Manitowoc®



S600M Model Ice Machines

Service Manual

Thank you for selecting a Manitowoc Ice Machine, the dependability leader in ice making equipment and related products. With proper installation, care and maintenance, your new Manitowoc Ice Machine will provide you with many years of reliable and economical performance.

This manual is updated as new information and models are released. Visit our website for the latest manual.
www.manitowocice.com

Part Number 80-1630-3
9/2004

Safety Notices

As you work on a S-Series Ice Machine, be sure to pay close attention to the safety notices in this manual. Disregarding the notices may lead to serious injury and/or damage to the ice machine.

Throughout this manual, you will see the following types of safety notices:

⚠ Warning
PERSONAL INJURY POTENTIAL

Do not operate equipment that has been misused, abused, neglected, damaged, or altered/modified from that of original manufactured specifications.

⚠ Warning

Text in a Warning box alerts you to a potential personal injury situation. Be sure to read the Warning statement before proceeding, and work carefully.

⚠ Caution

Text in a Caution box alerts you to a situation in which you could damage the ice machine. Be sure to read the Caution statement before proceeding, and work carefully.

Procedural Notices

As you work on a S-Series Ice Machine, be sure to read the procedural notices in this manual. These notices supply helpful information which may assist you as you work.

Throughout this manual, you will see the following types of procedural notices:

Important

Text in an Important box provides you with information that may help you perform a procedure more efficiently. Disregarding this information will not cause damage or injury, but it may slow you down as you work.

NOTE: Text set off as a Note provides you with simple, but useful, extra information about the procedure you are performing.

Read These Before Proceeding:

⚠ Caution

Proper installation, care and maintenance are essential for maximum ice production and trouble-free operation of you Manitowoc Ice Machine.
Read and understand this manual. It contains valuable care and maintenance information. If you encounter problems not covered by this manual, do not proceed, contact Manitowoc Ice, Inc. We will be happy to provide assistance.

Important

Routine adjustments and maintenance procedures outlined in this manual are not covered by the warranty.

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

Table of Contents

Section 1
General Information

Model Numbers 1-1
How to Read a Model Number 1-1
Ice Cube Sizes 1-1
Accessories 1-2
- Bin Caster 1-2
- Ice Bagger 1-2
- Guardian Sachet Packets 1-2
- Arctic Pure Water Filter System 1-2
- Manitowoc Cleaner and Sanitizer 1-2
- AuCS® Automatic Cleaning System 1-2
- Dispenser 1-2

Model/Serial Number Location 1-3
Owner Warranty Registration Card 1-4
- General 1-4

Warranty Coverage 1-4
- General 1-4
- Parts 1-4
- Labor 1-4
- Exclusions 1-4
- Authorized Warranty Service 1-4

Section 2
Installation Instructions

General 2-1
Ice Machine Dimensions 2-1
- S600M Water-Cooled Ice Machines 2-1

Ice Storage Bin Dimensions 2-2
- 30 inch (76 cm) Ice Storage Bins 2-2
- 22 Inch (56 cm) Ice Storage Bins 2-2
- 48 Inch (130 cm) Ice Storage Bins 2-2

Remote Condenser Dimensions 2-2
- JC0495 2-2

Location of Ice Machine 2-3
Ice Machine Heat of Rejection 2-3
Removing Drain Plug and Leveling the Ice Storage Bin 2-4
Electrical Service 2-5
- General 2-5
- Voltage 2-5
- Minimum Circuit Ampacity 2-5
- Electrical Requirements 2-5

Self-Contained Electrical Wiring Connections 2-6
- Self Contained Ice Machine 115/1/60 or 208-230/1/60 2-6
- Self Contained Ice Machine 208-230/3/60 2-6
- Self Contained Ice Machine 230/1/50 2-6

For United Kingdom Only 2-6
Water Supply and Drain Requirements 2-7
- Water Supply 2-7
- Water Inlet Lines 2-7
- Drain Connections 2-7

Cooling Tower Applications 2-7
Water Supply and Drain Line Sizing/Connections 2-8
Installation Check List 2-9
Before Starting the Ice Machine 2-10
AuCS® Automatic Cleaning System 2-10

Section 3
Ice Machine Operation

Component Identification 3-1
Sequence Of Operation 3-2
Initial Start-Up or Start-Up After Automatic Shut-Off 3-2
Freeze Sequence 3-2
Harvest Sequence 3-3
Automatic Shut-Off 3-3
Safety Timers 3-3
Warm Water Rinse Cycle 3-3
Operational Checks 3-4
General 3-4
Water Level 3-4
Ice Thickness Check 3-4
Harvest Sequence Water Purge 3-5

Section 4
Maintenance

General 4-1
Ice Machine Inspection 4-1
Exterior Cleaning 4-1
Water-Cooled Condenser and Water Regulating Valve 4-1
AlphaSan 4-1
Guardian 4-2
Guardian Sachet Replacement Frequency 4-2
Sachet Replacement Procedure 4-2
Clean Up Procedure for Damaged Sachet Packet 4-2
Interior Cleaning and Sanitizing 4-3
General 4-3
Cleaning Procedure 4-3
Sanitizing Procedure 4-4
Removal of Parts For Cleaning/Sanitizing 4-5
Removal from Service/Winterization 4-12
General 4-12
AuCS Accessory 4-12

Section 5
Before Calling For Service

Checklist 5-1
Safety Limit Feature 5-2

Section 6
Electrical System

Energized Parts Charts **6-1**
Self-Contained Water-Cooled Models **6-1**
Wiring Diagram Sequence of Operation **6-2**
Self-Contained Models **6-2**
Wiring Diagrams **6-9**
Wiring Diagram Legend **6-9**
S600M - Self Contained - 1 Phase **6-10**
Component Specifications and Diagnostics **6-11**
Main Fuse **6-11**
Bin Switch **6-11**
Compressor Electrical Diagnostics **6-13**
PTCR Diagnostics **6-14**
Diagnosing Start Components **6-17**
ICE/OFF/CLEAN Toggle Switch **6-17**
Electronic Control Board **6-18**
Ice Thickness Probe (Harvest Initiation) **6-20**
How The Probe Works **6-20**
Harvest Light **6-20**
Freeze Time Lock-In Feature **6-20**
Maximum Freeze Time **6-20**
Ice Thickness Check **6-20**
Diagnosing Ice Thickness Control Circuitry **6-21**
Water Level Control Circuitry **6-22**
Water Level Probe Light **6-22**
Water Inlet Valve Safety Shut-Off **6-22**
Freeze Cycle Circuitry **6-22**
Harvest Cycle Circuitry **6-22**
Diagnosing Water Level Control Circuitry **6-23**
Diagnosing An Ice Machine That Will Not Run **6-25**

Section 7
Refrigeration System

Sequence of Operation **7-1**
Self-Contained Water -Cooled Models **7-1**
Operational Analysis (Diagnostics) **7-3**
General **7-3**
Before Beginning Service **7-4**
Ice Production Check **7-4**
Installation/Visual Inspection Checklist **7-5**
Water System Checklist **7-5**
Ice Formation Pattern **7-6**
Safety Limits **7-8**
Analyzing Discharge Pressure During Freeze or Harvest Cycle **7-11**
Analyzing Suction Pressure During Freeze Cycle **7-12**
Single Expansion Valve Ice Machines - Comparing Evaporator Inlet and Outlet Temperatures **7-14**
Harvest Valve Temperature Check **7-15**
Discharge Line Temperature Analysis **7-16**
How to Use the Refrigeration System Operational Analysis Tables **7-17**
Refrigeration System Operational Analysis Tables **7-18**
Pressure Control Specifications and Diagnostics **7-19**
High Pressure Cut-Out (HPCO) Control **7-19**

Cycle Time/24 Hour Ice Production/Refrigerant Pressure Charts 7-20
S600M Series 7-20
Refrigerant Recovery/Evacuation and Recharging 7-21
Normal Self-Contained Model Procedures 7-21
System Contamination Clean-Up 7-26
Replacing Pressure Controls Without Removing Refrigerant Charge 7-28
Filter-Driers 7-30
Total System Refrigerant Charges 7-30
Refrigerant Definitions 7-31
Refrigerant Re-Use Policy 7-32
HFC Refrigerant Questions and Answers 7-33

Section 1
General Information

Model Numbers

This manual covers the following models:

Self-Contained Water-Cooled
SD0603W
SY0605W

NOTE: Model numbers ending in 3 indicate a 3-phase unit. Example: SY0605A3

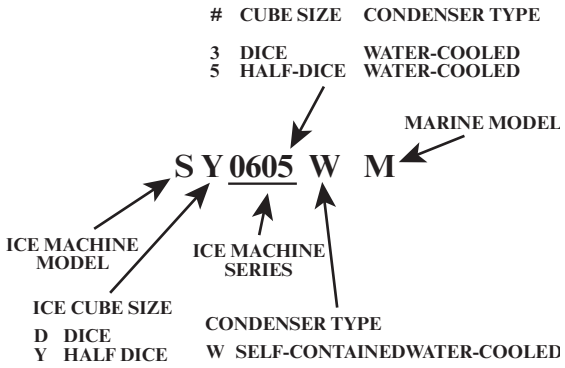
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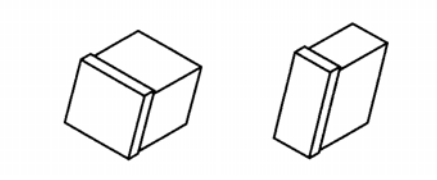
⚠ Warning
PERSONAL INJURY POTENTIAL

Remove all ice machine panels before lifting and installing.

How to Read a Model Number



Ice Cube Sizes



Dice	Half Dice
7/8" x 7/8" x 7/8"	3/8" x 1-1/8" x 7/8"
2.22 x 2.22 x 2.22 cm	0.95 x 2.86 x 2.22 cm

Accessories

Contact your Manitowoc distributor for these optional accessories:

BIN CASTER

Replaces standard legs.

ICE BAGGER

Maximize profits from bagged ice sales with this convenient accessory. This sturdy unit rests on the bin door frame, and adapts for left or right side filling.

GUARDIAN™ SACHET PACKETS

Guardian sachet packets release chlorine dioxide on a controlled basis to inhibit the growth of bacteria and slime.

Guardian sachet packets are available through your local Manitowoc Ice Machine dealer.

ARCTIC PURE™ WATER FILTER SYSTEM

Engineered specifically for Manitowoc ice machines, This water filter is an efficient, dependable, and affordable method of inhibiting scale formation, filtering sediment, and removing chlorine taste and odor.

MANITOWOC CLEANER AND SANITIZER

Manitowoc Ice Machine Cleaner and Sanitizer are available in convenient 16 oz. (473 ml) bottles. These are the only cleaner and sanitizer approved for use with Manitowoc products.

Cleaner Part Number	Sanitizer Part Number
16 ounce Bottle - 94-0546-3	16 ounce Bottle - 94-0565-3
AuCS®-SO - 94-0546-3	AuCS®-SO - 94-0565-3
AuCS®-SI - 40-1326-3	AuCS®-SI - 40-1327-3

AUCS® AUTOMATIC CLEANING SYSTEM

This accessory reduces equipment cleaning expense. The AuCS® accessory monitors ice making cycles and initiates cleaning procedures automatically.

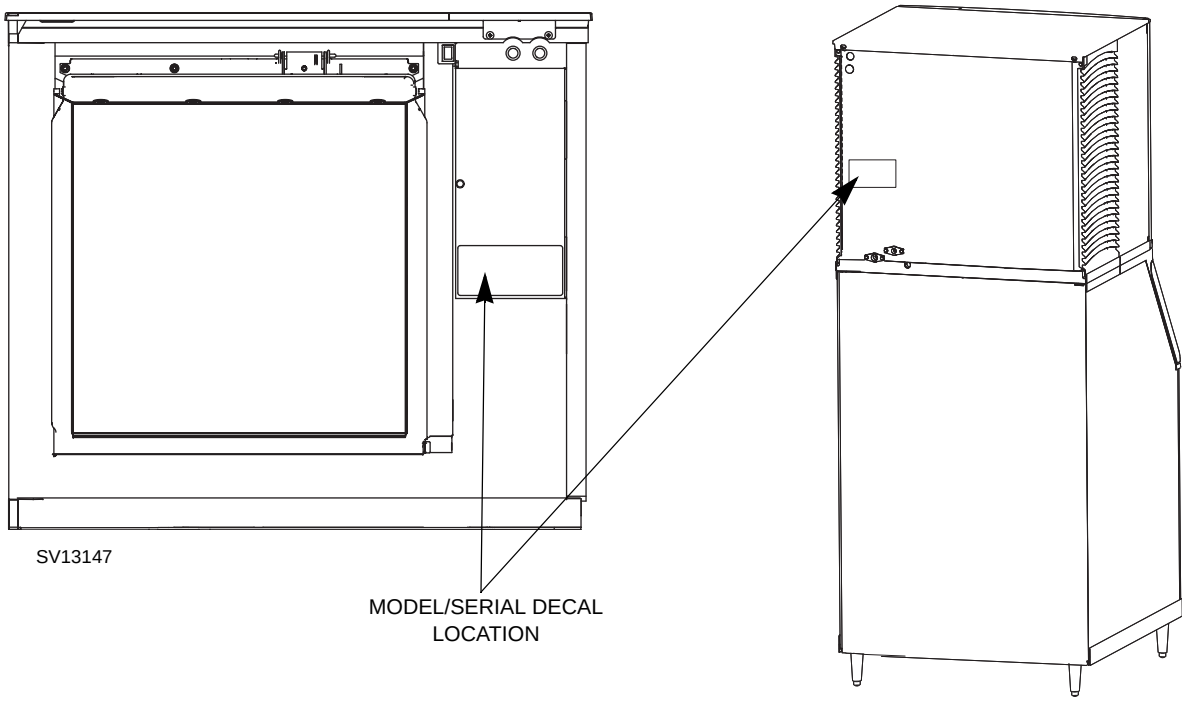
DISPENSER

A counter-top dispenser is ideal for cafeterias and many types of self-service facilities. Manitowoc auto-fill, floor-standing ice dispensers meet the strict sanitary requirements of the food service, lodging and health care industries.

Model/Serial Number Location

These numbers are required when requesting information from your local Manitowoc distributor, or Manitowoc Ice, Inc.

The model and serial number are listed on the MODEL/SERIAL NUMBER DECAL affixed to the ice machine, remote condenser and storage bin.



Model/Serial Number Location

Owner Warranty Registration Card

GENERAL

The packet containing this manual also includes warranty information. Warranty coverage begins the day your new ice machine is installed.

Important

Complete and mail the OWNER WARRANTY REGISTARATION CARD as soon as possible to validate the installation date.

If you do not return your OWNER WARRANTY REGISTRATION CARD, Manitowoc will use the date of sale to the Manitowoc Distributor as the first day of warranty coverage for your new ice machine.

Warranty Coverage

GENERAL

The following Warranty outline is provided for your convenience. For a detailed explanation, read the warranty bond shipped with each product.

Contact your local Manitowoc Distributor, Manitowoc Ice, Inc. or visit our website at www.manitowocice.com if you need further warranty information.

Important

This product is intended exclusively for commercial application. No warranty is extended for personal, family, or household purposes.

PARTS

1. Manitowoc warrants the ice machine against defects in materials and workmanship, under normal use and service for three (3) years from the date of original installation.
2. The evaporator and compressor are covered by an additional two (2) year (five years total) warranty beginning on the date of the original installation.

LABOR

1. Labor required to repair or replace defective components is covered for three (3) years from the date of original installation.
2. The evaporator is covered by an additional two (2) year (five years total) labor warranty beginning on the date of the original installation.

EXCLUSIONS

The following items are **not** included in the ice machine's warranty coverage:

1. **Normal maintenance**, **adjustments** and **cleaning**.
2. Repairs due to **unauthorized modification**s to the ice machine or **use of non-standard parts** without prior written approval from Manitowoc Ice, Inc.
3. Damage caused by **improper installation** of the ice machine, electrical supply, water supply or drainage, or damage caused by floods, 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. Additional labor charges **resulting from the inaccessibility of equipment** are also excluded.
5. Parts or assemblies subjected to **misuse, abuse, neglect or accidents**.
6. **Damage or problems** caused by installation, cleaning and/or maintenance p**rocedures inconsistent with the technical instructions provided in this manual.**
7. **This product is intended exclusively for commercial application.** No warranty is extended for personal, family, or household purposes.

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.**

NOTE: If the dealer you purchased the ice machine from is not authorized to perform warranty service, contact your Manitowoc distributor or Manitowoc Ice, Inc. for the name of the nearest authorized service representative.

Service Calls

Normal maintenance, adjustments and cleaning as outlined in this manual are not covered by the warranty. If you have followed the procedures listed on page 5-1 of this manual, and the ice machine still does not perform properly, call your authorized service company.

Section 2
Installation Instructions

General

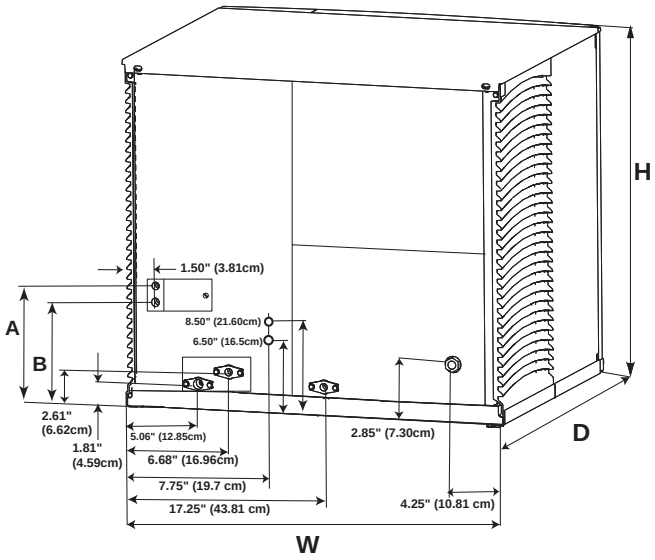
These instructions are provided to assist the qualified installer. Check your local Yellow Pages for the name of the nearest Manitowoc distributor, or call Manitowoc Ice, Inc. for information regarding start-up services.

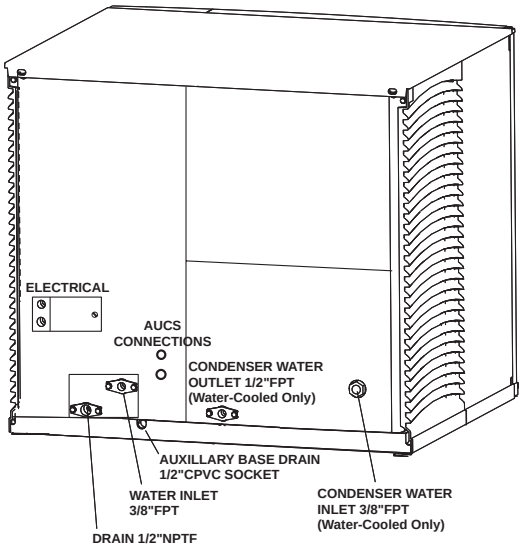
Important

Failure to follow these installation guidelines may affect warranty coverage.

Ice Machine Dimensions

S600M WATER-COOLED ICE MACHINES





Ice Machine	Dimension A	Dimension B	Dimension W	Dimension D	Dimension H
S600M	11.5 in (29.2 cm)	9.0 in (22.9 cm)	30 in. (76.2 cm)	24.50 in. (62.2 cm)	21.5 in (54.6 cm)

Location of Ice Machine

The location selected for the ice machine must meet the following criteria. If any of these criteria are not met, select another location.

- The location must be free of airborne and other contaminants.
- The air temperature must be at least 35°F (1.6°C), but must not exceed 110°F (43.4°C).
- The location must not be near heat-generating equipment or in direct sunlight and must be protected from weather.
- The location must not obstruct air flow through or around the ice machine. Refer to the chart below for clearance requirements.

S600M	Water-Cooled*
Top/Sides	8" (20.3 cm)
Back	5" (12.7 cm)

*There is no minimum clearance required for water-cooled or remote ice machines. This value is recommended for efficient operation and servicing only.

⚠ Caution

The ice machine must be protected if it will be subjected to temperatures below 32°F (0°C). Failure caused by exposure to freezing temperatures is not covered by the warranty. See “Removal from Service/Winterization”.

Ice Machine Heat of Rejection

Series Ice Machine	Heat of Rejection	
	Air Conditioning	Peak
S600M	9000	13900

B.T.U./Hour
Because the heat of rejection varies during the ice making cycle, the figure shown is an average.

Ice machines, like other refrigeration equipment, reject heat through the condenser. It is helpful to know the amount of heat rejected by the ice machine when sizing air conditioning equipment where self-contained air-cooled ice machines are installed.

This information is also necessary when evaluating the benefits of using water-cooled or remote condensers to reduce air conditioning loads. The amount of heat added to an air conditioned environment by an ice machine using a water-cooled or remote condenser is negligible.

Knowing the amount of heat rejected is also important when sizing a cooling tower for a water-cooled condenser. Use the peak figure for sizing the cooling tower.

Electrical Service

GENERAL

⚠ Warning

All wiring must conform to local, state and national codes.

VOLTAGE

The maximum allowable voltage variation is ±10% of the rated voltage at ice machine start-up (when the electrical load is highest).

⚠ Warning

The ice machine must be grounded in accordance with national and local electrical codes.

Important

Observe correct polarity of incoming line voltage.

Fuse/Circuit Breaker

A separate fuse/circuit breaker must be provided for each ice machine. Circuit breakers must be H.A.C.R. rated (does not apply in Canada).

MINIMUM CIRCUIT AMPACITY

The minimum circuit ampacity is used to help select the wire size of the electrical supply. (Minimum circuit ampacity is not the ice machine's running amp load.)

The wire size (or gauge) is also dependent upon location, materials used, length of run, etc., so it must be determined by a qualified electrician.

ELECTRICAL REQUIREMENTS

Refer to Ice Machine Model/Serial Plate for voltage/amperage specifications.

S Series Ice Machines

Ice Machine	Voltage Phase Cycle	Water Cooled	
		Maximum Fuse/Circuit Breaker	Minimum Circuit Amps
S600M	208-230/1/60	15	7.9
	230/1/50	15	6.1

Self-Contained Electrical Wiring Connections

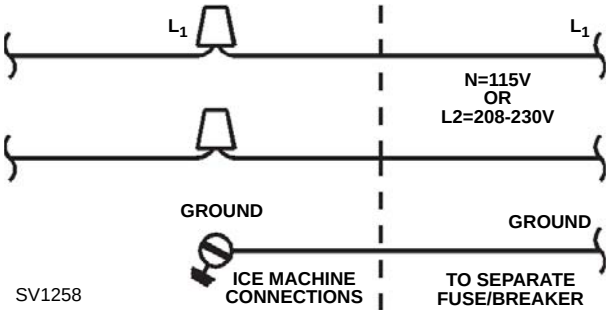
⚠ Warning

These diagrams are not intended to show proper wire routing, wire sizing, disconnects, etc., only the correct wire connections.

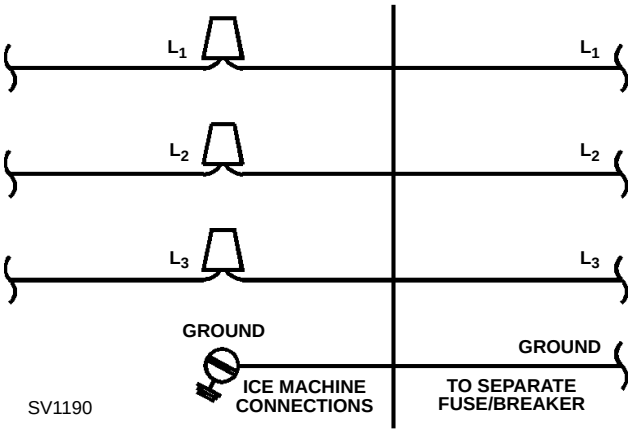
All electrical work, including wire routing and grounding, must conform to local, state and national electrical codes.

Though wire nuts are shown in the drawings, the ice machine field wiring connections may use either wire nuts or screw terminals.

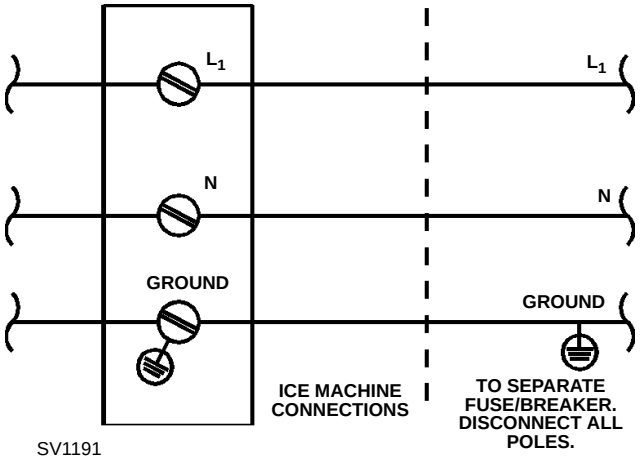
SELF CONTAINED ICE MACHINE 115/1/60 OR 208-230/1/60



SELF CONTAINED ICE MACHINE 208-230/3/60



SELF CONTAINED ICE MACHINE 230/1/50



For United Kingdom Only

As the colors of the wires in the mains lead of the appliance may not correspond with the colored markings identifying the terminals in your plug, proceed as follows:

- The wire which is colored green and yellow must be connected to the terminal in the plug which is marked with the letter E or by the earth ground symbol ⏚ or colored green or green and yellow.
- The wire colored blue must be connected to the terminal which is marked with the letter N or colored black.
- The wire colored brown must be connected to the terminal which is marked with the letter L or colored red.

Water Supply and Drain Requirements

WATER SUPPLY

Local water conditions may require treatment of the water to inhibit scale formation, filter sediment, and remove chlorine odor and taste.

Important

If you are installing a Manitowoc Arctic Pure™ water filter system, refer to the Installation Instructions supplied with the filter system for ice making water inlet connections.

WATER INLET LINES

Follow these guidelines to install water inlet lines:

- Do not connect the ice machine to a hot water supply. Be sure all hot water restrictors installed for other equipment are working. (Check valves on sink faucets, dishwashers, etc.)
- If water pressure exceeds the maximum recommended pressure, obtain a water pressure regulator from your Manitowoc distributor.
- Install a water shut-off valve for both the ice making and condenser water lines.
- Insulate water inlet lines to prevent condensation.

⚠ Caution

Do not apply heat to water valve inlet fitting. This will damage plastic valve body.

DRAIN CONNECTIONS

Follow these guidelines when installing drain lines to prevent drain water from flowing back into the ice machine and storage bin:

- Drain lines must have a 1.5 inch drop per 5 feet of run (2.5 cm per meter), and must not create traps.
- The floor drain must be large enough to accommodate drainage from all drains.
- Run separate bin and ice machine drain lines. Insulate them to prevent condensation.
- Vent the bin and ice machine drain to the atmosphere. Do not vent the condenser drain on water-cooled models.

Cooling Tower Applications

A water cooling tower installation does not require modification of the ice machine. The water regulator valve for the condenser continues to control the refrigeration discharge pressure.

