Scotsman®

30” Wide 1 and 2 Evaporator Compact Cubers

Technical Training

Presentation Topics

- Models Covered
- Components
- Installation
- Electrical Sequence
- Service Diagnosis
- Refrigeration System

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CM³ - "CM Cubed"

- Compact Modular Cubers - overflow drain type
  - CME256
  - CME506
  - CME656
  - CME806
- Similar technology used in SCE275
- Purge valve drains used in
  - CME306, CME456, CME686, CME810, CME1056, CME1356, CME1656, CME1856, CME2006

Cabinet

- 30” wide CM³ models
  - Fit many bins and dispensers
    - HTB250, HTB350, HTB555
    - ID200, ID250, HD356
  - Front Removable Top and Side Panels
    - Snap & Screw front panel attachment
    - No screws in back or top

Front Panel

- Removal of front panel provides access to
  - Controller
  - Water valve
  - Water pump
- Evaporator cover behind it provides a
  - Thermal barrier
  - Water barrier

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Front View

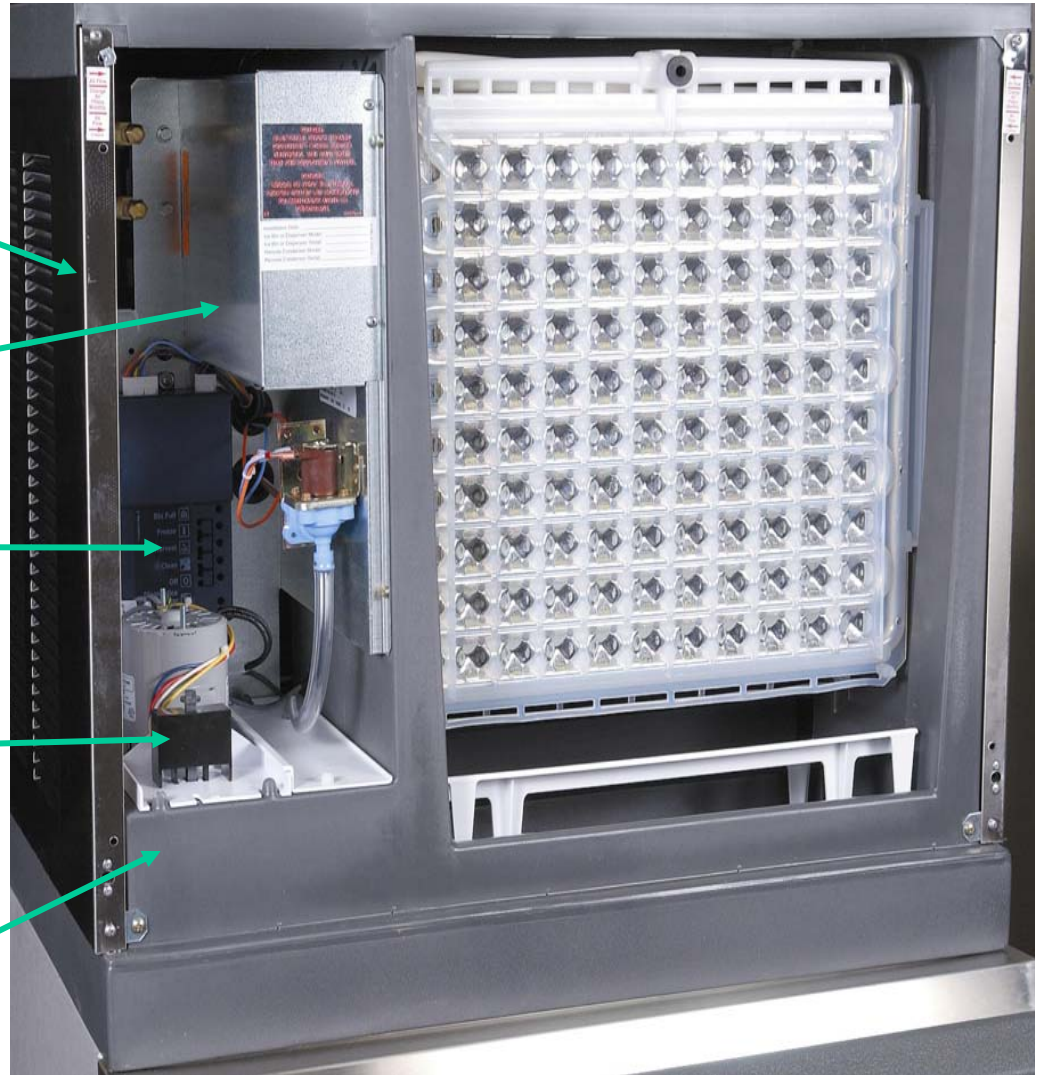
Disposable Air Filter
- one on each side

