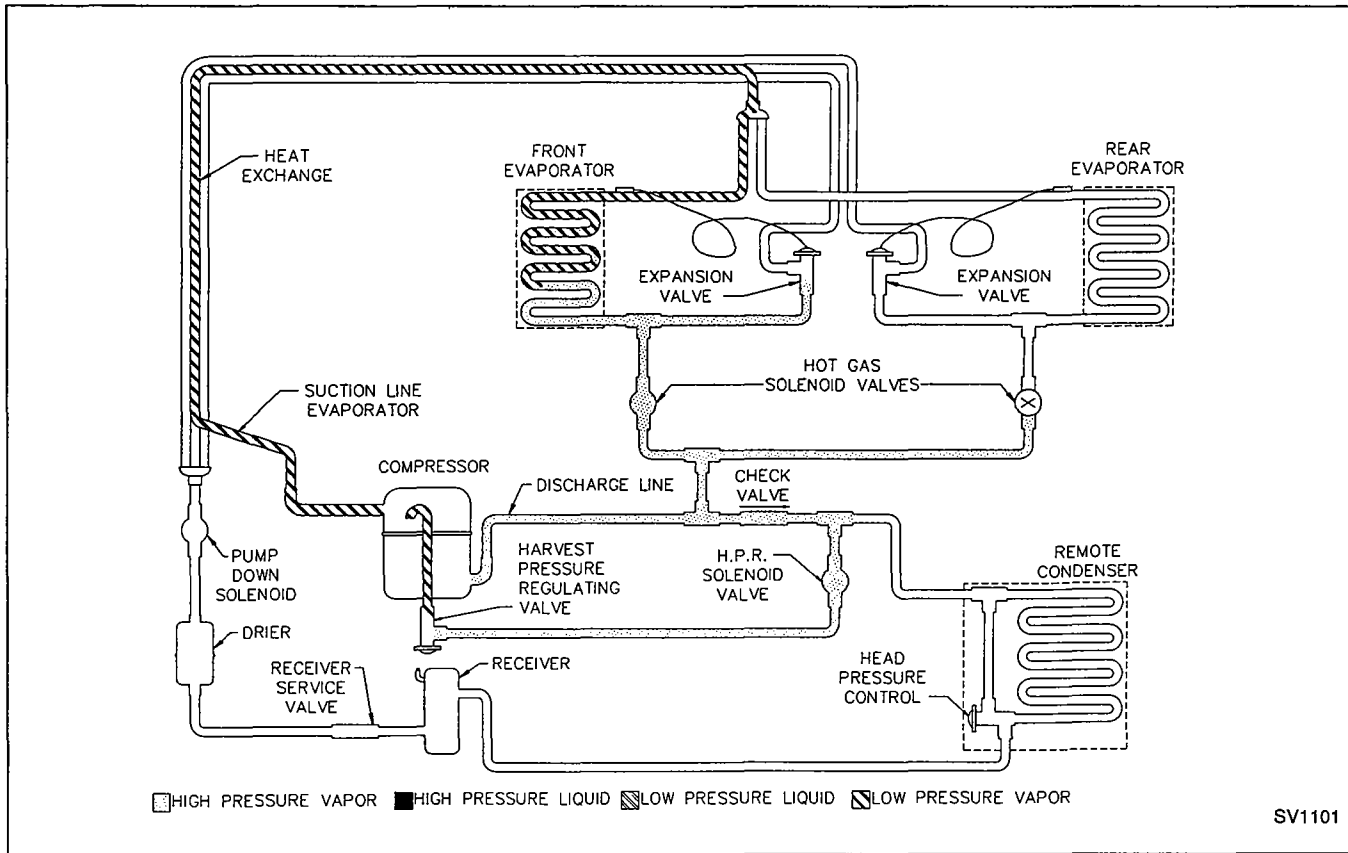


FIGURE 46. HARVEST CYCLE — ICE OFF FRONT EVAPORATOR BEFORE REAR EVAPORATOR

# HARVEST CYCLE (Remote Machines)



SV1101

**FIGURE 47. HARVEST CYCLE — ICE OFF REAR EVAPORATOR BEFORE FRONT EVAPORATOR**

### Harvest Cycle Refrigeration Sequence

The harvest cycle begins with hot gas flowing through both energized hot gas valves to heat the evaporators (Figure 45). The hot gas valves are sized to allow the proper amount of hot gas into the evaporators. This specific hot gas valve sizing along with the harvest pressure regulating (HPR) system assures proper heat transfer without the hot gas condensing to liquid and slugging the compressor. The harvest pressure regulating (HPR) valve maintains suction pressure of 71-79 psig during the harvest cycle.

The ice may drop from the front evaporator or the rear evaporator in any order. Figure 46 shows ice off the front

evaporator before the rear. After the ice falls off the front evaporator, the front hot gas valve de-energizes. Figure 47 shows ice off the rear evaporator before the front. After the ice falls off the rear evaporator, the rear hot gas valve de-energizes.

### REMOTE HARVEST CYCLE PRESSURES

Ambient Temp. °F	Head Pressure PSIG	Suction Pressure PSIG
-20 to 50	90-140	71-79
70	90-140	71-79
90	110-160	71-79
100	120-170	71-79
110	120-190	71-79

## AUTOMATIC SHUT-OFF (Remote Machines)

The liquid line solenoid (pump down solenoid) is de-energized and the compressor continues to run. The compressor pumps refrigerant out of the low side of the ice machine and into the high side past the check valve. The low pressure cut-out control opens when the low side pressure reaches 12-17 psig. When the cut-out control opens the compressor is de-energized. With the compressor not operating it is protected from refrigerant

migration during the off cycle, preventing refrigerant slogging upon start-up.

### IMPORTANT

Do not shut down a remote machine at the circuit breaker panel. The machine will not pump down before de-energizing the compressor for off cycle protection. Compressor failure may result when the ice machine is restarted.

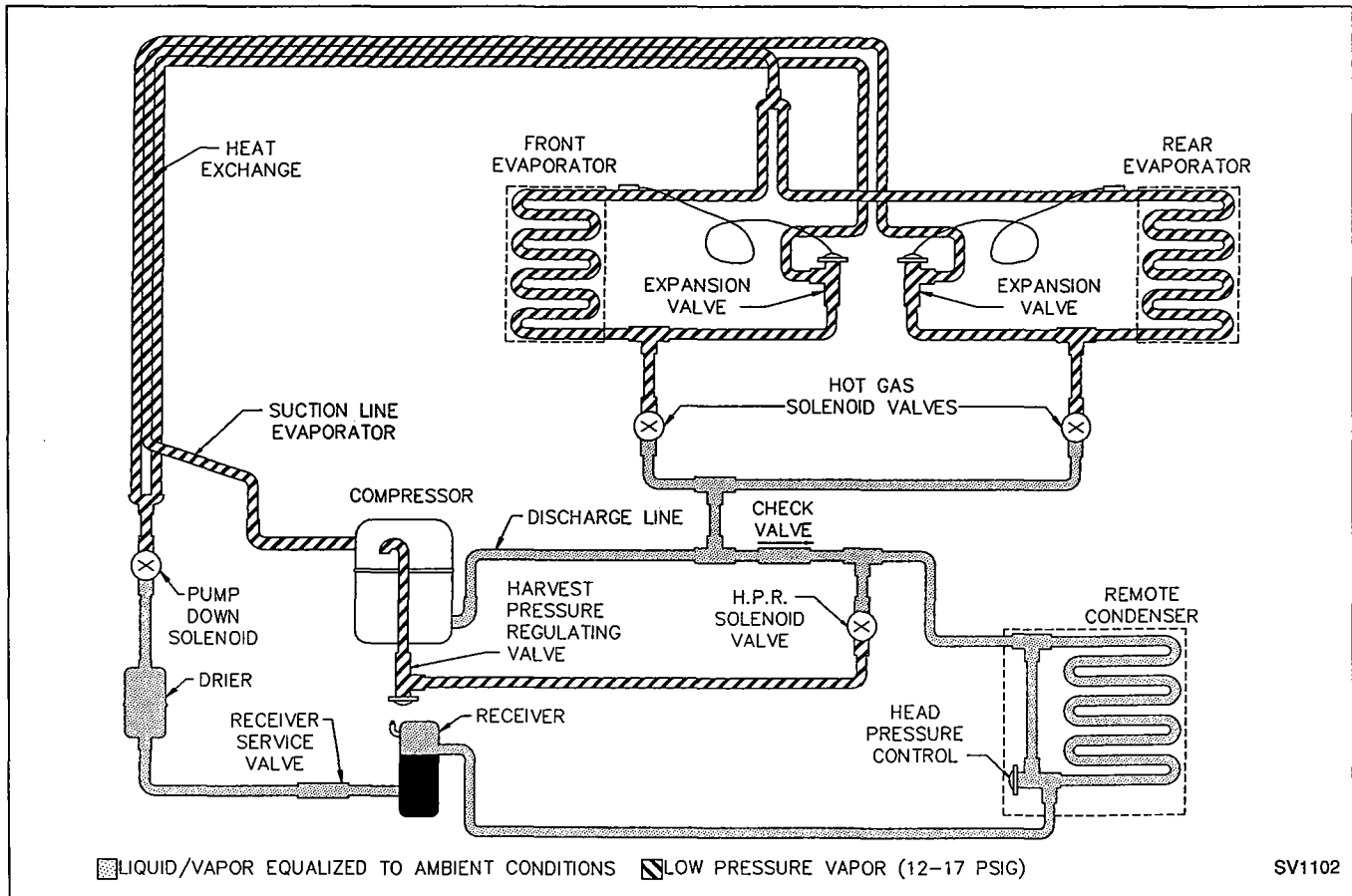


FIGURE 48. AUTOMATIC SHUT-OFF REFRIGERATION SEQUENCE

# SERVICE DIAGNOSTIC CHART

Symptom	Possible Cause	Corrective Action
Ice machine will not run.	ICE/OFF/WATER PUMP switch. a. Not in ICE position. b. Defective/miswired.	Set switch at ICE. Check ICE/OFF/WATER PUMP switch, page 46.
	High pressure cut-out control tripped. a. Condenser water pressure low or off (water cooled). b. Condenser water temperature above 90°F (water cooled). c. Dirty condenser (remote). d. Refrigerant overcharge. e. High side refrigerant lines or component plugged. f. Headmaster control valve defective. g. H.P.C.O. control defective. h. 7-second delay timer defective.	Open water service valve at water condenser inlet. Maintain water supply temperature between 33°F minimum and 90°F maximum. Clean condenser. Evacuate/recharge, page 76. Repair line/change drier.
	Circuit breaker tripped or blown fuse. Bin switch. a. Out of adjustment. b. Defective. Voltage too low. 5 amp fuse blown.	Reset circuit breaker or replace fuse. Check adjustment, page 44. Check bin switch, page 44. Electrical service must not fluctuate more than $\pm 10\%$ . Replace fuse.
	<u>Remote Machines Only:</u> Liquid line solenoid valve. a. Defective coil. b. Not opening. Refrigeration problem. Low pressure control.	Replace coil, page 73. Replace valve, page 73. Refer to Six-Step Diagnostic Procedure, page 58. Check control, page 50.
Dump valve will not energize at beginning of freeze cycle.	Dump valve timer. a. Out of adjustment. b. Defective timer.	Adjust timer to 20 seconds. Check timer, page 48.
Dump valve remains energized after 20-second prechill.	Dump valve timer. a. Out of adjustment. b. Defective timer.	Adjust timer to 20 seconds. Check timer, page 48.
Compressor cycles intermittently or will not run.	Voltage too low.  Defective start relay. Defective start capacitor. Wiring to compressor.  Defective compressor.	Electrical service must not fluctuate more than $\pm 10\%$ of nameplate voltage. Check relay, page 54. Check capacitor, page 55. Check for loose connection/miswiring or open and replace. Check compressor, page 54.
	<u>Remote Machines Only:</u> Low pressure cutout control. Refrigeration problem.	Check control, page 50. Refer to Six-Step Diagnostic Procedure, page 58.

Symptom	Possible Cause	Corrective Action
Ice machine will not cycle into harvest.		Refer to page 52 for Diagnostic Procedures.
Ice machine repeatedly cycles into harvest with little or no ice formation.		Refer to page 53 for Diagnostic Procedures.
Ice machine does not cycle from harvest to freeze when ice falls into bin.	Bin switch out of adjustment. Defective bin switch. Defective 7-second delay timer.	Adjust bin switch, page 44. Check bin switch, page 44. Check timer, page 48.
Water runs over evaporator during harvest cycle.	Drain line too small. Water dump valve defective or dirty.	Drain line must be 3/4" I.D. Refer to Checking and Cleaning Water Dump Valve, page 16.
Ice cubes too large/small.	Ice thickness probe out of adjustment.	Adjust ice thickness probe, page 46.
Shallow or incomplete cubes; incomplete ice fill pattern on evaporator.	Ice thickness probe out of adjustment. Ice machine dirty. Water related problems. Refrigeration problem.	Adjust ice thickness probe, page 46. Clean and sanitize ice machine, refer to pages 11 and 15. Refer to Six-Step Diagnostic Procedure, page 58. Refer to Six-Step Diagnostic Procedure, page 58.
Ice machine does not release ice or is slow to harvest.	Ice machine dirty. Water regulating valve leaking during harvest cycle (water-cooled models). R.T.V. sealant between white plastic and metal evaporator missing. Refrigeration problem.	Clean and sanitize ice machine. Refer to pages 11 and 15. Clean water regulating valve and condenser. Reseal with food grade R.T.V. sealant. Refer to Six-Step Diagnostic Procedure, page 58.
Low ice capacity.		Refer to Six-Step Diagnostic Procedure, page 58.

# COMPONENT FUNCTION, SPECIFICATIONS AND CHECK PROCEDURES

## BIN SWITCHES

### Function

1. The front evaporator or rear evaporator bin switch is controlled by movement of the corresponding water curtain (see Water Curtain, page 47).
2. The front bin switch movement energizes relay A and the rear bin switch movement energizes relay B during the harvest cycle.
3. Either bin switch may be held open to shut the ice machine off when the bin is full of ice

### Specifications

Single pole, double throw, normally closed.

### Bin Switch Setting (Figure 49)

1. During freeze cycle, pull water curtain away from evaporator until ice machine shuts off.

#### NOTE

On remote models the ice machine may run 20 to 30 seconds before shutting off.

2. Slowly return curtain to evaporator. Ice machine should restart as bottom edge of water curtain passes just inside edge of water trough.

The bin switch is factory set and should not require adjustment. If bin switch adjustment is necessary, adjust as follows:

1. Set ICE/OFF/WATER PUMP switch at OFF.
2. Slowly pull bottom of water curtain away from evaporator, then slowly return curtain toward evaporator.
3. Loosen appropriate locking screw.
4. If bin switch clicks before water curtain reaches water trough, move lever toward water curtain.
5. If bin switch clicks too far into water trough, move lever away from water curtain.
6. Tighten locking screw.
7. Set ICE/OFF/WATER PUMP switch at ICE after adjustment is complete.

### Bin Switch Replacement

If the bin switch does not operate properly after adjustment, check bin switch with Ohmmeter and/or voltmeter while depressing and releasing bin switch. If bin switch does not open and close properly, replace switch.