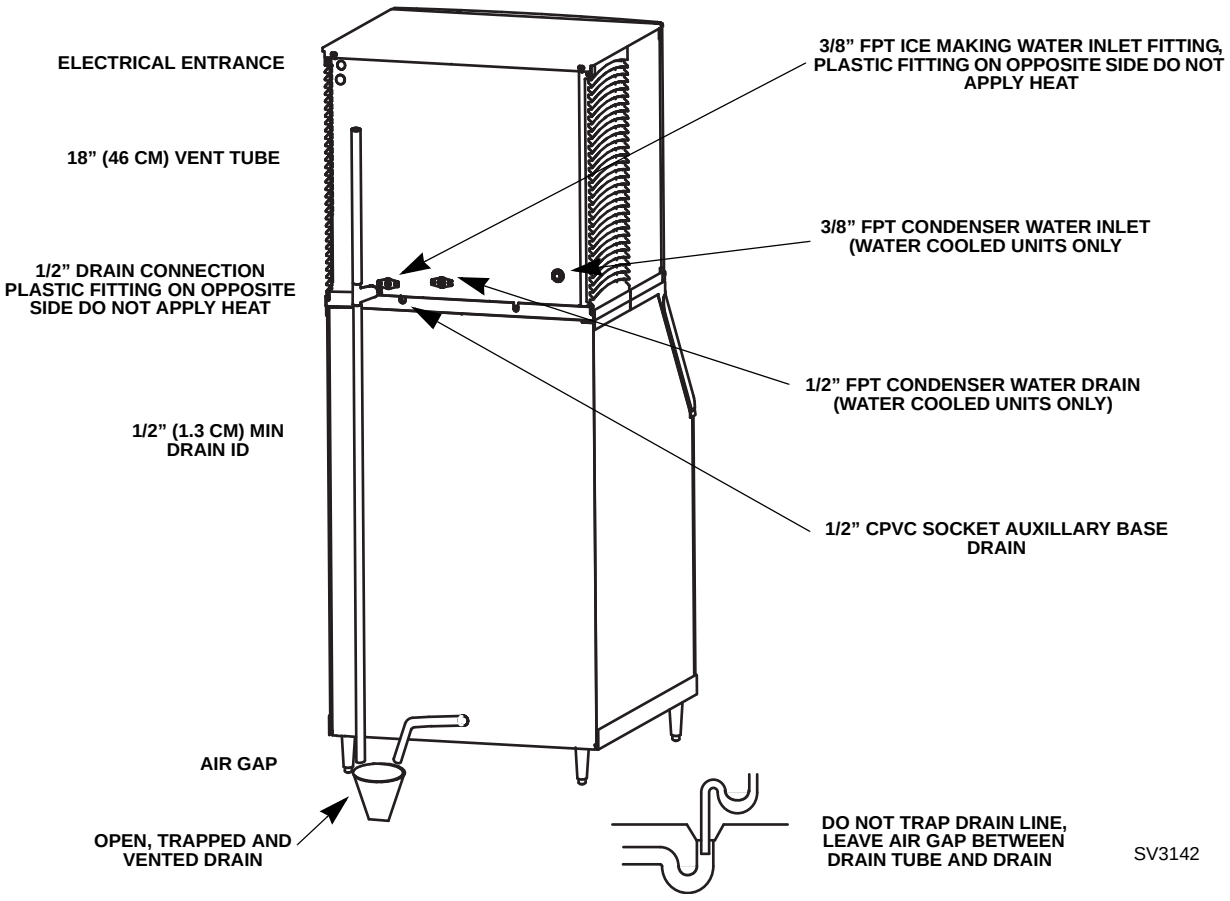
It is necessary to know the amount of heat rejection, and the pressure drop through the condenser and water valves (inlet and outlet) when using a cooling tower on an ice machine.

- Water entering the condenser must not exceed 90°F (32.2°C).
- Water flow through the condenser must not exceed 5 gallons (19 liters) per minute.
- Allow for a pressure drop of 7 psi (48 kPA) between the condenser water inlet and the outlet of the ice machine.
- Water exiting the condenser must not exceed 110°F (43.3°C).

WATER SUPPLY AND DRAIN LINE SIZING/CONNECTIONS

⚠ Caution
Plumbing must conform to state and local codes.

Location	Water Temperature	Water Pressure	Ice Machine Fitting	Tubing Size Up to Ice Machine Fitting
Ice Making Water Inlet	35°F (1.6°C) Min. 90°F (32.2°C) Max.	20 psi (137.9 kPA) Min. 80 psi (551.5 kPA) Max.	3/8" Female Pipe Thread	3/8" (.95 cm) minimum inside diameter
Ice Making Water Drain	---	---	1/2" Female Pipe Thread	1/2" (1.27 cm) minimum inside diameter
Condenser Water Inlet	40°F (4.4°C) Min. 90°F (32.2°C) Max.	20 psi (137.9 kPA) Min. 150 psi (1034.2 kPA) Max.	3/8" Female Pipe Thread	
Condenser Water Drain	---	---	1/2" Female Pipe Thread	1/2" (1.27 cm) minimum inside diameter
Bin Drain	---	---	3/4" Female Pipe Thread	3/4" (1.91 cm) minimum inside diameter



Typical Water Supply Drain Installation

Installation Check List

- ☐ Is the Ice Machine level?
- ☐ Has all of the internal packing been removed?
- ☐ Have all of the electrical and water connections been made?
- ☐ Has the supply voltage been tested and checked against the rating on the nameplate?
- ☐ Is there proper clearance around the ice machine for air circulation?
- ☐ Has the ice machine been installed where ambient temperatures will remain in the range of 35° - 110°F (1.6° - 43.3°C)?
- ☐ Has the ice machine been installed where the incoming water temperature will remain in the range of 35° - 90°F (1.6° - 32.2°C)?
- ☐ Is there a separate drain for the water-cooled condenser?
- ☐ Is there a separate drain for the bin?
- ☐ Are the ice machine and bin drains vented?
- ☐ Are all electrical leads free from contact with refrigeration lines and moving equipment?
- ☐ Has the owner/operator been instructed regarding maintenance and the use of Manitowoc Cleaner and Sanitizer?
- ☐ Has the owner/operator completed the warranty registration card?
- ☐ Has the ice machine and bin been sanitized?
- ☐ Is the toggle switch set to ice? (The toggle switch is located directly behind the front panel).
- ☐ Is the ice thickness control set correctly? (Refer to Operational Checks to check/set the correct ice bridge thickness).

Before Starting the Ice Machine

All Manitowoc ice machines are factory-operated and adjusted before shipment. Normally, new installations do not require any adjustment.

To ensure proper operation, follow the Operational Checks in Section 3 of this manual. Starting the ice machine and completing the Operational Checks are the responsibilities of the owner/operator.

Adjustments and maintenance procedures outlined in this manual are not covered by the warranty.

⚠ Warning

Potential Personal Injury Situation

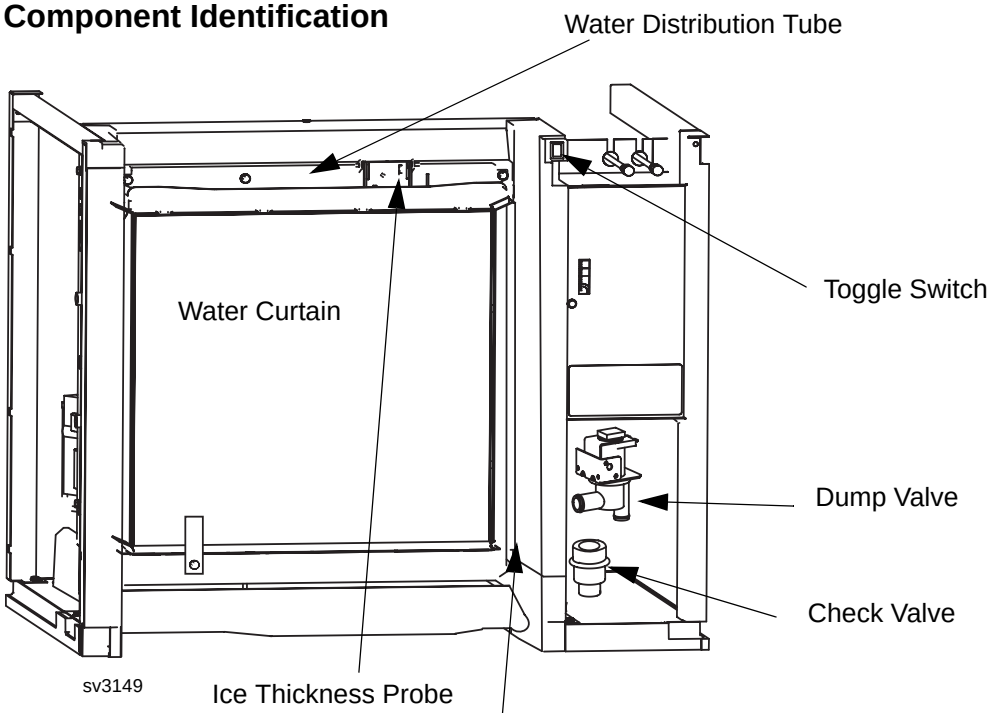
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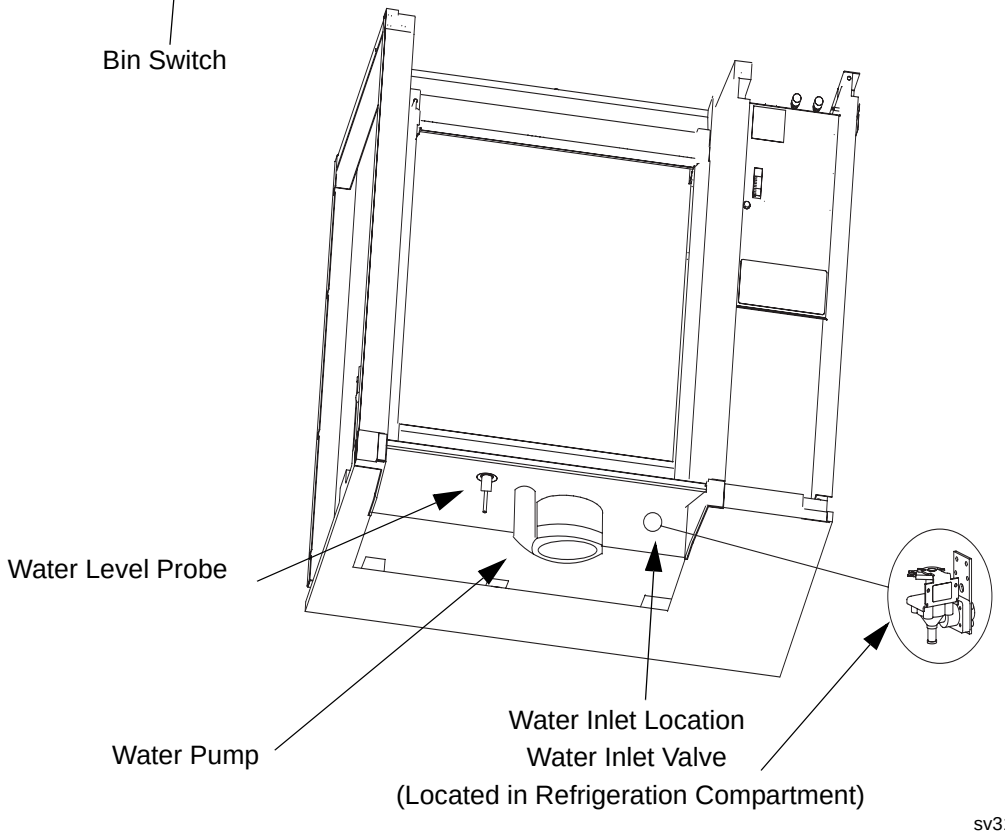
AuCS® Automatic Cleaning System

This optional accessory monitors ice making cycles and initiates cleaning procedures automatically. The AuCS® accessory can be set to automatically clean or sanitize the ice machine every 2, 4 or 12 weeks. Refer to the AuCS® Installation, Use and Care Manual for details.

Section 3
Ice Machine Operation

Component Identification





Sequence Of Operation

NOTE: The toggle switch must be in the ice position and the water curtain must be in place on the evaporator before the ice machine will start.

INITIAL START-UP OR START-UP AFTER AUTOMATIC SHUT-OFF

1. Water Purge

Before the compressor starts, the water pump and water dump solenoid are energized for 45 seconds, to completely purge the ice machine of old water. This feature ensures that the ice making cycle starts with fresh water.

The harvest valve(s) is also energized during water purge, although it stays on for an additional 5 seconds (50 seconds total on time) during the initial refrigeration system start-up.

2. Refrigeration System Start-Up

The compressor starts after the 45 second water purge, and it remains on throughout the entire Freeze and Harvest Sequences. The water fill valve is energized at the same time as the compressor. The harvest valve(s) remains on for 5 seconds during initial compressor start-up and then shuts off.

At the same time the compressor starts, the condenser fan motor (air-cooled models) is supplied with power throughout the entire Freeze and Harvest Sequences. The fan motor is wired through a fan cycle pressure control, therefore it may cycle on and off. (The compressor and condenser fan motor are wired through the contactor. As a result, anytime the contactor coil is energized, the compressor and fan motor are supplied with power.)

FREEZE SEQUENCE

3. Prechill

The compressor is on for 30 seconds (60 seconds initial cycle) prior to water flow, to prechill the evaporator. The water fill valve remains on until the water level probe is satisfied.

4. Freeze

The water pump restarts after the prechill. An even flow of water is directed across the evaporator and into each cube cell, where it freezes. The water fill valve will cycle on and then off one more time to refill the water trough.

When sufficient ice has formed, the water flow (not the ice) contacts the ice thickness probe. After approximately 10 seconds of continual water contact, the harvest sequence is initiated. The ice machine cannot initiate a harvest sequence until a 6 minute freeze lock has been surpassed.

NOTE: Freeze lock is bypassed after moving the toggle switch from OFF to ICE position for the first cycle only.

HARVEST SEQUENCE

5. Water Purge

The harvest valve(s) opens at the beginning of the water purge to divert hot refrigerant gas into the evaporator.

The water pump continues to run, and the water dump valve energizes for 45 seconds to purge the water in the sump trough. The water fill valve energizes (turns on) and de-energizes (turns off) strictly by time. The water fill valve energizes for the last 15 seconds of the 45-second water purge.

After the 45 second water purge, the water fill valve, water pump and dump valve de-energize. (Refer to “Water Purge Adjustment” for details.)

6. Harvest

The harvest valve(s) remains open and the refrigerant gas warms the evaporator causing the cubes to slide, as a sheet, off the evaporator and into the storage bin. The sliding sheet of cubes swings the water curtain out, opening the bin switch.

The momentary opening and re-closing of the bin switch terminates the harvest sequence and returns the ice machine to the freeze sequence (Step 3 - 4.)

AUTOMATIC SHUT-OFF

7. Automatic Shut-Off

When the storage bin is full at the end of a harvest sequence, the sheet of cubes fails to clear the water curtain and will hold it open. After the water curtain is held open for 30 seconds, the ice machine shuts off. The ice machine remains off for 3 minutes before it can automatically restart.

The ice machine remains off until enough ice has been removed from the storage bin to allow the ice to fall clear of the water curtain. As the water curtain swings back to the operating position, the bin switch re-closes and the ice machine restarts (steps 1 - 2), provided the 3 minute delay period is complete.

SAFETY TIMERS

The control board has the following non-adjustable safety timers:

- The ice machine is locked into the freeze cycle for 6 minutes before a harvest cycle can be initiated. Freeze lock is bypassed after moving the toggle switch from OFF to ICE position for the first cycle only.
- The maximum freeze time is 60 minutes at which time the control board automatically initiates a harvest sequence (steps 5 & 6).
- The maximum harvest time is 3.5 minutes at which time the control board automatically initiates a freeze sequence (steps 3 & 4).

WARM WATER RINSE CYCLE

Closing the back of the evaporator allows ice to build up on the rear of the evaporator and the plastic evaporator frame parts. After 200 freeze/harvest cycles have been complete the control board will initiate a warm water rinse.

After the 200th harvest cycle ends:

- The Clean and Harvest LED’s energize to indicate the ice machine is in a warm water rinse.
- The compressor and harvest valve remain energized.
- The water pump energizes.
- The water inlet valve energizes until water contacts the water level probe.
- The compressor and harvest valve warm the water for 5 minutes, then de-energize.
- The water pump remains energized for an additional 5 minutes (10 minute total on time) then de-energizes.

NOTE: The warm water rinse cycle can be terminated by moving the toggle switch to the OFF position, then back to ICE.

Operational Checks

GENERAL

Manitowoc ice machines are factory-operated and adjusted before shipment. Normally, new installations do not require any adjustment.

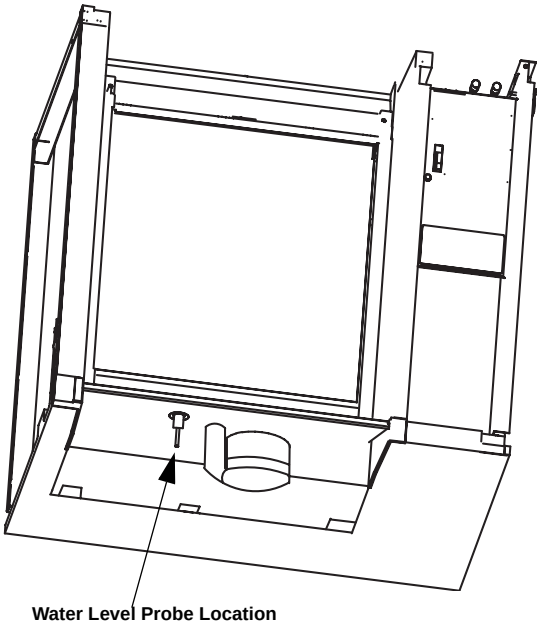
To ensure proper operation, always follow the Operational Checks:

- when starting the ice machine for the first time
- after a prolonged out of service period
- after cleaning and sanitizing

NOTE: Routine adjustments and maintenance procedures are not covered by the warranty.

WATER LEVEL

The water level sensor is set to maintain the proper water level above the water pump housing. The water level is not adjustable. If the water level is incorrect, check the water level probe for damage (probe bent, etc.). Clean the water level probe with ice machine cleaner, rinse thoroughly and re-check operation. Repair or replace the probe as necessary.

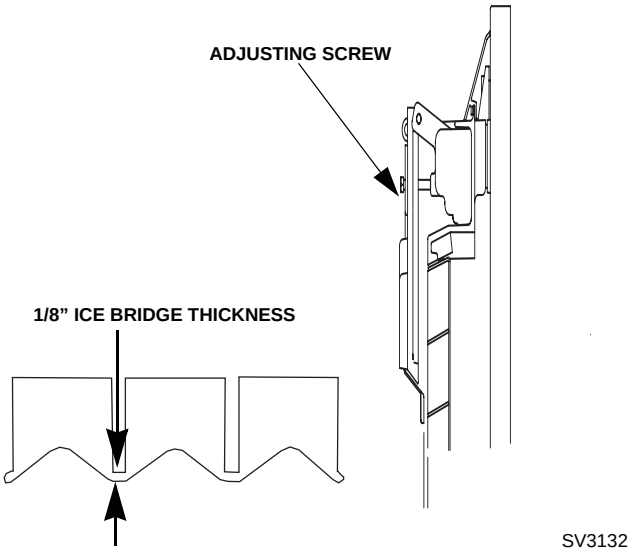


ICE THICKNESS CHECK

The ice thickness probe is factory-set to maintain the ice bridge thickness at 1/8" (.32 cm).

NOTE: Make sure the water curtain is in place when performing this check. It prevents water from splashing out of the water trough.

1. Inspect the bridge connecting the cubes. It should be about 1/8" (.32 cm) thick.
2. If adjustment is necessary, turn the ice thickness probe adjustment screw clockwise to increase bridge thickness, counterclockwise to decrease bridge thickness. Set at 1/4” gap between ice machine and evaporator as starting point, then adjust to achieve a 1/8” bridge thickness.



Ice Thickness Check

3. Make sure the ice thickness probe wire and the bracket do not restrict movement of the probe.

HARVEST SEQUENCE WATER PURGE

The harvest sequence water purge adjustment may be used when the ice machine is hooked up to special water systems, such as a de-ionized water treatment system.

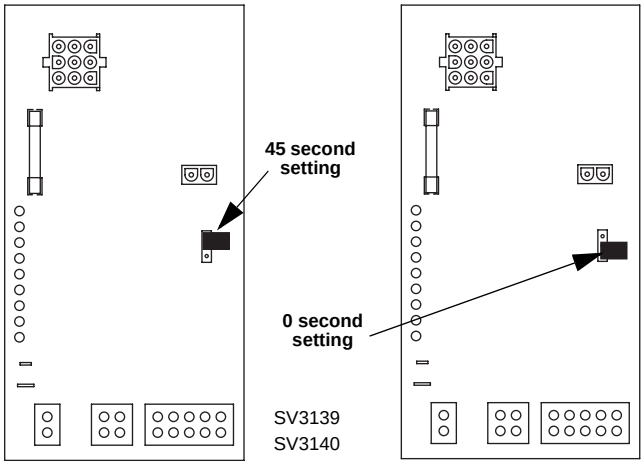
⚠ Warning

Disconnect electric power to the ice machine at the electrical disconnect before proceeding.

Important

The harvest sequence water purge is factory-set at 45 seconds. A shorter purge setting (with standard water supplies such as city water) is not recommended. This can increase water system cleaning and sanitizing requirements.

- The harvest sequence water purge is factory set for 45 seconds. Repositioning the jumper will set the harvest water purge to 0 seconds. This setting does not affect the SeCs or AuCs (cleaning) sequences.
- During the harvest sequence water purge, the water fill valve energizes and de-energizes by time. The water purge must be at the factory setting of 45 seconds for the water fill valve to energize during the last 15 seconds of the water purge. If it is set to less than 45 seconds, the water fill valve will not energize during the water purge.



Water Purge Adjustment

For your safety and to eliminate errors, we recommend that a qualified service technician make the harvest water purge adjustment.

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Section 4
Maintenance

General

You are responsible for maintaining the ice machine in accordance with the instructions in this manual. Maintenance procedures are not covered by the warranty.

⚠ Warning

If you do not understand the procedures or the safety precautions that must be followed, call your local Manitowoc service representative to perform the maintenance procedures for you.

We recommend that you perform the following maintenance procedures a minimum of once every six months to ensure reliable, trouble-free operation and maximum ice production.

Ice Machine Inspection

⚠ Warning

Disconnect electric power to the ice machine and the remote condensing unit at the electric service switch before cleaning the condenser.

Check all water fittings and lines for leaks. Also, make sure the refrigeration tubing is not rubbing or vibrating against other tubing, panels, etc.

Do not put anything (boxes, etc.) on the sides or back of the ice machine. There must be adequate airflow through and around the ice machine to maximize ice production and ensure long component life.

Exterior Cleaning

Clean the area around the ice machine as often as necessary to maintain cleanliness and efficient operation. Use cleaners designed for use with stainless steel products.

Sponge any dust and dirt off the outside of the ice machine with mild soap and water. Wipe dry with a clean, soft cloth.

Heavy stains should be removed with stainless steel wool. Never use plain steel wool or abrasive pads. They will scratch the panels.

Water-Cooled Condenser and Water Regulating Valve

Symptoms of restrictions in the condenser water circuit include:

- Low ice production
- High water consumption
- High operating temperatures
- High operating pressures

If the ice machine is experiencing any of these symptoms, the water-cooled condenser and water regulating valve may require cleaning due to scale build-up.

Because the cleaning procedures require special pumps and cleaning solutions, qualified maintenance or service personnel must perform them.

AlphaSan®

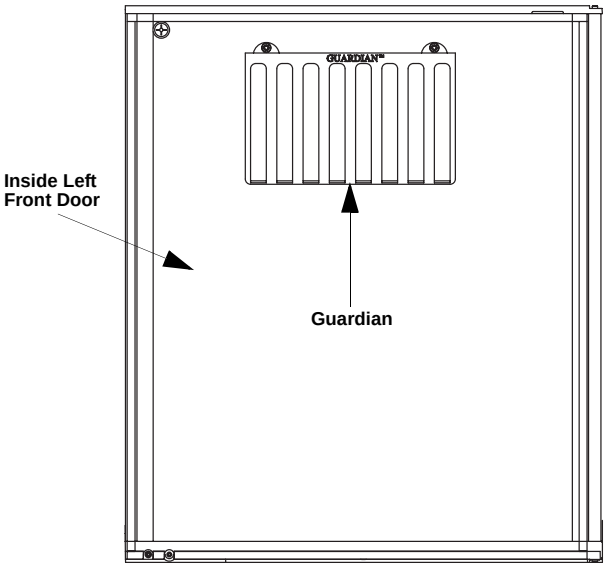
The goal of AlphaSan® is to keep the plastic surfaces of an ice machine cleaner, by reducing or delaying the formation of bio-film. The active ingredient in AlphaSan® is the element silver in the form of silver ions (Ag+). AlphaSan® slowly releases silver ions via an ion exchange mechanism. When AlphaSan® is compounded directly into a plastic part, a controlled release of silver ions from the surface is regulated to maintain an effective concentration at or near the surface of the plastic ice machine part. AlphaSan's® unique ability to effectively control the release of silver not only protects against undesired discoloration of the plastic, but also will last the life of the plastic part. Although AlphaSan® helps prevent bio-film build up it does not eliminate the need for periodic cleaning and maintenance. AlphaSan® has no adverse effect on the taste of the ice or beverage.

Guardian™

Slime is a leading cause of ice machine breakdowns and biological growth is a health concern. The Guardian™ system releases chlorine dioxide on a controlled basis to inhibit the growth of bacteria and fungi that form slime and cause malodors in the food zone of ice machines.

The Guardian™ will not control mineral or other water borne buildup. Your water quality will determine the length of time before mineral buildup affects ice machine performance. Mineral buildup must be removed as often as necessary to ensure trouble-free operation of the ice machine.

The Guardian™ is pre-installed on the inside of the left front door. No installation is necessary.



Guardian™ Location

GUARDIAN™ SACHET REPLACEMENT FREQUENCY

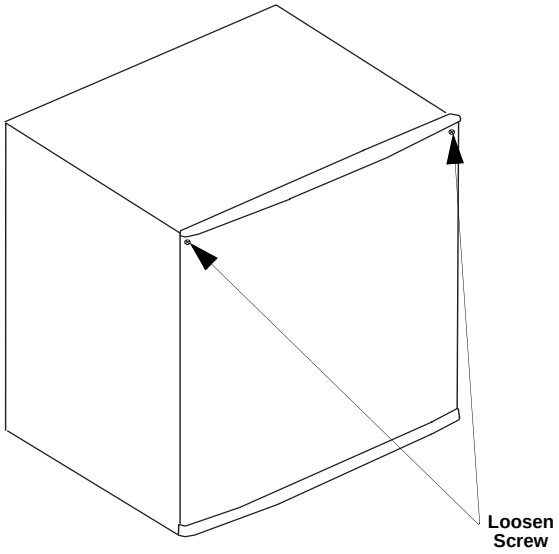
Sachet packet(s) require replacement every thirty (30) days or whenever they come in direct contact with water. Refer to chart below for requirements.

Ice Machine	Sachet Use
S600M	1

Guardian™ sachet packets are available through your local Manitowoc ice machine dealer.

SACHET REPLACEMENT PROCEDURE

1. Loosen the left screw and open the left front door. The right front panel does not need to be removed.



Screw Location

2. Remove and discard spent Guardian sachet packets.
3. Remove the new sachet packet from foil package and install into holder. Removing the foil package allows moisture in the air to activate the sachet contents.
4. Close the left front door and tighten the screw.
5. Discard the use sachet packet in the trash.

CLEAN UP PROCEDURE FOR DAMAGED SACHET PACKET

1. Remove all ice from bin/dispenser and discard.
2. Initiate a cleaning and sanitizing sequence on the ice machine (see next pages).
3. Clean the bin/dispenser. Flush the drain thoroughly to prevent future drain blockage.
4. Sanitize the bin/dispenser.
5. Install a replacement sachet packet and reinstall all panels.

Interior Cleaning and Sanitizing

GENERAL

Clean and sanitize the ice machine every six months for efficient operation. If the ice machine requires more frequent cleaning and sanitizing, consult a qualified service company to test the water quality and recommend appropriate water treatment. An extremely dirty ice machine must be taken apart for cleaning and sanitizing.

⚠ Caution

Use only Manitowoc approved Ice Machine Cleaner (part number 94-0546-3) and Sanitizer (part number 94-0565-3). It is a violation of Federal law to use these solutions in a manner inconsistent with their labeling. Read and understand all labels printed on bottles before use.

CLEANING PROCEDURE

⚠ Caution

Do not mix Cleaner and Sanitizer solutions together. It is a violation of Federal law to use these solutions in a manner inconsistent with their labeling.

⚠ Warning

Wear rubber gloves and safety goggles (and/or face shield) when handling ice machine Cleaner or Sanitizer.

Ice machine cleaner is used to remove lime scale or other mineral deposits. It is not used to remove algae or slime. Refer to the section on Sanitizing for removal of algae and slime.

Step 1 Set the toggle switch to the OFF position after ice falls from the evaporator at the end of a Harvest cycle. Or, set the switch to the OFF position and allow the ice to melt off the evaporator.

⚠ Caution

Never use anything to force ice from the evaporator. Damage may result.

Step 2 To start cleaning, place the toggle switch in the CLEAN position. The water will flow through the water dump valve and down the drain. The Clean light will turn on to indicate the ice machine is in the Cleaning mode.

Step 3 Wait about two minutes or until water starts to flow over the evaporator.

Step 4 Add the proper amount of Manitowoc Ice Machine Cleaner to the water trough.

Model	Amount of Cleaner
S600M	5 ounces (148 ml)

Step 5 The ice machine will automatically time out a ten minute cleaning cycle, followed by six rinse cycles, and stop. The Clean light will turn off to indicate the Cleaning cycle is completed. This entire cycle lasts approximately 30 minutes.

Step 6 When the cleaning process stops, move the toggle switch to OFF position. Refer to “Sanitizing Procedure” on the next page.

Step 7

A. The ice machine may be set to start and finish a self-cleaning procedure then automatically start ice making again.

B. You must wait about one minute into the cleaning cycle (until water starts to flow over the evaporator) then move the switch from CLEAN to ICE position.