Hi Voltage Box

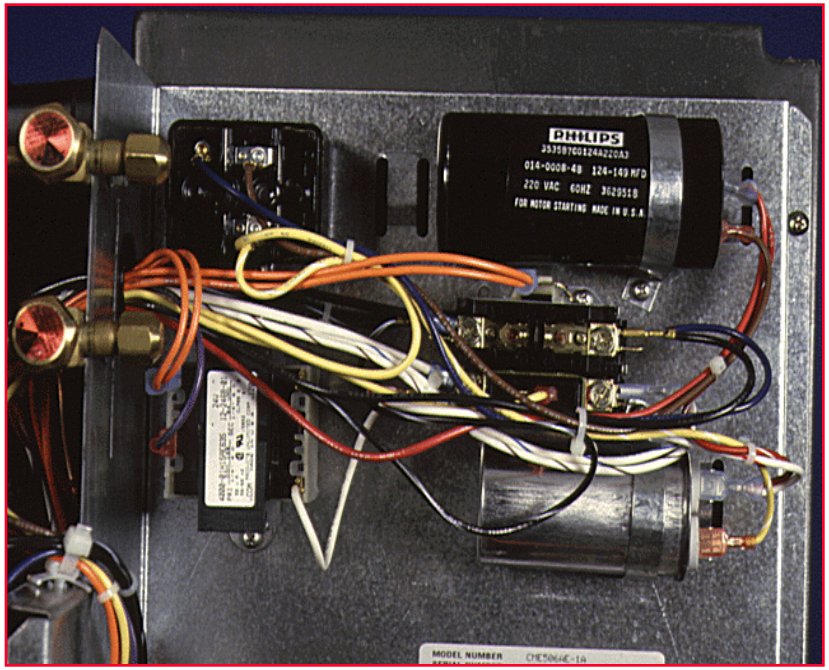
AutoIQ
Controller

Water Level
Sensor

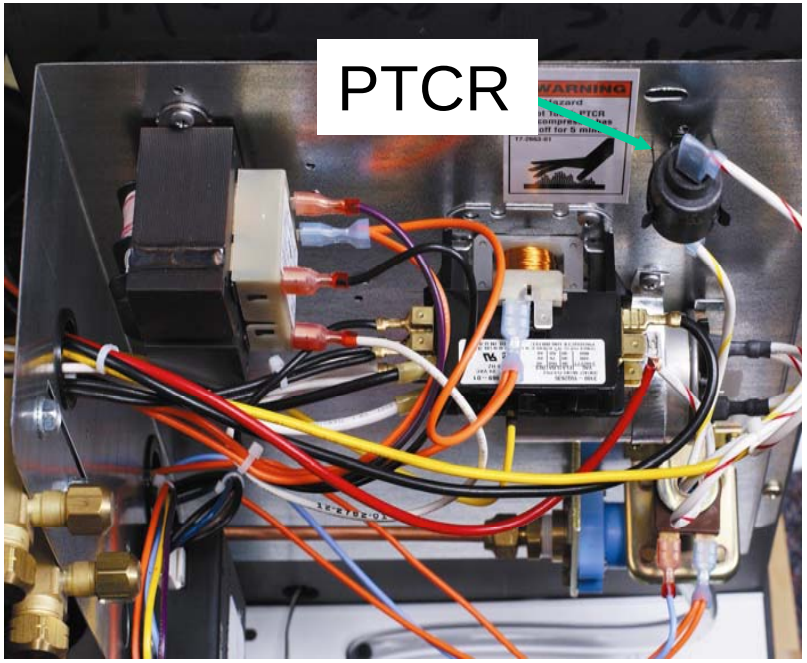
Water
Compartment



Hi Voltage Box



A - C Series Single Phase



D Series & higher use (PTCR) for Single Phase

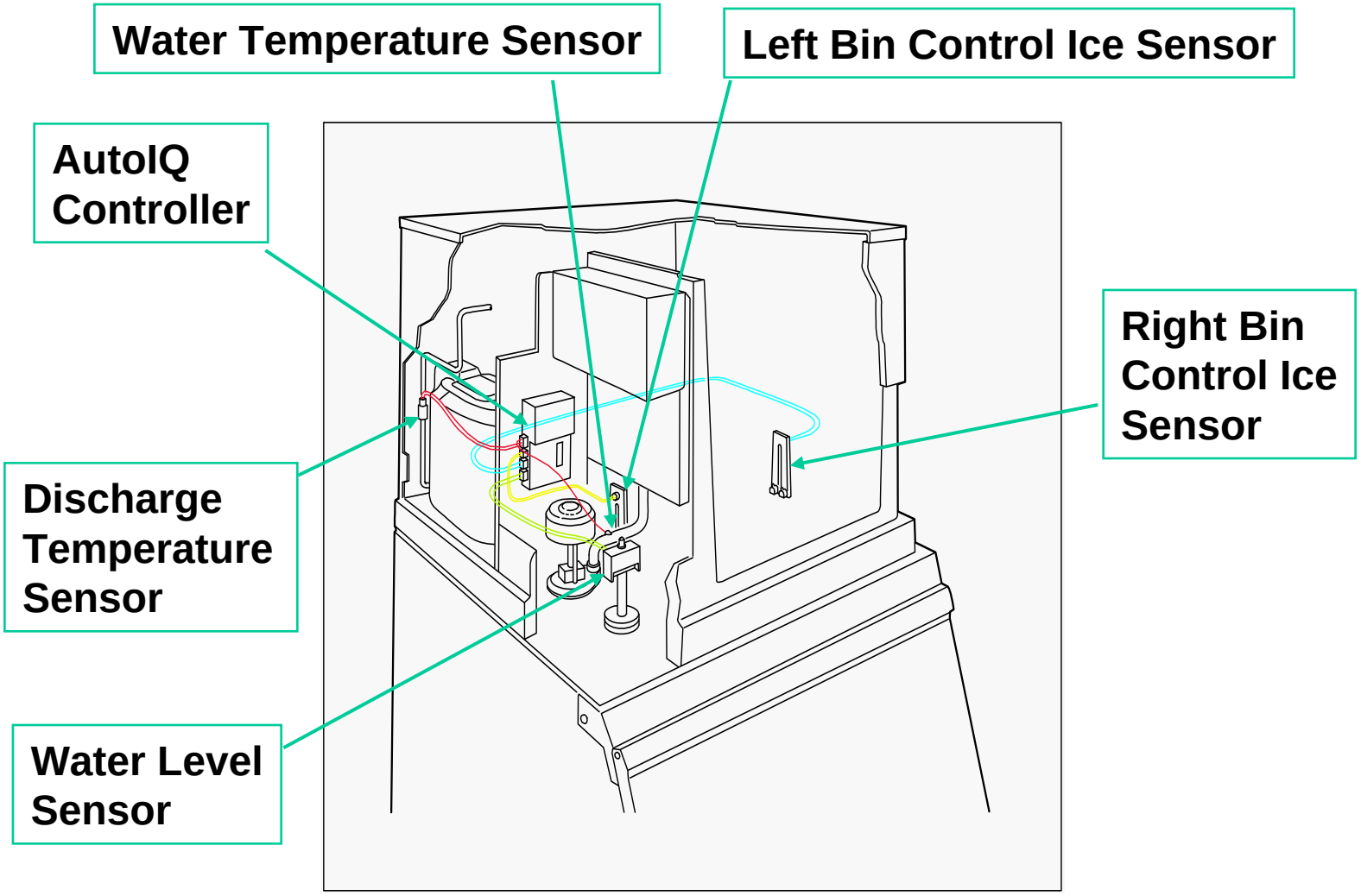
Scotsman AutoIQ Control System

- All electronic, microprocessor controlled
- Measures water level for cube size
- No altitude or ambient adjustments needed
- Freeze up protection
- Electric-eye ice sensors & bin control
- **New Controller in 2002**
  - Blue box, but same operation as prior black controller
  - Last 2 errors can be recalled
  - Displays EEPROM code at power up
  - Universal Service Controller - fits all CM^3

Control System

- Controller collects, stores and uses data to determine:
  - Pump and fan off time
  - Freeze times
  - End of Harvest time
  - Reservoir flush time
  - Bin full
  - Water or Refrigeration errors
  - Water level/cube size

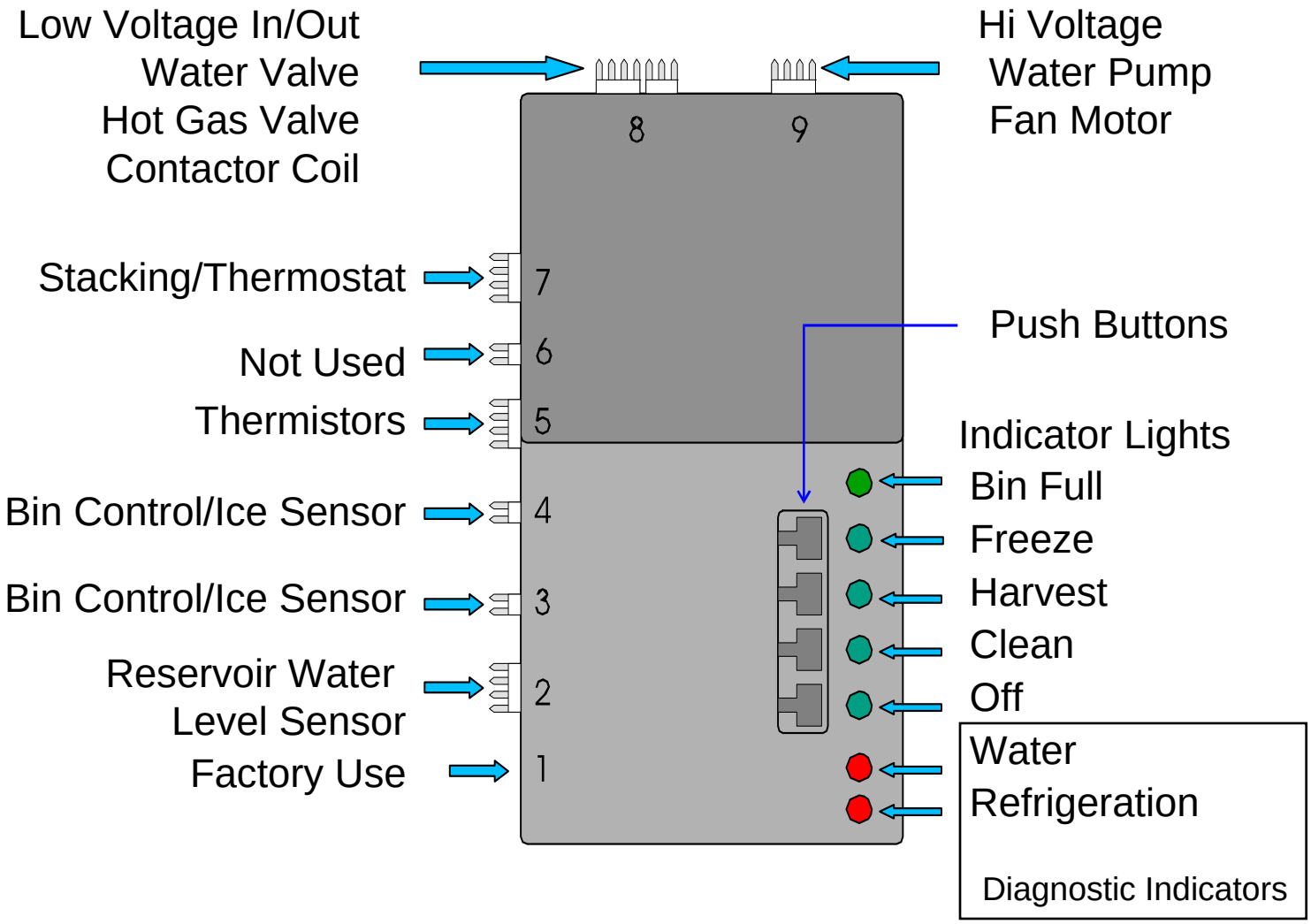
Control System



AutoIQ Controller

- Adaptive Harvest
  - Optimizes harvest time
- AutoRestart
  - After power interruptions
  - After water interruptions
  - After long harvest or freeze
- AntiSlush
  - First three cycles after restart
- Indicator Lights
  - Easier diagnostics

AutoIQ Controller



Scotsman Controls - Water System

- Water enters in harvest thru solenoid valve
  - Gravity drain overflow
    - Uses a standpipe in the reservoir to control maximum water height
- Control system calculates each cycle's water flow rate and adjusts for it
  - Benefit: Overflows the same amount of water under different water flow conditions, which provides an assured amount of rinse water
- Water overflow amount is manually adjustable for variations in water quality

Scotsman Controls - Water System

- Inlet Water Solenoid Valve
- These four models use the low flow rate valve
  - Low flow rate valve used on 7 different modular models **and** the SCE275
  - High flow rate valve used on the 5 other modular models
    - All are 24 volt
    - Large screen for dirt resistance

