Scotsman®

CM³ - CME1356, CME1656,
CME1856W and CME2006R

Technical Training

Scotsman® CME1356 and CME1656

- CM^3 product
  - 48” wide
  - 24” deep
  - 28” high
  - R-404A
  - Purge Valve
  - Air cooled
  - Water cooled
  - Remote air cooled

Scotsman® CME2006R & CME1856W

- CME2006R
  - Remote Only
  - Use with ERC611
  - Uses Copeland Scroll Compressor
- CME1856W
  - New in 2002
  - Same compressor as CME2006
  - Water Cooled Only

Presentation Topics

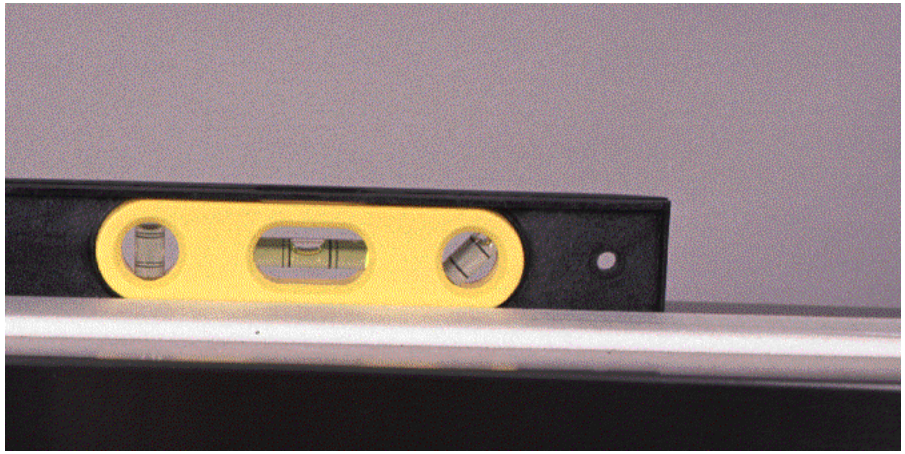
- Product Construction
- Installation
- Operation
- Cleaning & Maintenance
- Service Diagnosis
- Refrigeration Service

Models

- CME1656, CME1856 & CME2006
  - 6 evaporators
- CME1356
  - 5 evaporators
- CM^3 technology
  - Automatic harvest time adjustment
  - No seasonal adjustments
  - Controller aided diagnostics
  - Adjustable purge

Installation: All Models

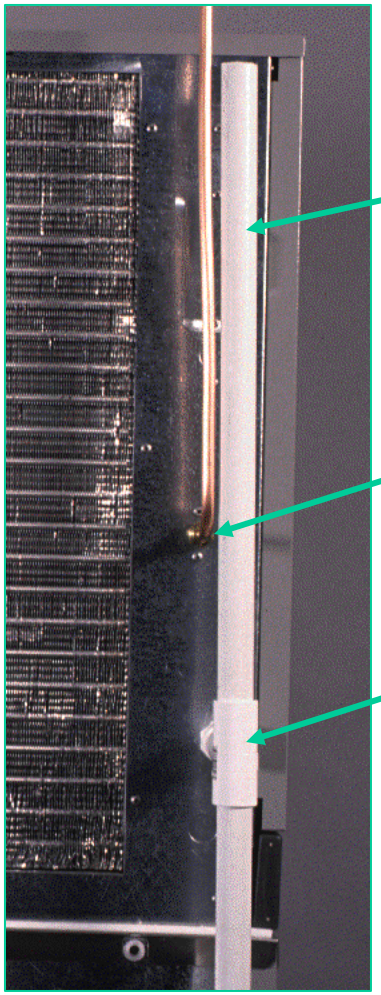
- Level the bin in the place where it will be located
- Use NEW plumbing - do NOT recycle old tubing!
  - Water must flow in at 2.7 GPM
  - Minimum 20 PSI
  - Use triple SSM filter system



Air Cooled

- Air flow
  - In the front and out the back up to E series
  - E series flows in the front & left side and then out the back
  - E Series new in 2002
    - Left side panel changed to louvered type
- Disposable air filter clipped to panels
  - Easy to change

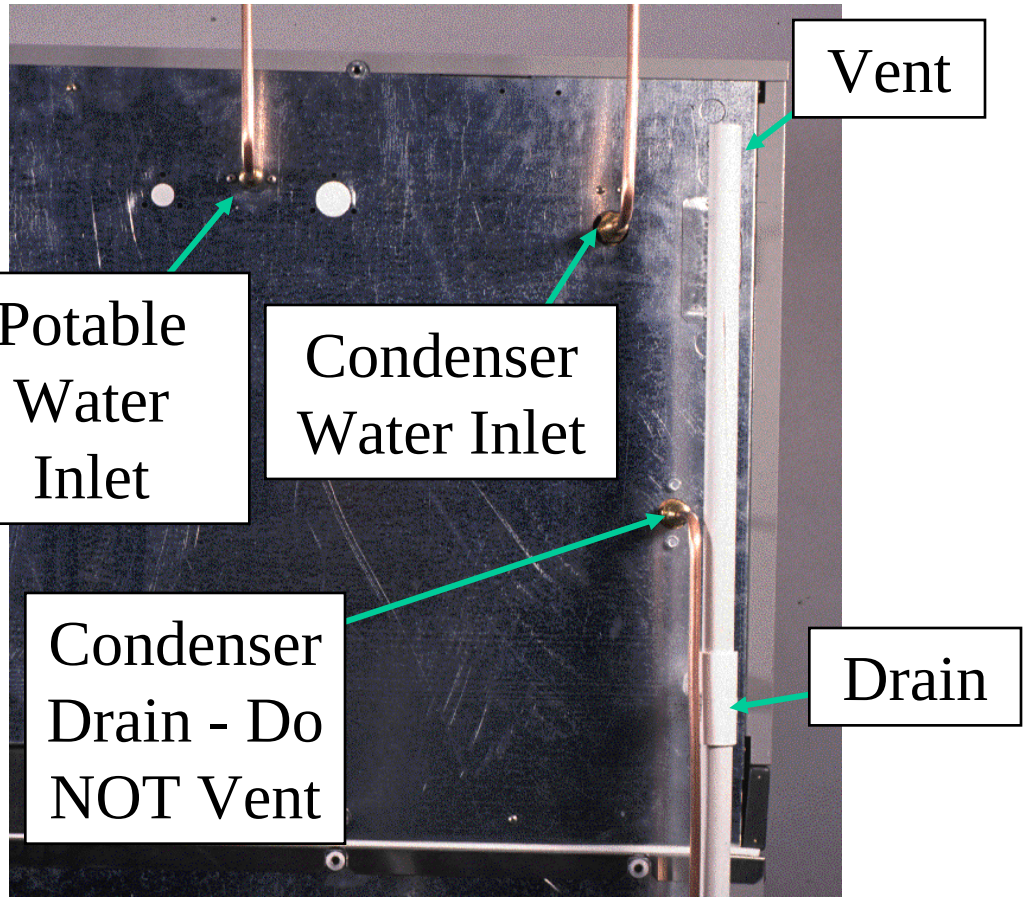
Air Cooled Installation



- 3/4” FPT drain
  - Use rigid pipes
  - Vent the drain - 18”
- 3/8” Male flare inlet
  - Use NEW 3/8” tubing - do not recycle old tubing!
  - Change filter cartridges!
- Electrical junction box inset into back panel

Water Cooled Installation

- 3/4” FPT purge valve drain - must be vented
- 3/8” Male Flare potable water inlet
- Water Cooled:
  - 1/2” FPT condenser drain
  - 3/8” FPT condenser inlet
  - 1/2” FPT condenser inlet for CME1856W
- Electrical junction box inset in back panel

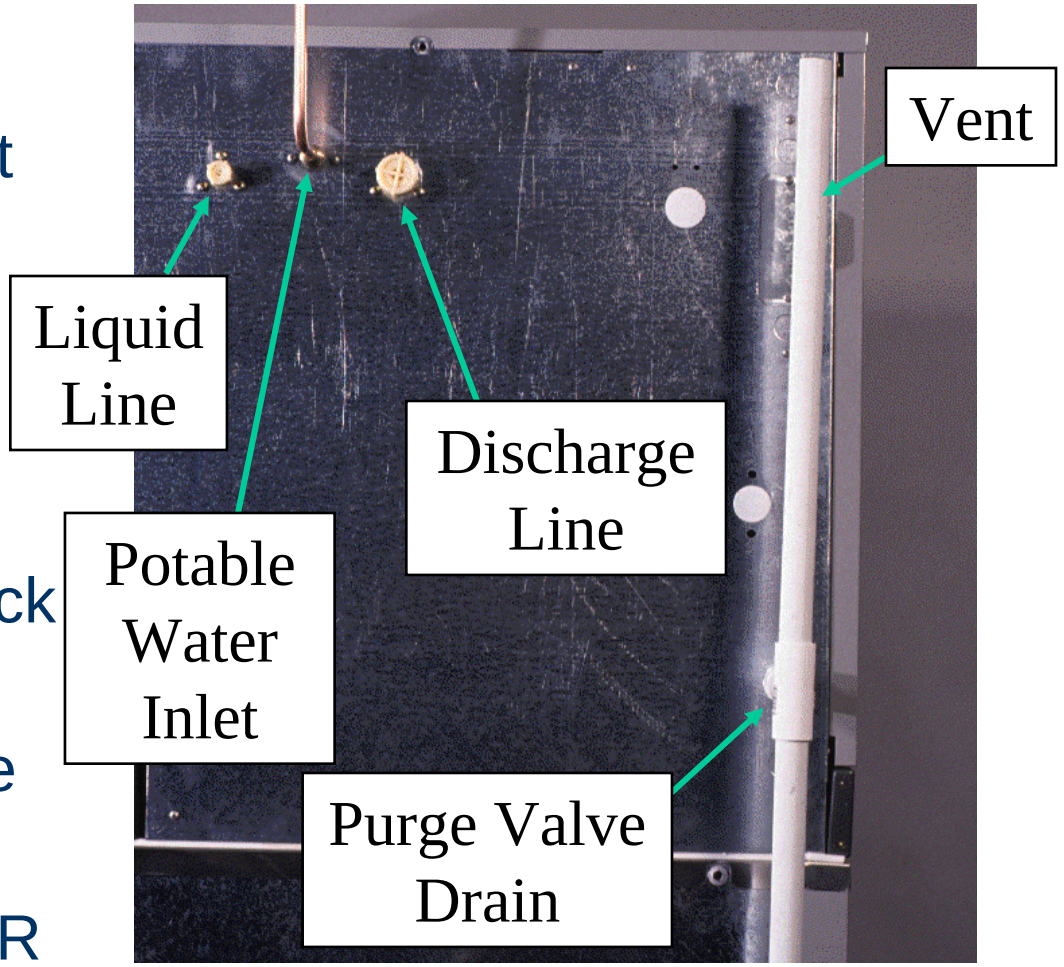


Remote Air Cooled

- No louvers
  - Quieter operation
- Refrigeration system
  - Liquid & Discharge check valves
  - Headmaster in condenser
  - No pump down
  - Top inlet receiver
    - No king valve

Remote Installation

- Utilities:
  - 3/8” Male Flare potable water inlet
  - 3/4” FPT purge valve drain - must be vented - 18”
- Pre-charged lines
  - 3/8” liquid line quick connect
  - 1/2” discharge line quick connect
  - 5/8” on CME2006R



Remote Installation

- All models have the electrical junction box inset into the back panel
- Remote models also have the fan power wires in the same box