C. When the self-cleaning cycle is completed, an ice making sequence will start automatically.

Important

After the toggle switch is moved to the ICE position, opening the curtain switch will interrupt the cleaning sequence. The sequence will resume from the point of interruption when the curtain switch closes.

SANITIZING PROCEDURE

Use sanitizer to remove algae or slime. Do not use it to remove lime scale or other mineral deposits.

Step 1 Set the toggle switch to the OFF position after ice falls from the evaporator at the end of a Harvest cycle. Or, set the switch to the OFF position and allow the ice to melt off the evaporator.

> **⚠ Caution**
> Never use anything to force ice from the evaporator. Damage may result.

> **⚠ Warning**
> Disconnect electric power to the ice machine (and dispenser if applicable) at the electric switch box before proceeding.

Step 2 Refer to Removal of Parts For Cleaning/ Sanitizing and remove ice machine parts.

Step 3 Mix a solution of water and sanitizer.

Solution Type	Water	Mixed With
Sanitizer	4 gal. (15 l)	3 oz (90 ml) sanitizer

Step 4 Use the sanitizing solution and a sponge or cloth to sanitize (wipe) all parts and interior surfaces of the ice machine. Sanitize the following areas:

A. Side walls

B. Base (area above water trough)

C. Evaporator plastic parts

D. Bin or dispenser

Step 5 Rinse all sanitized areas with clear water.

Step 6 Install the removed parts, restore power and place toggle switch in the ice position.

REMOVAL OF PARTS FOR CLEANING/SANITIZING

1. Turn off the electrical and water supply to the ice machine (and dispenser when applicable).

⚠ Warning

Disconnect electric power to the ice machine (and dispenser if applicable) at the electric switch box before proceeding.

2. Remove all ice from the bin.
3. Remove the water curtain and the components you want to clean or sanitize. See the following pages for removal procedures for these parts.

⚠ Warning

Wear rubber gloves and safety goggles (and/or face shield) when handling Ice Machine Cleaner or Sanitizer.

4. Soak the removed part(s) in a properly mixed solution.

Solution Type	Water	Mixed With
Cleaner	1 gal. (4 l)	16 oz (500 ml) cleaner
Sanitizer	4 gal. (15 l)	3 oz (90 ml) sanitizer

5. Use a soft-bristle brush or sponge (NOT a wire brush) to carefully clean the parts.

⚠ Caution

Do not mix Cleaner and Sanitizer solutions together. It is a violation of Federal law to use these solutions in a manner inconsistent with their labeling.

⚠ Caution

Do not immerse the water pump motor in the cleaning or sanitizing solution.

6. Use the sanitizing solution and a sponge or cloth to sanitize (wipe) the interior of the ice machine and the entire inside of the bin/dispenser.
7. Thoroughly rinse all of the parts and surfaces with clear water.
8. Install the removed parts.

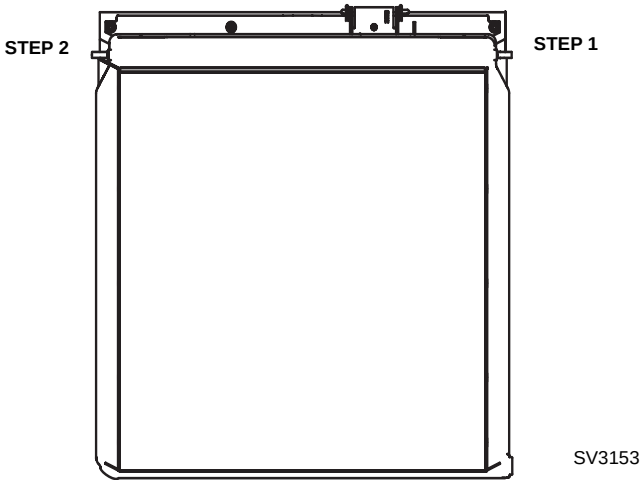
NOTE: Incomplete rinsing of the ice thickness probe or water level probe may leave a residue. This could cause the ice machine to malfunction. For best results, brush or wipe the probes off while rinsing it. Thoroughly dry the probes before installing them.

9. Turn on the water and electrical supply.

1. Water Curtain

A. Gently flex the curtain in the center and remove it from the right side.

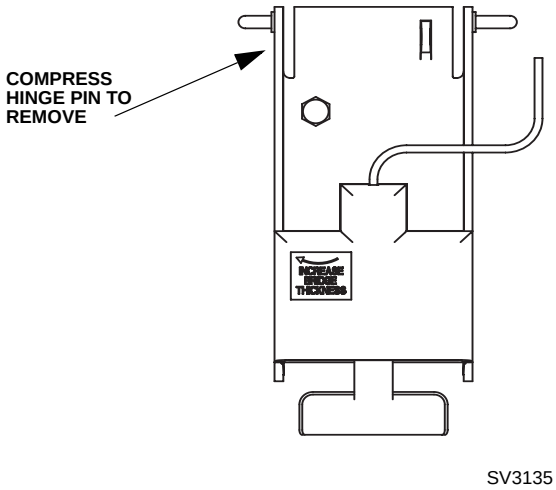
B. Slide the left pin out.



Water Curtain Removal

2. Ice Thickness Probe

A. Compress the hinge pin on the top of the ice thickness probe.



Ice Thickness Probe Removal

B. Pivot the ice thickness probe to disengage one pin then the other. The ice thickness probe can be cleaned at this point without complete removal. Follow Step C for complete removal.

> **⚠ Warning**
> Disconnect the electric power to the ice machine at the electric service switch box.

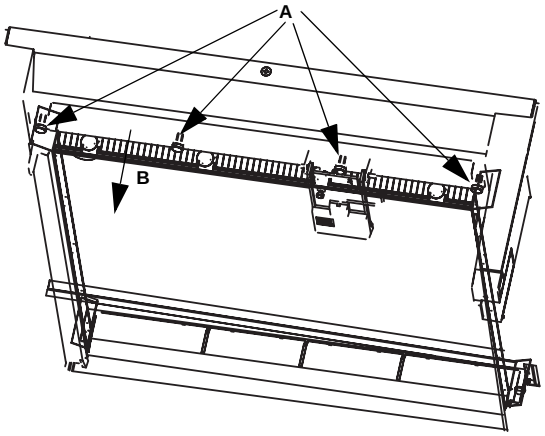
C. Disconnect the ice thickness control wiring from the control board.

3. Water Distribution Tube

⚠ Warning

Removing the distribution tube while the water pump is running will allow water to spray from ice machine. Disconnect the electrical power to the ice machine and dispenser at the electric service switch box and turn off the water supply.

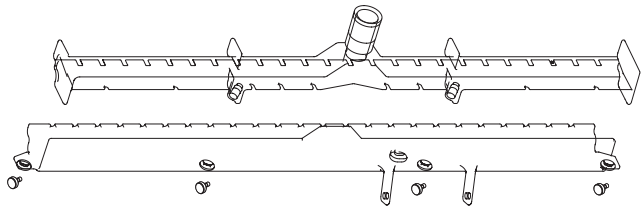
NOTE: Distribution tube thumbscrews are retained by o-rings to prevent loss. Loosen thumbscrews but do not pull thumbscrews out of distribution tube.



Water Distribution Tube Removal

A. Remove outer half of distribution tube by loosening the four (4) thumbscrews (o-rings retain thumbscrews to distribution tube).

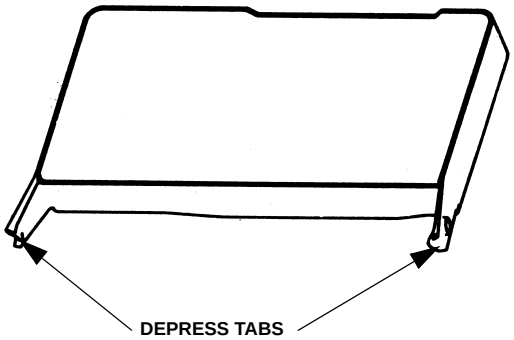
B. Pull inner half of water distribution tube forward to release slip joint from water pump tubing connection.



4. Water Trough

A. Depress tabs on right and left side of the water trough.

B. Allow front of water trough to drop as you pull forward to disengage the rear pins.

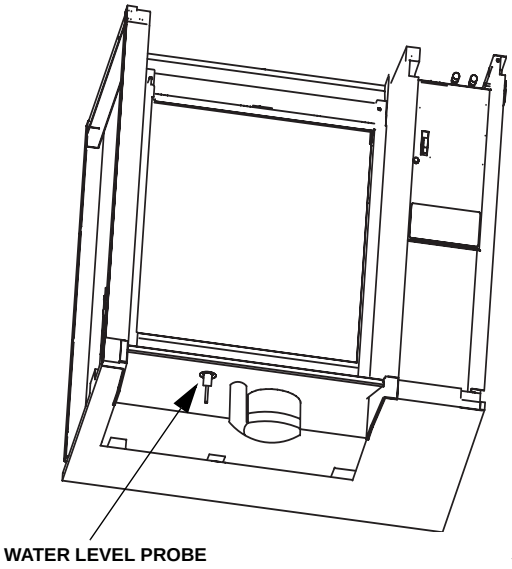


Water Level Probe

1. Remove the water trough.

> **⚠ Warning**
> Disconnect the electrical power to the ice machine at the electrical disconnect before proceeding.

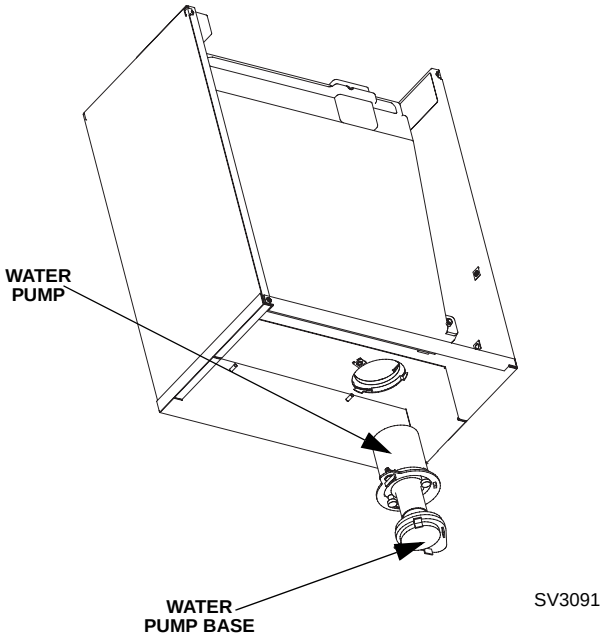
2. The water level probe normally does not require removal for cleaning. The probe can be wiped and cleaned in place or proceed to step 3.
3. Pull the water level probe straight down to disengage.
4. Lower the water level probe until the wiring connector is visible. Disconnect the wire lead from the water level probe.
5. Remove the water level probe from the ice machine.



Water Pump

> **⚠ Warning**
> Disconnect the electric power to the ice machine at the electric service switch box and turn off the water supply before proceeding.

1. Empty the water trough.
   A. Move the toggle switch from OFF to ICE.
   B. Wait 45 seconds.
   C. Place toggle switch in OFF position.



Water Pump Removal

2. Remove the water trough.
3. The water pump normally does not require removal for cleaning. The water pump base can be wiped and cleaned in place or proceed to step 4.
4. Grasp pump and pull straight down on pump assembly until water pump disengages and electrical connector is visible.
5. Disconnect the electrical connector.
6. Remove the water pump assembly from ice machine.
7. Do not soak the water pump in cleaner or sanitizer. Wipe the pump and ice machine base clean.

Water Dump Valve

The water dump valve normally does not require removal for cleaning. To determine if removal is necessary:

1. Locate the water dump valve.
2. Set the toggle switch to ICE.
3. While the ice machine is in the freeze mode, check the dump valve's clear plastic outlet drain hose for leakage.
   A. If the dump valve is leaking, remove, disassemble and clean it.
   B. If the dump valve is not leaking, do not remove it. Instead, follow the "Ice Machine Cleaning Procedure".

Follow the procedure below to remove the dump valve.

⚠ Warning

Disconnect the electric power to the ice machine at the electric service switch box and turn off the water supply before proceeding.

1. If so equipped, remove the water dump valve shield from its mounting bracket.
2. Lift and slide the coil retainer cap from the top of the coil.
3. Note the position of the coil assembly on the valve for assembly later. Leaving the wires attached, lift the coil assembly off the valve body and the enclosing tube.
4. Press down on the plastic nut on the enclosing tube and rotate it 1/4 turn. Remove the enclosing tube, plunger, and plastic gasket from the valve body.

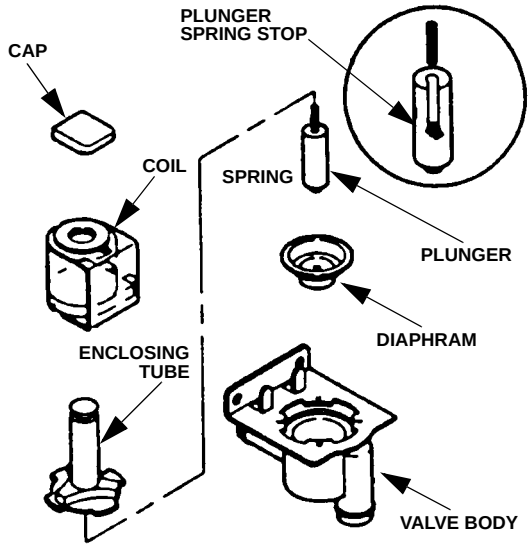
NOTE: At this point, the water dump valve can easily be cleaned. If complete removal is desired, continue with step 5.

Important

The plunger and the inside of the enclosing tube must be completely dry before assembly.

NOTE: During cleaning, do not stretch, damage or remove the spring from the plunger. If it is removed, slide the spring's flared end into the plunger's slotted top opening until the spring contacts the plunger spring stop.

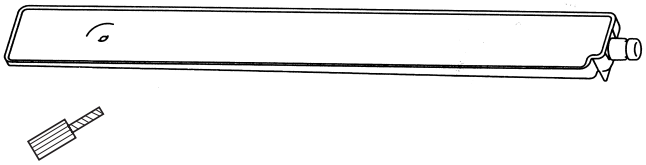
5. Remove the valve body.
6. Remove the tubing from the dump valve by twisting the clamps off.
7. Remove the two screws securing the dump valve and the mounting bracket.



Dump Valve Disassembly

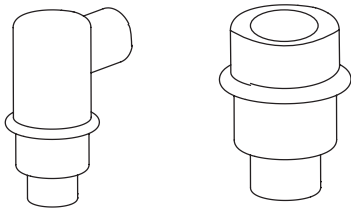
Evaporator Tray Removal

1. Remove the water trough.
2. Remove thumbscrew on left side of tray.
3. Allow left side of tray to drop as you pull the tray to the left side. Continue until the outlet tube disengages from the right side.



Drain Line Check Valve

The drain line check valve normally does not require removal for cleaning. Water loss from the sump trough will indicate removal and cleaning are required.



sv3154

1. Remove check valve and tube assembly.
   A. Tip assembly to right until tubing disengages.
   B. Lift up on assembly to remove.
2. Remove insulation from check valve assembly.
3. Remove vinyl tubing from top of check valve.
4. Soak in cleaner solution 10 minutes, and then flush with water to remove debris.

Water Inlet Valve

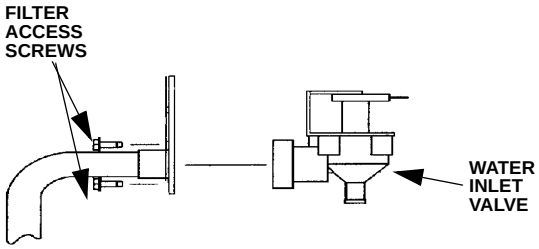
The water inlet valve normally does not require removal for cleaning. Refer to Section 5 for a list of causes for “No Water Entering Water Trough” or “Water Overflows Water Trough.

1. When the ice machine is off, the water inlet valve must completely stop water flow into the machine.
2. When the ice machine is on, the water inlet valve must allow the proper water flow through it. Set the toggle switch to ON. Watch for water flow into the ice machine. If the water flow is slow or only trickles into the ice machine, refer to Section 5.

Follow the procedure below to remove the water inlet valve.

> **⚠ Warning**
> Disconnect the electric power to the ice machine and dispenser at the electric service switch box and turn off the water supply before proceeding.

1. Remove the 1/4” hex head screws.
2. Remove, clean, and install the filter screen.



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Removal from Service/Winterization

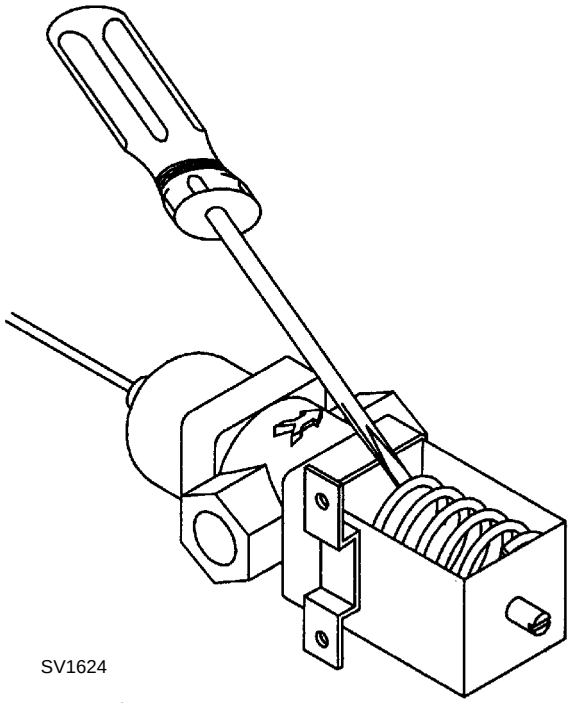
GENERAL

Special precautions must be taken if the ice machine is to be removed from service for an extended period of time or exposed to ambient temperatures of 32°F (0°C) or below.

> **⚠ Caution**
> If water is allowed to remain in the ice machine in freezing temperatures, severe damage to some components could result. Damage of this nature is not covered by the warranty.

Follow the applicable procedure below.

1. Disconnect the electric power at the circuit breaker or the electric service switch.
2. Turn off the water supply.
3. Remove the water from the water trough.
4. Disconnect and drain the incoming ice-making water line at the rear of the ice machine.
5. Blow compressed air in both the incoming water and the drain openings in the rear of the ice machine until no more water comes out of the inlet water lines or the drain.
6. Make sure water is not trapped in any of the water lines, drain lines, distribution tubes, etc.
7. Disconnect the incoming water and drain lines from the water-cooled condenser.
8. Insert a large screwdriver between the bottom spring coils of the water regulating valve. Pry upward to open the valve.
9. Hold the valve open and blow compressed air through the condenser until no water remains.



Pry Open the Water Regulating Valve

AUCS® Accessory

Refer to the AuCS® Accessory manual for winterization of the AuCS® Accessory.

Section 5
Before Calling For Service

Checklist

If a problem arises during operation of your ice machine, follow the checklist below before calling service. Routine adjustments and maintenance procedures are not covered by the warranty.

Problem	Possible Cause	To Correct
Ice machine does not operate.	No electrical power to the ice machine and/or condensing unit.	Replace the fuse/reset the breaker/turn on the main switch.
	High pressure cutout tripping.	Clean condenser coil. (See Section 4)
	ICE/OFF/CLEAN toggle switch set improperly.	Move the toggle switch to the ICE position.
	Water curtain stuck open.	Water curtain must be installed and swinging freely. (See Section 4)
	Remote receiver service valve and/or Liquid/suction line shut off valves are closed.	Open the valve(s). (See Section 2)
Ice machine stops, and can be restarted by moving the toggle switch to OFF and back to ICE.	Safety limit feature stopping the ice machine.	Refer to “Safety Limit Feature” on the next page.
Ice machine does not release ice or is slow to harvest.	Ice machine is dirty.	Clean and sanitize the ice machine. (See Section 4)
	Ice machine is not level.	Level the ice machine. (See Section 2)
	Low air temperature around ice machine head section.	Air temperature must be at least 35°F (1.6°C).
	Fan cycling control does not de-energize condenser fan motor.	Verify pressure is below cut-out setpoint, replace fan cycling control.
Ice machine does not cycle into harvest mode.	The six-minute freeze time lock-in has not expired yet.	Wait for the freeze lock-in to expire.
	Ice thickness probe is dirty.	Clean and sanitize the ice machine. (See Section 4)
	Ice thickness probe is disconnected.	Connect the wire.
	Ice thickness probe is out of adjustment.	Adjust the ice thickness probe. (See Section 3)
	Uneven ice fill (thin at the top of evaporator).	Verify sufficient water level in sump trough. Contact a qualified service company to check refrigeration system.
Ice quality is poor (soft or not clear).	Poor incoming water quality.	Contact a qualified service company to test the quality of the incoming water and make appropriate filter recommendations.
	Water filtration is poor.	Replace the filter.
	Ice machine is dirty.	Clean and sanitize the ice machine. (See Section 4)
	Water dump valve is not working.	Disassemble and clean the water dump valve. (See Section 4)
	Water softener is working improperly (if applicable).	Repair the water softener.

Problem	Possible Cause	To Correct
Ice machine produces shallow or incomplete cubes, or the ice fill pattern on the evaporator is incomplete.	Ice thickness probe is out of adjustment.	Adjust the ice thickness probe. (See Section 4)
	Water trough level is too low.	Check the water level probe for damage. (See Section 3)
	Water inlet valve filter screen is dirty.	Remove the water inlet valve and clean the filter screen. (See Section 4)
	Water filtration is poor.	Replace the filter.
	Hot incoming water.	Connect the ice machine to a cold water supply. (See Section 2)
	Water inlet valve is not working.	Replace the water inlet valve.
	Incorrect incoming water pressure.	Water pressure must be 20-80 psi (1.4 bar - 5.5 bar)
	Ice machine is not level.	Level the ice machine. (See Section 2)
Low ice capacity.	Water inlet valve filter screen is dirty.	Remove the water inlet valve and clean the filter screen. (See Section 4)
	Incoming water supply is shut off.	Open the water service valve.
	Water inlet valve stuck open or leaking.	Place toggle switch in OFF position, if water continues to enter water trough replace the water inlet valve.

Safety Limit Feature

In addition to the standard safety controls, such as the high pressure cutout, your Manitowoc ice machine features built-in safety limits which will stop the ice machine if conditions arise which could cause a major component failure.

Before calling for service, re-start the ice machine using the following procedure:

1. Move the ICE/OFF/CLEAN switch to OFF and then back to ICE.
   A. If the safety limit feature has stopped the ice machine, it will restart after a short delay. Proceed to step 2.
   B. If the ice machine does not restart, see “Ice machine does not operate” on the previous page.
2. Allow the ice machine to run to determine if the condition is recurring.
   A. If the ice machine stops again, the condition has recurred. Call for service.
   B. If the ice machine continues to run, the condition has corrected itself. Allow the ice machine to continue running.

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Section 6
Electrical System

Energized Parts Charts

SELF-CONTAINED WATER-COOLED MODELS

Ice Making Sequence Of Operation	Control Board Relays							Contactor		Length Of Time
	1	2	3	4	5	6	7	7A	7B	
	Water Pump	Harvest Valve (Left)	Harvest Valve (Right)*	Air Comp.*	Water Inlet Valve	Dump Valve	Contactor Coil	Comp.	Cond. Fan Motor	
START-UP [1] 1. Water Purge	On	On	On (when used)	Not Used	Off	On	Off	Off	Off	45 Seconds
2. Refrigeration System Start-Up	Off	On	Off	Not Used	On	Off	On	On	Off	5 Seconds
FREEZE SEQUENCE 3. Pre-Chill	Off	Off	Off	Not Used	May Cycle On/Off during the first 45 sec.	Off	On	On	May Cycle On/Off	Initial Start-Up is 60 Seconds 30 Seconds thereafter
4. Freeze	On	Off	Off	Not Used	Cycles Off, then On one more time	Off	On	On	May Cycle On/Off	Until 10 sec. water contact with ice thickness probe
HARVEST SEQUENCE 5. Water Purge	On	On	On	Not Used	30 sec. Off, 15 sec. On	On	On	On	May Cycle On/Off	Factory-set at 45 Seconds
6. Harvest	Off	On	On	Not Used	Off	Off	On	On	May Cycle On/Off	Bin switch activation
7. AUTOMATIC SHUT-OFF	Off	Off	Off	Not Used	Off	Off	Off	Off	Off	Until bin switch re-closes & 3 min. delay

1. Initial Start-Up or Start-Up After Automatic Shut-Off
* Not Used on all Models

Condenser Fan Motor

The fan motor is wired through a fan cycle pressure control, therefore, it may cycle on and off.

Harvest Water Purge

The circuit board has an adjustable water purge in the harvest cycle. This permits a 0 or 45 second purge cycle.

Auto Shut-Off

The ice machine remains off for 3 minutes before it can automatically restart. The ice machine restarts (steps 1-2) immediately after the delay period, if the bin switch re-closes prior to 3 minutes.

Safety Timers

The control board has the following non-adjustable safety timers:

- The ice machine is locked into the freeze cycle for 6 minutes, before a harvest sequence can be initiated. The freeze lock is bypassed when the toggle switch is moved from the OFF to ICE position on the first cycle only.
- The maximum freeze time is 60 minutes, at which time the control board automatically initiates a harvest sequence (steps 5-6).
- The maximum harvest time is 3-1/2 minutes, at which time the control board automatically terminates the harvest sequence. If the bin switch is open, the ice machine will go to automatic shut-off (step 7). If the bin switch is closed, the ice machine will go to the freeze sequence (steps 3-4).

Wiring Diagram Sequence of Operation

SELF-CONTAINED MODELS

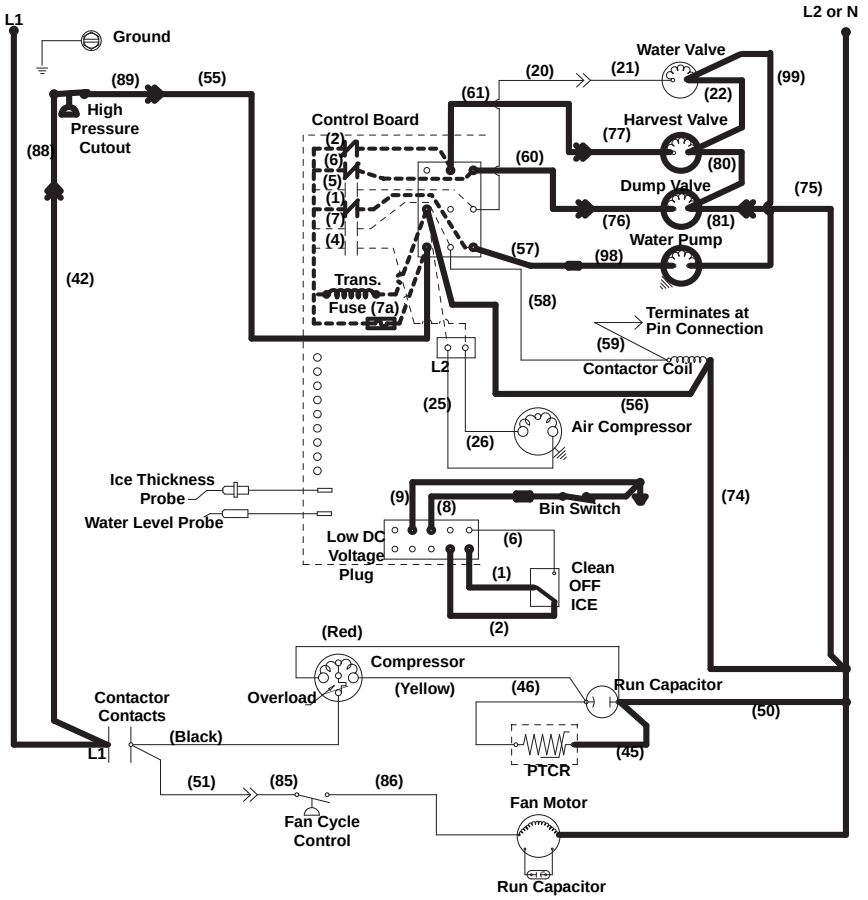
Initial Start-Up or Start-Up After Automatic Shut-Off

1. WATER PURGE

Before the compressor starts, the water pump and water dump solenoid are energized for 45 seconds to purge old water from the ice machine. This ensures that the ice-making cycle starts with fresh water.

The harvest valve(s) is also energized during the water purge. In the case of an initial refrigeration start-up or auto shut-off, it stays on for an additional
5 seconds (50 seconds total).

When Used - The air compressor energizes for the last 10 seconds of the cycle.



