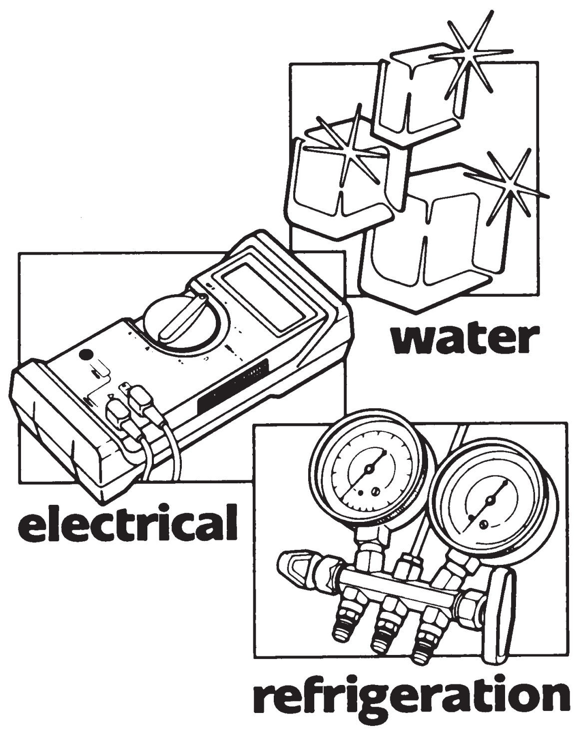
Manitowoc®

SERVICE TECHNICIAN'S HANDBOOK

J MODEL ICE MACHINES



Recycled Paper

Rev A 8/97 P/N 83-5723-9

TABLE OF CONTENTS

(Continued on next page)

Table of Contents (continued)

(Continued on next page)

Table of Contents (continued)

(Continued on next page)

Table of Contents (continued)

(End)

ICE MACHINE WARRANTY INFORMATION

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

OWNER WARRANTY REGISTRATION CARD

Warranty coverage begins the day the ice machine is installed.

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

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

WARRANTY COVERAGE

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

Parts

1. The ice machine is warranted against defects in materials and workmanship under normal use and service for three (3) years from the date of the original installation. It is important to send in the warranty registration card so Manitowoc can begin your warranty on the installation date.
2. An additional two (2) years (five (5) years total) warranty is provided on evaporator and compressor from the date of original installation.

Labor

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

Exclusions from Warranty Coverage

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

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

Authorized Warranty Service

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

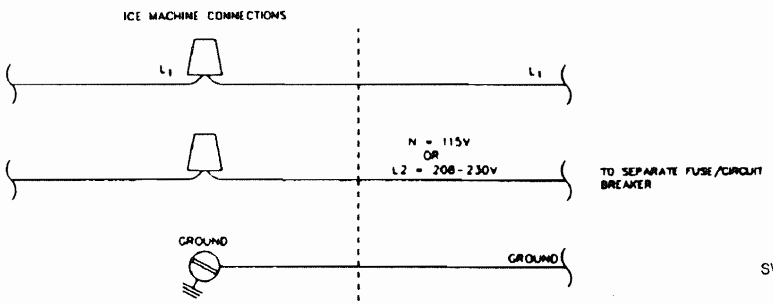
INSTALLATION: WIRING CONNECTIONS

SELF-CONTAINED ELECTRICAL CONNECTIONS

CAUTION

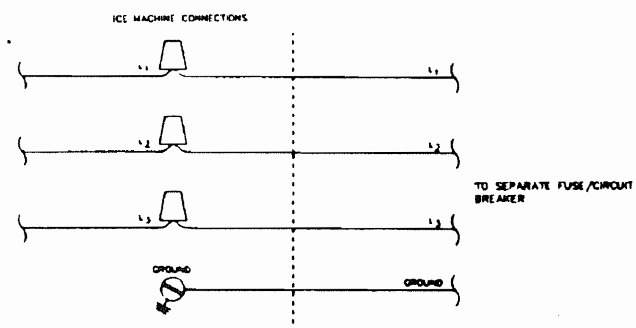
The accompanying diagrams are not intended to show proper wire routing, wire sizing, disconnects, etc.; only the correct wire connections. **All electrical connections and routing must conform to local and national codes.**

115/1/60
-OR-
208-230/1/60



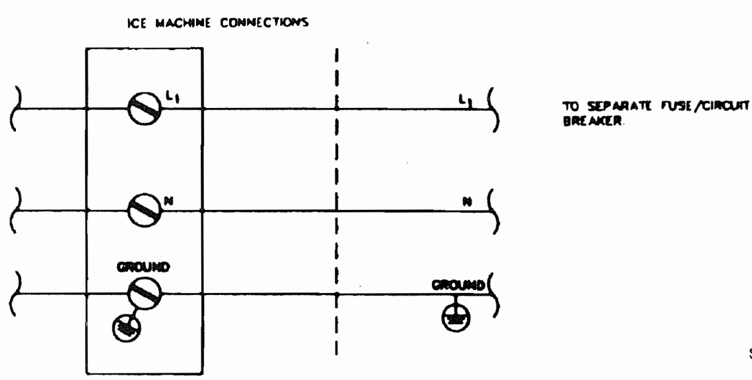
SV 1258

208-230/3/60



SV 1190

220-240/1/50



SV 1191

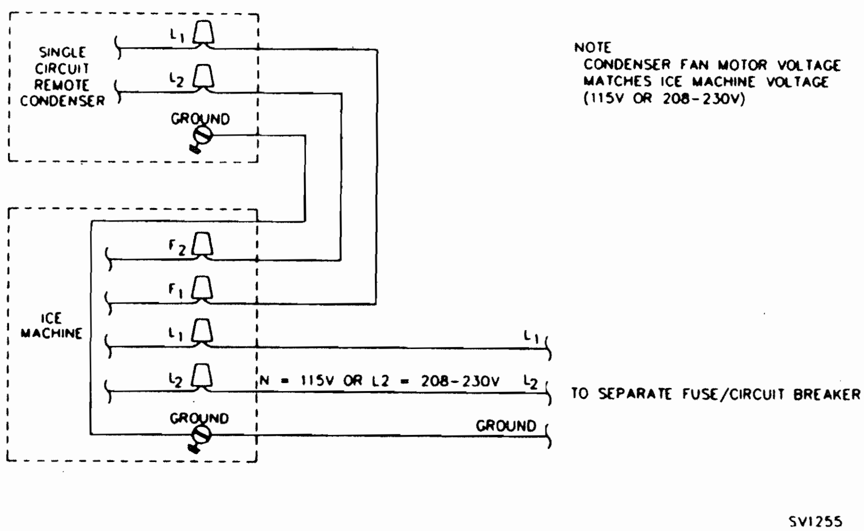
REMOTE ELECTRICAL CONNECTIONS

CAUTION

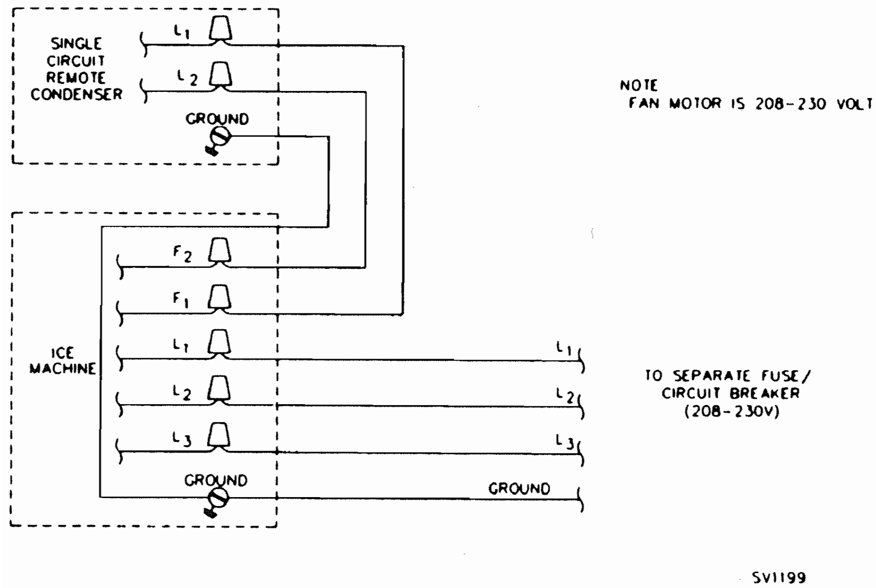
The diagrams are not intended to show proper wire routing, wire sizing, disconnects, etc.; only the proper wire connections. **All electrical connections and routing must conform to local and national codes.**

The single circuit condenser should be wired directly to the ice machine's electrical panel. The condenser fan runs only when the ice machine is operating.

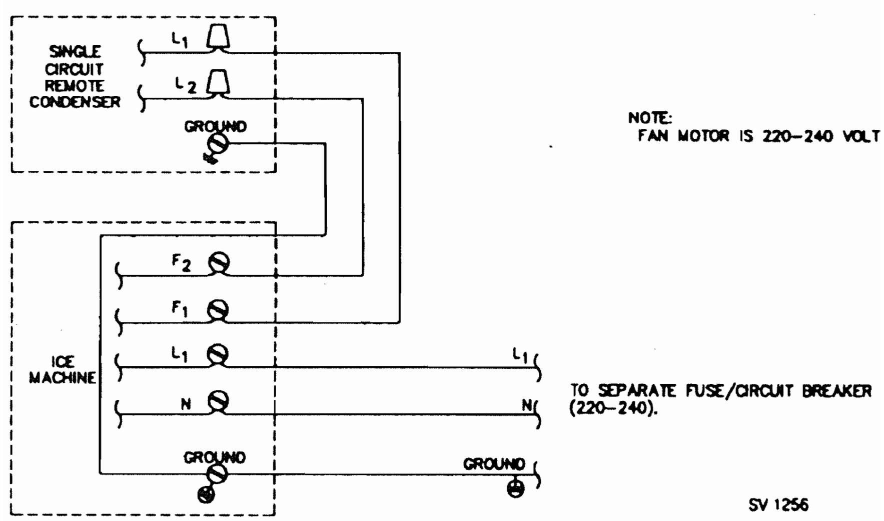
REMOTE ICE MACHINE
115/1/60
-OR-
208-230/1/60
With model condenser single circuit



REMOTE ICE MACHINE
208-230/3/60
With single circuit model condenser



REMOTE ICE MACHINE
220-240/1/50
With single circuit model condenser



REMOTE CONDENSER/ LINE SET INSTALLATION

Ice Machine	Remote Single Circuit Condenser	Line Set Size	
		Discharge	Liquid
J450	JC0495	1/2"	5/16"
J600	JC0895	1/2"	5/16"
J800	JC0895	1/2"	5/16"
J1000	JC1095	1/2"	5/16"
J1300	JC1395	1/2"	3/8"
J1800	JC1895	1/2"	3/8"

Air temperature entering the condenser	+
Minimum	Maximum
-20°F (-28.9°C)	130°F (54.4°C)

Condensers must be mounted horizontally with the fan motor on top (Refer to illustrations).

GENERAL

Remote condenser installations consist of vertical and horizontal line set distances between the machine and condenser. When combined, they must fit within approved guidelines. These guidelines, drawings, and calculation methods must be followed to verify a proper remote condenser installation.

Warranty Note

The sixty (60) month compressor warranty, including the thirty-six (36) month labor replacement warranty, will not apply when the remote ice machine is not installed according to specifications, or the refrigeration system is modified with a condenser, heat reclaim device, or parts and assemblies other than those manufactured by Manitowoc Ice, Inc., unless Manitowoc Ice, Inc. approves these modifications for specific locations in writing.

ROUTING OF LINE SET

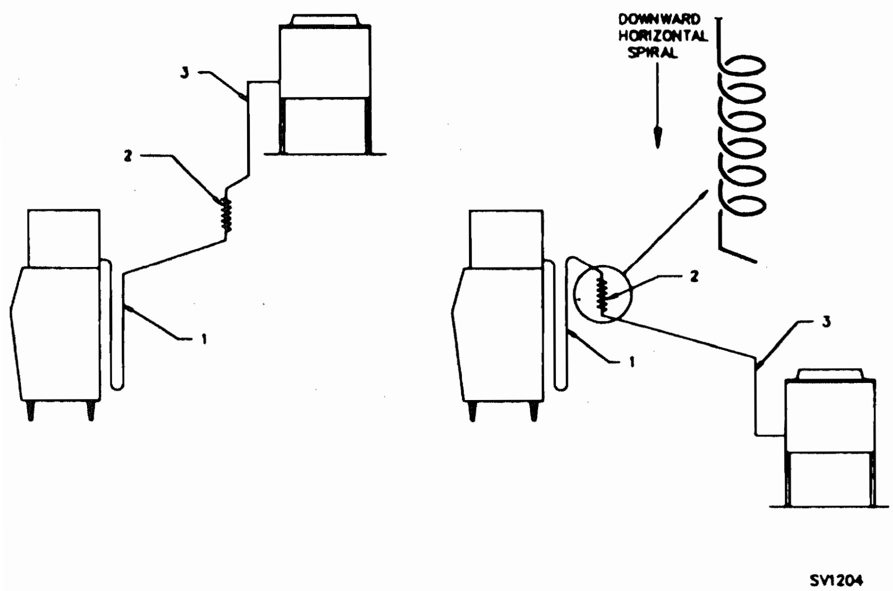
Follow these guidelines when routing refrigerant lines. This will insure the proper performance and service accessibility to the ice machine. A 2-1/2" round hole in the wall or roof is needed for tubing routing.

NOTE

Line set end with 90° bend connects to ice machine. The straight end connects to the remote condenser.

1. Make the service loop in the line sets as shown. This permits easy access to the ice machine for cleaning and service. Hard riged copper should not be used at this location.
2. Never form a trap in refrigeration lines. Refrigerant oil must always be free to drain toward the ice maker or the condenser. The trap formed by the service loop is part of the ice machine's design.

   Excess tubing must be routed in a downward horizontal spiral and supported to assure it does not collapse. Do not coil tubing vertically.
3. Refrigerant lines located outdoors should be kept as short as possible, and must be run to prevent traps.



REMOTE CONDENSER MAXIMUM LOCATION DISTANCES

Physical Line Set Length: 100 Ft. Maximum
The ice machine compressor must have the proper oil return. The receiver capacity is only designed to hold the nameplate charge. This is sufficient to operate the ice machine in ambient temperatures of -20°F (-28.9°C) to 130°F (54.4°C) with line set lengths up to 100 ft.

LINE SET RISE: 35 FT. MAXIMUM
LINE SET DROP: 15 FT. MAXIMUM

Line set rises, drops, or horizontal runs greater than the maximum distance allowed will exceed the compressor start-up and pumping design limits, and will result in poor oil return to the compressor.

Calculated Line Set Distance: 150 Ft. Maximum
To eliminate the combination of rises, drops, and horizontal runs exceeding the compressor start-up and pumping design limits, the following calculations must be made:

Step 1. Insert measured rise (R) into formula and multiply it by 1.7 to get a calculated rise.

Example: A condenser located 10 ft. above the ice machine has a 17 ft. calculated total (10 ft. x 1.7 = 17 ft.).

Step 2. Insert measured drop (D) into formula and multiply by 6.6 to get a calculated drop.

Example: A condenser located 10 ft. below the ice machine has a 66 ft. calculated total (10 ft. x 6.6 - 66 ft.).

Step 3. Insert measured horizontal distance into formula. No calculation is necessary.

Step 4. Add the calculated rise, calculated drop, and horizontal distance together to get the total calculated distance. If 150 ft. total calculated distance is exceeded, the condenser must be moved to a new location which permits proper equipment operation.

IMPORTANT

If a line set rise is followed by a line set drop, a second line set rise cannot be made.

-OR-

If a line set drop is followed by a line set rise, a second line set drop cannot be made.

MAXIMUM LINE SET DISTANCE FORMULA

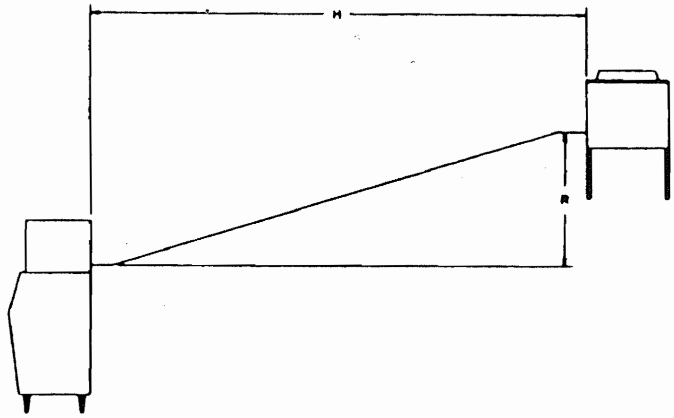
Step 1.
Measured Rise _______ x 1.7 = __________ Calculated Rise
(35 ft. Maximum)

Step 2.
Measured Drop _______ x 6.6 =__________ Calculated Drop
(15 ft. Maximum)

Step 3.
Measured Horizontal Distance = ______________ Horizontal Distance
(100 ft. Maximum)

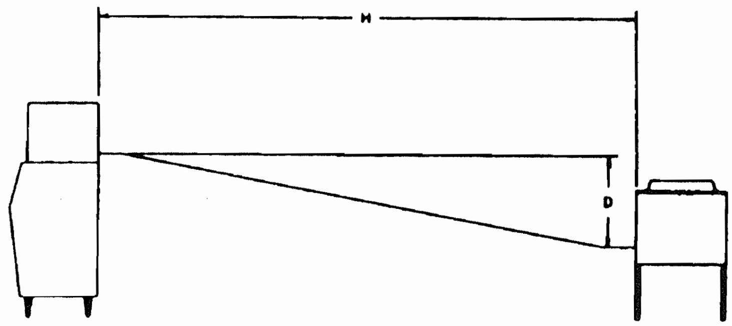
Step 4.
Total Calculated Distance = ______________ Total Calculated Distance
(150 ft. Maximum)

Combination of
Rise(s) with Horizontal



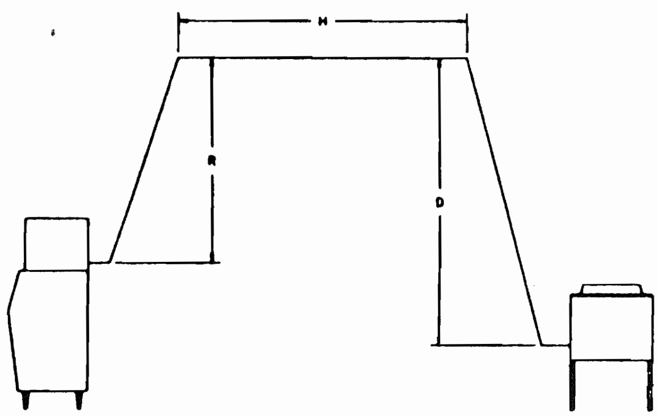
SV 1196

Combination of
Drop(s) with Horizontal



SV 1195

Combination of
Rise and Drop with Horizontal



SV 1194

LENGTHENING OR REDUCING LINE SET LENGTHS

In most cases, by routing the line set properly, shortening will not be necessary (refer to illustration). When shortening or lengthening is required, do so before connecting the line set to the ice machine or the remote condenser. This prevents the loss of refrigerant in the ice machine or the condenser.

The quick connect fittings on the line sets are equipped with Schrader valves. Use these valves to recover any vapor charge from the line set. When lengthening or shortening lines, apply good refrigeration practices and insulate new tubing. Do not change the tube sizes. Evacuate the lines and place approximately 5 oz. of vapor refrigerant charge in each line.

CONNECTION OF LINE SET

1. Remove the dust caps from the line set, the condenser, and the ice machine.
2. Apply refrigeration oil to the threads on the quick disconnect couplers before connecting them to the condenser.
3. Carefully thread the female fitting to the condenser or ice machine by hand.
4. Using the proper size wrench, tighten the couplings until they bottom out. Turn an additional 1/4 turn to ensure proper brass-to-brass seating. (If a torque wrench is used, liquid line: 10-12 ft. lbs; discharge line: 35-45 ft. lbs.).
5. Check all fittings for leaks.

CAUTION

If it is necessary to remove the connecting couplers from the ice machine or remote condenser, remove all refrigerant from the ice machine before attempting to remove the quick connect couplers.

ICE MACHINE HEAT REJECTION

Ice machines, like other refrigeration equipment, reject heat through the condenser. It is helpful to know the amount of heat rejected to accurately size air conditioning equipment when self-contained air-cooled ice machines are installed in air conditioned environments. **This heat rejection information is also necessary to evaluate 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 unit.

	Heat Rejected (BTU's/Hr)	
Model Series	**Air Conditioning***	**Peak**
J200	3,800	5,000
J250	4,000	5,200
J320	4,600	6,200
J420/J450	7,000	9,600
J600	9,000	13,900
J800	12,400	19,500
J1000	16,000	24,700
J1300	24,000	35,500
J1800	36,000	50,000

* Because the heat of rejection varies during the ice making cycle, the figure shown is an average.

Water-Cooled Models (Cooling Tower Applications)

A water-cooling tower installation does not require modification to 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 valve (inlet and outlet of the ice machine) to apply these types of systems to the ice machine.

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

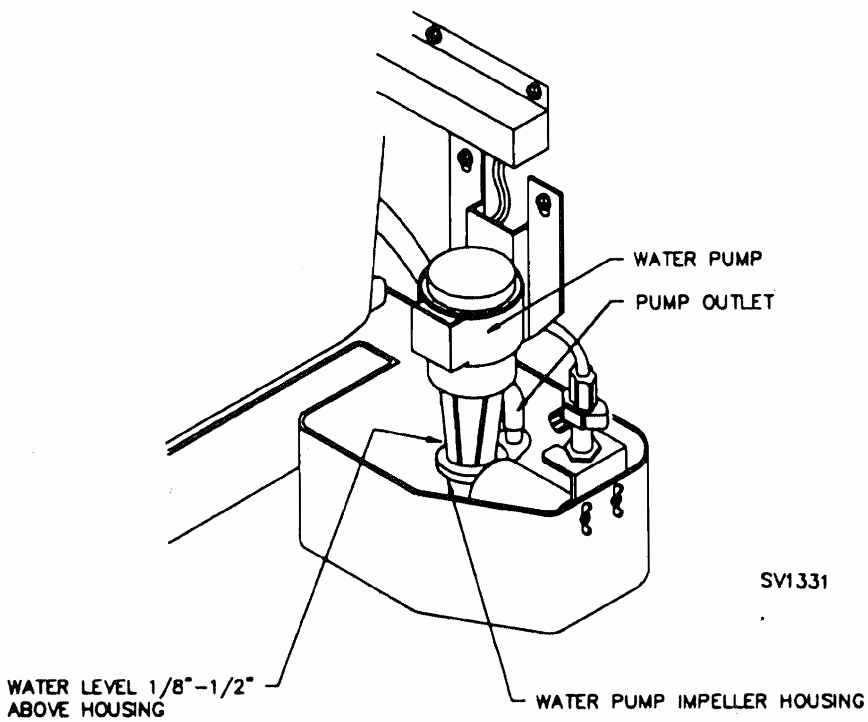
OPERATIONAL CHECKS

Your Manitowoc ice machine is 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, and after cleaning and sanitizing.

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

WATER LEVEL CHECK

1. Check the water level while the machine is in the freeze mode and the water pump is running.



WATER LEVEL CHECK

2. The water level is correct when it is 1/8" -1/2" above the water pump impeller housing.

   Carefully bend the float arm to achieve the correct water level.

ICE THICKNESS CHECK

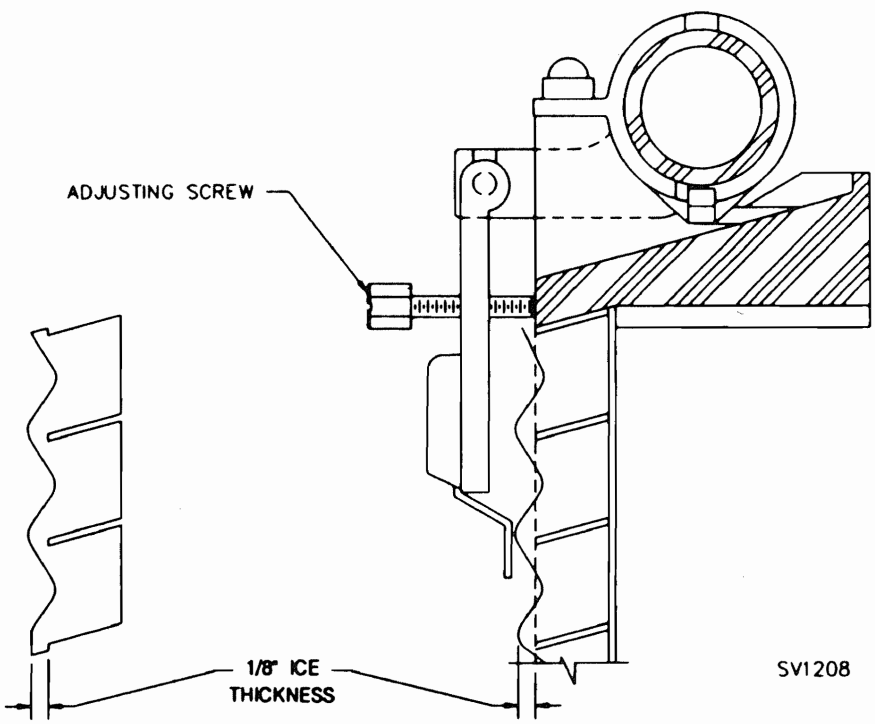
The ice thickness probe is factory set to maintain the ice bridge thickness at 1/8".

Make sure the water curtain is in place when performing the Ice Thickness Check. The water curtain prevents water from splashing out of the water trough.

Inspect the bridge connecting the cubes. The bridge should be approximately 1/8" thick. Follow the steps below if any adjustment is needed.

1. Turn the ice thickness probe adjustment screw clockwise to increase the bridge thickness or counterclockwise to decrease the bridge thickness.

> **NOTE**
>
> A 1/3 turn of the adjustment screw changes the ice thickness approximately 1/16".



ICE THICKNESS CHECK

2. Make sure that the ice thickness probe wires and bracket do not restrict movement of the probe.

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 or installation of AuCS™ accessory (Automatic Cleaning System). If required, an extremely dirty ice machine may be taken apart for cleaning and sanitizing.

> **WARNING**
>
> 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.

> **CAUTION**
>
> Do not mix Cleaner and Sanitizer solutions together. It is a violation of Federal law to use these products 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.

CLEANING PROCEDURES

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 OFF position and allow the ice to melt off the evaporator. **Never use anything to force ice from the evaporator. Damage may result.**

Step 2 To start self-cleaning, place the toggle switch in the CLEAN position. The water will flow through the water dump valve and down the drain. (New style control boards will also energize the CLEAN light.)

Step 3 Wait about one minute or until water starts to flow over the evaporator.

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

Ice Machine	Cleaner to be added
J200 J250 J320 J420 J450 J600 J800 J1000	2 ounces
J1300 J1800	4 ounces

Step 5 The ice machine will automatically time out a ten minute cleaning cycle, followed by six rinse cycles (de-energize the CLEAN light), and then stop. This entire cycle lasts approximately 25 minutes.

Step 6 When the self-cleaning stops, move the toggle switch to OFF position. Refer to sanitizing procedures on page 17.

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.

NOTE

After the toggle switch is placed in the ICE position, opening the curtain switch will interrupt the cleaning sequence. The sequence will resume from the point of interruption when the curtain re-closes.

SANITIZING PROCEDURES

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 OFF position and allow the ice to melt off the evaporator. **Never use anything to force ice from the evaporator. Damage may result.**

Step 2 To start self-sanitizing, place the toggle switch in the CLEAN position. The water will flow through the water dump valve and down the drain. (New style control boards will also energize the CLEAN light.)

Step 3 Wait about one minute or until water starts to flow over the evaporator.

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

Ice Machine	Sanitizer to be added
J200 J250 J320 J420 J450 J600 J800 J1000	3 ounces
J1300 J1800	6 ounces

Step 5 The ice machine will automatically time out a ten minute sanitizing cycle, followed by six rinse cycles (de-energize the CLEAN light), and then stop. This entire cycle lasts approximately 25 minutes.

If the bin requires sanitizing, remove all the ice and sanitize it with a solution of one ounce of sanitizer with up to 4 gallons of water.

Step 6 When the self-sanitizing stops, move the toggle switch to ICE position to start ice making again.