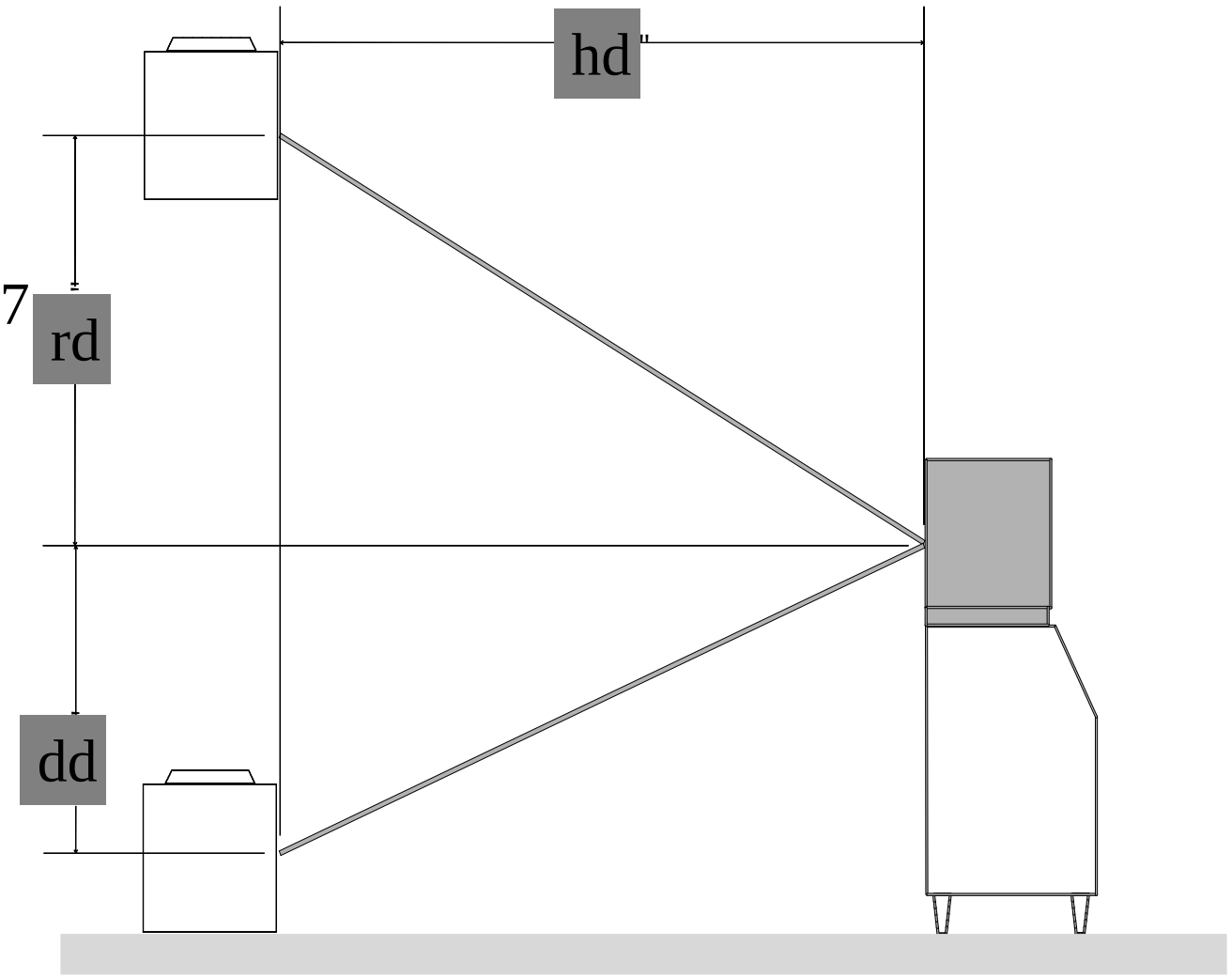
Remote Installation

- Select the location for the ice machine and condenser
  - Minimize line set length for ease of installation
  - Follow Scotsman's guidelines for location

Remote Installation

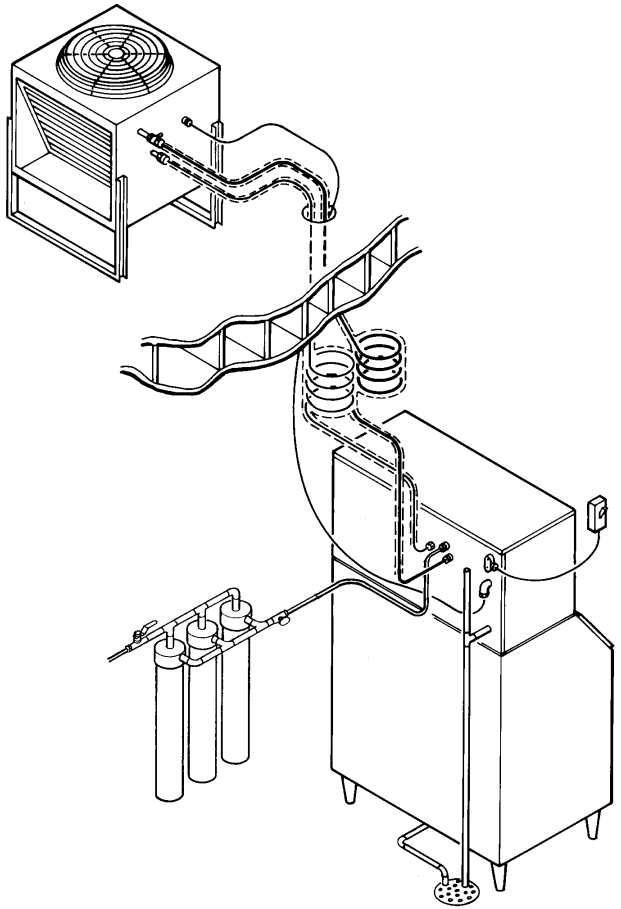
hd=
horizontal
distance
rd=
rise distance x 1.7
dd=
drop distance x
6.6
hd+rd+dd=total

Total Drop
Cannot
Exceed
15 feet



Remote Installation

- Typical Installation
  - Condenser above ice machine
  - Precharged line set coiled within building
    - Use horizontal coil
    - NEVER leave excess coiled up on the roof!



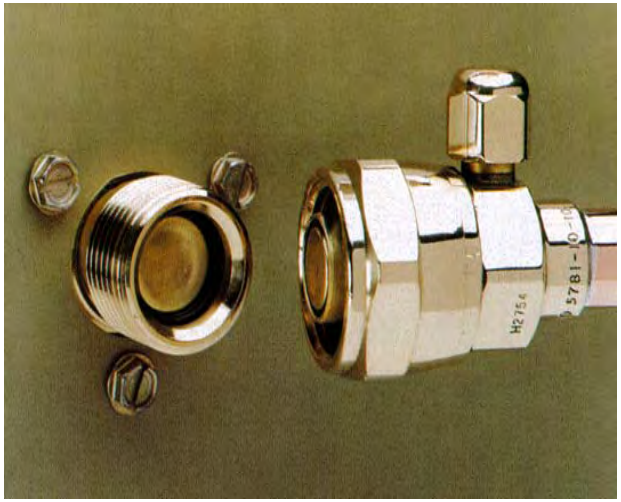
Remote Condenser

- For CME1356R or CME1656R
  - Use ERC411
  - or MAC “G” or “X” with a RCKCME6GX accessory
    - RCKCME6GX required to add headmaster to the central condenser
- CME2006R
  - Use ERC611 ONLY!

ERC411/611 - Leg Location when Shipped

Scotsman®

Remote Installation

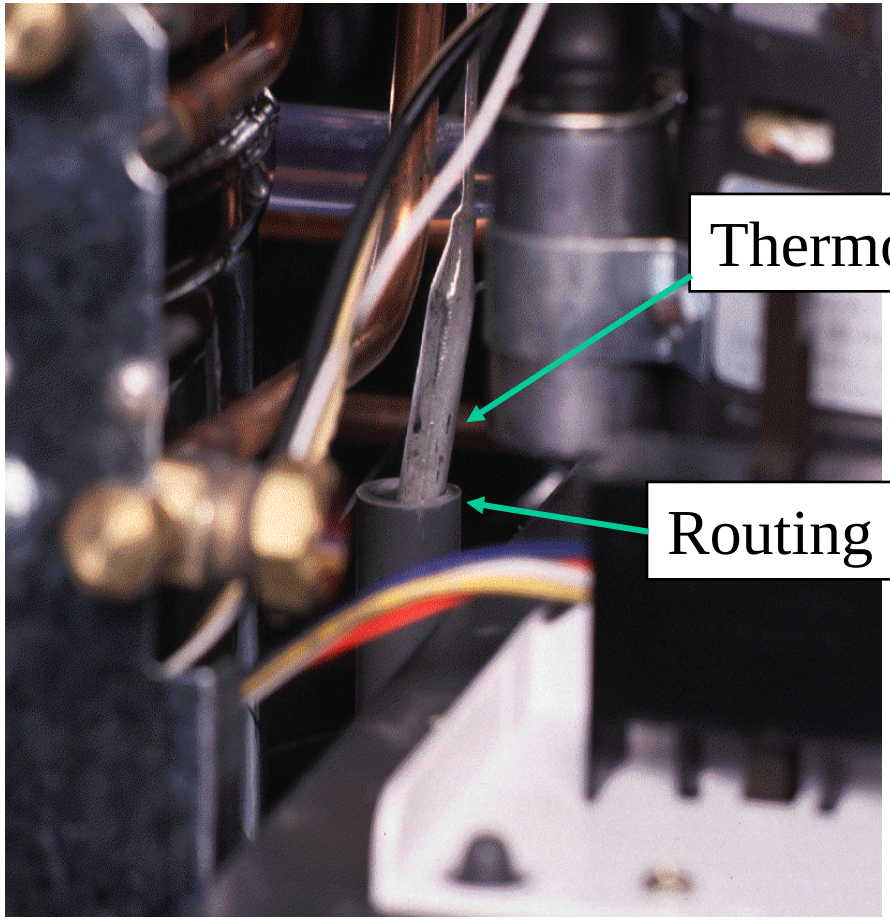


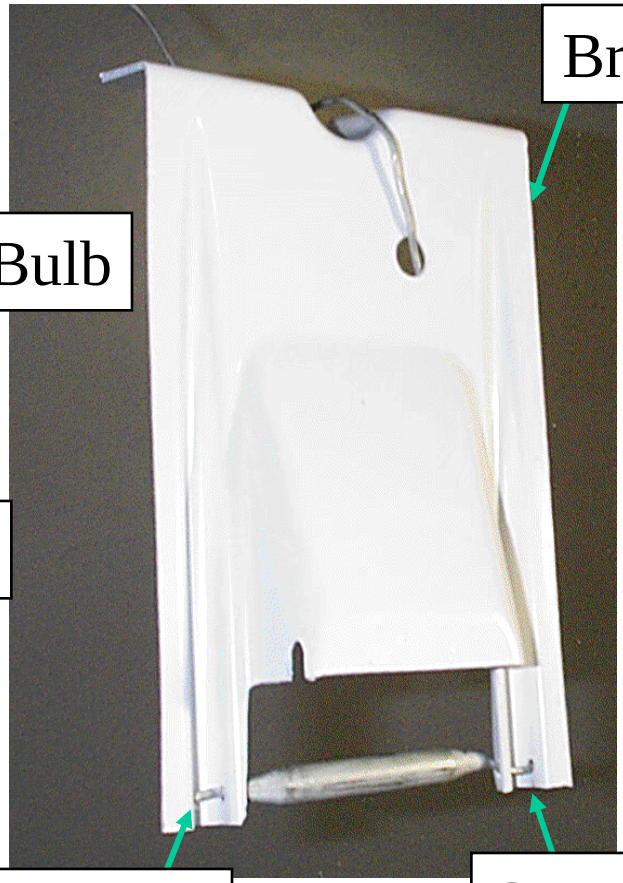
Clean and Lubricate Quick Connect Couplings

Use Two Wrenches to Tighten

Rotate Swivel Nut One Quarter Turn More After Nut Becomes Tight

Scotsman® Installation: Bin Thermostat

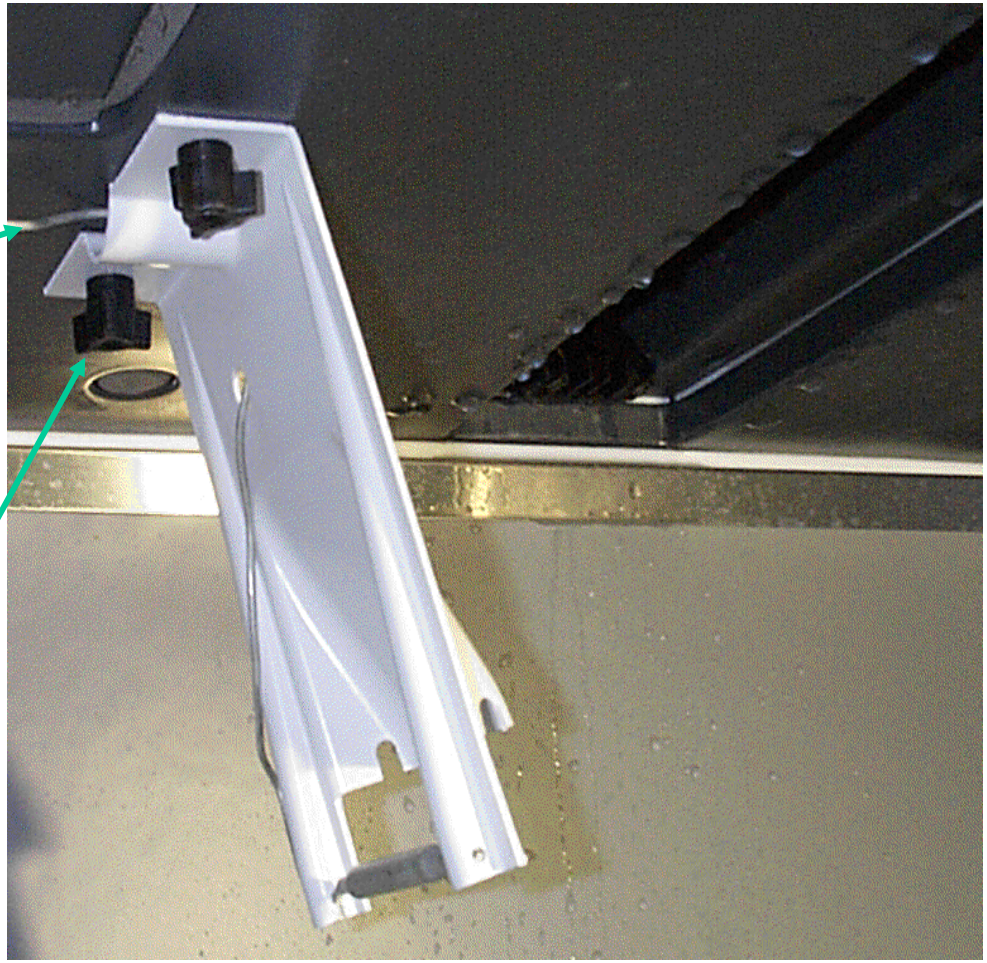




Scotsman® Installation: Bin Thermostat

Pull Excess Cap Tube Back into Machine Compartment

Secure Thermostat Bulb and Bracket to the Bottom of the Machine with Two Fasteners