SV3137-2

Self-Contained — Water Purge

Table 6-1. Self-Contained Models

1. Water Purge (45 Seconds)		
Toggle Switch		ICE
Bin Switch		Closed
Control Board Relays		
#1	Water Pump	ON
#2	Harvest Valve (Left)	ON
#3	Harvest Valve (Right)	ON (When Used)
#4	Air Compressor	Not Used
#5	Water Inlet Valve	OFF
#6	Water Dump Valve	ON
#7	Contactor Coil	Open / OFF
#7A	Compressor	OFF
#7B	Condenser Fan Motor	OFF
Safety Controls (Which could stop ice machine operation)		
	High Pressure Cut-Out	Closed
	Main Fuse (On Control Board)	Closed

2. REFRIGERATION SYSTEM START-UP

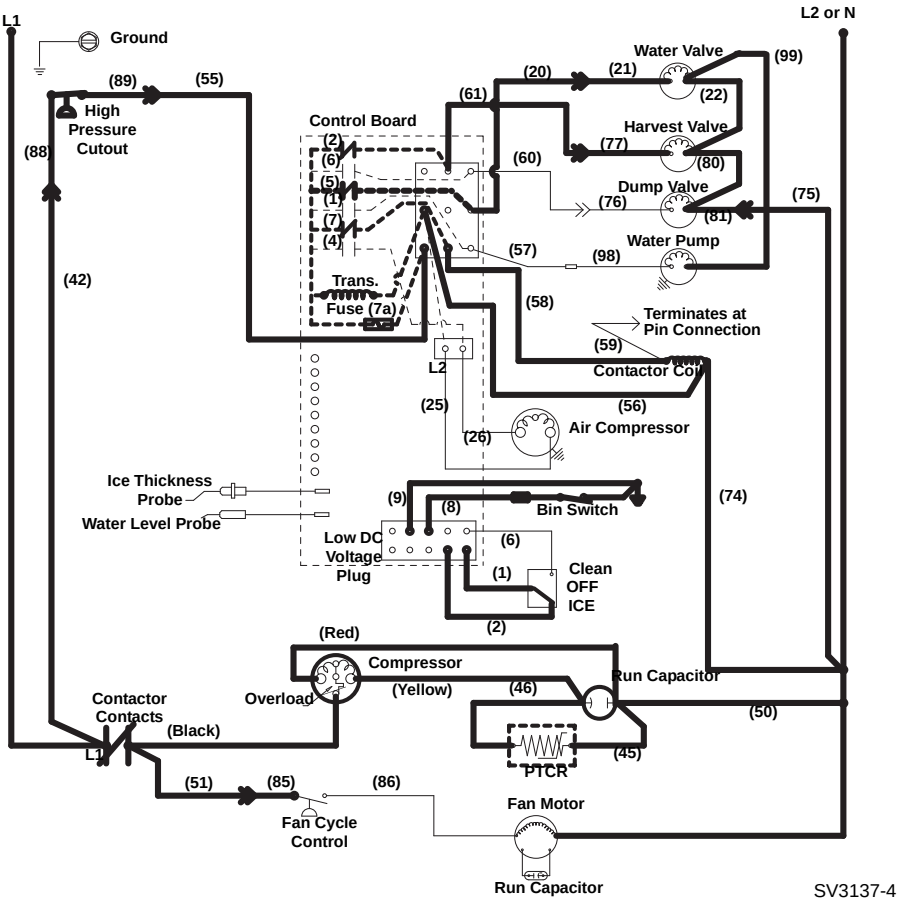
The compressor starts after the 45-second water purge, and it remains on throughout the Freeze and Harvest cycles.

The water fill valve is energized at the same time as the compressor.

The harvest valve(s) remains on for the first 5 seconds of the initial compressor start-up and then shuts off.

At the same time the compressor starts, the condenser fan motor (air-cooled models) is supplied with power throughout the entire freeze and harvest sequences.

The fan motor is wired through a fan cycle pressure control, and may cycle on and off. (The compressor and the condenser fan motor are wired through the contactor. Any time the contactor coil is energized, the compressor and fan motor are supplied with power.)



Self-Contained — Refrigeration System Start-Up

Table 6-2. Self-Contained Models

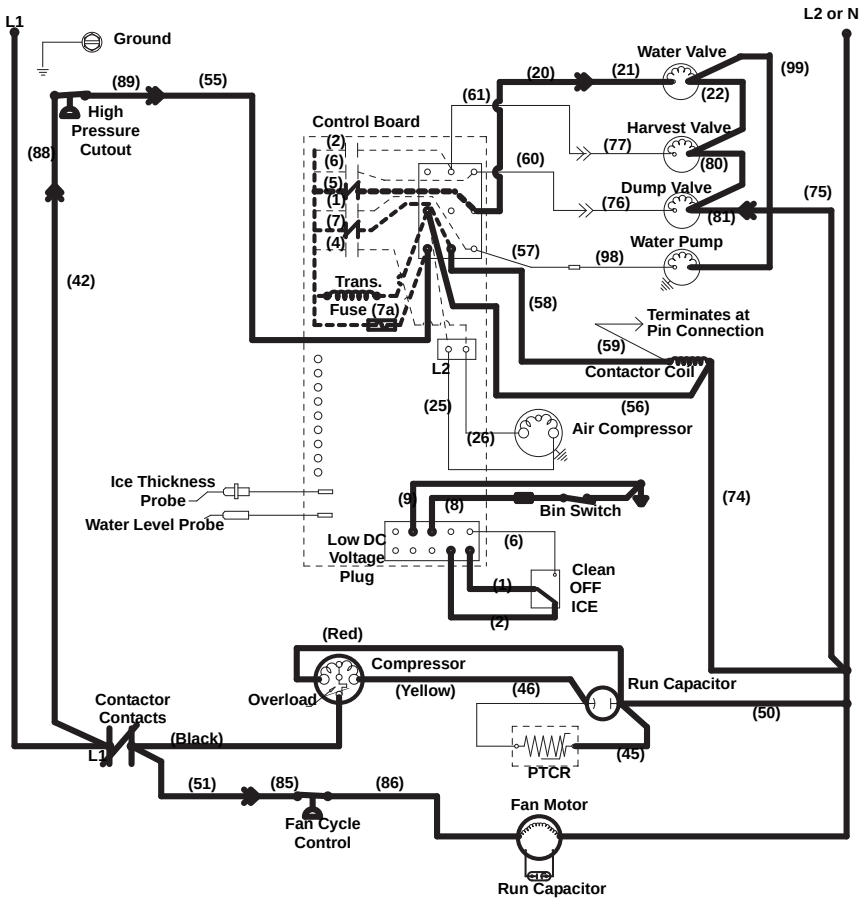
2. Refrigeration System Start Up (5 Seconds)		
Toggle Switch		ICE
Bin Switch		Closed
Control Board Relays		
#1	Water Pump	OFF
#2	Harvest Valve (Left)	ON
#3	Harvest Valve (Right)	ON (When Used)
#4	Air Compressor	Not Used
#5	Water Inlet Valve	ON
#6	Water Dump Valve	OFF
#7	Contactor Coil	Closed / ON
#7A	Compressor	ON
#7B	Condenser Fan Motor	OFF
Safety Controls (Which could stop ice machine operation)		
	High Pressure Cut-Out	Closed
	Main Fuse (On Control Board)	Closed

Freeze Sequence

3. PRE-CHILL

To pre-chill the evaporator, the compressor runs for 30 seconds (60 seconds initial cycle) prior to water flow.

The water fill valve remains on until the water level probe is satisfied.



SV3137-3

Self-Contained — Pre-Chill

Table 6-3. Self-Contained Models

3. Pre-Chill (60 Seconds Initial Cycle - 30 Seconds thereafter)		
Toggle Switch		ICE
Bin Switch		Closed
Control Board Relays		
#1	Water Pump	OFF
#2	Harvest Valve (Left)	OFF
#3	Harvest Valve (Right)	OFF (When Used)
#4	Air Compressor	Not Used
#5	Water Inlet Valve	On
#6	Water Dump Valve	OFF
#7	Contactor Coil	Closed / ON
#7A	Compressor	ON
#7B	Condenser Fan Motor	May Cycle ON / OFF
Safety Controls (Which could stop ice machine operation)		
	High Pressure Cut-Out	Closed
	Main Fuse (On Control Board)	Closed

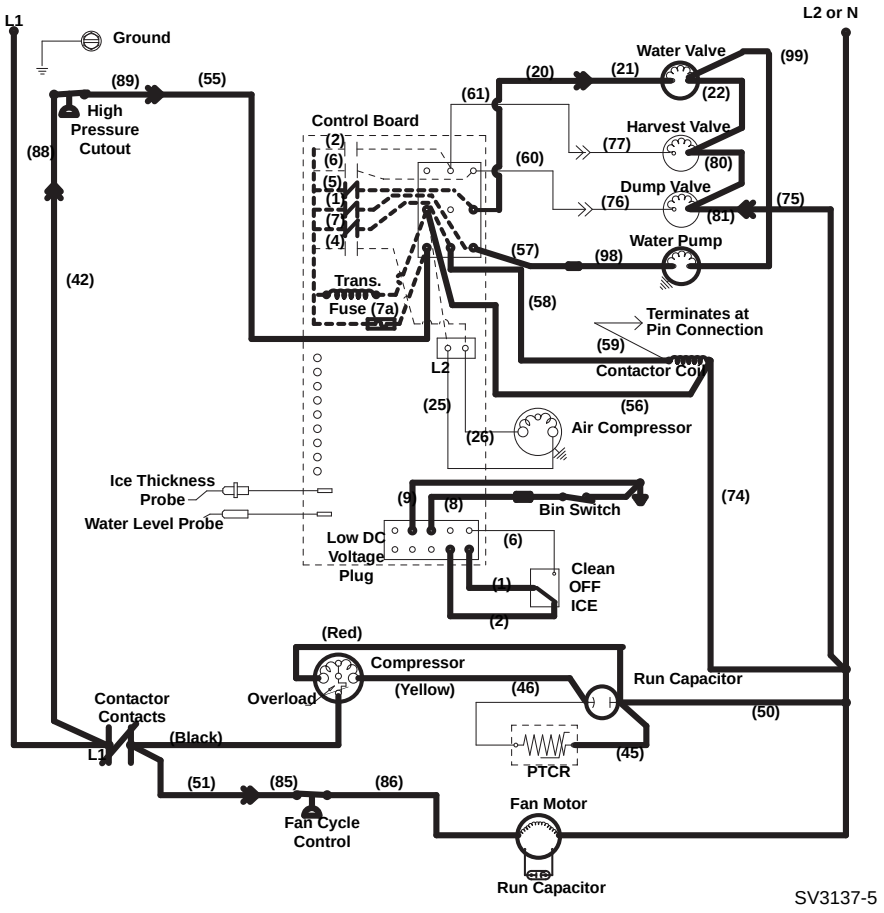
4. FREEZE

The water pump starts after the pre-chill. An even flow of water is directed across the evaporator and into each cube cell, where it freezes.

The water fill valve will cycle off then on one more time to refill the water trough.

When sufficient ice has formed, the water flow (not the ice) contacts the ice thickness probes. After approximately 10 seconds of continual contact, a harvest cycle is initiated.

NOTE: The ice machine cannot initiate a harvest cycle until a 6-minute freeze lock has expired.



Self-Contained — Freeze

Table 6-4. Self-Contained Models

4. Freeze (Until 10 Seconds of Water Contact with Ice Thickness Probe)		
Toggle Switch		ICE
Bin Switch		Closed
Control Board Relays		
#1	Water Pump	ON
#2	Harvest Valve (Left)	OFF
#3	Harvest Valve (Right)	OFF (When Used)
#4	Air Compressor	Not Used
#5	Water Inlet Valve	Cycles OFF, then ON one more time
#6	Water Dump Valve	OFF
#7	Contactor Coil	Closed / ON
#7A	Compressor	ON
#7B	Condenser Fan Motor	May Cycle ON / OFF
Safety Controls (Which could stop ice machine operation)		
	High Pressure Cut-Out	Closed
	Main Fuse (On Control Board)	Closed

Harvest Sequence

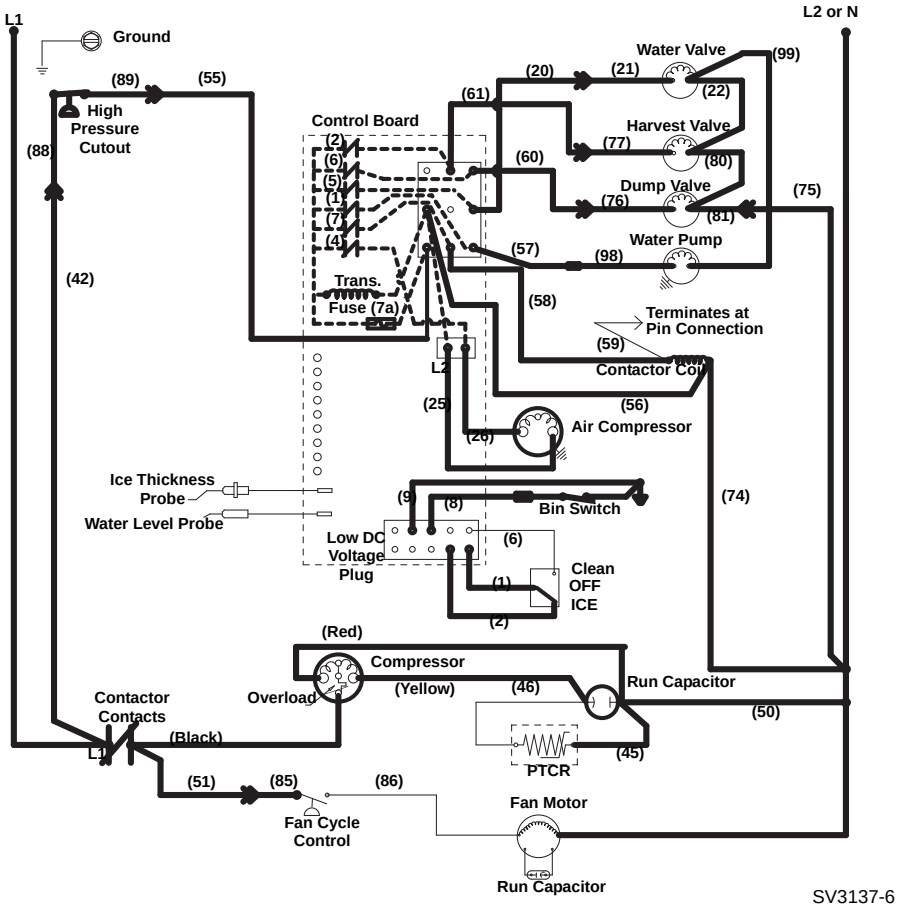
5. WATER PURGE

The harvest valve(s) opens at the beginning of the water purge to divert hot refrigerant gas into the evaporator.

The water pump continues to run, and the water dump valve energizes for 45 seconds to purge the water in the sump trough. The water fill valve energizes and de-energizes strictly by time. The water fill valve energizes for the last 15 seconds of the 45-second water purge.

After the 45 second water purge, the water fill valve, water pump and dump valve de-energize. (Refer to “Water Purge Adjustment” for details.)

The air compressor (when used) will energize after 35 seconds.



Self-Contained — Water Purge

Table 6-5. Self-Contained Models

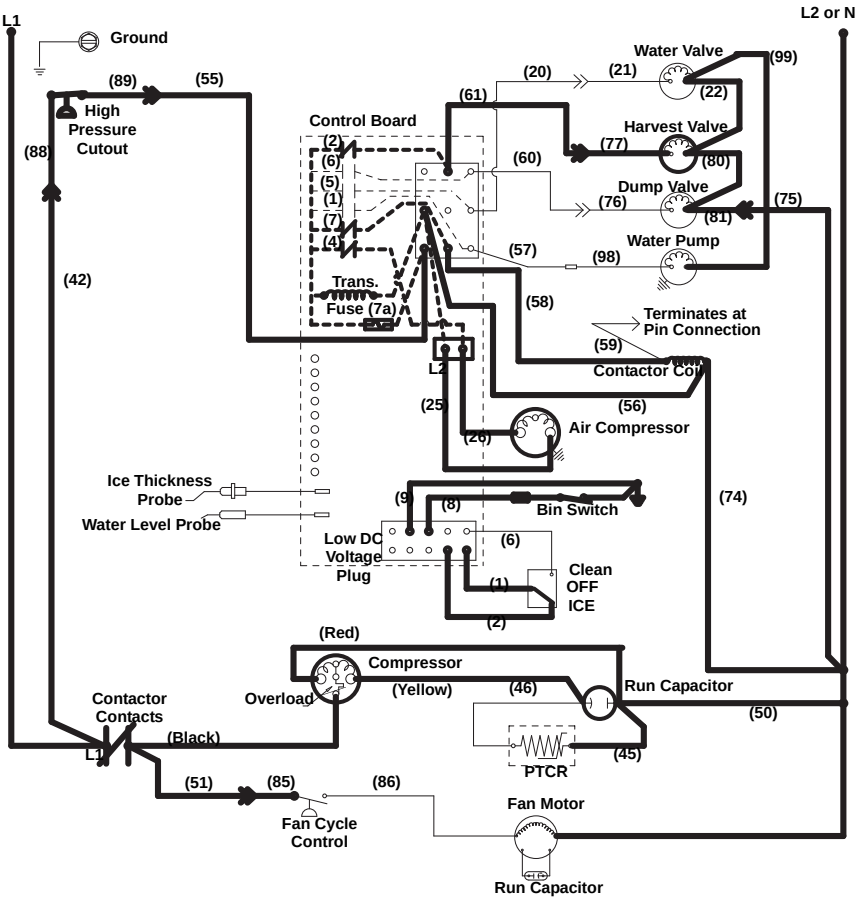
5. Water Purge (45 Seconds)		
Toggle Switch		ICE
Bin Switch		Closed
Control Board Relays		
#1	Water Pump	ON
#2	Harvest Valve (Left)	ON
#3	Harvest Valve (Right)	ON (When Used)
#4	Air Compressor	Not Used
#5	Water Inlet Valve	30 seconds OFF, 15 seconds ON
#6	Water Dump Valve	ON
#7	Contactor Coil	Closed / ON
#7A	Compressor	ON
#7B	Condenser Fan Motor	OFF; May Cycle ON
Safety Controls (Which could stop ice machine operation)		
	High Pressure Cut-Out	Closed
	Main Fuse (On Control Board)	Closed

6. HARVEST

The harvest valve(s) remains open and the refrigerant gas warms the evaporator. This causes the cubes to slide, as a sheet, off the evaporator and into the storage bin.

The sliding sheet of cubes swings the water curtain out, opening the bin switch. This momentary opening and closing of the bin switch terminates the Harvest Cycle and returns the ice machine to the Freeze Cycle (steps 3-4).

The air compressor (when used) remains energized throughout the entire harvest cycle. The air compressor will automatically energize after 60 seconds when the harvest cycle time exceeded 75 seconds in the previous cycle.



SV3137-7

Table 6-6. Self-Contained Models

6. Harvest (Until Bin Switch Activation)		
Toggle Switch		ICE
Bin Switch		Closed
Control Board Relays		
#1	Water Pump	OFF
#2	Harvest Valve (Left)	ON
#3	Harvest Valve (Right)	ON (When Used)
#4	Air Compressor	Not Used
#5	Water Inlet Valve	OFF
#6	Water Dump Valve	OFF
#7	Contactor Coil	Closed / ON
#7A	Compressor	ON
#7B	Condenser Fan Motor	OFF; May Cycle ON
Safety Controls (Which could stop ice machine operation)		
	High Pressure Cut-Out	Closed
	Main Fuse (On Control Board)	Closed

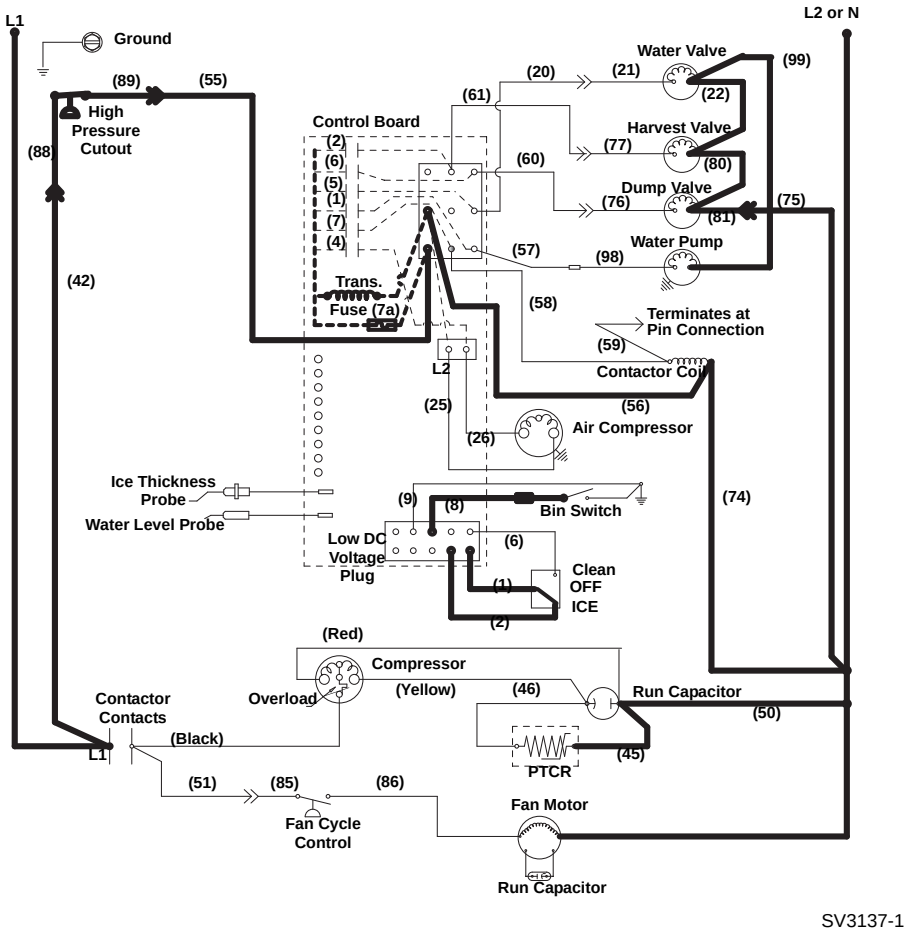
Automatic Shut-Off

7. AUTOMATIC SHUT-OFF

When the storage bin is full at the end of a harvest cycle, the sheet of cubes fails to clear the water curtain and holds it open. After the water curtain is held open for 30 seconds, the ice machine shuts off.

The ice machine remains off until enough ice is removed from the storage bin to allow the sheet of cubes to drop clear of the water curtain. As the water curtain swings back to the operating position, the bin switch closes and the ice machine restarts (steps 1-2), provided the 3 minute delay period is complete.

NOTE: The ice machine must remain off for 3 minutes before it can automatically restart.



SV3137-1

Self-Contained — Automatic Shut-Off

Table 6-7. Self-Contained Models

7. Automatic Shut-Off (Until Bin Switch Closes)		
Toggle Switch		ICE
Bin Switch		Open
Control Board Relays		
#1	Water Pump	OFF
#2	Harvest Valve (Left)	OFF
#3	Harvest Valve (Right)	OFF (When Used)
#4	Air Compressor	Not Used
#5	Water Inlet Valve	OFF
#6	Water Dump Valve	OFF
#7	Contactor Coil	Open / OFF
#7A	Compressor	OFF
#7B	Condenser Fan Motor	OFF
Safety Controls (Which could stop ice machine operation)		
	High Pressure Cut-Out	Closed
	Main Fuse (On Control Board)	Closed

Wiring Diagrams

The following pages contain electrical wiring diagrams. Be sure you are referring to the correct diagram for the ice machine which you are servicing.

⚠ Warning

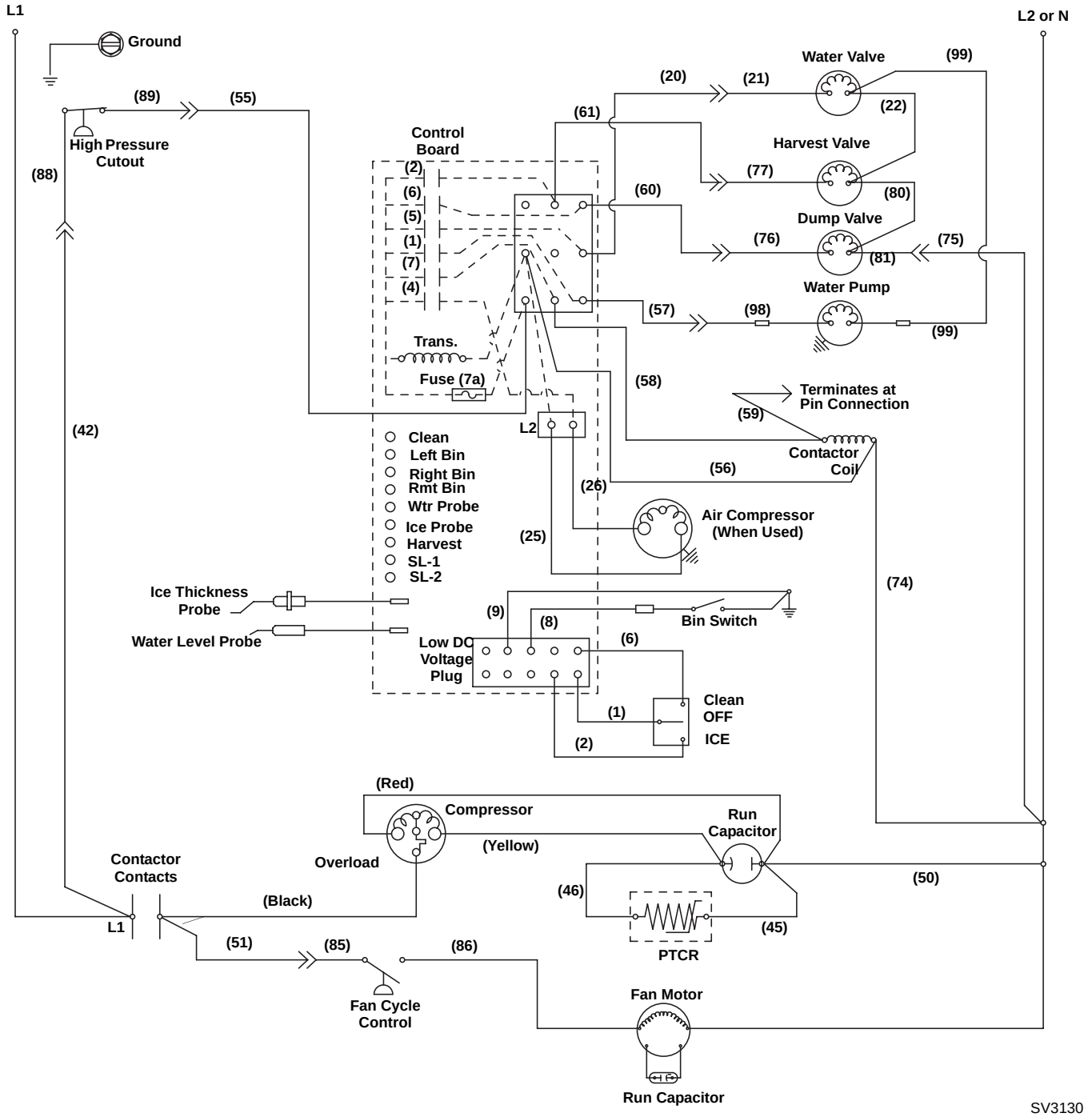
Always disconnect power before working on electrical circuitry.

WIRING DIAGRAM LEGEND

The following symbols are used on all of the wiring diagrams:

*	Internal Compressor Overload (Some models have external compressor overloads)
**	Fan Motor Run Capacitor (Some models do not incorporate fan motor run capacitor)
TB	Terminal Board Connection (Terminal board numbers are printed on the actual terminal board)
( )	Wire Number Designation (The number is marked at each end of the wire)
—>>—	Multi-Pin Connection (Electrical Box Side) —>>— (Compressor Compartment Side)

S600M - SELF CONTAINED - 1 PHASE



Component Specifications and Diagnostics

MAIN FUSE

Function

The control board fuse stops ice machine operation if electrical components fail causing high amp draw.

Specifications

The main fuse is 250 Volt, 7 amp.

Check Procedure

⚠ Warning

High (line) voltage is applied to the control board (terminals #55 and #56) at all times. Removing the control board fuse or moving the toggle switch to OFF will not remove the power supplied to the control board.

1. If the bin switch light is on with the water curtain closed, the fuse is good.

⚠ Warning

Disconnect electrical power to the entire ice machine before proceeding.

2. Remove the fuse. Check the resistance across the fuse with an ohm meter.

Reading	Result
Open (OL)	Replace fuse
Closed (O)	Fuse is good

BIN SWITCH

Function

Movement of the water curtain controls bin switch operation. The bin switch has two main functions:

1. Terminating the harvest cycle and returning the ice machine to the freeze cycle.

   This occurs when the bin switch is opened and closed again within 30 seconds during the harvest cycle.