Benefit: Only two valves to stock for entire CM^3 line

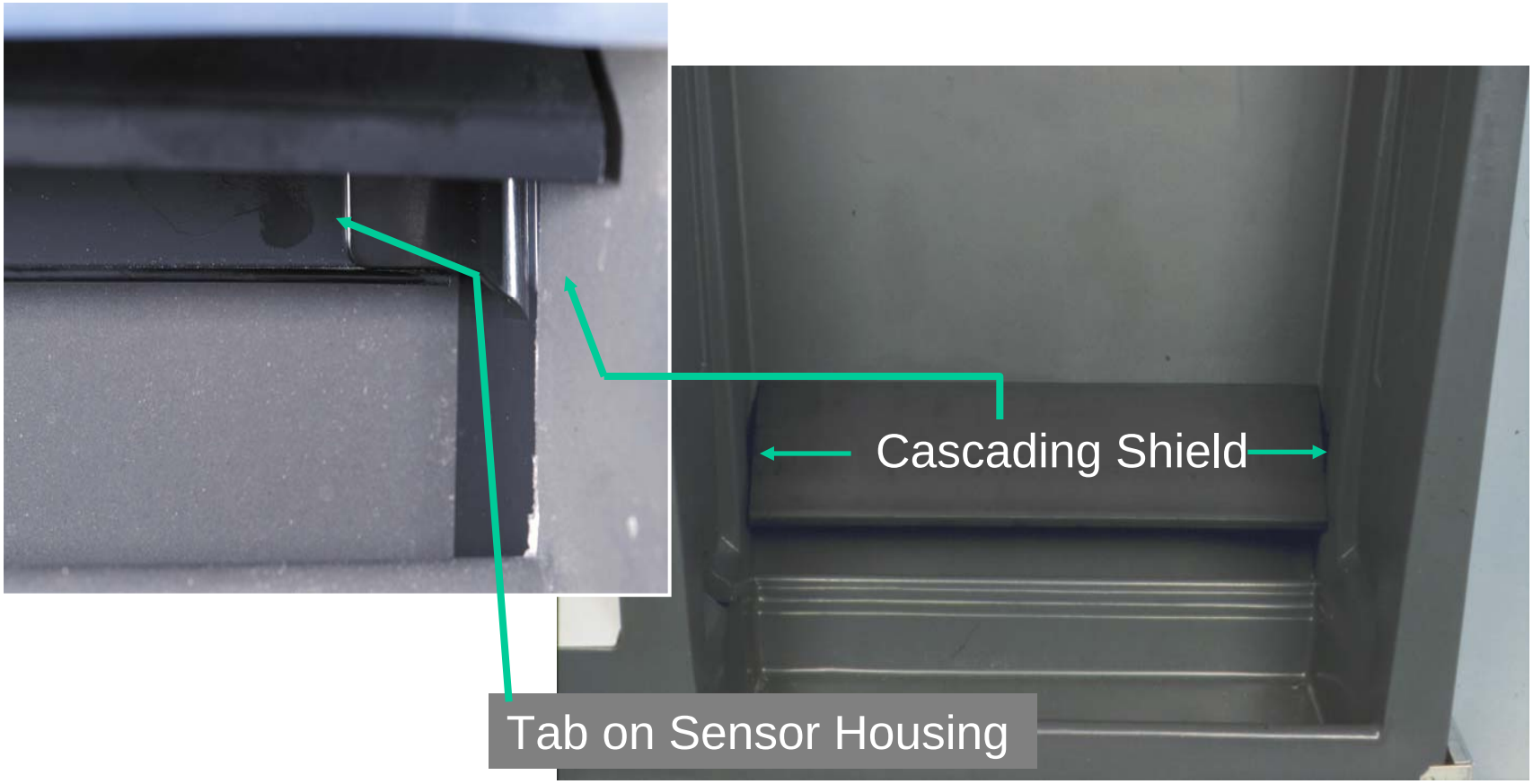
Water System

- Ice & water separated by the cube deflector
  - Located under the evaporators

Cube Deflector

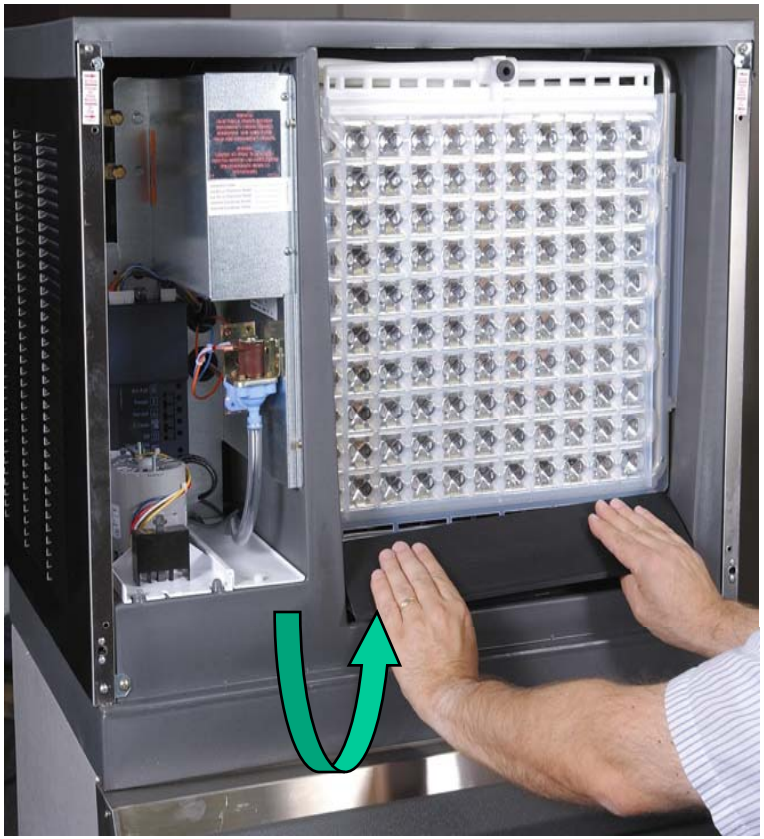
Cascading Shield

- The Two Evaporator models have a cascading shield
  - CME506, CME656 and CME806
  - Snaps onto tabs molded onto the bin control/ice sensors



Cascading Shield

Removal, Twist Front Down



Return, Snap Front Up

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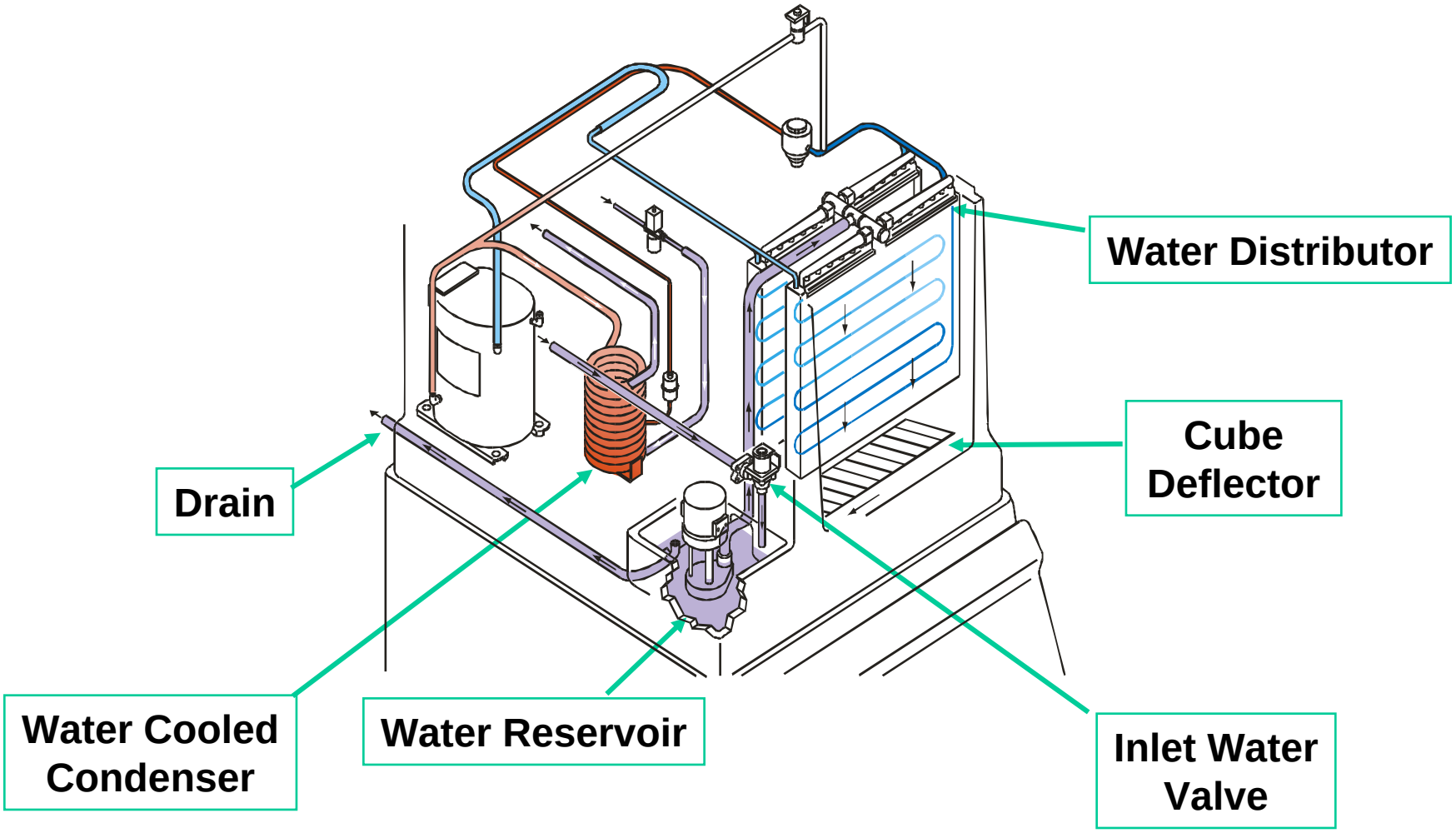
Water System



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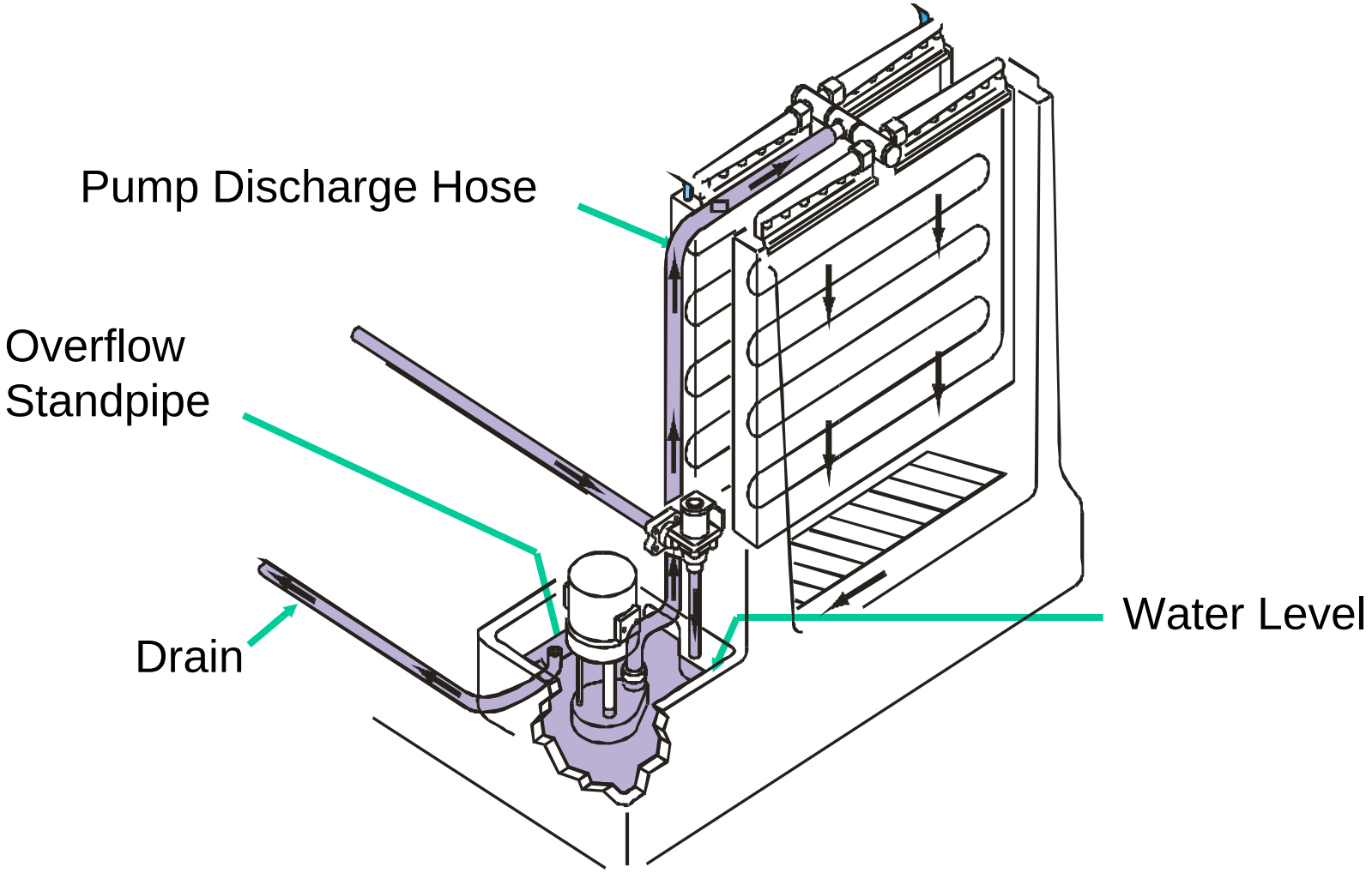
Water System