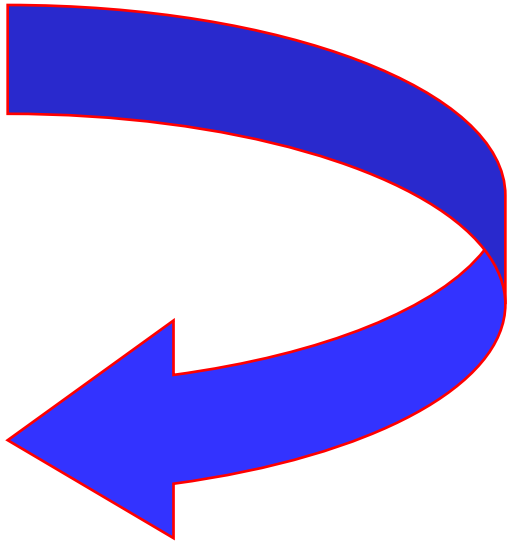


Initial Start Up

- Remotes: Supply electrical power 4 hours before starting compressor
- Remotes: Open liquid line valve
- All models: Switch on the water supply
- All models: Check voltage - compare to nameplate
- All models: Push Freeze to start

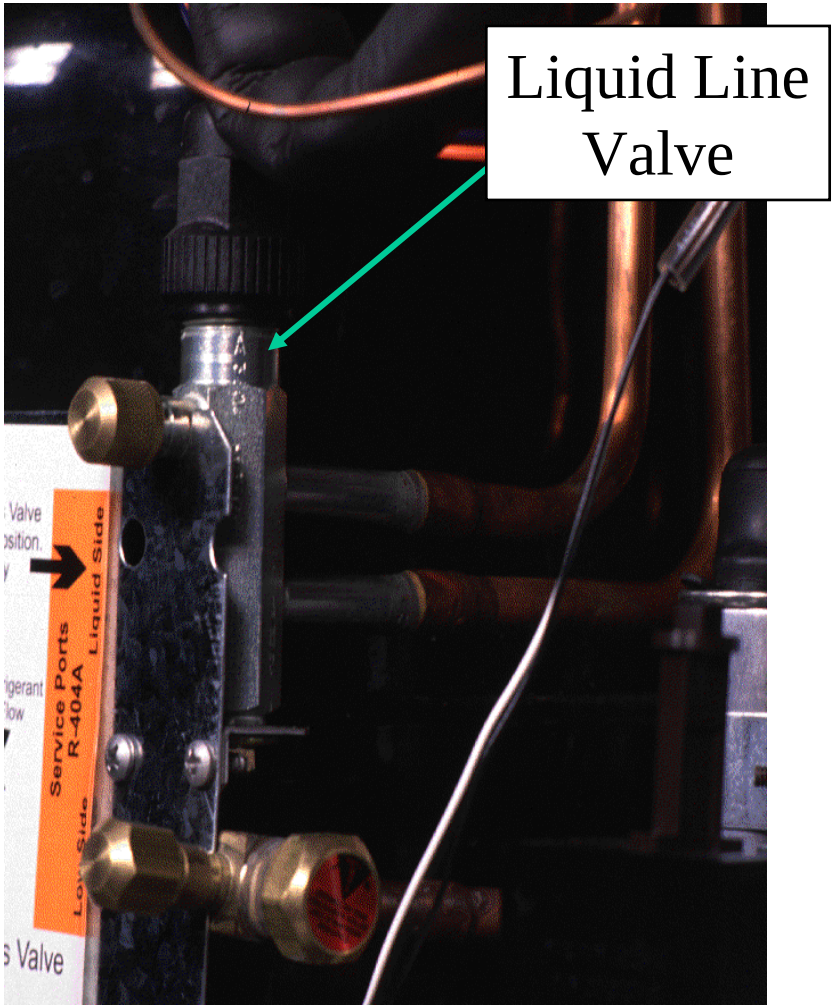
Scroll Compressor

- CME1856 & CME2006
- Three phase
  - Must run in proper direction
  - But Will run either CW or CCW
  - Wire phasing controls direction
  - Switch two lead wires to change direction



Liquid Line Valve: Remote

- Valve must be opened fully (stem in the UP position) to open the path from the receiver to the TXV
- Open partially to recover, evacuate and recharge
- There is NO discharge access valve

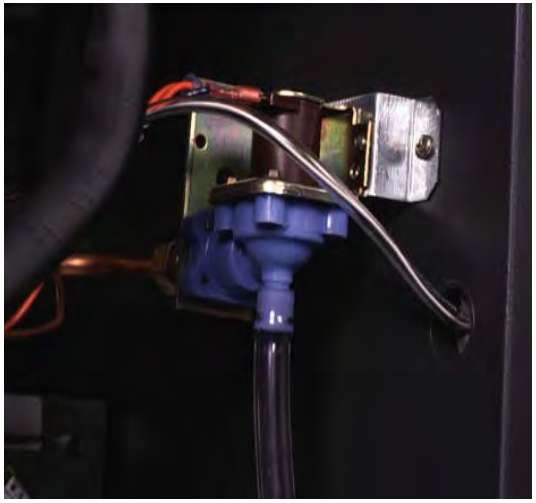


Operation: Initial Start Up

- Purge valve opens for 30 seconds
- Hot gas valve opens for 30 seconds
- Water pump is on
- Purge and hot gas valves shut off
- Water valve opens and fills the reservoir
- Compressor starts -
  - AFTER reservoir is full
- No manual adjustments

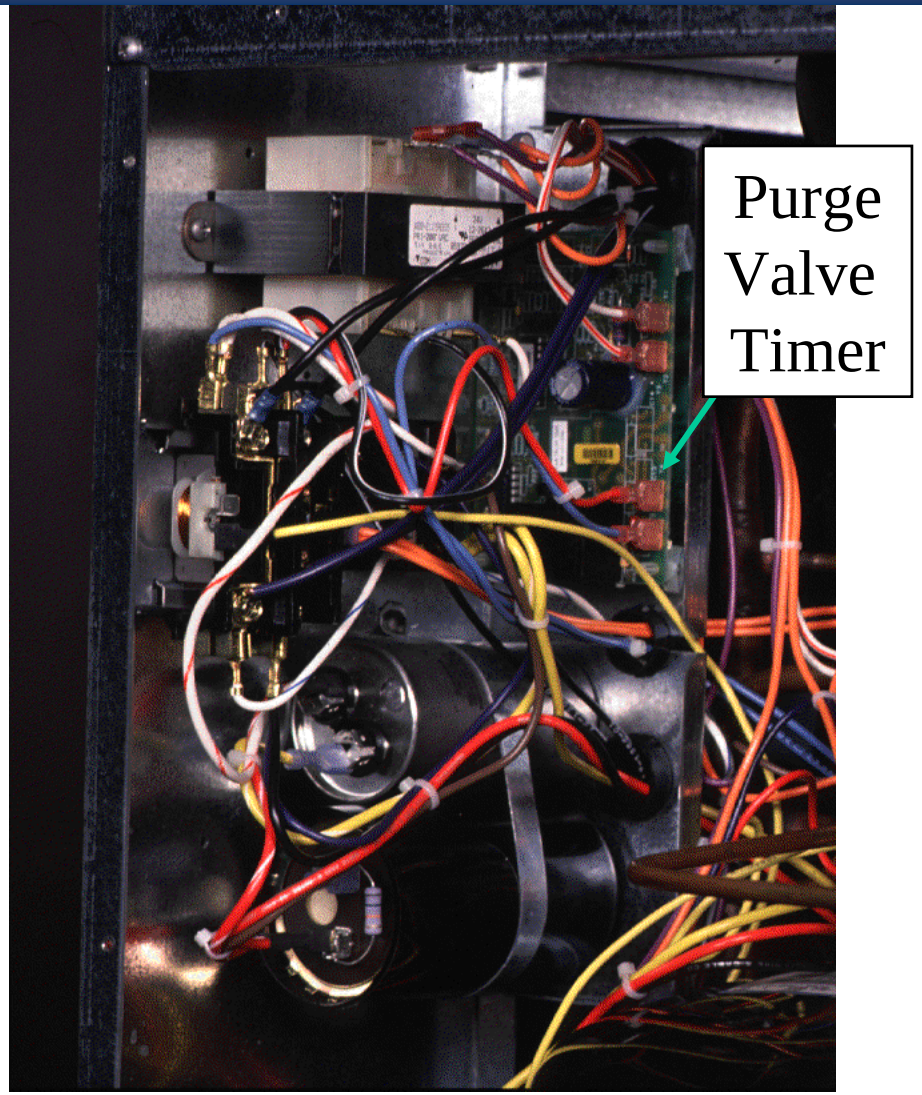
Components

- Inlet water valve
  - Flows 2.7 GPM
  - 24 volt coil
- Purge valve
  - Powered by purge valve timer
  - 220 volt coil



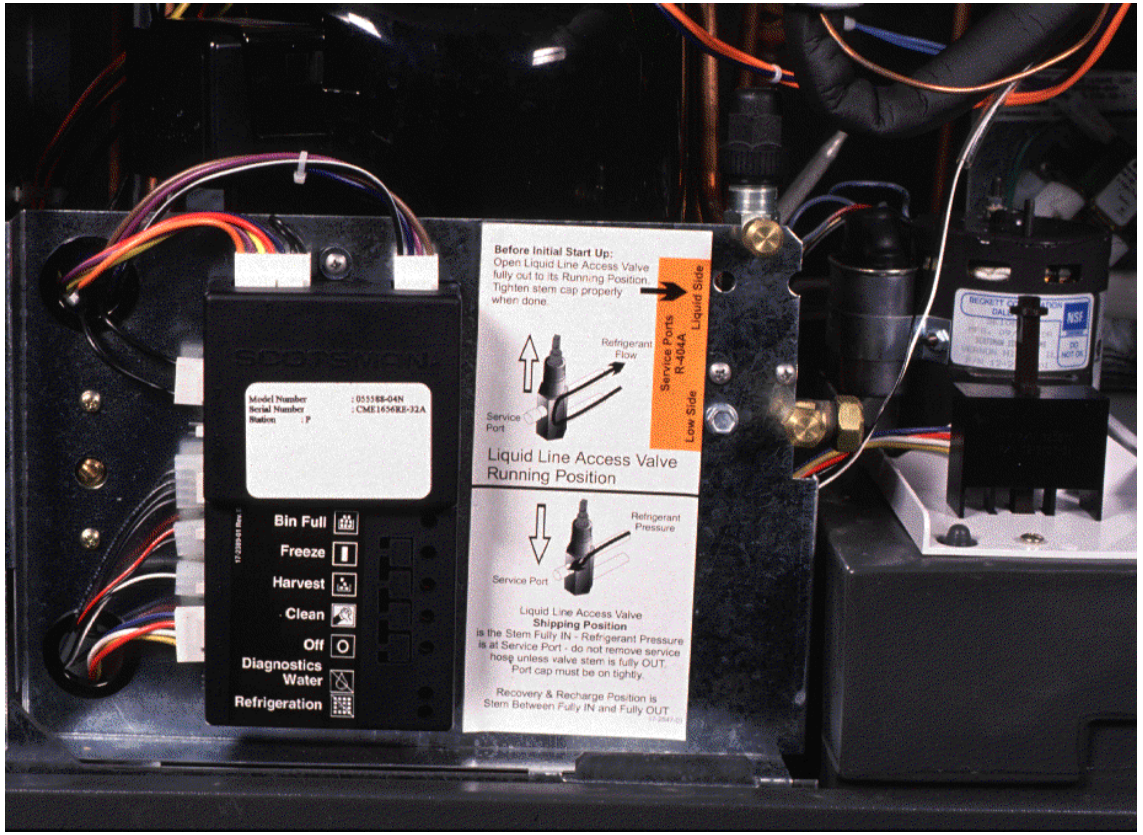
Components

- Hi Voltage Box
  - Purge Valve Timer
    - 74 second output
    - Triggered by controller
    - Same time as Hot Gas Valve
  - Transformer
  - Contactor
  - Start Relay
  - Capacitors



Components

- At the front
  - Controller
  - Bin thermostat
  - Refrigeration system access valves
  - Water pump
  - Water level sensor