2. Automatic ice machine shut-off.

   If the storage bin is full at the end of a harvest cycle, the sheet of cubes fails to clear the water curtain and holds it open. After the water curtain is held open for 30 seconds, the ice machine shuts off. The ice machine remains off until enough ice is removed from the storage bin to allow the sheet of cubes to drop clear of the water curtain. As the water curtain swings back to the operating position, the bin switch closes and the ice machine restarts, provide the three-minute delay has expired.

Important

The water curtain must be ON (bin switch(s) closed) to start ice making.

Specifications

The bin switch is a magnetically operated reed switch. The magnet is attached to the lower right corner of the water curtain. The switch is attached to the right bulkhead wall.

The bin switch is connected to a varying D.C. voltage circuit. (Voltage does not remain constant.)

NOTE: Because of a wide variation in D.C. voltage, it is not recommended that a voltmeter be used to check bin switch operation.

Symptoms

Bin Switch Fails Open

- The ice machine will not start with the toggle switch in the ice position, but runs normally with the toggle switch in the clean position.

Bin Switch Fails Closed

- Safety limit 2 is recorded in the control board memory and the harvest cycle continues after the ice opens and closes the water curtain (harvest cycle is 3.5 minutes long).

Diagnostic Aids:

- Always use the water curtain magnet to cycle the switch (a larger or smaller magnet will affect switch operation).
- Readings are affected by your test lead connection and VOM battery strength. Verify you have solid connections and a correctly functioning VOM before testing bin switch.
- Open the curtain for 3 seconds, then close the curtain for 3 seconds. This will allow your VOM display to settle.
- With the bin switch closed your meter reading should be 0 (0 to 10 is acceptable). With the curtain open the reading must be infinity (OL).

Continuity Test

1. Disconnect the bin switch wires to isolate the bin switch from the control board.
2. Connect an ohmmeter to the disconnected bin switch wires.
3. Cycle the bin switch open and closed 25 times by opening and closing the water curtain. Watch for consistent readings each time the bin switch is cycled open and closed (bin switch failure could be erratic).

Water Curtain Removal Notes

The water curtain must be on (bin switch closed) to start ice making. While a freeze cycle is in progress, the water curtain can be removed and installed at any time without interfering with the electrical control sequence.

If the ice machine goes into harvest sequence while the water curtain is removed, one of the following will happen:

- Water curtain remains off:
  When the harvest cycle time reaches 3.5 minutes and the bin switch is not closed, the ice machine stops as though the bin were full.
- Water curtain is put back on:
  If the bin switch closes prior to reaching the 3.5-minute point, the ice machine immediately returns to another freeze sequence prechill.

COMPRESSOR ELECTRICAL DIAGNOSTICS

The compressor will not start or will trip repeatedly on overload.

Check Resistance (Ohm) Values

NOTE: Compressor windings can have very low ohm values. Use a properly calibrated meter.

Perform the resistance test after the compressor cools. The compressor dome should be cool enough to touch (below 120°F/49°C) to assure that the overload is closed and the resistance readings will be accurate.

SINGLE PHASE COMPRESSORS

1. Disconnect power from the cuber and remove the wires from the compressor terminals.
2. The resistance values between C and S and between C and R, when added together, should equal the resistance value between S and R.
3. If the overload is open, there will be a resistance reading between S and R, and open readings between C and S and between C and R. Allow the compressor to cool, then check the readings again.

THREE PHASE COMPRESSORS

1. Disconnect power from the cuber and remove the wires from the compressor terminals.
2. The resistance values between L1 and L2, between L2 and L3, and between L3 and L1 should all be equal.
3. If the overload is open, there will be open readings between L1 and L2, between L2 and L3, and between L3 and L1. Allow the compressor to cool, then check the readings again.

Check Motor Windings to Ground

Check continuity between all three terminals and the compressor shell or copper refrigeration line. Scrape metal surface to get good contact. If continuity is present, the compressor windings are grounded and the compressor should be replaced.

Determine if the Compressor is Seized

Check the amp draw while the compressor is trying to start.

COMPRESSOR DRAWING LOCKED ROTOR

The two likely causes of this are:

- Defective starting component
- Mechanically seized compressor

To determine which you have:

1. Install high and low side gauges.
2. Try to start the compressor.
3. Watch the pressures closely.
   A. If the pressures do not move, the compressor is seized. Replace the compressor.
   B. If the pressures move, the compressor is turning slowly and is not seized. Check the capacitors and start relay.

COMPRESSOR DRAWING HIGH AMPS

The continuous amperage draw on start-up should not be near the maximum fuse size indicated on the serial tag.

Diagnosing Capacitors

- If the compressor attempts to start, or hums and trips the overload protector, check the starting components before replacing the compressor.
- Visual evidence of capacitor failure can include a bulged terminal end or a ruptured membrane. Do not assume a capacitor is good if no visual evidence is present.
- A good test is to install a known good substitute capacitor.
- Use a capacitor tester when checking a suspect capacitor. Clip the bleed resistor off the capacitor terminals before testing.

PTCR DIAGNOSTICS

What is a PTCR?

A PTCR (or Positive Temperature Coefficient Resistor) is made from high-purity, semi-conducting ceramics.

A PTCR is useful because of its resistance versus temperature characteristic. The PTCR has a low resistance over a wide (low) temperature range, but upon reaching a certain higher temperature, its resistance greatly increases, virtually stopping current flow. When the source of heat is removed, the PTCR returns to its initial base resistance.

In severe duty cycles, it can be used to repeatedly switch (virtually stop) large currents at line voltages.

PTCR's have been used for many years in millions of HVAC applications. In place of using the conventional start relay/start capacitor, a simple PTCR provides the starting torque assistance to PSC (Permanent Split Capacitor) single-phase compressors, which can equalize pressures before starting.

Compressor Start Sequence

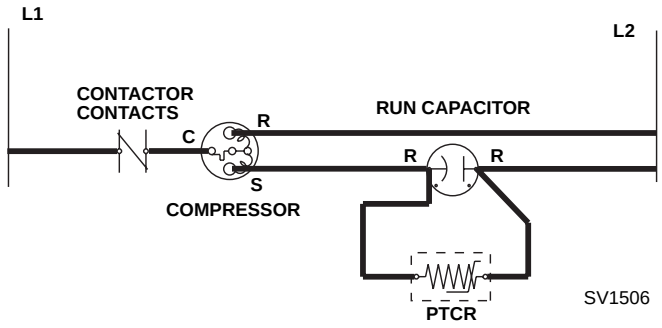
PTCR's provide additional starting torque by increasing the current in the auxiliary (start) winding during starting. The PTCR is wired across the run capacitor (in series with the start winding).

1. It is important for the refrigerant discharge and suction pressures to be somewhat equalized prior to the compressor starting. To assure equalization of pressures the harvest valve (and HPR valve on remotes) will energize for 45 seconds prior to compressor starting. The harvest valve (and HPR valve on remotes) remains on for an additional 5 seconds while the compressor is starting.
2. When starting the compressor, the contactor closes and the PTCR, which is at a low resistance value, allows high starting current to flow in the start winding.
3. The current passing through the PTCR causes it to rapidly heat up, and after approximately .25-1 second it abruptly "switches" to a very high resistance, virtually stopping current flow through it.
4. At this point the motor is up to speed and all current going through the start winding will now pass through the run capacitor.
5. The PTCR remains hot and at a high resistance as long as voltage remains on the circuit.
6. It is important to provide time between compressor restarts to allow the PTCR to cool down to near its initial temperature (low resistance). When the contactor opens to stop the compressor, the PTCR cools down to its initial low resistance and is again ready to provide starting torque assistance. To assure the PTCR has cooled down, during an automatic shut-off, the S model ice machines have a built-in 3-minute off time before it can restart.

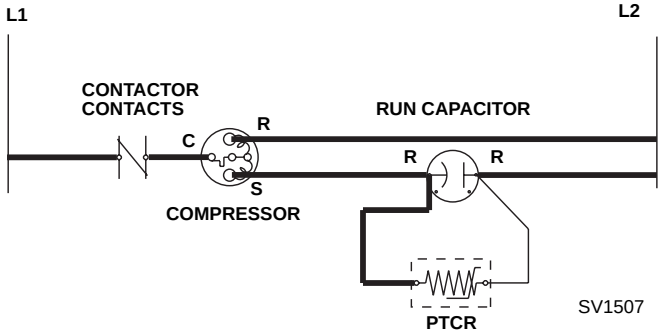
S-Model Automatic Shut-Off and Restart

When the storage bin is full at the end of a harvest cycle, the sheet of cubes fails to clear the water curtain and will hold it open. After the water curtain is held open for 30 seconds, the ice machine shuts off. To assure the PTCR has cooled, the ice machine remains off for 3 minutes before it can automatically restart.

The ice machine remains off until enough ice has been removed from the storage bin to allow the ice to fall clear of the water curtain. As the water curtain swings back to operating position, the bin switch closes and the ice machine restarts, provided the three-minute delay period is complete.



During Start-Up (First .25 - 1.0 Seconds)



After Start-Up
(Current Flows Through Run Capacitor)

Troubleshooting PTCR's

WHY A GOOD PTCR MAY FAIL TO START THE COMPRESSOR

The PTCR must be cooled before attempting to start the compressor, otherwise the high starting torque may not last long enough.

For example, if the PTCR is properly cooled, say 60°F (15.6°C) when the compressor starts, it will take .25 to 1.0 seconds before its temperature reaches 260°F (126.6°C), and current flow is stopped.

If the PTCR is still warm, say 160°F (71.1°C) when the compressor starts, it will take only .125 to .50 seconds before its temperature reaches 260°F (126.6°C), and current flow is stopped. This decreased time may be insufficient to start the compressor.

A good PTCR may be too hot to operate properly at start-up because:

- The ice machine's 3-minute delay has been overridden. Opening and closing the service disconnect or cycling the toggle switch from OFF to ICE will override the delay period.
- The control box temperature is too high. Though rare, very high air temperatures (intense sunlight, etc.) can greatly increase the temperature of the control box and its contents. This may require a longer off time to allow the PTCR to cool.
- The compressor has short-cycled, or the compressor overload has opened. Move the toggle switch to OFF and allow the compressor and PTCR to cool.

Continued on next page …

There are other problems that may cause compressor start-up failure with a good PTCR in a new, properly wired ice machine.

- The voltage at the compressor during start-up is too low.

  Manitowoc ice machines are rated at ±10% of nameplate voltage at compressor start-up. (Ex: An ice machine rated at 208-230 should have a compressor start-up voltage between 187 and 253 volts.)

- The compressor discharge and suction pressures are not matched closely enough or equalized.

  These two pressures must be somewhat equalized before attempting to start the compressor. The harvest valve (and HPR valve on remotes) energizes for 45 seconds before the compressor starts, and remains on 5 seconds after the compressor starts. Make sure this is occurring and the harvest valve (and HPR solenoid) coil is functional before assuming that the PTCR is bad.

CHECKING THE PTCR

⚠ Warning

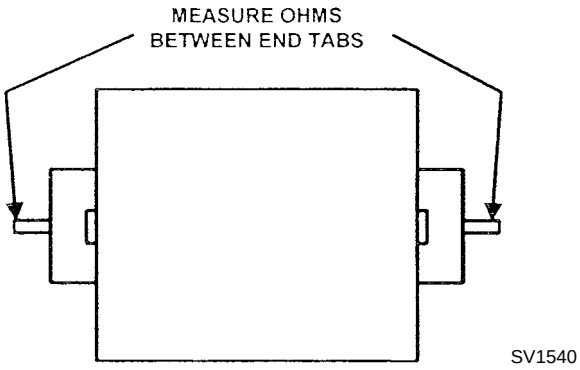
Disconnect electrical power to the entire ice machine at the building electrical disconnect box before proceeding.

1. Visually inspect the PTCR. Check for signs of physical damage.

NOTE: The PTCR case temperature may reach 210°F (100°C) while the compressor is running. This is normal. Do not change a PTCR just because it is hot.

2. Wait at least 10 minutes for the PTCR to cool to room temperature.
3. Remove the PTCR from the ice machine.
4. Measure the resistance of the PTCR as shown below. If the resistance falls outside of the acceptable range, replace it.

Model	Manitowoc Part Number	Cera-Mite Part Number	Room Temperature Resistance
S500/S600	8505003	305C20	22-50 Ohms



Manitowoc PTCR's 8505003

DIAGNOSING START COMPONENTS

If the compressor attempts to start, or hums and trips the overload protector, check the start components before replacing the compressor.

Capacitor

Visual evidence of capacitor failure can include a bulged terminal end or a ruptured membrane. Do not assume a capacitor is good if no visual evidence is present. A good test is to install a known good substitute capacitor. Use a capacitor tester when checking a suspect capacitor. Clip the bleed resistor off the capacitor terminals before testing.

Relay

The relay has a set of contacts that connect and disconnect the start capacitor from the compressor start winding. The contacts on the relay are normally closed (start capacitor in series with the start winding). The relay senses the voltage generated by the start winding and opens the contacts as the compressor motor starts. The contacts remain open until the compressor is de-energized.

Relay Operation Check

1. Disconnect wires from relay terminals.
2. Verify the contacts are closed.
   Measure the resistance between terminals 1 and 2. No continuity indicates open contacts. Replace the relay.
3. Check the relay coil.
   Measure the resistance between terminals 2 and 5. No resistance indicates an open coil. Replace the relay.

ICE/OFF/CLEAN TOGGLE SWITCH

Function

The switch is used to place the ice machine in ICE, OFF or CLEAN mode of operation.

Specifications

Single-pole, single-throw switch. The switch is connected into a varying low D.C. voltage circuit.

Check Procedure

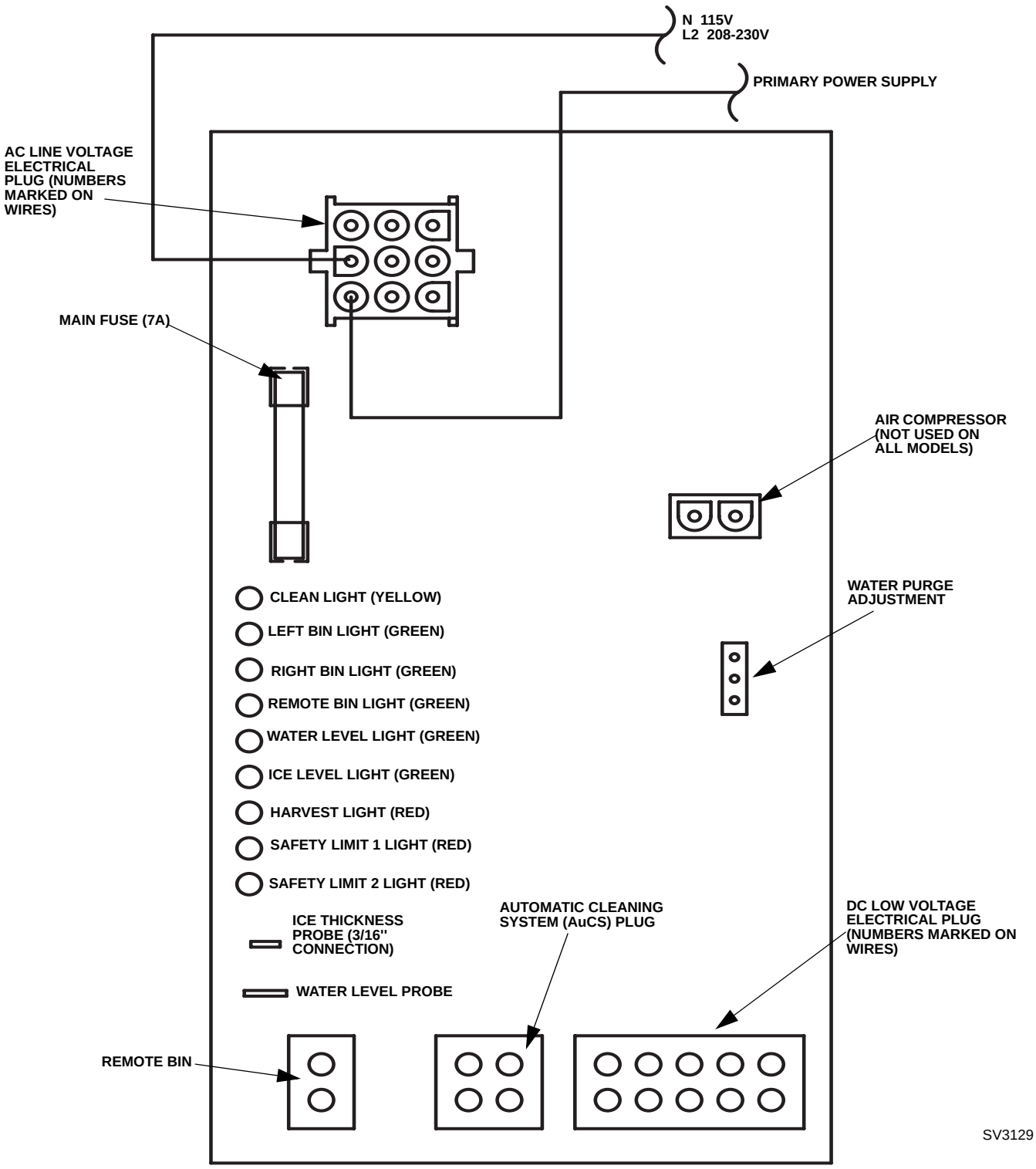
NOTE: Because of a wide variation in D.C. voltage, it is not recommended that a volt meter be used to check toggle switch operation.

1. Inspect the toggle switch for correct wiring.
2. Isolate the toggle switch by disconnecting the Molex connector.
3. Check continuity across the toggle switch terminals. Note where the wire numbers are connected to the switch terminals, or refer to the wiring diagram to take proper readings.

Switch Setting	Terminals	Ohm Reading
ICE	1-6	Open
	1-2	Closed
	2-6	Open
CLEAN	1-6	Closed
	1-2	Open
	2-6	Open
OFF	1-6	Open
	1-2	Open
	2-6	Open

4. Replace the toggle switch if ohm readings do not match all three switch settings.

ELECTRONIC CONTROL BOARD



Control Board

General

S-Model control boards use a dual voltage transformer. This means only one control board is needed for both 115V and 208-230V use.

Safety Limits

In addition to standard safety controls, such as the high pressure cut-out, the control board has built-in safety limits.

These safety limits protect the ice machine from major component failures. For more information, see “Safety Limits” in Section 7.

Inputs

The control board, along with inputs, controls all electrical components, including the ice machine sequence of operation. Prior to diagnosing, you must understand how the inputs affect the control board operation.

Refer to specific component specifications (inputs), wiring diagrams and ice machine sequence of operation sections for details.

As an example, refer to “Ice Thickness Probe” on the next page for information relating to how the probe and control board function together.

This section will include items such as:

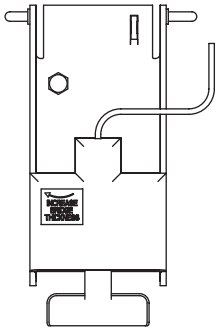
- How a harvest cycle is initiated
- How the harvest light functions with the probe
- Freeze time lock-in feature
- Maximum freeze time
- Diagnosing ice thickness control circuitry

Ice Thickness Probe (Harvest Initiation)

HOW THE PROBE WORKS

Manitowoc's electronic sensing circuit does not rely on refrigerant pressure, evaporator temperature, water levels or timers to produce consistent ice formation.

As ice forms on the evaporator, water (not ice) contacts the ice thickness probe. After the water completes this circuit across the probe continuously for 6-10 seconds, a harvest cycle is initiated.



SV3135

Ice Thickness Probe

HARVEST LIGHT

This light's function is to be on as water contacts the ice thickness probe during the freeze cycle, and remain on throughout the entire harvest cycle. The light will flicker as water splashes on the probes.

FREEZE TIME LOCK-IN FEATURE

The ice machine control system incorporates a freeze time lock-in feature. This prevents the ice machine from short cycling in and out of harvest.

The control board locks the ice machine in the freeze cycle for six minutes. If water contacts the ice thickness probe during these six minutes, the harvest light will come on (to indicate that water is in contact with the probe), but the ice machine will stay in the freeze cycle. After the six minutes are up, a harvest cycle is initiated. This is important to remember when performing diagnostic procedures on the ice thickness control circuitry.

To allow the service technician to initiate a harvest cycle without delay, this feature is not used on the first cycle after moving the toggle switch OFF and back to ICE.

MAXIMUM FREEZE TIME

The control system includes a built-in safety which will automatically cycle the ice machine into harvest after 60 minutes in the freeze cycle.

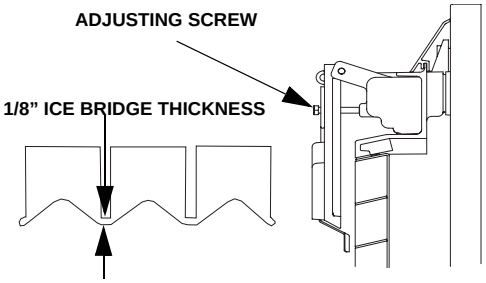
ICE THICKNESS CHECK

The ice thickness probe is factory-set to maintain the ice bridge thickness at 1/8" (.32 cm).

NOTE: Make sure the water curtain is in place when performing this check. It prevents water from splashing out of the water trough.

1. Inspect the bridge connecting the cubes. It should be about 1/8" (.32 cm) thick.
2. If adjustment is necessary, turn the ice thickness probe adjustment screw clockwise to increase bridge thickness, or counterclockwise to decrease bridge thickness. Set a 1/4" gap between the ice thickness probe and evaporator as a starting point. Then adjust to achieve a 1/8" bridge thickness.

NOTE: The starting point before final adjustment is approximately a 3/16 inch gap.



SV3132

Ice Thickness Check

Make sure the ice thickness probe wire and the bracket do not restrict movement of the probe.

Ice Thickness Probe Cleaning

1. Mix a solution of Manitowoc ice machine cleaner and water (2 ounces of cleaner to 16 ounces of water) in a container.
2. Soak ice thickness probe in container of cleaner/water solution while disassembling and cleaning water circuit components (soak ice thickness probe for 10 minutes or longer).
3. Clean all ice thickness probe surfaces including all plastic parts (do not use abrasives). Verify the ice thickness probe cavity is clean. Thoroughly rinse ice thickness probe (including cavity) with clean water, then dry completely. **Incomplete rinsing and drying of the ice thickness probe can cause premature harvest.**
4. Reinstall ice thickness probe, then sanitize all ice machine and bin/dispenser interior surfaces.

DIAGNOSING ICE THICKNESS CONTROL CIRCUITRY

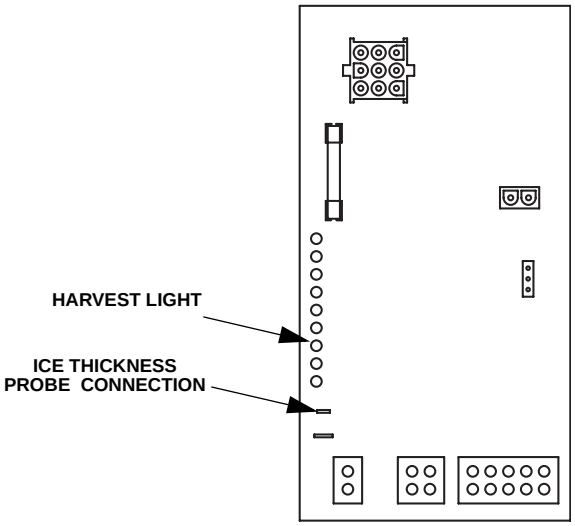
Ice Machine Does Not Cycle Into Harvest When Water Contacts The Ice Thickness Control Probe

Step 1 Bypass the freeze time lock-in feature by moving the ICE/OFF/CLEAN switch to OFF and back to ICE.

Step 2 Wait until the water starts to flow over the evaporator (freeze cycle).

Step 3 Disconnect the ice thickness control from the control board, then connect a jumper wire from the control board to any cabinet ground and monitor the harvest light.

Monitoring of Harvest Light	Correction
The harvest light comes on, and 10 seconds later, ice machine cycles from freeze to harvest.	The ice thickness probe is causing the malfunction.
The harvest light comes on but the ice machine stays in the freeze sequence.	The control circuitry is functioning properly. The ice machine is in a six-minute freeze time lock-in (verify step 1 of this procedure was followed correctly).
The harvest light does not come on.	The control board is causing the malfunction.



Ice Machine Cycles Into Harvest Before Water Contact With The Ice Thickness Probe

Step 1 Disconnect the ice thickness probe from the control board.

Step 2 Wait until water starts to flow over the evaporator, then monitor the harvest light:

Monitoring of Harvest Light	Correction
The harvest light stays off and the ice machine remains in the freeze sequence.	The ice thickness probe is causing the malfunction. Verify that the Ice Thickness probe is adjusted correctly.
The harvest light comes on, and 10 seconds later, the ice machine cycles from freeze to harvest.	The control board is causing the malfunction.

Water Level Control Circuitry

WATER LEVEL PROBE LIGHT

The water level probe circuit can be monitored by watching the water level light. The water level light is on when water contacts the probe, and off when no water is in contact with the probe. The water level light functions any time power is applied to the ice machine, regardless of toggle switch position.

During the freeze cycle, the water level probe is set to maintain the proper water level above the water pump housing. The water level is not adjustable. If the water level is incorrect, check the water level probe position. Reposition or replace the probe as necessary.

WATER INLET VALVE SAFETY SHUT-OFF

In the event of a water level probe failure, this feature limits the water inlet valve to a 6-minute on time. Regardless of the water level probe input, the control board automatically shuts off the water inlet valve if it remains on for 6 continuous minutes.

FREEZE CYCLE CIRCUITRY

Manitowoc's electronic sensing circuit does not rely on float switches or timers to maintain consistent water level control. During the freeze cycle, the water inlet valve energizes (turns on) and de-energizes (turns off) in conjunction with the water level probe located in the water trough.

During the first 45 seconds of the Freeze Cycle:

- The water inlet valve is **on** when there is no water in contact with the water level probe.
- The water inlet valve turns **off** after water contacts the water level probe for 3 continuous seconds.
- The water inlet valve will cycle on and off as many times as needed to fill the water trough.

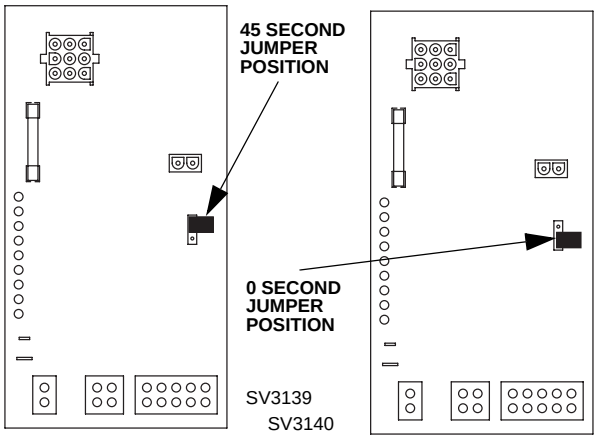
After 45 seconds into the Freeze Cycle:

The water inlet valve will cycle on, and then off one more time to refill the water trough. The water inlet valve is now off for the duration of the freeze sequence.

HARVEST CYCLE CIRCUITRY

The water level probe does not control the water inlet valve during the harvest cycle. During the harvest cycle water purge, the water inlet valve energizes and de-energizes strictly by time. The harvest water purge jumper may be set at 45 seconds (top and center terminals) or 0 seconds (center and bottom terminals). Set the harvest water purge to 0 seconds when reverse osmosis or deionized water is used. Use the factory setting of 45 seconds for all other types of water.

HARVEST WATER PURGE ADJUSTMENT



DIAGNOSING WATER LEVEL CONTROL CIRCUITRY

Problem: Water Trough Overfilling During The Freeze Cycle

Step 1 Start a new freeze sequence by moving the ICE/OFF/CLEAN toggle switch to OFF, then back to ICE. (if water flows with the switch off, check the water inlet valve).