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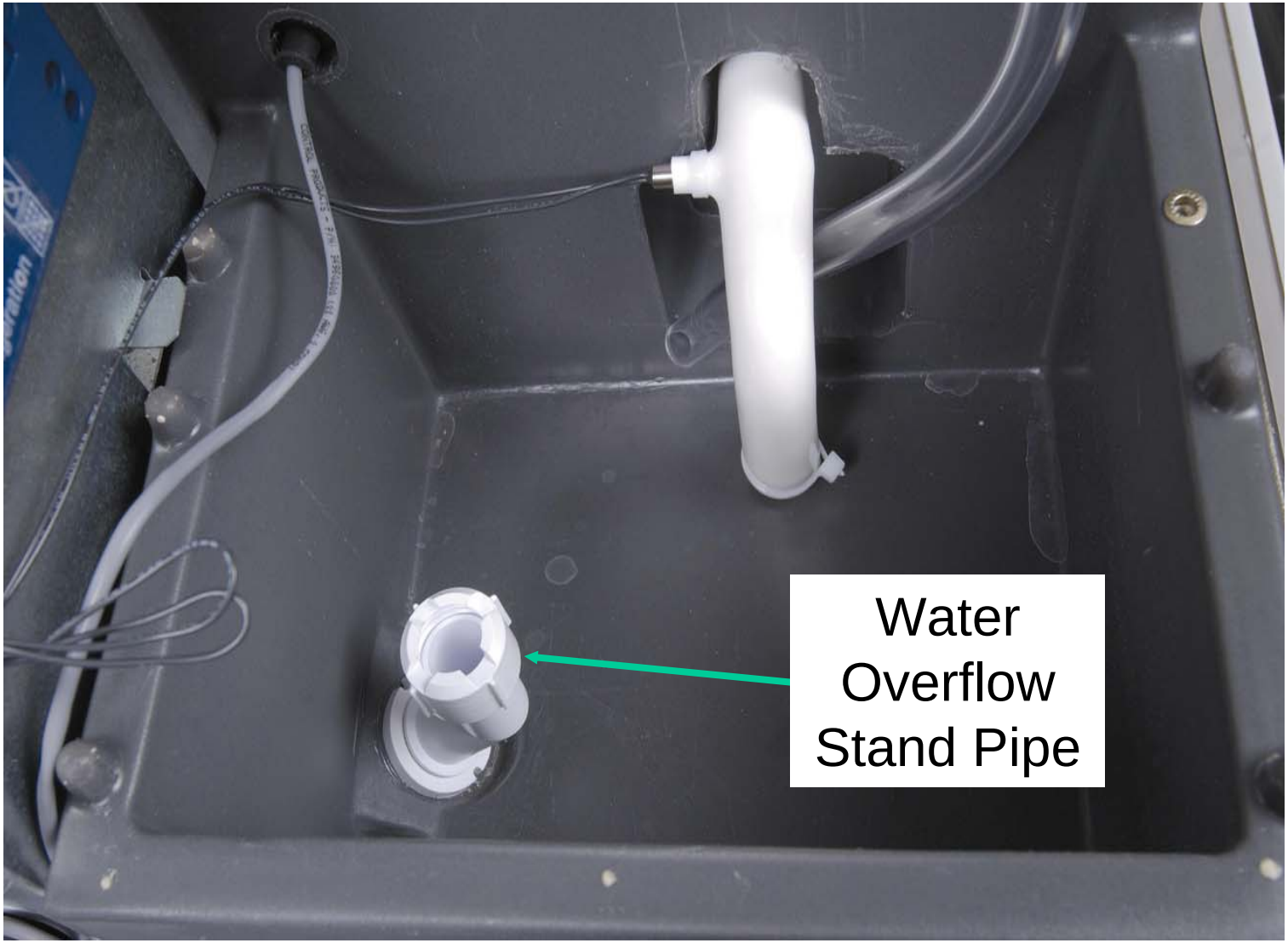
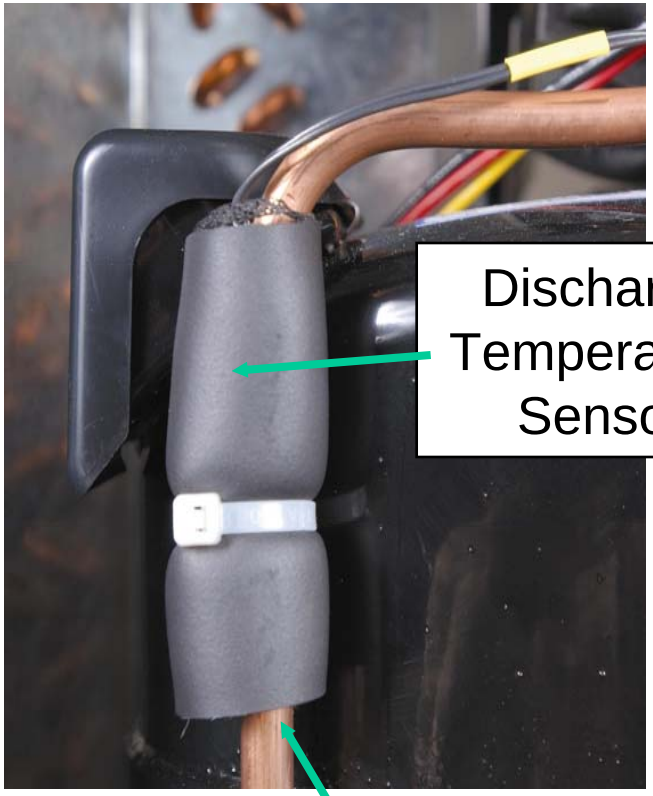
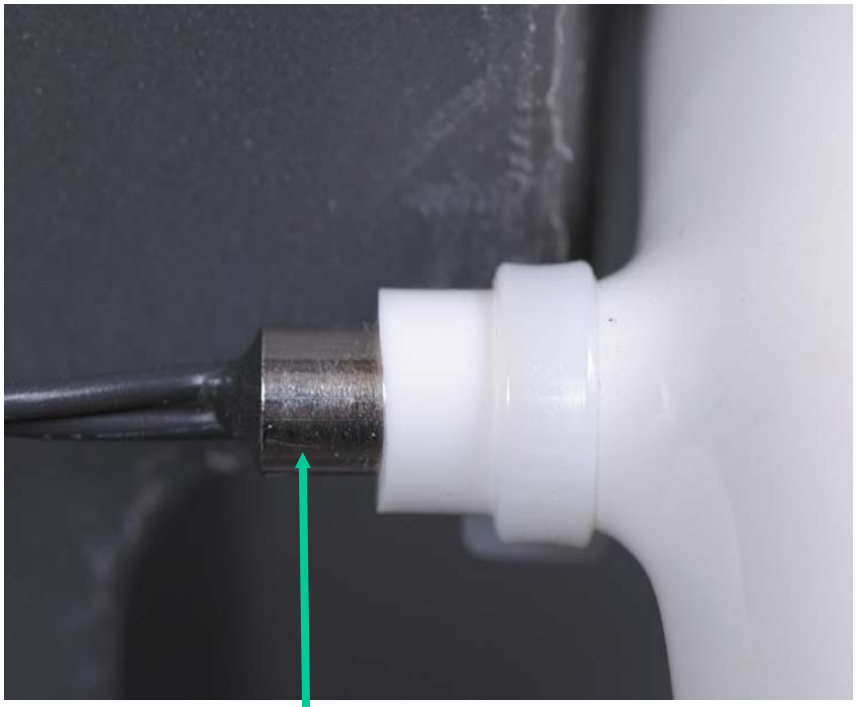
Water Reservoir