System Controller

- Connected to sensors
  - Water level
  - Water temperature
  - Ice
  - Bin thermostat
  - Discharge temperature
- Controls loads
  - Water, purge, hot gas, and bypass (remote) valves
  - Contactor and water pump
  - Fan motor (air cooled)

Blue Controller

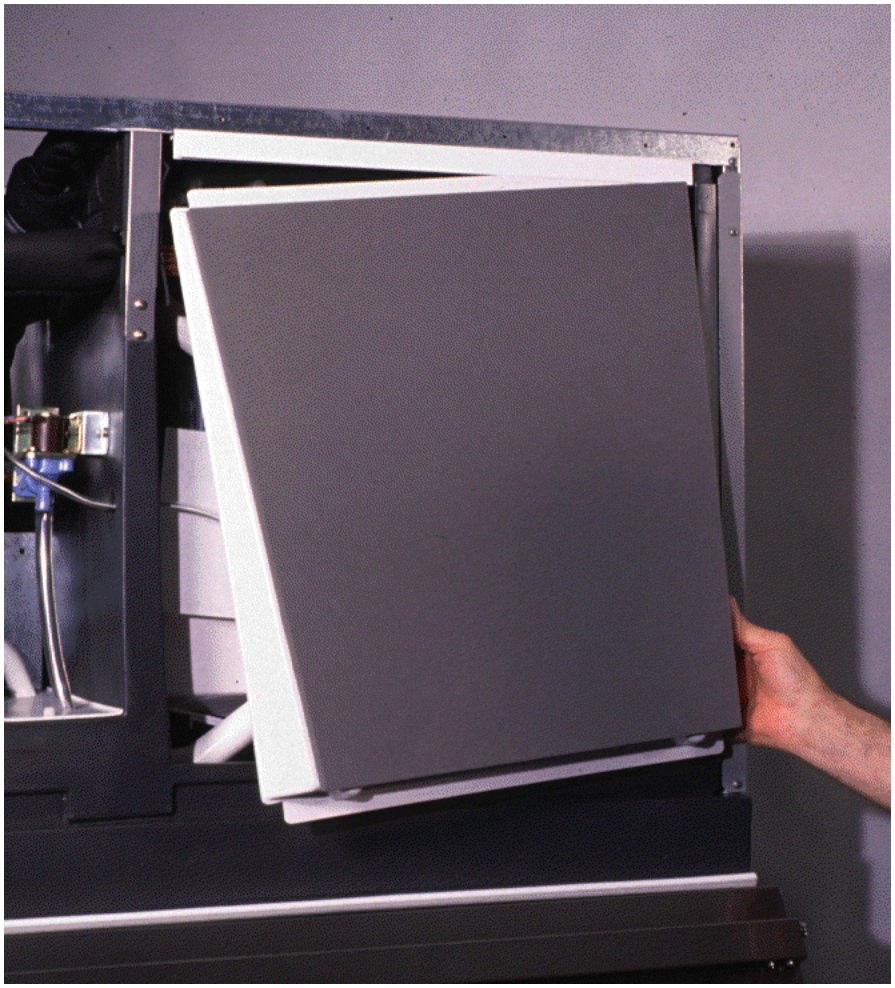
- Last Error Recall
  - Shut unit off
  - Hold Off button until Green lights appear
  - Push and release Harvest button to show last error code
  - Push and release Harvest button again to show second to last error code

Service Controller

- Single Service Controller
  - For all existing CM³ models
  - Model selection table on back and in the instructions
  - Model selected by rotary switch

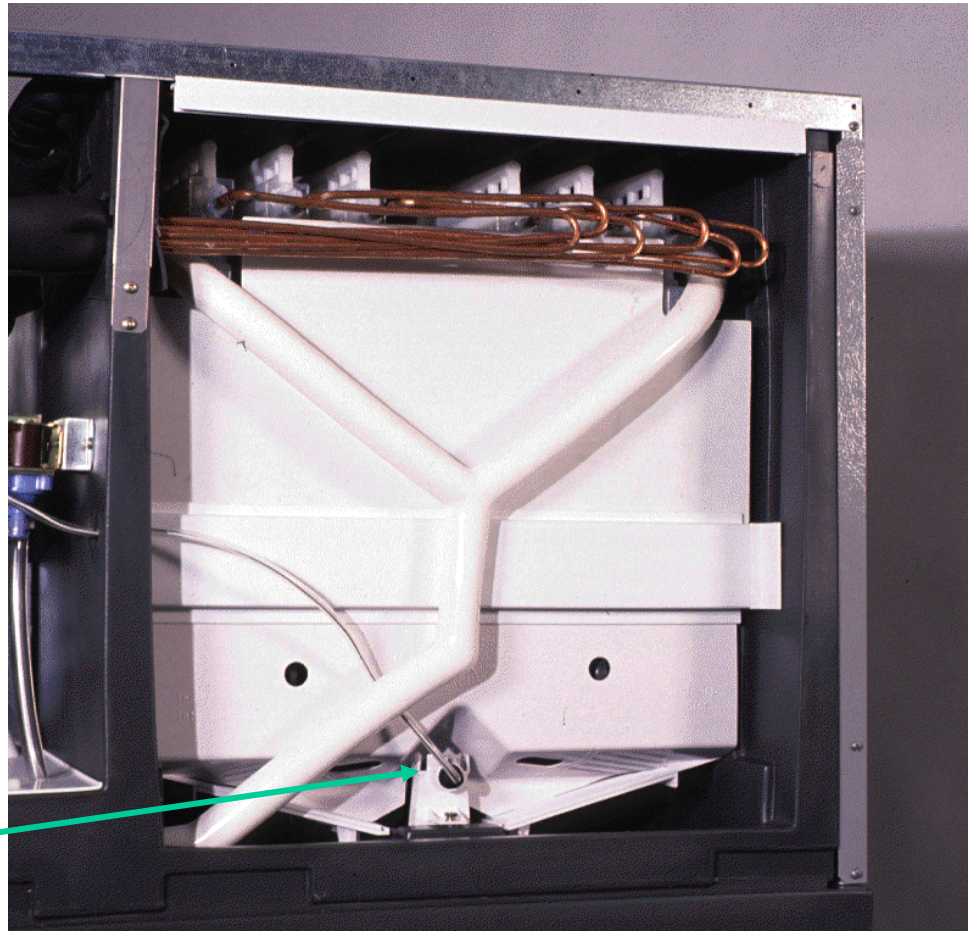
Components

- Evaporator cover over the ice making zone
  - Provides thermal barrier
- Push up to release at the bottom

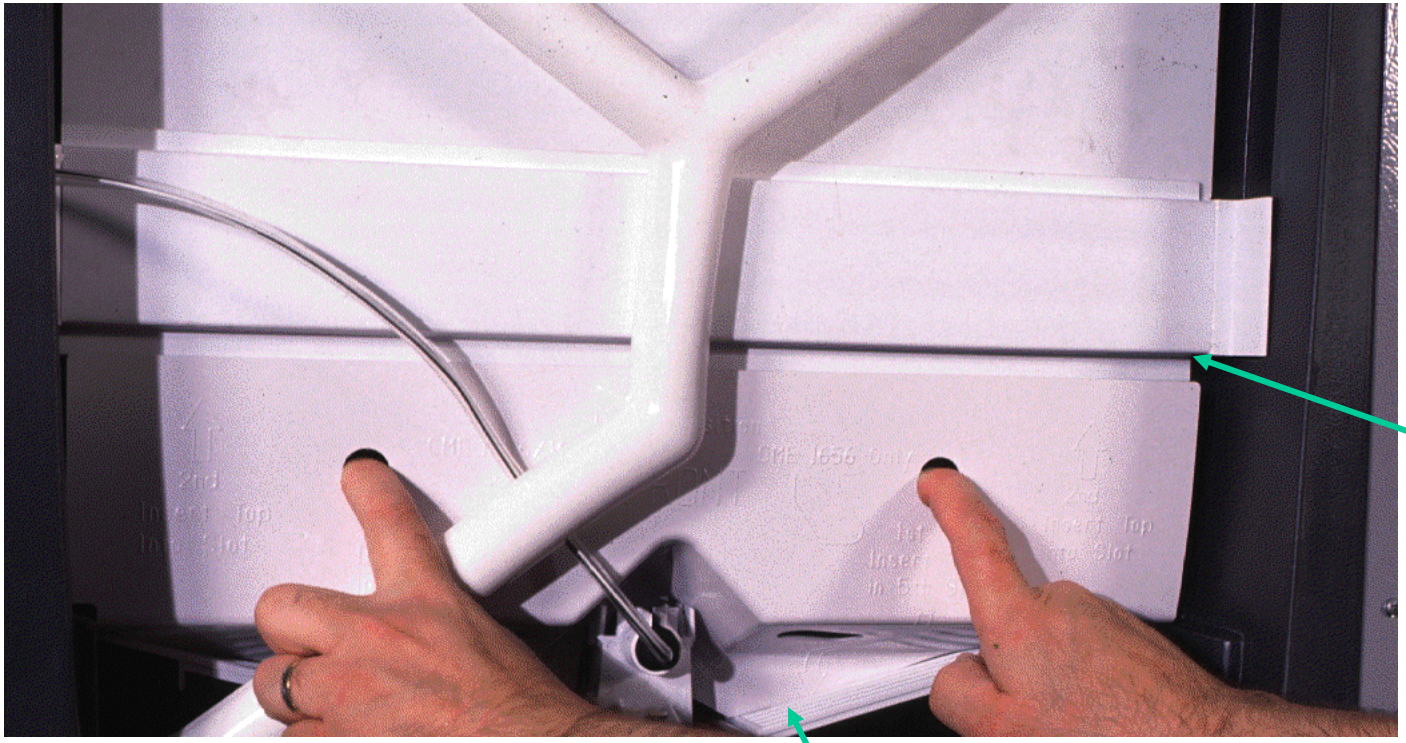


Components

- Under the evaporator cover
  - Two more covers to keep ice out of the reservoir
  - Water pump discharge hose
  - Front ice sensor