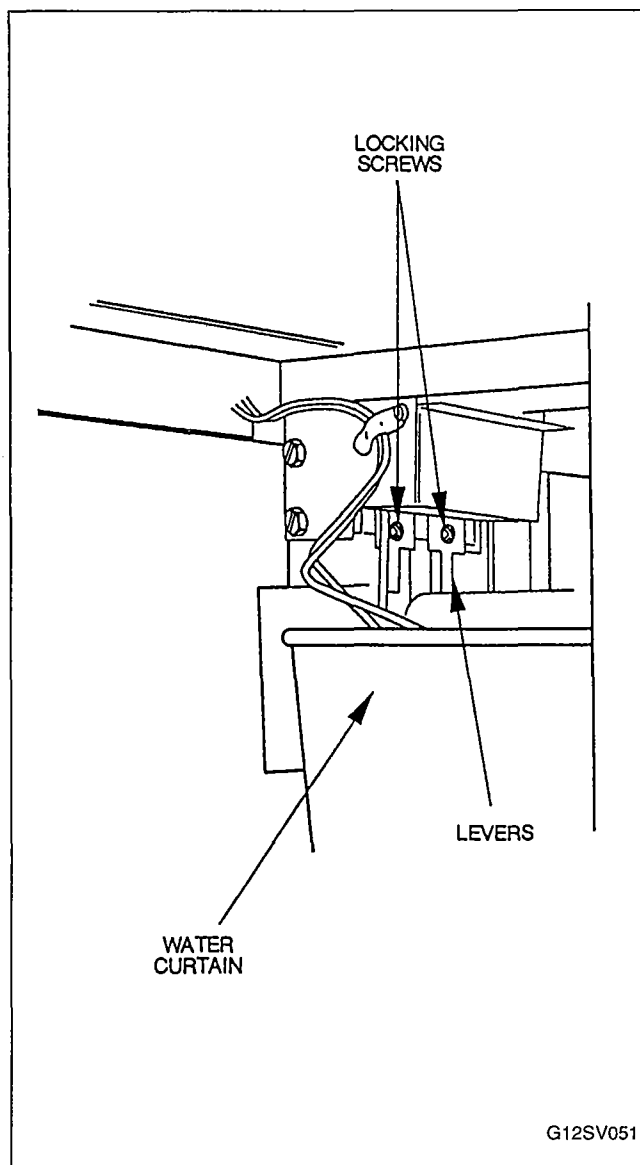


FIGURE 49. BIN SWITCH CHECK

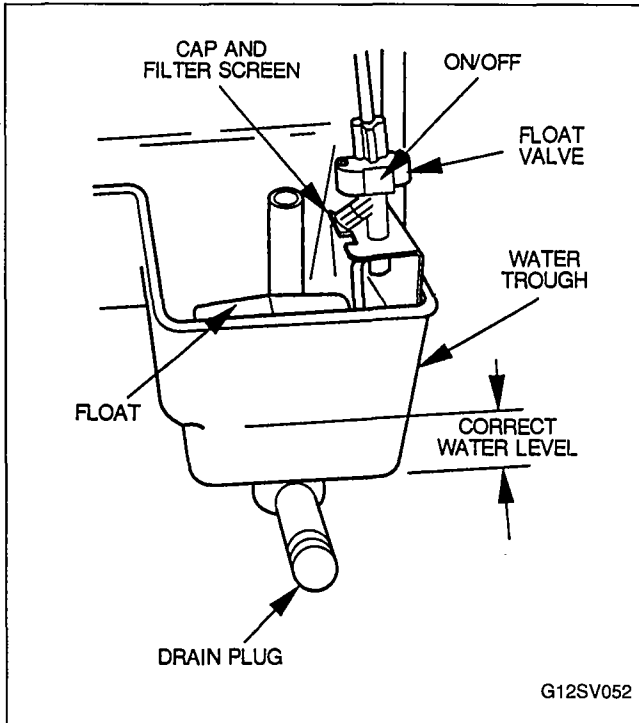
## FLOAT VALVE

### Function

Maintains correct water level in water trough.

### Water Level Setting Check (Figure 50)

1. Set ICE/OFF/WATER PUMP switch at OFF.



**FIGURE 50. WATER LEVEL SETTING CHECK**

2. Remove drain plug from trough and allow water to drain.
3. Reinstall drain plug on trough and allow trough to refill to proper level of offset in trough.

The float valve is factory set for proper water level. If adjustment is necessary, carefully bend float arm to achieve correct level.

### Float Valve Replacement

If float valve cannot be adjusted to maintain proper water level in trough, replace float valve. The float valve may be dirty. Attempt to clean the valve before replacement.

## HIGH PRESSURE CUT-OUT CONTROL — H.P.C.O.

### Function

Safety control which turns the ice machine off if subjected to excessive high-side pressure. The H.P.C.O. control is a normally closed control and opens on a rise in pressure. See Figure 5, page 7.

### Specifications

Cut-out — 440 psig  $\pm$  10.

Cut-in — manual reset (below 300 psig to reset).

### Check Procedure

1. Set ICE/OFF/WATER PUMP switch at OFF and reset H.P.C.O. (if tripped).
2. Hook voltmeter in parallel (across) to the H.P.C.O. leaving wires attached.
3. Connect manifold gauges. Refer to page 71.
4. Procedures:
  - a. Water-Cooled Machines — Close the water service valve to the water condenser inlet. See Typical Installation illustration, page 5.
  - b. Remote Machines — Disconnect fan motor.
5. Set ICE/OFF/WATER PUMP switch to ICE.

No water or air flowing through the condenser will cause the H.P.C.O. control to turn the ice machine off because of excessive high pressure. Watch the high-pressure gauge and record the pressure at which the cut-out takes place.

Replace the H.P.C.O. control if:

1. The control will not reset. (Note: High-side pressure must be below 300 psig before resetting.)
2. The control does not open at the specified cut-out point of 440 psig  $\pm$  10.

## ICE THICKNESS PROBE

### Function

Maintain correct ice thickness.

### Ice Thickness Check (Figure 51)

Be sure the water curtain is in place to prevent water from splashing out of water trough.

Inspect bridge connecting the cubes. The bridge should be approximately 1/8" thick.

The ice thickness probe is factory set to maintain 1/8 inch ice bridge thickness. If adjustment is necessary, adjust as follows:

1. Turn adjustment screw on ice thickness probe clockwise to increase thickness, counter-clockwise to decrease thickness.

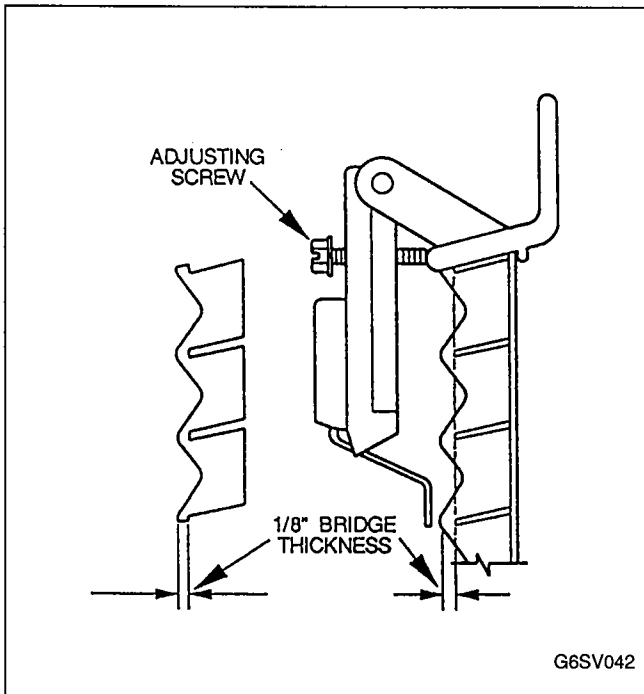


FIGURE 51. ICE THICKNESS CHECK

### NOTE

Do not turn the adjusting screw more than 1/4 turn at a time. If necessary, check the bridge for two harvest cycles after initial adjustment before adjusting again.

2. Ensure ice thickness probe wires and bracket do not restrict movement of probe.

## ICE/OFF/WATER PUMP TOGGLE SWITCH

### Function

Place ice machine in ICE, OFF, or WATER PUMP mode of operation.

### Specifications

Double pole/double throw.

### Check Procedure

1. Check for proper line voltage to the ice machine ( $\pm 10\%$ ).
2. Inspect switch (Figure 52) for correct wiring.
3. Inspect terminals for clean, tight connections.
4. Check across switch terminals with voltmeter for correct readings as follows (replace switch if readings are incorrect):

- a. Switch set at ICE:

	Switch Position	Voltage
48 to 50	Open	Line Voltage
48 to 49	Closed	0 Volts
44 to 45	Closed	0 Volts

- b. Switch set at OFF:

	Switch Position	Voltage
48 to 50	Open	Line Voltage
48 to 49	Open	Line Voltage
44 to 45	Open	Line Voltage

- c. Switch set at WATER PUMP:

	Switch Position	Voltage
48 to 50	Closed	0 Volts
48 to 49	Open	Line Voltage
44 to 45	Open	Line Voltage

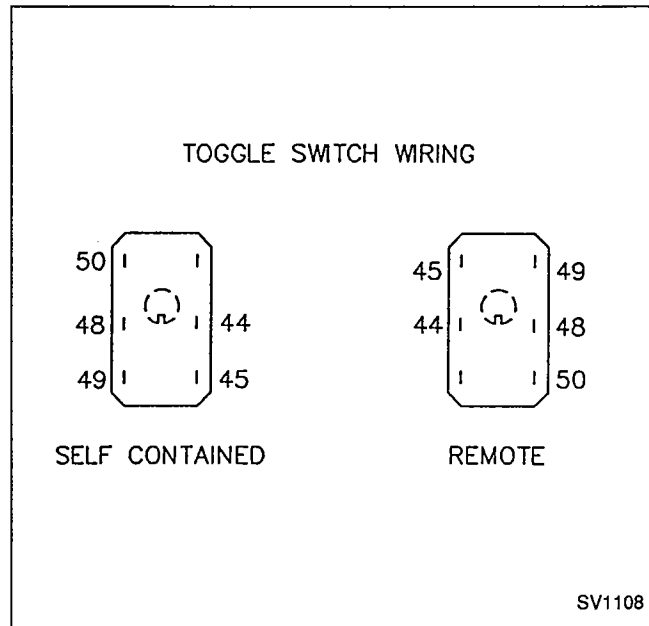


FIGURE 52. ICE/OFF/WATER PUMP SWITCH CHECK

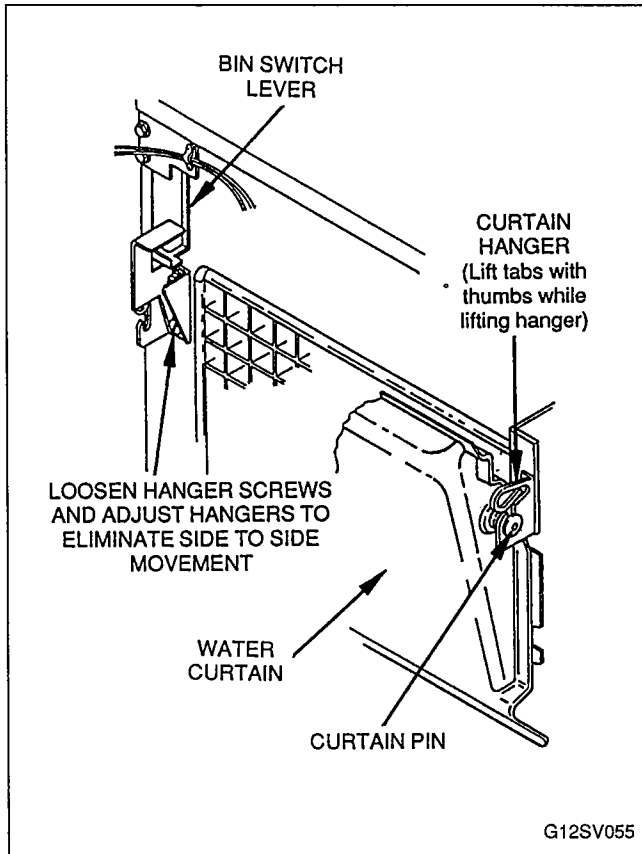
## WATER CURTAIN

### Function

1. Prevents water from splashing into bin.
2. Acts as a lever to depress and release bin switches as ice falls from the evaporator.

### Check Procedure

1. Pull bottom of water curtain (Figure 53) away from evaporator, then release. Curtain should fall back to evaporator.



**FIGURE 53. WATER CURTAIN CHECK**

2. Move curtain from side to side. There should be little or no movement.

The water curtain is factory set and should require no adjustment. If adjustment is necessary, adjust as follows:

- a. Remove water curtain.
- b. Loosen curtain hanger screws (two per hanger) and slide hangers in or out to prevent side to side movement.
- c. Retighten hanger screws.
- d. Reinstall water curtain.

### NOTE

Water curtain heads must be positioned under curtain hanger tabs. Curtain must be centered on evaporator when installed.

## WATER PUMP

### Function

1. Pump water over evaporator during freeze cycle.
2. Pump water through the dump valve and down the drain during first 20 seconds of freeze cycle.

### Specifications

Refer to ice machine serial number plate for correct voltage and running amps.

### Check Procedure

### NOTE

Water pump runs quietly with no water in water trough.

Set ICE/OFF/WATER PUMP switch at WATER PUMP. If water pump runs with switch at WATER PUMP and does not run with switch set at ICE, the water pump is operating properly.

If water pump will not run with switch set at WATER PUMP, check the following procedures:

1. Check for proper line voltage to the ice machine ( $\pm 10\%$ ).
2. Unplug the water pump.
3. Set ICE/OFF/WATER PUMP switch at WATER PUMP and check voltage at water pump electric plug receptacle.
  - a. Line voltage — replace water pump after verifying pump impeller is not blocked by foreign objects.

### NOTE

For proper ice machine operations replace only with Manitowoc original (OEM) water pump designed and sized specifically for this ice machine.

- b. No voltage — Check toggle switch (page 46) and check fuse on relay board.

## DUMP VALVE TIMER

### Function

The S.C.R. switch is normally closed (N.C.) and energizes the dump valve for the first 20 seconds of the freeze mode. This prechills the evaporator while flushing the water from the last freeze mode. The timer is factory set at 20 seconds and should require no further adjustment.

### Specifications

208-230 volt, 50/60 Hertz.

Normally closed silicon rectifier (S.C.R.) switch.

### Check Procedure

Clip voltmeter leads across S.C.R. switch terminals #1 and #2. Keep all wire leads attached.

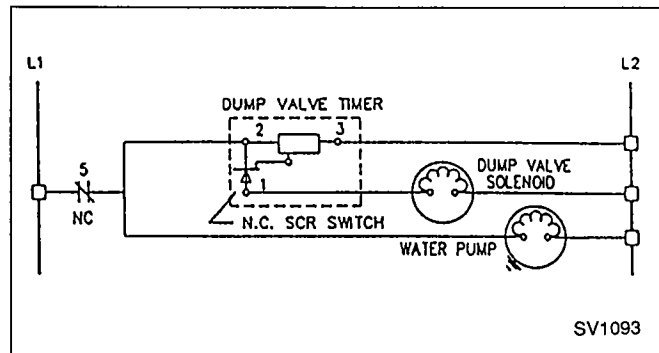


FIGURE 54. DUMP VALVE TIMER CHECK

### NORMAL OPERATIONAL SEQUENCE (No Failure)

No Failure	Voltage Reading Terminals #1 and #2
First 20 seconds of freeze cycle. Dump valve energized.	0-4 Volts
After 20 seconds into freeze cycle. Dump valve de-energized.	Line Voltage

### DUMP VALVE TIMER FAILURE CHART

Symptom	Voltage Terminals #1 and #2	Cause
Dump valve will not energize.	Line voltage.	S.C.R. switch is failed open and will not close.
Dump valve energized and will not de-energize after 20 seconds.	0-4 volts.	S.C.R. switch is failed closed and will not open.
Dump valve de-energized and may be chattering.	Approximately 1/2 line voltage.	S.C.R. switch is failed half-wave.

## 7-SECOND DELAY TIMER

### Function

The normally closed S.C.R. switch is in series with the primary of the transformer. The timer resets the ice machine to the freeze mode by momentarily interrupting the power to the transformer. The time delay is initiated after relays A and B are both energized through the front and rear bin switches. On completion of delay period (7 seconds) the S.C.R. switch opens and the transformer power supply is interrupted. This cycles the ice machine back into the freeze mode.