Scotsman Temperature Sensors





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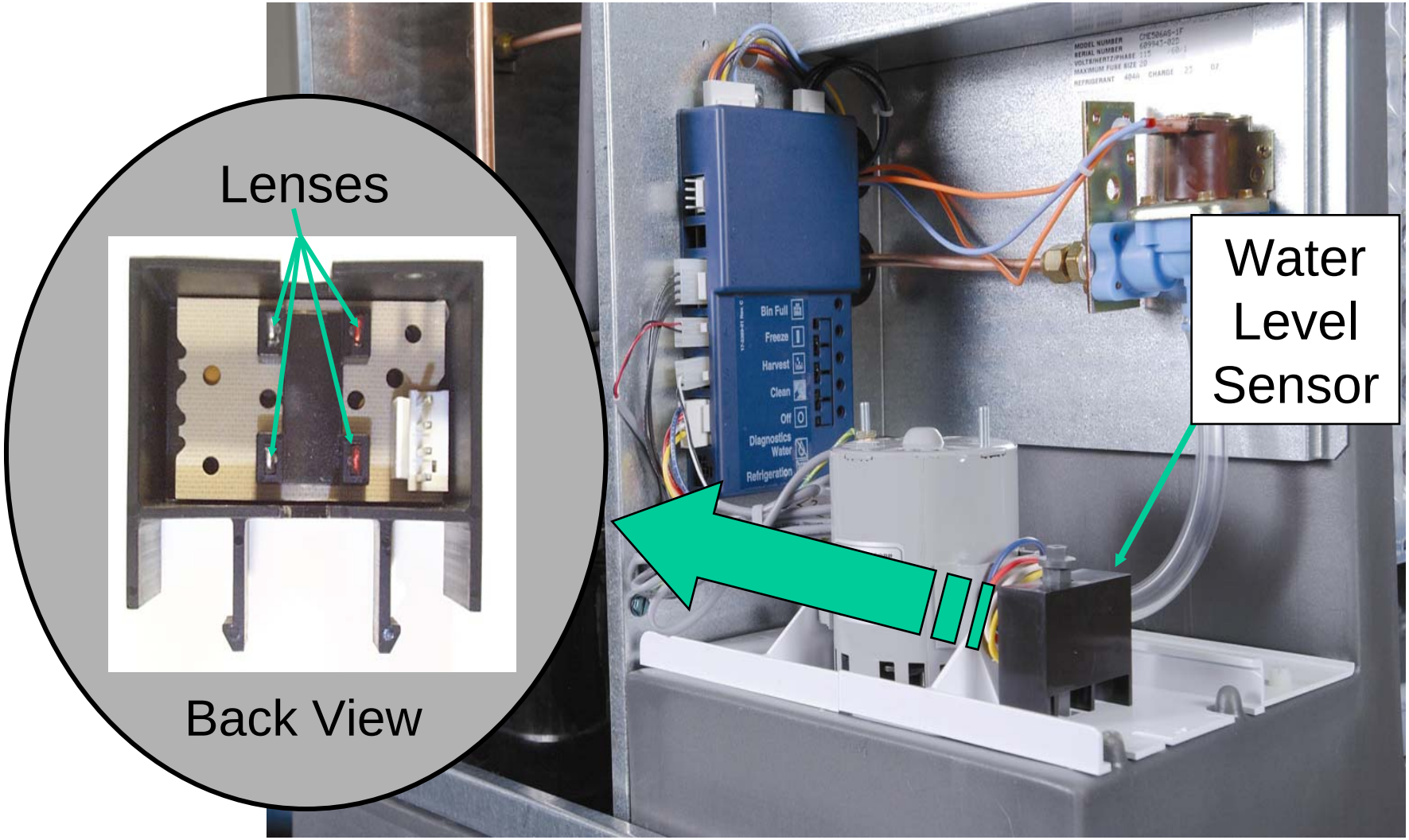
Ice Thickness/Size



Bin Control/Ice Sensors

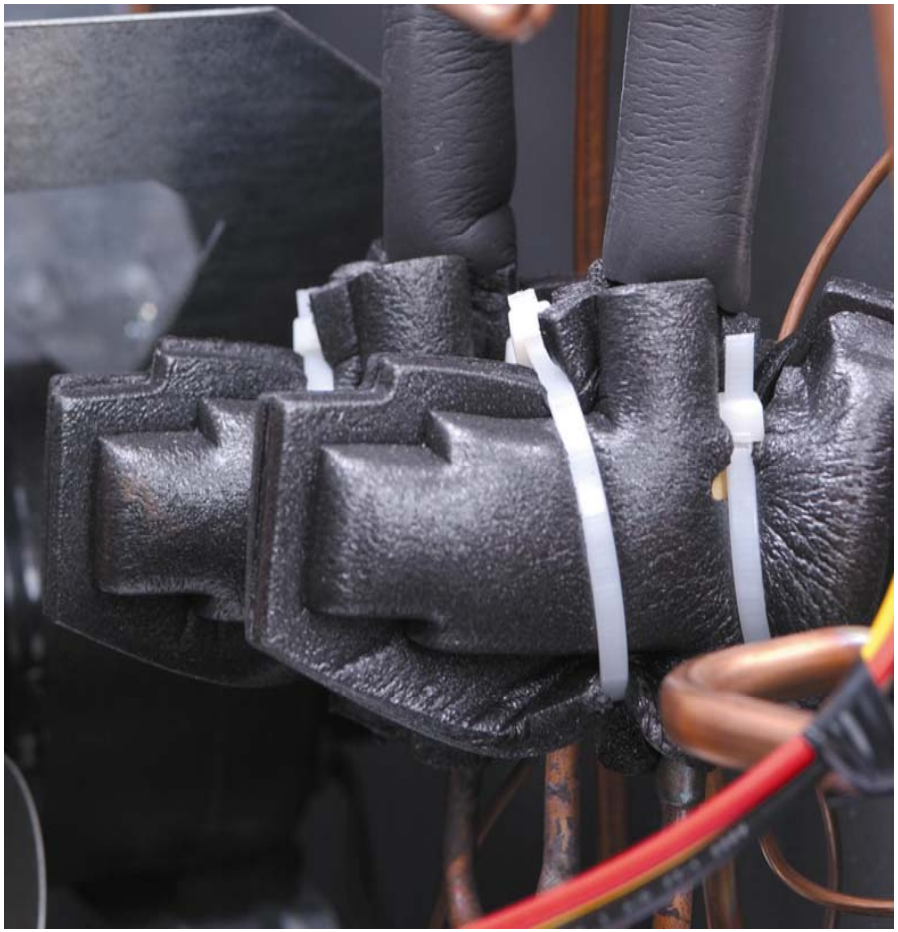
- Uses Photo-Electric Eyes
- Located on ends of ice chute
  - Emitter on one side
  - Receiver on the other
  - Two eyes per side
  - Creates a “Light Curtain”

Refrigeration Systems

- All R-404A, TXV, Hot Gas Bypass
- Single Evaporator Model
  - CME256
- Two Evaporator Models
  - CME506
    - One TXV with distributor up to E series
    - CME506 E series & up have two internally equalized expansion valves, no distributor & check valves in the hot gas valve outlets
  - CME656 - one TXV with distributor
  - CME806 - one TXV with distributor

Refrigeration Systems

- Two Expansion Valve System
  - Similar to CME456
  - Internally equalized valves
  - Check valves in hot gas valve outlet to direct refrigerant to single evaporator



Refrigeration Systems

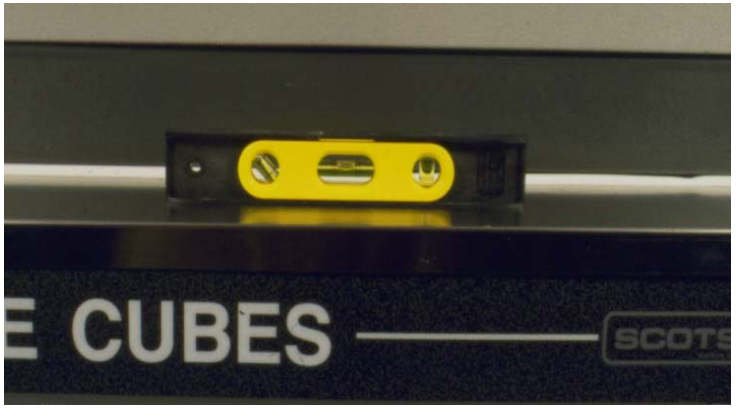
- Water Cooled Condenser Change
  - A through E series use same condenser
  - F series and up use different one
    - Small charge change
    - Separate service parts

Refrigeration Systems

- Remote Air Cooled
  - CME506, CME656 and CME806 available in Remote Air Cooled
  - Headmaster in ice machine
  - Pump down system
    - Pressure control closes at 30 PSIG
    - Opens at 15 PSIG

Installation

- Level the unit
  - Level the bin left to right
    - At the canopy
  - Level the machine front to back
    - At the reservoir
- If placing on a dispenser
  - ID200 or ID250 require adapter KBT44
  - IM must be sealed to adapter
  - Must install baffle from adapter



Installation

- Connect the water
  - 3/8" Male Flare
- Connect the drain
  - 3/4" Female Pipe Thread
- Connect the power
  - Recessed junction box on the back

Installation Details

- Use water filter and a new cartridge
- Vent the drain
- Gravity flow
- Run separate drain lines
- Do NOT connect to bin drain!

Initial Start Up

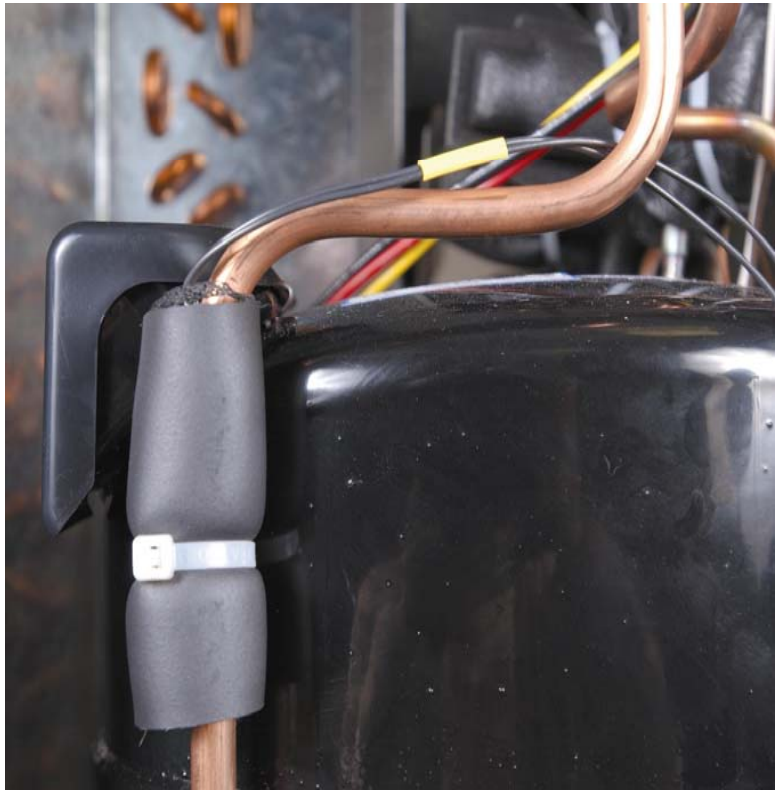
- Remove front panel.
  - Check for power. All lights on the controller flash once when power is first connected.
  - Blue Controllers blink their red lights for 20 seconds while displaying their EEPROM code
  - Blue Controllers then display the Bin Full light and the Off Light. The Bin Full light will go out after a few seconds
  - Then the Off light will be ON.

Initial Start Up

- Push Freeze to Start!
  - Push and Release the Freeze Button.
  - The ice machine will fill with water and begin to make ice.
- No adjustments to make
- First harvest cycle will be long to establish a baseline harvest time.