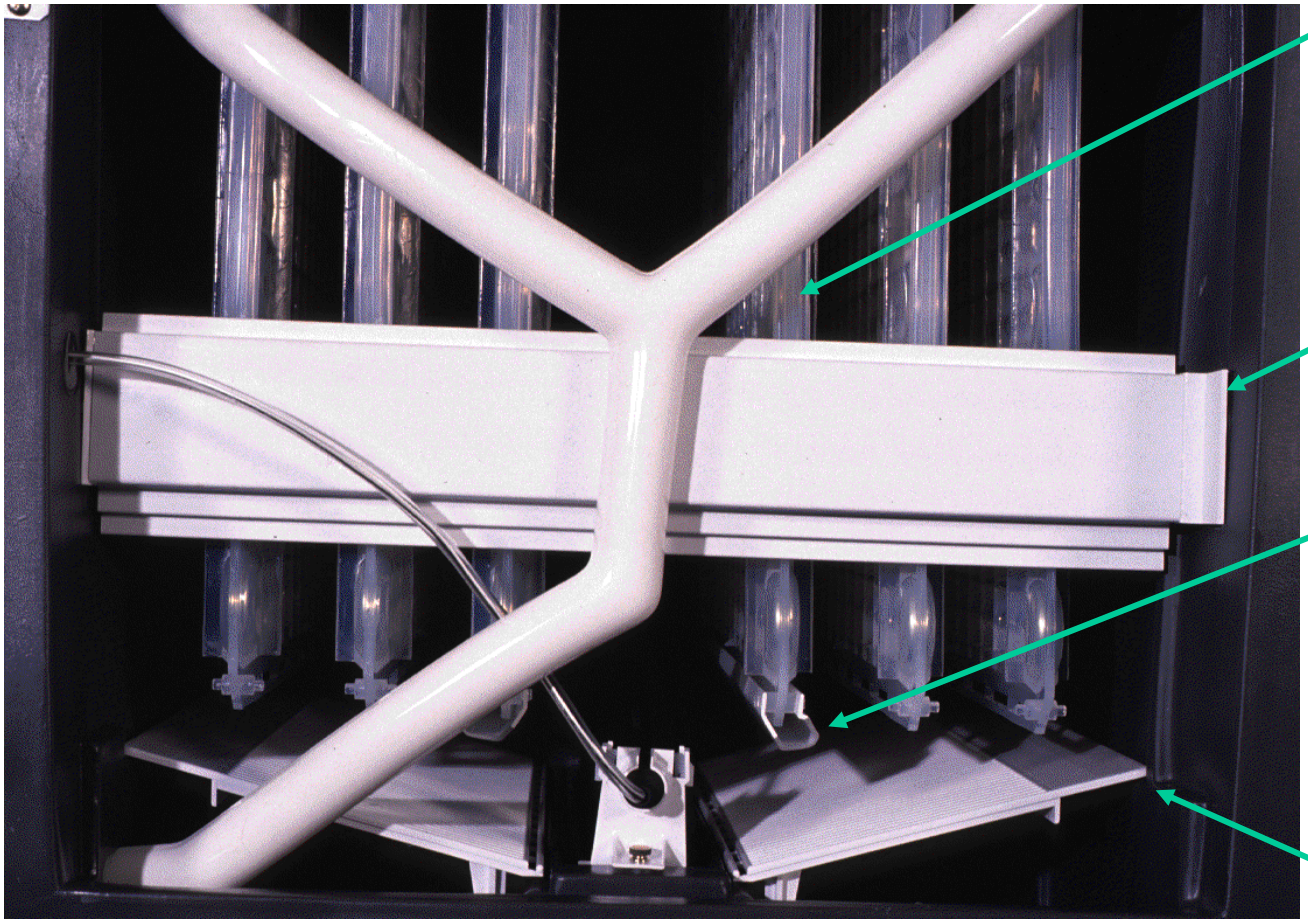


Scotsman® Lower Inner Splash Panel



Scotsman®

Freezing Compartment



"6th" Evaporator

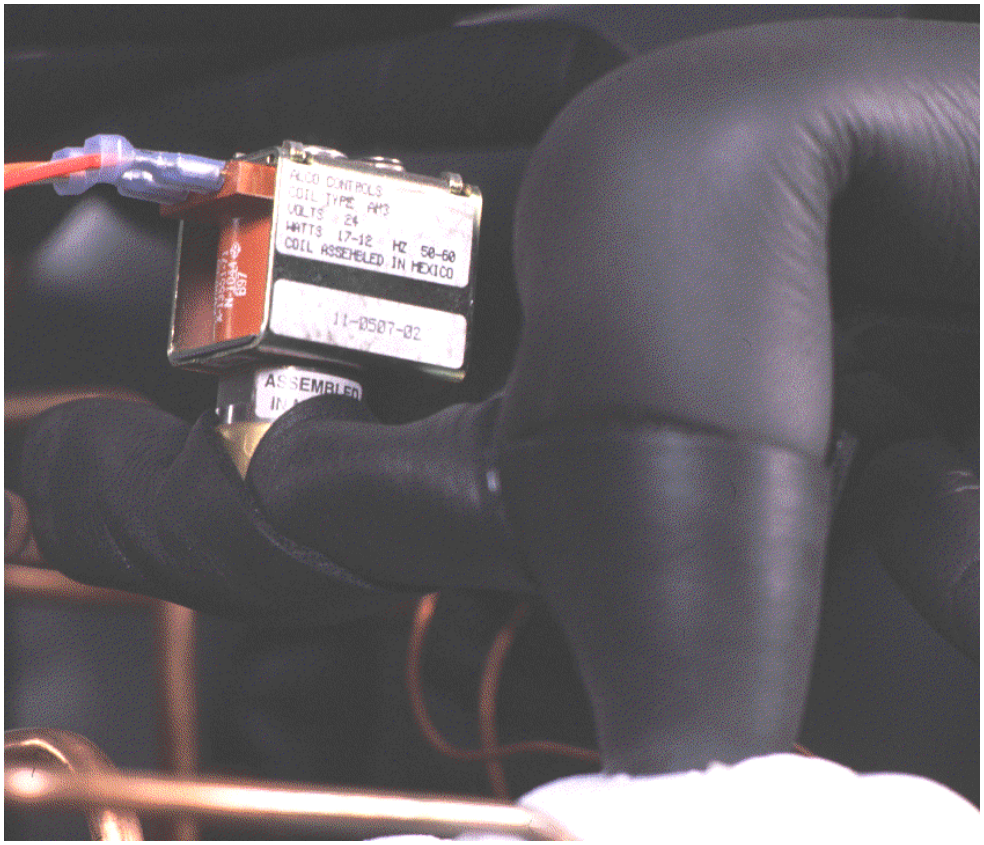
Evaporator Support Bracket

Water Trough - Must be in this position

Cube Deflector

Refrigeration Components

- Hot Gas Valve
  - Feeds directly into refrigerant distributor
  - No separate hot gas manifold



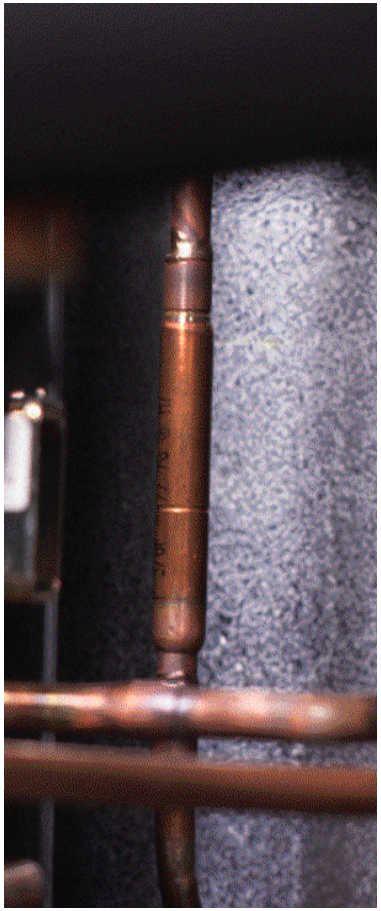
Refrigeration Scroll

- ZS30K4E compressor
  - Z = Z family
  - S = Medium temp
  - 30K = 30,000 BTUH base capacity
  - 4 = 4th generation (2nd generation refrig. Scroll)
  - E = Ester oil

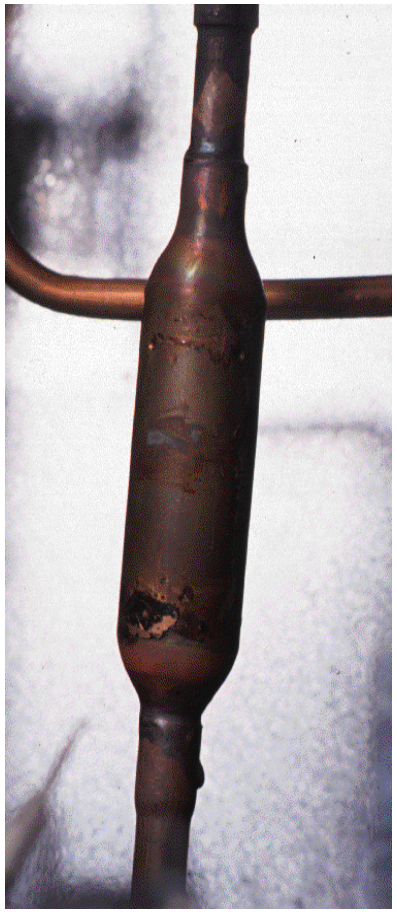
Scroll Compressor

- Single Phase
  - Must also run in proper direction
  - Can reverse if stopped & immediately restarted
  - CME1856 & CME2006 single phase models have short term (less than 1 second) power interruption relay to delay compressor restart for 30 seconds