### Specifications

208-230 volt, 50/60 Hertz.

Normally closed silicon rectifier (S.C.R.) switch.

### Check Procedure

Clip voltmeter leads across S.C.R. switch terminals #1 and #2. Keep all wire leads attached. The transformer and Harvest Pressure Limiter Control (remote models) must operate properly to check 7-second delay timer.

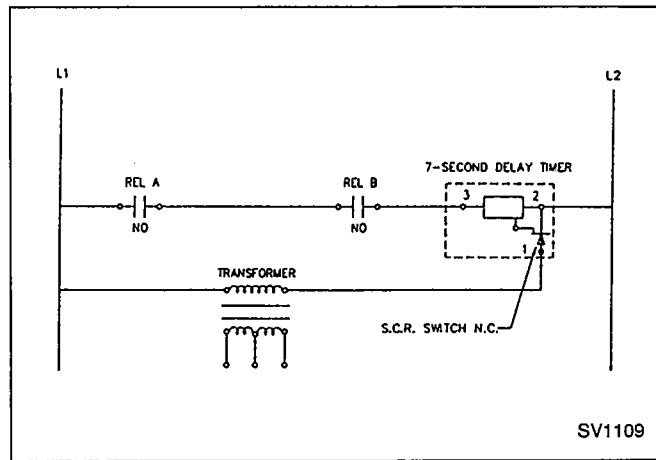


FIGURE 55. 7-SECOND COMPRESSOR DELAY TIMER

### NORMAL OPERATIONAL SEQUENCE (No Failure)

Toggle Switch in ICE Position:

Voltage between terminals #1 and #2 must be 0-4 volts.

The ice machine will freeze ice and cycle into Harvest mode.

Approximately 7 seconds after relays A and B are both energized during harvest the voltage will "jump" to line voltage, then back to 0-4 volts.

### 7-SECOND DELAY TIMER FAILURE CHART

Symptom	Voltage Terminals #1 and #2	Cause
Ice machine will freeze ice but will not go into harvest cycle.	Line voltage.	S.C.R. switch is failed open and will not close.
Ice machine will not cycle from harvest mode on the 7-second delay timer. It will cycle back into freeze mode on 4-1/2 to 5 minute safety timer or harvest pressure limiter (remotes).	0-4 volts continually after both relays A and B are energized during harvest.	S.C.R. switch is failed closed and will not open.
The hot gas valves chatter during the harvest cycle.	Approximately 1/2 line voltage.	S.C.R. switch is failed half-wave.

## **LOW PRESSURE CUT-OUT CONTROL (Remote Machines Only)**

### **Function**

1. Energizes and de-energizes the contactor to start and stop the ice machine.
2. A drop in suction pressure opens the low pressure cut-out control.

### **Specifications**

Cut-out — 15 psig  $\pm$  3.

Cut-in — 40 psig  $\pm$  3.

### **Check Procedure**

1. Connect manifold gauges, page 71.
2. Connect a voltmeter in parallel (across) wires leaving the cut-out control.
3. Set toggle switch to OFF position. The liquid line solenoid valve will de-energize and the suction pressure will begin to decrease. The low pressure cut-out control will open at 15 psig ( $\pm$  3). The contactor will de-energize and the voltage across the L.P. cut-out control will be "line voltage."
4. Set toggle switch to ICE position. The liquid line solenoid valve will energize and the suction pressure will rise. The low pressure cut-out control will close at 40 psig. The contactor will energize and the voltage reading across the low pressure cut-out will be "0."
5. Replace the low pressure cut-out control if it does not open and close properly or does not maintain proper settings.

## **HARVEST PRESSURE LIMITER CONTROL (Remote Machines Only)**

### **Function**

1. Safety control which cycles the ice machine out of a harvest cycle and returns it to a freeze cycle if suction pressure becomes excessive.
2. The H.P.L. safety control is normally closed and *opens* on a rise in *suction* pressure.

### **Specifications**

Cut-out — 110 psig  $\pm$  5.

Cut-in — 85 psig  $\pm$  7.

### **Check Procedure**

1. Connect a voltmeter in parallel (across) the H.P.L. safety control.
2. Connect manifold gauges, page 71.
3. Pressures:
  - a. When suction pressure rises above 110 psig the H.P.L. safety control must open. The voltmeter must read "line voltage."
  - b. When the suction pressure drops below 85 psig the H.P.L. safety control must close. The voltmeter must read "0" volts.
4. Replace the H.P.L. safety control if it does not open or close properly or does not maintain proper settings.

# ELECTRONIC CONTROL CIRCUITRY

The ice machine uses either a transformer board with a plug-in sensor module or a unitized sensor board to control the ice thickness and initiate the harvest cycle. See Figure 56.

The transformer board and sensor module are not available as replacement parts. If either fails, replace both with a unitized sensor board.

Refer to ice machine Electrical Sequence of Operation (see Table of Contents) for operation of control circuitry.

## SENSOR MODULE

The plug-in sensor module has four functions:

1. A relay to energize or de-energize electrical components utilized during the harvest cycle.
2. Electronics to sense when water is in contact with the ice thickness control probe.
3. A 6- to 10-second timer ensuring the water flowing over the evaporator completes an electrical circuit through the ice thickness control probe.

4. A safety timer ensuring the ice machine does not remain in the harvest cycle for longer than 4 to 5 minutes.

## TRANSFORMER BOARD

The transformer board reduces line voltage to the sensor module to 12-24 VAC.

## UNITIZED SENSOR BOARD

This board combines the functions of the sensor module and transformer board into one assembly.

## ICE THICKNESS CONTROL PROBE

The ice thickness control probe adjusts the ice thickness. Water comes into contact with the two probes for 6 to 10 seconds and completes an electrical circuit initiating the harvest cycle.

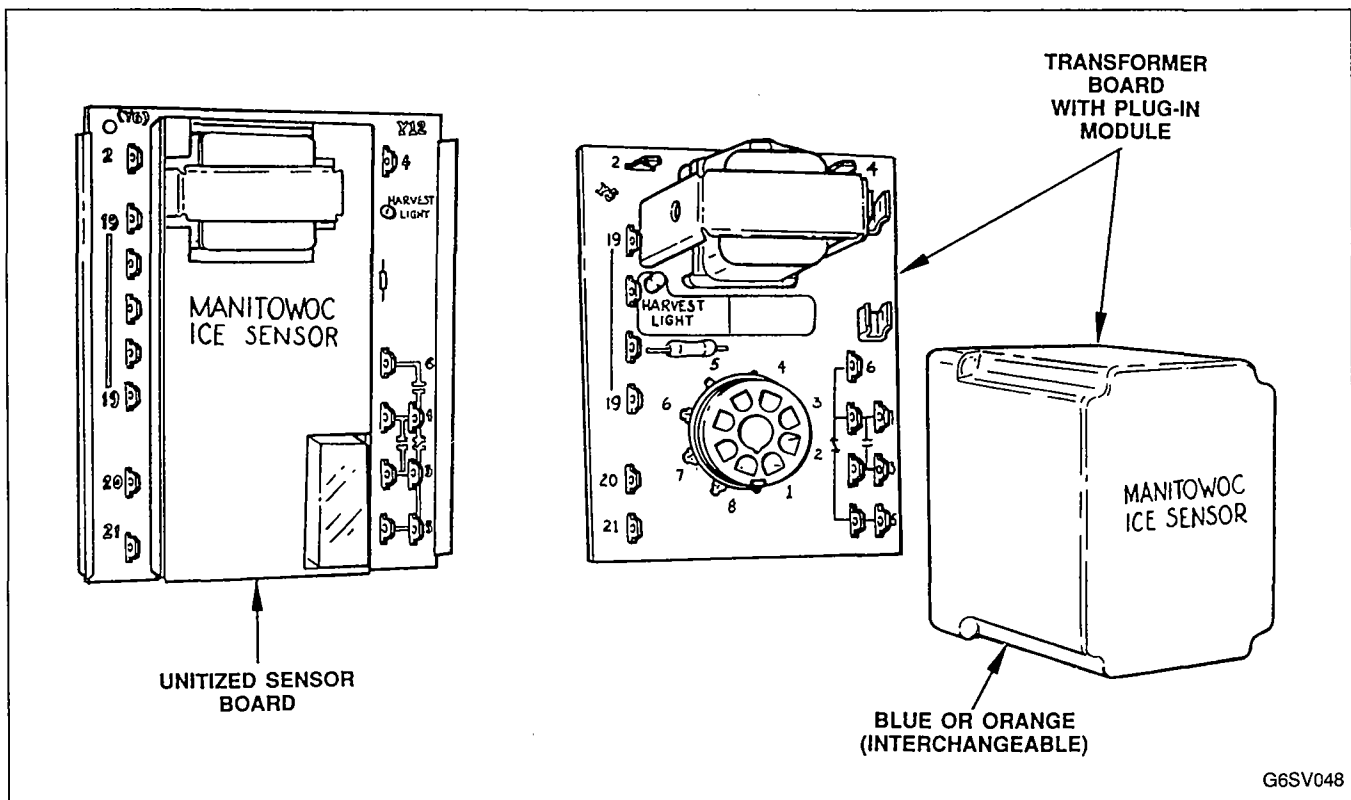


FIGURE 56. ELECTRONIC CONTROLS

# DIAGNOSING ELECTRONIC CONTROL CIRCUITRY

## IMPORTANT

The transformer board and sensor module are not available as replacement parts. If either fails, replace both with Unitized Sensor Board.



## CAUTION

**THESE PROCEDURES MUST BE PERFORMED BY A QUALIFIED TECHNICIAN.**

Do not make adjustments or turn the ice machine off until the malfunction is identified. The problem may be intermittent and you may lose the opportunity to make the checks while it is malfunctioning.

Follow the systematic approach throughout the diagnosis and write down information as it is collected. This will keep you organized.

## A. POSSIBLE PROBLEM: ICE MACHINE WILL NOT GO INTO HARVEST

### NOTE

These procedures require the use of a jumper wire with clip ends attached.

Step 1: Check primary voltage at transformer terminals 1 and 2 on board.

Does voltmeter indicate line voltage ( $\pm 10\%$ )?

IF NO: Check for correct wiring and loose or corroded connections. Also check 7-second delay timer (page 49) and Harvest Pressure Limiter Control (page 50).

Do not proceed until line voltage is restored.

IF YES: Proceed to Step 2.

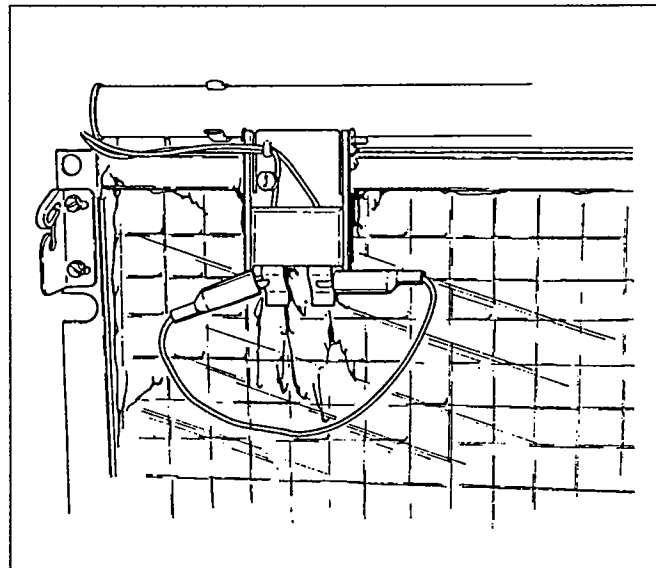
Step 2: Clip the leads of the jumper wire to the ice thickness control probe, Figure 57.

Does the ice machine go into the harvest cycle?

IF NO: The ice machine still will not harvest. Proceed to Step 3.

IF YES: The entire control circuitry is functioning properly. Check the following:

- Ice thickness probe adjustment, page 46.
- Ice thickness probe has scale build-up acting as an insulator. Clean probe.
- The water to the ice machine may not offer a low enough resistance across the probes for proper operation. To check, put a small amount of salt into water trough to lower the resistance level of the water. If the ice machine goes into harvest after putting salt into the water trough, order Resistor Kit, part number 76-2266-3, from your local Manitowoc Distributor. Install resistor kit across terminals 20 and 21. The ice machine will now operate properly.



**FIGURE 57. JUMPER WIRE CONNECTED TO PROBES**



# DIAGNOSING SINGLE (1) PHASE COMPRESSOR AND START COMPONENTS ELECTRICALLY

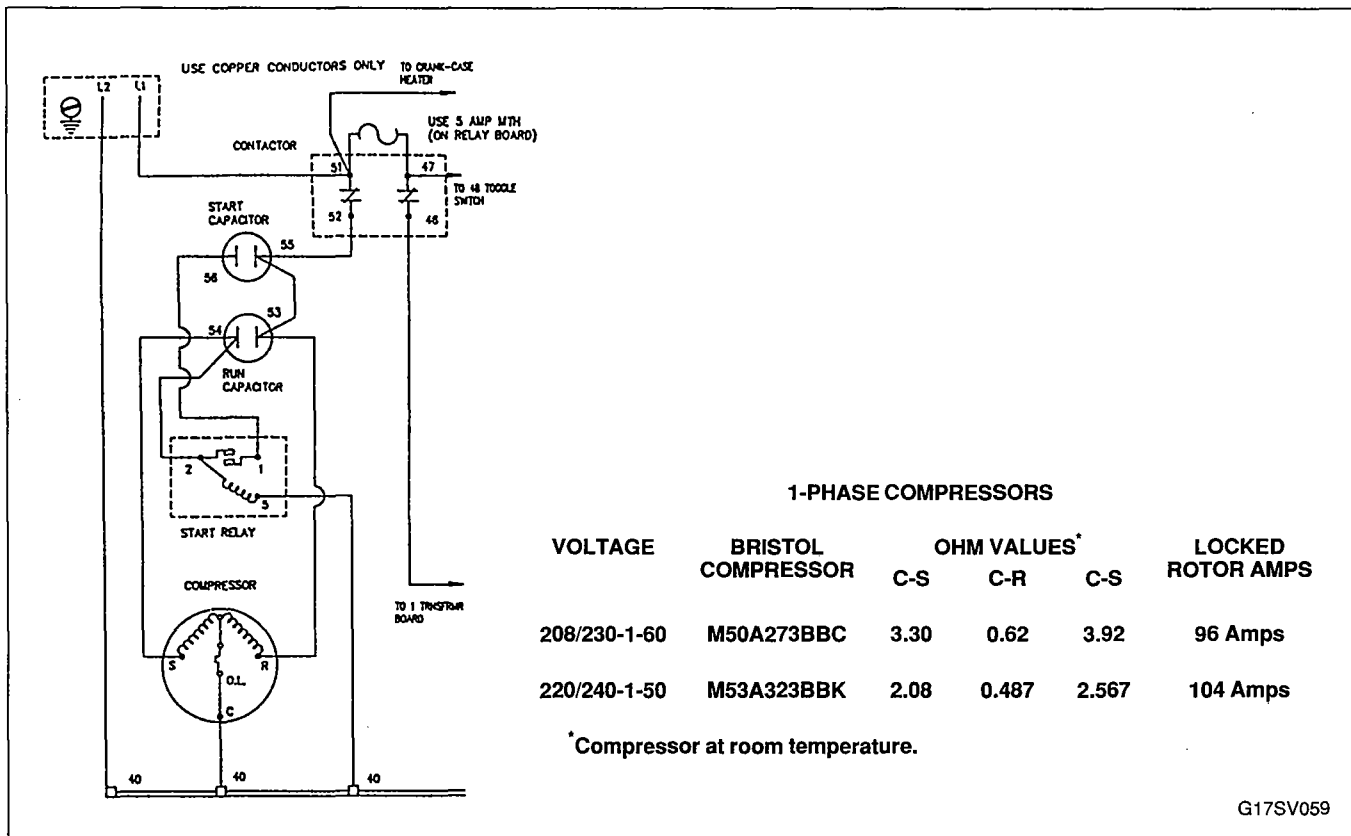


FIGURE 59. ONE PHASE COMPRESSOR AND START COMPONENTS SCHEMATIC

Perform the following tests, in sequence, using a quality, calibrated volt-ohmmeter.