Step 7

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

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

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

> **NOTE**
>
> After the toggle switch is placed in the ICE position, opening the curtain switch will interrupt the cleaning sequence. The sequence will resume from the point of interruption when the curtain re-closes.

PROCEDURES TO CANCEL A SELF-CLEANING OR SANITIZING CYCLE AFTER IT HAS STARTED

If less then 45 seconds into cycle:

Move the toggle switch to the OFF position. The cycle is now canceled.

If more then 45 seconds into cycle:

Step 1 Move toggle switch to OFF position.

Step 2 Move toggle switch to ICE position.

Step 3 Move toggle switch to OFF position.
The cycle is now canceled.

AUTOMATIC CLEANING SYSTEM (AuCS™) ACCESSORY

This accessory monitors ice making cycles and initiates self-cleaning (or sanitizing) procedures automatically. The AuCS™ Accessory can be set to automatically clean or sanitize the ice machine every 2, 4 or 12 weeks.

DANGER

Refer to the AuCS™ Accessory Installation-Use and Care Guide for complete details on the installation, operation, maintenance and cautionary statements of this accessory.

AUTOMATIC OPERATION

The following occurs when the toggle switch is in the ice making position:

- The ice machine control board counts the number of ice harvest cycles.
- The AuCS™ accessory interrupts the ice making mode and starts the automatic cleaning (or sanitizing) mode when the harvest count equals the "frequency of cleaning" setting of the AuCS™.
- When the automatic cleaning (or sanitizing) cycle is complete (approximately 25 minutes), ice making resumes automatically.
- The harvest count is reset to zero after the AuCS™ cycle is completed.

NOTE

Opening the curtain switch will interrupt the cleaning or sanitizing sequence. The sequence will resume from the point of interruption when the curtain re-closes.

MANUAL START OPERATION

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 OFF position and allow the ice to melt off the evaporator. **Never use anything to force ice from the evaporator. Damage may result.**

Step 2 To start the Automatic Cleaning System (AuCS™), place the toggle switch in the CLEAN position. The water will flow through the water dump valve and down the drain. (New style control boards will also energize the CLEAN light.) The AuCS will then automatically add cleaner or sanitizer to the ice machine.

Step 3 The ice machine will automatically time out a ten minute cleaning (or sanitizing) cycle, followed by six rinse cycles (de-energize the CLEAN light), and then stop. This entire cycle lasts approximately 25 minutes.

Step 4 After the cleaning (sanitizing) cycle stops move the toggle switch to ICE position.

Step 5

A. The ice machine may be set to start and finish a self-cleaning or sanitizing 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.

REMOVAL OF PARTS FOR CLEANING/SANITIZING

IMPORTANT

The following procedures and illustrations are typical. Procedures may vary slightly by model.

Water Dump Valve Operation Check

1. Locate the water dump valve in the ice machine.
2. Set the ICE/OFF/CLEAN switch to ICE.
3. Check the dump valve's clear plastic outlet drain hose (refer to illustration) for leakage while the ice machine is in the freeze mode.
4. If the dump valve is leaking, remove; disassemble and clean it.
5. Do not remove the dump valve if it is not leaking. Follow the normal cleaning procedures.

Water Dump Valve Removal

WARNING

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

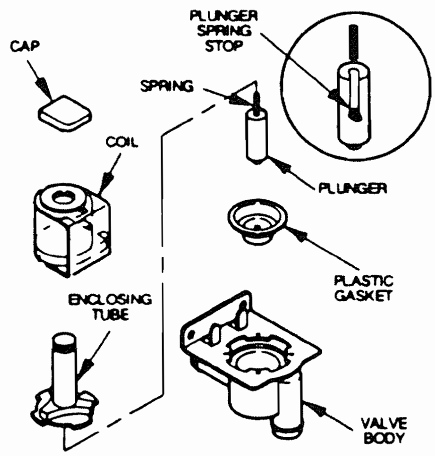
1. Remove the water dump valve shield from its mounting bracket (if applicable).
2. Lift and slide the coil retainer cap from the top of the coil.
3. Leaving the wires attached, lift the coil assembly off of the valve body (enclosing tube). Note the position of the coil assembly on the valve before removing it. Make sure the coil is in the same position when reassembling the valve.
4. Press the enclosing tube's plastic nut down and rotate it 1/4 turn. Remove the enclosing tube, plunger and plastic gasket from the valve body.

The water dump valve can easily be cleaned at this point, without removing the entire valve body.

You do not need to remove the spring from the plunger when cleaning. If the spring is removed, insert the spring's **flared** end into the slotted opening in the top of the plunger, until it comes in contact with the plunger spring stop. Do not stretch or damage the spring when cleaning.

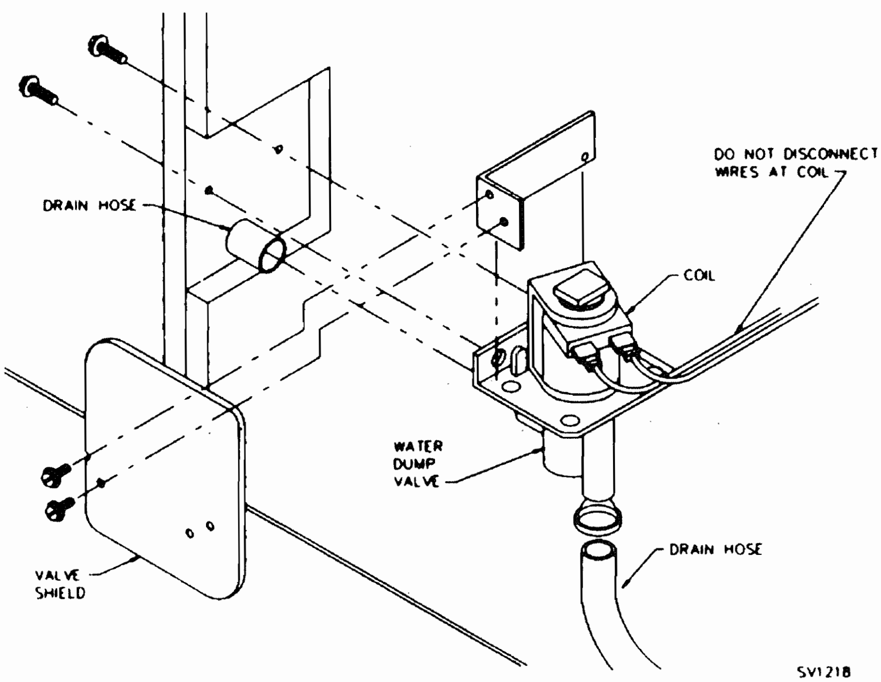
IMPORTANT

The plunger and the inside of enclosing tube must be thoroughly dry before reassembling.



DUMP VALVE DISASSEMBLY

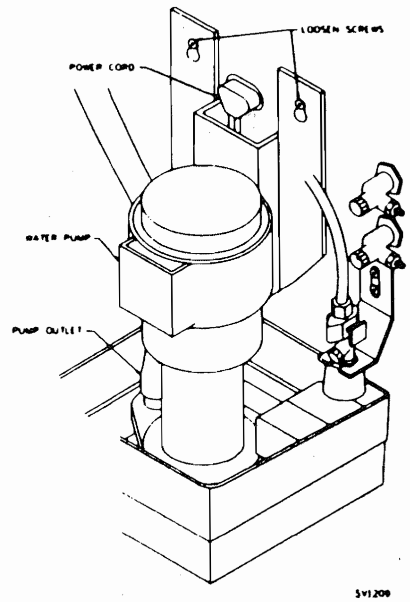
5. Remove the valve body.
   a. Remove the tubing from the dump valve by twisting the clamps off.
   b. Remove the two screws securing the dump valve and the mounting bracket.



DUMP VALVE REMOVAL

Water Pump Removal

1. Disconnect the water pump power cord.



WATER PUMP REMOVAL

2. Disconnect the hose from the pump outlet.
3. Loosen the two screws which hold the pump mounting bracket to the bulkhead.
4. Lift the pump and bracket assembly off screws.

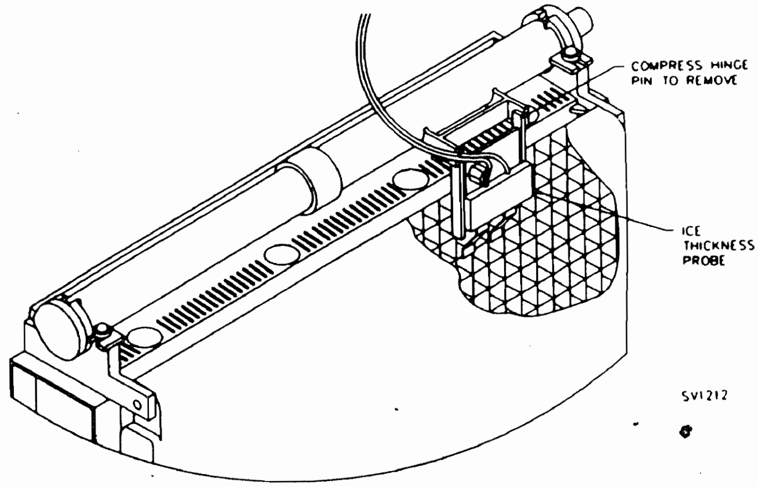
Ice Thickness Probe Removal

1. Remove the ice thickness probe by compressing the side of the probe near the top hinge pin and removing it from the bracket.

> **NOTE**
>
> The ice thickness probe can easily be cleaned at this point without proceeding to Step 2.

> **WARNING**
>
> Disconnect the electric power to ice machine at the electric service switch box before proceeding.

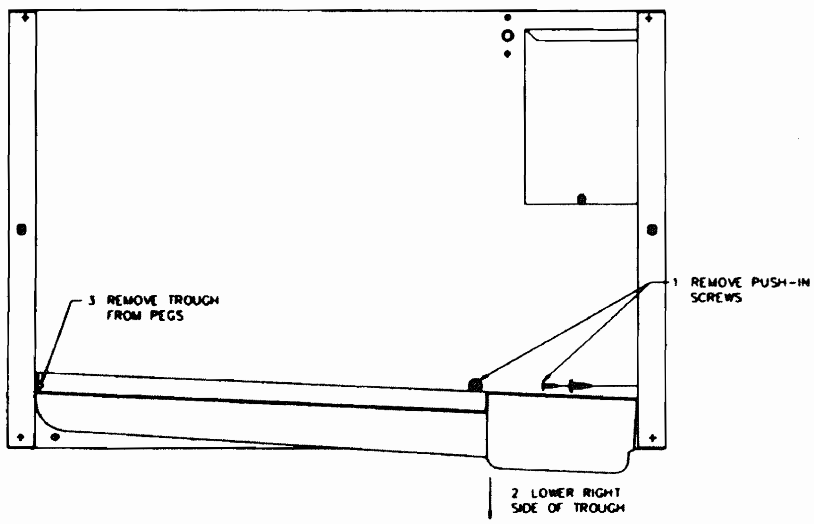
2. If complete removal is required, disconnect the wire leads from the unitized sensor board inside the electrical control box.



ICE THICKNESS PROBE REMOVAL

Water Trough Removal

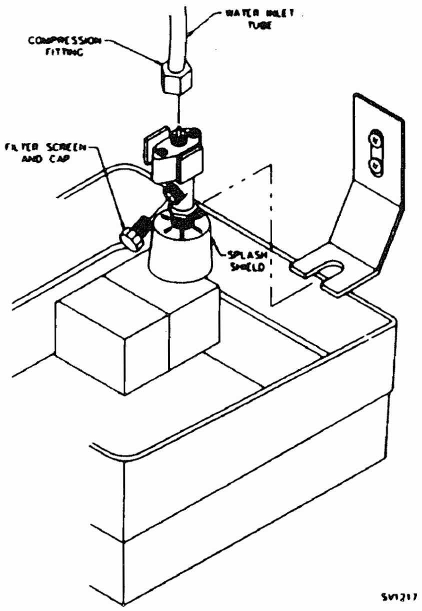
1. Remove the screws holding the sump trough in place.
2. Lower the right side of the trough into the bin.
3. Disengage the left side of the trough from its holding pegs and remove the trough from the ice machine.



WATER TROUGH REMOVAL

Float Valve Removal

1. Turn the valve splash shield counter-clockwise one or two turns. Pull the valve forward, off the mounting bracket.
2. Disconnect the water inlet tube from the float valve at the compression fitting.
3. Remove the filter screen and cap for cleaning.

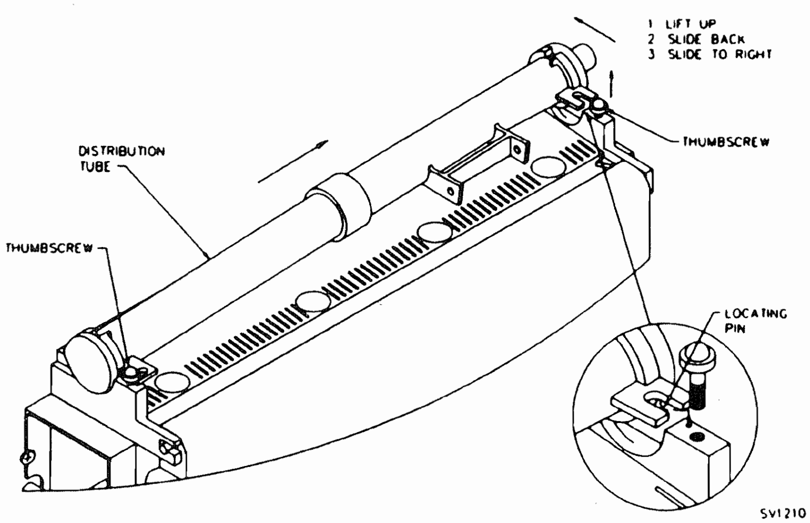


FLOAT VALVE REMOVAL

Water Distribution Tube Removal

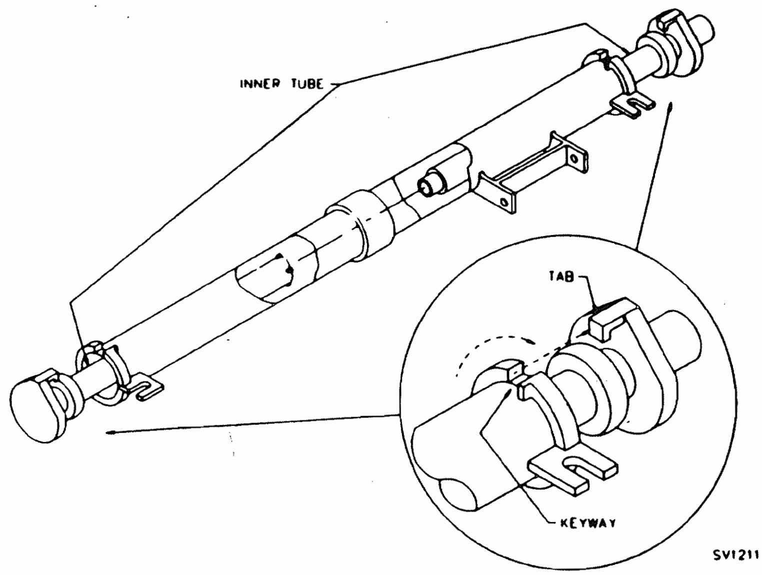
1. Disconnect the water hose from the distribution tube.
2. Loosen the two thumbscrews which hold the distribution tube in place.
3. Lift the right side up to clear the locating pin, then slide it back and to the right.

> **IMPORTANT**
>
> Do not force this removal. Be sure the locating pin clears the hole before sliding it out.



WATER DISTRIBUTION TUBE REMOVAL

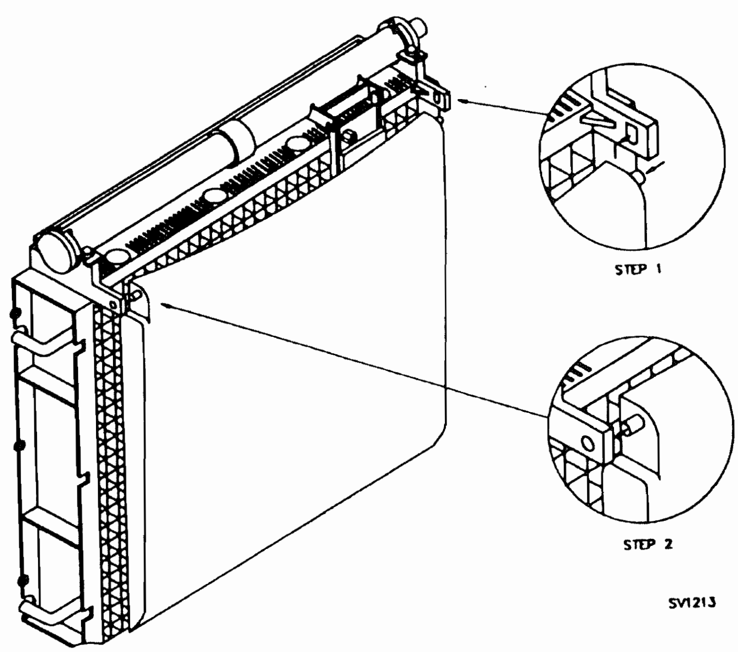
4. Disassemble for cleaning.
   a. Twist both of the inner tube ends until the tabs line up with the keyways.
   b. Pull the inner tube ends outward.



WATER DISTRIBUTION TUBE DISASSEMBLY

Water Curtain Removal

1. Gently flex the curtain in the center and remove it from the right side.
2. Slide the left pin out.



WATER CURTAIN REMOVAL

WATER TREATMENT/FILTRATION

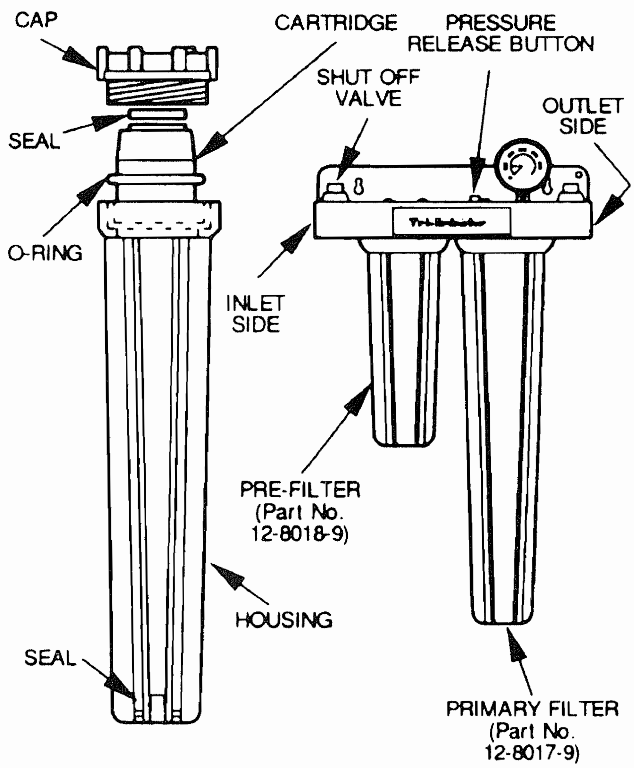
Local water conditions may require the installation of water treatment to inhibit scale formation, filter sediment, and remove chlorine taste and odor. Consult your local dealer or distributor for information on Manitowoc's full line of Tri-Liminator filtration systems.

Replace the primary filter cartridge every six months to ensure maximum filtration efficiency. The filter gauge indicates if earlier replacement is necessary (below 20 psig).

Tri-Liminator systems include a prefilter and should not require primary filter replacement prior to six months usage. If replacement is needed, replace the prefilter first.

Replacement Procedure

1. Turn off the water supply using the inlet shut-off valve.
2. Depress the pressure release button to relieve pressure.
3. Unscrew the housing from the cap (refer to illustration).
4. Remove the used cartridge from the housing and discard.



WATER FILTRATION

5. Remove the O-ring from the groove in the housing and wipe the groove and O-ring clean. Relubricate the O-ring with a coating of clean petroleum jelly (Vaseline). Replace the O-ring and press it down into the groove with two fingers.
6. Insert a new cartridge into the housing. Make sure that it slips down over the housing standpipe.
7. Screw the housing onto the cap and **hand tighten. Do not over-tighten or use spanner wrench.**
8. Repeat steps 3 through 7 for each filter housing.
9. Turn on the water supply to allow the housing (and filter) to slowly fill with water.
10. Depress the pressure release button to release trapped air from the housing. Check for leaks.

REMOVAL FROM SERVICE/WINTERIZATION

You must take special precautions if the ice machine is to be removed from service for extended periods, or exposed to ambient temperatures of 32°F (0°C) or below.

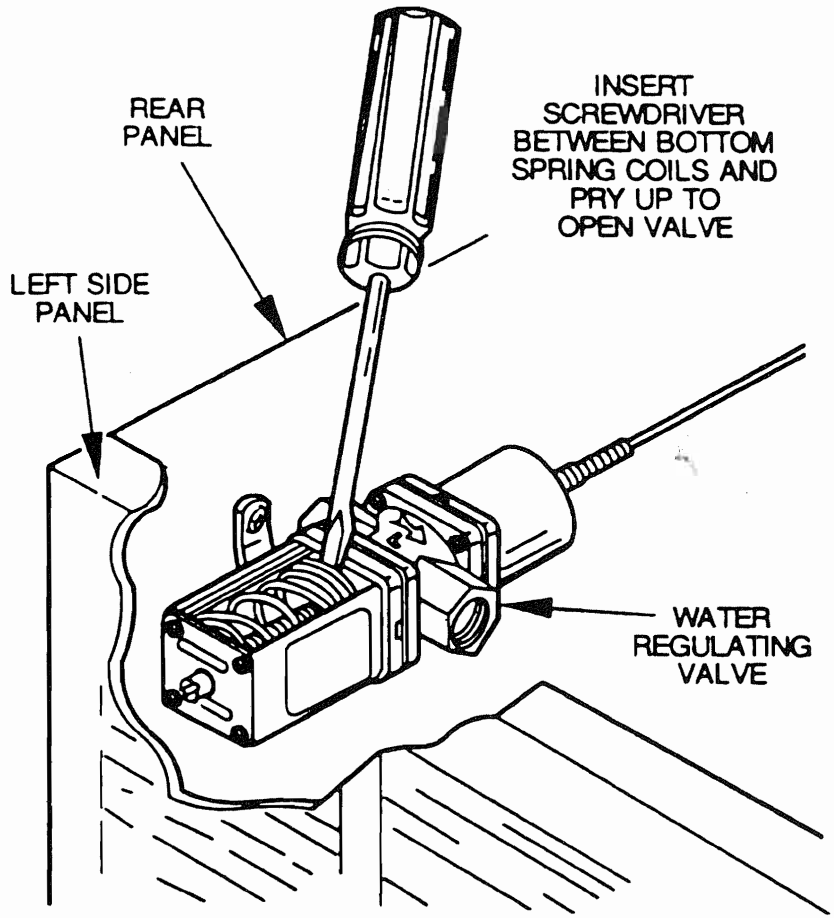
> **CAUTION**
>
> If water is allowed to remain in the ice machine in freezing temperatures, severe damage to some components could result. Damage of this nature is not covered by warranty.

Self-Contained Air-Cooled Machines

1. Disconnect the electric power at the circuit breaker or the electric service switch.
2. Turn off the water going to the ice machine.
3. Remove the water from the sump trough.
4. Disconnect the incoming ice making water line, and drain the line at the rear of the ice machine.
5. Blow compressed air in both the incoming water and drain openings (in the rear of the machine) until no more water comes out of the float valve and drain.
6. Be sure no water is trapped in any of the machine's water lines, drain lines, distribution tubes, etc.

Water-Cooled Machines

1. Perform all the procedures listed under "Self-Contained Air-Cooled Machines" above.
2. Disconnect the incoming water and drain lines from the water-cooled condenser.
3. Pry open the water regulating valve by inserting a large standard screwdriver between the bottom spring coils of the valve. Pry the spring upward to open the valve (refer to illustration).
4. Hold the valve open and blow compressed air through the condenser until no water remains.



MANUALLY OPEN
WATER REGULATING VALVE

Remote Machines

1. Turn the ICE/OFF/CLEAN switch to OFF.
2. Frontseat (shut off) the receiver service valve. (Hang a tag by the toggle switch as a reminder to open the receiver service valve before restarting.)
3. Perform all the procedures listed under "Self-Contained Air-Cooled Machines."

Automatic Cleaning System (AuCS™) Accessory

Refer to the AuCS™ Accessory Installation-Owner/Operator Use and Care Guide for Winterization of AuCS™ Accessory.

– NOTES –

SEQUENCE OF OPERATION

SELF-CONTAINED AIR & WATER-COOLED J200/J250/J320/J420/J450/J600 J800/J1000/J1300/J1800

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 hot gas 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 remains on throughout the entire Freeze and Harvest Sequences. The hot gas valve(s) remains on for 5 seconds during initial compressor start-up and then shuts off. At the same time the compressor starts, the fan condenser motor (air-cooled models) is supplied 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 power.)

FREEZE SEQUENCE

3. **Prechill** — The compressor is on for 30 seconds prior to water flow, to prechill the evaporator.

4. **Freeze** — The water pump restarts after the 30 second prechill. An even flow of water is directed across the evaporator and into each cube cell, where it freezes. When sufficient ice has formed, the water flow (not the ice) contacts the ice thickness probes. After approximately 7 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.

HARVEST SEQUENCE

5. **Water purge —** The water pump continues to run and the water dump valve energizes for 45 seconds, to purge the water in the sump trough. After the 45 second water purge, the water pump and dump valve de-energize. The hot gas valve(s) also opens at the beginning of the water purge, to divert hot refrigerant gas into the evaporator.

6. **Harvest —** The hot gas 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 (steps 3 - 4).

AUTOMATIC SHUT-OFF

7. 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 7 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.

SELF-CONTAINED AIR AND WATER COOLED

ICE MAKING SEQUENCE of OPERATION	CONTROL BOARD RELAYS				CONTACTOR		LENGTH of TIME
	1 WATER PUMP	**2** HOT GAS VALVE	**3** WATER DUMP VALVE	**4** CONTACTOR COIL	**4A** COMPRESSOR	**4B** CONDENSER FAN MOTER	
INITIAL START-UP / START-UP AFTER AUTO SHUT-OFF: 1. Water Purge	**on**	**on**	**on**	**off**	**off**	**off**	*45 Seconds*
2. Refrigeration system start-up	**off**	**on**	**off**	**on**	**on**	May cycle **on/off**	*5 Seconds*
FREEZE SEQUENCE: 3. Prechill	**off**	**off**	**off**	**on**	**on**	May cycle **on/off**	*30 Seconds*
4. Freeze	**on**	**off**	**off**	**on**	**on**	May cycle **on/off**	*Until 7 sec. water contact with ice thickness probe*

SELF-CONTAINED AIR AND WATER COOLED – CONTINUED

ICE MAKING SEQUENCE of OPERATION	CONTROL BOARD RELAYS				CONTACTOR		LENGTH of TIME
	1 WATER PUMP	2 HOT GAS VALVE	3 WATER DUMP VALVE	4 CONTACTOR COIL	4A COMPRESSOR	4B CONDENSER FAN MOTER	
HARVEST SEQUENCE:							
5. Water Purge	**on**	**on**	**on**	**on**	**on**	May cycle **on/off**	*45 Seconds*
6. Harvest	**off**	**on**	**off**	**on**	**on**	May cycle **on/off**	*Bin switch activation*
7. AUTO SHUT-OFF	**off**	**off**	**off**	**off**	**off**	**off**	*Until bin switch re-closes*

SEQUENCE OF OPERATION

REMOTE J450/J600/J800
J1000/J1300/J1800

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 hot gas and harvest pressure regulating (HPR) solenoid valves also energize during water purge, although they stay on for an additional 5 seconds (50 second total on time) during the initial refrigeration system start-up.

2. **Refrigeration system start-up** — The compressor and liquid line solenoid valve energize after the 45 second water purge and remain on throughout the entire Freeze and Harvest Sequences. The hot gas and HPR solenoid valves remain on for 5 seconds during initial compressor start-up and then shut off.
   The remote condenser fan motor starts at the same time the compressor starts and remains on throughout the entire Freeze and Harvest Sequences.
   (The compressor and condenser fan motor are wired through the contactor, therefore, anytime the contactor coil is energized, the compressor and fan motor are on.)

FREEZE SEQUENCE

3. **Prechill** — The compressor is on for 30 seconds prior to water flow, to prechill the evaporator.