Important

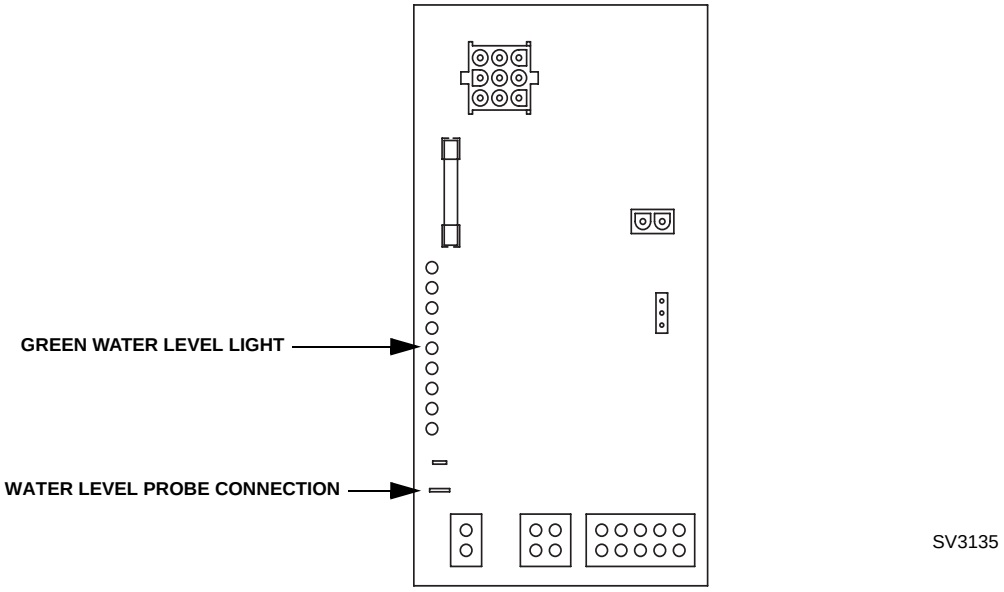
This restart must be done prior to performing diagnostic procedures. This assures the ice machine is not in a freeze cycle water inlet valve safety shut off mode. You must complete the entire diagnostic procedure within 6 minutes of starting.

Step 2 Wait until the freeze cycle starts
(the freeze cycle starts when the water pump energizes).

Step 3 Disconnect water level probe wire from control board and connect a jumper from the control board terminal and any cabinet ground, then refer to chart.

Important

For the test to work properly you must wait until the freeze cycle starts, prior to connecting the jumper wire. If you restart the test you must disconnect the jumper wire, restart the ice machine, (step 1) and then reinstall the jumper wire after the compressor starts.



Step 3

Step 3 Jumper wire connected from control board terminal to ground			
Is water flowing into the water trough?	**The Water Level Light is:**	**The Water Inlet Valve Solenoid Coil is:**	**Cause**
NO	ON	De-Energized	The water level probe is causing the problem. Clean or replace the water level probe.
YES	ON	Energized	The control board is causing the problem.
YES	OFF	De-Energized	The water fill valve is causing the problem.

Problem: Water Will Not Run Into The Sump Trough During The Freeze Cycle

Step 1 Verify water is supplied to the ice machine, and then start a new freeze sequence by moving the ICE/OFF/CLEAN toggle switch to OFF then back to ICE.

Important

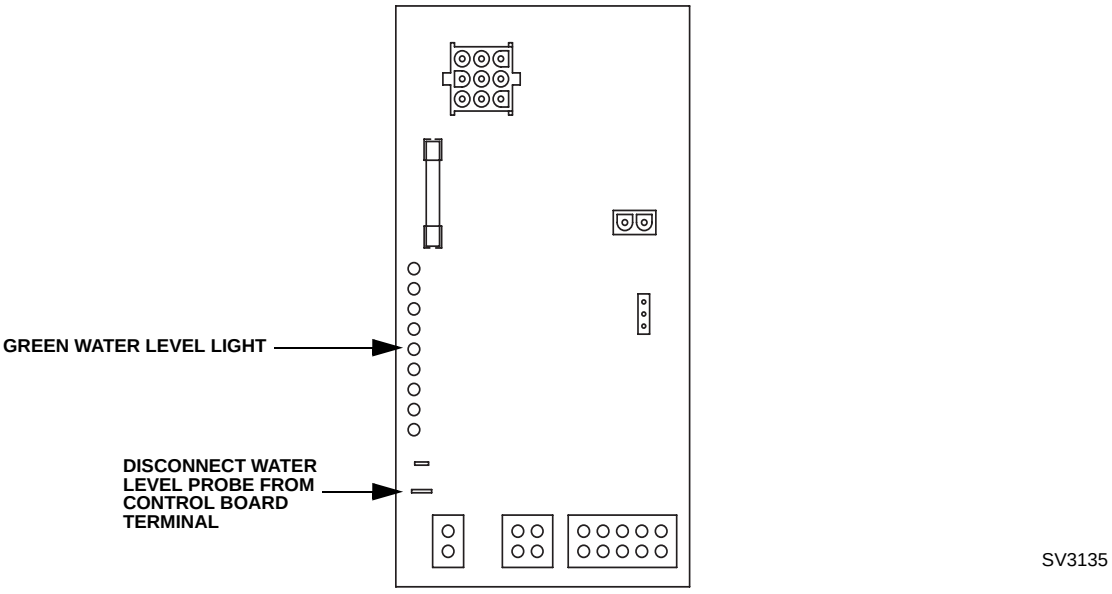
This restart must be done prior to performing diagnostic procedures. This assures the ice machine is not in a freeze cycle water inlet valve safety shut-off mode. You must complete the entire diagnostic procedure within 6 minutes of starting.

Step 2 Wait until the freeze cycle starts (approximately 45 seconds, the freeze cycle starts when the compressor energizes).

Step 3 Disconnect the water level probe from the water level probe terminal on the control board.

Important

For the test to work properly you must wait until the freeze cycle starts, prior to disconnecting the water level probe. If you restart the test you must reconnect the water level probe, restart the ice machine, (step 1) and then disconnect the water level probe after the compressor starts**.**



Step 3

Step 3 Disconnect water level probe from control board terminal			
Is water flowing into the water trough?	**The Water Level Light is:**	**The Water Inlet Valve Solenoid Coil is:**	**Cause**
YES	OFF	Energized	The water level probe is causing the problem. Clean or replace the water level probe.
NO	OFF	Energized	The water inlet valve is causing the problem.
NO	ON OR OFF	De-Energized	The control board is causing the problem.

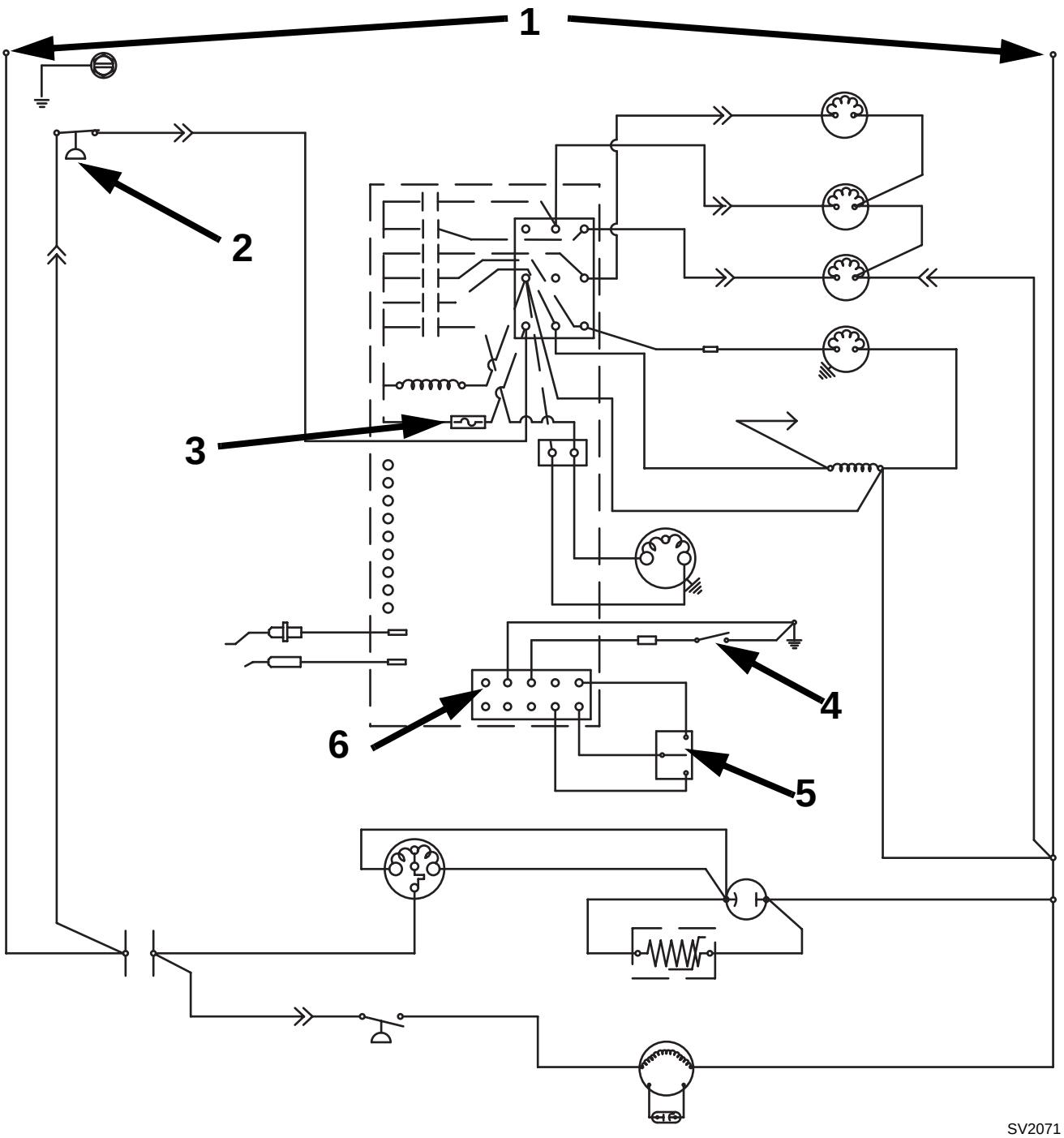
Diagnosing An Ice Machine That Will Not Run

⚠ Warning

High (line) voltage is applied to the control board (terminals #55 and #56) at all times. Removing control board fuse or moving the toggle switch to OFF will not remove the power supplied to the control board.

Step	Check	Notes
1	Verify primary voltage supply to ice machine.	Verify that the fuse or circuit breaker is closed.
2	Verify the high-pressure cutout is closed.	The H.P.C.O. is closed if primary power voltage is present at terminals #55 and #56 on the control board.
3	Verify control board fuse is OK.	If the bin switch light functions, the fuse is OK.
4	Verify the bin switch functions properly.	A defective bin switch can falsely indicate a full bin of ice.
5	Verify ICE/OFF/CLEAN toggle switch functions properly.	A defective toggle switch may keep the ice machine in the OFF mode.
6	Verify low DC voltage is properly grounded.	Loose DC wire connections may intermittently stop the ice machine.
7	Replace the control board.	Be sure Steps 1-6 were followed thoroughly. Intermittent problems are not usually related to the control board.

S600M - SELF CONTAINED -
1 PHASE WITH TERMINAL BOARD



Section 7
Refrigeration System

Sequence of Operation

SELF-CONTAINED WATER -COOLED MODELS

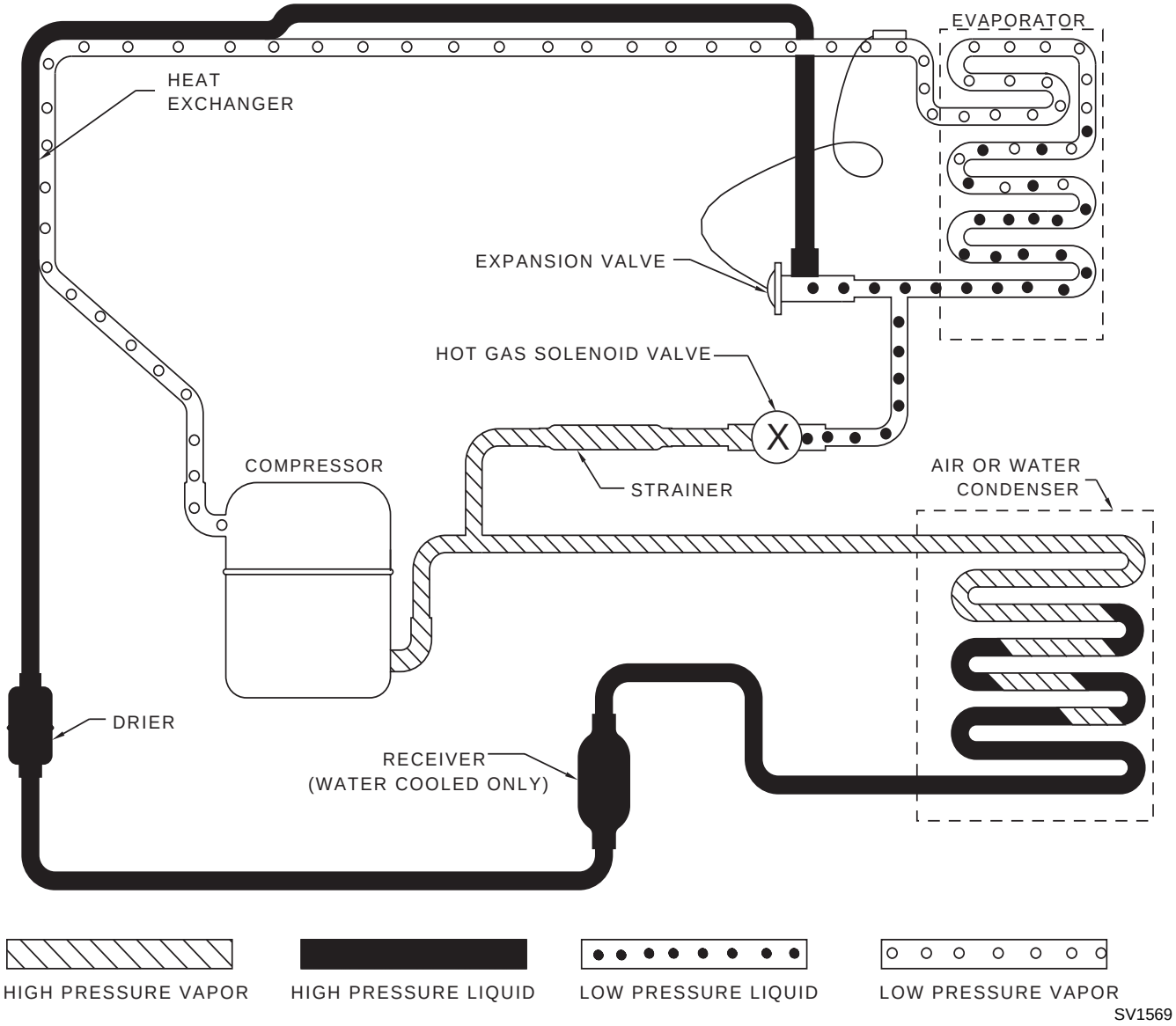


Figure 7-1. Self-Contained Prechill and Freeze Cycle

Prechill Refrigeration Sequence

No water flows over the evaporator during the prechill. The refrigerant absorbs heat (picked up during the harvest cycle) from the evaporator. The suction pressure decreases during the prechill.

Freeze Cycle Refrigeration Sequence

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

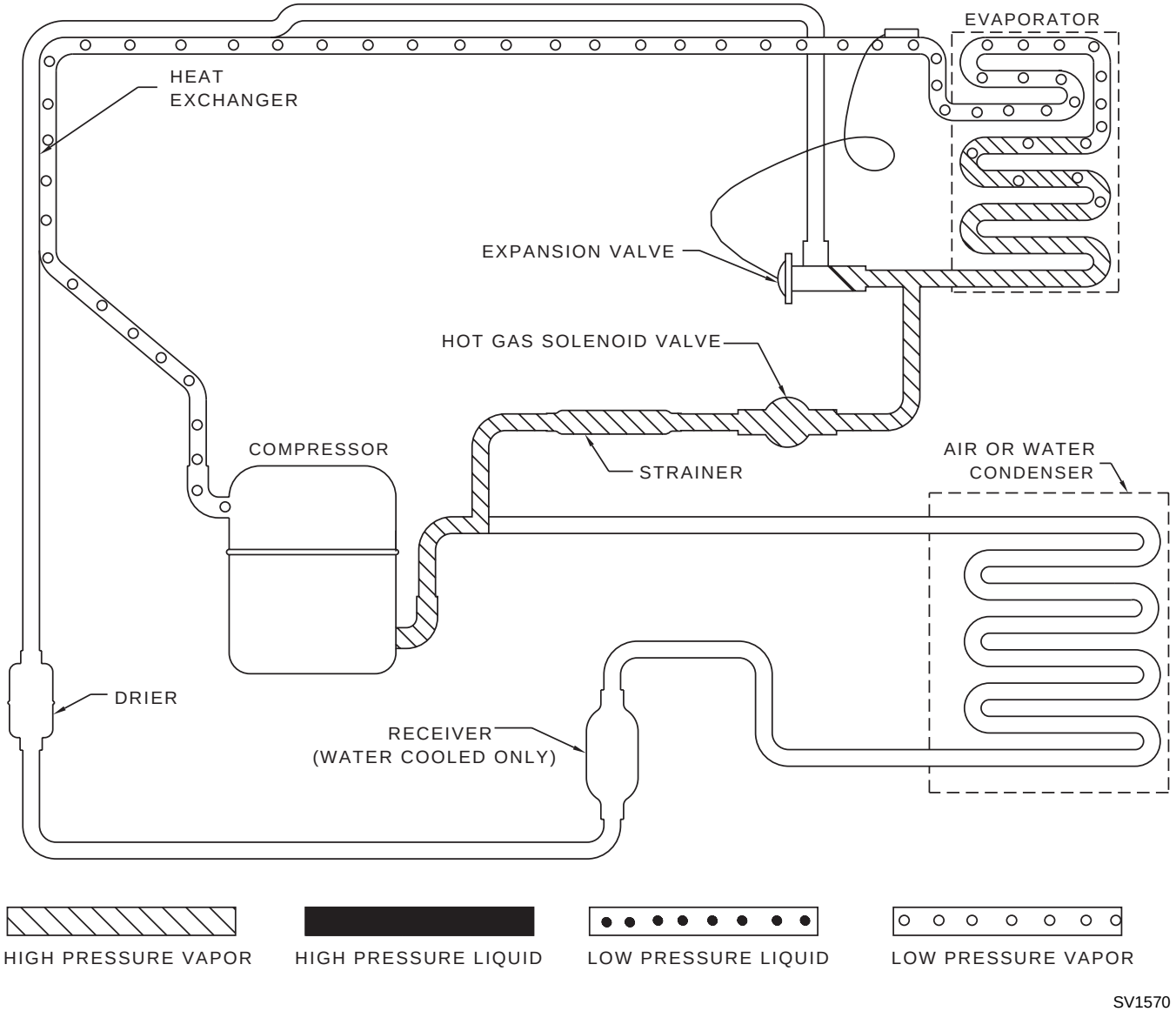


Figure 7-2. Self-Contained Harvest Cycle

Harvest Cycle Refrigeration Sequence

Hot gas flows through the energized harvest valve, heating the evaporator. The harvest valve is sized to allow the proper amount of refrigerant into the evaporator. This specific sizing (along with the proper system refrigerant charge) assures proper heat transfer, without the refrigerant condensing and slugging the compressor.

Operational Analysis (Diagnostics)

GENERAL

When analyzing the refrigeration system, it is important to understand that different refrigeration component malfunctions may cause very similar symptoms.

Also, many external factors can make good refrigeration components appear bad. These factors can include improper installation, or water system malfunctions such as hot incoming water supply or water loss.

The following two examples illustrate how similar symptoms can result in a misdiagnosis.

1. An expansion valve bulb that is not securely fastened to the suction line and/or not insulated will cause a good expansion valve to flood. If a service technician fails to check for proper expansion valve bulb mounting, he may replace the expansion valve in error.

   The ice machine now functions normally. The technician erroneously thinks that the problem was properly diagnosed and corrected by replacing the expansion valve. Actually, the problem (loose bulb) was corrected when the technician properly mounted the bulb of the replacement expansion valve.

   The service technician's failure to check the expansion valve bulb for proper mounting (an external check) resulted in a misdiagnosis and the needless replacement of a good expansion valve.

2. An ice machine that is low on charge may cause a good expansion valve to starve. If a service technician fails to verify the system charge, he may replace the expansion valve in error.

   During the replacement procedure, recovery, evacuation and recharging are performed correctly. The ice machine now functions normally. The technician erroneously thinks that the problem was properly diagnosed and corrected by replacing the expansion valve.

   The service technician's failure to check the ice machine for a low charge condition resulted in a misdiagnosis and the needless replacement of a good expansion valve.

When analyzing the refrigeration system, use the Refrigeration System Operational Analysis Table. This table, along with detailed checklists and references, will help prevent replacing good refrigeration components due to external problems.

BEFORE BEGINNING SERVICE

Ice machines may experience operational problems only during certain times of the day or night. A machine may function properly while it is being serviced, but malfunctions later. Information provided by the user can help the technician start in the right direction, and may be a determining factor in the final diagnosis.

Ask these questions before beginning service:

- When does the ice machine malfunction? (night, day, all the time, only during the freeze cycle, etc.)
- When do you notice low ice production? (one day a week, every day, on weekends, etc.)
- Can you describe exactly what the ice machine seems to be doing?
- Has anyone been working on the ice machine?
- During “store shutdown,” is the circuit breaker, water supply or air temperature altered?
- Is there any reason why incoming water pressure might rise or drop substantially?

ICE PRODUCTION CHECK

The amount of ice a machine produces directly relates to the operating water and air temperatures. This means an ice machine in a 70°F (21.1°C) room with 50°F (10.0°C) water produces more ice than the same model condensing unit with a 90°F (32.2°C) outdoor ambient temperature and 70°F (21.1°C) water.

1. Determine the ice machine operating conditions:
   Air temp. entering condenser: _____ °
   Air temp. around ice machine: _____ °
   Water temp. entering sump trough: _____ °
2. Refer to the appropriate 24 Hour Ice Production Chart. Use the operating conditions determined in Step 1 to find published 24 hour ice production.
3. Perform an actual ice production check. Use the formula below.

1.	_____ Freeze Time	+	_____ Harvest Time	=	_____ Total Cycle Time
2.	1440 Minutes in 24 Hours	÷	_____ Total Cycle Time	=	_____ Cycles Per Day
3.	_____ Weight of One Harvest	x	_____ Cycles Per Day	=	_____ Actual 24 Hour Ice Production

Important

Times are in minutes.
Example: 1 min., 15 sec. converts to 1.25 min.
(15 seconds ÷ 60 seconds = .25 minutes)

Weights are in pounds.
Example: 2 lb., 6 oz. converts to 2.375 lb.
(6 oz. ÷ 16 oz. = .375 lb.)

Weighing the ice is the only 100% accurate check. However, if the ice pattern is normal and the 1/8" thickness is maintained, the ice slab weights listed with the 24 Hour Ice Production Charts may be used.

4. Compare the results of step 3 with step 2. Ice production checks that are within 10% of the chart are considered normal. If they match closely, determine if:
   - another ice machine is required.
   - more storage capacity is required.
   - relocating the existing equipment to lower the load conditions is required.

   Contact the local Manitowoc distributor for information on available options and accessories.

INSTALLATION/VISUAL INSPECTION CHECKLIST

Possible Problem	Corrective Action
Ice machine is not level	Level the ice machine
Condenser is dirty	Clean the condenser
Water filtration is plugged (if used)	Install a new water filter
Water drains are not run separately and/or are not vented	Run and vent drains according to the Installation Manual

WATER SYSTEM CHECKLIST

A water-related problem often causes the same symptoms as a refrigeration system component malfunction.

Water system problems must be identified and eliminated prior to replacing refrigeration components.

Possible Problem	Corrective Action
Water area (evaporator) is dirty	Clean as needed
Water inlet pressure not between 20 and 80 psi (1-5 Bar, 138- 552 kPa)	Install a water regulator valve or increase the water pressure
Incoming water temperature is not between 35°F (1.6°C) and 90°F (32.2°C).	If too hot, check the hot water line check valves in other store equipment
Water filtration is plugged (if used)	Install a new water filter
Water dump valve leaking during the freeze cycle	Clean/replace dump valve as needed
Vent tube is not installed on water outlet drain	See Installation Instructions
Hoses, fittings, etc., are leaking water	Repair/replace as needed
Water fill valve is stuck open	Clean/replace as needed
Water is spraying out of the sump trough area	Stop the water spray
Uneven water flow across the evaporator	Clean the ice machine
Water is freezing behind the evaporator	Correct the water flow
Plastic extrusions and gaskets are not secured to the evaporator	Remount/replace as needed

ICE FORMATION PATTERN

Evaporator ice formation pattern analysis is helpful in ice machine diagnostics.

Analyzing the ice formation pattern alone cannot diagnose an ice machine malfunction. However, when this analysis is used along with Manitowoc's Refrigeration System Operational Analysis Table, it can help diagnose an ice machine malfunction.

Improper ice formation can be caused by any number of problems.

Important

Keep the water curtain in place while checking the ice formation pattern to ensure no water is lost.

1. Normal Ice Formation

Ice forms across the entire evaporator surface.

At the beginning of the freeze cycle, it may appear that more ice is forming at the inlet of the evaporator than at the outlet. At the end of the freeze cycle, ice formation at the outlet will be close to, or just a bit thinner than, ice formation at the inlet. The dimples in the cubes at the outlet of the evaporator may be more pronounced than those at the inlet. This is normal.

The ice thickness probe must be set to maintain the ice bridge thickness at approximately 1/8". If ice forms uniformly across the evaporator surface, but does not reach 1/8" in the proper amount of time, this is still considered normal.

2. Extremely Thin at Evaporator Outlet

There is no ice, or a considerable lack of ice formation at the outlet of the evaporator.

Examples: No ice at all at the outlet half of the evaporator, but ice forms at the inlet half of the evaporator. Or, the ice at the outlet of the evaporator reaches 1/8" to initiate a harvest, but the inlet of the evaporator already has 1/2" to 1" of ice formation.

Possible cause: Water loss, low on refrigerant, starving TXV, faulty water fill valve etc.

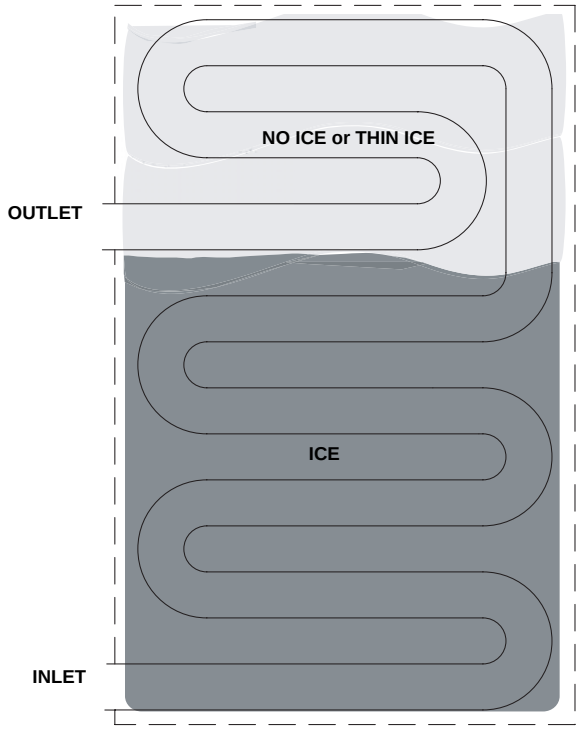


Figure 7-3. Extremely Thin Ice Formation at Evaporator Outlet

3. Extremely Thin at Evaporator Inlet

There is no ice, or a considerable lack of ice formation at the inlet of the evaporator. Examples: The ice at the outlet of the evaporator reaches 1/8" to initiate a harvest, but there is no ice formation at all at the inlet of the evaporator.

Possible causes: Insufficient water flow, flooding TXV, etc.

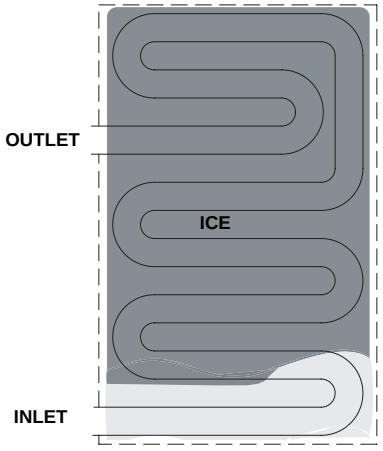


Figure 7-4. Extremely Thin Ice Formation at Evaporator Inlet

4. Spotty Ice Formation

There are small sections on the evaporator where there is no ice formation. This could be a single corner, or a single spot in the middle of the evaporator. This is generally caused by loss of heat transfer from the tubing on the back side of the evaporator.