1. Verify electric power to the ice machine at time of compressor start-up is "line voltage" ( $\pm 10\%$ ).
2. Verify the following control components are in the closed position:
  - Bin Switch, page 44.
  - High Pressure Cut-Out Control, page 45.
  - ICE/OFF/WATER PUMP Switch, page 46.
  - Contactor.
  - Low Pressure Cut-Out Control (Remote Machines), page 50.

**WARNING**  
 DISCONNECT ELECTRIC POWER TO THE ICE MACHINE AT THE ELECTRIC SERVICE SWITCH BOX BEFORE PROCEEDING WITH THE FOLLOWING STEPS.

3. Continuity check of start relay (RX10,000 scale):
  - a. Disconnect wires from start relay. (If relay is being removed, keep it upright.)

- b. Terminals 1 and 2 (contact normally closed).  
 No continuity — replace relay.  
 Continuity — relay OK.
- c. Terminals 2 and 5.  
 No continuity — replace relay.  
 Continuity — relay OK.

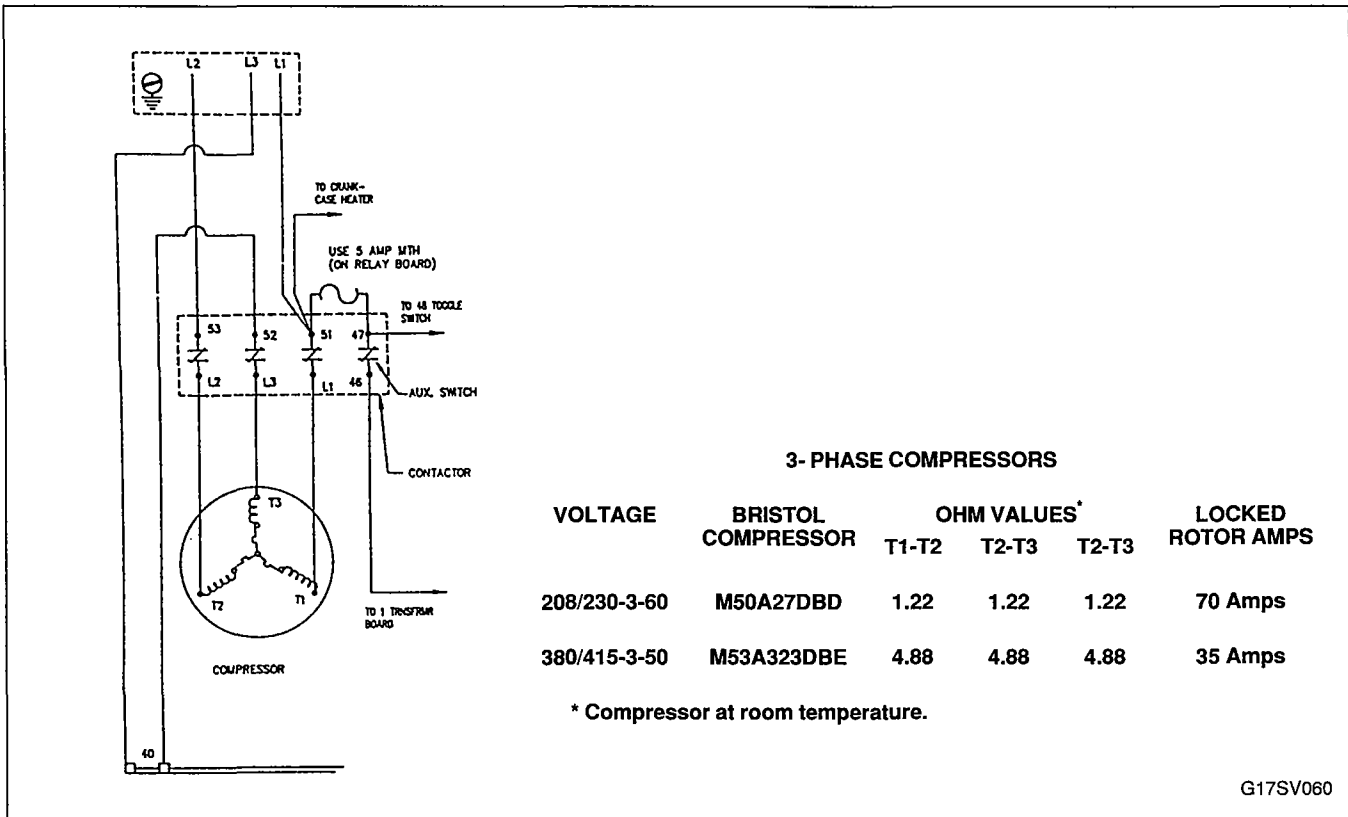
4. Continuity check of compressor:

**NOTE**  
 Compressor must be at room temperature.

- a. Disconnect wires from compressor terminals.
- b. Terminal C to Terminal R.  
 Continuity — see step e.  
 No continuity — open run winding. Replace compressor.
- c. Terminal C to Terminal S.  
 Continuity — see step e.  
 No continuity — open start winding. Replace compressor.
- d. Terminal C to shell of compressor.  
 Continuity — compressor grounded. Replace compressor.  
 No continuity — compressor not grounded.

- e. Check winding resistance against values given in chart. The resistance values from C-R and C-S added together should equal the reading from S to R.
5. Capacitor check (run and start):
- a. Capacitors may show visual evidence of failure, such as a bulged terminal end or a ruptured membrane. However, *do not* assume a capacitor is good just because there are no visual signs of failure.
  - b. An effective test is to disconnect leads to the capacitor in the ice machine and connect them to a good capacitor.
- c. Use of a capacitor analyzer is recommended when checking a suspect capacitor. Follow instructions supplied with capacitor analyzer.
  - d. If all of the capacitor tests prove satisfactory and the compressor still fails to start:
    - 1) Replace start relay.  
The new relay eliminates any faulty electrical characteristics such as improper pick-up or drop-out, which cannot be determined by the tests.
    - 2) If new relay fails to correct the problem, the compressor can be considered inoperative because of internal defects. Replace compressor.

# DIAGNOSING THREE (3) PHASE COMPRESSOR AND START COMPONENTS ELECTRICALLY



**FIGURE 60. THREE PHASE COMPRESSOR AND START COMPONENTS SCHEMATIC**

Perform the following tests, in sequence, using a quality, calibrated volt-ohmmeter.

1. Verify electric power to the ice machine at time of compressor start-up is "line voltage" ( $\pm 10\%$ ).
2. Verify the following control components are in the closed position:
  - Bin Switch, page 44.
  - High Pressure Cut-Out Control, page 45.
  - ICE/OFF/WATER PUMP Switch, page 46.
  - Contactors.
  - Low Pressure Cut-Out Control (Remote Machines), page 50.
3. Check amperage in each line. One or two high-amperage legs on a three phase motor indicates an unbalanced voltage supply, or a winding imbalance. If all three legs are not drawing approximately equal amperage, temporarily switch the leads to the motor to determine if the high leg stays with the line or stays with the terminal. If the high amperage stays

with the line, the problem is in the line voltage supply. If the amperage reading stays with the terminal the problem is in the compressor motor. If the amperage is sufficiently unbalanced to cause the overload to trip, and the voltage supply is unbalanced, check with the power company to see if the condition can be corrected. If the voltage supply is balanced, indicating a defective motor phase, the compressor should be replaced.

**⚠ WARNING**  
**DISCONNECT ELECTRIC POWER TO THE ICE MACHINE AT THE ELECTRIC SERVICE SWITCH BOX BEFORE PROCEEDING WITH THE FOLLOWING STEPS.**

4. Continuity check of compressor (ohm check):

**NOTE**  
 Compressor must be at room temperature.

- a. Disconnect wires from compressor terminals.
- b. Check continuity between terminals T1 to T2, T1 to T3, and T2 to T3.  
Continuity — see step d.  
No continuity — open winding.  
Replace compressor.
- c. Check continuity at each terminal, T1, T2, and T3, to compressor shell.

Terminals to shell of compressor.

Continuity — compressor grounded.

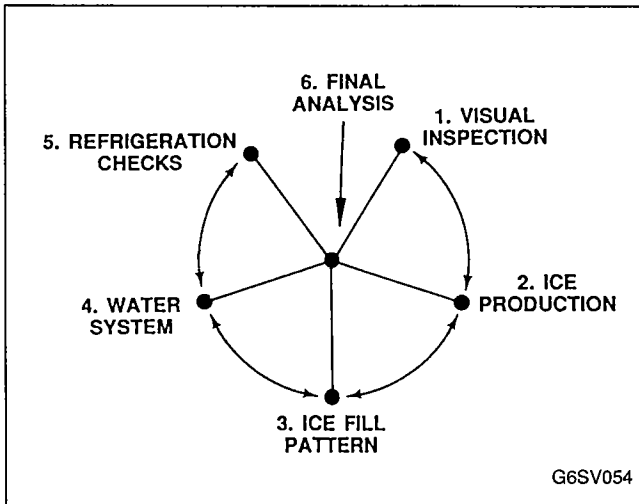
Replace compressor.

No continuity — compressor not grounded.

- d. Check winding resistance against values given in Figure 60. The values of all readings should be equal.

# REFRIGERATION AND OTHER NON-ELECTRICAL PROBLEMS

## INTRODUCTION TO THE SIX-STEP DIAGNOSTIC PROCEDURE



**FIGURE 61. SIX-STEP DIAGNOSTIC PROCEDURE**

The Six-Step Procedure (Figure 61) is designed to increase the accuracy of your service call, while decreasing the time required to identify any problems.

Refrigeration components will react and try to compensate for nonrefrigeration component problems. By following this procedure step by step, problems that affect the refrigeration sequence can be identified without needless changing of components.

Each of the six steps have several items to check before proceeding to the next step. Follow each step carefully as the problem may be identified prior to the completion of all six steps.

Step 6 requires the use of information gathered in the previous steps. Write down information as you collect it and record it on the Refrigeration Component Diagnostic Chart, page 69. This will keep you organized and simplify the 6th step of determining the malfunction.

### NOTE

Do not make adjustments or turn the ice machine off until you have identified the malfunction. The problem may not repeat itself.

## STEP 1 — VISUAL INSPECTION

Talk to the ice machine user to identify the perceived problem(s). The user's information could help you start in the right direction and may be a determining factor in your final diagnosis.

Following are a few questions to consider when talking to the ice machine user:

- When is the ice machine malfunctioning? (Night, day, all the time, during freeze cycle, harvest cycle, etc.)

- When do you notice low production? (One day a week, every day, weekends, etc.)
- Can you describe exactly what the ice machine seems to be doing?
- Has anyone been working on the ice machine?
- Were items such as boxes obstructing air flow moved from around the ice machine before you arrived?

### EQUIPMENT VISUAL INSPECTION

(Record Your Findings on Refrigeration Component Diagnostic Chart, Page 69)

Possible Problem	Actual Finding	Corrective Measure
1. Ice machine not properly installed.		Reinstall in accordance with installation manual.
2. Air temperatures/air flow restrictions, etc.		Reinstall in accordance with installation manual.
3. Air space clearances at back and sides of ice machine.		Must have a minimum of 5 inches clearance around all sides and top of machine.
4. Ice machine not level side-to-side, back-to-front.		Level machine.
5. Remote condenser dirty.		Clean condenser.
6. Ice machine not on separate fused electrical circuit.		Install electrical in accordance with installation manual.
7. Drains not run separate and/or vented.		Run drains separate and vent according to installation manual.
8. Water filtration restricted (if used).		Install new water filter.
9. Remote condenser line set not properly installed.		Refer to Installation Instructions.

#### NOTE

Steps 2, 3 and 4 can be completed in conjunction with each other. Be careful not to interfere with the ice production check.

## STEP 2 — ICE PRODUCTION

The amount of ice a machine produces is in direct relationship to water and air temperatures, this means an ice machine produces more ice in a 70°F room with 50°F water than in a 90°F room with 70° F water.

### ICE PRODUCTION CHARTS (Lbs. of Ice per 24 Hours)

#### Self-Contained Water-Cooled

Air Temp. °F	Water Temp. °F		
	50	70	90
70	1710	1530	1390
80	1700	1520	1380
90	1690	1510	1370
100	1680	1500	1360

#### Remote Machines (With AC1795A Condenser)

Air Temp. °F	Water Temp. °F		
	50	70	90
70	1780	1600	1460
80	1750	1530	1390
90	1660	1480	1320
100	1550	1390	1230

#### Remote Machines (With AC1796B Condenser)

Air Temp. °F	Water Temp. °F		
	50	70	90
-20 to 70	1780	1600	1460
90	1715	1500	1365
100	1630	1450	1290
110	1520	1365	1205

These figures are based on a clean, properly maintained ice machine running continually for a 24-hour period, with an average ice weight of 12.25 lb. to 14.50 lb. per harvest.

Use the following to check and compare ice production:

#### IMPORTANT

Water curtain must be in place to assure no water is being lost while checking ice production.

## OPERATING CONDITIONS

1. Condenser inlet air temperature \_\_\_\_\_
2. Water inlet temperature (taken at float outlet) \_\_\_\_\_
3. The published 24-hour ice production at the above conditions: \_\_\_\_\_ lb/24 hours

## ICE PRODUCTION CHECK

1. Freeze time \_\_\_\_\_ + harvest time \_\_\_\_\_  
= \_\_\_\_\_ total cycle time
2.  $1440 \div$  total cycle time \_\_\_\_\_  
= \_\_\_\_\_ cycles/day
3. Weight 1 harvest \_\_\_\_\_ x cycles/day \_\_\_\_\_  
= \_\_\_\_\_ lb/24 hours

#### NOTE

To use the 24-hour ice production formulas, time must be in minutes and weight of ice in pounds.

Times are in minutes.

Example: 1 min. 15 sec. convert to 1.25 min.  
 $15 \text{ sec.} \div 60 \text{ sec.} = .25 \text{ min.}$

Weights are in pounds.

Example: 12 lb. 4 oz. convert to 12.25 lb.  
 $4 \text{ oz.} \div 16 \text{ oz.} = .25 \text{ lb.}$

Compare your findings in the Ice Production Check to published specifications in Operating Conditions. Record your findings on Refrigeration Diagnostic Chart, page 69.

- A. Ice Production OK:  
Determine if another ice machine is needed, more storage capacity, or if moving existing equipment to lower load conditions will meet the customer's needs. (Contact local Manitowoc Distributor for options and accessories available.)
- B. Low Ice Production:  
Record your findings on the Refrigeration Diagnostic Chart, page 69, Step 2 (actual findings column of chart).  
Continue through Six-Step Procedures.

### STEP 3 — ICE FILL PATTERN

The fill patterns on the evaporators are normal when the ice thickness is a uniform 1/8 inch from top to bottom and side to side. (The ice bridge is the inter-connecting waffle between the cubes. Refer to page 46.) The water should freeze on the entire evaporator at the same time and both evaporators at the same rate. Ice forming on the bottom of an evaporator and then working its way up to the top is not normal and must be noted as "thin on top and thick on bottom."

#### IMPORTANT

The water curtain must be in place to ensure no water is being lost while checking ice fill pattern.

Examples of ice fill patterns:

Normal ice fill — uniform 1/8-inch bridge thickness on entire evaporator surface.

Thick on top and thin on bottom.

Thin on top and thick on bottom.