Scotsman Electrical Sequence: Starting

- Water valve opens, float rises
- Pump & Compressor start
  - Reservoir must be full
- 3 minutes into freeze
  - Discharge temp measured
  - If less than 125^0F., fan cycles every 30 seconds



Scotsman Electrical Sequence: Freeze

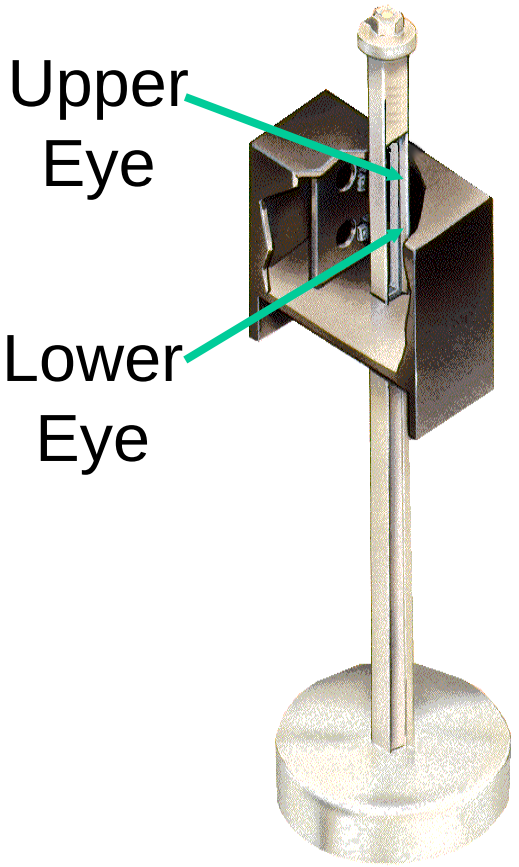
- Reservoir water must cool to preset point (38 degrees) in 5 minutes
  - Controller checks water and discharge temps.
  - Checking to see that refrigeration system is working
  - And that inlet water valve is not leaking thru
    - If not, will do a check of the discharge temp

Scotsman Electrical Sequence: Freeze

- The first 3 cycles have an anti-slush cycle.
  - When water temp falls to the set point, the pump switches off for 30 seconds
  - Can happen any time within the first 5 minutes of freeze
  - Re-fills the reservoir after the pump restarts

Scotsman Electrical Sequence: Freeze

- End of Freeze determined by water level
  - Water Level Determines Cube Size
  - In the water level sensor
    - Upper electric eye determines the end of the freeze cycle.
    - Lower eye determines when the reservoir is full of water.



Electrical Sequence

- Fan Control - temperature & cycle based
  - Fan cycles on and off throughout the freeze cycle if discharge temp is low at the beginning
    - Maintains discharge pressure - if temp is high fan is on till the end of the cycle
    - Old controllers (from 1996) use a fan control switch (pressure control).
  - The system controller shuts the fan off just before the end of the freeze cycle.
    - Fan off time varies between 0 and 60 seconds - based on the discharge line temp at the end of the freeze cycle.
  - The fan is off during Harvest.

Harvest Time

- ANY Cube Ice Machine's Harvest time will vary because of changes in:
  - Ambient Temperature
  - Incoming Water Temperature
  - Condition of Water System - how much scale
- CM^3 Harvest time adapts to changing conditions
  - Bin control / ice sensors "see" ice falling.
  - The first harvest cycle after start up will be 5 minutes
    - Determines the base line harvest time.
  - After that the controller adjusts the harvest cycle time to match the requirements for harvest.

Harvest Cycle Timing

- Controller begins timing harvest
- Ice falling interrupts the signal from the ice sensor emitter to the receiver
  - The time of that interrupt is recorded by the controller
  - The last time the controller receives an interrupt signal is saved as the cube release time
  - Extra time is calculated from the actual cube release time

Measured Cube Release Time + Calculated Extra Time = Harvest Time

Harvest Cycle

- All controllers
  - AC Fan is off
  - Pump is off for 40 seconds
  - Water valve opens
- If harvest is very long
  - Pump is off after 8 minutes of harvest
- If bin fills early in harvest
  - Pump is off when bin is full, but harvest continues

Water Fill

- Water re-fills during Harvest
  - Controller measures flow rate
    - Time between start and completion of fill is measured every time
  - Always adds and **flushes** the **same amount of water**
  - Amount of water & rinse is adjustable
  - Will shut down if does not fill fast enough or at all
    - Will try to restart every 20 minutes

End of Harvest

- Harvest time expired
  - Return to Freeze
  - Bin Full - when bin controls are blocked for 5 - 20 seconds
    - Off if thermostat connected to controller terminal 7 is closed
- If ice wasn't "seen" by the bin controls
  - Will make one more cycle
    - If it happens again, unit shuts down

Restarts

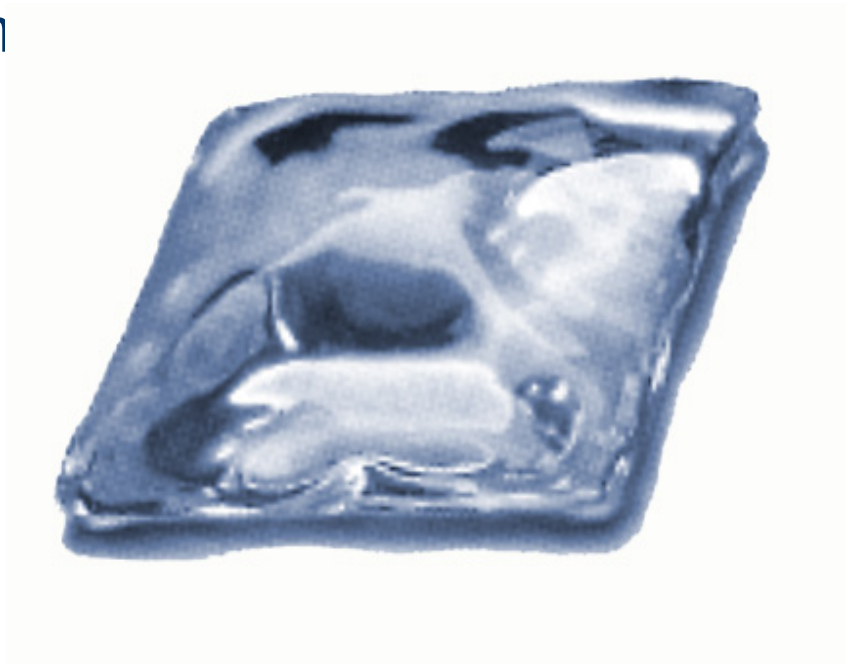
- Electrical Power Interruption
  - Automatic restart
    - Open hot gas valve for 20 seconds
    - Open water valve to fill reservoir
    - Start Pump
    - Start compressor, freeze for 30 seconds
    - Harvest for 4 minutes
    - Freeze light will be blinking
    - If bin is not full will automatically start a new freeze cycle
- Blue controllers manual harvest must be complete or pushing freeze will trigger this restart sequence

Restarts

- Water supply interruption
  - Automatic shut off and restart
    - Shuts off if float does not rise enough during Harvest
    - 130 second time limit to fill reservoir
  - Controller checks for water by opening the inlet water valve every 20 minutes
    - Will restart if float rises far enough to break beam in water level sensor

Ice & Evaporator

- Ice Formation
  - Freezes from the bottom of the evaporator(s) to the top.
  - 3.25 to 3.5 LB. per evaporator per cycle.
  - Harvests as vertical strips - not individual cubes.
  - Cubes from the strips break up when falling down.



Ice Level Control

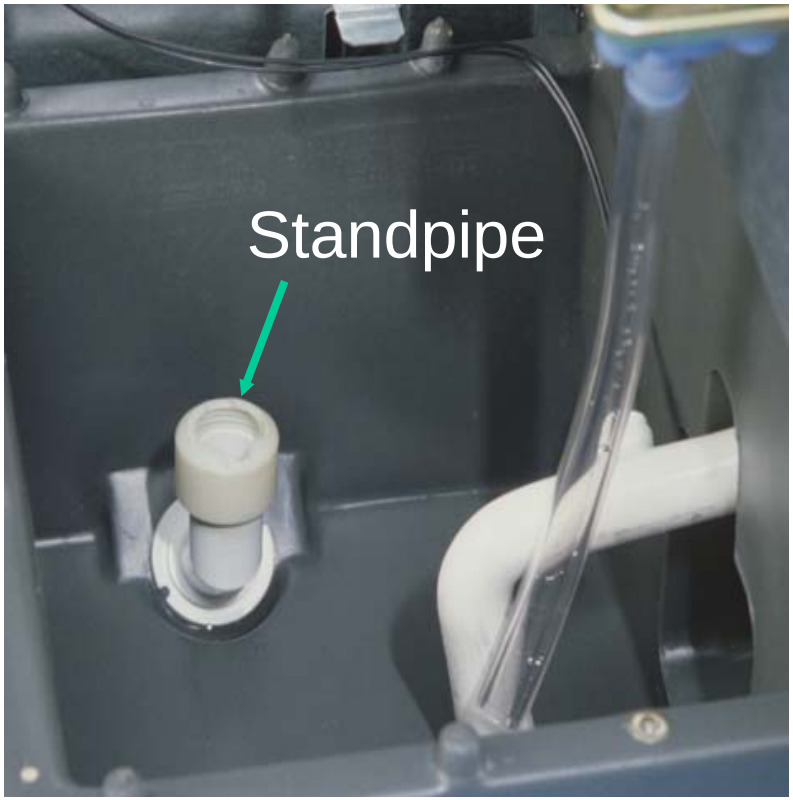
- What controls ice making?
  - There are two methods of on-off control - ice sensors or bin thermostat
  - At the base of the cube chute is a set of electric eyes - the ice sensors.
  - When ice has filled the bin, ice will be between the ice sensors. The bin full light will blink and then be on.
    - Thermostat sometimes used - accessory kit can add it
    - Thermostat must close on temperature fall
    - Plugs onto terminal 7 on the controller
    - Controls bin full light too

Ice Level Control

- Control System
  - When the ice sensors have been "blocked" for more than 20 seconds (5 with the blue controller), the Bin Full Light will glow steadily and:
    - The machine will shut down at the end of the next harvest cycle.
    - It can not restart until 4 minutes have passed.