4. **Freeze** — The water pump restarts after the 30 second prechill. An even flow of water is directed across the evaporator and into each cube cell, where it freezes.
   When sufficient ice has formed, the water flow (not the ice) contacts the ice thickness probes. After approximately 7 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.

HARVEST SEQUENCE

5. **Water purge** — The water pump continues to run and the water dump valve energizes for 45 seconds, to purge the water in the sump trough. After the 45 second water purge, the water pump and dump valve de-energize. The hot gas valve(s) and HPR solenoid valve also open at the beginning of the water purge.

6. **Harvest** — The HPR valve and the hot gas valve(s) remain 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 (steps 3 - 4).

AUTOMATIC SHUT-OFF

7. 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 7 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 enongh ice has been removed from the storage bin to allow the ice to drop 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 l - 2) provided the 3 minute delay period is complete.

REMOTE

ICE MAKING SEQUENCE of OPERATION	CONTROL BOARD RELAYS				CONTACTOR		LENGTH of TIME
	1 WATER PUMP	**2** a) HOT GAS VALVE b) H.P.R SOLENOID	**3** WATER DUMP VALVE	**4** a) CONTACTOR COIL b) LIQUID LINE SOLENOID	**4A** COMPRESSOR	**4B** CONDENSER FAN MOTER	
INITIAL START-UP / START-UP AFTER AUTO SUT-OFF: 1. Water Purge	on	on	on	off	off	off	*45 Seconds*
2. Refrigeration System Start-up	off	on	off	on	on	on	*5 Seconds*
FREEZE SEQUENCE: 3. Prechill	off	off	off	on	on	on	*30 Seconds*
4. Freeze	on	off	off	on	on	on	*Until 7 sec. water contact with ice thickness probe*

REMOTE - CONTINUED

ICE MAKING SEQUENCE of OPERATION	CONTROL BOARD RELAYS				CONTACTOR		LENGTH of TIME
	1 WATER PUMP	**2** a) HOT GAS VALVE b) H.P.R SOLENOID	**3** WATER DUMP VALVE	**4** a) CONTACTOR COIL b) LIQUID LINE SOLENOID	**4A** COMPRESSOR	**4B** CONDENSER FAN MOTER	
HARVEST SEQUENCE:							
5. Water Purge	**on**	**on**	**on**	**on**	**on**	**on**	*45 Seconds*
6. Harvest	**off**	**on**	**off**	**on**	**on**	**on**	*Bin switch activation*
7. AUTO SHUT-OFF	**off**	**off**	**off**	**off**	**off**	**off**	*Until bin switch re-closes*

ELECTRICAL SYSTEM

BIN SWITCH

Function

Bin switch operation is controlled by movement of the water curtain and has two functions:

1. The momentary opening of the bin switch terminates the harvest sequence and returns the ice machine to the freeze sequence.

2. Automatic ice machine shut off. The bin switch can be opened and closed at any point during the freeze cycle without interfering with the electrical control sequence. At the end of a harvest sequence, when the storage bin is full, the last sheet of cubes hold the water curtain open. When the bin switch is held open for more than 7 seconds, the ice machine will shut off.
   The ice machine remains off until enough ice has been removed from the storage bin to allow the ice to drop 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, provided the 3 minute delay period is complete.

Specifications

The bin switch is a magnetically operated reed switch. The magnet is attached to the lower right hand corner of the water curtain, the switch portion is attached to the evaporator mounting bracket.

The bin switch is connected into 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.

Check Procedure Using Light on Control Board

1. Place the toggle switch in the OFF position.

2. Watch bin switch light (bottom one) on the control board.

3. With the water curtain toward the evaporator, the switch must close. The light "on" indicates the switch properly closed.

(Continued on next page)

4. With the water curtain pulled away from the evaporator, the switch must open. The light "off" indicates the switch opened properly.

Bin Switch Ohm Test

Step 1 Isolate bin switch by disconnecting wires.

Step 2 Connect an accurate ohmmeter to the disconnected bin switch leads. Set to 10,000 ohm scale.

Step 3 Cycle bin switch by opening and closing the water curtain.

With switch open: A resistance reading of LESS than 30,000 ohms indicates a defective switch.

With switch closed: A resistance reading GREATER than 70 ohms indicates a defective switch.

IMPORTANT

Any reading between 70 and 30,000 ohms, regardless of curtain position, indicates a defective bin switch.

Water Curtain Removal

The water curtain must be on (Bin Switch closed) to start ice making. After it has started, the water curtain can be removed and replaced at any point during the freeze cycle without interfering with the electrical control sequence. If the ice machine goes into harvest while the curtain is removed, one of the following will happen:

a. If the water curtain remains off:

   When the harvest cycle time reaches 3.5 minutes and the bin switch is not reclosed, the ice machine stops as though the bin is full.

b. If the water curtain is put back on:

   When the bin switch recloses prior to reaching the 3.5 minute point, the ice machine immediately returns to another freeze sequence.

DIAGNOSING COMPRESSOR (AND START COMPONENTS) ELECTRICAL FAILURES

Compressor will not start or will trip repeatedly on overload.

A. CHECK RESISTANCE (OHM) VALUES

Compressors winding can have very low OHM values. The use of properly calibrated meter is recommended.

The resistance test is done after the compressor is cool. The compressor dome should be cool enough to touch (approximately 120°F/48.9°C) to assure overload is closed and resistance readings will be accurate.

1. Single phase compressors
    a. Disconnect power to cuber; wires from compressor terminals.
    b. With wires removed, the resistance values must be within guidelines for the compressor. The resistance value from C to S and C to R added together, should equal value from S to R.
    c. An open overload will give a resistance reading from S to R and an "Open" reading from C to S and C to R. Allow the compressor to cool, then recheck readings.

2. Three phase compressors
    a. Disconnect power to cuber; remove wires from compressor terminals.
    b. With wires removed, the resistance values must be within guidelines for the compressor. L1 to L2; L2 to L3; and L1 to L3, should all be equal to each other.
    c. An open overload will give a resistance reading of "Open" from L1 to L2; L2 to L3; and L1 to L3. Allow compressor to cool, then recheck reading.

B. CHECK MOTOR WINDINGS TO GROUND

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

C. DETERMINE IF THE COMPRESSOR IS "SEIZED"
Check amp draw while compressor is trying to start.

1. Compressor drawing locked rotor, the two likely causes would be a defective starting component or a mechanically seized compressor. To determine which you have:
   a. Install high and low side gauges.
   b. Try to start compressor (watch pressures closely).
   c. If pressures do not move, compressor is seized up. Replace compressor.
   d. If pressures move, the compressor is turning slowly and is not seized. Check capacitors and start relay.

2. Compressor drawing high amps
   The continuous amperage draw on start-up should not near the maximum fuse size as indicated on the serial tag.
   Check the following:
   Low voltage — The voltage at the time the compressor is trying to start must be within ±10% of the nameplate voltage.

D. DIAGNOSING CAPACITORS AND PTCR
1. Capacitors
   If the compressor attempts to start, or hums and trips the overload protector, you must check the starting components before replacing a compressor.
   a. Capacitors can show visual evidence of failure, such as a bulged terminal end or a ruptured membrane. **Do not assume a capacitor is good** if no visual signs are evident.
   b. A good test is to install a known good substitute capacitor.
   c. Use of a capacitor tester is recommended when checking a suspect capacitor. Remember to clip the bleed resistor off the capacitor terminals before testing.

2. PTCR
   Refer to Positive Temperature Coefficient Resistors (PTCR's), page 44, for operation and diagnostic procedures.

POSITIVE TEMPERATURE COEFFICIENT RESISTORS (PTCR's)

PTCR's (Positive Temperature Coefficient Resistors) are made from high purity semi-conducting ceramics. What makes the PTCR such a useful device is its Resistance versus Temperature characteristic. It has the ability in severe duty cycle applications to repeatedly switch (virtually stop) large currents at line voltages. It exhibits a low resistance over a wide (lower) temperature range, but upon reaching a certain (higher) temperature it undergoes a dramatic increase in resistance, virtually stopping current flow. When the source of heat is removed, the PTCR returns to its initial base resistance.

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 Permanent Split Capacitor (PSC) single phase compressors, which have a means to equalize pressures prior to 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 hot gas valve (and HPR valve on remotes) will energize for 45 seconds prior to compressor starting. The hot gas 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.

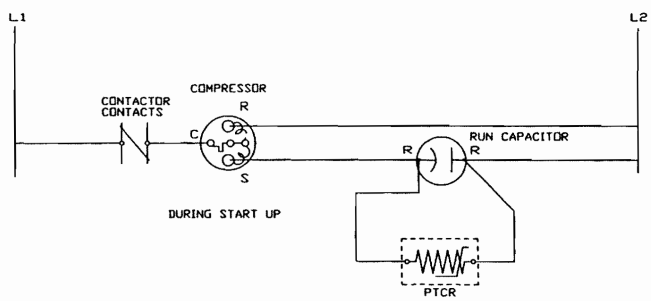
6. It is important to provide time between compressor restarts to allow the PTCR to cool down to near its initial temperature (low resistance). When the contactor opens to stop the compressor, the PTCR cools down to its initial low resistance and is again ready to provide starting torque assistance. To assure the PTCR has cooled down, during an automatic shut-off, the J model ice machines have a built in 3 minute off time before it can restart.

J Model Automatic Shut-off and Restart

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 7 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.

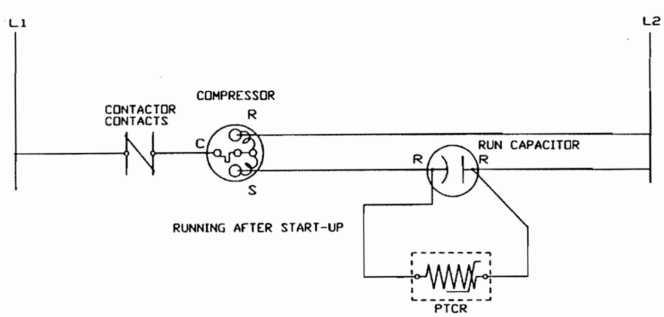
The ice machine remains off until enough ice has been removed from the storage bin to allow the ice to fall clear of the water curtain. As the water curtain swings back to the operating position, the bin switch re-closes and the ice machine restarts, provided the 3 minute delay period is complete.

Start-up (first 0.25 - 1 second)



SV1506

After Start-up (current through run capacitor)



SV1507

Trouble Shooting PTCR's

Why a good PTCR might 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 60°F (15.6°C) when the compressor starts, its temperature will increase steadily until it reaches 260°F (126.6°C), when it will stop current flow. This net increase of 200°F (111°C) will take about 0.25 to 1 second. On the other hand, if the PTCR starts out at 160°F (71.1°C) when the compressor is turned on, its temperature must increase only l00°F (55.5°C) before it reaches 260°F (126.6°C) and stops current flow. This is half the number of degrees, and will take about half the time before stopping current flow. In this case, high starting torque would be applied for only 0.125 to 0.50 seconds, not 0.25 to 1.0 seconds and the compressor may not start.

There are several reasons why a good PTCR may be too hot to operate properly upon start-up:

1. Moving the toggle switch from off to ice prior to allowing the PTCR to cool. The ice machine must be off for approximately 3 minutes for the PTCR to cool properly.

2. Opening and closing the disconnect while servicing the ice machine. During installation and service, there are many reasons why a service technician may wish to restart the ice machine shortly after it was shut off.

3. Control box temperature is too high. Although not common in ice machines, very high air temperatures (intense sunlight, etc.) can greatly increase the temperature of the control box and everything in it. These warmer temperatures may extend the time required for the PTCR to cool.

If the compressor should short cycle before the PTCR is able to cool enough to start the compressor, the compressor may hum but not rotate (locked rotor). Eventually the compressor overload may open. To restart, turn the toggle switch off and wait for the compressor and PTCR to cool.

Other problems that may lead to a compressor start-up failure with a good PTCR in a new, properly wired ice machine:

1. The voltage measured at the compressor during start-up, is too low. Manitowoc ice machines are rated at ±10% of nameplate line voltage during compressor start-up. Example: The voltage of a 208-230 rated machine must not drop below 187 volts or go above 253 volts during compressor start-up. (208-10% (20.8) = 187.2), (230+l0% (23) = 253)

2. The compressor discharge and suction pressures are not approximately the same during start-up. 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 hot gas valve (and HPR valve on remotes) will energize for 45 seconds prior to compressor starting. The hot gas valve (and HPR valve -

remotes) remains on for an additional 5 seconds while the compressor is starting. Assure this start-up sequence of energizing the hot gas valve is occurring prior to assuming something is wrong with the PTCR.

Checking the PTCR

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

Step 1 Visually inspect the PTCR

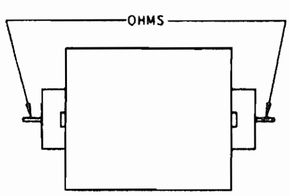
Assure the PTCR has no signs of physical damage. Replace if cracked or damaged. The PTCR case temperature may reach 210°F(100°C) while the compressor is running. This hot case temperature is normal, therefore do not change a PTCR because it is hot.

Step 2 Measure the PTCR resistance

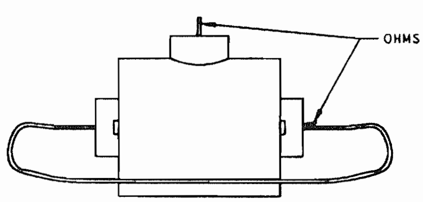
A. Wait at least 10 minutes for the PTCR to cool and then remove it from the ice machine.

B. Measure the resistance as indicated in the chart and figures below. If the measured resistance of the room temperature PTCR falls outside of the ranges indicated, replace it.

Manitowoc Ice Machine	**PTCR Part Numbers**		**Resistance** (Ohm reading at room temp.)
	Manitowoc	Cera-Mite	
J200 J250 J320 J420 J450	8505003	305C20	22 to 50 ohms
J600 J800 J1000	8504993	305C19	18 to 40 ohms
J1300 J1800	8504913	305C9	8 to 22 ohms



Part Number 8505003 and 8504993



Part Number 8504913

Leave jumper wire in place and measure between center tab and end tab.

DISCHARGE LINE THERMISTOR

NOTE

The discharge line thermistor is not used on later production J-model ice machines. The part has been removed due to the redundancy of safety limits 3 and 4. Any fault that would stop the ice machine on safety limit 3 or 4 would also stop the ice machine on safety limit 1 or 2.

When replacing an old style control board with a new style control board, the thermistor will no longer be used.

Function

Senses the compressor discharge line temperature. This is used in conjunction with the unitized ice sensor safety limits to stop the ice machine if discharge line temperature falls below 85°F (29.4°C) or above 255°F (123.9 °C).

Specifications

100,000 Ohms +/- 2% @ 77°F (25°C)

IMPORTANT

Use only Manitowoc thermistors.

Thermistors generally fail because of moisture or physical damage. Manitowoc J-Model discharge line thermistors are encased in a specially designed, moisture sealed, aluminum block. This eliminates physical damage and moisture related concerns.

Check Procedure

Verify that the thermistor resistance is accurate and corresponding to both high and low temperature ranges.

Step 1. Disconnect discharge line thermistor from terminals 1A and 1B on unitized ice sensor board. Connect ohm meter to isolated thermistor wire leads.

Step 2. Using a quality temperature meter capable of taking readings on curved copper lines, attach temperature

IMPORTANT

Do not simply "insert" probe (or other sensing device) under insulation. It must be "attached to" and reading the **actual** temperature of the copper compressor discharge line.

meter sensing device to compressor discharge line next to thermistor aluminum block.

Step 3. With the ice machine running, verify the thermistor resistance (Step 1) corresponds to the temperature of the thermistor block on the Compressor Discharge Line (Step 2). It is normal for the Compressor Discharge Line temperature to rise during the freeze cycle and lower during the harvest cycle. Use the freeze cycle to verify that thermistor is accurate at higher temperatures and the harvest cycle to verify it is accurate at lower temperatures.

NOTE

If ice machine is inoperable, the thermistor may be removed and placed for a short period of time in an ice bath and then in boiling water to verify accuracy.

Discharge Line Thermistor Temperature/Resistance

As the temperature Rises at the thermistor "block", the resistance Drops

Temperature (of thermistor "block")		Resistance
°F	°C	K ohms (x 1000)
32°	0° (Ice Bath)	376.7 -283.6
50° - 60°	10.0° -15.6°	198.9 -153.1
60° - 70°	15.6° -21.1°	153.1 -118.8
70° - 80°	21.1° -26.7°	118.8 - 92.9
80° - 90°	26.7° -32.2°	92.9 - 73.3
90° - 100°	32.2° -37.8°	73.3 - 58.2
100° - 110°	37.8° -43.3°	58.2 - 46.6
110° - 120°	43.3° -48.9°	46.6 - 37.5
120° - 130°	48.9° -54.4°	37.5 - 30.5
130° - 140°	54.4° -60.0°	30.5 - 24.9
140° - 150°	60.0° -65.6°	24.9 - 20.4
150° - 160°	65.6° -71.1°	20.4 - 16.8
160° - 170°	71.1° -76.7°	16.8 - 14.0
170° - 180°	76.7° -82.2°	14.0 - 11.7
180° - 190°	82.2° -87.8°	11.7 - 9.8
190° - 200°	87.8° -93.3°	9.8 - 8.2
200° - 210°	93.3° -98.9°	8.2 - 7.0
212°	100° (boiling water)	7.3 - 6.2
220° - 230°	104.4° -110.0°	5.9 - 5.1
230° - 240°	110.0° -115.6°	5.1 - 4.3
240° - 250°	115.6° -121.1°	4.3 - 3.7
250° - 260°	121.1° -126.7°	3.7 - 3.3

IMPORTANT

If ohm meter reads "O.L.", check "scale setting" on meter before changing thermistor.

ICE/OFF/CLEAN TOGGLE SWITCH

Function
To place ice machine in ICE, OFF, or CLEANING mode of operation.

Specifications
Double pole, double throw switch

The toggle switch is connected into a "varying" low D.C. voltage circuit. (Voltage does not remain constant.)

Check Procedure

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

1. Inspect toggle switch for correct wiring.
2. Isolate toggle switch from other components by disconnecting all wires from switch.
   Or disconnect molex connector from circuit board and wire #69 from toggle switch.
3. Check across toggle switch terminals using a calibrated ohmmeter. Correct readings should be as follows:

   a. Switch set at ICE:

Terminals	OHM reading
66-62	Open
67-68	Closed
67-69	Open

   b. Switch set at CLEAN:

Terminals	OHM reading
66-62	Closed
67-68	Open
67-69	Closed

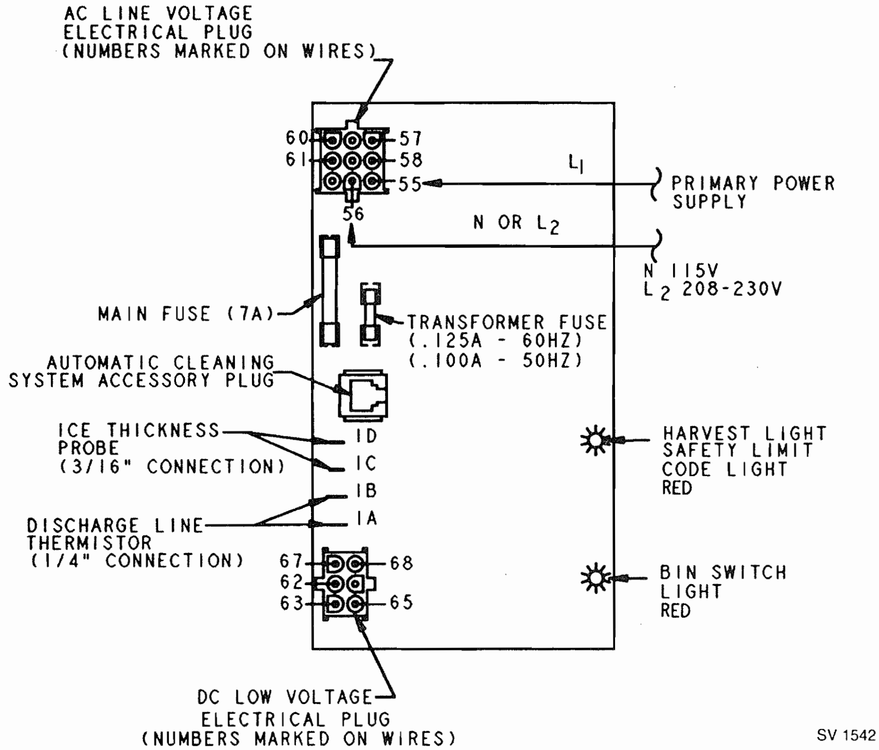
   c. Switch set at OFF:

Terminals	OHM reading
66-62	Open
67-68	Open
67-69	Open

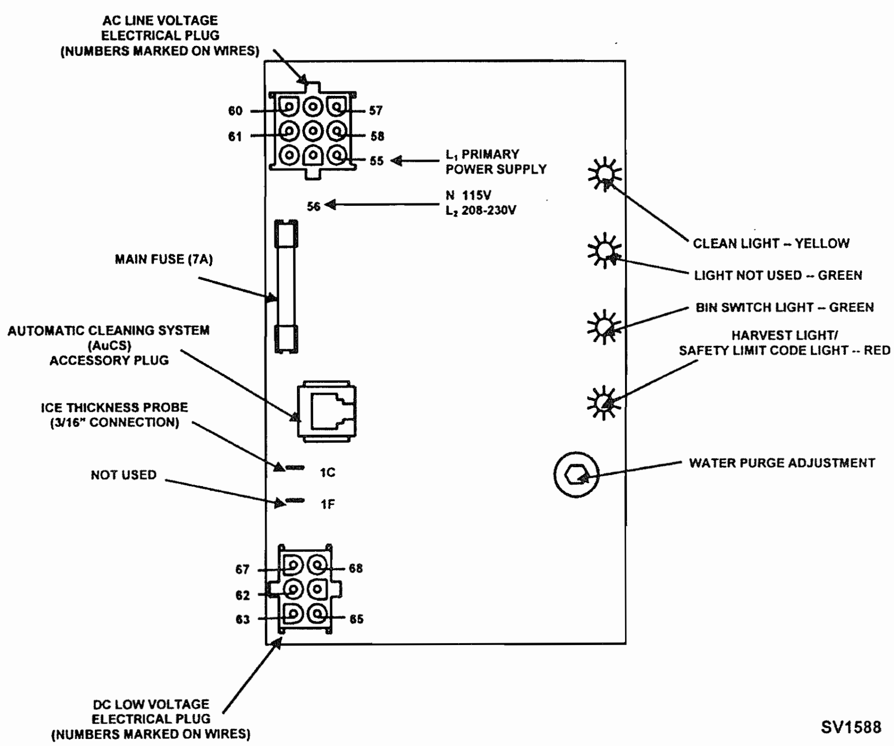
Replace toggle switch if OHM readings do not match all three switch settings.

CONTROL BOARD

Old Style Control Board



New Style Control Board



CONTROL BOARD

1. **General**
   The control board controls all electrical components including the ice machine sequence of operation. **Prior to diagnosing,** you must understand how this board functions (what it is supposed to do).

   Refer to wiring diagrams and ice machine sequence of operation sections for details including:
   a. Initial start-up or start-up after auto shut off mode
   b. Freeze sequence
   c. Harvest sequence
   d. Automatic shut-off
   e. Self-cleaning

2. **Harvest Initiation (ice thickness probe)**
   Manitowoc's patented solid state electronic sensing circuit which does not rely on the refrigeration system (pressure), temperature of evaporator, or timers, assures consistent ice formation. The ice machine must be in the freeze cycle for 6 minutes prior to harvest initiation. Refer to "Freeze Time Lock-In" for details.

   As the ice forms outward on the evaporator, water (not ice) will contact the ice thickness probes. After the water completes this circuit across the probes continually for 6-10 seconds, a harvest cycles is initiated.

3. **L.E.D. Lights**
   Bin Switch Light
   The light is ON when the bin switch (water curtain) is closed, and OFF when the bin switch is open.

   This light functions anytime power is supplied to the ice machine, even when the toggle switch is in the OFF or CLEAN position. This feature indicates the primary power supply (line voltage) at the control board is okay, without having to take a voltage reading.

   Harvest Light/
   Safety Limit Light
   Its primary function is to be on as water contacts the ice thickness probe during the freeze cycle and remain on throughout the complete harvest cycle. The light will flicker as water splashes on the probes.

Its secondary function is to continually flash when the ice machine is shut off on a safety limit and to indicate which safety limit shut off the ice machine.

4. **Freeze Time "Lock-in" Feature**

This feature protects the ice machine from short cycling in and out of harvest.

The control board locks the ice machine in the freeze cycle for 6 minutes. If water contacts the ice thickness probes during the first 6 minutes of the freeze cycle, the harvest light will come on (to indicate water is in contact with the probes), but the ice machine stays in the freeze cycle. After the 6 minutes "lock-in" time is reached, a harvest cycle will be initiated.

To allow the service technician to initiate a harvest without delay, this feature is not used on the first cycle after turning the toggle switch off and then back to ice making position.

5. **Water Curtain Removal**

The water curtain must be on (Bin Switch closed) to start ice making. After it has started, the water curtain can be removed and replaced at any point during the freeze cycle without interfering with the electrical control sequence. If the ice machine goes into harvest while the curtain is removed, one of the following will happen:

a. If water curtain remains off:

When the harvest cycle time reaches 3.5 minutes and the bin switch is not reclosed, the ice machine stops as though the bin is full.

b. If water curtain is put back on:

When the bin switch recloses prior to reaching the 3.5 minute point, the ice machine immediately returns to another freeze sequence.

6. **Fuses**

Transformer Fuse

Function

This fuse stops all ice machine operation if the transformer fails, causing high amp draw. It will also "blow" if high voltage is supplied to the ice machine.

Specifications: 250V 60 Hz, .125 Amp
250V 50 Hz, .100 Amp

Main Fuse

Function

This fuse stops the entire ice machine operation if electrical components fail causing high amp draw.

Specifications: 250V, 7 Amp

Check Procedure for Fuses

Step 1. If bin switch light is on with water curtain closed, both fuses are okay.

> **DANGER**
>
> Disconnect electrical power to entire ice machine before proceeding. High (line) voltage is applied to the control board (pin connector terminals #55 and #56) at all times. Removing control board fuses or placing the toggle switch in OFF position will not remove the power supplied to the control board.

Step 2. Remove fuse. Using an ohmmeter, check the resistance across removed fuse.

a. Open (OL) reading - replace fuse
b. Closed (O) reading - fuse is okay

7. Safety Limits

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

Refer to safety limits, page 98, for further information.

8. New Style Control Board

- A dual voltage transformer means only one control board for both 115V and 208-230V use.
- One 7-amp fuse - no separate transformer fuse.
- A single ice thickness probe eliminates the possibility of scale or slime bridging the probes, causing premature harvests.
- A yellow "Clean" light energizes when a SeCS™ or AuCS™ cycle is in progress.

> **CAUTION**
>
> J-model control boards that have only terminal 1C (no terminal 1D on board) must use the new single probe ice thickness control.

- An adjustable harvest cycle water purge can be set to 15, 30, or 45 seconds. This will not affect clean cycle purge time.

CAUTION

This control is factory-set to 45 seconds. A reduced setting will increase cleaning frequency.

- Safety limits 3 and 4 have been eliminated; no thermistor is required.
- Electrical sequence of operation is identical to the old style control board.

DIAGNOSING ELECTRICAL CONTROL CIRCUITRY

I. ICE MACHINE WILL NOT RUN

DANGER

High (line) voltage is applied to the control board (pin connector terminals #55 and #56) at all times. Removing control board fuses or placing the toggle switch in OFF position will not remove the power supplied to the control board.

Step	Check in Order:	Notes
1	Verify primary voltage supply to ice machine.	Verify that the fuse or circuit breaker is closed.
2	Verify the high pressure cut-out is closed.	The high pressure cut-out is closed if primary power voltage is present at pin connector (on control board) terminals #55 and #56.
3	Verify main and transformer control board fuses are both OK.	If bin switch light functions, the fuses are okay. (Refer to page 54 for fuse diagnostics).
4	Verify the bin switch functions properly.	A defective bin switch can cause a false indication of a full bin of ice. (Refer to Bin Switch Diagnostics, p. 40.)

5	Verify Ice/Off/Clean toggle switch functions properly.	A defective toggle switch may keep the ice machine in the OFF mode. (Refer to Toggle Switch Diagnostics, p. 51.)
6	Verify low DC voltage is properly grounded.	Loose DC wire connections may intermittently stop the ice machine.
7	Replace control board.	Be sure Steps 1-6 were followed thoroughly. "Intermittent" problems are not usually control board related.