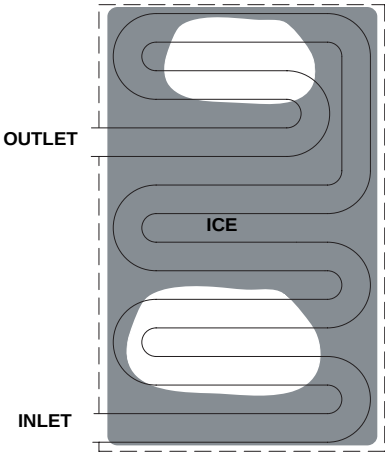


Figure 7-5. Spotty Ice Formation

5. No Ice Formation

The ice machine operates for an extended period, but there is no ice formation at all on the evaporator.

Possible causes: Water inlet valve, water pump, starving expansion valve, low refrigerant charge, compressor, etc.

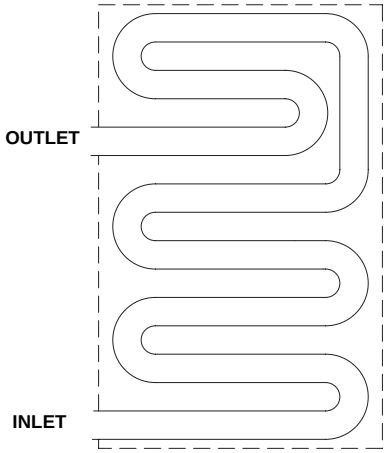


Figure 7-6. No Ice Formation

SAFETY LIMITS

General

In addition to standard safety controls, such as high pressure cut-out, the control board has two built in safety limit controls which protect the ice machine from major component failures.

Safety Limit #1: If the freeze time reaches 60 minutes, the control board automatically initiates a harvest cycle. If 6 consecutive 60-minute freeze cycles occur, the ice machine stops.

Safety Limit #2: If the harvest time reaches 3.5 minutes, the control board automatically returns the ice machine to the freeze cycle.
If 500 consecutive 3.5 minute harvest cycles occur, the ice machine stops.

Safety Limit Indication

When a safety limit condition is exceeded:

- Six consecutive cycles for safety limit 1 - the control board enters the limit into memory.
- Three consecutive cycles for safety limit 2 - the control board enters the limit into memory and the ice machine continues to run.

Use the following procedures to determine if the control board contains a safety limit indication.

1. Move the toggle switch to OFF.
2. Move the toggle switch back to ICE.
3. Watch the safety limit lights (SL-1 and SL-2). If a safety limit has been recorded, either the SL-1 light will flash once or the SL-2 light will flash twice, corresponding to safety limit 1 or 2 to indicate which safety limit stopped the ice machine.

Analyzing Why Safety Limits May Stop the Ice Machine

According to the refrigeration industry, a high percentage of compressors fail as a result of external causes. These can include: flooding or starving expansion valves, dirty condensers, water loss to the ice machine, etc. The safety limits protect the ice machine (primarily the compressor) from external failures by stopping ice machine operation before major component damage occurs.

The safety limit system is similar to a high pressure cut-out control. It stops the ice machine, but does not tell what is wrong. The service technician must analyze the system to determine what caused the high pressure cut-out, or a particular safety limit, to stop the ice machine.

The safety limits are designed to stop the ice machine prior to major component failures, most often a minor problem or something external to the ice machine. This may be difficult to diagnose, as many external problems occur intermittently.

Example: An ice machine stops intermittently on safety limit #1 (long freeze times). The problem could be a low ambient temperature at night, a water pressure drop, the water is turned off one night a week, etc.

Refrigeration and electrical component failures may also trip a safety limit. Eliminate all electrical components and external causes first. If it appears that the refrigeration system is causing the problem, use Manitowoc's Refrigeration System Operational Analysis Table, along with detailed charts, checklists, and other references to determine the cause.

The following checklists are designed to assist the service technician in analysis. However, because there are many possible external problems, do not limit your diagnosis to only the items listed.

Safety Limit #1

Refer to previous page for safety limit operation.

Freeze time exceeds 60 minutes for 6 consecutive freeze cycles**.**

Possible Cause	Check/Correct
Improper installation	See “Installation/Visual Inspection Checklist”
Water system	Low water pressure [20 psi (138 kPa) min.] High water pressure [80 psi (552 kPa) max.] High water temperature (90°F/32.2°C max.) Clogged water distribution tube Dirty/defective water fill valve Dirty/defective water dump valve Defective water pump Loss of water from sump area
Electrical system	Low incoming voltage Ice thickness probe out of adjustment Harvest cycle not initiated electrically Contactor not energizing Compressor electrically non-operational
Miscellaneous	Restricted condenser airflow Condenser discharge air recirculation Dirty condenser filter Dirty condenser Restricted condenser water flow Low water pressure [20 psi (138 kPa) min.] High water temperature (90°F/32.2°C max.) Dirty/defective water regulating valve Water regulating valve out of adjustment
Refrigeration system	Improper refrigerant charge Non-Manitowoc components Defective harvest valve Defective compressor TXV starving or flooding (check bulb mounting) Non-condensables in refrigeration system Plugged or restricted high side refrigerant lines or component

SAFETY LIMIT NOTES

- Because there are many possible external problems, do not limit your diagnosis to only the items listed in this chart.
- A continuous run of 100 harvests automatically erases the safety limit code.
- The control board will store and indicate only one safety limit – the last one exceeded.
- If the toggle switch is moved to the OFF position and then back to the ICE position prior to reaching the 100-harvest point, the last safety limit exceeded will be indicated.
- If a Safety Limit light did not flash prior to the ice machine restarting, then the ice machine did not stop because it exceeded a safety limit.

Safety Limit #2

Refer to page 7-11 for safety limit operation.

Harvest time exceeds 3.5 minutes for 500 consecutive harvest cycles.

Possible Cause	Check/Correct
Improper installation	See “Installation/Visual Inspection Checklist”
Water system	Water area (evaporator) dirty Dirty/defective water dump valve Vent tube not installed on water outlet drain Water freezing behind evaporator Plastic extrusions and gaskets not securely mounted to the evaporator Low water pressure [20 psi (138 kPa) min.] Loss of water from sump area Clogged water distribution tube Dirty/defective water fill valve Defective water pump
Electrical system	Ice thickness probe out of adjustment Ice thickness probe dirty Bin switch defective Premature harvest
Refrigeration system	Non-Manitowoc components Water regulating valve dirty/defective Improper refrigerant charge Defective harvest valve TXV flooding (check bulb mounting)

SAFETY LIMIT NOTES

- Because there are many possible external problems, do not limit your diagnosis to only the items listed in this chart.
- A continuous run of 100 harvests automatically erases the safety limit code.
- The control board will store and indicate only one safety limit – the last one exceeded.
- If the toggle switch is moved to the OFF position and then back to the ICE position prior to reaching the 100-harvest point, the last safety limit exceeded will be indicated.
- If a Safety Limit light did not flash prior to the ice machine restarting, then the ice machine did not stop because it exceeded a safety limit.

ANALYZING DISCHARGE PRESSURE DURING FREEZE OR HARVEST CYCLE

Procedure

1. Determine the ice machine operating conditions:

   Air temp. entering condenser _____
   Air temp. around ice machine _____
   Water temp. entering sump trough _____

2. Refer to Operating Pressure Chart for ice machine being checked.

   Use the operating conditions determined in step 1 to find the published normal discharge pressures.

   Freeze Cycle _____ Harvest Cycle_____

3. Perform an actual discharge pressure check.

	Freeze Cycle PSIG (kPa)	Harvest Cycle PSIG (kPa)
Beginning of Cycle	_____	_____
Middle of Cycle	_____	_____
End of Cycle	_____	_____

4. Compare the actual discharge pressure (step 3) with the published discharge pressure (step 2).

The discharge pressure is normal when the actual pressure falls within the published pressure range for the ice machine's operating conditions.

Freeze Cycle Discharge Pressure High Checklist

Possible Cause	Check/Correct
Improper installation	See "Installation/Visual Inspection Checklist"
Restricted condenser water flow (water-cooled models)	Low water pressure [20 psi (138 kPa) min.] High inlet water temperature (90°F/32.2°C max.) Dirty condenser Dirty/defective water regulating valve Water regulating valve out of adjustment
Improper refrigerant charge	Overcharged Non-condensables in system Wrong type of refrigerant
Other	Non-Manitowoc components in system High side refrigerant lines/component restricted (before mid-condenser)

Freeze Cycle Discharge Pressure Low Checklist

Possible Cause	Check/Correct
Improper installation	See "Installation/Visual Inspection Checklist"
Improper refrigerant charge	Undercharged Wrong type of refrigerant
Water regulating valve (water-cooled condensers)	Out of adjustment Defective
Other	Non-Manitowoc components in system

NOTE: Do not limit your diagnosis to only the items listed in the checklists.

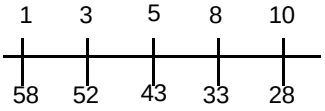
ANALYZING SUCTION PRESSURE DURING FREEZE CYCLE

The suction pressure gradually drops throughout the freeze cycle. The actual suction pressure (and drop rate) changes as the air and water temperatures entering the ice machine change. This affects freeze cycle times.

To analyze and identify the proper suction pressure drop throughout the freeze cycle, compare the published suction pressure to the published freeze cycle time. “Operating Pressure” and “Freeze Cycle Time” charts can be found later in this section.

NOTE: Analyze discharge pressure before analyzing suction pressure. High or low discharge pressure may be causing high or low suction pressure.

Procedure

<table>
<tr><th>Step</th><th colspan="4">Example Using SY605W Model Ice Machine</th></tr>
<tr><td>1. Determine the ice machine operating conditions.</td><td colspan="4">Air temp. entering condenser: 90°F/32.2°C
Air temp. around ice machine: 80°F/26.7°C
Water temp. entering water fill valve: 70°F/21.1°C</td></tr>
<tr><td>2A. Refer to “Cycle Time” and “Operating Pressure” charts for ice machine model being checked. Using operating conditions from Step 1, determine published freeze cycle time and published freeze cycle suction pressure.</td><td colspan="4">Published freeze cycle time: 8.5 - 9.8 minutes
Published freeze cycle suction pressure: 58-28 PSIG</td></tr>
<tr><td>2B. Compare the published freeze cycle time and published freeze cycle suction pressure. Develop a chart.</td><td colspan="4">Published Freeze Cycle Time (minutes)


Published Freeze Cycle Suction Pressure (psig)</td></tr>
<tr><td>3. Perform an actual suction pressure check at the beginning, middle and end of the freeze cycle. Note the times at which the readings are taken.</td><td colspan="4">Beginning of freeze cycle: 70 PSIG at 1 minute
Middle of freeze cycle: 57 PSIG at 7 minutes
End of freeze cycle: 40 PSIG at 14 minutes</td></tr>
<tr><td rowspan="4">4. Compare the actual freeze cycle suction pressure (Step 3) to the published freeze cycle time and pressure comparison (Step 2B). Determine if the suction pressure is high, low or acceptable.</td><td>Time Into Freeze Cycle</td><td>Published Pressure</td><td>Actual Pressure</td><td>Result</td></tr>
<tr><td>1 minutes</td><td>58 PSIG</td><td>70 PSIG</td><td>High</td></tr>
<tr><td>5 minutes</td><td>43 PSIG</td><td>48 PSIG</td><td>High</td></tr>
<tr><td>10 minutes</td><td>28 PSIG</td><td>40 PSIG</td><td>High</td></tr>
</table>

Freeze Cycle Suction Pressure High Checklist

Possible Cause	Check/Correct
Improper installation	See “Installation/Visual Inspection Checklist”
Discharge pressure	Discharge pressure is too high, and is affecting low side (See “Freeze Cycle Discharge Pressure High Checklist”)
Improper refrigerant charge	Overcharged Wrong type of refrigerant
Other	Non-Manitowoc components in system H.P.R. solenoid leaking Harvest valve stuck open TXV flooding (check bulb mounting) Defective compressor

Freeze Cycle Suction Pressure Low Checklist

Possible Cause	Check/Correct
Improper installation	See “Installation/Visual Inspection Checklist”
Discharge pressure	Discharge pressure is too low, and is affecting low side (See “Freeze Cycle Discharge Pressure Low Checklist”)
Improper refrigerant charge	Undercharged Wrong type of refrigerant
Other	Non-Manitowoc components in system Improper water supply over evaporator (See “Water System Checklist”) Loss of heat transfer from tubing on back side of evaporator Restricted/plugged liquid line drier Restricted/plugged tubing in suction side of refrigeration system TXV starving

NOTE: Do not limit your diagnosis to only the items listed in the checklists.

SINGLE EXPANSION VALVE ICE MACHINES - COMPARING EVAPORATOR INLET AND OUTLET TEMPERATURES

NOTE: This procedure will not work on the dual expansion valve ice machines.

The temperatures of the suction lines entering and leaving the evaporator alone cannot diagnose an ice machine. However, comparing these temperatures during the freeze cycle, along with using Manitowoc's Refrigeration System Operational Analysis Table, can help diagnose an ice machine malfunction.

The actual temperatures entering and leaving the evaporator vary by model, and change throughout the freeze cycle. This makes documenting the "normal" inlet and outlet temperature readings difficult. The key to the diagnosis lies in the difference between the two temperatures five minutes into the freeze cycle. These temperatures must be within 7° of each other.

Use this procedure to document freeze cycle inlet and outlet temperatures.

1. Use a quality temperature meter, capable of taking temperature readings on curved copper lines.
2. Attach the temperature meter sensing device to the copper lines entering and leaving the evaporator.

Important

Do not simply insert the sensing device under the insulation. It must be attached to and reading the actual temperature of the copper line.

3. Wait five minutes into the freeze cycle.
4. Record the temperatures below and determine the difference between them.
5. Use this with other information gathered on the Refrigeration System Operational Analysis Table to determine the ice machine malfunction.

_____ Inlet Temperature

_____ Outlet Temperature

_____ Difference
Must be within 7° at 5 minutes into freeze cycle

HARVEST VALVE TEMPERATURE CHECK

General

A harvest valve requires a critical orifice size. This meters the amount of hot gas flowing into the evaporator during the harvest cycle. If the orifice is even slightly too large or too small, long harvest cycles will result.

A too-large orifice causes refrigerant to condense to liquid in the evaporator during the harvest cycle. This liquid will cause compressor damage. A too-small orifice does not allow enough hot gas into the evaporator. This causes low suction pressure, and insufficient heat for a harvest cycle.

Refer to the Parts Manual for proper valve application. If replacement is necessary, Use only “original” Manitowoc replacement parts.

Harvest Valve Analysis

Symptoms of a harvest valve remaining partially open during the freeze cycle can be similar to symptoms of either an expansion valve or compressor problem. The best way to diagnose a harvest valve is by using Manitowoc’s Ice Machine Refrigeration System Operational Analysis Table.

Use the following procedure and table to help determine if a harvest valve is remaining partially open during the freeze cycle.

1. Wait five minutes into the freeze cycle.
2. Feel the inlet of the harvest valve(s).

Important

Feeling the harvest valve outlet or across the harvest valve itself will not work for this comparison.

The harvest valve outlet is on the suction side (cool refrigerant). It may be cool enough to touch even if the valve is leaking.

3. Feel the compressor discharge line.

⚠ Warning

The inlet of the harvest valve and the compressor discharge line could be hot enough to burn your hand. Just touch them momentarily.

4. Compare the temperature of the inlet of the harvest valves to the temperature of the compressor discharge line.

Findings	Comments
The inlet of the harvest valve is cool enough to touch and the compressor discharge line is hot.	This is normal as the discharge line should always be too hot to touch and the harvest valve inlet, although too hot to touch during harvest, should be cool enough to touch after 5 minutes into the freeze cycle.
The inlet of the harvest valve is hot and approaches the temperature of a hot compressor discharge line.	This is an indication something is wrong, as the harvest valve inlet did not cool down during the freeze cycle. If the compressor dome is also entirely hot, the problem is not a harvest valve leaking, but rather something causing the compressor (and the entire ice machine) to get hot.
Both the inlet of the harvest valve and the compressor discharge line are cool enough to touch.	This is an indication something is wrong, causing the compressor discharge line to be cool to the touch. This is not caused by a harvest valve leaking.

DISCHARGE LINE TEMPERATURE ANALYSIS

General

Knowing if the discharge line temperature is increasing, decreasing or remaining constant can be an important diagnostic tool. Maximum compressor discharge line temperature on a normally operating ice machine steadily increases throughout the freeze cycle. Comparing the temperatures over several cycles will result in a consistent maximum discharge line temperature.

Ambient air temperatures affect the maximum discharge line temperature.

Higher ambient air temperatures at the condenser and/or higher inlet water temperature = higher discharge line temperatures at the compressor.

Lower ambient air temperatures at the condenser and/or lower supply water temperature= lower discharge line temperatures at the compressor.

Regardless of ambient and water temperatures, the freeze cycle discharge line temperature will be higher than 160°F (71.1°C) on a normally operating ice machine.

Procedure

Connect a temperature probe on the compressor discharge line with-in 6" of the compressor and insulate.

Observe the discharge line temperature for the last three minutes of the freeze cycle and record the maximum discharge line temperature.

Discharge Line Temperature Above 160°F (71.1°C) At End Of Freeze Cycle:

Ice machines that are operating normally will have consistent maximum discharge line temperatures above 160°F (71.1°C).

Discharge Line Temperature Below 160°F (71.1°C) At End Of Freeze Cycle

Ice machines that have a flooding expansion valve will have a maximum discharge line temperature that decreases each cycle.

Verify the expansion valve sensing bulb is 100% insulated and sealed airtight. Condenser air contacting an incorrectly insulated sensing bulb will cause overfeeding of the expansion valve.

Verify the expansion valve sensing bulb is positioned and secured correctly.

HOW TO USE THE REFRIGERATION SYSTEM OPERATIONAL ANALYSIS TABLES

General

These tables must be used with charts, checklists and other references to eliminate refrigeration components not listed on the tables and external items and problems which can cause good refrigeration components to appear defective.

The tables list five different defects that may affect the ice machine's operation.

NOTE: A low-on-charge ice machine and a starving expansion valve have very similar characteristics and are listed under the same column.

NOTE: Before starting, see "Before Beginning Service" for a few questions to ask when talking to the ice machine owner.

Procedure

Step 1 Record the ice machine model number.

Step 2 Complete the "Operation Analysis" column.

Read down the left "Operational Analysis" column. Perform all procedures and check all information listed. Each item in this column has supporting reference material to help analyze each step.

While analyzing each item separately, you may find an "external problem" causing a good refrigerant component to appear bad. Correct problems as they are found. If the operational problem is found, it is not necessary to complete the remaining procedures.

NOTE: Discharge Line Temperature will vary by model. Refer to the model number to verify the correct temperature to analyze.

Step 3 Enter check marks (√) in the small boxes.

Each time the actual findings of an item in the "Operational Analysis" column matches the published findings on the table, enter a check mark.

Example: Freeze cycle suction pressure is determined to be low. Enter a check mark in the "low" box.

Step 4 Add the check marks listed under each of the four columns. Note the column number with the highest total and proceed to "Final Analysis."

NOTE: If two columns have matching high numbers, a procedure was not performed properly and/or supporting material was not analyzed correctly.

Final Analysis

The column with the highest number of check marks identifies the refrigeration problem.

COLUMN 1 - HARVEST VALVE LEAKING

A leaking harvest valve must be replaced.

COLUMN 2 - LOW CHARGE/TXV STARVING

Normally, a starving expansion valve only affects the freeze cycle pressures, not the harvest cycle pressures. A low refrigerant charge normally affects both pressures. Verify the ice machine is not low on charge before replacing an expansion valve.

1. Add refrigerant charge in 2 to 4 oz. increments as a diagnostic procedure to verify a low charge. If the problem is corrected, the ice machine is low on charge. Find the refrigerant leak.

   The ice machine must operate with the nameplate charge. If the leak cannot be found, proper refrigerant procedures must still be followed Change the liquid line drier. Then, evacuate and weigh in the proper charge.

2. If the problem is not corrected by adding charge, the expansion valve is faulty.

   On dual expansion valve ice machines, change only the TXV that is starving. If both TXV's are starving, they are probably good and they are being affected by some other malfunction; such as low charge.

COLUMN 3 - TXV FLOODING

A loose or improperly mounted expansion valve bulb causes the expansion valve to flood. Check bulb mounting, insulation, etc., before changing the valve. On dual expansion valve machines, the service technician should be able to tell which TXV is flooding by analyzing ice formation patterns. Change only the flooding expansion valve.

COLUMN 4 - COMPRESSOR

Replace the compressor and start components. To receive warranty credit, the compressor ports must be properly sealed by crimping and soldering them closed. Old start components must be returned with the faulty compressor.

REFRIGERATION SYSTEM OPERATIONAL ANALYSIS TABLES

S Models Single Expansion Valve - Ice Machine Model Number_____

This table must be used with charts, checklists and other references to eliminate refrigeration components not listed on the table and external items and problems, which can cause good refrigeration components to appear defective.

Operational Analysis	1	2	3	4
Ice Production	Air-Temperature Entering Condenser_____ Water Temperature Entering Ice Machine_____ Published 24 hour ice production_____ Calculated (actual) ice production_____ NOTE: The ice machine is operating properly if the ice fill patterns is normal and ice production is within 10% of charted capacity.			
Installation and Water System	All installation and water related problems must be corrected before proceeding with chart.			
Ice Formation Pattern	Ice formation is extremely thin on outlet of evaporator -or- No ice formation on the entire evaporator	Ice formation is extremely thin on outlet of evaporator -or- No ice formation on entire evaporator	Ice formation normal -or- Ice formation is extremely thin on inlet of evaporator -or- No ice formation on entire evaporator	Ice formation normal -or- No ice formation on entire evaporator
Safety Limits Refer to "Analyzing Safety Limits" to eliminate all non-refrigeration problems.	Stops on safety limit: **1**	Stops on safety limit: **1**	Stops on safety limit: **1 or 2**	Stops on safety limit: **1**
Freeze Cycle Discharge Pressure _____ _____ _____ 1 minute Middle End into cycle	If discharge pressure is High or Low refer to freeze cycle high or low discharge pressure problem checklist to eliminate problems and/or components not listed on this table before proceeding.			
Freeze Cycle Suction Pressure _____ _____ _____ 1 minute Middle End	If suction pressure is High or Low refer to freeze cycle high or low suction pressure problem checklist to eliminate problems and/or components not listed on this table before proceeding.			
	Suction pressure is **High**	Suction pressure is **Low or Normal**	Suction pressure is **High**	Suction pressure is **High**
Wait 5 minutes into the freeze cycle. Compare temperatures of **evaporator inlet & evaporator outlet.** Inlet ____ ° F (° C) Outlet ____ ° F (° C) Difference ____ ° F (° C)	Inlet and outlet **within 7°** of each other	Inlet and outlet **not within 7°** of each other -and- Inlet is colder than outlet	Inlet and outlet **within 7°** of each other -or- Inlet and outlet **not within 7°** of each other -and- Inlet is warmer than outlet	Inlet and outlet **within 7°** of each other
Wait 5 minutes into the freeze cycle. Compare temperatures of **compressor discharge line** and **harvest valve inlet.**	The harvest valve inlet is **Hot** -and- approaches the temperature of a **Hot** compressor discharge line.	The harvest valve inlet is **Cool** enough to hold hand on -and- the compressor discharge line is **Hot.**	The harvest valve inlet is **Cool** enough to hold hand on -and- the compressor discharge line is **Cool** enough to hold hand on.	The harvest valve inlet is **Cool** enough to hold hand on -and- the compressor discharge line is **Hot.**
Discharge Line Temperature Record freeze cycle discharge line temperature at the end of the freeze cycle _____**°F (°C)**	Discharge line temperature **160°F (71.1°C) or higher at the end of the freeze cycle**	Discharge line temperature **160°F (71.1°C) or higher at the end of the freeze cycle**	Discharge line temperature **less than 160°F (71.1°C) at the end of the freeze cycle**	Discharge line temperature **160°F (71.1°C) or higher at the end of the freeze cycle**
Final Analysis Enter total number of boxes checked in each column.	**Harvest Valve Leaking**	**Low On Charge -Or- TXV Starving**	**TXV Flooding**	**Compressor**

Pressure Control Specifications and Diagnostics

HIGH PRESSURE CUT-OUT (HPCO) CONTROL

Function

Stops the ice machine if subjected to excessive high-side pressure.

The HPCO control is normally closed, and opens on a rise in discharge pressure.

Specifications

Cut-out: 450 psig ±10 (3103 kPa ±69, 31 Bar ±.69)

Cut-in: Manual or automatic reset
Must be below 300 psig (2068 kPa, 20.68 Bar ±.69) to reset

Check Procedure

1. Set ICE/OFF/CLEAN switch to OFF.
2. Connect manifold gauges.
3. Hook voltmeter in parallel across the HPCO, leaving wires attached.
4. On water-cooled models, close the water service valve to the water condenser inlet. On self-contained air-cooled and remote models, disconnect the fan motor.
5. Set ICE/OFF/CLEAN switch to ICE.
6. No water or air flowing through the condenser will cause the HPCO control to open because of excessive pressure. Watch the pressure gauge and record the cut-out pressure.

⚠ Warning

If discharge pressure exceeds 460 psig (2068 kPa, 20.68 Bar) and the HPCO control does not cut out, set ICE/OFF/CLEAN switch to OFF to stop ice machine operation.

Replace the HPCO control if it:

- Will not reset [below 300 psig (2068 kPa, 20.68 Bar)]
- Does not open at the specified cut-out point

Cycle Time/24 Hour Ice Production/ Refrigerant Pressure Charts

These charts are used as guidelines to verify correct ice machine operation.

Accurate collection of data is essential to obtain the correct diagnosis.

- Refer to “OPERATIONAL ANALYSIS TABLE” for the list of data that must be collected for refrigeration diagnostics. This list includes: before beginning service, ice production check, installation/visual inspection, water system checklist, ice formation pattern, safety limits, comparing evaporator inlet/ outlet temperatures, discharge and suction pressure analysis.
- Ice production checks that are within 10% of the chart are considered normal. This is due to variances in water and air temperature. Actual temperatures will seldom match the chart exactly.
- Zero out manifold gauge set before obtaining pressure readings to avoid misdiagnosis.
- Discharge and suction pressure are highest at the beginning of the cycle. Suction pressure will drop throughout the cycle. Verify the pressures are within the range indicated.
- Record beginning of freeze cycle suction pressure one minute after water pump energizes.
- Regular cube production derate is 7%
- 50Hz production derate is 7%

S600M SERIES

Self-Contained Water-Cooled

NOTE: These characteristics may vary depending on operating conditions.

Cycle Times

Freeze Time + Harvest Time = Total Cycle Time

Air Temp. Around Ice Machine °F/°C	Freeze Time			Harvest Time
	Water Temperature °F/°C			
	50/10.0	70/21.1	90/32.2	
70/21.1	7.6-9.0	7.9-9.4	8.6-10.1	1-2.5
80/26.7	7.8-9.2	8.1-9.5	8.8-10.3	
90/32.2	7.9-9.4	8.2-9.7	8.8-10.3	
100/37.8	8.1-9.5	8.4-9.9	9.1-10.7	
Times in minutes				

24 Hour Ice Production

Air Temp. Around Ice Machine °F/°C	Water Temperature °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	650	630	590
80/26.7	640	620	580
90/32.2	630	610	580
100/37.8	620	600	560
Based on average ice slab weight of 4.12 - 4.75lb			

Operating Pressures

Air Temp. Around Ice Machine °F/°C	Freeze Cycle		Harvest Cycle	
	Discharge Pressure PSIG	Suction Pressure PSIG	Discharge Pressure PSIG	Suction Pressure PSIG
50/10.0	225-235	36-26	140-190	65-95
70/21.1	225-235	36-26	140-190	65-95
80/26.7	225-245	40-28	150-195	70-100
90/32.2	230-255	40-29	160-200	70-100
100/37.8	230-260	40-30	170-205	75-105
110/43.3	230-260	40-30	180-210	80-110
Suction pressure drops gradually throughout the freeze cycle				

Refrigerant Recovery/Evacuation and Recharging

NORMAL SELF-CONTAINED MODEL PROCEDURES

Refrigerant Recovery/Evacuation

Do not purge refrigerant to the atmosphere. Capture refrigerant using recovery equipment. Follow the manufacturer's recommendations.

Important

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

Important

Replace the liquid line drier before evacuating and recharging. Use only a Manitowoc (O.E.M.) liquid line filter drier to prevent voiding the warranty.

CONNECTIONS

Manifold gauge sets must utilize low loss fittings to comply with U.S. Government rules and regulations. Make these connections:

1. Suction side of the compressor through the suction service valve.
2. Discharge side of the compressor through the discharge service valve.

SELF-CONTAINED RECOVERY/EVACUATION

1. Place the toggle switch in the OFF position.
2. Install manifold gauges, scale, and recovery unit or two-stage vacuum pump.