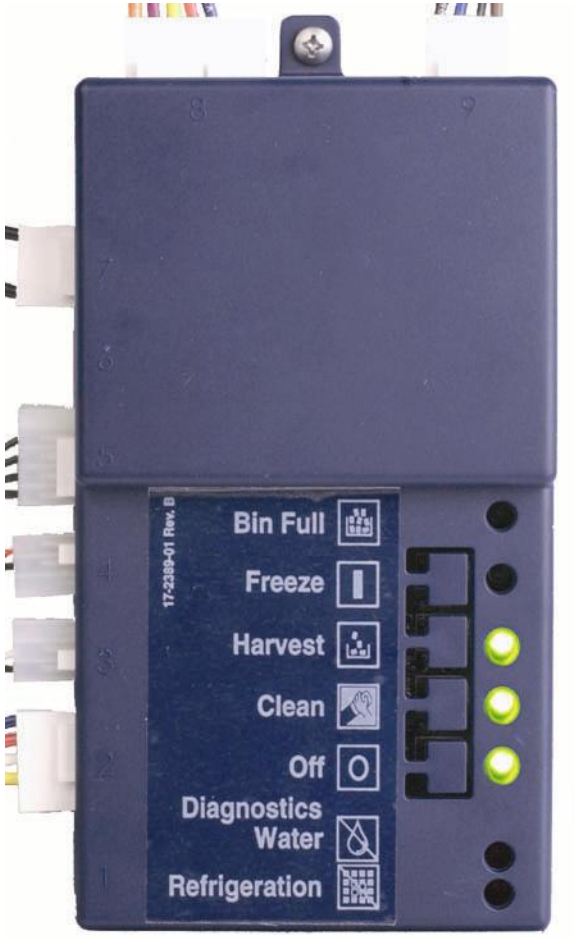
Operation

- How Does It Flush The Reservoir?
  - Inlet water valve is open for extra time after filling.
  - Excess water overflows thru a standpipe; extra water flows out by gravity.
  - Water overflow time set by the controller
    - More time in low water pressure locations to maintain amount overflowed

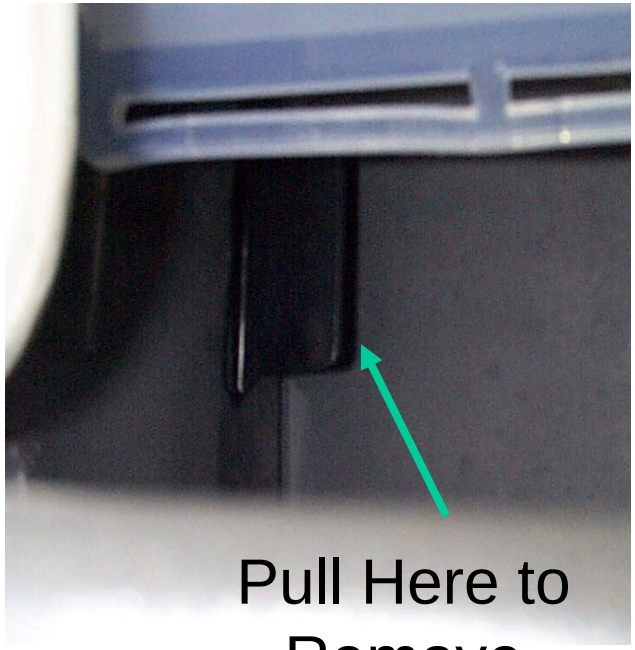


Operation

- Is the amount of water rinse adjustable?
  - Yes it is, the 5 levels are:
    - Maximum
    - Heavy
    - Standard - the factory setting
    - Moderate
    - Minimum



Cleaning



Pull Here to Remove Photo-Eyes

Place Ends of Photo-Eyes in Reservoir for Cleaning

Cleaning & Sanitizing

- Water System Cleaning
  - Push and release the clean button.
    - The cycle begins by re-starting the pump.
    - Pour in the cleaner; circulate for as long as needed - 10 minutes or so.
    - Push the clean button again to flush the residual cleaner for about 20 minutes.
    - Push the Freeze button to resume making ice.

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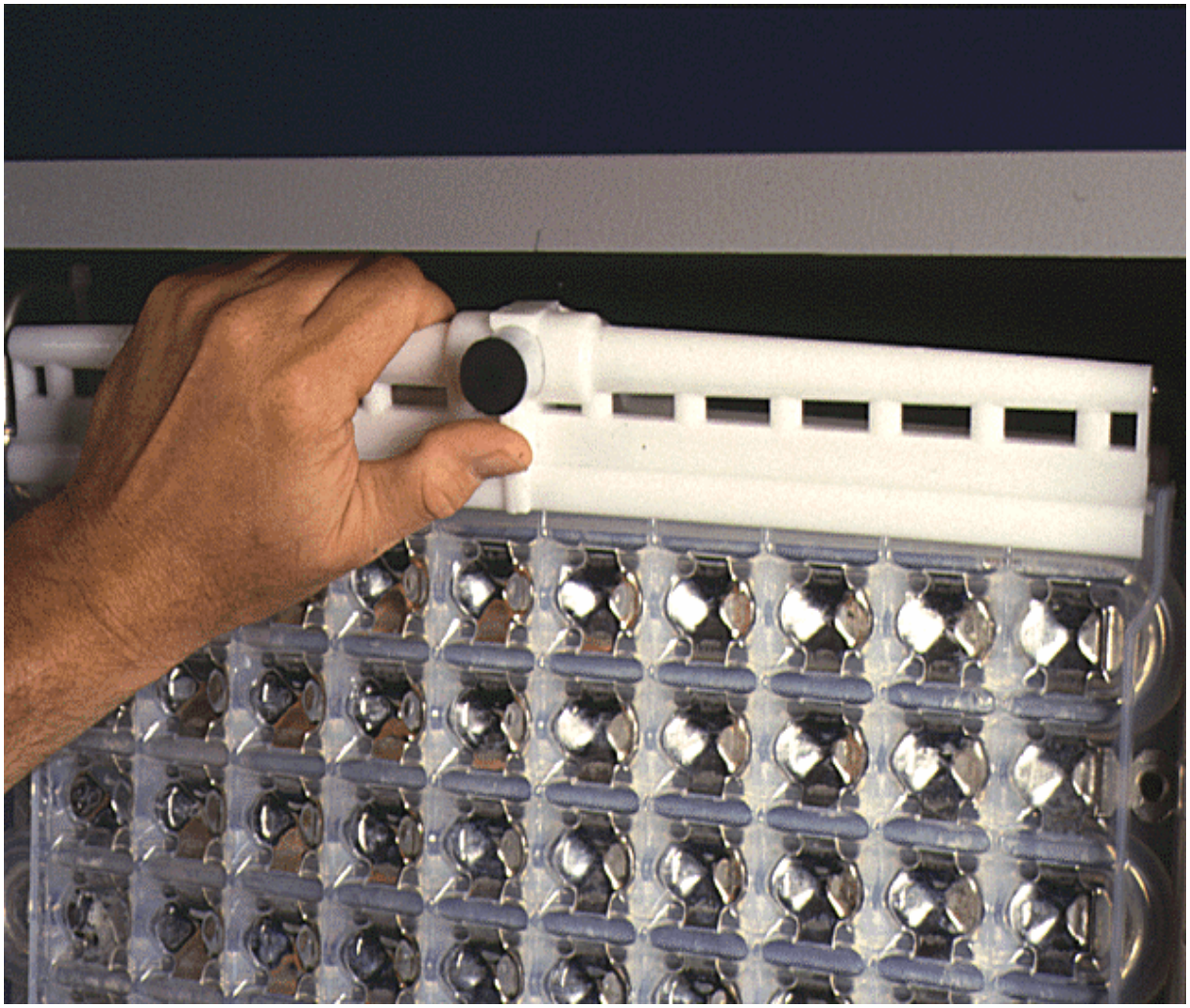
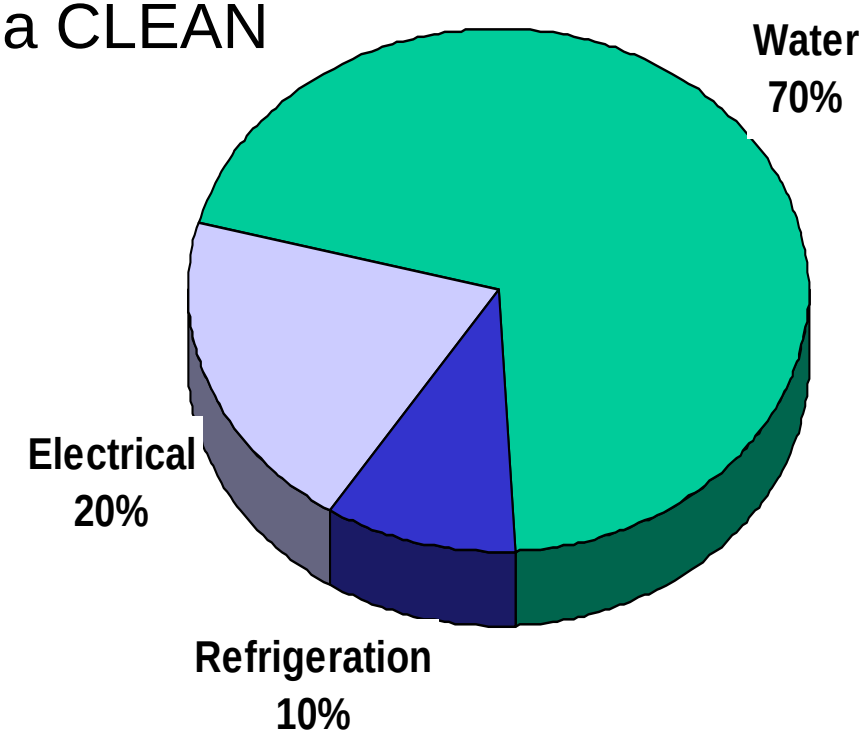
Cleaning



General Service

- Remember the Recipe for ICE!
  - Water issues most common
- And Start with a CLEAN MACHINE!



Unit is Off, Why?

- Check Controller
  - No Power to unit
    - No lights ON.
  - Transformer failed
    - No lights ON.
  - Loose wire at Controller
    - No lights ON.
  - Unit is switched to OFF
    - Off light is ON.