II. ICE MACHINE OPERATES BUT WILL NOT CYCLE INTO HARVEST

This ice machine control system incorporates a **freeze time "lock-in" feature** which protects the ice machine from short cycling in and out of harvest. The control board locks the ice machine in the freeze cycle for 6 minutes. If water contacts the ice thickness probes during the first 6 minutes of the freeze cycle, the harvest light will come on (to indicate water is in contact with the probes), but the ice machine stays in the freeze cycle. After the 6 minutes "lock-in" time is reached, a harvest cycle will be initiated.

To allow the service technician to initiate a harvest without delay, this feature **is not** used on the first cycle after turning the toggle switch off and then back to the ice making position.

NOTE

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

Step 1. Bypass the freeze time lock-in feature by setting the ICE/OFF/CLEAN toggle switch to off and then back to ice making position.

Wait (approximately 1.5 minutes) until the water starts to flow over the evaporator, then proceed to Step 2.

Step 2. Dual Probe
While monitoring the harvest light, clip the leads of the jumper wire to the ice thickness control probe.

Step 2. Single Probe

Clip one jumper wire lead to the ice thickness control probe and clip the other lead to a cabinet ground anywhere on the ice machine.

Monitoring of Harvest Light	**Correction**
a. The harvest light comes on and 6-10 seconds later, the ice machine cycles from freeze to harvest.	The entire control circuitry is functioning properly. Check the following: a. Ice thickness probe adjustment b. Ice thickness probe has scale build-up. Clean probe. c. Water extremely pure. Add 820 K ohm pure water resistor P/N 76-2266-3.
b. The harvest light comes on but the ice machine stays in the freeze sequence.	Verify the ice machine is not in "Freeze Time Lock-In", then change control board.
c. The harvest light does not come on.	Proceed to Step 3.

Step 3. Dual Probe

Disconnect the ice thickness probe wires from the control board, terminals 1C and 1D. While monitoring the harvest light, clip the leads of jumper wire to terminals 1C and 1D.

Step 3. Single Probe

Disconnect the ice thickness probe wire from 1C. While monitoring the harvest light, clip the leads of the jumper wire to terminal 1C and any cabinet ground.

Monitoring of Harvest Light	**Correction**
a. The harvest light comes on and 6-10 seconds later, the ice machine cycles from freeze to harvest.	Replace ice thickness probe.
b. The harvest light comes on but the ice machine stays in the freeze sequence.	Verify the ice machine is not in "Freeze Time Lock-In", then change control board.
c. The harvest light does not come on.	Replace the control board.

III. ICE MACHINE OPERATES BUT CYCLES INTO HARVEST PREMATURELY

This ice machine control system incorporates a **freeze time "lock-in" feature** which protects the ice machine from short cycling in and out of harvest. The control board locks the ice machine in the freeze cycle for 6 minutes. If water contacts the ice thickness probes during the first 6 minutes of the freeze cycle, the harvest light will come on (to indicate water is in contact with the probes), but the ice machine stays in the freeze cycle. After the 6 minutes "lock-in" time is reached, a harvest cycle will be initiated.

To allow the service technician to initiate a harvest without delay, this feature **is not** used on the first cycle after turning the toggle switch off and then back to the ice making position.

> **NOTE**
>
> It is normal for the harvest light to be flashing as water begins to splash on the ice thickness probe.

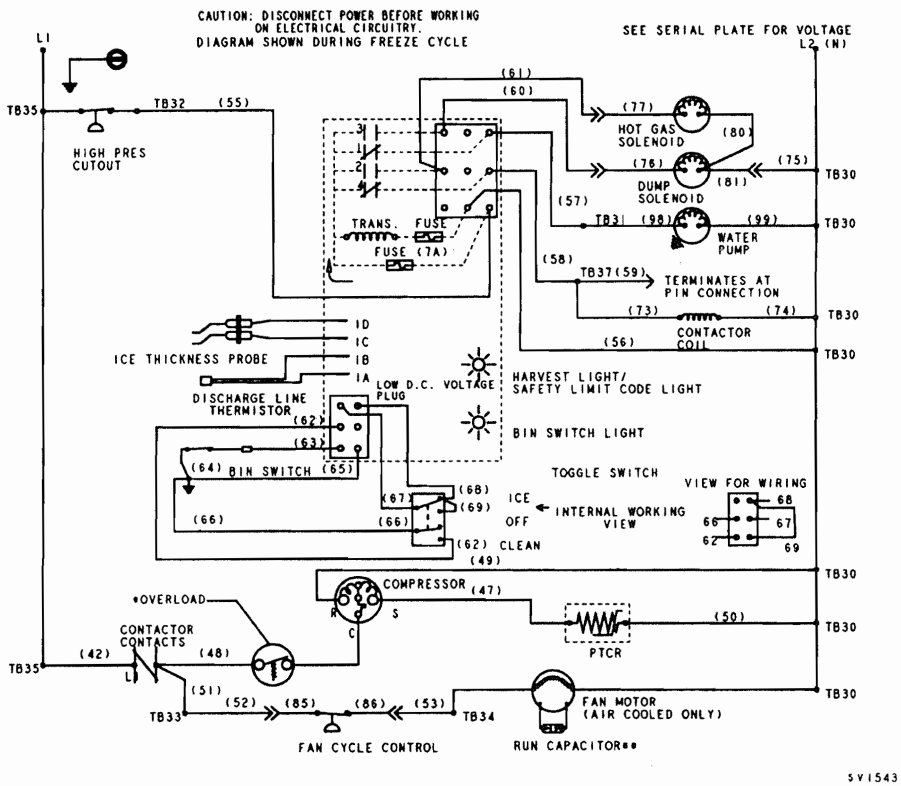
Step 1. Dual Probe
Disconnect the ice thickness probe wires from control board terminals 1C and 1D.

Step 1. Single Probe
Disconnect the ice thickness control probe from terminal 1C.

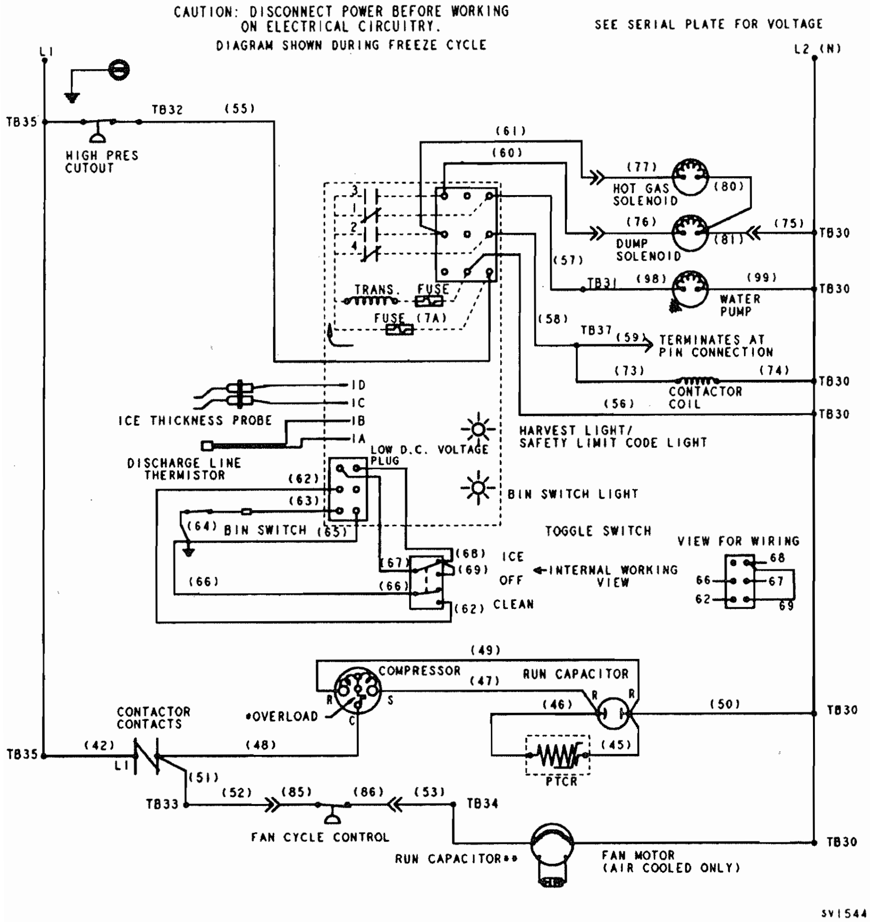
Step 2. Bypass the freeze time lock-in feature by setting the ICE/OFF/CLEAN toggle switch to off and then back to the ice making position. Wait (approximately 1.5 minutes) until the water starts to flow over the evaporator, then monitor the harvest light.

Monitoring Of Harvest Light	**Correction**
a. The harvest light is staying off and the ice machine remains in the freeze sequence.	The ice thickness probe is causing the malfunction. The ice thickness probe may simply be out of adjustment or dirty. Clean and check adjustment of probe **before replacing.**
b. The harvest light is coming on and 6-10 seconds later the ice machine changes from the freeze to harvest sequence.	Replace the control board.

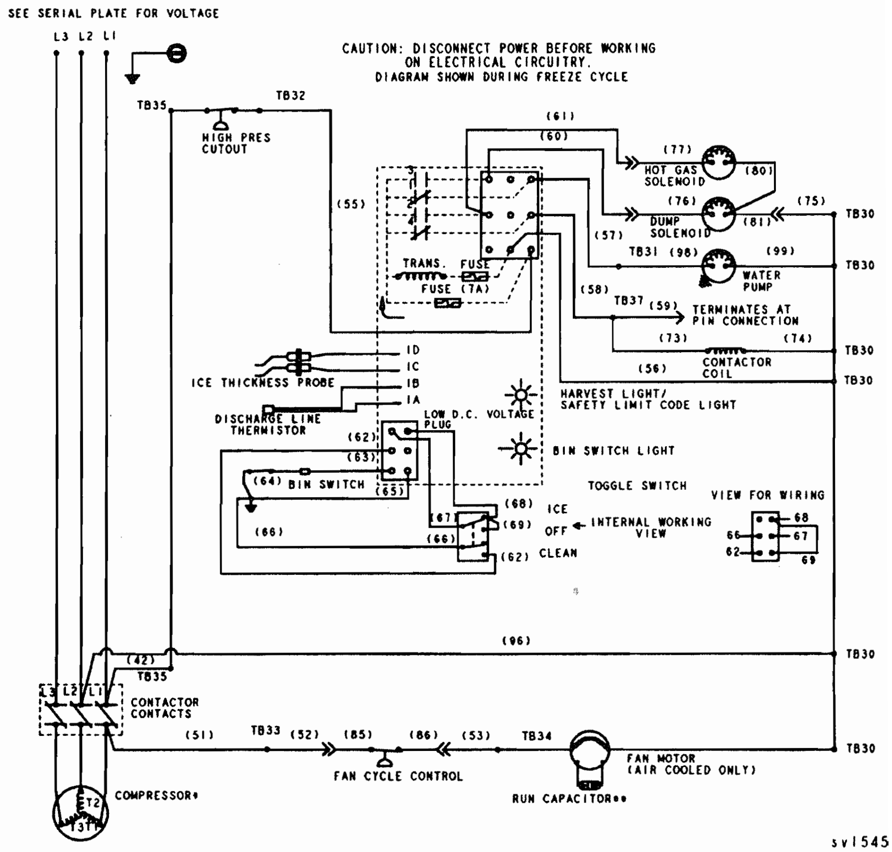
SELF-CONTAINED
J200/J250/J320
1 PHASE



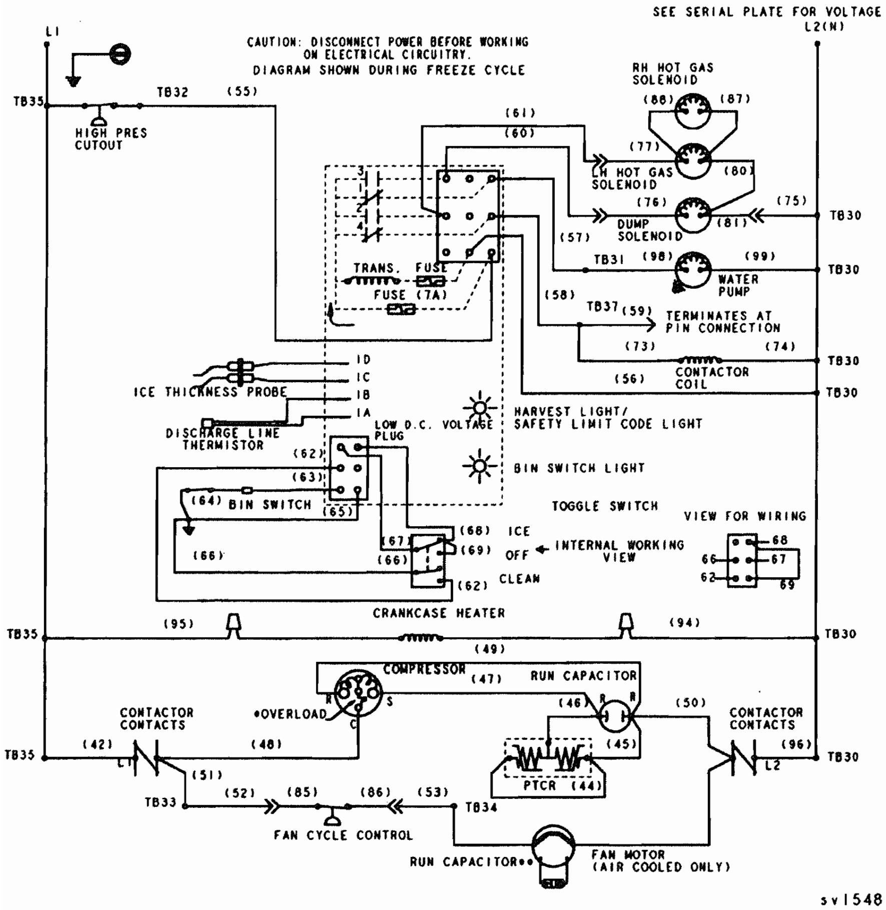
SELF-CONTAINED
J420/J450/J600/J800/J1000
1 PHASE



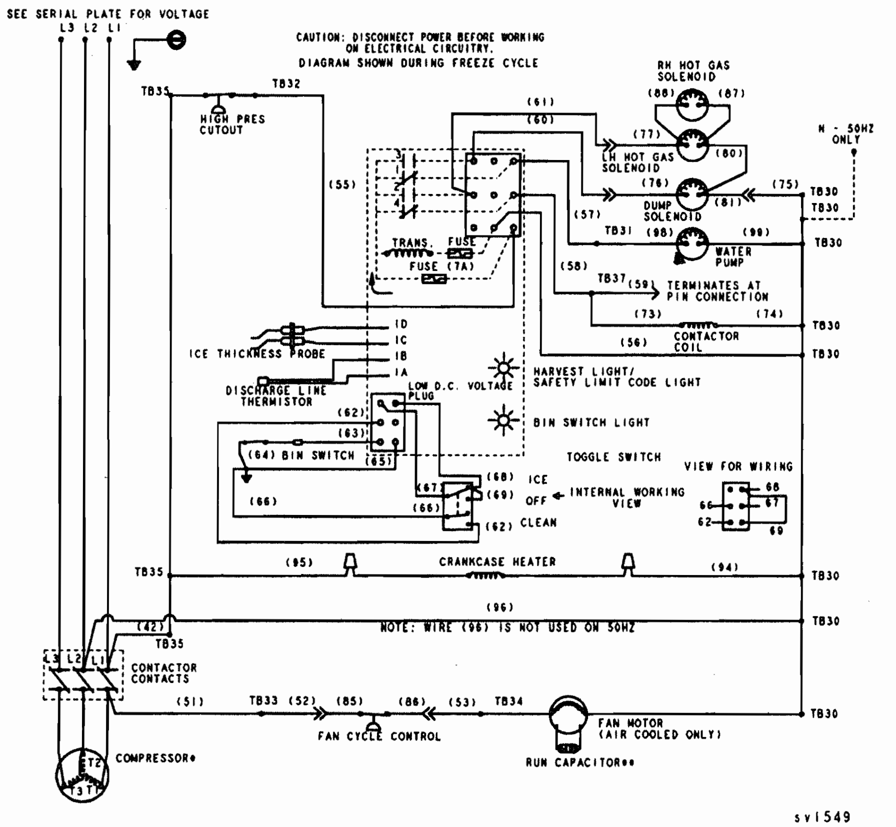
SELF-CONTAINED
J800/J1000
3 PHASE



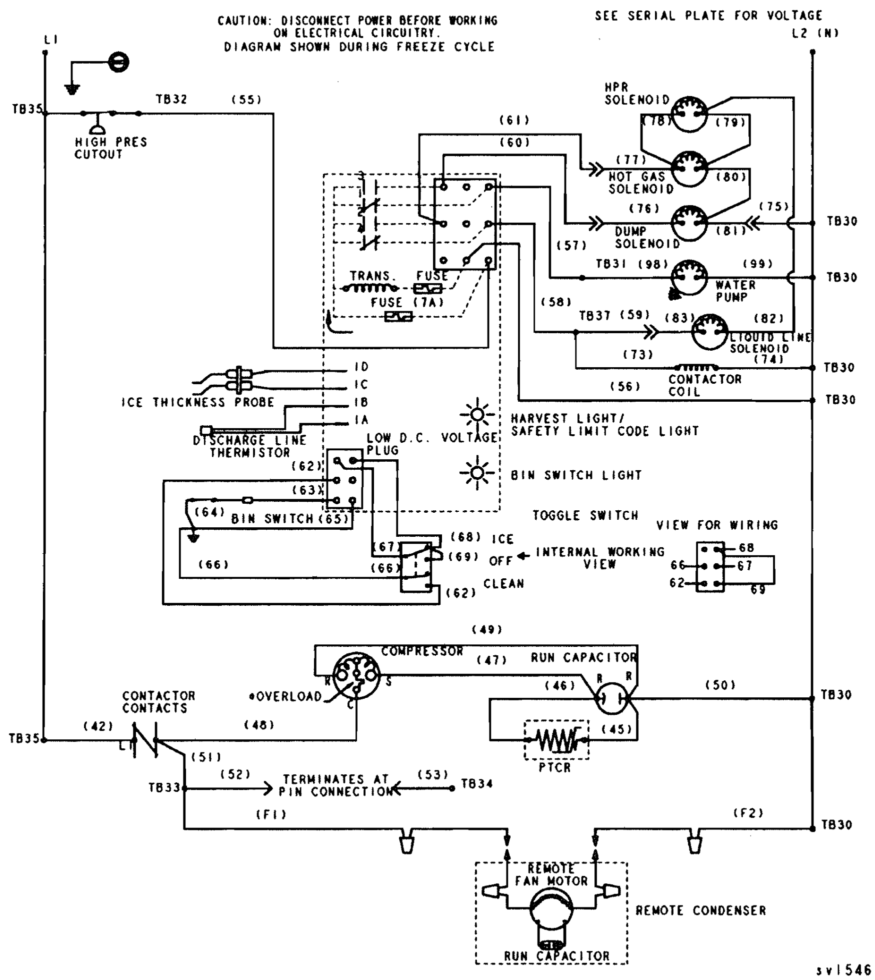
SELF-CONTAINED
J1300/J1800
1 PHASE



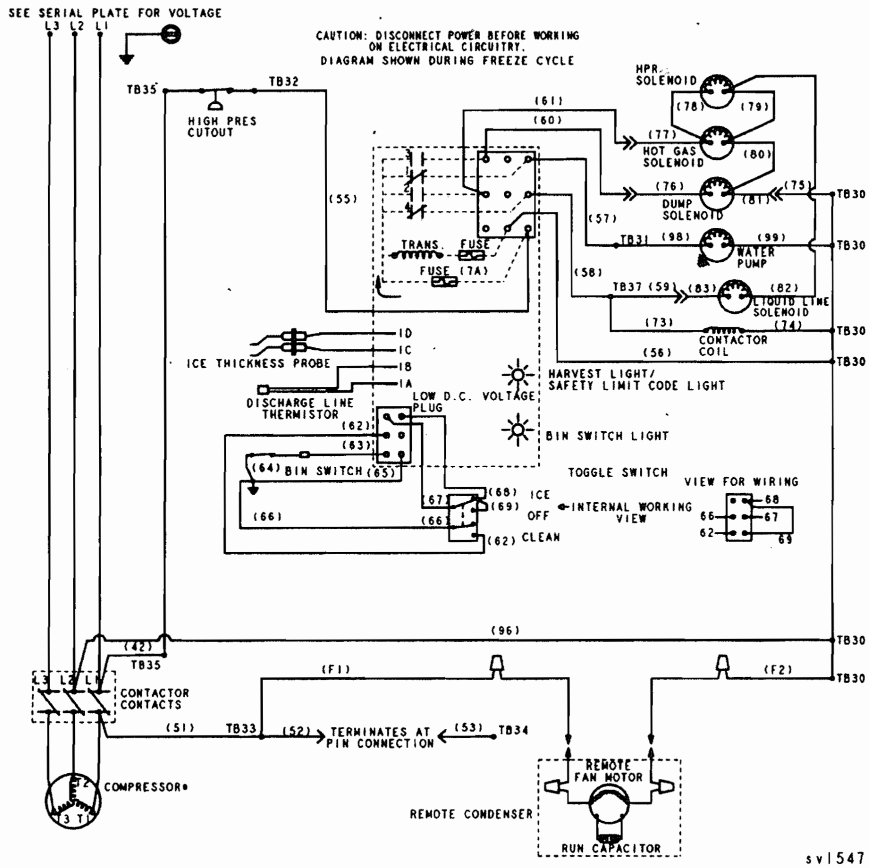
SELF-CONTAINED
J1300/J1800
3 PHASE



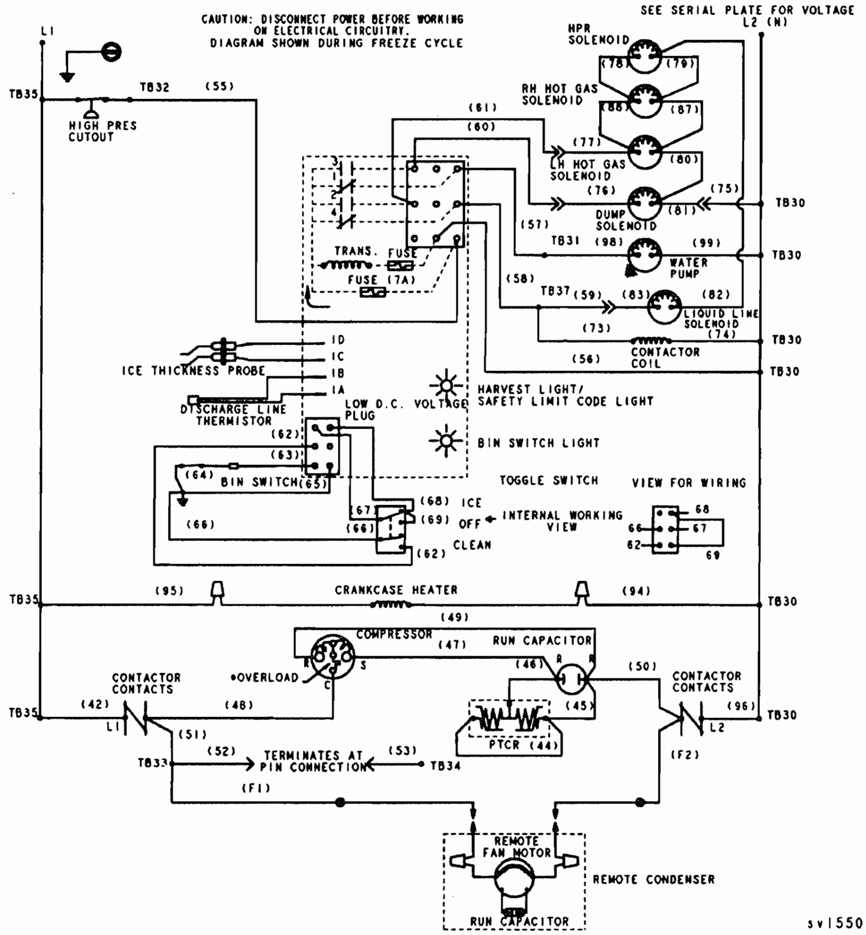
REMOTE
J450/J600/J800/J1000
1 PHASE



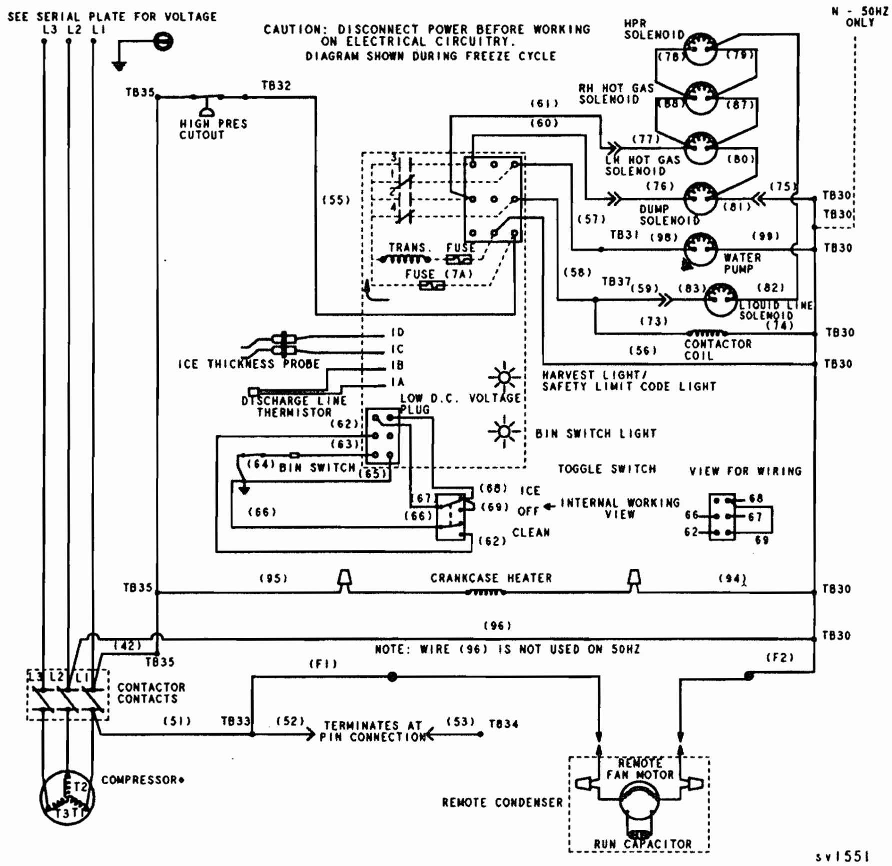
REMOTE
J800/J1000
3 PHASE



REMOTE
J1300/J1800
1 PHASE



REMOTE
J1300/J1800
3 PHASE



WIRING DIAGRAM LEGEND

Symbol on Diagram	Meaning
*	The wire diagrams show an internal compressor overload. Some models have external compressor overloads.
* *	The wire diagram shows a fan motor run capacitor. Some models do not incorporate a fan motor run capacitor.
T.B.	The letters **T.B.** followed by a number shows a connection at the terminal board. The T.B. numbers are printed on the actual terminal board.
( )	Numbers inside of "**( )**" are separate wire number designations. Each separate wire has its own number, and the number is marked at each end of the wire.
—> >—	This is the plastic multi-pin connector which wires pass through to exit the electrical box and enter into the refrigeration system area. (The arrows do not indicate direction of current flow.)