Spotty ice fill (i.e., corner not filling, etc.).

Record your findings for both front and rear fill patterns on the Refrigeration Diagnostic Chart, page 69, step 3 (actual findings column of chart).

### STEP 4 — WATER SYSTEM

Water related problems in ice machines often have the same symptoms as a refrigeration system malfunction.

Water area failures must be identified and eliminated prior to changing of refrigeration components. An example is a water dump valve leaking during the freeze cycle and a starving TXV. The characteristics of both failures are similar.

### CHECK WATER RELATED PROBLEMS

(Record Your Findings on Refrigeration Component Diagnostic Chart, Page 69, Step 4, Actual Findings Column of Chart)

Possible Problem	Actual Finding	Corrective Measure
1. Water area (evaporator) dirty.		Clean.
2. Water inlet pressure not between 20-80 psi.		Install water regulator valve or increase water pressure.
3. Incoming water supply temperature must be 35°F to 90°F.		Too hot — check hot water line check valves in other store equipment.
4. Water filter restricted (if used).		Replace filter.
5. Dump valve malfunctioning.		Clean dump valve. Replace as needed, page 16.
6. Vent tube not installed on water outlet drain.		See Installation Instructions.
7. Water trough hoses leaking water.		Install properly or replace.
8. Water float valve stuck open or out of adjustment.		Readjust float, page 45.
9. Water freezing behind evaporators.		Check water flow.
10. Water freezing between white plastic extrusions and evaporator.		Seal with food-grade silicone (RTV) adhesive.
11. Water flow uneven across evaporator(s).		Clean ice machine. Check water flow rate.

## STEP 5 — REFRIGERATION

The refrigeration section requires taking several checks to gather information.

### NOTE

Only proceed to Refrigeration System Step 5 after Steps 1-4 have been thoroughly checked and a final diagnosis could not be determined.

## OPERATIONAL PRESSURE CHARTS

### Self-Contained Water Cooled

Ambient Temp. °F	Freeze Cycle		Harvest Cycle	
	Head Pressure PSIG	Suction Pressure PSIG	Head Pressure PSIG	Suction Pressure PSIG
50	210-230	40-26	110-150	65-80
70	210-230	40-26	110-150	65-80
80	210-230	42-28	120-160	70-85
90	210-230	42-28	120-160	70-85
100	210-230	42-28	120-160	75-90
110	210-230	42-28	120-160	75-90

### Remote Machines

Ambient Temp. °F	Freeze Cycle		Harvest Cycle	
	Head Pressure PSIG	Suction Pressure PSIG	Head Pressure PSIG	Suction Pressure PSIG
-20 to 50	170-190	40-25	90-140	71-79
70	175-200	40-25	90-140	71-79
80	200-225	40-25	100-150	71-79
90	220-250	42-26	110-160	71-79
100	250-330	44-28	120-170	71-79
110	290-330	46-30	120-180	71-79

## CYCLE TIME CHART

### NOTE

To calculate total cycle time, add harvest time to freeze time listed in charts.

### Self-Contained Water Cooled

Ambient Temp. °F	Freeze Time			Harvest Time
	Water Temp.			
	50°F	70°F	90°F	
70	8-10	9.5-11.5	10.5-13.0	1.5-2.5
80	8-10	9.5-11.5	10.5-13.0	
90	8.5-10.5	9.5-12.0	11.0-13.5	
100	8.5-10.5	9.5-12.0	11.0-13.5	
		9.5-12.0	11.0-13.5	

### Remote Machines

Condenser Ambient Temp. °F	Freeze Time			Harvest Time
	Water Temp.			
	50°F	70°F	90°F	
-20 to 70	8-10	9.0-11.0	10.0-12.0	1.5-2.5
90	8-10	9.5-11.5	10.5-13.0	
100	8.5-10.5	10.0-12.0	11.0-15.0	
110	9.0-11.0	10.5-13.0	12.0-15.5	
		10.5-13.0	12.0-15.5	

## Record Pressure of Freeze and Harvest Cycles

Freeze Cycle	Discharge	Suction
<ol style="list-style-type: none"> <li>One minute to freeze</li> <li>Middle of freeze</li> <li>End of freeze</li> </ol>		
Harvest Cycle		
<ol style="list-style-type: none"> <li>Start of harvest</li> <li>Middle of harvest</li> <li>End of harvest</li> </ol>		

**Step 5A — Analyze Discharge Pressure**

Using the Operational Pressure Chart, page 62, determine if the discharge pressure is correct for the ambient temperature the ice machine is located in.

A. If discharge pressure is within normal range, proceed to Step 5B to analyze suction pressure.

B. If discharge pressure is not within normal range, refer to the appropriate chart below.

C. Record findings on Refrigeration Diagnostic Chart, page 69.

**DISCHARGE PRESSURE HIGH**

Eliminate possible problems in the order listed on chart and follow appropriate corrective measures.

Possible Problem	Actual Finding	Corrective Measure
1. Excessive load conditions (air/water temperatures).		Relocate ice machine to location within guidelines (refer to Installation Instructions).
2. Dirty condenser.		Clean.
3. Water regulating valve (water-cooled condenser): a. Too small supply water line. b. Out of adjustment. c. Defective regulating valve. d. Dirty (scaled).		Replace with proper size line.  Replace. Clean.
4. Restriction in high side lines.		Repair, see Evacuation/Charging Procedures, page 76.
5. Headmaster Control Valve defective (remote machines).		Refer to Headmaster Control Valve Diagnostics, page 70.
6. Improper refrigerant charge.		Refer to Evacuation/Charging Procedures, page 76.
7. Noncondensables in system.		Refer to Evacuation/Charging Procedures, page 76.

**DISCHARGE PRESSURE LOW**

Eliminate possible problems in the order listed on chart and follow appropriate corrective measures.

Possible Problem	Actual Finding	Corrective Measure
1. Load conditions low (air/water temperatures).		Relocate ice machine to location within guidelines (refer to Installation Instructions).
2. Water regulating valve (water-cooled condensers): a. Out of adjustment. b. Leaking water during harvest cycle. c. Defective.		Readjust/replace if necessary.  Replace.
3. Headmaster Control Valve defective (remote machines).		Refer to Headmaster Control Valve Diagnostics, page 70.
4. Low refrigerant charge.		Refer to Headmaster Control Valve Diagnostics, page 70.

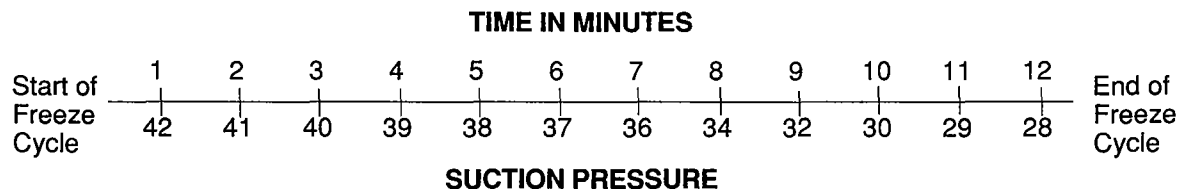
## Step 5B — Analyze Suction Pressure

### NOTE

Discharge pressures must be analyzed before suction pressure.

To analyze suction pressure you must compare the Operational Pressure Chart, page 62, to the Cycle Time Chart, page 62. The suction pressure gradually drops as ice forms throughout the freeze cycle.

- A. **Normal suction pressure:** proceed through Six-Step Procedure. (Example: 32 psig after 9 minutes into the freeze cycle is normal at 90°F air and 70°F water.)
- B. **Low suction pressure:** Refer to Suction Pressure Low chart, page 65. (Example: 12 psig after 3 minutes into the freeze cycle is considered low.)
- C. **High suction pressure:** Refer to Suction Pressure High chart below. (Example: 38 psig after 10 minutes into the freeze cycle is considered high.)



By comparing the two charts you can determine if suction pressure is properly pulling down. Develop a chart as above and you will easily see where the suction pressure should be compared to the amount of time the ice machine is into the freeze cycle.

### NOTE

If the ice machine is located in other than 90°F air and 70°F water another chart must be developed for comparison purposes.

Example: G1700 self-contained, water cooled:  
air temperature 90°F  
water temperature 70°F

From Cycle Time Chart, page 62:  
freeze time — 9.5 to 12.0 minutes  
harvest time — 1.5 to 2.5 minutes  
total cycle time — 11.0 to 14.5 minutes

From Operational Pressure Chart, page 62:  
Suction pressure:  
start of freeze — 42 psig  
end of freeze — 28 psig

## SUCTION PRESSURE HIGH

Eliminate the possible problems in the order listed on chart and follow appropriate corrective measure.

Possible Problem	Actual Findings	Corrective Measure
1. High discharge pressure affecting low side.		See Discharge Pressure High, page 63.
2. Hot gas valve stuck wide open.		Replace valve, page 73.
3. TXV flooding.		Continue through Six-Step Procedure.
4. Inefficient compressor (do not perform pumpdown test).		Continue through Six-Step Procedure.
5. Harvest pressure regulating solenoid valve leaking (remote machines).		Replace valve.

## SUCTION PRESSURE LOW

Eliminate the possible problems in the order listed on chart and follow appropriate corrective measure.

Possible Problem	Actual Findings	Corrective Measure
1. Low load conditions.		Relocate ice machine to location within guidelines.
2. Water area problem.		Refer to Step 4.
3. Tubing separating from backside of evaporator.		Replace evaporator.
4. Plugged drier/restriction in liquid line.		Repair — refer to Evacuation/Charging Procedures, page 76.
5. TXV is starving/low on charge.		Continue through Six-Step Procedure.

### Step 5C — Hot Gas Valve Check

#### POSSIBLE PROBLEMS:

1. Improper valve.  
A hot gas valve requires a specific orifice size which meters the proper amount of hot gas flow into the evaporator during the harvest cycle. Replace defective hot gas valves with original Manitowoc replacement (O.E.M.) parts only. Refer to your Parts Manual for proper valve application.

2. Stuck in harvest cycle: Check for voltage at coil.

IF YES: Refer to Electrical Sequence of Operation, (Table of Contents).

IF NO: Normally a hot gas valve can be repaired without changing the entire valve. Rebuild or replace the hot gas valve as required. Refer to Refrigeration Solenoid Valve Replacement, page 73.

3. Leaking during freeze cycle.
  - a. Symptoms of leaking hot gas valve:
    - 1) Ice production loss will be normal.
    - 2) Ice fill on both evaporators will be normal.
    - 3) Suction pressure at the end of the freeze cycle will be slightly high. (This 1 to 4 psig increase can be difficult to detect.)
  - b. Check procedures (Figure 62, page 66).

#### NOTE

Procedures must be performed twice, once for each hot gas valve.

- 1) Feel **hot gas valve inlet** after 5 minutes into freeze cycle.



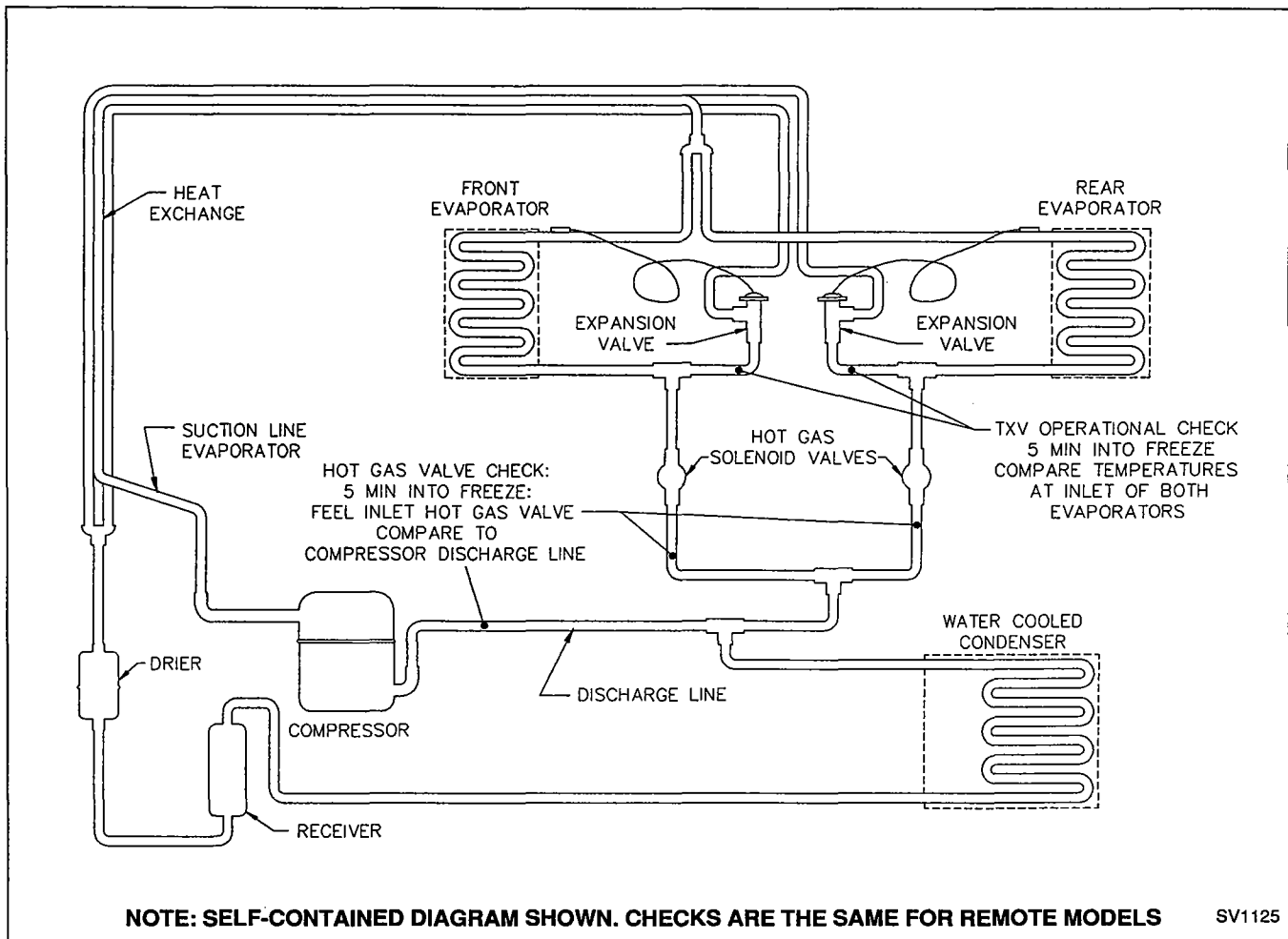
#### CAUTION

**HOT GAS VALVE INLET COULD BE HOT ENOUGH TO BURN YOUR HAND. TOUCH IT BRIEFLY.**

- 2) Determine if the inlet of hot gas valve is hot or close to compressor discharge line temperature.
- 3) A **good hot gas** valve inlet line will be hot to touch during the harvest cycle and be cool enough to touch after approximately 5 minutes into the freeze cycle. With a **leaking hot gas valve**, the inlet temperature will remain close to the discharge line temperature (hot to touch) during the freeze cycle.

Record your findings on the Refrigeration Component Diagnostic Chart, page 69.

Hot Gas Valve Inlet Feel Check Findings: (circle one)  
 Compressor discharge temperature — Hot or Cool  
 Front hot gas valve **inlet** temperature — Hot or Cool  
 Rear hot gas valve **inlet** temperature — Hot or Cool



**FIGURE 62. HOT GAS VALVE INLET FEEL CHECK/TXV OPERATIONAL CHECK**

**Step 5D — Thermal Expansion Valve (TXV) Checks**

**POSSIBLE PROBLEMS:**

1. Improper valve.  
An improper valve will not achieve a uniform ice fill on the evaporator or proper ice production under all load conditions. Manitowoc O.E.M. expansion valves use special bulb gas charges, port sizes and stroke lengths to achieve this. Refer to the Parts Manual for proper valve usage.
2. TXV not installed properly.  
Refer to TXV Installation Procedures, page 72.
3. TXV starving or flooding.  
It is extremely rare for two TXV's to fail at the same time. When both TXV's are flooding or starving it indicates that both valves are operating normally and the symptom indicates trouble in another area.