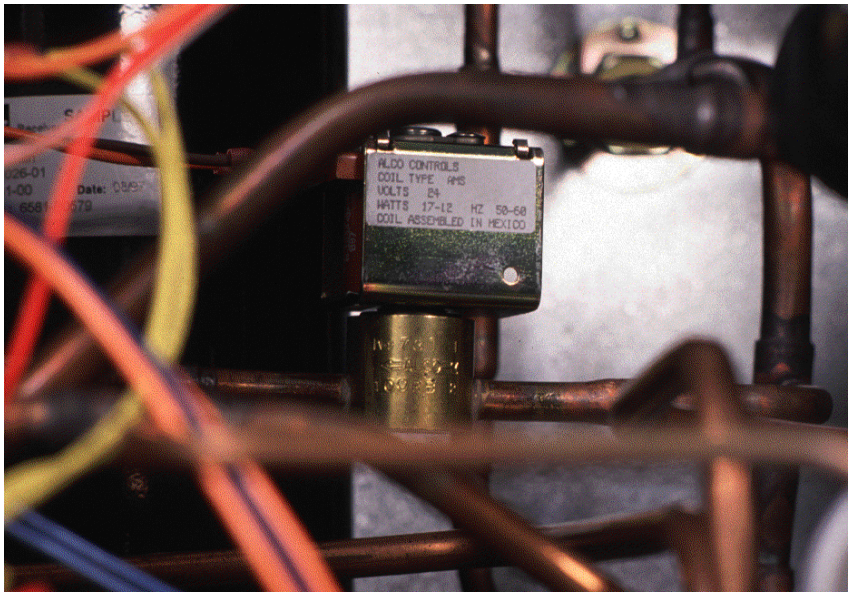
Remote Refrigeration



Liquid Line
Check Valve



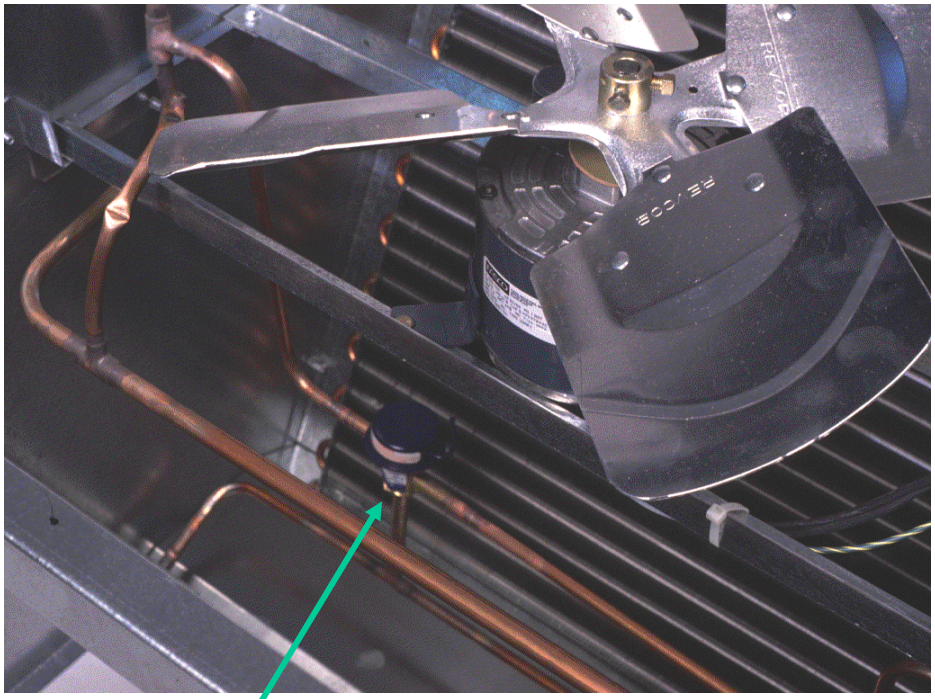
Discharge Line
Check Valve



Harvest Bypass Valve

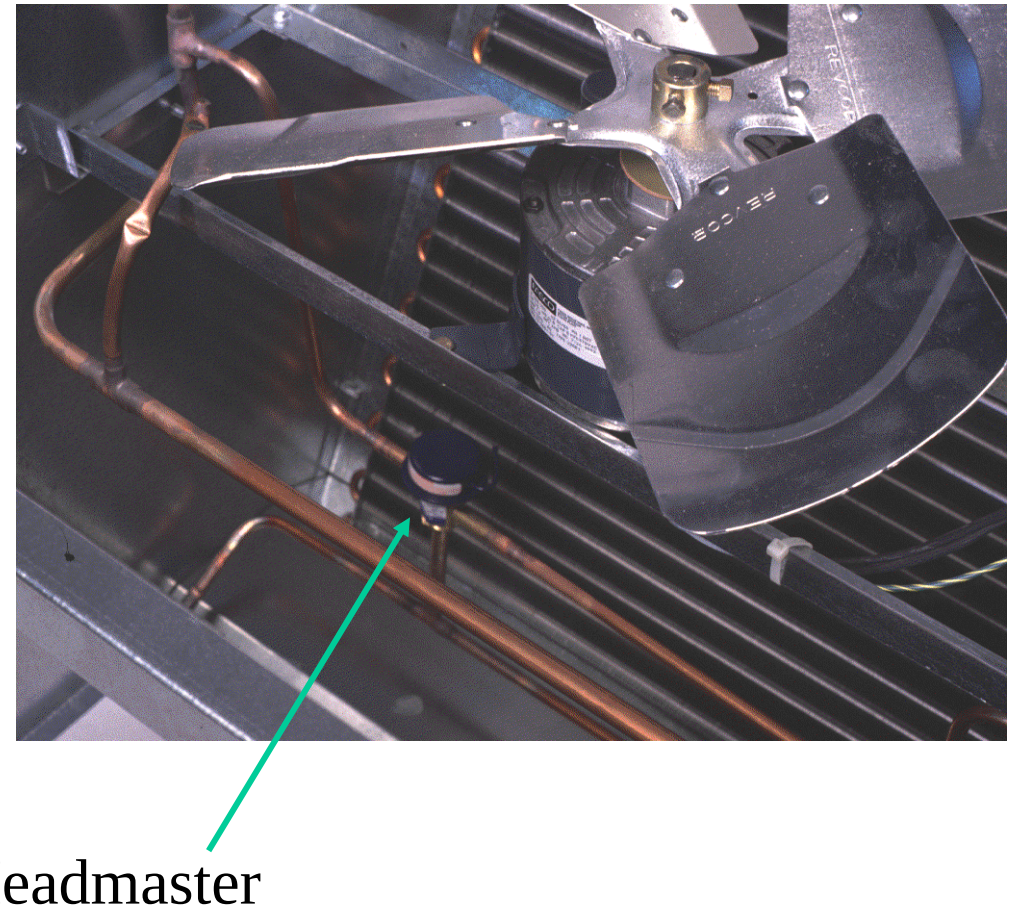
Remote Refrigeration

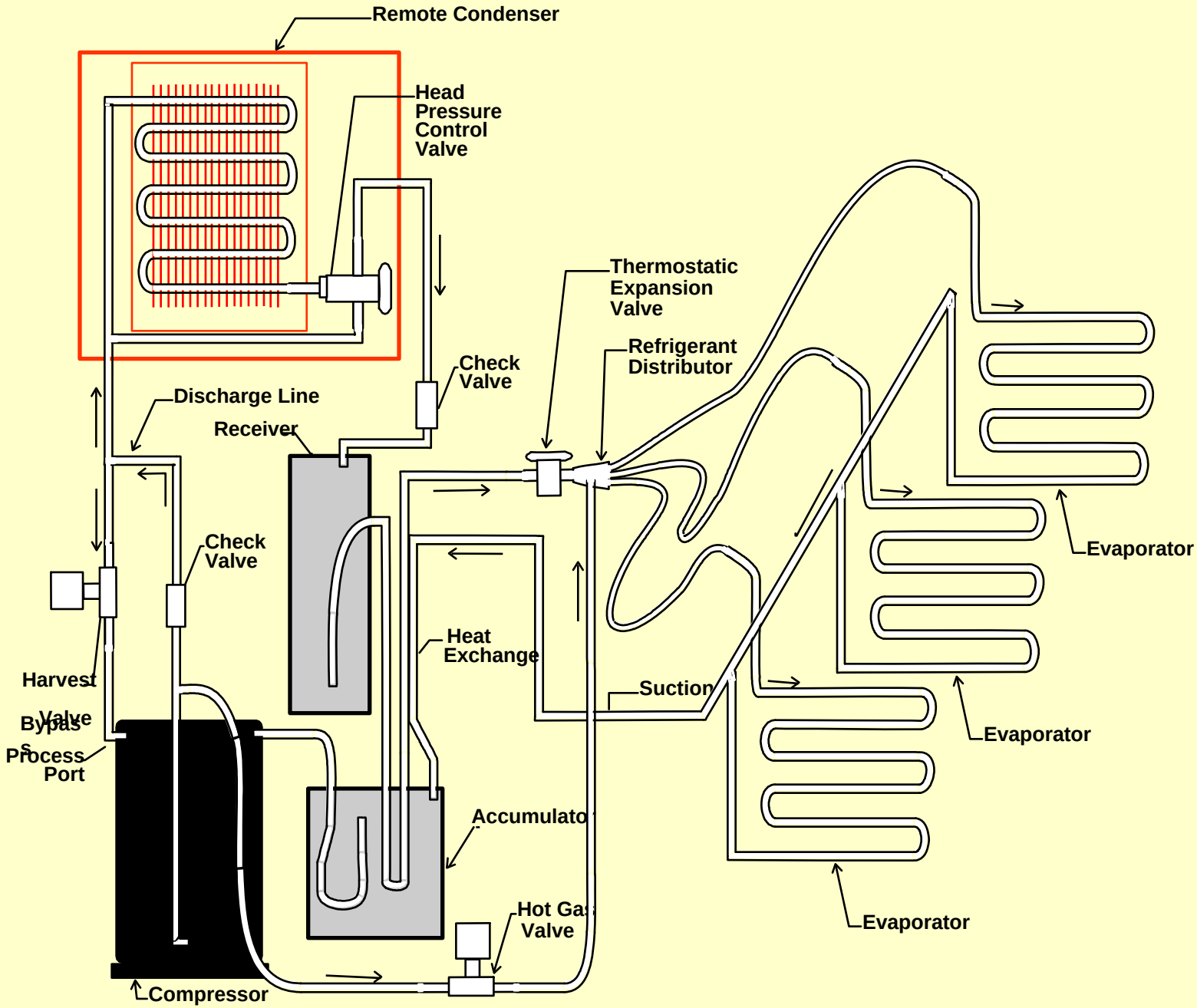
- Headmaster inside the ERC411 remote condenser
- Maintains minimum discharge pressure during freeze - 240 PSIG



Remote Refrigeration

- Headmaster inside the ERC611 remote condenser
- Maintains minimum discharge pressure during freeze - 217 PSIG




Remote Condenser
Head Pressure Control Valve
Thermostatic Expansion Valve
Refrigerant Distributor
Check Valve
Discharge Line
Receiver
Check Valve
Evaporator
Heat Exchange
Suction
Harvest Valve
Bypass
Process Port
Evaporator
Accumulator
Hot Gas Valve
Evaporator
Compressor

Water Sequence

- Reservoir drains during harvest
  - Amount varies depending upon level of purge set on controller
  - Pump start time determines amount of water purged out
- Partial refill during harvest
- Top off at the beginning of freeze
- Refill once more half-way thru freeze

Scotsman® Electrical Sequence: Freeze

- Reservoir water must cool to a preset point within 5 minutes after the freeze cycle begins
  - Controller checks water and discharge temps to see if refrigeration is taking place
  - Will go thru a multiple step diagnostic if it is not

Scotsman® Electrical Sequence: Freeze

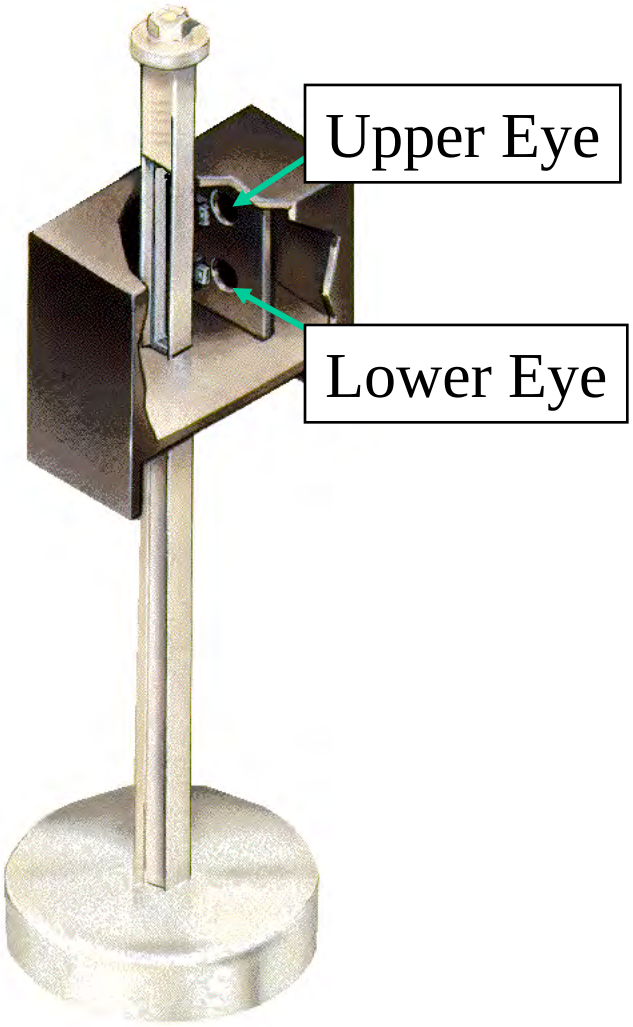
- Water pump will switch off for a few seconds early in the freeze cycle
- Coats the evaporators with a thin layer of ice
  - Promotes better water distribution

Scotsman® Electrical Sequence: Freeze

- About 1/2 way thru the freeze cycle the float stem in the water sensor will break the top beam of the water level sensor and the water valve will open to refill the reservoir
- The next time this happens starts the end of the freeze cycle

Water Control

- The controller senses how much water is in the reservoir thru the water level sensor
  - Upper electric eye indicates when water falls
  - Lower electric eye indicates when water rises



Scotsman® Electrical Sequence: Freeze

- Fan Control (Air Cooled)
  - Fan off time determined by discharge temperature taken early in the freeze cycle
    - Lower discharge temperature = longer fan off time to build up heat for harvest
  - In low ambients the fan will cycle on and off throughout the freeze cycle
  - The Fan is Off during harvest

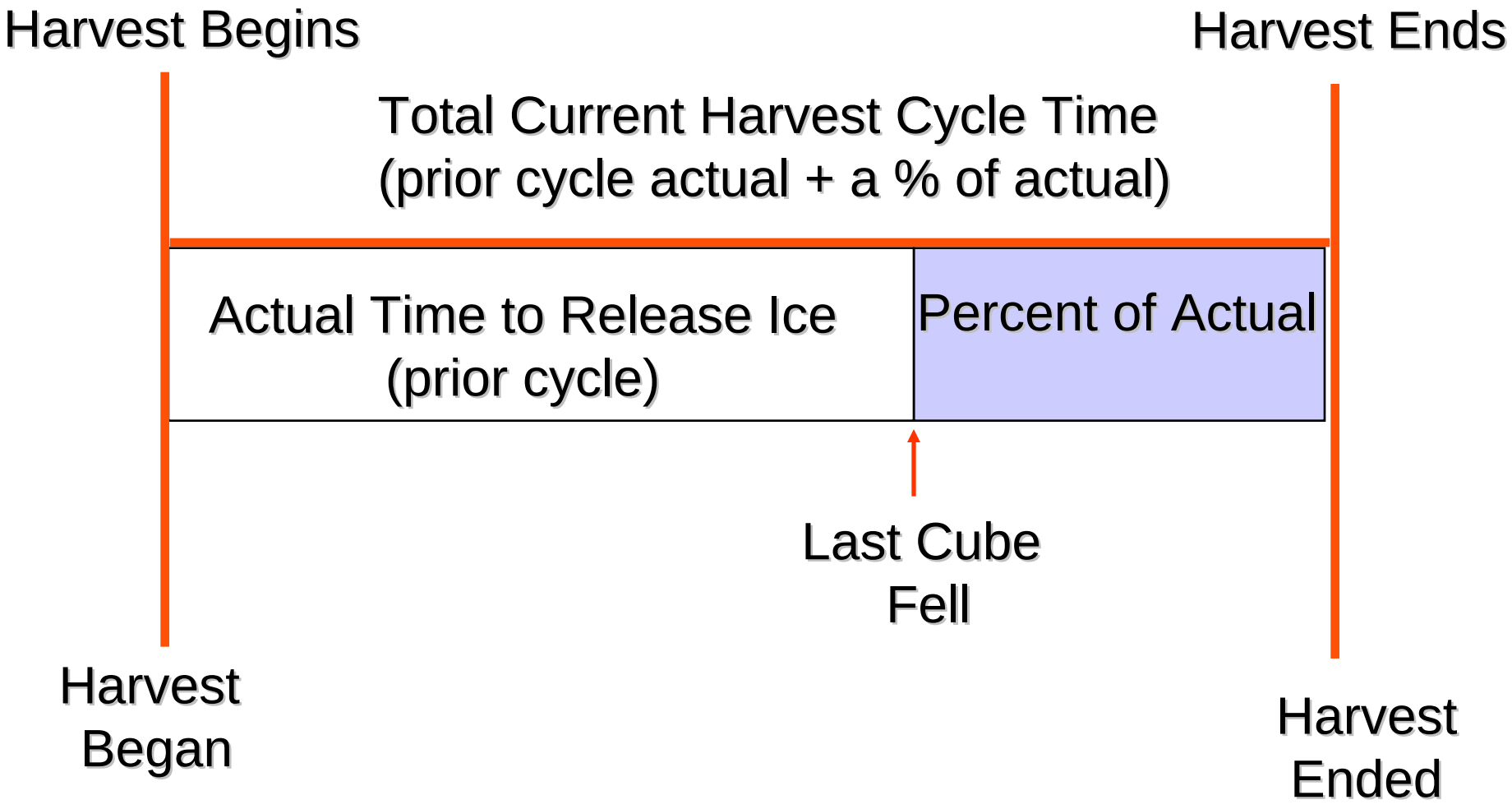
Scotsman® Electrical Sequence: Harvest

- Harvest time for any cube ice machine will vary depending upon:
  - Ambient temperature
  - Incoming water temperature
  - Degree of mineral scale build up

Harvest Cycle

- The first harvest will be about 6 minutes long
  - Allows enough time for all ice to harvest
  - Controller will be timing from the beginning of harvest until when the last cube fell thru the ice sensor’s “light curtain”