Electrical box side —> >— Compressor compartment side

NOTES

NOTES

NOTES

NOTES

NOTES

NOTES

NOTES

NOTES

HARVEST PRESSURE REGULATING (H.P.R.) SYSTEM

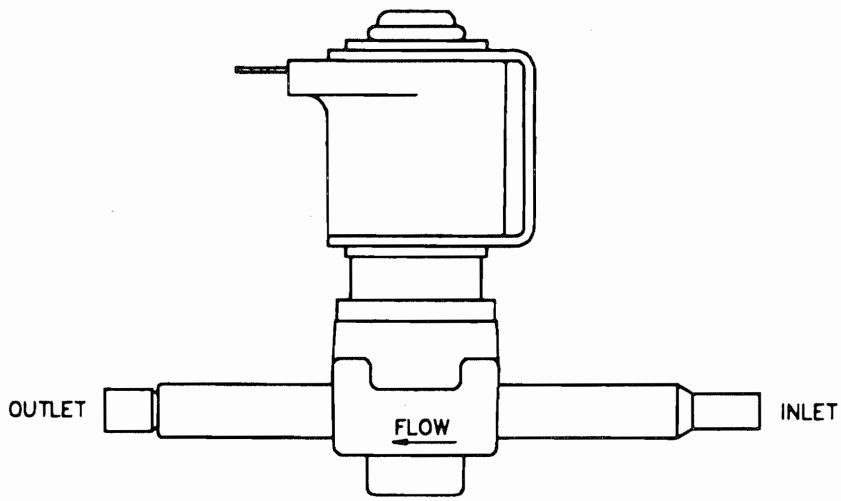
Remote Ice Machines

GENERAL

The harvest pressure regulating (H.P.R.) system includes:

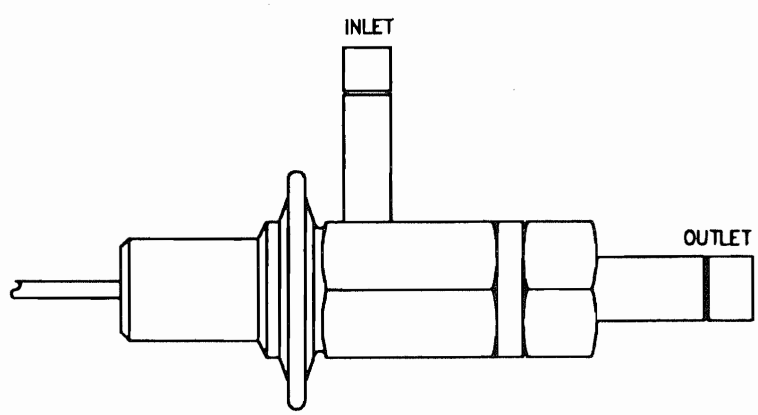
1 **Harvest pressure regulating solenoid valve** (H.P.R. solenoid)

This is an electrically operated valve which opens when energized and closes when de-energized.



2 **Harvest pressure regulating valve** (H.P.R. valve)

This is a non-adjustable pressure regulating valve which modulates open and closed, based on the refrigerant pressure at the outlet of the valve. The valve closes completely and stops refrigerant flow when the pressure at the outlet raises above the setting of the valve.



NORMAL OPERATION

Freeze Cycle

The H.P.R. system is not used during the freeze cycle. The H.P.R. solenoid is closed (de-energized) preventing refrigerant flow into the H.P.R. valve.

Harvest Cycle

The check valve in the discharge line prevents refrigerant in the remote condenser and receiver from back-feeding into the evaporator and condensing to liquid during the harvest cycle. The H.P.R. solenoid is opened (energized) during the harvest cycle allowing refrigerant gas from the top of the receiver to flow into the H.P.R. valve. The H.P.R. valve modulates opened and closed raising the suction pressure high enough to sustain heat for the harvest cycle without refrigerant condensing to liquid in the evaporator.

In general, the harvest cycle suction pressure raises, then stabilizes somewhere in the range of 75-100 PSIG (517-758 Kpa).

The stabilized pressures, which vary from model to model, are found by referring to appropriate "Operational Refrigeration Pressure" chart.

H.P.R. SYSTEM FAILURE CHART

SYMPTOMS		POSSIBLE CAUSE
Freeze cycle	The ice machine functions properly (the H.P.R. solenoid is closed preventing refrigerant flow into the H.P.R. valve).	H.P.R. Solenoid remains closed - OR - H.P.R. Valve remains closed
Harvest cycle	The discharge pressure is low or normal and the suction pressure is low which causes extended harvest times.	
Notes	The ice machine usually continues to run, although with the extended harvest times, the ice production decreases. If harvest time exceeds 3.5 minutes for three consecutive cycles, the control board stops the entire ice machine operation on Safety Limit #2. Low discharge pressure during the freeze cycle causes H.P.R. valve to appear as though it is not feeding properly during harvest. **Verify discharge pressure during the freeze is normal (correct if necessary) <u>prior to</u> assuming the H.P.R. valve is faulty.**	

(continued on next page)

H.P.R. SYSTEM FAILURE CHART

(continued from previous page)

	SYMPTOMS	POSSIBLE CAUSE
Freeze cycle	The discharge pressure is normal and the suction pressure is slightly high.	H.P.R. Solenoid leaks or remains open
Harvest cycle	The discharge pressure is slightly low or normal and the suction pressure slightly low or normal.	
Notes	The liquid line solenoid closes, when shutting the ice machine off. The discharge pressure should remain higher than the suction pressure. If the discharge and suction pressure equalize immediately, a solenoid valve such as H.P.R., Liquid Line or a Hot Gas Valve is most likely leaking.	

FILTER-DRIERS

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

The difference between Manitowoc driers and off-the-shelf type driers is in filtration. Manitowoc's 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 every harvest cycle. These filter-driers have very high moisture removal capability and good acid removal capacity.

The size of the filter-drier is important. The refrigerant charge is critical and use of an oversized or undersized drier will cause the ice machine to be improperly charged.

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

Machine Size	Drier Size	End Connection Size	Part Number
J200, J250 J320, J420 J450, J600	UK-032S	1/4	89-3022-9
J800, J1000	UK-083S	3/8	89-3026-3
J1300, J1800	UK-083S	3/8	89-3026-3
Suction Filter*	UK-165S	5/8	89-3028-3

*Used when cleaning up severely contaminated systems.

DRIERS ARE COVERED AS A WARRANTY PART AND ARE TO BE REPLACED ANY TIME THE SYSTEM IS OPENED FOR REPAIRS.

HEADMASTER CONTROL VALVE

(Remote Machines)

Manitowoc remote systems require headmaster control valves with special settings. Replace defective headmaster control valves **only** with "original" Manitowoc replacement parts.

Operation

The R404A headmaster control valve has a non-adjustable setting of 225 PSIG. At ambient temperatures of approximately 70°F (21.1°C) or above, refrigerant flows through the valve from the condenser to the receiver inlet. At temperatures below approximately 70°F (21.1°C), the head pressure control dome's nitrogen charge closes the condenser port and opens the bypass port from the compressor discharge line. In this modulating mode, the valve maintains minimum head pressure by building up liquid in the condenser and bypassing discharge gas directly to the receiver.

Diagnosing Headmaster Valve

1. Determine air temperature entering remote condenser.
2. Determine if head pressure is high or low in relationship to outside temperature (refer to an Operation Pressure Chart for the model of ice machine on which you are working). If air temperature is below approximately 70°F (21.1°C), the head pressure should be modulating around 225 PSIG.
3. Determine the temperature of the liquid line entering the receiver by feeling with hand. This line is normally "body temperature" (warm).
4. Using the symptoms gathered in Steps 2 and 3, refer to Failure Chart on page 85.

NOTE

An ice machine with a failed headmaster that will not bypass will function properly with condenser air temperatures of approximately 70°F (21.1°C) or above. When temperature drops below approximately 70°F (21.1°C), the headmaster fails to bypass and the ice machine malfunctions.

Low On Charge Verification

The remote ice machine requires more refrigerant charge at lower ambient temperatures than at higher temperatures. A low on charge ice machine may function properly during the day (higher condenser air temperature) and then malfunction during the night (when the temperature drops).

Following this procedure, if after using the Headmaster Control Valve failure chart, it is still not verified that the ice machine is low on charge,:

1. Add refrigerant in 2 lb. increments, but do not exceed 6 lbs.
2. If the ice machine was low on charge, the headmaster function and discharge pressure will return to normal after the charge is added. Do not leave the ice machine run. To assure operation in all ambient conditions, the refrigerant leak must be found and repaired, the liquid line drier changed, and the ice machine evacuated and recharged with proper nameplate charge.
3. If the ice machine does not start to operate properly after adding charge, replace the headmaster.

HEADMASTER CONTROL VALVE FAILURE CHART

Possible Problem	Probable Cause	Corrective Measure
Valve not maintaining pressures	Non-approved valve	Install Manitowoc Headmaster Control Valve with proper setting
a. Discharge pressure extremely high b. Liquid line entering receiver feels hot	Valve stuck in bypass	Replace valve
a. Discharge pressure low b. Liquid line entering receiver extremely cold	Valve not bypassing	Replace valve
a. Discharge pressure low b. Liquid line entering receiver is warm-to-hot	Ice machine low on charge	Refer to "Low on charge verification" listed on page 84

FAN CYCLE CONTROL

(Self-Contained Air-Cooled Models)

Function

Cycles fan motor on and off to maintain proper operating discharge pressure.

The fan cycle control is normally closed and opens on a drop in discharge pressure.

Specifications

MODEL	CLOSE Cut-In (±5)	OPEN Cut-Out (±5)
J200 J250 J320 J420 J450	250 PSIG	200 PSIG
J600 J800 J1000 J1300 J1800	275 PSIG	225 PSIG

Check Procedure

1. Verify fan motor windings are not open or grounded and fan spins freely.
2. Connect manifold gauges to ice machine.
3. Hook voltmeter in parallel (across) to the fan cycle control, leaving wires attached.
4. Pressure above listed specification — read 0 volts and fan should be running.

   Pressure below listed specification — read line voltage and fan should be off.

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

Function

Safety control which stops the ice machine if subjected to excessive high-side pressure. The H.P.C.O. control is a normally closed control and opens on a rise in pressure.

Specifications

Cut-out — 450 PSIG
Cut-in — manual reset
(below 300 PSIG to reset).

Check Procedure

1. Set ICE/OFF/CLEAN switch at OFF and reset H.P.C.O. (if tripped).
2. Connect manifold gauges.
3. Hook voltmeter in parallel (across) to the H.P.C.O. leaving wires attached.
4. a. Water-Cooled Models — Close the water service valve to the water condenser inlet.
   b. Self-Contained Air-Cooled and Remote Models — Disconnect fan motor.
5. Set ICE/OFF/CLEAN switch to ICE.

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

CAUTION

Stop ice machine operation by turning the toggle switch off if discharge pressure is exceeding 450 PSIG and H.P.C.O. did not open to stop the ice machine.

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

1. The control will not reset.

NOTE

High-side pressure must be below listed specifications before reseting.

2. The control does not open at the specified cut-out point.

NOTES

REFRIGERATION SYSTEM OPERATIONAL ANALYSIS

GENERAL

When analyzing the refrigeration system, it is important to understand that different refrigeration component malfunctions may cause very similar symptoms. Also, external factors such as improper installation, incoming water supply being too hot, and water system malfunctions can often cause good refrigeration components to appear to be defective.

The following two examples illustrate how similar symptoms can result in a mis-diagnosis and the replacement of good components in error:

Example 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. A service technician fails to check for proper expansion valve bulb mounting and replaces the expansion valve in error.

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

In this example, 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.

Example 2 An ice machine that is low on charge may cause a good expansion valve to starve. A service technician fails to verify system charge and replaces the expansion valve in error. During the expansion valve replacement procedure, recovery; evacuation; and recharging are performed correctly and the ice machine now functions normally. The service technician mistakenly believes that the problem has been diagnosed correctly and that by replacing the expansion valve, he restored the ice machine to normal operation.

In this second example, the service technician's failure to check the ice machine for a low charge condition also resulted in the needless replacement of a good expansion valve.

REFRIGERATION SYSTEM OPERATIONAL ANALYSIS TABLES

When analyzing the refrigeration system, one can avoid replacing good refrigeration components caused by "external problems" by using a Refrigeration System Operational Analysis Table with the use of detailed checklists and references.

A list of some of the detailed charts/checklists and other references used with the Refrigeration System Operational Analysis Table includes:

- Before beginning service (Questions to ask end user)
- Installation/Visual Inspection Checklist
- Water System Checklist
- How to perform Ice Production Check
- Analyzing ice formation
- Understanding and analyzing Safety Limits
- Analyzing hot gas valves
- Comparing evaporator inlet to outlet temperatures
- Understanding and analyzing discharge pressure
- Understanding and analyzing suction pressure

BEFORE BEGINNING SERVICE

It is common for ice machines to experience operational problems only during certain times of the day or night. The ice machine may be functioning properly while servicing it, but malfunctions later. The information the user provides helps the service technician start in the right direction and may be a determining factor in the final diagnosis.

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

- When is the ice machine malfunctioning? (Night, day, all the time, during the freeze cycle, harvest cycle, etc.)
- When do you notice low production? (One day a week, every day, weekends, etc.)
- Can you describe exactly what the ice machine seems to be doing?
- Has anyone been working on the ice machine?
- Were items (such as boxes obstructing air flow) moved from around the ice machine before you arrived?
- During "store shutdown", is the circuit breaker, water supply, or air temperature altered?
- Can you think of any reason that might cause water pressure to rise or drop substantially?

INSTALLATION/VISUAL INSPECTION CHECKLIST

Possible Problem	Corrective Action
1. Ice machine not level.	Level ice machine.
2. Improper air clearance around top, sides, and/or back of ice machine.	Reinstall in accordance with Installation Manual.
3. Air-cooled condenser filter dirty.	Clean condenser and/or condenser filter.
4. Ice machine not on independent electrical circuit	Install electrical in accordance with Installation Manual.
5. Water filtration plugged (if used).	Install new water filter.
6. Water drains not run separately and/or not vented.	Run drains separately and vent according to Installation Manual.
7. Remote condenser line set improperly installed.	Refer to Installation Instructions.

WATER SYSTEM CHECKLIST

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

Water area problems must be identified and eliminated prior to replacing refrigeration components. An example is a water dump valve leaking during the freeze cycle, low on charge, or starving TXV. The symptoms of all 3 of these problems are similar.

Possible Problem	Corrective Action
1. Water area (evaporator) dirty.	Clean.
2. Water inlet pressure must be between 20-80 psi.	Install water regulator valve or increase water pressure.
3. Incoming water supply temperature must be 35°F (1.7°C) to 90°F (32.2°C).	Too hot - check hot water line check valves in other store equipment.
4. Water filter restricted (if used).	Replace filter.
5. Water dump valve leaking during the freeze cycle.	Clean dump valve. Replace as needed.
6. Vent tube not installed on water outlet drain.	See Installation Instructions.
7. Hoses, fittings, etc. leaking water.	Repair/replace as needed.
8. Water float valve stuck open or out of adjustment.	Readjust or replace as needed.
9. Water spraying out of sump trough area.	Stop water spray.
10. Water flow uneven across evaporator.	Clean ice machine.
11. Water freezing behind evaporator.	Correct water flow.
12. Plastic extrusions and gasket material not securely mounted to evaporator.	Remount or replace as needed.
13. Water flow must start over evaporator (not trickle) immediately after 30 second prechill.	Readjust or replace float valve.

ICE PRODUCTION CHECK

The amount of ice a machine produces has a direct relationship to the operating water and air temperatures. This means an ice machine produces more ice in a 70°F (21.2°C) room with 50°F (10.0°C) water than in a 90°F (32.2°C) room with 70°F (21.1°C) water.

STEP 1 DETERMINE THE ICE MACHINE OPERATING CONDITIONS

Air temperature entering condenser ________

Air temperature around ice machine ________

Water temperature entering float valve ________

STEP 2 REFER TO A 24 HOUR PRODUCTION CHART FOR THE ICE MACHINE MODEL BEING TESTED

Using the operating conditions determined in Step 1, find the published 24 hour ice production:

____

This is the approximate amount of ice the ice machine is capable of producing at these operating conditions.

STEP 3 PERFORM AN ACTUAL ICE PRODUCTION CHECK

1.	________	+	________	=	________
	Freeze time		Harvest time		Total Cycle Time
2.	1440	÷	________	=	________
	Minutes in 24 hrs.		Total cycle time		Cycles per day
3.	________	x	________	=	________
	Weight of 1 harvest		Cycles/day		Actual 24 hr. ice production

IMPORTANT NOTES

- Times are in minutes.
  Example: 1 min. 15 sec. converts to 1.25 min.
  (15 sec. ÷ 60 sec. = .25 min.)
- 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. Although, if ice pattern is normal and 1/8" thickness is maintained, the ice slab weights listed with the published 24 hr. ice production charts may be used.

STEP 4 COMPARE THE ACTUAL 24 HR. ICE PRODUCTION FINDINGS WITH THE PUBLISHED 24 HR. ICE PRODUCTION CHART

The ice production is normal when the published 24 hr. ice production (Step 2) and actual (Step 3) match closely. Determine if another ice machine is needed, more storage capacity is required, or if relocating existing equipment to lower load conditions will meet the customer's needs. (Contact local Manitowoc Distributor for options and accessories available.)

ICE FORMATION PATTERN

Evaporator ice formation pattern analysis is helpful in ice machine diagnostics, however, an improper ice formation can be caused by any number of problems. Because of this, **never attempt** to analyze only the ice formation pattern in an attempt to determine what is wrong with an ice machine. A good example of this is an ice formation of "extremely thin on top". This could be caused by hot water supply, dump valve leaking water, faulty float valve, low on refrigerant charge, etc.

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

DETERMINING ICE FORMATION PATTERN

1. **NORMAL ICE FORMATION** - There is ice forming on the entire evaporator surface.

   At the beginning of the freeze cycle, it may appear that there is more ice forming on the bottom of the evaporator than on the top. However, by the end of the freeze cycle, the ice formation on the top will "catch up" and be close to, or just slightly thinner than, the ice formation on the bottom. This is normal and the "dimples" in the ice cubes on the top of the evaporator will be more pronounced than those on the bottom of the evaporator.

   The ice thickness probe must be properly set to maintain the ice bridge thickness at approximately 1/8". Ice forming uniformly on the entire evaporator surface, although not reaching the 1/8" setting in the proper amount of time, is considered "normal ice formation".

2. **EXTREMELY THIN AT OUTLET OF EVAPORATOR** - There is no ice, or considerably less ice formation on the top of evaporator (tubing outlet) compared to the bottom

Examples:
a. No ice at all at the top of evaporator, but ice forms on the bottom half of evaporator.
b. The ice on the top of the evaporator reaches the 1/8" setting to initiate a harvest, but the bottom of the evaporator already has 1/2" - 1" of ice formation.

3 **EXTREMELY THIN AT INLET OF EVAPORATOR** - There is no ice, or considerably less ice formation on the bottom of the evaporator (tubing inlet) compared to the top.

Example: The ice on the top of the evaporator reaches the 1/8" setting to initiate a harvest, but there is no ice formation at all on the bottom of the evaporator.

4. **"SPOTTY" ICE PATTERN** - There are small sections of no ice formation such as a single corner or single spot in the middle of the evaporator. This is generally caused by loss of heat transfer from tubing on backside of evaporator.

5. **NO ICE FORMATION** - The ice machine operates for an extended period, but there is no ice formation at all on the evaporator.

IMPORTANT

The J1300 and J1800 model ice machines utilize left and right hand expansion valves and seperate evaporator circuits. These circuits operate independently from each other, therefore one may be operating properly while the other is malfunctioning. As an example, if the left expansion valve is starving, it may not affect the ice formation pattern on the entire right side of the evaporator.

SAFETY LIMITS

GENERAL

In addition to standard safety controls such as high pressure cut-out, the control board has four 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 three 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 three consecutive 3.5 minute harvest cycles occur, the ice machine stops.

Safety Limit #3: If the compressor discharge line temperature falls below 85°F/29.4°C for three consecutive harvest cycles, the ice machine stops.

Safety Limit #4: If the compressor discharge line temperature reaches 255°F/123.8°C for 15 continuous seconds during a freeze or harvest cycle, the ice machine stops.

DETERMINING WHICH SAFETY LIMIT STOPPED THE ICE MACHINE

When a safety limit condition causes the ice machine to stop, the harvest light on the control board continually flashes on and off. Use the following procedures to determine which safety limit has stopped the ice machine.

Step 1 Move the toggle switch to off.

Step 2 Move the toggle switch back to ice making position.

Step 3 Watch the harvest light. It will "flash on" one to four times, corresponding to safety limits 1-4, to indicate which safety limit stopped the ice machine.

After safety limit indication, the ice machine will restart and run until a safety limit is exceeded again.

NOTES

- 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.
- Any time the toggle switch is moved to the "off" position and then back to the "on" position again prior to reaching the 100 harvest point, the last safety limit exceeded will be indicated.
- The ice machine did not stop on a safety limit if the harvest light did not "flash on" prior to ice machine restarting.

ANALYZING WHY SAFETY LIMITS STOPPED ICE MACHINE

According to the refrigeration industry, a high percentage of compressors fail as a result of external causes such as flooding or starving expansion valves, overcharge, undercharge, dirty condensers, water loss to 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 ice machine to stop on the high pressure cut-out, or a particular safety limit.

The safety limits are designed to stop the ice machine prior to major component failures, most often non-major problems or something external to the ice machine that may be causing the problem. This may be difficult to diagnose, as many external problems may occur intermittently. (An example of this would be an ice machine stopping intermittently on safety limit #3 -low discharge temperature. The service technician may find that at night the ambient temperature is dropping too low, the store has a water pressure drop problem, or the water is being turned off one night a week, etc.) It is always good to remember that when a high pressure cut out or a safety limit stops the ice machine, they are doing what they are supposed to do...stop the ice machine before a major component failure occurs.

Ice machine refrigeration and electrical component failures may also cause the ice machine to stop on one of the safety limits. After all electrical component and all external causes are eliminated and it is thought 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. Because many external problems are possible, do not limit yourself only to the items listed in the checklists.

CONDITION FOUND	POSSIBLE CAUSE
I. **SAFETY LIMIT #1** stopped the ice machine. (Freeze time exceeded 60 minutes for three consecutive freeze cycles.) **NOTE:** This chart reflects the removal of safety limits #3 and #4 from the new style control boards.	1. Improper installation • Refer to Installation/Visual Inspection Checklist 2. Water system • Incoming water pressure low • Excessive water pressure (80 psi maximum) • Excessive water temperature (90°F/32.2°C maximum) • Dirty (clogged) water distribution tube • Dirty/defective float valve • Dirty/defective water dump valve • Defective water pump 3. Electrical system • Ice thickness probe out of adjustment • Electrically not going into harvest • Contactor not energizing • Compressor (electrically non-operational) 4. Restricted condenser air flow (air-cooled models) • Inlet air temperature excessive Condenser discharge air recirculation • Dirty condenser filter • Dirty condenser fins • Defective fan cycling control • Defective fan motor 5. Restricted condenser water flow (water-cooled models) • Insufficient water pressure (20 psi minimum) • Excessive water temperature (90°F/32.2°C maximum) • Dirty condenser and/or water regulating valve • Water regulating valve out of adjustment • Defective water regulating valve 6. Refrigeration system • Non-Manitowoc components • Under or over refrigerant charge • Defective head pressure control (remotes) • Defective hot gas valve • TXV starving or flooding (check bulb mounting)

CONDITION FOUND	POSSIBLE CAUSE
II. **SAFETY LIMIT #2** stopped the ice machine. (Harvest time exceeded 3.5 minutes for three consecutive harvest cycles.) **NOTE:** This chart reflects the removal of safety limits #3 and #4 from the new style control boards.	1. Improper installation • Refer to Installation/Visual Inspection Checklist 2. Water system • Water area (evaporator) dirty • Dump valve malfunctioning/dirty • Vent tube not installed on water outlet drain • Water freezing behind evaporator • Plastic extrusions and gasket material not securely mounted to evaporator • Low water pressure (20 psi min.) • Loss of water from sump area • Clogged water distribution tube • Dirty/defective float valve • Defective water pump 3. Electrical system • Ice thickness probe out of adjustment • Ice thickness probe dirty • Bin switch defective • Premature harvest 4. Refrigeration system • Non-Manitowoc components • Water regulating valve dirty/ defective • Under or over refrigerant charge • Defective head pressure control valve (remotes) • Defective harvest pressure control valve (H.P.R.) valve (remotes) • Defective hot gas valve • TXV flooding (check bulb mounting) • Defective fan cycling control

CONDITION FOUND	POSSIBLE CAUSE
III. **SAFETY LIMIT #3** stopped the ice machine. (Compressor discharge temperature fell below 85°F/29.4°C for three consecutive harvest cycles.)	1. Improper installation • Refer to Installation/Visual Inspection Checklist 2. Ice thickness set too thin or too thick 3. Water system - loss or restricted water flow over evaporator • Incoming water pressure low • Loss of water from sump area • Dirty (clogged) water distributing tube • Dirty/detective float valve • Dirty/defective water dump valve • Defective water pump 4. Refrigeration system • Non-Manitowoc components • Defective head pressure control valve (remotes) • Defective harvest pressure regulating (H.P.R.) valve (remotes) • Defective fan cycle control • Under or over refrigerant charge • Defective hot gas valve • Flooding TXV (check bulb mounting) 5. Defective thermistor

CONDITION FOUND	POSSIBLE CAUSE
IV. **SAFETY LIMIT #4** stopped the ice machine. (Compressor discharge temperature exceeded 255°F/123.8°C for fifteen continuous seconds.)	1. Improper installation • Refer to Installation/Visual Inspection Checklist 2. Restricted condenser air flow (air-cooled models) • Inlet air temperature above 110°F/43.3°C • Condenser discharge air recirculation • Dirty condenser filter • Dirty condenser fins • Defective fan cycling control • Defective fan motor 3. Restricted condenser water flow (water-cooled models) • Insufficient water pressure (20 psi minimum) • Intet water temperature above 90°F /32.2°C • Dirty condenser and/or water regulating valve • Water regulating valve out of adjustment • Defective water regulating valve 4. Refrigeration system • Non-Manitowoc components • Defective head pressure control valve (remote models only) • Under or over refrigerant charge • Non-condensibles in refrigeration system • High side refrigerant lines (or component) restricted or plugged • TXV starving (check bulb mounting) • Defective compressor 5. Defective thermistor

HOT GAS VALVE

GENERAL

A hot gas valve requires a critical orifice size which meters the proper amount of hot gas flow into the evaporator during the harvest cycle. **Even a slightly too large or too small orifice will cause long harvest cycles.**

An orifice which is slightly too large causes refrigerant to condense to liquid in the evaporator during harvest and can cause potential compressor damage. An orifice which is slightly too small will not allow enough hot gas into the evaporator causing low suction pressure, thus not generating enough heat for a harvest cycle.

Replace defective hot gas valves with "original" Manitowoc replacement parts only. Normally a hot gas valve can be repaired by rebuilding it instead of changing the entire valve. Refer to Parts Manual for proper valve application and rebuild kits.

ANALYZING HOT GAS VALVE

Characteristics of a hot gas valve partially open during the freeze cycle can be similar to an expansion valve or compressor problem. The best way to diagnose a hot gas valve is by using Manitowoc's Ice Machine Refrigeration System Operational Analysis Table.

The following procedure, used with the Refrigeration Failure Comparison Table, helps determine if the hot gas valve is partially open during the freeze cycle.

STEP 1 Wait for 5 minutes into the freeze cycle

STEP 2 Feel the **inlet** of the hot gas valves

STEP 3 Feel the compressor discharge line

CAUTION

Hot gas valve inlet and compressor discharge could be hot enough to burn your hand. Just "touch" it momentarily.

STEP 4 Compare the compressor discharge line temperature to the hot gas valve **inlet** temperature.

IMPORTANT

Feeling the hot gas valve outlet or across the hot gas valve for any type of comparison **will not work**. The hot gas valve outlet, being on the suction side (cool refrigerant) of the ice machine, may be cool enough to touch, even though the valve is leaking.

Examples of hot gas valve inlet/compressor discharge line temperature comparison

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

SINGLE EXPANSION VALVE ICE MACHINES COMPARE EVAPORATOR INLET TO OUTLET TEMPERATURE CHECK

This procedure will not work on the dual expansion valve, J1300 and J1800 ice machines.

The temperature of the suction line entering and leaving the evaporator by itself cannot indicate what's wrong with an ice machine. It is, however, beneficial to compare these temperatures to each other during the freeze cycle and use it along with Manitowoc's "Refrigeration System Operational Analysis Table" in determining what may be causing an ice machine malfunction.

The actual temperatures entering and leaving the evaporator varies model-by-model and changes throughout the freeze cycle. Therefore, it is difficult to document the "normal" inlet and outlet temperature readings at a given moment during the freeze cycle. The benefit is knowing the difference between the two temperatures 5 minutes into the freeze cycle.

Use the following procedure to document freeze cycle evaporator inlet and outlet temperatures.

STEP 1 Use a quality meter capable of taking temperature readings on curved copper lines.

STEP 2 Attach temperature meter sensing device to copper lines entering and leaving the evaporator.

> **IMPORTANT**
>
> Do not simply "insert" probe (or other sensing device) under insulation - it must be "attached to" and reading the **actual** temperature of the copper lines.