A starving or flooding expansion valve may be reacting to or trying to compensate for other refrigeration problems. All conditions that could cause a good TXV to starve or flood must be eliminated. The following example emphasizes this point:

An ice machine low on charge will cause both TXV's to starve.

A service technician forgets to verify system charge and changes both TXV's for starving.

While changing the TXV's the evacuation/charging procedures are performed correctly, and the proper charge put into the ice machine. The ice machine functions properly and the technician thinks he has diagnosed the problem correctly (bad TXV's). In reality the problem was corrected because the proper charge was put into the ice machine.

- a. Symptoms of a starving valve:
  - 1) Ice production will be low or ice machine may not make ice.

- 2) The suction pressure will be lower than normal.
  - 3) The ice pattern (page 61) will be thin on top and thick on bottom of evaporator fed by a starving TXV and normal on evaporator fed by a good TXV.
- b. Symptoms of a flooding valve:
- 1) Ice production will be low or ice machine may not make ice.
  - 2) The suction pressure will be higher than normal.
  - 3) The ice pattern will be thick on top and thin on bottom of evaporator fed by flooding TXV and normal on evaporator fed by a good TXV.
4. TXV operational check (Figure 62, page 66) is used to determine how the TXV's are functioning. As temperature readings must be accurate, a thermocouple type of temperature meter is recommended.

**NOTE**

Measure the **inlet** temperature of both evaporators at least 5 minutes into the freeze cycle. Compare the temperatures to each other.

- a. Temperature indications:
- 1) Properly operating TXV's will maintain the inlet temperatures within 5° of each other.
  - 2) An ice machine with one good TXV and one starving TXV will maintain the inlet temperatures of the evaporators within 5° of each other.
  - 3) An ice machine with one good TXV and one flooding TXV will not maintain the inlet temperatures of the evaporators within 5° of each other. This indicates the TXV feeding the warmer of the two temperatures is a flooding TXV.

Record your findings on the Refrigeration Component Diagnostic Chart (page 69).

Front evaporator inlet temperature \_\_\_\_\_

Rear evaporator inlet temperature \_\_\_\_\_

**Step 5E — Compressor**

1. Suction valves (inefficient compressor).  
An inefficient compressor can be hard to detect. Components or problems that are not directly related to the compressor can simulate a faulty compressor.

To diagnose a faulty compressor, systematically check other components and rule them out one by one, following the entire Six-Step Procedure. Step 6 will then indicate if a compressor change is needed.

Symptoms of an inefficient compressor:

- a. Reduced ice production will be noticeable at lower ambient conditions and become more pronounced as ambient temperatures increase.
- b. Ice fill pattern (both evaporators) normal at lower ambients, although in extreme high ambient cases there may be little or no ice formation.
- c. Suction pressures at the end of freeze cycle will be slightly high and become more pronounced as ambient temperature increases.
- d. There may be intermittent flooding by the TXV's.

**NOTE**

An inefficient compressor may "pump down" and hold; therefore this type of test must not be used as a determining factor for replacing compressors.

2. Discharge valves.
  - a. The compressor shell will become hot and compressor may cycle on overload.
  - b. Suction pressure will be high.
  - c. Discharge pressure will be lower than normal.
  - d. Check procedure for discharge valves:
    - 1) Ensure compressor is running.
    - 2) Turn ice machine off.
    - 3) Immediately feel suction line — it will turn hot if the discharge valve is leaking or broken.

## STEP 6 — FINAL ANALYSIS

Thoroughly following the first 5 steps has eliminated all nonrefrigerant problems. The Refrigeration Component Chart will verify what is causing the problem.

Fill out the chart using the following procedures:

1. Based on the symptoms found while performing Steps 1 through 5, fill in the Actual Findings column.
2. Each time the actual finding is the same as the characteristic listed to the right of a step number, put a check in the appropriate box. (Example: the actual finding is "thin ice on top of evaporator.") The box under starving TXV is the only box checked across the ice fill pattern section.
3. Add the number of boxes checked (under) each component failure and put the total in the bottom column. Refer to the component column with the most boxes checked and follow the appropriate procedures as listed in "a" through "d" below.
  - a. Hot Gas Valve Leaking column: Normally a leaking hot gas valve can be repaired without changing the entire valve. Rebuild or replace the hot gas valve as required. Refer to Refrigeration Solenoid Valve Replacement, page 73.
  - b. TXV Starving column: Verify the ice machine is not low on charge before replacing both TXV's. Use the following guidelines:

By observing the ice fill pattern, change only the TXV that is starving. If both TXV's are starving the TXV's are most likely to be good and are affected by some other malfunction such as an ice machine that is low on charge.

### NOTE

A low refrigerant charge will affect both freeze and harvest cycle pressures.

- 1) Add charge in 2 to 4 oz. increments to see if the problem is corrected.
- 2) If problem is not corrected by adding charge, change the TXV and drier. (Refer to Evacuating/Recharging, page 76.)
- 3) If problem is corrected by adding charge, find the refrigerant leak, change the drier, evacuate and recharge, page 76. (System must operate with proper charge — do not leave run without changing drier, evacuating, and recharging.)
  - c. TXV Flooding column: By observing the ice fill pattern, change only the TXV that is flooding. If both TXV's are flooding go back through the Six-Step Procedure to locate the cause.
  - d. Inefficient Compressor column: Replace the compressor (and start components) and drier, evacuate, and recharge, page 76.

### NOTE

To receive warranty credit on compressor, old start components must be returned with faulty compressor.

## DUAL EVAPORATOR ICE MACHINE REFRIGERATION COMPONENT DIAGNOSTIC CHART

This chart is used with a detailed outline of each of the Six Steps listed.  
Failure to follow the details of each step in order will result in a misdiagnosis.

STEPS	HOT GAS VALVE LEAKING (not wide open)	TXV STARVING	TXV FLOODING	INEFFICIENT COMPRESSOR	ACTUAL FINDINGS
1. Visual Inspection	Visual inspection includes checking for proper installation, location, dirty condensers, etc., and talking to the ice machine user to identify the perceived problem(s). (Refer to Step 1, page 59.)				
2. Ice Production	Normal ice production.	1. Low ice production. 2. Not making ice.	1. Low ice production. 2. Not making ice.	1. Minimal ice production loss (almost normal). 2. Low ice production.	
3. Ice Fill Pattern	Ice fill is normal on both evaporators.	Ice fill will be thick on the bottom portion of the evaporator and thin on the top or no ice.	Ice fill will be thin on the bottom portion of the evaporator and thick on the top or no ice.	Ice fill is normal on both evaporators.	Front _____ Rear _____
4. Water System	Water related problems can simulate a refrigeration component malfunction. Water related problems must be eliminated before proceeding to Step 5.				
5. Refrigeration System	Discharge pressure must be normal before proceeding to Step 5B.				
5A. Discharge Pressure	Refer to High/Low discharge pressure charts (page 63).				
5B. Freeze Cycle Suction Pressures	Normal to 4 psig high at end of freeze cycle.	Lower than normal throughout freeze cycle.	Higher than normal throughout freeze cycle.	Slightly higher throughout freeze cycle. Pressures normally do pull down although take a long time.	
5C. Hot Gas Valve Inlet Feel Check	The inlet of hot gas valve is hot and approaches temperature of discharge line.			The inlet of hot gas valve is cooler than discharge line.	Front _____ Rear _____
5D. TXV Operational Check	Evaporator inlet temperatures within 5°F of each other.	Evaporator inlet temperatures within 5°F of each other.	Evaporator inlet temperatures not within 5°F: Warmer temperature indicates a flooding valve.	Evaporator inlet temperatures within 5°F of each other.	Front _____ Rear _____
Miscellaneous					
6. Final Analysis (number of boxes checked)	A.	B.	C.	D.	

## HEADMASTER CONTROL VALVE (Remote Machines)

Manitowoc remote systems require Headmaster Control Valves with special settings. Replace defective Headmaster Control Valves **only** with "original" Manitowoc replacement parts.

### Operation

The R-502 Headmaster Control Valve has a non-adjustable setting of 185 psig ( $\pm 10$ ). At ambient temperatures of 70°F and above refrigerant flows through the valve from the condenser to the receiver inlet. At temperatures below 70°F the Headmaster pressure control dome's nitrogen charge closes the condenser port. The bypass port from the compressor discharge line opens. In this mode the valve maintains minimum compressor head pressure by building up liquid in the condenser and bypassing discharge gas directly to the receiver.

### Diagnosing Headmaster Control Valves

- Determine air temperature entering remote condenser.
- Determine if head pressure is low or high in relationship to outside temperature (refer to Operation Pressure Chart, page 62). If air temperature is below approximately 70°F, the head pressure should be modulating around 185 psig ( $\pm 10$ ).
- Determine the temperature of the liquid line entering the receiver by feeling with hand. This line is normally "body" temperature (warm).
- Refer to Failure Chart to determine cause.

#### NOTE

An ice machine with a failed Headmaster Control Valve that will not bypass will function properly with condenser air temperatures of approximately 70° or above. When the temperature drops below approximately 70° the Headmaster Control Valve fails to bypass and the ice machine malfunctions.

Use the following procedure if the ice machine is suspected of being low on charge:

- Add refrigerant in 2-pound increments but do not exceed 6 pounds
- If the ice machine was low on charge the Headmaster Control Valve function and discharge pressure will return to normal after the charge is added. Do not leave ice machine operate; to assure operation in all ambient conditions the ice machine must be evacuated and recharged with proper nameplate charge.
- If the ice machine does not start to operate properly after adding charge, replace the Headmaster Control Valve.

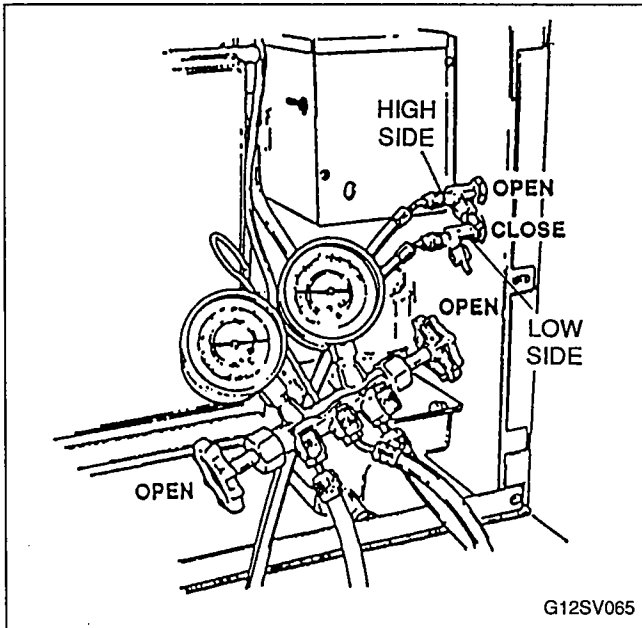
**HEADMASTER CONTROL VALVE FAILURE CHART**

Possible Problem	Probable Cause	Corrective Measure
Valve not maintaining proper pressures.	Non-approved valve.	Install O.E.M. Headmaster Control Valve.
1. Discharge pressure extremely high. 2. Liquid line receiver feels hot.	Valve stuck in bypass.	Replace valve.
1. Discharge pressure low. 2. Liquid line entering receiver extremely cold.	Valve not bypassing.	Replace valve.
1. Discharge pressure low. 2. Liquid line entering receiver is warm to hot.	Ice machine low on charge.	Refer to procedures above.

# HOW TO USE MANIFOLD GAUGES

Manifold gauges must be installed and removed properly to ensure no refrigerant contamination or loss occurs.

## INSTALLING MANIFOLD GAUGES



**FIGURE 63. INSTALLING MANIFOLD GAUGES**

1. Connect high side line to high side service valve at ice machine. See Figure 63.
2. Start low side line onto low side service valve at ice machine. Do not tighten.
3. Open both high and low side valves on manifold gauges. Be sure middle charging port is capped.
4. Backseat (open) high side service valve on ice machine. Allow a *small amount* of refrigerant to bleed from valve.

### IMPORTANT

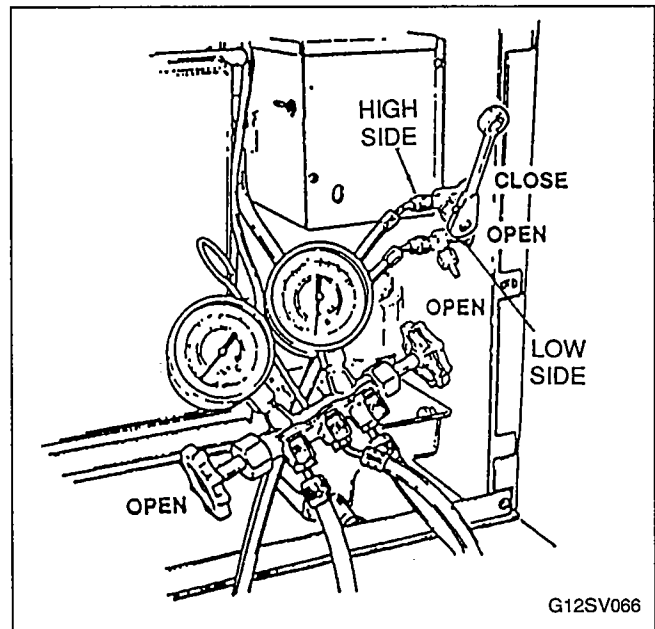
Tighten low side line as refrigerant bleeds through. This purges contaminants and noncondensables from manifold and hoses.

## READING OPERATIONAL PRESSURES

1. Close both high and low side valves on manifold gauge set.

2. Backseat (open) both high and low side service valves at the ice machine.
3. With machine operating, read high and low side pressures on gauges.

## REMOVAL OF MANIFOLD GAUGES



**FIGURE 64. REMOVAL OF MANIFOLD GAUGES**

1. Run ice machine in freeze cycle.
2. Close high side service valve at ice machine.
3. Backseat (open) low side service valve at ice machine.
4. Open both high and low side valves on manifold gauge set. Refrigerant in lines will now be pulled into the low side of system. Allow pressures to equalize with ice machine still in freeze cycle.
5. Frontseat (close) low side service valve at ice machine.
6. Remove hoses from ice machine and install caps.

### NOTE

Removing manifold properly will ensure you do not alter charge and will eliminate releasing C.F.C.'s into atmosphere.

# TXV INSTALLATION

Correct expansion valve installation is essential for proper operation. Some key points to remember when installing a valve include:

## SOLDERING IN VALVE

Wrap the TXV with a wet rag or another heat sink. This will prevent damage to the valve from overheating.

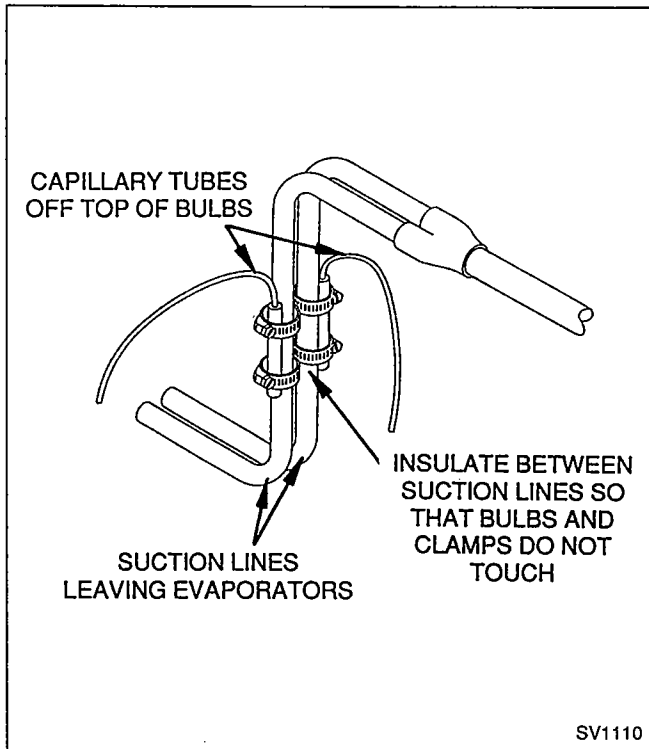


FIGURE 65. TXV BULB LOCATION

## BULB LOCATION

1. Bulb must be clamped to a smooth, clean copper tube, not to a weld joint.
2. The capillary tube of the TXV must come out of the top of the bulb in a vertical position.