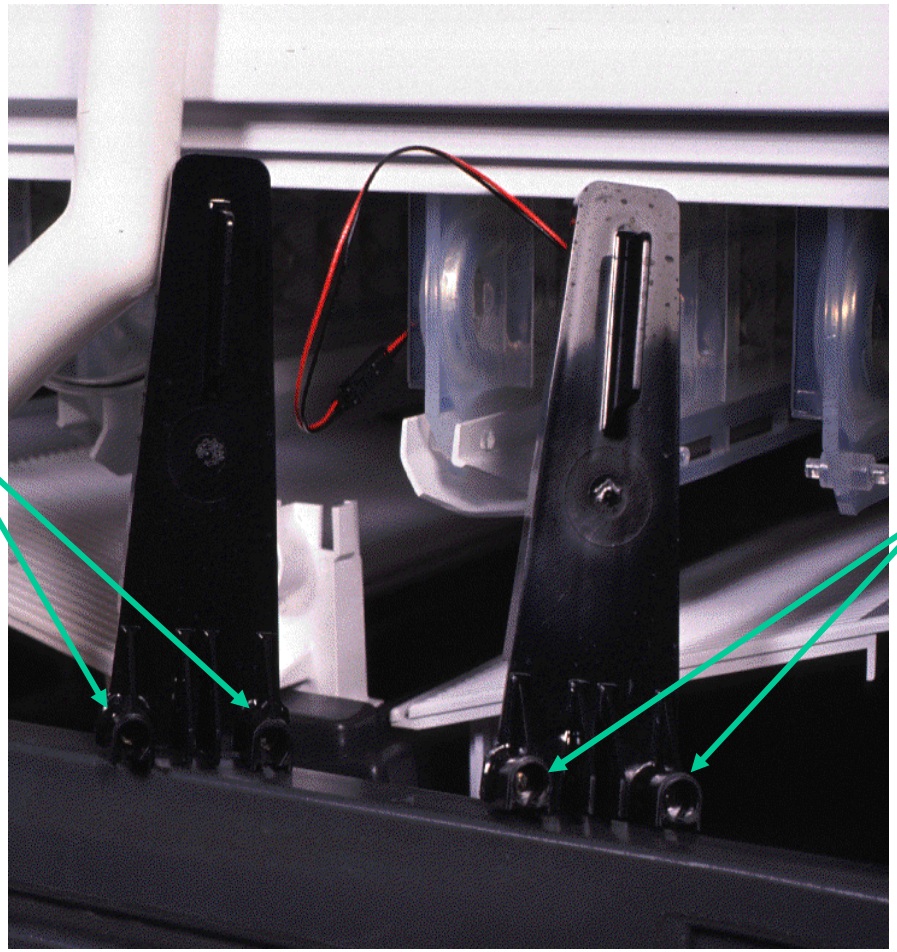
Scotsman® Ice Sensing / Harvest Control



Prior Ice Sensor

Located at the Front and Back of the ice chute

Infrared Receiver



Infrared Emitter

New Ice Sensor

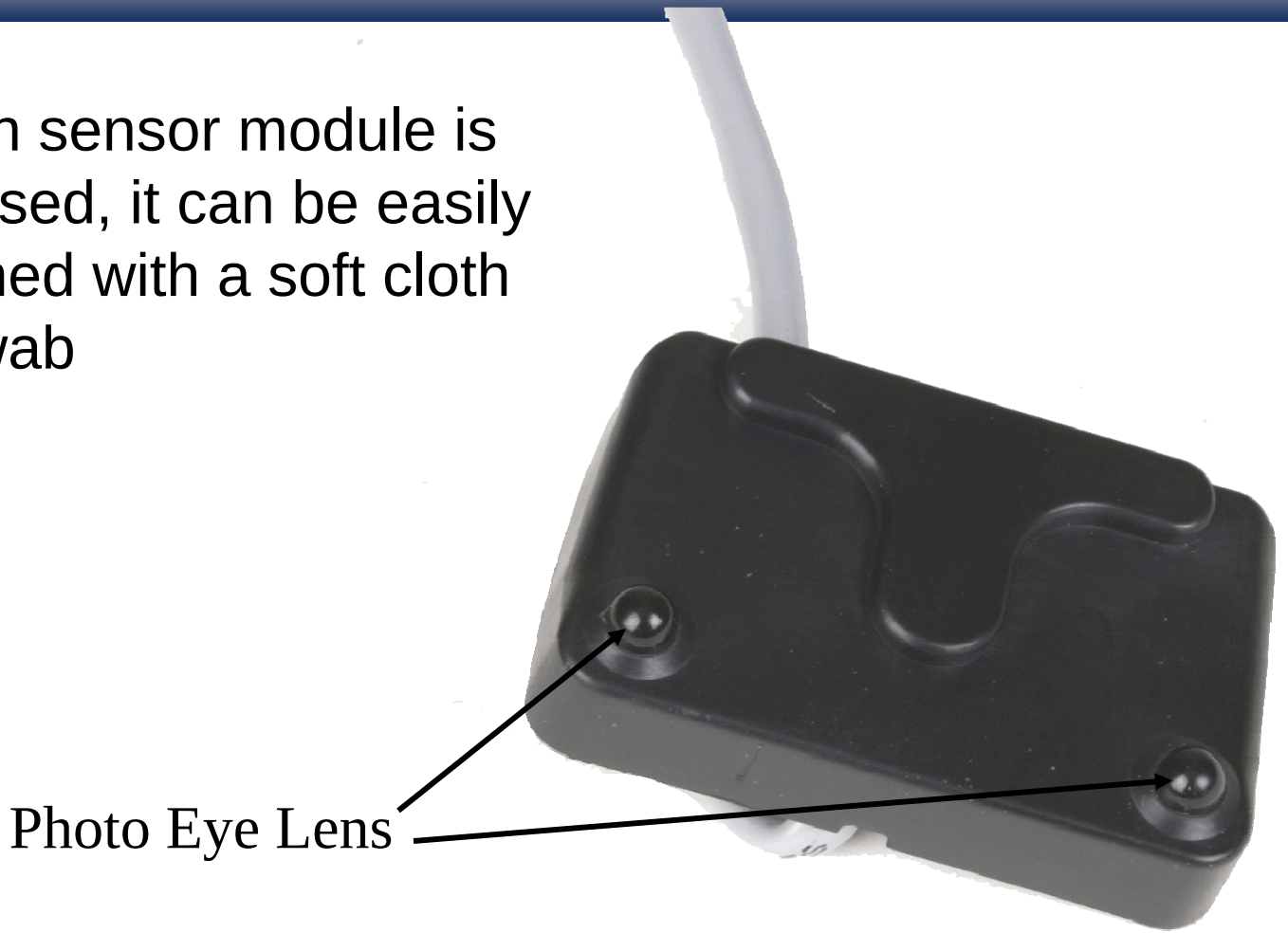
- Modular Cuber Sensor -
  - Two piece construction
    - Holder
    - Photo-eye module
- Interchangeable with prior sensors

Ice Sensor

- Push in on front of sensor module to release it from the holder

Ice Sensor

- When sensor module is released, it can be easily cleaned with a soft cloth or swab



Ice Sensor

- Re-assemble the sensor
  - Tuck wire under the clip
  - Push module into place
  - Be sure wire doesn't stick out past edge of holder

Scotsman® Electrical Sequence: Harvest

- Fan is off (air cooled)
- Harvest bypass valve opens for a few seconds (remote)
- Pump is off for a varying amount of time depending upon purge level
- Hot gas valve is open
- Purge timer has power and has opened the purge valve
  - No water drains until the pump starts

Scotsman® Electrical Sequence: Harvest

- Pump re-starts
- 74 seconds after the beginning of harvest the purge valve timer closes the purge valve
- The inlet water valve opens for 30 seconds
- Harvest continues until the controller stops it

End of Harvest

- Time expired
  - Either the unit returns to freeze or
  - It shuts off on Bin Full - when the bin thermostat contacts are closed
  - If ice was not “seen” by the ice sensors
    - Will make one more cycle
    - If it happens again, the unit shuts down
    - Will automatically restart for another try in 50 minutes

Restarts

- Electrical Power Interruption
  - Automatic restart
    - Open the hot gas valve for 20 seconds
    - Open the purge valve
    - Start the pump
    - Shut the purge valve
    - Fill the reservoir
    - Start the compressor, freeze for 30 seconds
    - Harvest for 6 minutes

Restarts

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

Ice and Evaporators

- Ice Formation
  - Refrigerant enters the evaporators at the top
  - Cubes will form at the top first
  - Ice harvests mostly as vertical strips - not individual cubes
  - Strips break up when impacting the cube deflector

Scotsman® Operation: Purge Adjustment

- There are 5 levels
  - Maximum
  - Heavy
  - Standard - the factory setting
  - Moderate
  - Minimum
- Number of green lights indicates purge level

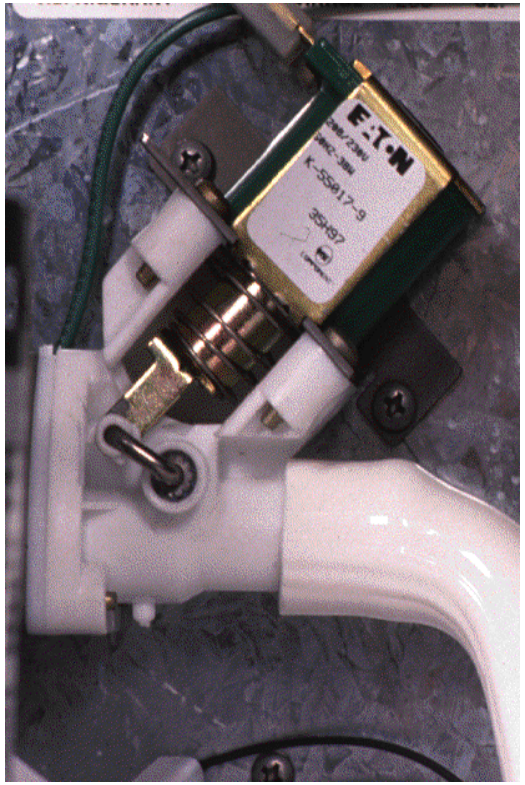
Scotsman® Cleaning and Sanitation

- Push Harvest to release any ice and warm the evaporators
- Push Clean and add 24 ounces of cleaner
- After 10 minutes push Clean again to flush out the cleaner
- After 20 minutes push off to stop