STEP 3 **After 5 minutes into the freeze cycle,** record the temperature of copper lines entering and leaving the evaporator and use with other information gathered on the "Refrigeration System Operational Analysis Table" to analyze the ice machine.

Temperature Findings
(After 5 minutes into freeze cycle)

________________ Evaporator Inlet

________________ Evaporator Outlet

________________ Difference
(Within 7° of each other)

NOTES

ANALYZING DISCHARGE PRESSURE DURING FREEZE OR HARVEST CYCLE

STEP 1 DETERMINE THE ICE MACHINE OPERATING CONDITIONS

Air temperature entering condenser __________

Air temperature around ice machine __________

Water temperature entering float valve __________

STEP 2 REFER TO OPERATING PRESSURE CHART FOR ICE MACHINE MODELS BEING CHECKED

Using operating conditions determined in Step 1, find the published normal discharge pressures:

Freeze cycle ________ Harvest cycle ________

STEP 3 PERFORM AN ACTUAL DISCHARGE PRESSURE CHECK:

	Freeze Cycle PSIG	Harvest Cycle PSIG
Beginning of cycle	________	________
Middle of cycle	________	________
End of cycle	________	________

STEP 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 between the published freeze or harvest cycle pressure range for the ice machine's operating conditions.

FREEZE CYCLE DISCHARGE PRESSURE HIGH CHECKLIST

1. Non-Manitowoc components in system
2. Improper installation
   - Refer to "Installation/Visual Inspection" Checklist
3. Restricted condenser air flow (air-cooled models)
   - Inlet air temperature above 110ºF/43.3ºC
   - Condenser discharge air recirculation
   - Dirty condenser filter
   - Dirty condenser fins
   - Defective fan cycling control
   - Defective fan motor
4. Restricted condenser water flow (water-cooled models)
   - Insufficient water pressure (20 psi minimum)
   - Inlet water temperature above 90ºF/32.2ºC
   - Dirty condenser and/or water regulating valve
   - Water regulating valve out of adjustment
   - Defective water regulating valve
5. Defective head pressure control valve (remote models)
6. Improper refrigerant charge
   - Over-charged
   - Non-condensibles in system
   - Wrong type of refrigerant
7. Restriction in high side refrigerant lines or component (before mid-condenser)

FREEZE CYCLE DISCHARGE PRESSURE LOW CHART

1. Non-Manitowoc components in system
2. Improper installation
   - Refer to "Installation/Visual Inspection" Checklist
3. Improper refrigerant charge
   - Under-charged
   - Wrong type of refrigerant
4. Defective head pressure control (remote models)
5. Water regulating valve (water-cooled condensers):
   a. Out of adjustment
   b. Leaking water during harvest cycle
   c. Defective
6. Fan cycle control defective

ANALYZING SUCTION PRESSURE DURING FREEZE CYCLE

The suction pressure gradually drops throughout the freeze cycle. The actual suction pressure (and drop rate) change as the air and water temperature entering the ice machine change, affecting the freeze cycle times. To analyze and identify the proper suction pressure drop throughout the freeze cycle, compare the published suction pressure (listed in "Operating Pressure" charts) to the published freeze cycle time (listed in "Cycle Times" charts).

Remember to analyze discharge pressure prior to analyzing suction pressure. High or low discharge pressure may be causing the suction pressure to be high or low.

	Example using JY604A model ice machine
STEP 1 Determine the ice machine operating conditions.	Air temperature entering condenser 90°F/32.2°C Air temperature around ice machine 80°F/26.7°C Water temperature entering float valve 70°F/21.1°C
STEP 2 A. 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.	10.6 - 12.5 minutes Published freeze cycle time 52-23 PSIG Published freeze cycle suction pressure
B. Compare the published freeze cycle time to the published freeze cycle suction pressure. (Developing a chart is helpful when doing this.)	Published freeze cycle time (minutes) 0 1 2 4 6 8 10 12 52 48 43 38 33 28 23 Published freeze cycle suction pressure (PSIG) In the example, the proper suction pressure should be approximate 38 PSIG at 6 minutes; 28 PSIG at 10 minutes; etc.

(continued)

(continued)

STEP 3	Perform an actual suction pressure check at the beginning, middle, and end of freeze cycle. It is also helpful to note the time during the freeze cycle that the readings are taken.	The gauges were connected to example ice machine and suction pressure readings taken as follows: PSIG Beginning of freeze cycle: 48 (at 4 min.) Middle of freeze cycle: 42 (at 8 min.) End of freeze cycle: 28 (at 12 min.)
STEP 4	Compare the actual freeze cycle suction pressure Step 3) to the published freeze cycle time and pressure comparison (Step 2B)	In this example, the suction pressure is considered high throughout the freeze cycle. It should have been: Approximately 43 PSIG (at 4 minutes) - not 48 Approximately 28 PSIG (at 8 minutes) - not 42 Approximately 23 PSIG (at 12 minutes) - not 28

(end)

ANALYZING SUCTION PRESSURE DURING HARVEST CYCLE

STEP 1 DETERMINE THE ICE MACHINE OPERATING CONDITIONS

Air temperature entering condenser ________

Air temperature around ice machine ________

Water temperature entering float valve ________

STEP 2 REFER TO OPERATING PRESSURE CHART FOR ICE MACHINE MODEL BEING CHECKED

Using operating conditions determined in Step 1, find the published normal harvest cycle suction pressure.

Published harvest cycle suction pressure ________

STEP 3 PERFORM AN ACTUAL HARVEST CYCLE SUCTION PRESSURE CHECK

	PSIG
Beginning of harvest cycle	________
Middle of harvest cycle	________
End of harvest cycle	________

STEP 4 COMPARE THE ACTUAL HARVEST SUCTION PRESSURE (STEP 3) WITH THE PUBLISHED HARVEST SUCTION PRESSURE (STEP 2)

The harvest cycle suction pressure is normal when the actual pressure falls between the published pressure ranges for the ice machine operating conditions.

FREEZE CYCLE SUCTION PRESSURE HIGH CHECKLIST

1. Non-Manitowoc components in system
2. Improper installation
   - Refer to "Installation/Visual Inspection" Checklist
3. **IMPORTANT:** Freeze cycle discharge pressure high affecting low side
   - Refer to "Freeze Cycle Discharge Pressure High" Checklist
4. Improper refrigerant charge
   - Over-charged
   - Wrong type of refrigerant

Remote Ice Machines Only

5. Harvest pressure regulating solenoid (H.P.R.) leaking
6. Hot gas valve stuck open
7. TXV flooding (check bulb mounting)
8. Defective compressor

FREEZE CYCLE SUCTION PRESSURE LOW CHECKLIST

1. Non-Manitowoc components in system
2. Improper installation
   - Refer to "Installation/Visual Inspection" Checklist
3. **IMPORTANT:** Freeze cycle discharge pressure low affecting low side
   - Refer to "Freeze Cycle Discharge Pressure Low" Checklist
4. Improper water supply over evaporator
   - Refer to "Water System" Checklist
5. Loss of heat transfer from tubing on backside of evaporator
6. Restricted or plugged liquid line drier, or tubing in suction side of refrigeration system
7. Improper refrigerant charge
   - Under charged
   - Wrong type of refrigerant
8. Expansion valve starving (check bulb mounting)

HOW TO USE REFRIGERATION SYSTEM OPERATIONAL ANALYSIS TABLES

The tables list 5 different defects that may affect the ice machine's operation. There are only 4 columns listed across the top. A low-on-charge ice machine and a starving expansion valve have very similar characteristics and are therefore listed under the same column.

Before starting, refer to "Before Beginning Service" for a few questions to ask when talking to the ice machine user.

STEP 1 **COMPLETE "OPERATIONAL ANALYSIS" COLUMN.**

Read **down** the left "Operational Analysis" column and perform all procedures and check all information listed. All items under "Operational Analysis" column have supporting reference material to help analyze each step.

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

STEP 2 **ENTER CHECK MARKS (✔) IN SMALL SQUARE BOXES.**

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

Example: After analyzing freeze cycle suction pressure, it is determined to be low. Check the symptoms listed across the freeze cycle suction column, and enter a check mark (✔) only in box marked "low". The other three boxes indicate "high", which does not match the actual finding of low.

STEP 3 **ADD THE CHECK MARKS LISTED UNDER EACH COLUMN.**

Add the number of check marks listed under each of the 4 columns. When completed, there will be 4 separate totals. If two columns have matching high numbers, a procedure was not performed properly and/or supporting material was not analyzed correctly. Refer to "Final Analysis" and column with highest number of check marks prior to changing refrigeration component.

Final Analysis

The column with the highest total number of check marks identifies the refrigeration problem. It is important to analyze all detailed charts, check lists, and other references to eliminate external items for causing a good refrigeration component to appear defective.

Refer to column with highest number of check marks and follow appropriate procedures below.

Column 1 - Hot Gas Valve Leaking: Normally a leaking hot gas valve can be repaired with a rebuild kit without changing the entire valve. Rebuild or replace the hot gas valve as required.

Column 2 - Low on Charge Expansion Valve Starving: Verify the ice machine is not low on charge before replacing an expansion valve. Use the following guidelines:

A starving expansion valve normally only affects the freeze cycle pressures and not the harvest cycle pressures. A low refrigerant charge normally affects both freeze and harvest cycle pressures.

STEP 1 Add refrigerant charge in 2 to 4 oz. increments as a diagnostic procedure to verify a low charge.

STEP 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, the TXV's are most likely good and are affected by some other malfunction such as an ice machine that is low on charge.

STEP 3 If the problem is corrected by adding charge, the ice machine is low on charge. **Find the refrigerant leak!**

The ice machine must operate with proper nameplate charge. If no leak is found, the ice machine must still be evacuated and recharged using proper procedures which include changing the drier.

Column 3 - Expansion Valve Flooding: A loose or improperly mounted expansion valve bulb causes expansion valve to flood. Verify bulb mounting, insulation, etc. prior to changing valve.

On dual expansion valve ice machines, by comparing the Ice formation pattern analysis, the service technician should be able to tell which expansion valve Is flooding. Change only the flooding expansion valve.

Column 4 - Compressor: Replace the compressor (and start components).

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

MANITOWOC J-MODEL SINGLE EXPANSION VALVE ICE MACHINE

Refrigeration System Operational Analysis Table

This table must be used with detailed charts/checklists and other references to eliminate external items (or problems) which can cause good refrigeration components to appear defective

OPERATIONAL ANALYSIS (Listed below)	1	2	3	4
Ice Production	Published 24 hour ice production________ Calculated (actual) ice production________ NOTE: The ice machine is operating properly if the ice production and ice formation pattern is normal			
Installation and Water System	Installation and/or water related problems can simulate a refrigeration component malfunction. Refer to "Installation/Visual Inspection Checklist" and "Water System Checklist" and correct all problems before proceeding.			
Ice Formation Pattern ________ ________ Refer to "Determining Ice Formation Patterns" for further details.	1. Ice formation is extremely thin on top of evaporator -or- 2. No ice formation on entire evaporator ☐	1. Ice formation is extremely thin on top of evaporator -or- 2. No ice formation on entire evaporator ☐	1. Ice formation is normal -or- 2. Ice formation is extremely thin on bottom of evaporator -or- 3. No ice formation on entire evaporator ☐	1. Ice formation is normal (It's normal for "dimples" in top ice cubes of evaporator to be more pronounced than "dimples" in ice cubes in bottom of evaporator.) -or- 2. No ice formation ☐

(Continued on next page)

MANITOWOC J-MODEL SINGLE EXPANSION VALVE ICE MACHINE

Refrigeration System Operational Analysis Table

(Continued from previous page)

OPERATIONAL ANALYSIS (listed below)	1.	2.	3.	4.
Safety Limits Refer to "Analyzing Safety Limits" to eliminate problems and/or components not listed on this table.	Stops on Safety Limit 1	Stops on Safety Limit 1 or 4	Stops on Safety Limit 1 or 2 or 3	Stops on Safety Limit 4
After 5 minutes into freeze cycle, compare compressor discharge line temperature to the **hot gas valve <u>inlet</u> temperature.** Comp disc ________ Hot gas inlet ________	The inlet of hot gas valve is hot and approaches the temperature of a **hot** compressor discharge line.	The inlet of hot gas valve is cool enough to hold hand on and the compressor discharge line is hot.	Both the inlet to hot gas valve and compressor discharge line are cool enough to hold hand on.	The inlet of hot gas valve is cool enough to hold hand on and the compressor discharge line is hot.

(Continued on next page)

MANITOWOC J-MODEL SINGLE EXPANSION VALVE ICE MACHINE

Refrigeration System Operational Analysis Table

(Continued from previous page)

OPERATIONAL ANALYSIS (listed below)	**1.**	**2.**	**3.**	**4.**
Compare **inlet to outlet temperature of evaporator** after 5 min. into freeze cycle Inlet _____ Outlet _____	Inlet and outlet temperature within 7°F of each other ☐	Not within 7°F and inlet is colder than outlet ☐	1. Not within 7°F and inlet is warmer than outlet or 2. Inlet & outlet temperature within 7°F of each other ☐	Inlet and outlet temperatures within 7°F of each other ☐
Freeze cycle discharge pressure ___________________ Beginning Middle End	**Normal** discharge pressure - refer to "Analyzing Discharge Pressure" to determine if normal. **High or low** pressure - refer to a freeze cycle high or low discharge pressure checklist to eliminate problems and/or components not listed on this table before proceeding.			
Freeze cycle suction pressure ___________________ Beginning Middle End	**Normal** suction pressure - suction pressure drops throughout freeze cycle. Refer to "Analyzing Suction Pressure" to determine if dropping normally. **High or low** suction pressure - refer to a freeze cycle high or low suction pressure checklist to eliminate problems and/or components not listed on this table before proceeding.			
	High ☐	**Low** ☐	**High** ☐	**High** ☐

(Continued on next page)

MANITOWOC J-MODEL SINGLE EXPANSION VALVE ICE MACHINE

Refrigeration System Operational Analysis Table

(Continued from previous page)

OPERATIONAL ANALYSIS (listed below)	**1.**	**2.**	**3.**	**4.**
Miscellaneous Enter miscellaneous items in proper boxes.	______ ______ ______ ☐	______ ______ ______ ☐	______ ______ ______ ☐	______ ______ ______ ☐
Final Analysis Going downward, enter total number of boxes checked in each column.	Total boxes checked ______ **HOT GAS VALVE LEAKING**	Total boxes checked ______ LOW ON CHARGE -OR - TXV STARVING	Total boxes checked ______ TXV FLOODING	Total boxes checked ______ COMPRESSOR

(End)

MANITOWOC J1300/J1800 MODEL DUAL EXPANSION VALVE ICE MACHINES

Refrigeration System Operational Analysis Table

This table must be used with detailed charts/checklists and other references to eliminate external items (or problems) which can cause good refrigeration components to appear defective.

OPERATIONAL ANALYSIS (listed below)	**1.**	**2.**	**3.**	**4.**
Ice Production	Published 24 hour ice production______ Calculated (actual) ice production______ NOTE: The ice machine is operating properly if the ice production and ice formation pattern is normal.			
Installation and Water System	Installation and/or water related problems can simulate a refrigeration component malfunction. Refer to "Installation/Visual Inspection Checklist" and "Water System Checklist" and correct all problems before proceeding.			
Ice Formation Pattern Left Side______ Right Side______ Refer to "Determining Ice Formation Patterns" for further details.	1. Ice formation is extremely thin on top of one side of evaporator -or- 2. No ice formation on one side of evaporator ☐	1. Ice formation is extremely thin on top of one, or both sides of evaporator -or- 2. No ice formation on one side of evaporator ☐	1. Ice formation is normal on entire evaporator -or- 2. Ice formation is extremely thin on bottom of one side of evaporator -or- 3. No ice formation on one side of evaporator ☐	1. Ice formation is normal (It is normal for "dimples" in top ice cubes of evaporator to be more pronounced than "dimples" in ice cubes in bottom of evaporator.) -or- 2. No ice formation on entire evaporator ☐

(Continued on next page)

MANITOWOC J1300/J1800 MODEL DUAL EXPANSION VALVE ICE MACHINES

Refrigeration System Operational Analysis Table

(Continued from previous page)

OPERATIONAL ANALYSIS (listed below)	**1.**	**2.**	**3.**	**4.**
Safety Limits Refer to "Analyzing Safety Limits" to eliminate problems and/or components not listed on this table.	Stops on Safety Limit 1 ☐	Stops on Safety Limit 1 or 4 ☐	Stops on Safety Limit 1 or 2 or 3 ☐	Stops on Safety Limit 4 ☐
After 5 minutes into freeze cycle, compare compressor discharge line temperature to inlet temperature of both hot gas valves. Comp disc ________ Left ______ Right _____	The inlet of hot gas valve is **hot** and approaches the temperature of a **hot** compressor discharge line. ☐	The inlets of both hot gas valves are cool enough to hold hand on and the compressor discharge is hot. ☐	The inlets of both hot gas valves and compressor discharge line are cool enough to hold hand on. ☐	The inlets of both hot gas valves are cool enough to hold hand on and the compressor discharge line is hot. ☐

(Continued on next page)

MANITOWOC J1300/J1800 MODEL DUAL EXPANSION VALVE ICE MACHINES

Refrigeration System Operational Analysis Table

(Continued from previous page)

OPERATIONAL ANALYSIS (listed below)	1.	2.	3.	4.
	☐	☐	☐	☐
Freeze cycle discharge pressure ____________ Beginning Middle End	**Normal** discharge pressure - refer to “Analyzing Discharge Pressure” to determine if normal. **High or low discharge** pressure - refer to a freeze cycle high or low discharge pressure checklist to eliminate problems and/or components not listed on this table before proceeding.			
Freeze cycle suction pressure ____________ Beginning Middle End	**Normal** suction pressure - suction pressure drops throughout freeze cycle. Refer to “Analyzing Suction Pressure” to determine if dropping normally. **High or low** suction pressure - refer to a freeze cycle high or low suction pressure checklist to eliminate problems and/or components not listed on this table before proceeding.			
	High ☐	**Low** ☐	**High** ☐	**High** ☐

(Continued on next page)

MANITOWOC J1300/J1800 MODEL DUAL EXPANSION VALVE ICE MACHINES

Refrigeration System Operational Analysis Table

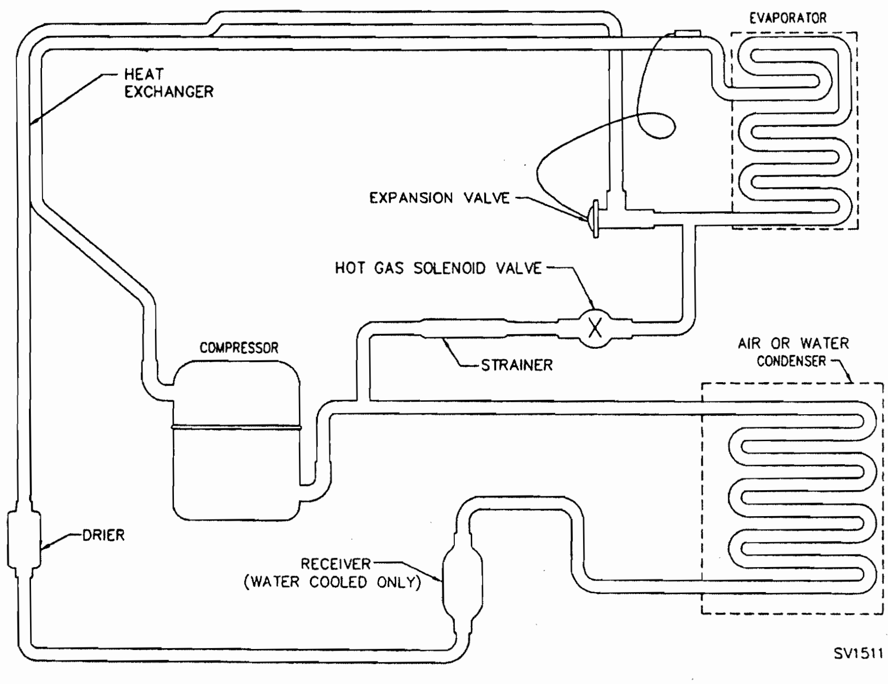
(Continued from previous page)

OPERATIONAL ANALYSIS (listed below)	1.	2.	3.	4.
Miscellaneous Enter miscellaneous items in proper boxes.				
Final Analysis Going downward, enter total number of boxes checked in each column.	Total boxes checked ______ **HOT GAS VALVE LEAKING**	Total boxes checked ______ **LOW ON CHARGE - OR - TXV STARVING**	Total boxes checked ______ **TXV FLOODING**	Total boxes checked ______ **COMPRESSOR**

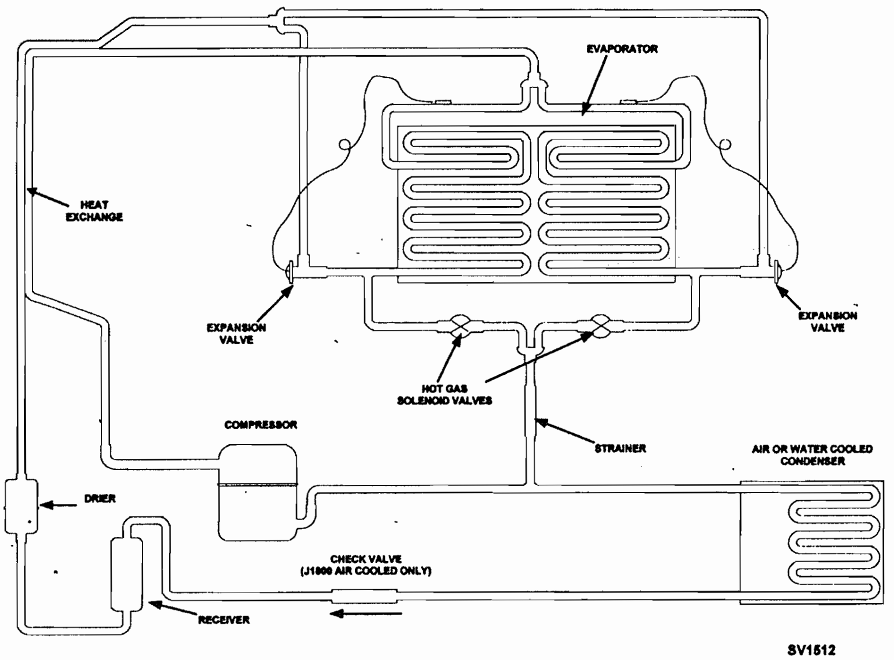
(End)

NOTES

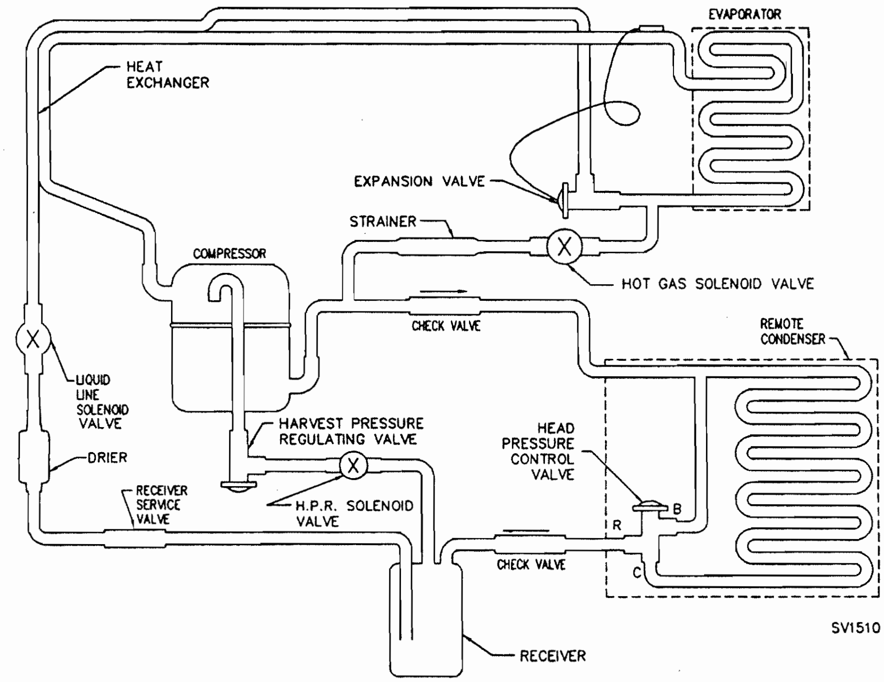
REFRIGERATION TUBING SCHEMATIC
SELF-CONTAINED AIR OR WATER-COOLED MODELS
J200/J250/J320/J420/J450/J600/J800/J1000



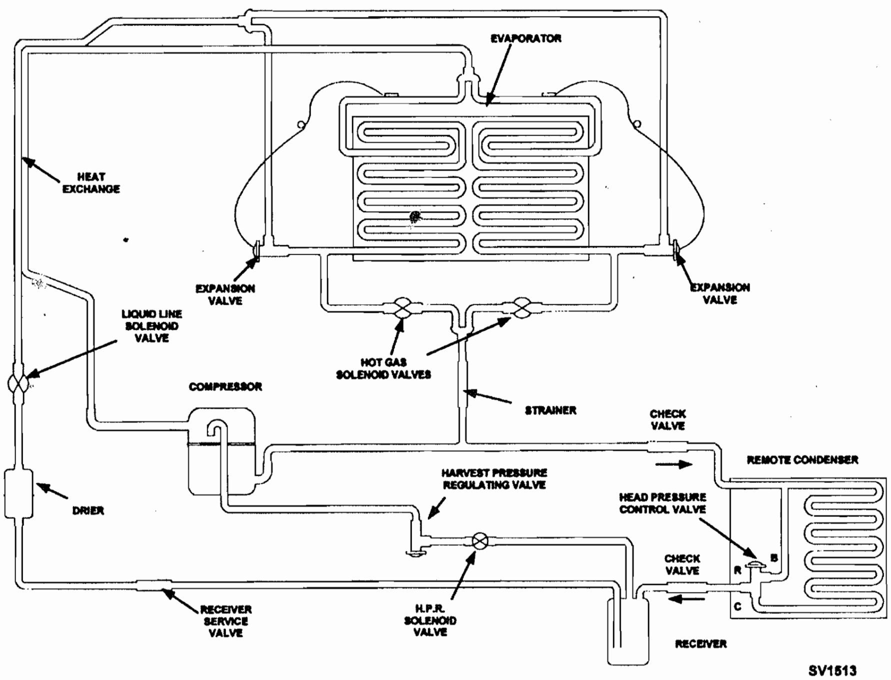
REFRIGERATION TUBING SCHEMATIC
SELF-CONTAINED AIR OR WATER-COOLED MODELS
J1300/J1800



REFRIGERATION TUBING SCHEMATIC
REMOTE MODELS
J450/J600/J800/J1000



REFRIGERATION TUBING SCHEMATIC
REMOTE MODELS
J1300/J1800



NOTES

NOTES

J200 SERIES SELF CONTAINED AIR-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	11.5-13.5	13.8-16.1	15.2-17.8	1.0-2.5
80/26.7	12.6-14.7	15.2-17.8	17.5-20.4	
90/32.2	14.5-16.9	17.0-19.8	19.8-23.0	
100/37.8	17.0-19.8	20.5-23.8	23.6-27.4	

Based on average ice slab weight of 2.44 lb. to 2.81 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	270	230	210
80/26.7	250	210	185
90/32.2	220	190	165
100/37.8	190	160	140

Regular cube derate 7%

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	190-260	60-28	120-190	85-110
70/21.1	190-260	60-28	120-190	85-110
80/26.7	210-270	65-28	160-190	90-110
90/32.2	240-290	70-30	190-210	100-120
100/37.8	270-330	70-35	220-240	120-140
110/43.3	310-390	90-40	250-270	120-150

* Suction pressure drops gradually throughout freeze cycle

J200 SERIES WATER-COOLED

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 — WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	11.8-13.8	14.5-16.9	17.0-19.8	1.0-2.5
80/26.7	12.0-14.1	14.5-16.9	17.0-19.8	
90/32.2	12.6-14.7	15.2-17.8	18.2-21.0	
100/37.8	12.6-14.7	15.2-17.8	18.2-21.0	

Based on average ice slab weight of 2.44 lb. to 2.81 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. AROUND ICE MACHINE °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	265	220	190
80/26.7	260	220	190
90/32.2	250	210	180
100/37.8	250	210	180