Last Error Recall

- If the controller has been reset, and is blue, the last two error codes can still be recalled
  - Stop unit by holding the Off button in for 3 seconds
  - Push and hold Off button again for 3 seconds until the green lights come on
  - Push and release the Harvest button to see the last error
  - Push and release the Harvest button again to the second to last error - Bin Full light will glow

Unit is Off, Why?

- Unit has turned itself OFF
  - Water or Refrigeration Error light is ON.
  - Bin Full light is ON.
    - Bin is Full or sensors need cleaning

Service Diagnosis

- Water Light On
  - Continuous light
    - Water valve leaks-thru?
  - One blink and repeats
    - Water pump failed?
  - **Two blinks and repeats** - the most common water issue
    - Water filters plugged?
    - Inlet water valve stuck?
    - Water supply shut off?
    - Water level sensor failed?

Service Diagnosis

- Water fill problems
  - Check water filters
  - Check levelness of machine
  - Check standpipe measurement
- Reset machine
  - If water error repeats
    - Check harness to controller from water level sensor
    - Replace the water level sensor or harness

Standpipe

- Measurement
  - Height is factory set, should not need adjustment, but..
  - Correct height is 2 and 5 eighths inches from the top of the standpipe adjustment nut to the top of the reservoir wall
  - Set measuring device first, then adjust nut

Scotsman Water Sensor Diagnostics

- Check voltage w/ DC VM
  - Controller must have power and be “alive”
  - a) Unplug harness from position 2, check voltage at top and bottom pins
  - b) Reconnect, check voltage again
  - Negative on yellow, positive on white, move float. Voltage should change
  - Positive on red, move float

	Black	Blue
a) Top to Bottom	24 to 30	.5 to 2
b) Top to bottom	2 to 3.5	.4 to 2
White to Yellow, blocked	5	5
White to Yellow, unblocked	<1	Less than when blocked
Red to Yellow, blocked	5	5
Red to Yellow, unblocked	<1	Less than when blocked

Service Diagnosis

- Refrigeration Diagnostic Light is ON but does not blink
  - Maximum Freeze Time - 50 minutes - exceeded.
    - Check for water pump failure
    - Check if the float is in the UP position
    - Check refrigeration system
  - Reset the machine and check operation. See if the unit will go into Harvest when the float stem is pushed down.

Service Diagnosis

- Refrigeration Light ON but does not blink
  - Maximum Freeze Time Exceeded
  - Water cooled or Remote tripped the Hi Pressure Cut Out.
    - Pressure switch will auto-reset but the controller may exceed maximum freeze time and shut the machine down.

Service Diagnosis

- Refrigeration Light ON but does not blink
  - Sump water temp not falling AND
  - Discharge temp not increasing
  - **Both** temperature sensors indicating **no refrigeration**
    - If operation had continued, would have resulted in a maximum freeze timer error, which is the **same code** & probably has the **same causes**

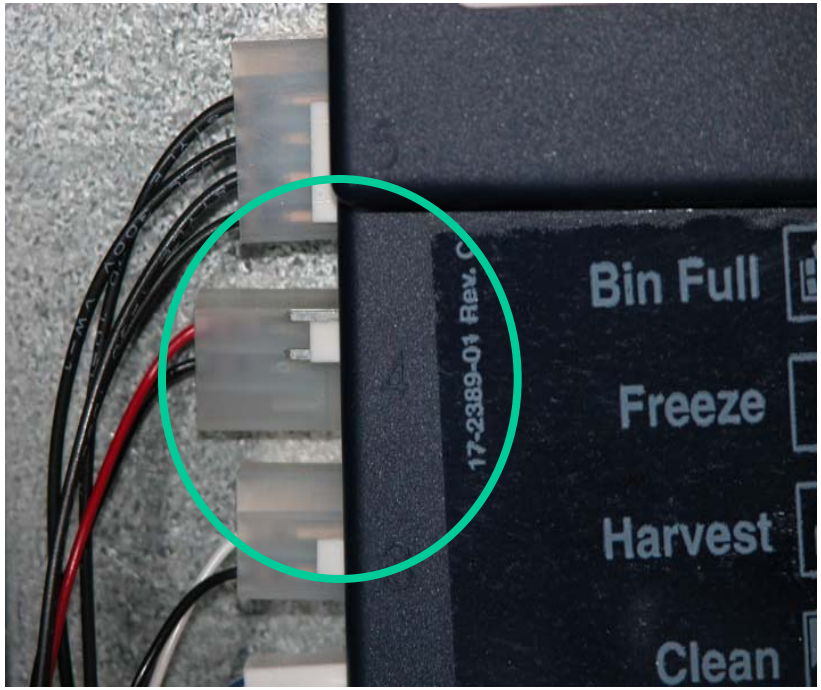
Service Diagnosis

- Refrigeration Light is ON
  - One blink and repeats
    - Very slow ice release - maximum time - 10 minutes - used
  - Two blinks and repeats
    - Maximum harvest time used
    - No ice “seen” during harvest
    - No ice release
    - Ice sensor problem
  - Three blinks and repeats
    - High Discharge temperature

Procedures

- Check for not sensing ice

Black Box,
Jump pins on 4



Blue Box, Remove
Connector from 4

Service Diagnosis

- Check the Bin Control System
  - Check the Bin Full Light.
    - If On when the bin is not full, the ice sensors may be dirty - clean them and try again. If Off,
    - Place something between the eyes, the Bin Full light should blink or go ON.
    - If not,
      - unplug number 4 (black controllers), jump the two pins on the Controller together or
      - unplug number 4 (blue controllers)
    - The Bin Full light should begin to blink or switch on. If it does replace the ice sensor. If not, replace the controller.

Service Controller

- One replacement controller for all CM³ models
  - 12-2838-22
  - Will change as new models come out
- Locate model & reference number on chart on back
- Rotate selector switch dial to correct reference number

Service Ice Sensors

- One part number covers 11 CM^3 modular cubers
  - Part # 11-0540-21
  - Only CME686 & CME810 Eclipse models use a different part

Set of Replacement Ice Sensors

Scale on Ice Sensors

I worked until I got this dirty.

Clean Me!

Removal of Sensors

- Remove cascading shield
  - Used on all two evaporator models
- Reach in and twist cascading shield's top forward to release it from its snap-on mounts
- Push-pull sensors out of the machine

Cleaning Sensors

- Clean sensors
  - Two types - tunnel mounted and module mounted
  - Eyes either in the back of the tunnel or on the module
  - Clean both with cotton swab or soft cloth

Tunnel Type

Module Mounted

Scotsman Cleaning Sensors

Remove Module

Clean Eyes

Reassemble

Check Wire

Compressor Diagnosis

- Will not start
  - Check voltage at the compressor
  - Check resistance of windings
    - Is there any?
    - Off on overload?
    - Has the compressor overheated?
      - Check start relay or PTCR
      - Check start capacitor
    - TXV not opening
    - Low charge
    - Hot gas valve leaks thru

Compressor Diagnosis

- Trips breaker
  - Check for shorted winding
  - Could be defective breaker
- Low capacity
  - Check for other cause
    - Water in bin
    - TXV, hot gas valve, low charge, inlet water valve leak thru, dirty condenser, high ambients
    - Hot water back up

Service Diagnosis

- Machine is working, but..
  - Both Error Lights are ON continuously
    - Reconnect or Change the Compressor Discharge and Water Temperature Sensor Set

TXV Diagnosis

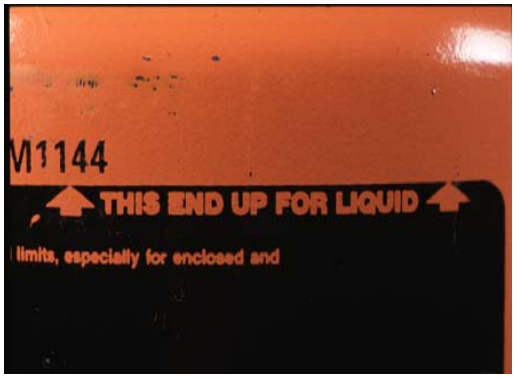
- Controls refrigerant flow to maintain suction line temperature
  - Bulb must be securely clamped in the right position AND insulated
  - Most multiple evaporator machines have a refrigerant distributor & externally equalized TXVs
    - CME506 “E” and up have two internally equalized TXVs
  - Low charge can look like TXV not metering

Charge Diagnosis

- Low charge can cause
  - High compressor temperatures
  - Ice not forming at the top of ALL evaporators
  - Long cycle times
    - Controller may shut unit down
- Weigh OUT the charge to confirm

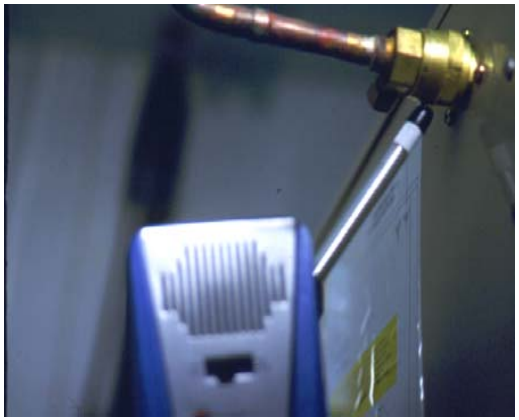
Scotsman

Refrigeration Service



Liquid Charge

R-404A



Use HFC Leak Detectors

Evacuate to 300 microns

Weigh In Charge

Use Nitrogen Purge

Refrigeration Data

- CME256 (70º/50º)
  - Suction - end of Freeze 25 - 27 PSIG
  - Discharge - 5 minutes into freeze 245 PSIG
- CME506 (70º/50º)
  - Suction - end of Freeze 35 - 37 PSIG
  - Discharge - 5 minutes into freeze 250 PSIG
- CME656 (70º/50º)
  - Suction - end of Freeze 25 - 27 PSIG
  - Discharge - 5 minutes into freeze 220 PSIG
- CME806 (70º/50º)
  - Suction - end of Freeze 20 - 21 PSIG
  - Discharge - 5 minutes into freeze 215 PSIG

Summary

- Control System enhances
  - Reliability
  - Performance
- Water System enhances
  - Flexibility in water use
  - Consistency in water rinse
- Common/reduced count replacement parts
  - Controller
  - Ice Sensors
  - Water Sensor
  - Inlet Water Solenoid Valves