3. The bulb or the clamps holding the bulb must never touch the other bulb or the clamps holding the other bulb.
4. The outer edges of the clamps must be even with the ends of the bulb.

## BULB CLAMP LOCATION

All Manitowoc expansion valve bulbs are to be mounted with two stainless steel screw clamps (Figure 65). Both clamps must be used. Clamps must be flush with each end of the bulb. Do not put both clamps in the middle of the bulb, as this can cause the bulb to bow or warp.

## BULB CLAMP TIGHTNESS

Bulbs must be tight for good thermal contact. A properly tightened bulb will not move around the suction line when twisted by hand. Properly tightened clamps may slightly deform the bulb. This is normal and will not hurt valve operation.

## BULB INSULATION

1. The bulb insulation must be at least 3/8 inch thick. If thinner insulation is used, apply additional layers.
2. Insulate between the bulbs before wrapping both together.
3. Insulate the valve body to prevent sweating.

## BULB INSTALLATION CHECK

To check if the bulb has good thermal contact, hold a flashlight under the bulb and look for light between the bulb and the suction line. If no light is seen, the contact is good. If light can be seen between the bulb and the suction line, the contact is poor, and the valve may misfeed. The bulb must be retightened and/or moved slightly and rechecked.

# ALCO REFRIGERATION SOLENOID VALVES (200 RB SERIES) REPLACEMENTS

The internal parts of Alco solenoid valves (200 RB Series) are replaceable without changeout of the brass body. Rebuild kit, Manitowoc part No. 24-0460-3, is available for these Alco solenoid valves. The rebuild kit includes the plunger, spring, O-ring, and piston assembly. A solenoid valve which has a damaged seat or is stuck open or closed can, in most cases, be repaired by installing the rebuild kit. See Figure 66.

Use the following guidelines for warranty replacements.

1. Install rebuild kit when the enclosing tube and brass valve body are **not defective**.
2. Replace the entire solenoid assembly when the brass valve body is found defective or if the internal surface of the enclosing tube does not permit smooth plunger and piston operation.
3. Replace coil only when a coil malfunctions (open, shorts, etc.).

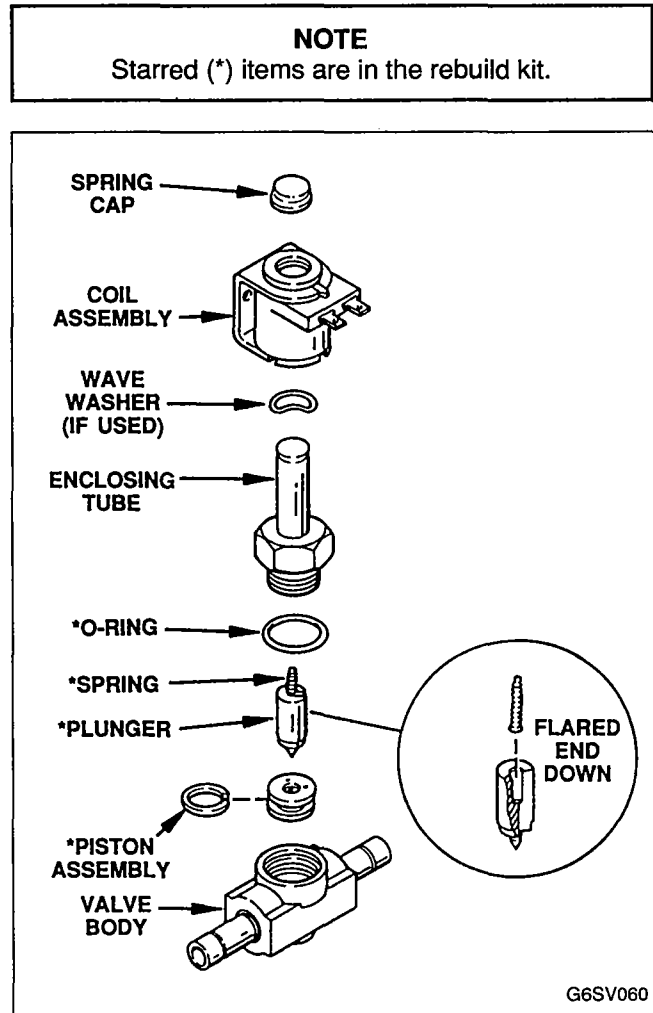


FIGURE 66. REFRIGERATION SOLENOID VALVE

# LEAK CHECKING CONDENSER AND WATER REGULATING VALVE

## IMPORTANT

Both the condenser and water regulating valve must be leak checked.

## LEAK CHECKING CONDENSER

1. Set ICE/OFF/WATER PUMP switch at OFF.
2. Turn off incoming condenser water supply.
3. Disconnect incoming condenser water inlet and outlet lines.
4. Disconnect water regulating valve from condenser.
5. Blow water out of condenser with compressed air.

## NOTE

Water in the condenser may cause an electronic leak detector to give a false signal.

6. Ensure refrigeration system is pressurized.
7. Check condenser water inlet and outlet with electronic leak detector. If a leak is detected, replace condenser.

## NOTE

If no leak is detected with the ice machine off, set the ICE/OFF/WATER PUMP switch at ICE. Allow discharge pressure to reach 250 psig, then set ICE/OFF/WATER PUMP switch at OFF and recheck for leaks.

## LEAK CHECKING WATER REGULATING VALVE

## NOTE

Water regulating valve must be disconnected from the condenser. Completely dry water valve inlet and outlet to eliminate false readings from the leak detector.

1. Ensure refrigeration system is pressurized.
2. Leak check where cap tube meets the bellows housing. See Figure 67.
3. Leak check around bellows seal.
4. Open valve by prying open at spring with screwdriver, leak check inlet and outlet with leak detector. If leak is detected, replace valve.
5. If no leak is detected, refer to NOTE under step 7 of Leak Checking the Condenser and recheck valve for leaks.

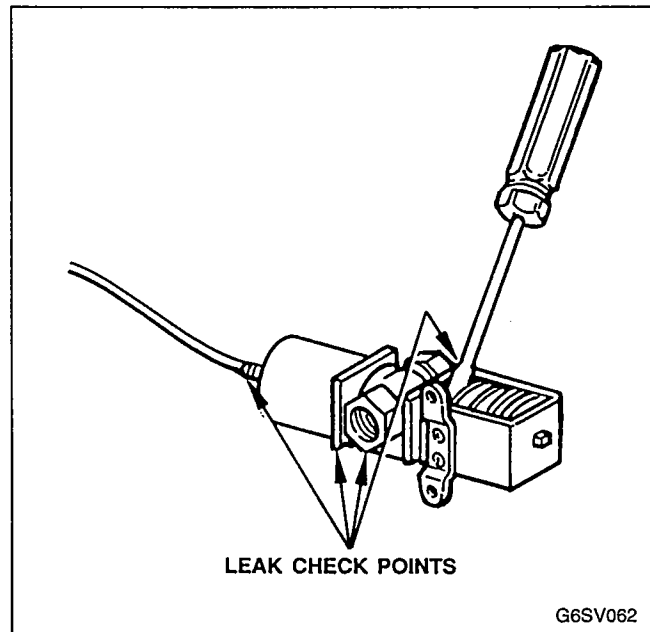


FIGURE 67. WATER REGULATING VALVE LEAK CHECK POINTS

# REMOVAL FROM SERVICE/WINTERIZATION

You must take special precautions if the ice machine is to be removed from service for extended periods or exposed to ambient temperatures of 32°F or below.



## CAUTION

IF WATER IS ALLOWED TO REMAIN IN THE MACHINE IN FREEZING AMBIENT TEMPERATURES, IT WILL FREEZE, RESULTING IN SEVERE DAMAGE TO COMPONENTS. A FAILURE OF THIS NATURE IS NOT COVERED BY WARRANTY.

### Self-Contained Water-Cooled Machines

1. Disconnect electric power at circuit breaker or electric service switch.
2. Turn off water going to ice machine.
3. Remove drain plug from water trough.
4. Disconnect ice making drain line and incoming ice making water line at rear of ice machine.
  - a. Blow compressed air in both incoming water opening and drain opening in rear of machine until water is no longer coming out of float valve and drain.
  - b. Ensure that no water is trapped in any of the machine's water lines, drain lines, distribution tubes, etc.
5. Disconnect incoming water line and drain line from water-cooled condenser.
  - a. Pry open water regulating valve by inserting large standard screwdriver between bottom spring coils of valve. Pry spring upward to open valve, Figure 68.
  - b. Hold valve open and blow compressed air through condenser until no water remains.

6. If ice machine is outside, cover machine to prevent exposure to elements.

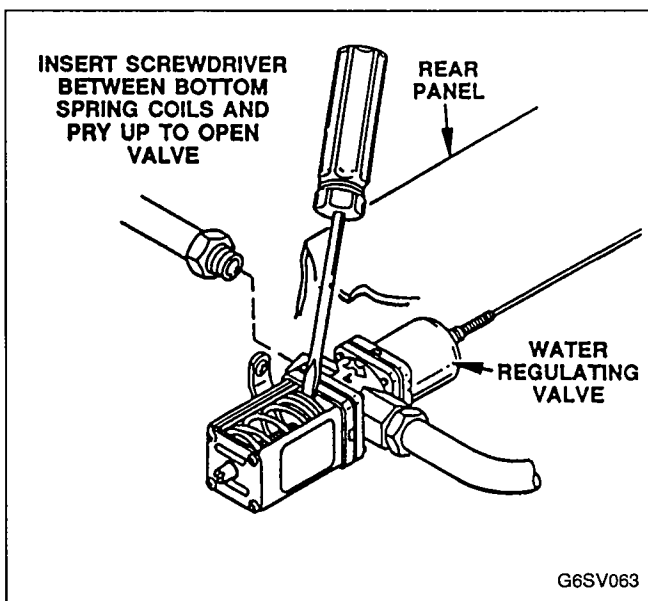


FIGURE 68. MANUALLY OPENING WATER REGULATING VALVE

### Remote Machines

1. Frontseat receiver service valve, then pump down ice machine. (Hang a tag on toggle switch as a reminder to open receiver service valve on start-up.)
2. Perform steps 1 through 4 listed under "Self-Contained Water-Cooled Machines."

### NOTE

Before putting a remote machine back into operation after winterization, backseat the receiver service valve.

# EVACUATION AND RECHARGING

## REMOVAL OF REFRIGERANT

Do not purge the refrigerant to the atmosphere. Recapture refrigerant using recovery equipment by following specific manufacturer's recommendations.

### IMPORTANT

Manitowoc Ice, Inc. assumes no responsibility for the use of recycled refrigerant. Damage resulting from the use of recycled refrigerant is solely the responsibility of the servicing company.

## EVACUATION AND RECHARGING OF SELF-CONTAINED SYSTEMS

Before proceeding, determine severity of contamination and clean-up procedures, page 80.

1. Replace liquid line drier.

### IMPORTANT

TO PREVENT VOIDING WARRANTY, USE ONLY MANITOWOC (O.E.M.) LIQUID LINE FILTER DRIERS.

2. Fully open service valves.
3. Evacuation of the ice machine requires connections at two points as follows:
  - a. Suction service valve.
  - b. Discharge service valve.Connect manifold gauges, dial-a-charge (or weigh-in method), and vacuum pump to ice machine, Figure 69.

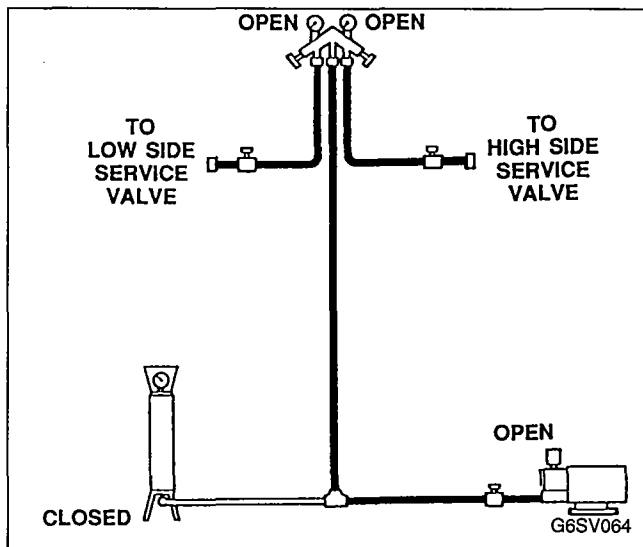


FIGURE 69. EVACUATION OF SELF-CONTAINED SYSTEMS

### NOTE

Install a two-stage vacuum pump to manifold gauges. A single stage pump will slow the evacuation process.

## Procedures for Self-Contained Evacuation

### IMPORTANT

Refer to refrigeration system Contamination Clean-Up Procedures, page 80, for proper clean-up procedures if system contamination is suspected or detected. Improper or insufficient clean-up will lead to repeat failures.

1. Place toggle switch in OFF position.
2. Open (backseat) high and low side ice machine service valves. Open vacuum pump valve. Open high and low side on manifold gauges. Refer to Figure 69.
3. Start vacuum pump. Pull system down to 250 microns. Allow pump to run for 1/2 hour after reaching 250 microns.

### NOTE

Turn off vacuum pump after 1/2 hour and ensure pressures do not rise.

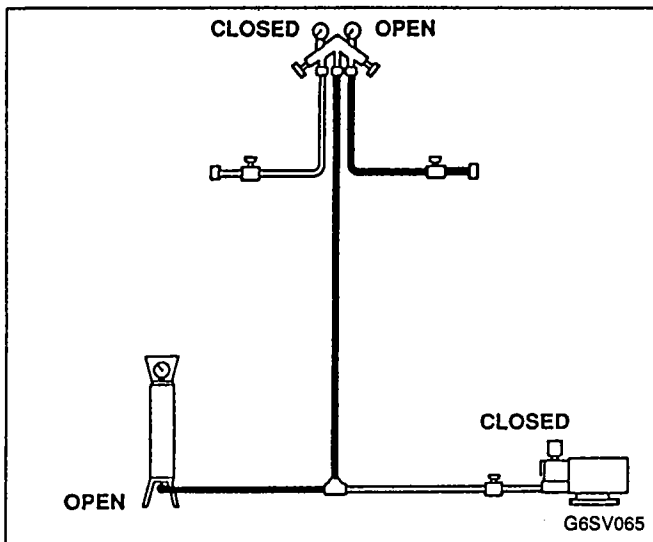
4. Refer to Recharging Procedures and recharge ice machine.

## Procedures for Self-Contained Recharging

### IMPORTANT

Charge must be weighed or measured into ice machine to assure proper operation under all load conditions. Do not charge by sight glass, pressure, etc.