Regular cube derate 7%

CONDENSER WATER CONSUMPTION	90/32.2 AIR TEMPERATURE — WATER TEMPERATURE °F/°C		
	50/10.0	70/21.1	90/32.2
Gal/24 hours	230	430	2230

Water regulating valve set to maintain 230 PSIG discharge pressure

OPERATING PRESSURES

AIR TEMP. AROUND ICE MACHINE °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	225-240	60-28	170-200	90-110
70/21.1	225-240	60-28	170-200	90-110
80/26.7	225-240	60-28	175-205	90-110
90/32.2	225-245	65-28	175-205	90-115
100/37.8	225-245	70-30	180-210	90-115
110/43.3	225-250	75-30	185-215	90-120

* Suction pressure drops gradually throughout freeze cycle

J250 SERIES SELF CONTAINED AIR-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	12.0-14.1	13.8-16.1	16.1-18.7	1.0-2.5
80/26.7	13.1-15.4	15.2-17.8	17.0-19.8	
90/32.2	14.5-16.9	18.2-21.0	20.5-23.8	
100/37.8	17.5-20.4	21.2-24.6	23.6-27.4	

Based on average ice slab weight of 2.44 lb. to 2.81 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	260	230	200
80/26.7	240	210	190
90/32.2	220	180	160
100/37.8	185	155	140

Regular cube derate 7%

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	200-250	70-28	160-180	80-100
70/21.1	210-280	70-28	160-180	80-100
80/26.7	230-300	75-28	170-200	90-110
90/32.2	270-340	80-30	190-220	95-115
100/37.8	310-380	85-34	220-250	120-140
110/43.3	340-430	90-38	250-280	130-150

* Suction pressure drops gradually throughout freeze cycle

J250 SERIES WATER-COOLED

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 WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	11.0-13.0	13.8-16.1	16.1-18.7	1.0-2.5
80/26.7	11.0-13.0	13.8-16.1	16.1-18.7	
90/32.2	11.5-13.5	14.5-16.9	17.0-19.8	
100/37.8	11.5-13.5	14.5-16.9	17.0-19.8	

Based on average ice slab weight of 2.44 lb. to 2.81 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. AROUND ICE MACHINE °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	280	230	200
80/26.7	280	230	200
90/32.2	270	220	190
100/37.8	270	220	190

Regular cube derate 7%

CONDENSER WATER CONSUMPTION	90/32.2 AIR TEMPERATURE WATER TEMPERATURE °F/°C		
	50/10.0	70/21.1	90/32.2
Gal/24 hours	250	510	2400

Water regulating valve set to maintain 225 PSIG discharge pressure

OPERATING PRESSURES

AIR TEMP. AROUND ICE MACHINE °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	220-240	60-28	170-200	80-100
70/21.1	220-240	60-28	170-200	85-105
80/26.7	220-240	62-30	175-205	85-105
90/32.2	220-240	65-32	180-210	90-110
100/37.8	220-240	65-32	180-210	90-110
110/43.3	220-260	65-32	210-230	90-115

* Suction pressure drops gradually throughout freeze cycle

J320 SERIES SELF CONTAINED AIR-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C 50/10.0	70/21.1	90/32.2	HARVEST TIME
70/21.1	11.7-13.4	13.1-14.9	14.7-16.8	1.0-2.5
80/26.7	13.6-15.5	15.1-17.2	17.7-20.2	
90/32.2	16.1-18.4	18.6-21.2	21.9-25.0	
100/37.8	19.6-22.3	23.3-26.5	26.6-30.3	

Based on average ice slab weight of 2.93 lb. to 3.31 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C 50/10.0	70/21.1	90/32.2
70/21.1	320	290	260
80/26.7	280	250	220
90/32.2	240	210	180
100/37.8	200	170	150

Regular cube derate 7%

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	200-250	50-34	150-180	75-90
70/21.1	200-250	50-34	160-190	80-100
80/26.7	220-280	50-36	170-200	90-110
90/32.2	230-320	52-38	180-220	90-120
100/37.8	270-360	54-40	200-250	95-140
110/43.3	280-380	56-44	210-260	95-150

* Suction pressure drops gradually throughout freeze cycle

J320 SERIES WATER-COOLED

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 WATER TEMP. °F/°C 50/10.0	70/21.1	90/32.2	HARVEST TIME
70/21.1	11.9-13.6	13.8-15.8	16.1-18.4	1.0-2.5
80/26.7	12.1-13.9	14.4-16.5	16.5-18.8	
90/32.2	12.6-14.4	15.0-17.1	17.3-19.7	
100/37.8	13.1-14.9	15.1-17.2	17.7-20.2	

Based on average ice slab weight of 2.93 lb. to 3.31 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. AROUND ICE MACHINE °F/°C	WATER TEMP. °F/°C 50/10.0	70/21.1	90/32.2
70/21.1	315	275	240
80/26.7	310	265	235
90/32.2	300	255	225
100/37.8	290	250	220

Regular cube derate 7%

CONDENSER WATER CONSUMPTION °F/°C	90/32.2 AIR TEMPERATURE WATER TEMPERATURE °F/°C 50/10.0	70/21.1	90/32.2
Gal/24 hours	280	460	2300

Water regulating valve set to maintain 230 PSIG discharge pressure

OPERATING PRESSURES

AIR TEMP. AROUND ICE MACHINE °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	225-240	50-38	160-180	80-110
70/21.1	225-240	50-38	170-190	85-115
80/26.7	225-250	50-38	170-200	85-115
90/32.2	225-260	50-40	170-210	90-120
100/37.8	225-265	52-42	170-210	90-120
110/43.3	225-265	52-44	175-215	95-125

* Suction pressure drops gradually throughout freeze cycle

J420/J450 SERIES SELF CONTAINED AIR-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	9.5-11.2	10.9-12.8	12.3-14.4	1-2.5
80/26.7	10.4-12.2	12.0-14.1	13.7-16.0	
90/32.2	12.0-14.0	14.1-16.5	16.5-19.2	
100/37.8	13.3-15.6	16.0-18.6	18.3-21.3	

Based on average ice slab weight of 4.12 lb. to 4.75 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	540	480	430
80/26.7	500	440	390
90/32.2	440	380	330
100/37.8	400	340	300

Regular cube derate 7%

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	195-240	45-30	150-170	75-90
70/21.1	205-260	47-33	165-180	80-100
80/26.7	230-265	50-35	165-185	80-100
90/32.2	260-290	55-36	190-210	90-110
100/37.8	290-340	60-38	215-235	105-125
110/43.3	330-395	75-40	235-255	125-140

* Suction pressure drops gradually throughout freeze cycle

J420/J450 SERIES WATER-COOLED

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 TEMP. °F/°C			
	50/10.0	70/21.1	90/32.2	
70/21.1	9.9-11.7	11.4-13.4	13.3-15.6	1-2.5
80/26.7	10.1-11.9	11.7-13.7	13.7-16.0	
90/32.2	10.4-12.2	12.0-14.1	14.1-16.5	
100/37.8	10.6-12.5	12.3-14.4	14.5-17.0	

Based on average ice slab weight of 4.12 lb. to 4.75 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. AROUND ICE MACHINE °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	520	460	400
80/26.7	510	450	390
90/32.2	500	440	380
100/37.8	490	430	370

Regular cube derate 7%

CONDENSER WATER CONSUMPTION	90/32.2 AIR TEMPERATURE		
	WATER TEMPERATURE °F/°C		
	50/10.0	70/21.1	90/32.2
Gal/24 hours	400	740	2400

Water regulating valve set to maintain 240 PSIG discharge pressure

OPERATING PRESSURES

AIR TEMP. AROUND ICE MACHINE °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	235-245	50-35	165-180	85-100
70/21.1	235-245	50-35	165-180	85-100
80/26.7	235-245	50-35	165-180	85-100
90/37.8	235-245	52-35	165-180	85-100
100/32.8	235-245	52-35	165-185	85-100
110/43.3	240-250	55-36	165-185	85-100

* Suction pressure drops gradually throughout freeze cycle

J450 SERIES REMOTE

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME			HARVEST TIME
	WATER TEMP. °F/°C			
	50/10.0	70/21.1	90/32.2	
-20 to 70/-28.9 to 21.1	10.9-12.8	12.6-14.8	14.1-16.5	1-2.5
80/26.7	11.1-13.1	13.0-15.2	14.5-17.0	
90/32.2	11.4-13.4	13.3-15.6	15.0-17.5	
100/37.8	12.6-14.8	15.0-17.5	17.0-19.9	
110/43.3	14.1-16.5	17.1-19.9	19.0-22.1	

Based on average ice slab weight of 4.12 lb. to 4.75 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	480	420	380
80/26.7	470	410	370
90/32.2	460	400	360
100/37.8	420	360	320
110/43.3	380	320	290

Regular cube derate 7%

Rating using JC0495 condenser, dice or half-dice cubes

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
-20 to 50/-29 to 10.0	220-245	50-30	175-190	85-100
70/21.1	230-250	50-31	175-190	85-100
80/26.7	240-260	52-32	180-195	85-100
90/32.2	245-270	54-32	185-200	85-100
100/37.8	280-310	57-32	190-205	90-105
110/43.3	290-325	64-39	190-205	95-110

* Suction pressure drops gradually throughout freeze cycle

J600 SERIES SELF CONTAINED AIR-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	8.1-9.5	9.5-11.2	10.9-12.8	1-2.5
80/26.7	8.4-9.9	9.7-11.4	11.2-13.1	
90/32.2	9.3-10.9	10.6-12.5	12.3-14.4	
100/37.8	10.6-12.5	12.3-14.4	14.5-17.0	

Based on average ice slab weight of 4.12 lb. to 4.75 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	620	540	480
80/26.7	600	530	470
90/32.2	550	490	430
100/37.8	490	430	370

Regular cube derate 7%

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	220-280	42-22	155-180	75-95
70/21.1	220-290	44-22	160-185	85-100
80/26.7	220-305	52-22	160-190	90-110
90/32.2	250-325	52-23	175-195	95-115
100/37.8	280-355	54-30	195-210	95-125
110/43.3	300-385	56-32	200-225	100-135

* Suction pressure drops gradually throughout freeze cycle

J600 SERIES WATER-COOLED

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 WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	8.1-9.5	9.2-10.8	11.7-13.7	1-2.5
80/26.7	8.2-9.7	9.4-11.1	12.0-14.1	
90/32.2	8.4-9.9	9.6-11.3	12.3-14.4	
100/37.8	8.6-10.1	9.8-11.5	12.6-14.8	

Based on average ice slab weight of 4.12 lb. to 4.75 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. AROUND ICE MACHINE °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	620	555	450
80/26.7	610	545	440
90/32.2	600	535	430
100/37.8	590	525	420

Regular cube derate 7%

CONDENSER WATER CONSUMPTION	90/32.2 AIR TEMPERATURE WATER TEMPERATURE °F/°C		
	50/10.0	70/21.1	90/32.2
Gal/24 hours	550	1000	4600

Water regulating valve set to maintain 230 PSIG discharge pressure

OPERATING PRESSURES

AIR TEMP. AROUND ICE MACHINE °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	225-235	46-25	140-184	80-102
70/21.1	225-235	46-26	148-184	82-104
80/26.7	225-235	48-26	154-186	86-108
90/32.2	225-235	48-26	154-190	86-108
100/37.8	225-240	50-28	162-194	86-112
110/43.3	225-245	52-28	165-200	86-115

* Suction pressure drops gradually throughout freeze cycle

J600 SERIES REMOTE

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C 50/10.0	70/21.1	90/32.2	HARVEST TIME
70/21.1	8.2-9.7	9.9-11.7	12.0-14.1	1-2.5
80/26.7	8.3-9.8	10.0-11.8	12.1-14.2	
90/32.2	8.4-9.9	10.2-11.9	12.3-14.4	
100/37.8	8.9-10.5	10.9-12.8	12.6-14.8	
110/43.3	9.9-11.7	12.0-14.1	14.1-16.5	

Based on average ice slab weight of 4.12 lb. to 4.75 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C 50/10.0	70/21.1	90/32.2
70/21.1	610	520	440
80/26.7	605	515	435
90/32.2	600	510	430
100/37.8	570	480	420
110/43.3	520	440	380

Regular cube derate 7%

Rating using JC0895 condenser, dice or half-dice cubes

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE HEAD PRESSURE PSIG	FREEZE CYCLE SUCTION PRESSURE PSIG	HARVEST CYCLE HEAD PRESSURE PSIG	HARVEST CYCLE SUCTION PRESSURE PSIG
-20 to 50/-29 to 10.0	220-250	42-26	152-170	75-90
70/21.1	245-260	44-26	155-172	82-94
80/26.7	245-265	46-26	156-174	82-95
90/32.2	250-265	48-26	157-174	84-96
100/37.8	265-295	52-26	158-176	84-98
110/43.3	300-335	52-28	158-176	84-102

* Suction pressure drops gradually throughout freeze cycle

J800 SERIES SELF CONTAINED AIR-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER F°/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	8.8-10.2	10.3-11.9	11.9-13.6	1-2.5
80/26.7	9.4-10.8	11.0-12.7	12.5-14.4	
90/32.2	10.5-11.5	11.6-13.3	13.3-15.2	
100/37.8	11.6-13.4	13.6-15.5	15.0-17.2	

Based on average ice slab weight of 5.75 lb. to 6.50 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	800	700	620
80/26.7	760	660	590
90/32.2	720	630	560
100/37.8	630	550	500

Regular cube derate 7%

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	220-240	31-18	135-180	65-90
70/21.1	220-240	32-18	140-180	70-90
80/26.7	225-260	36-20	140-180	70-95
90/32.2	260-295	38-22	150-200	80-100
100/37.8	300-330	40-24	210-225	80-100
110/43.3	320-360	44-26	210-240	85-120

* Suction pressure drops gradually throughout freeze cycle

J800 SERIES WATER-COOLED

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 WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	8.8-10.2	9.7-11.1	11.9-13.6	1-2.5
80/26.7	9.1-10.5	10.5-11.5	12.3-14.1	
90/32.2	9.4-10.8	10.3-11.9	12.8-14.6	
100/37.8	9.7-11.1	10.7-12.3	13.3-15.2	

Based on average ice slab weight of 5.75 lb. to 6.50 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. AROUND ICE MACHINE °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	800	740	620
80/26.7	780	720	600
90/32.2	760	700	580
100/37.8	740	680	560

Regular cube derate 7%

CONDENSER WATER CONSUMPTION °F/°C	90/32.2 AIR TEMPERATURE WATER TEMPERATURE °F/°C		
	50/10.0	70/21.1	90/32.2
Gal/24 hours	610	1300	6700

Water regulating valve set to maintain 230 PSIG discharge pressure

OPERATING PRESSURES

AIR TEMP. AROUND ICE MACHINE °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	225-235	33-20	160-185	65-85
70/21.1	225-235	34-20	165-185	70-85
80/26.7	225-235	34-20	165-185	70-85
90/37.8	225-235	36-22	165-185	70-85
100/32.8	225-235	36-22	165-185	70-85
110/43.3	225-240	38-24	170-190	75-90

* Suction pressure drops gradually throughout freeze cycle

J800 SERIES REMOTE

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	8.8-10.2	10.3-11.9	12.1-13.8	1-2.5
80/26.7	8.9-10.3	10.4-12.0	12.2-14.0	
90/32.2	9.0-10.3	10.5-12.1	12.3-14.1	
100/37.8	9.7-11.1	11.4-13.1	13.6-15.5	
110/43.3	10.9-12.5	13.6-15.5	15.0-17.2	

Based on average ice slab weight of 5.75 lb. to 6.50 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	800	700	610
80/26.7	795	695	605
90/32.2	790	690	600
100/37.8	740	640	550
110/43.3	670	550	500

Regular cube derate 7%

Rating using JC0895 condenser, dice or half-dice cubes

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
-20 to 50/-29 to 10.0	220-250	30-22	180-200	65-90
70/21.1	230-250	32-22	190-200	70-90
80/26.7	240-260	33-22	190-205	70-90
90/32.2	255-265	34-22	195-205	70-90
100/37.8	275-295	38-24	200-210	70-90
110/43.3	280-320	40-26	200-225	75-100

* Suction pressure drops gradually throughout freeze cycle

J1000 SERIES SELF CONTAINED AIR-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER F°/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	8.8-9.5	10.1-10.9	11.2-12.0	1-2.5
80/26.7	9.1-9.8	10.5-11.3	11.6-12.5	
90/32.2	9.7-10.4	11.2-12.0	12.5-13.4	
100/37.8	10.6-11.4	12.5-13.4	14.0-15.0	

Based on average ice slab weight of 7.75 lb. to 8.25 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	1080	960	880
80/26.7	1050	930	850
90/32.2	1000	880	800
100/37.8	920	800	720

Regular cube derate 7%

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	220-240	38-18	135-180	65-90
70/21.1	220-240	40-18	140-180	70-90
80/26.7	225-260	42-20	140-180	70-95
90/32.2	260-295	42-22	150-200	80-100
100/37.8	300-330	42-24	210-225	80-100
110/43.3	320-360	44-24	210-240	85-120

* Suction pressure drops gradually throughout freeze cycle

J1000 SERIES WATER-COOLED

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 WATER TEMP. °F/°C 50/10.0	70/21.1	90/32.2	HARVEST TIME
70/21.1	8.8-9.5	10.1-10.9	11.3-12.2	1-2.5
80/26.7	8.9-9.6	10.2-11.0	11.5-12.3	
90/32.2	8.9-9.6	10.2-11.0	11.5-12.3	
100/37.8	9.0-9.7	10.4-11.1	11.6-12.5	

Based on average ice slab weight of 7.75 lb. to 8.25 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. AROUND ICE MACHINE °F/°C	WATER TEMP. °F/°C 50/10.0	70/21.1	90/32.2
70/21.1	1080	960	870
80/26.7	1070	950	860
90/32.2	1070	950	860
100/37.8	1060	940	850

Regular cube derate 7%

CONSENDER WATER CONSUMPTION °F/°C	90/32.2 AIR TEMPERATURE WATER TEMPERATURE °F/°C 50/10.0	70/21.1	90/32.2
Gal/24 hours	840	1650	6600

Water regulating valve set to maintain 230 PSIG discharge pressue

OPERATING PRESSURES

AIR TEMP. AROUND ICE MACHINE °F/°C	FREEZE CYCLE HEAD PRESSURE PSIG	FREEZE CYCLE SUCTION PRESSURE PSIG	HARVEST CYCLE HEAD PRESSURE PSIG	HARVEST CYCLE SUCTION PRESSURE PSIG
50/10.0	225-235	36-18	160-185	65-85
70/21.1	225-235	38-18	165-185	70-85
80/26.7	225-235	40-18	165-185	70-85
90/32.2	225-235	40-20	165-185	70-85
100/37.8	225-235	40-20	165-185	70-85
110/43.3	225-240	42-20	170-190	75-90

* Suction pressure drops gradually throughout freeze cycle

J1000 SERIES REMOTE

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME			HARVEST TIME
	WATER TEMP. °F/°C			
	50/10.0	70/21.1	90/32.2	
70/21.1	9.1-9.8	10.6-11.4	11.8-12.6	1-2.5
80/26.7	9.3-10.0	10.4-11.6	12.0-12.8	
90/32.2	9.4-10.2	10.8-11.7	12.1-13.0	
100/37.8	10.0-10.8	11.6-12.5	13.0-13.9	
110/43.3	10.8-11.6	12.6-13.5	14.2-15.2	

Based on average ice slab weight of 7.75 lb. to 8.25 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	1050	920	840
80/26.7	1035	910	830
90/32.2	1020	900	820
100/37.8	970	850	770
110/43.3	910	790	710

Regular cube derate 7%

Rating using JC1095 condenser, dice or half-dice cubes

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
-20 to 50/-29 to 10.0	220-250	40-22	180-200	65-90
70/21.1	230-250	40-22	190-200	70-90
80/26.7	240-260	42-22	190-205	70-90
90/32.2	255-265	44-22	195-205	70-90
100/37.8	275-295	44-24	200-210	70-90
110/43.3	280-320	46-26	200-225	75-100

* Suction pressure drops gradually throughout freeze cycle

J1300 SERIES SELF CONTAINED AIR-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	8.8-9.8	10.2-11.4	11.5-12.8	1-2.5
80/26.7	9.1-10.1	10.5-11.7	12.0-13.3	
90/32.2	9.8-10.9	11.4-12.6	13.0-14.5	
100/37.8	10.8-12.0	12.8-14.2	14.9-16.5	

Based on average ice slab weight of 10.0 lb. to 11.0 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	1400	1230	1110
80/26.7	1360	1200	1070
90/32.2	1280	1120	990
100/37.8	1170	1010	880

Regular cube derate 7%

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	220-280	40-20	140-170	65-80
70/21.1	220-280	40-20	145-170	70-80
80/26.7	220-280	42-22	150-185	70-80
90/32.2	245-300	48-26	160-190	70-85
100/37.8	275-330	50-26	160-210	70-90
110/43.3	280-360	52-28	165-225	75-100

* Suction pressure drops gradually throughout freeze cycle

J1300 SERIES WATER-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. AROUND ICE MAHCINE °F/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	8.5-9.5	9.5-10.6	11.1-12.4	1-2.5
80/26.7	8.6-9.7	9.7-10.8	11.4-12.6	
90/32.2	8.8-9.8	9.8-11.0	11.6-12.9	
100/37.8	8.9-10.0	10.0-11.2	11.8-13.2	

Based on average ice slab weight of 10.0 lb. to 11.0 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. AROUND ICE MAHCINE °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	1440	1310	1140
80/26.7	1420	1290	1120
90/32.2	1400	1270	1100
100/37.8	1380	1250	1080

Regular cube derate 7%

CONDENSER WATER CONSUMPTION °F/°C	90/32.2 AIR TEMPERATURE WATER TEMPERATURE °F/°C		
	50/10.0	70/21.1	90/32.2
Gal/24 hours	1150	2400	7700

Water regulating valve set to maintain 240 PSIG discharge pressue

OPERATING PRESSURES

AIR TEMP. AROUND ICE MACHINE °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	235-245	40-18	150-180	70-80
70/21.1	235-245	40-18	150-180	70-80
80/26.7	235-245	40-20	150-180	70-80
90/32.2	235-250	42-20	150-180	70-80
100/37.8	235-255	44-20	150-180	70-80
110/43.3	240-265	46-20	150-180	70-80

* Suction pressure drops gradually throughout freeze cycle

J1300 SERIES REMOTE

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
-20 to 70/ -28.9 to 21.1	9.2-10.2	10.5-11.7	11.8-13.2	1-2.5
80/26.7	9.4-10.4	10.7-11.9	12.0-13.4	
90/32.2	9.5-10.6	10.9-12.2	12.2-13.6	
100/37.8	10.1-11.3	11.6-12.9	13.0-14.5	
110/43.3	11.0-12.3	12.8-14.2	14.5-16.1	

Based on average ice slab weight of 10.0 lb. to 11.0 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
-20 to 70/ -29 to 21.1	1350	1200	1080
80/26.7	1325	1180	1066
90/32.2	1310	1160	1050
100/37.8	1240	1100	990
110/43.3	1150	1010	900

Regular cube derate 7%
Rating using JC1395 condenser, dice or half-dice cubes

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
-20 to 50/ -29 to 10.0	220-250	40-22	135-170	75-95
70/21.1	240-260	40-22	140-180	80-95
80/26.7	240-270	41-22	140-190	80-95
90/32.2	250-290	42-22	140-200	80-95
100/37.8	280-320	46-22	140-210	80-95
110/43.3	310-360	48-24	140-220	85-100

* Suction pressure drops gradually throughout freeze cycle

J1800 SERIES SELF CONTAINED AIR-COOLED

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER F°/°C	FREEZE TIME			HARVEST TIME
	WATER TEMP. °F/°C			
	50/10.0	70/21.1	90/32.2	
70/21.1	9.0-10.0	10.1-11.3	11.4-12.6	1-2.5
80/26.7	9.5-10.5	10.8-11.9	12.1-13.2	
90/32.2	10.4-11.4	11.9-13.0	13.6-14.9	
100/37.8	11.9-13.0	13.8-15.2	15.6-17.1	

Based on average ice slab weight of 13.19 lb. to 14.31 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	1800	1620	1470
80/26.7	1720	1540	1400
90/32.2	1600	1420	1260
100/37.8	1420	1240	1110

Regular cube derate 7%

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	220-280	40-20	155-190	60-80
70/21.1	220-280	40-20	160-190	65-80
80/26.7	230-290	42-20	160-190	65-80
90/32.2	260-320	44-22	185-205	70-90
100/37.8	300-360	46-24	210-225	75-100
110/43.3	320-400	48-26	215-240	80-100

* Suction pressure drops gradually throughout freeze cycle

J1800 SERIES WATER-COOLED

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 WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
70/21.1	8.8-9.7	10.1-11.1	11.9-13.1	1-2.5
80/26.7	8.9-9.9	10.2-11.2	12.1-13.2	
90/32.2	9.0-10.0	10.4-11.4	12.3-13.4	
100/37.8	9.2-10.1	10.6-11.6	12.5-13.7	

Based on average ice slab weight of 13.19 lb. to 14.31 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. AROUND ICE MACHINE °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
70/21.1	1840	1640	1420
80/26.7	1820	1620	1400
90/32.2	1800	1600	1380
100/37.8	1780	1580	1360

Regular cube derate 7%

CONDENSER WATER CONSUMPTION	90/32.2 AIR TEMPERATURE WATER TEMPERATURE °F/°C		
	50/10.0	70/21.1	90/32.2
Gal/24 hours	1300	2400	7100

Water regulating valve set to maintain 240 PSIG discharge pressue

OPERATING PRESSURES

AIR TEMP. AROUND ICE MACHINE °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
50/10.0	235-245	36-20	170-190	65-80
70/21.1	235-245	38-20	170-190	65-80
80/26.7	235-245	40-20	170-190	65-80
90/32.2	235-250	42-22	175-190	65-80
100/37.8	235-255	44-22	175-190	65-80
110/43.3	235-260	46-22	175-190	65-80

* Suction pressure drops gradually throughout freeze cycle

J1800 SERIES REMOTE

These characteristics may vary depending on operating conditions.

CYCLE TIMES

Freeze Time + Harvest Time = Total Cycle Time

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE TIME WATER TEMP. °F/°C			HARVEST TIME
	50/10.0	70/21.1	90/32.2	
-20 to 70/-29 to 21.1	9.2-10.2	10.6-11.6	11.5-12.6	1-2.5
80/26.7	9.4-10.4	10.8-11.8	11.7-12.9	
90/32.2	9.7-10.7	11.2-12.2	12.1-13.2	
100/37.8	10.2-11.2	11.9-13.1	13.3-14.6	
110/43.3	11.0-12.1	12.9-14.2	14.9-16.3	

Based on average ice slab weight of 13.19 lb. to 14.31 lb.
Times in minutes

24 HOUR ICE PRODUCTION

AIR TEMP. ENTERING CONDENSER °F/°C	WATER TEMP. °F/°C		
	50/10.0	70/21.1	90/32.2
-20 to 70/ -29.0 to 21.1	1770	1570	1470
80/26.7	1735	1545	1435
90/32.2	1700	1500	1400
100/37.8	1620	1420	1280
110/43.3	1520	1320	1160

Regular cube derate 7%

Rating using JC 1895A condenser, dice or half-dice cubes

OPERATING PRESSURES

AIR TEMP. ENTERING CONDENSER °F/°C	FREEZE CYCLE		HARVEST CYCLE	
	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG	HEAD PRESSURE PSIG	SUCTION PRESSURE PSIG
-20 to 50/ -29.0 to 10.0	220-250	38-24	160-180	60-80
70/21.1	250-260	40-24	170-180	60-80
80/26.7	250-270	48-24	175-190	70-90
90/32.2	250-280	50-24	180-200	80-90
100/37.8	270-300	52-28	205-215	80-95
110/43.3	300-350	54-28	205-230	80-100

* Suction pressure drops gradually throughout freeze cycle

NOTES

NOTES

REFRIGERANT RECOVERY EVACUATION AND RECHARGING J-MODEL ICE MACHINES

REMOVAL OF REFRIGERANT

Do not purge refrigerant to the atmosphere. Capture refrigerant using recovery equipment by following specific 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.