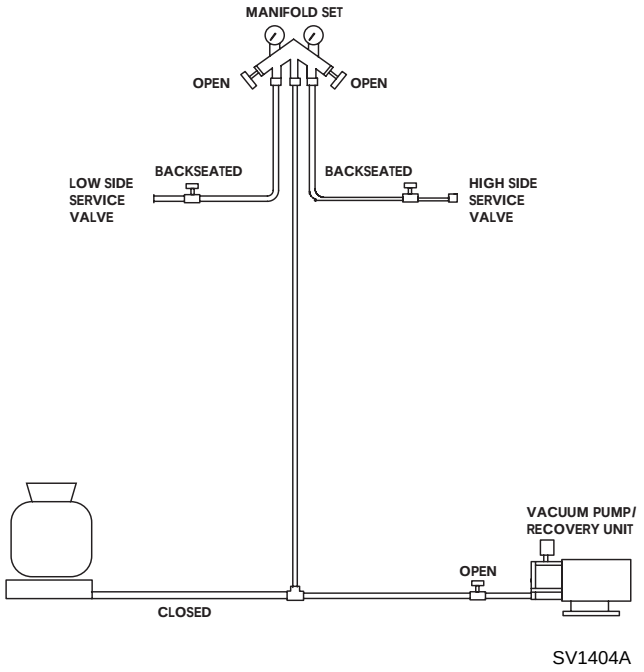


Figure 7-7. Recovery/Evacuation Connections

3. Open (backseat) the high and low side ice machine service valves, and open high and low side on manifold gauges.
4. Perform recovery or evacuation:
   A. Recovery: Operate the recovery unit as directed by the manufacturer's instructions.
   B. Evacuation prior to recharging: Pull the system down to 500 microns. Then, allow the pump to run for an additional half hour. Turn off the pump and perform a standing vacuum leak check.
5. Follow the Charging Procedures.

Self-Contained Charging Procedures

Important

The charge is critical on all Manitowoc ice machines. Use a scale or a charging cylinder to ensure the proper charge is installed.

1. Be sure the toggle switch is in the OFF position.

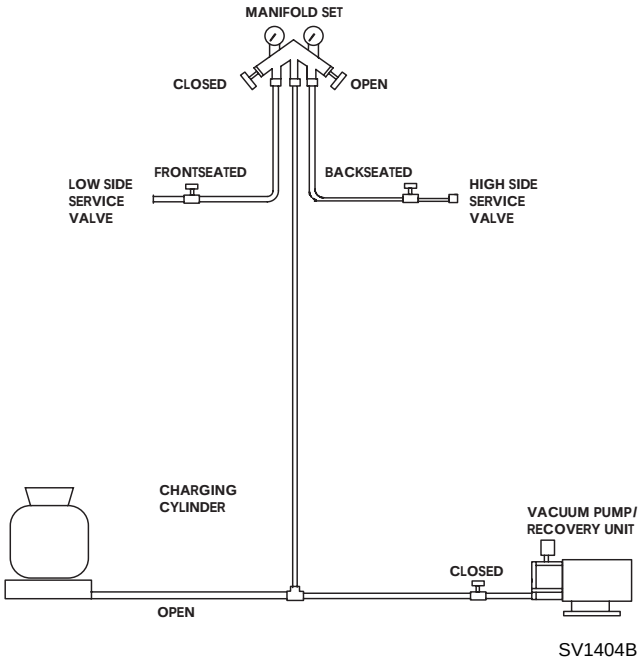


Figure 7-8. Charging Connections

2. Close the vacuum pump valve, the low side service valve, and the low side manifold gauge valve.
3. Open the high side manifold gauge valve, and backseat the high side service valve.
4. Open the charging cylinder and add the proper refrigerant charge (shown on nameplate) through the discharge service valve.
5. Let the system “settle” for 2 to 3 minutes.
6. Place the toggle switch in the ICE position.
7. Close the high side on the manifold gauge set. Add any remaining vapor charge through the suction service valve (if necessary).

NOTE: Manifold gauges must be removed properly to ensure that no refrigerant contamination or loss occurs.

8. Make sure that all of the vapor in the charging hoses is drawn into the ice machine before disconnecting the charging hoses.
   A. Run the ice machine in freeze cycle.
   B. Close the high side service valve at the ice machine.
   C. Open the low side service valve at the ice machine.
   D. Open the high and low side valves on the manifold gauge set. Any refrigerant in the lines will be pulled into the low side of the system.
   E. Allow the pressures to equalize while the ice machine is in the freeze cycle.
   F. Close the low side service valve at the ice machine.
   G. Remove the hoses from the ice machine and install the caps.

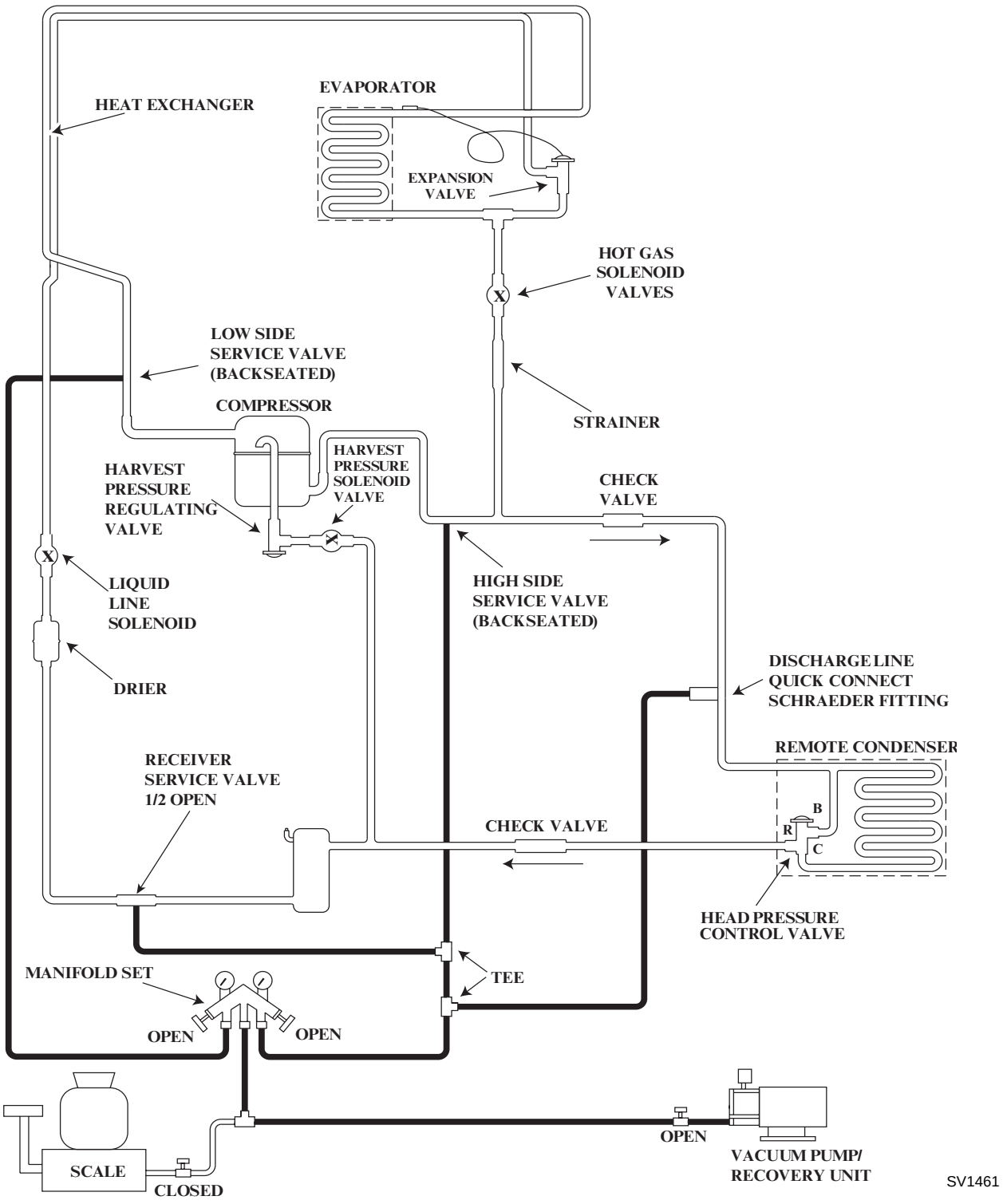


Figure 7-9. Recovery/Evacuation Connections

Remote Charging Procedures

1. Be sure the toggle switch is in the OFF position.
2. Close the vacuum pump valve, the low and high side service valves (frontseat), and the low side manifold gauge valve.
3. Open the charging cylinder and add the proper refrigerant charge (shown on nameplate) into the system high side (receiver outlet valve and discharge lines quick-connect fitting).
4. If the high side does not take the entire charge, close the high side on the manifold gauge set, and backseat (open) the low side service valve and receiver outlet service valve. Start the ice machine and add the remaining charge through the low side (in vapor form) until the machine is fully charged.
5. Ensure all vapor in charging hoses is drawn into the machine, then disconnect the manifold gauges.

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

6. Run the ice machine in freeze cycle.
7. Close the high side service valve at the ice machine.
8. Open the low side service valve at the ice machine.
9. Open the high and low side valves on the manifold gauge set. Any refrigerant in the lines will be pulled into the low side of the system.
10. Allow the pressures to equalize while the ice machine is in the freeze cycle.
11. Close the low side service valve at the ice machine.
12. Remove the hoses from the ice machine and install the caps.

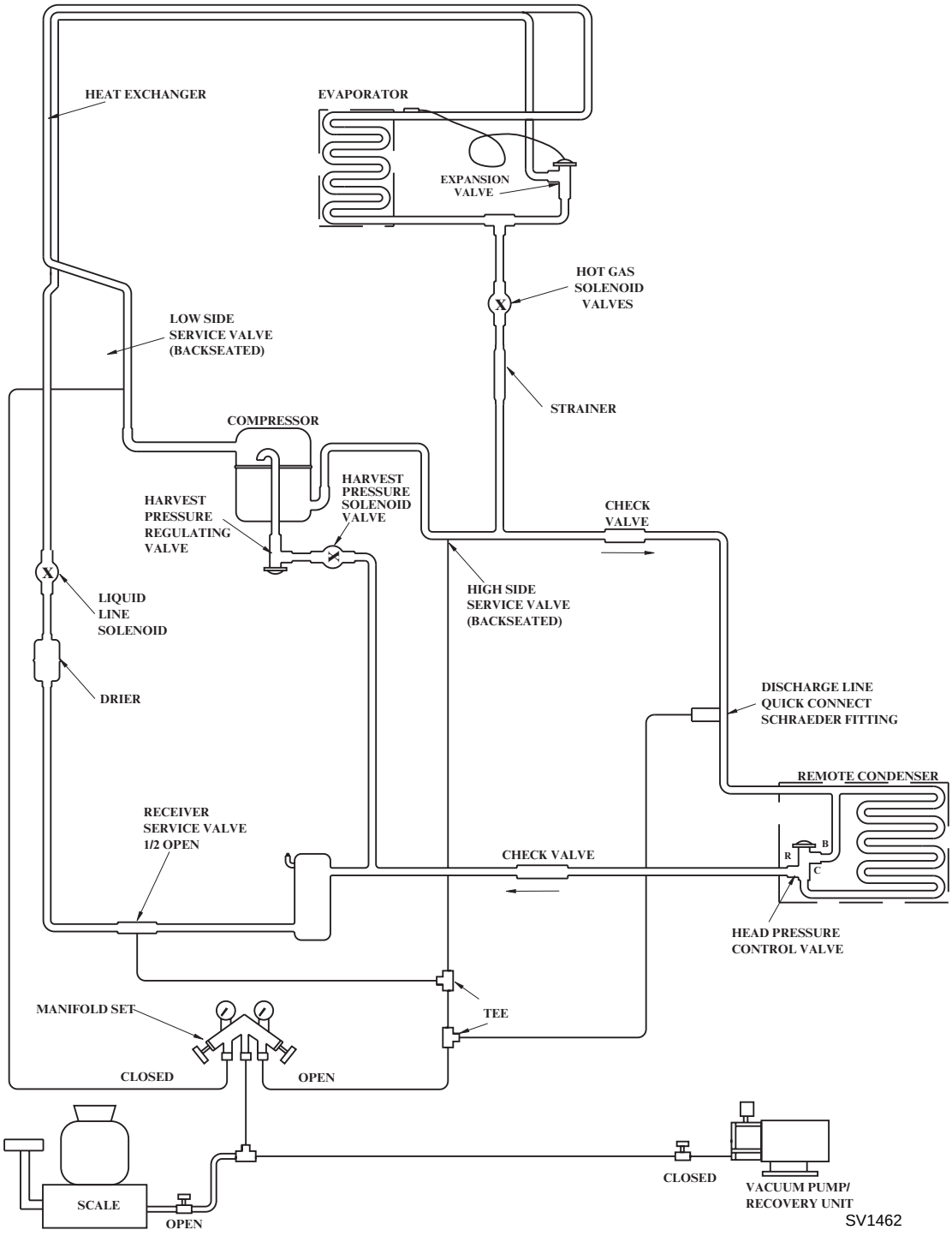


Figure 7-10. Remote Charging Connections

SYSTEM CONTAMINATION CLEAN-UP

General

This section describes the basic requirements for restoring contaminated systems to reliable service.

Important

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

Determining Severity Of Contamination

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

Inspection of the refrigerant usually provides the first indication of system contamination. Obvious moisture or an acrid odor in the refrigerant indicates contamination.

If either condition is found, or if contamination is suspected, use a Total Test Kit from Totaline or a similar diagnostic tool. These devices sample refrigerant, eliminating the need to take an oil sample. Follow the manufacturer's directions.

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

1. Remove the refrigerant charge from the ice machine.
2. Remove the compressor from the system.
3. Check the odor and appearance of the oil.
4. Inspect open suction and discharge lines at the compressor for burnout deposits.
5. If no signs of contamination are present, perform an acid oil test.

Check the chart below to determine the type of cleanup required.

Contamination/Cleanup Chart	
Symptoms/Findings	**Required Cleanup Procedure**
No symptoms or suspicion of contamination	Normal evacuation/recharging procedure
Moisture/Air Contamination symptoms Refrigeration system open to atmosphere for longer than 15 minutes Refrigeration test kit and/or acid oil test shows contamination Leak in water-cooled condenser No burnout deposits in open compressor lines	Mild contamination cleanup procedure
Mild Compressor Burnout symptoms Oil appears clean but smells acrid Refrigeration test kit or acid oil test shows harmful acid content No burnout deposits in open compressor lines	Mild contamination cleanup procedure
Severe Compressor Burnout symptoms Oil is discolored, acidic, and smells acrid Burnout deposits found in the compressor and lines, and in other components	Severe contamination cleanup procedure

Mild System Contamination Cleanup Procedure

1. Replace any failed components.
2. If the compressor is good, change the oil.
3. Replace the liquid line drier.

NOTE: If the contamination is from moisture, use heat lamps during evacuation. Position them at the compressor, condenser and evaporator prior to evacuation. Do not position heat lamps too close to plastic components, or they may melt or warp.

Important

Dry nitrogen is recommended for this procedure. This will prevent CFC release.

4. Follow the normal evacuation procedure, except replace the evacuation step with the following:
   A. Pull vacuum to 1000 microns. Break the vacuum with dry nitrogen and sweep the system. Pressurize to a minimum of 5 psi (35 kPa).
   B. Pull vacuum to 500 microns. Break the vacuum with dry nitrogen and sweep the system. Pressurize to a minimum of 5 psi (35 kPa).
   C. Change the vacuum pump oil.
   D. Pull vacuum to 500 microns. Run the vacuum pump for 1/2 hour on self-contained models, 1 hour on remotes.

NOTE: You may perform a standing vacuum test to make a preliminary leak check. You should use an electronic leak detector after system charging to be sure there is no leak.

5. Charge the system with the proper refrigerant to the nameplate charge.
6. Operate the ice machine.

Severe System Contamination Cleanup Procedure

1. Remove the refrigerant charge.
2. Remove the compressor.
3. Disassemble the harvest solenoid valve. If burnout deposits are found inside the valve, install a new harvest valve, and replace manifold strainer, TXV and harvest pressure regulating valve.
4. Wipe away any burnout deposits from suction and discharge lines at compressor.
5. Sweep through the open system with dry nitrogen.

Important

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

6. Install a new compressor and new start components.
7. Install a suction line filter-drier with acid and moisture removal capability (P/N 89-3028-3). Place the filter drier as close to the compressor as possible.
8. Install an access valve at the inlet of the suction line drier.
9. Install a new liquid line drier.

Continued on next page …

10. Follow the normal evacuation procedure, except replace the evacuation step with the following:

Important

Dry nitrogen is recommended for this procedure. This will prevent CFC release.

A. Pull vacuum to 1000 microns. Break the vacuum with dry nitrogen and sweep the system. Pressurize to a minimum of 5 psi (35 kPa .35 bar).

B. Change the vacuum pump oil.

C. Pull vacuum to 500 microns. Break the vacuum with dry nitrogen and sweep the system. Pressurize to a minimum of 5 psi (35 kPa .35 bar).

D. Change the vacuum pump oil.

E. Pull vacuum to 500 microns. Run the vacuum pump for 1/2 hour on self-contained models, 1 hour on remotes.

NOTE: You may perform a standing vacuum test to make a preliminary leak check. You should use an electronic leak detector after system charging to be sure there is no leak.

11. Charge the system with the proper refrigerant to the nameplate charge.
12. Operate the ice machine for one hour. Then, check the pressure drop across the suction line filter-drier.

A. If the pressure drop is less than 1 psi (7 kPa, .7 bar), the filter-drier should be adequate for complete cleanup.

B. If the pressure drop exceeds 1 psi (7 kPa, .7 bar), change the suction line filter-drier and the liquid line drier. Repeat until the pressure drop is acceptable.

13. Operate the ice machine for 48-72 hours. Then, remove the suction line drier and change the liquid line drier.
14. Follow normal evacuation procedures.

REPLACING PRESSURE CONTROLS WITHOUT REMOVING REFRIGERANT CHARGE

This procedure reduces repair time and cost. Use it when any of the following components require replacement, and the refrigeration system is operational and leak-free.

- Water regulating valve
- High pressure cut-out control
- High side service valve
- Low side service valve

Important

This is a required in-warranty repair procedure.

1. Disconnect power to the ice machine.
2. Follow all manufacturer's instructions supplied with the pinch-off tool. Position the pinch-off tool around the tubing as far from the pressure control as feasible. (See the figure on next page.) Clamp down on the tubing until the pinch-off is complete.

⚠ Warning

Do not unsolder a defective component. Cut it out of the system. Do not remove the pinch-off tool until the new component is securely in place.

3. Cut the tubing of the defective component with a small tubing cutter.
4. Solder the replacement component in place. Allow the solder joint to cool.
5. Remove the pinch-off tool.
6. Re-round the tubing. Position the flattened tubing in the proper hole in the pinch off tool. Tighten the wingnuts until the block is tight and the tubing is rounded. (See the drawing on next page.)

NOTE: The pressure controls will operate normally once the tubing is re-rounded. Tubing may not re-round 100%.

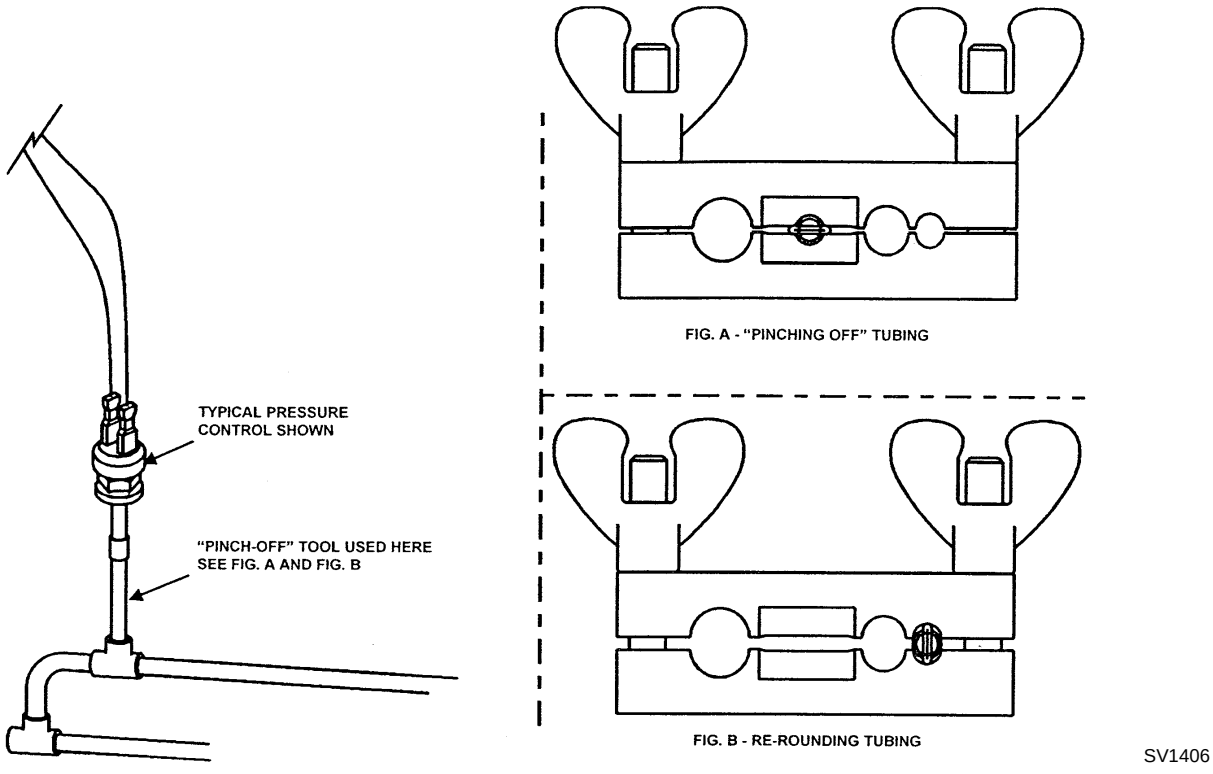


Figure 7-11. Using Pinch-Off Tool

FILTER-DRIERS

The filter-driers used on Manitowoc ice machines are manufactured to Manitowoc specifications.

The difference between Manitowoc driers and off-the-shelf driers is in filtration. Manitowoc driers have dirt-retaining filtration, with fiberglass filters on both the inlet and outlet ends. This is very important because ice machines have a back-flushing action which takes place during every harvest cycle.

These filter-driers have a very high moisture removal capability and a good acid removal capability.

The size of the filter-drier is important. The refrigerant charge is critical. Using an improperly sized filter-drier will cause the ice machine to be improperly charged with refrigerant.

Important

Driers are covered as a warranty part. The drier must be replaced any time the system is opened for repairs.

Listed below are the recommended O.E.M. field replacement driers:

Model	Drier Size	End Connection Size	Part Number
Self-Contained Water Cooled	UK-032S	1/4"	89-3023-3
Suction Filter	UK-165S	5/8"	89-3028-3
Suction Filter used when cleaning up severely contaminated systems			

TOTAL SYSTEM REFRIGERANT CHARGES

Important

This information is for reference only. Refer to the ice machine serial number tag to verify the system charge. Serial plate information overrides information listed on this page.

Series	Version	Charge
S600	Water-Cooled	28 oz.

NOTE: All ice machines on this list are charged using R-404A refrigerant.

REFRIGERANT DEFINITIONS

Recover

To remove refrigerant, in any condition, from a system and store it in an external container, without necessarily testing or processing it in any way.

Recycle

To clean refrigerant for re-use by oil separation and single or multiple passes through devices, such as replaceable core filter-driers, which reduce moisture, acidity and particulate matter. This term usually applies to procedures implemented at the field job site or at a local service shop.

Reclaim

To reprocess refrigerant to new product specifications (see below) by means which may include distillation. A chemical analysis of the refrigerant is required after processing to be sure that product specifications are met. This term usually implies the use of processes and procedures available only at a reprocessing or manufacturing facility.

Chemical analysis is the key requirement in this definition. Regardless of the purity levels reached by a reprocessing method, refrigerant is not considered “reclaimed” unless it has been chemically analyzed and meets ARI Standard 700 (latest edition).

New Product Specifications

This means ARI Standard 700 (latest edition). Chemical analysis is required to assure that this standard is met.

REFRIGERANT RE-USE POLICY

Manitowoc recognizes and supports the need for proper handling, re-use, and disposal of, CFC and HCFC refrigerants. Manitowoc service procedures require recapturing refrigerants, not venting them to the atmosphere.

It is not necessary, in or out of warranty, to reduce or compromise the quality and reliability of your customers' products to achieve this.

Important

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

Manitowoc approves the use of:

1. **New Refrigerant**
   - Must be of original nameplate type.
2. **Reclaimed Refrigerant**
   - Must be of original nameplate type.
   - Must meet ARI Standard 700 (latest edition) specifications.
3. **Recovered or Recycled Refrigerant**
   - Must be recovered or recycled in accordance with current local, state and federal laws.
   - Must be recovered from and re-used in the same Manitowoc product. Re-use of recovered or recycled refrigerant from other products is not approved.
   - Recycling equipment must be certified to ARI Standard 740 (latest edition) and be maintained to consistently meet this standard.
   - Recovered refrigerant must come from a "contaminant-free" system. To decide whether the system is contaminant free, consider:
     – Type(s) of previous failure(s)
     – Whether the system was cleaned, evacuated and recharged properly following failure(s)
     – Whether the system has been contaminated by this failure
     – Compressor motor burnouts and improper past service prevent refrigerant re-use.
     – Refer to "System Contamination Cleanup" to test for contamination.
4. **"Substitute" or "Alternative" Refrigerant**
   - Must use only Manitowoc-approved alternative refrigerants.
   - Must follow Manitowoc-published conversion procedures.

HFC REFRIGERANT QUESTIONS AND ANSWERS

Manitowoc uses R-404A and R-134A HFC refrigerants with ozone depletion potential (ODP) factors of zero (0.0). R-404A is used in ice machines and reach-in freezers and R-134A is used in reach-in refrigerators.

1. What compressor oil does Manitowoc require for use with HFC refrigerants?

   Manitowoc products use Polyol Ester (POE) type compressor oil. It is the lubricant of choice among compressor manufacturers.

2. What are some of the characteristics of POE oils?

   They are hygroscopic, which means they have the ability to absorb moisture. POE oils are 100 times more hygroscopic than mineral oils. Once moisture is absorbed into the oil, it is difficult to remove, even with heat and vacuum. POE oils are also excellent solvents, and tend to “solvent clean” everything inside the system, depositing material where it is not wanted.

3. What do these POE oil characteristics mean to me?

   You must be more exacting in your procedures. Take utmost care to prevent moisture from entering the refrigeration system. Refrigeration systems and compressors should not be left open to the atmosphere for more than 15 minutes. Keep oil containers and compressors capped at all times to minimize moisture entry. Before removing the system charge to replace a faulty component, be sure you have all of the needed components at the site. Remove new system component plugs and caps just prior to brazing. Be prepared to connect a vacuum pump immediately after brazing.

4. Are there any special procedures required if a POE system is diagnosed with a refrigerant leak?

   For systems found with positive refrigerant system pressure, no special procedures are required.

   For systems found without any positive refrigerant pressure, assume that moisture has entered the POE oil. After the leak is found and repaired, the compressor oil must be changed. The compressor must be removed and at least 95% of the oil drained from the suction port of the compressor. Use a “measuring cup” to replace the old oil with exactly the same amount of new POE oil, such as Mobil EAL22A.

   Remember, care must be taken to prevent moisture from getting into the refrigeration system during refrigeration repairs.

5. How do I leak-check a system containing HFC refrigerant?

   Use equipment designed for HFC detection. Do not use equipment designed for CFC detection. Consult leak detection equipment manufacturers for their recommendations. Also, standard soap bubbles will work with HFC refrigerants.

6. Does Manitowoc use a special liquid line filter-drier with HFC refrigerants?

   Yes. Manitowoc uses an ALCO “UK” series filter-drier for increased filtration and moisture removal. During a repair, Manitowoc recommends installing the drier just before hooking up a vacuum pump.

7. Is other special equipment required to service HFC refrigerants?

   No. Standard refrigeration equipment such as gauges, hoses, recovery systems, vacuum pumps, etc., are generally compatible with HFC refrigerants. Consult your equipment manufacturer for specific recommendations for converting existing equipment to HFC usage. Once designated (and calibrated, if needed) for HFC use, this equipment should be used specifically with HFC refrigerants only.

8. Do I have to recover HFC refrigerants?

   Yes. Like other refrigerants, government regulations require recovering HFC refrigerants.

9. Will R-404A or R-134A separate if there is a leak in the system?

   No. Like R-502, the degree of separation is too small to detect.

10. How do I charge a system with HFC refrigerant?

    The same as R-502. Manitowoc recommends charging only liquid refrigerant into the high side of the system.

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