1. Ensure toggle switch is in OFF position. Refer to Figure 70 and recharge system.



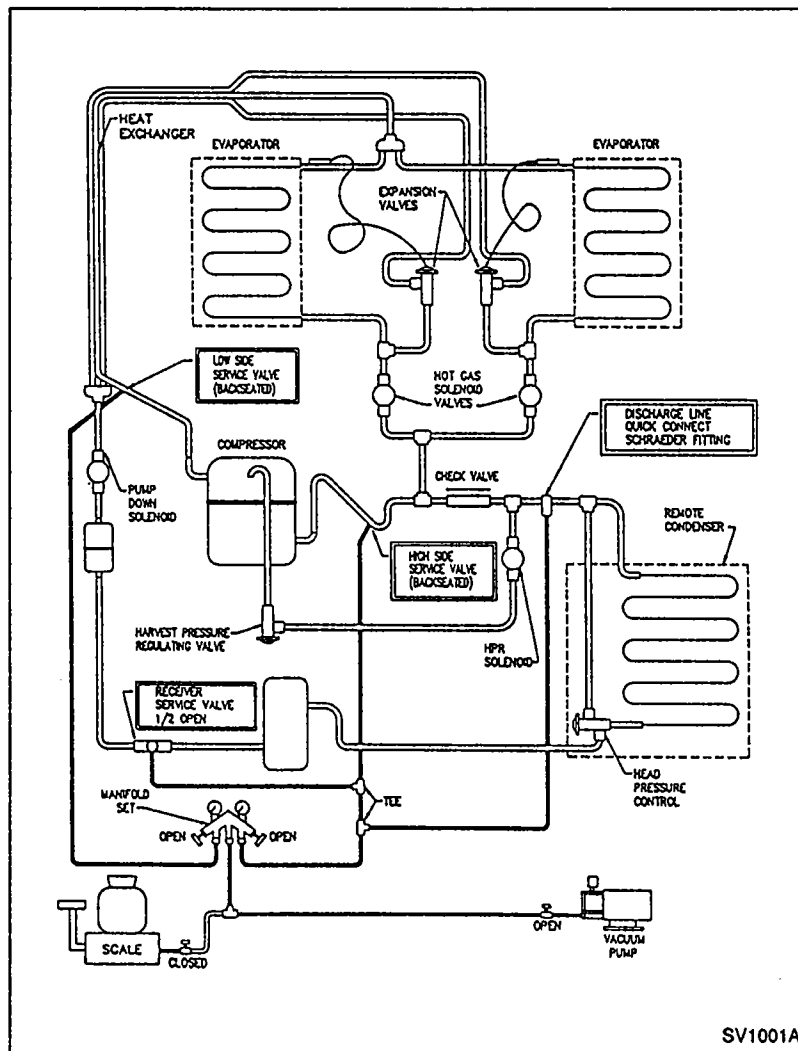
**FIGURE 70. RECHARGING OF SELF-CONTAINED SYSTEMS**

2. Close vacuum pump valve, low side service valve, and low side valve on manifold gauge.

3. Open high side manifold gauge valve, backseat high side service valve.
4. Open charging cylinder and add measured nameplate charge through discharge service valve.
5. Allow system to "settle" for 2 or 3 minutes after charging.
6. Place ice machine toggle switch in ICE position, close high side on manifold gauge set, and add remaining vapor charge through suction service valve (if necessary).
7. Ensure all vapor in charging hoses is drawn into the ice machine before disconnecting manifold gauges.

**NOTE**

Recheck for leaks with a Halide or electronic leak detector after recharging ice machine.



**FIGURE 71. EVACUATION OF REMOTE SYSTEMS**

## EVACUATION AND RECHARGING OF REMOTE SYSTEMS

Before proceeding, determine severity of contamination and cleanup procedures, page 80.

1. Evacuation of remote systems requires connection at four points for complete evacuation as follows. Refer to Figure 71.
  - a. Suction side of compressor through suction service valve.
  - b. Discharge side of compressor through discharge service valve.
  - c. Receiver outlet service valve. (Evacuates area between head pressure control valve in condenser and pump-down solenoid.)
  - d. Access (Schraeder) valve on discharge line quick connect fitting on outside of compressor/evaporator compartment. This connection is necessary to evacuate the condenser. Without this connection, the magnetic check valve would close upon the pressure drop produced by evacuation prohibiting complete condenser evacuation.

### NOTE

Manitowoc recommends using an access valve core removal and installation tool on the discharge line quick connect fitting. The tool permits removal of the access valve core for faster evacuation and charging without removing the manifold gauge hose.

### NOTE

Install a two-stage vacuum pump to manifold gauges. A single-stage pump will slow the evacuation process.

### Procedures for Remote System Evacuation

#### IMPORTANT

Refer to refrigeration system Contamination Clean-Up Procedures, page 80, for proper clean-up procedures if system contamination is suspected or detected. Improper or insufficient clean-up will lead to repeat failures.

1. Place toggle switch in OFF position.
2. Install manifold gauges, scale and two-stage vacuum pump as shown on Figure 71.

3. Open (backseat) high and low side ice machine service valves, position receiver service valve 1/2 open, and open high and low side on manifold gauge set.

### NOTE

If access valve core removal and installation tool is used, remove discharge line quick-connect valve core at this time.

4. Start vacuum pump, pull system down to 250 microns. Allow pump to run for 1 hour after reaching 250 microns. Turn off vacuum pump, ensure pressures do not rise (standing vacuum leak-check).
5. Charge the ice machine per the following charging procedures.

### Procedures for Remote System Recharging

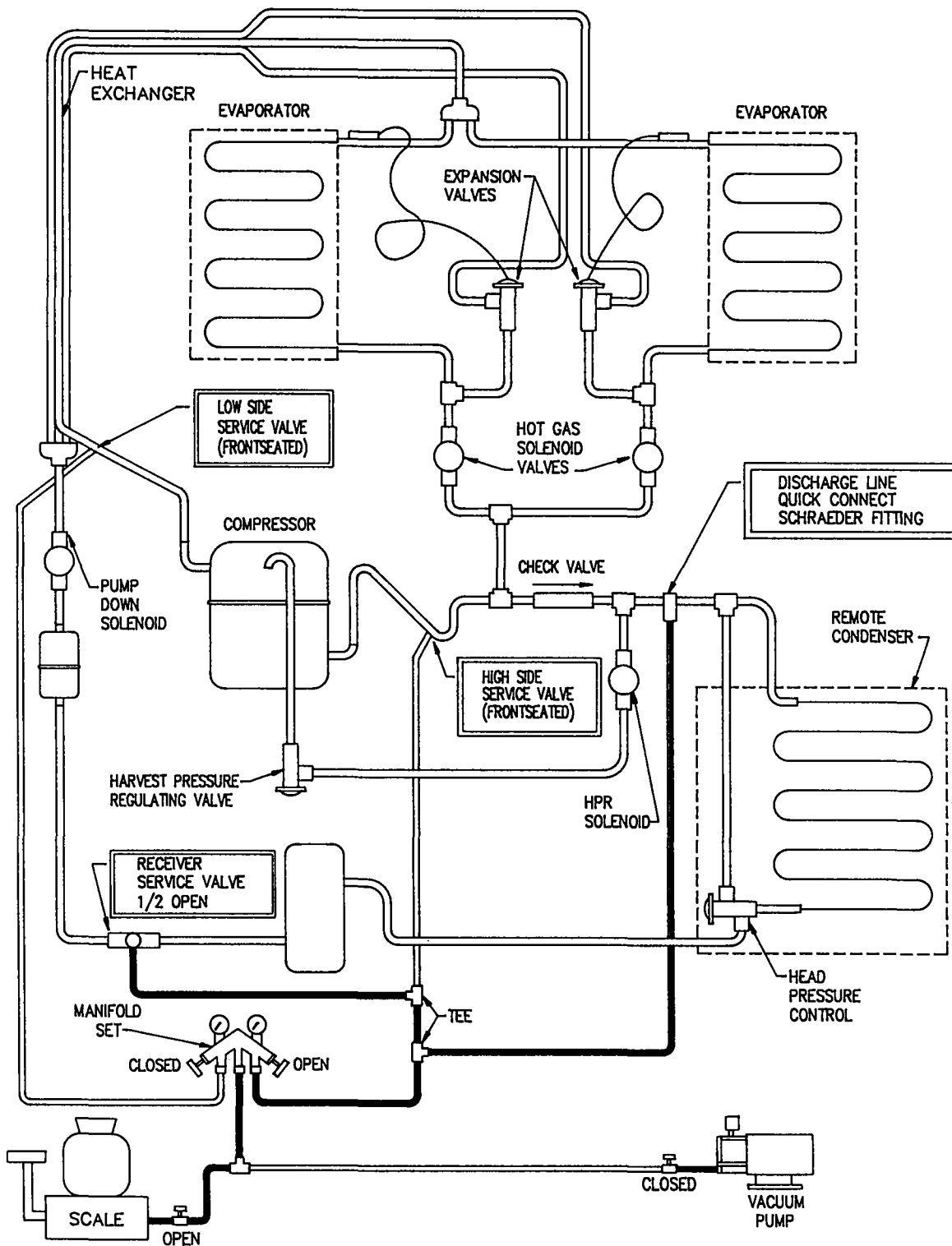
### NOTE

Refer to Figure 72 to connect cylinder or scale and vacuum pump to recharge the system.

1. Ensure toggle switch is in the OFF POSITION.
2. Close vacuum pump valve, frontseat (close) low side and high side service valves, close low side valve on manifold gauge set.
3. Add measured nameplate charge from charging scale through high side of manifold gauge set into system high side (receiver outlet valve and discharge lines quick-connect fitting).
4. If high side does not take entire charge, close high side on manifold gauge set, backseat (open) low side service valve, and receiver outlet service valve. Start ice machine and add remaining charge through low side in vapor form until the machine is fully charged.
5. Ensure all vapor in charging hoses is drawn into the machine before disconnecting manifold gauges.

### NOTE

Backseat (open) receiver outlet service valve after charging is complete and before operating the ice machine. If access valve core removal and installation tool is used on the discharge line quick-connect fitting, reinstall Schraeder valve core before disconnecting access tool and hose.



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FIGURE 72. RECHARGING OF REMOTE SYSTEMS

# SEVERE SYSTEM CONTAMINATION

## GENERAL

It is important to read and understand the following text regarding severe system contamination. The purpose is to describe the basic requirements for restoring contaminated systems to reliable service.

### IMPORTANT

Manitowoc Ice, Inc. assumes no responsibility for use of recycled refrigerant. Damage resulting from the use of contaminated recycled refrigerant is the sole responsibility of the servicing company.

## DETERMINING SEVERITY OF CONTAMINATION AND CLEAN-UP PROCEDURES

System contamination is generally caused by the introduction of either moisture or residue from compressor burnout into the refrigeration system.

Inspection of the refrigerant is usually the first indication of contaminants in the system. If obvious moisture or an acrid odor indicating burnout is present in the refrigerant, steps must be taken to determine the severity of contamination as well as the required clean up-procedure.

If visible moisture or an acrid odor is detected, or if contamination *is suspected*, the use of a Total Test Kit from Totaline or similar diagnostic tool is recommended. These devices read refrigerant, therefore eliminating the need for an initial oil sample for testing.

If a refrigerant test kit indicates harmful levels of contamination, or if the kit is not available, then inspect the compressor oil as follows:

1. Remove refrigerant charge from ice machine.
2. Remove compressor from the system.
3. Check odor and condition (appearance) of the oil.
4. Inspect open suction and discharge lines at compressor for burnout deposits.
5. Perform an acid oil test if contamination signs are not evident per the above procedure to ensure no harmful contamination is present.

The following chart lists findings and matches them with required clean-up procedure. Use this chart for determining type of clean-up required.

**CONTAMINATION/CLEAN-UP CHART**

Symptoms/Findings	Required Clean-Up Procedure
No symptoms or suspicion of contamination	Normal evacuation and recharging procedures, page 76.
Moisture/Air Contamination (one or more of the following conditions will exist) — Refrigeration system open to atmosphere for prolonged periods — Refrigeration test kit and/or acid oil test shows contamination — Leak in water-cooled condenser — Oil appears muddy, or visible moisture in oil	Mild contamination clean-up procedures, page 81.
Mild Compressor Burnout — Oil appears clean with acrid odor and/or — Refrigeration test kit or acid oil test shows harmful acid content — No burnout deposits in open compressor lines	Mild contamination clean-up procedures, page 81.
Severe Compressor Burnout — Oil discolored and acidic with acrid odor, burnout deposits in compressor, discharge and suction lines and other components	Severe contamination clean-up procedures, page 81.

## **MILD SYSTEM CONTAMINATION CLEAN-UP PROCEDURES**

1. Replace failed components if applicable. If compressor checks good, change oil in compressor.
2. Replace liquid line drier.
3. Follow normal evacuation procedure, page 76, except replace the evacuation step with the following:

### **NOTE**

If contamination is from moisture, the use of heat lamps or heaters is recommended during evacuation. Place heat lamps at the compressor, condenser, and at the evaporator prior to evacuation. (Ensure heat lamps are not positioned too close to plastic components such as evaporator extrusions, water trough, etc., as they could melt, warp, etc.)

### **IMPORTANT**

Dry nitrogen is recommended for this procedure to prevent C.F.C. release into the atmosphere.

- a. Pull vacuum to 1000 microns. Break vacuum with dry nitrogen and sweep system. Pressurize to a minimum of 5 psi.
  - b. Pull vacuum to 500 microns. Break vacuum with dry nitrogen and sweep system. Pressurize to a minimum of 5 psig.
  - c. Change vacuum pump oil. Pull system down to 250 microns. When 250 microns have been achieved, allow vacuum pump to run for 1/2 hour on self-contained models, 1 hour for remotes. A standing vacuum test may be performed at this time as a preliminary means of leak checking; however, the use of an electronic leak detector after the system has been charged is recommended.
4. Charge system with proper refrigerant to nameplate charge.
  5. Operate ice machine.

## **SEVERE SYSTEM CONTAMINATION CLEAN-UP PROCEDURES**

1. Remove refrigerant charge.
2. Remove compressor.
3. Disassemble hot gas solenoid valve. If burnout deposits are found inside valve, install rebuild kit and replace TXV. If contaminants are found replace harvest pressure limiter control.
4. Check discharge and suction lines at compressor for burnout deposits. Wipe out as necessary.

5. Sweep through open system with dry nitrogen.

### **NOTE**

Refrigerant sweeps are not recommended, as they release C.F.C.'s into the atmosphere.

6. Installation Procedures:
  - a. Install new compressor and start components.
  - b. Install an adequately sized suction line filter-drier with acid/moisture removal capability and inlet/outlet access valves. Place the filter-drier as close to the compressor as practical.
  - c. Replace liquid line filter-drier.
7. Follow normal evacuation procedures, page 76, except replace the evacuation step with the following:

### **IMPORTANT**

Dry nitrogen is recommended for this procedure to prevent C.F.C. release into the atmosphere.

- a. Pull vacuum to 1000 microns. Break vacuum with dry nitrogen and sweep system. Pressurize to a minimum of 5 psig.
  - b. Change vacuum pump oil. Pull vacuum to 500 microns. Break vacuum with dry nitrogen and sweep system. Pressurize to a minimum of 5 psi.
  - c. Change vacuum pump oil. Pull system down to 250 microns. When 250 microns have been achieved, allow vacuum pump to run for 1/2 hour for self-contained models, 1 hour for remotes. A standing vacuum test may be performed at this time as a preliminary means of leak checking; however, the use of an electronic leak detector after the system has been charged is recommended.
8. Charge system with proper refrigerant to nameplate charge.
  9. Operate ice machine.
    - a. Check pressure drop across the suction line filter-drier after 1 hour running time. If pressure drop is not excessive (up to 1 psig differential) the filter-drier should be adequate for complete clean-up. Proceed to step 10.
    - b. If pressure drop is greater than 1 psig after 1 hour run time, change the suction line filter-drier and liquid line drier. Repeat until ice machine will run 1 hour without pressure drop.
  10. Remove suction line filter-drier after 48-72 hours run time. Change liquid line drier and follow normal evacuation procedures, page 76.



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