RECOVERY/EVACUATION AND CHARGING OF SELF-CONTAINED SYSTEMS

REFRIGERANT RECOVERY/EVACUATION

(Refer to illustration - SELF-CONTAINED EVACUATION CONNECTIONS)

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

Refrigerant Recovery/Evacuation of self-contained equipment requires connections at 2 points as follows:

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

Procedures for Self-Contained Recovery/Evacuation

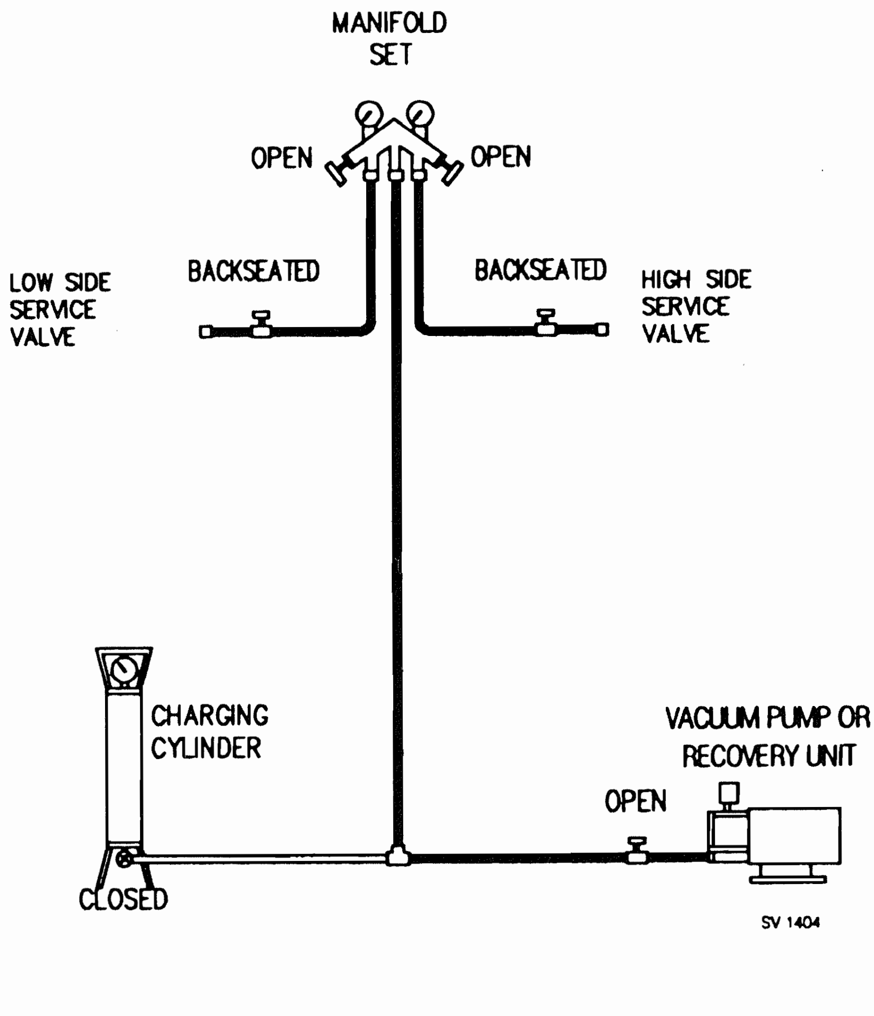
1. Place toggle switch to "OFF" position.
2. Install manifold gauges, charging cylinder/scale, and recovery unit or 2 stage vacuum pump per illustration.
3. Open (backseat) high and low side ice machine service valves, and open high and low side on manifold gauges.

4. Recovery: Operate recovery unit per manufacturer's instructions.

   Evacuation prior to recharging: Pull system down to 250 microns. Allow pump to run for 1/2 hour after reaching 250 microns. Turn off vacuum pump after 1/2 hour and ensure pressures do not rise. (Standing vacuum leak check).

> **NOTE**
>
> Recheck for leaks with a halide or electronic leak detector after charging ice machine.

5. Charge the ice machine per the Self-Contained Charging Procedures.



SELF-CONTAINED RECOVERY/EVACUATION CONNECTIONS

SELF-CONTAINED CHARGING PROCEDURES

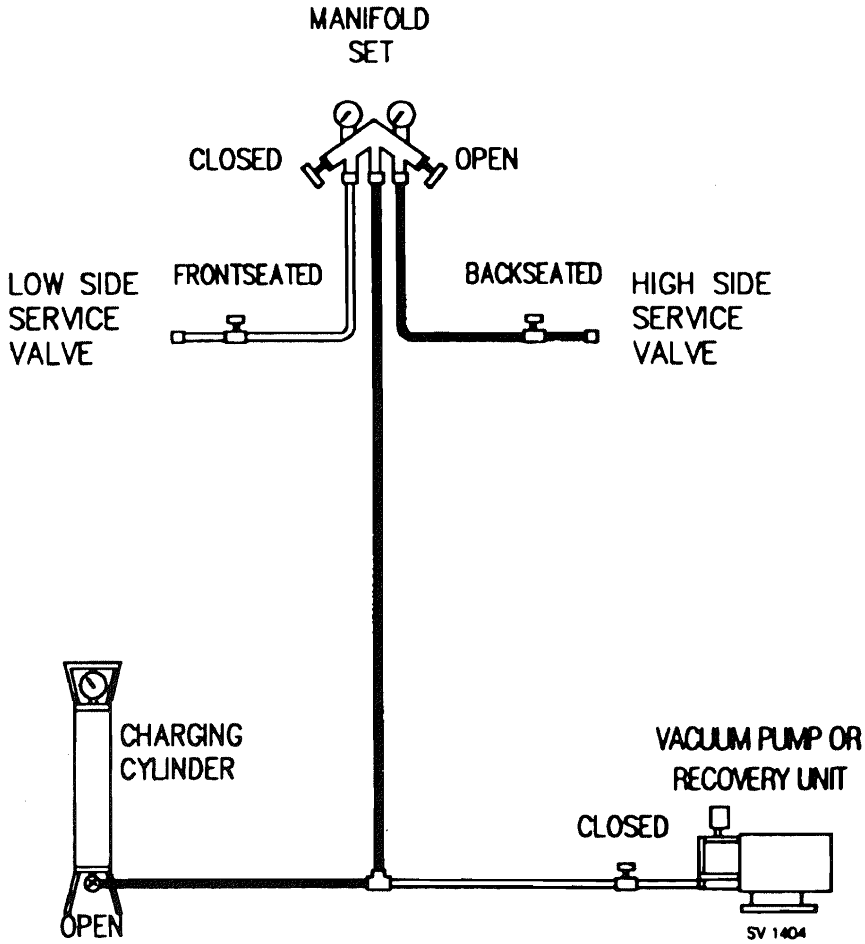
(Refer to illustration - SELF-CONTAINED CHARGING CONNECTIONS)

> **IMPORTANT**
>
> The charge is critical on all Manitowoc Series ice machines; therefore, use weight or charging cylinder to determine proper charge.

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

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

a. Run ice machine in freeze cycle.
b. Close high side service valve at ice machine.
c. Open low side service valve at ice machine.
d. Open both high and low side valves on manifold gauge set. Refrigerant in lines will be pulled into the low side of system. Allow pressures to equalize with ice machine still in freeze cycle.
e. Close low side service valve at ice machine.
f. Remove hoses from ice machine and install caps.



SELF-CONTAINED CHARGING CONNECTIONS

RECOVERY/EVACUATION AND CHARGING OF REMOTE SYSTEMS

REMOTE RECOVERY/EVACUATION CONNECTIONS

Recovery/Evacuation of remote systems requires connections at **4-points** for complete system evacuation as follows:

1. Suction side of compressor through suction service valve.
2. Discharge side of compressor through discharge service valve.
3. Receiver outlet service valve (Evacuates area between check valve in liquid line and pump-down solenoid.)
4. Access (Schraeder) valve on discharge line quick connect fitting on outside of compressor/evaporator compartment. This connection is necessary to evacuate the condenser. Without this connection, the magnetic check valves would close upon the pressure drop produced by evacuation prohibiting complete condenser evacuation.

NOTE

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

REMOTE SYSTEM REFRIGERANT RECOVERY/EVACUATION PROCEDURES:

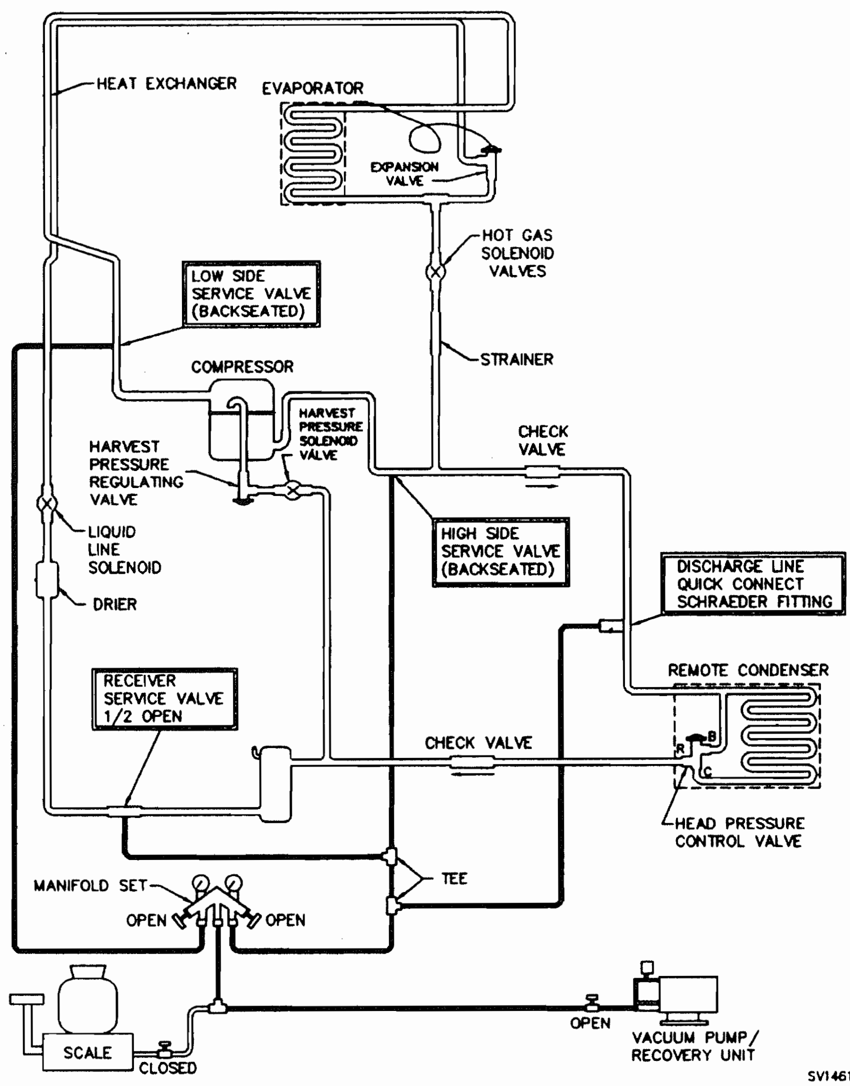
1. Place toggle switch in "OFF" position.
2. Install manifold gauges, scale, and recovery unit or 2-stage vacuum pump per illustration, 4-Point Evacuation Connections.
3. Open (backseat) high and low side ice machine service valves, position receiver service valve 1/2 open, and open high and low side on manifold gauge set.

4. Recovery: Operate recovery unit per manufacturer's instructions.

   Evacuation prior to recharging: Pull system down to 250 microns. Allow to run for 1 hour after reaching 250 microns. Turn off vacuum pump, ensure pressures do not rise (standing vacuum leak-check).

NOTE
Recheck for leaks with a halide or electronic leak detector after charging ice machine.

5. Charge the ice machine per the following charging procedures.



REMOTE RECOVERY/EVACUATION CONNECTIONS

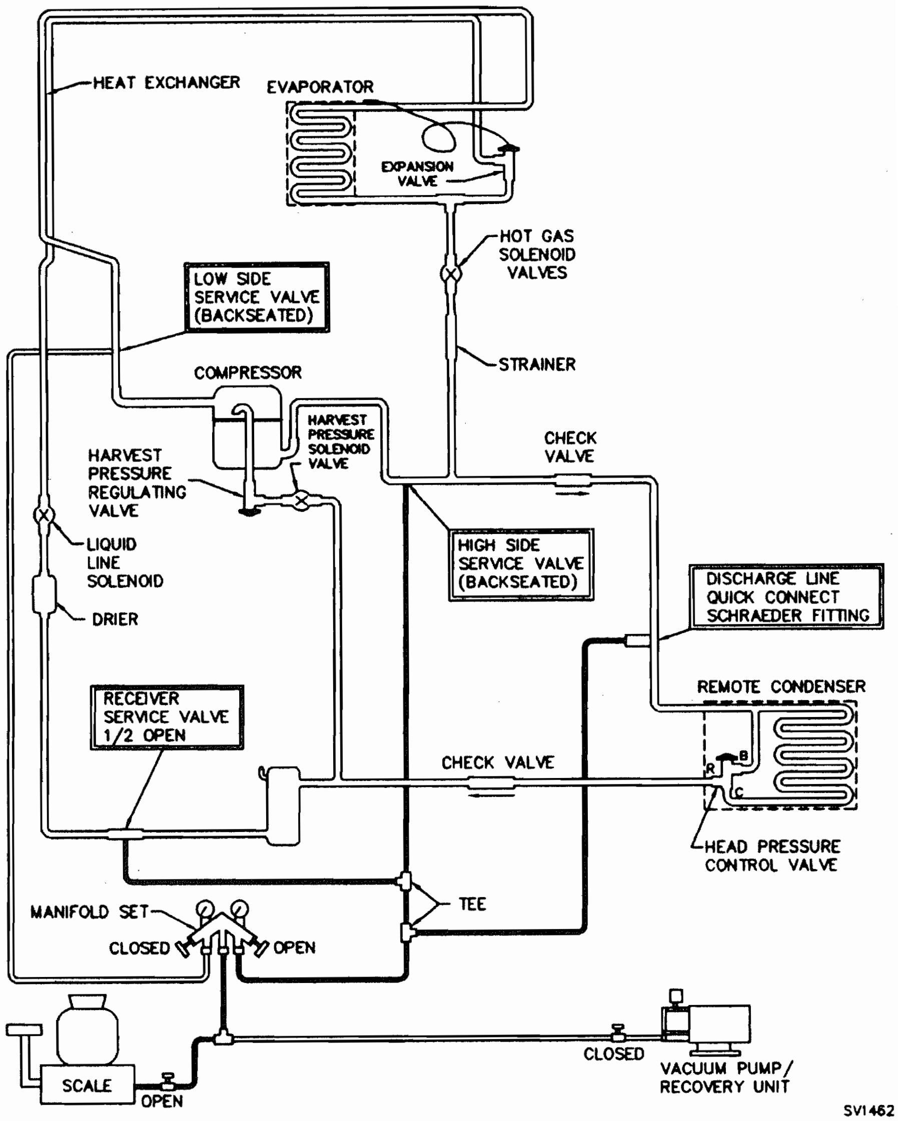
REMOTE CHARGING PROCEDURES

(Refer to illustration - REMOTE CHARGING CONNECTIONS)

1. Ensure toggle switch is in the "OFF" position.
2. Close vacuum pump valve, frontseat (close) low side and high side service valves, close low side valve on manifold gauge set.
3. Add measured nameplate charge from charging scale through high side of manifold gauge set into system high side (receiver outlet valve and discharge lines quick-connect fitting).
4. If high side does not take entire charge, close high side on manifold gauge set, backset (open) low side service valve, and receiver outlet service valve. Start ice machine and add remaining charge through low side in vapor form until the machine is fully charged.
5. Ensure all vapor in charging hoses is drawn into the machine before disconnecting manifold gauges as described in Step 7 of "Self Contained Charging Procedures".

NOTE

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



REMOTE CHARGING CONNECTIONS

REFRIGERANT CHARGE

IMPORTANT
Refer to machine serial tag to verify system charge.

J200 Series		
Air-Cooled	18 oz.	R404A
Water-Cooled	15 oz.	R404A
J250 Series		
Air-Cooled	18 oz.	R404A
Water-Cooled	13 oz.	R404A
J320 Series		
Air-Cooled	20 oz.	R404A
Water-Cooled	16 oz.	R404A
J420/J450 Series		
Air-Cooled	24 oz.	R404A
Water-Cooled	22 oz.	R404A
Remote (J450)	6 lb.	R404A
J600 Series		
Air-Cooled	32 oz.	R404A
Water-Cooled	26 oz.	R404A
Remote	8 lb.	R404A
J800 Series		
Air-Cooled	36 oz.	R404A
Water-Cooled	31 oz.	R404A
Remote	8 lb.	R404A
J1000 Series		
Air-Cooled	38 oz.	R404A
Water-Cooled	34 oz.	R404A
Remote	9.5 lb.	R404A
J1300 Series		
Air-Cooled	48 oz.	R404A
Water-Cooled	50 oz.	R404A
Remote	12.5 lb.	R404A
Remote with 50' to 100' lineset	14 lb	R404A
J1800 Series		
Air-Cooled	65 oz.	R404A
Water-Cooled	52 oz.	R404A
Remote	15 lb.	R404A
Remote with 50' to 100' lineset	17 lb	R404A

NOTES

REPLACING PRESSURE CONTROLS WITHOUT REMOVING REFRIGERANT CHARGE

The following procedure prevents opening of the refrigeration system and reduces repair time and cost. Use this procedure when one of the following components requires replacing and the refrigeration system is leak free and operational.

IMPORTANT: This is a required in-warranty repair procedure.

- Fan cycle control (air-cooled only)
- Water regulating valve (water-cooled only)
- High pressure cut-out control
- High side service valve
- Low side service valve

INSTRUCTIONS:

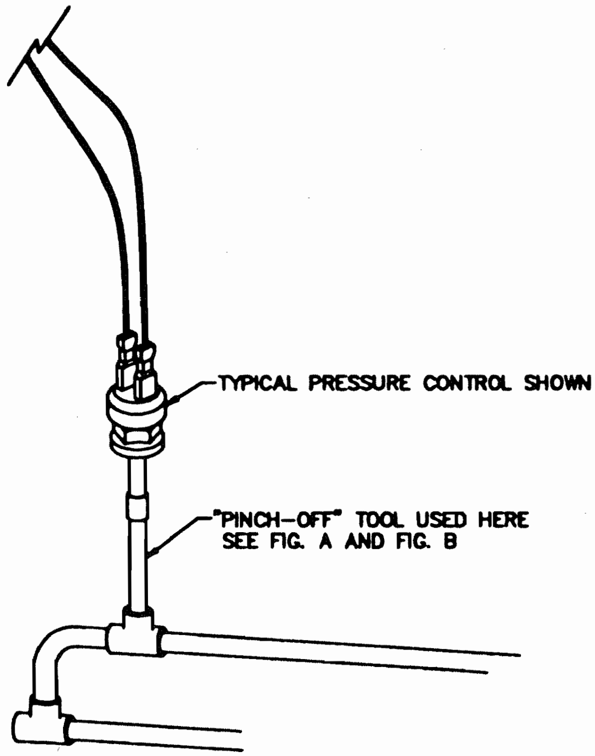
1. Disconnect power to ice machine. **Follow all manufacturer's instructions supplied with "pinch-off" tool.**
2. Position pinch-off tool around tubing as far away from pressure control as feasible. Clamp down on tubing until pinch-off is complete. Figure A.

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

3. Leaving pinch-off tool securely in place, **cut tubing** of defective component with a small tubing cutter.
4. Install new component. Allow solder joint to cool.
5. Remove pinch-off tool.
6. To re-round tubing, position wide angle of pinched tubing into corresponding diameter hole of pinch-off tool. Tighten wing nuts until block is tight and tubing is rounded. Figure B.

NOTE:

Pressure controls will operate normally once "pinched off" tubing is re-rounded. (Tubing may not re-round 100%.)



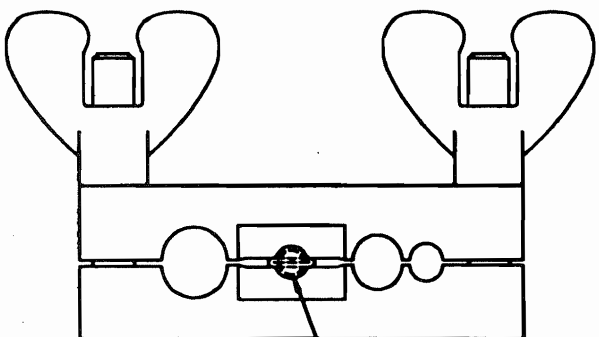


FIG. A - "PINCHING OFF" TUBING

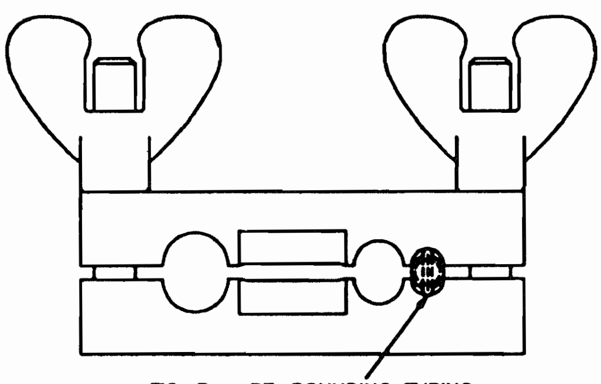


FIG. B - RE-ROUNDING TUBING

SV 1406
9/93

SYSTEM CONTAMINATION

GENERAL

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

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

DETERMINING SEVERITY OF CONTAMINATION AND CLEAN-UP PROCEDURES

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

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

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

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

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

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

CONTAMINATION/CLEAN-UP CHART

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

MILD SYSTEM CONTAMINATION CLEAN-UP PROCEDURES

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

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

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

   a. Pull vacuum to 1000 microns. Break vacuum with dry nitrogen and sweep system. Pressurize to a minimum of 5 psi.

   b. Pull vacuum to 500 microns. Break vacuum with dry nitrogen and sweep system. Pressurize to a minimum of 5 psi.

   c. Change vacuum pump oil. Pull system down to 250 microns. When 250 microns have been achieved, allow vacuum pump to run for 1/2 hour on self-contained models, 1 hour for remotes. A standing vacuum test may be performed at this time as a preliminary means of leak checking; however, the use of an electronic leak detector after the system has been charged is recommended.

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

SEVERE SYSTEM CONTAMINATION CLEAN-UP PROCEDURES

1. Remove refrigerant charge.
2. Remove compressor.
3. Disassemble hot gas solenoid valve. If burnout deposits are found inside valve, install rebuild kit and replace TXV and harvest pressure regulating valve.
4. Check discharge and suction lines at compressor for burnout deposits. Wipe out as necessary.
5. Sweep through open system with dry nitrogen.

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

6. Installation Procedures:
   a. Install new compressor and start components.
   b. Install suction line filter-drier (PN 89-3028-3) with acid/moisture removal capability and install an inlet access valve. Place the filter-drier as close to the compressor as practical.
   c. Replace liquid line filter-drier.
7. Follow normal evacuation procedures except replace the evacuation step with the following:

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

   a. Pull vacuum to 1000 microns. Break vacuum with dry nitrogen and sweep system. Pressurize to a minimum of 5 psi.
   b. Change vacuum pump oil. Pull vacuum to 500 microns. Break vacuum with dry nitrogen and sweep system. Pressurize to a minimum of 5 psi.
   c. Change vacuum pump oil. Pull system down to 250 microns. When 250 microns have been achieved, allow vacuum pump to run for 1/2 hour for self-con-

tained models, 1 hour for remotes. A standing vacuum test may be performed at this time as a preliminary means of leak checking; however, the use of an electronic leak detector after the system has been charged is recommended.

8. Charge system with proper refrigerant to nameplate charge.

9. Operate ice machine.

   a. Check pressure drop across the suction line filter-drier after 1 hour running time. If pressure drop is not excessive (up to 1 psi differential), the filter-drier should be adequate for complete clean-up. Proceed to step 10.

   b. If pressure drop is greater than 1 psi after 1 hour run time, change the suction line filter-drier and liquid line drier. Repeat until ice machine will run 1 hour without pressure drop.

10. Remove suction line filter-drier after 48-72 hours run time. Change liquid line drier and follow normal evacuation procedures.

REFRIGERANT DEFINITIONS

RECOVERY
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.

RECYCLING
To clean refrigerant for reuse 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 by means which may include distillation. Will require chemical analysis of the refrigerant to determine that appropriate product specifications are met. This term usually implies the use of processes or procedures available only at a reprocessing or manufacturing facility.

NOTES REGARDING RECLAIM:
"New product specifications" currently means ARI Standard 700 (latest edition). Note that chemical analysis is required to assure that this standard is met.

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

MANITOWOC REFRIGERANT USE POLICY

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

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

Manitowoc **approves** the use of:

1. *New refrigerant* (original name plate type).
2. *Reclaimed refrigerant* (original name plate type) - must meet A.R.I. Standard 700 (latest edition) specifications.
3. *Recovered or recycled refrigerant* reuse:

   A. Refrigerant must be recovered and/or recycled in accordance with latest local, state, and federal laws.

   B. Refrigerant must be recovered from the same Manitowoc product which it will be reused in. Recovered or recycled refrigerant reuse from other products is not approved.

   C. Recycling equipment must be certified to A.R.I. Standard 740 (latest edition) and be maintained to consistently meet this standard.

   D. Refrigerant recovered and reused must come from a "contaminant free" system. "Contaminant free" decision is influenced by type of previous failures, was the system cleaned, evacuated, and recharged properly after previous failures, and the present failure did not contaminate the system. Compressor motor burnouts and systems not serviced properly in the past (an acid test can help determine system condition) prevent reuse of recovered refrigerant.

   If you are not sure of the contaminant level, refer to service manual for "Determining Severity of System Contamination and Proper Clean-Up Procedures".

   E. Whether recovering and reusing, or recycling, the **service person is responsible** to assure the refrigerant is not mixed with air, other refrigerants, etc., and is "contaminant free" prior to reuse.

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.

4. *"Substitute" or "Alternative" refrigerant:*

   A. Must use only Manitowoc approved alternative refrigerants.

   B. Must follow Manitowoc published conversion procedures.

HFC REFRIGERANT
Questions and Answers

What compressor oil is Manitowoc requiring for use with HFC refrigerants? Manitowoc products use Polyol Ester (POE) type compressor oil. It is the lubricant of choice by compressor manufacturers.

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 which have the tendency to "solvent clean" everything inside the system and deposit material where it is not wanted.

What do these POE characteristics mean to me? Simply requires you to be more persistent in your procedures. Utmost care must be taken to prevent moisture from getting into the refrigeration system. Be conscientious of your techniques, such as keeping oil containers and compressors capped at all times to minimize, if not eliminate, moisture entry into the oil or refrigeration system. The preferred method of repair is to have all new system components at the job site prior to removing system charge to take out faulty component(s). Remove new system component plugs and caps just prior to brazing and be prepared to hook up a vacuum pump immediately after brazing.

How do I leak check a system containing HFC refrigerant? Use equipment designed for HFC detection. Do not use your "old" leak detection equipment designed for CFC detection. Consult leak detection equipment manufacturers for their recommendation on new equipment available for HFC leak detection. Standard soap bubbles do work with HFC refrigerants.

Does Manitowoc use a special liquid line filter/drier with HFC refrigerants? Yes, Manitowoc uses ALCO "UK" series filter/drier to gain the better filtration and increased moisture removal capacity needed for use with HFC refrigerants. During repairs, it is recommended to install the drier just before hooking up a vacuum pump.

Is other special equipment required to service HFC refrigerants? No, in general refrigeration equipment such as standard refrigeration gauges, hoses, recovery systems, vacuum pumps, etc. are compatible with HFC refrigerants. Consult your equipment manufacturer for specific recommendations for converting existing equipment to HFC usage. Once designed and calibrated (if required) for HFC use, this equipment should be used specifically for HFC refrigerants only.

Do I have to recover HFC refrigerants? Yes, like other refrigerants, government regulations require recovering HFC refrigerants.

Will R404A separate if there is a leak in the system? No, like R502 the degree ol separation is too small to detect.

How do I charge a system with HFC refrigerant? The same as R502, in a liquid state into the high side of the system.

NOTES

NOTES

NOTES

NOTES

NOTES

NOTES

Factory School

- Improve Your Service Techniques.
- 4 Days of Intensive Training on Manitowoc Ice Machines, Dispensers, and Reach-Ins.
- Contact Your Distributor For Dates and Further Information.

MANITOWOC ICE, INC.
2110 South 26th Street P.O. Box 1720
Manitowoc WI. 54221-1720 USA
Phone: 920-682-0161 Fax: 920-683-7585
Website – www.manitowocice.com