Scotsman® Water System Cleaning

Remove Water Distributors As a Set
Remove Upper Brace for Better Access

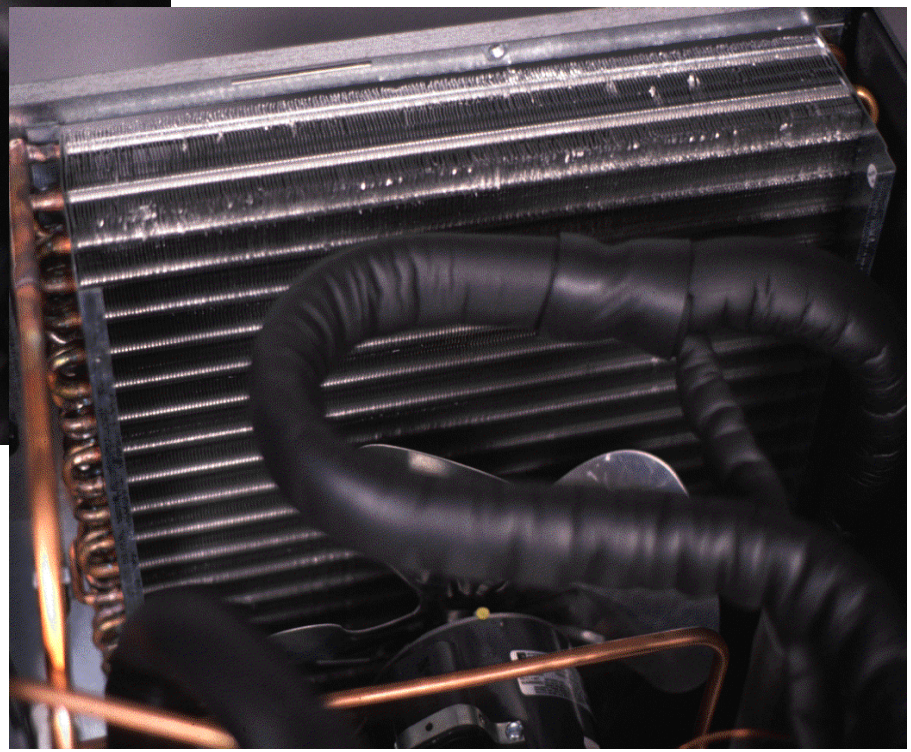
Draining the Reservoir



Hold Purge Valve Open

Push and hold OFF until unit stops, Push and hold Clean and the unit will drain

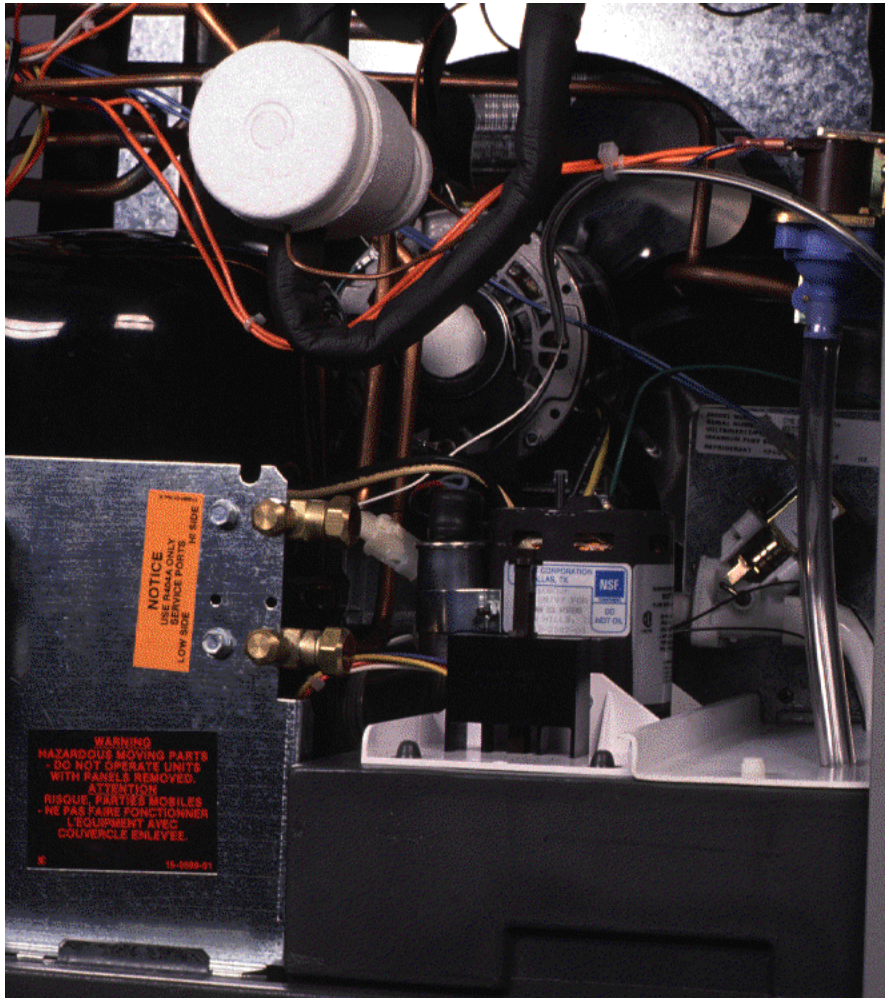
Scotsman® Split Condenser Fan Shroud



Top Half of Shroud is Removable

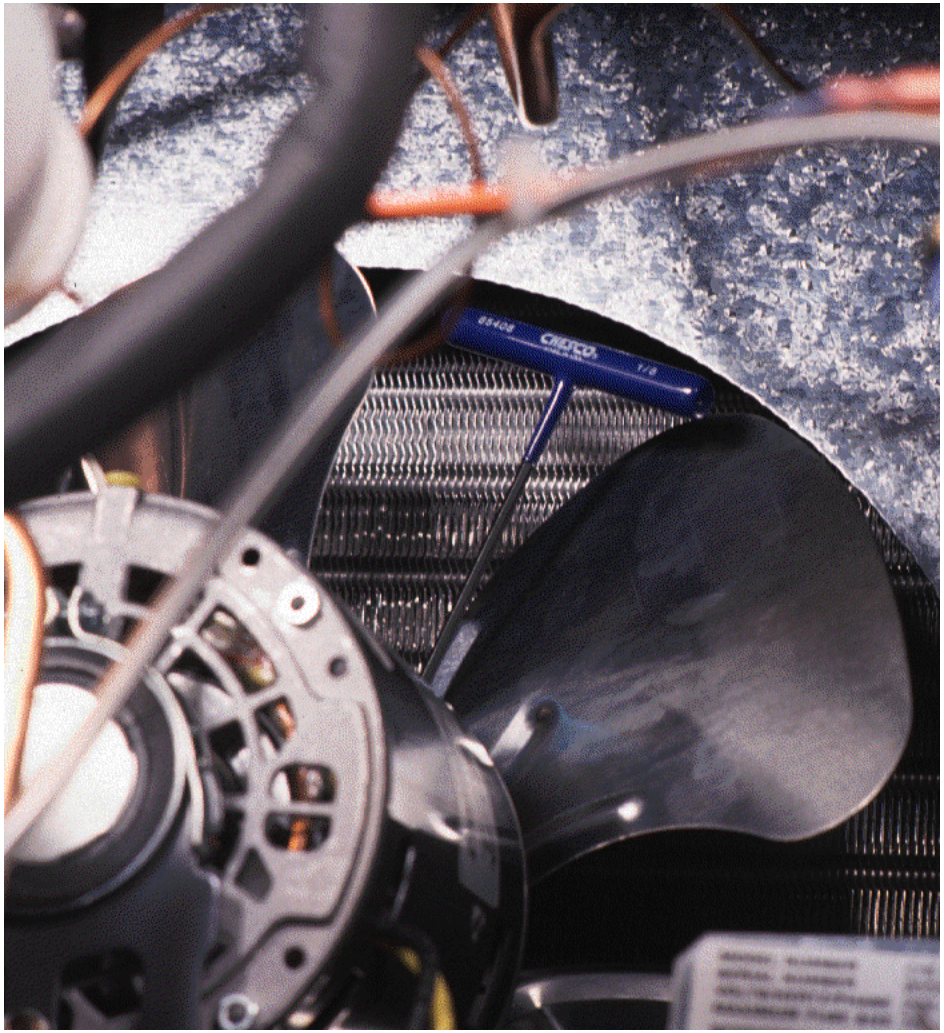
Service Procedures

- Air Cooled Fan Motor Change
  - Begin by removing the water pump and
  - Disconnecting the water line from the inlet water valve



Service Procedures

- Fan Motor
  - Loosen set screw holding fan blade to motor shaft
  - 1/8” hex wrench



Service Procedures

- Fan Motor
  - Remove bolts holding motor mount to bracket
  - Pull motor out of unit
  - Will fit thru where pump was

Service Diagnosis

- No ice, machine is off
  - Check the controller for lights
    - No lights = no power to controller
      - Check for power to machine
      - Check for transformer output

Service Diagnosis

- If there are lights - which ones are on?
  - Off light means the machine was switched off by someone
  - A Diagnostic light means a machine malfunction
  - Bin Full light means something has triggered either the bin thermostat or the ice sensors are blocked

Service Diagnosis

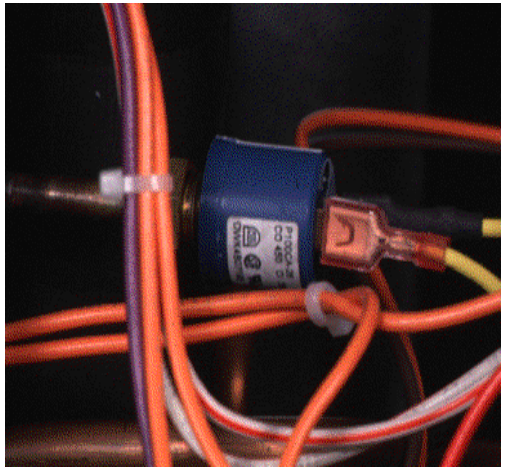
- Water Diagnostic Light
  - Blinks once and repeats
    - Water pump may not be working
  - Blinks twice and repeats
    - Water flow into machine too slow
  - Is ON without blinking
    - Inlet water valve leaking thru rapidly
  - If both the Water AND Refrigeration lights are on, check the thermistor set

Service Diagnosis

- Refrigeration Light
  - Blinks once and repeats
    - Ice release very slow, took maximum length harvest
  - Blinks twice and repeats
    - No ice sensed during maximum length harvest
  - Blinks three times and repeats
    - High discharge temperature

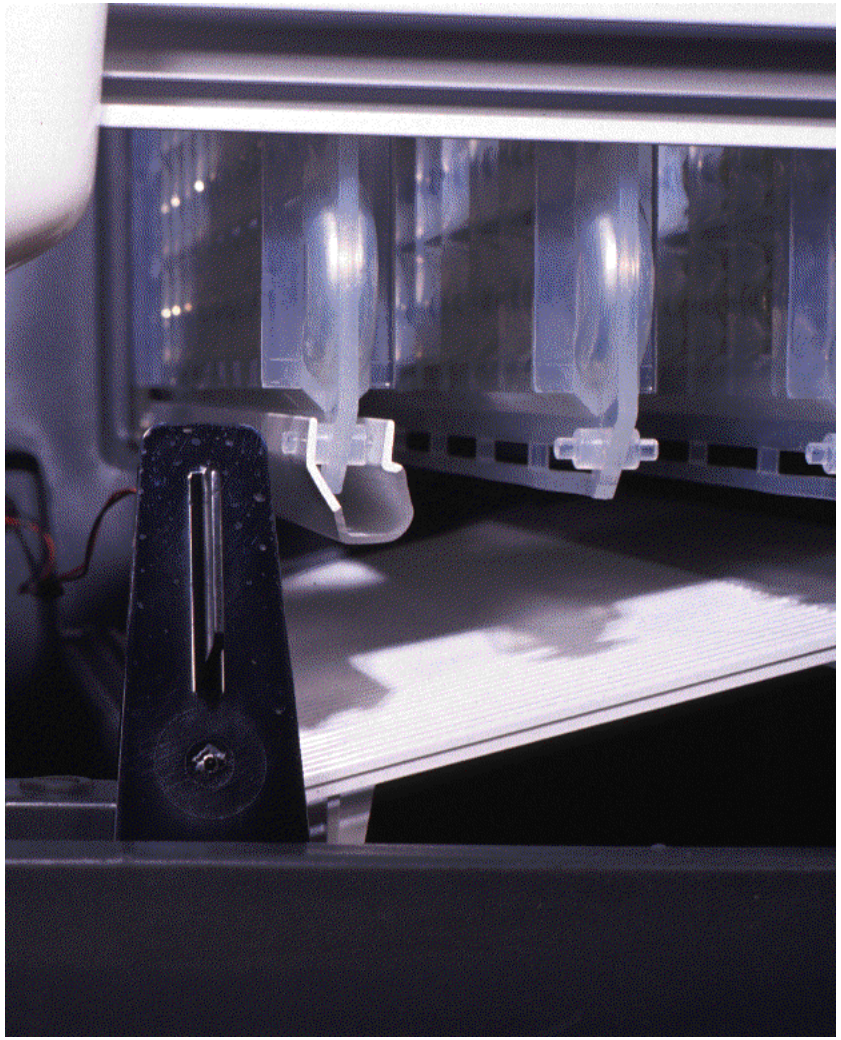
Service Diagnosis

- Refrigeration Light
  - Is ON without blinking
    - Low discharge temperature OR
    - Maximum length freeze cycle OR
    - Water cooled or remote may have cut out on high discharge pressure
      - Control resets automatically, but the controller may have timed out, depending upon when in the freeze cycle the control reset



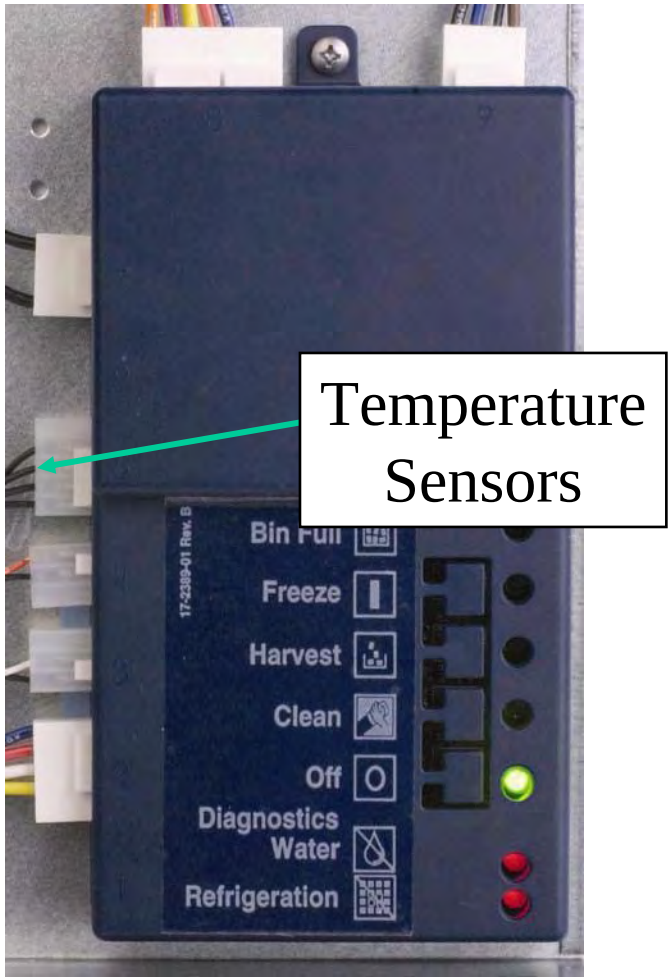
Service Diagnosis

- Bin Full light is ON
  - Bin may be full
  - 4 minute delay
  - Thermostat may be closed - is bin very cold?
  - Ice sensors may be blocked
    - Could need cleaning



Service Diagnosis

- Unit is running but both Diagnostic lights are ON
  - Check if temperature sensor (thermistor) set is plugged into the controller
  - If it is, replace the temperature sensor set



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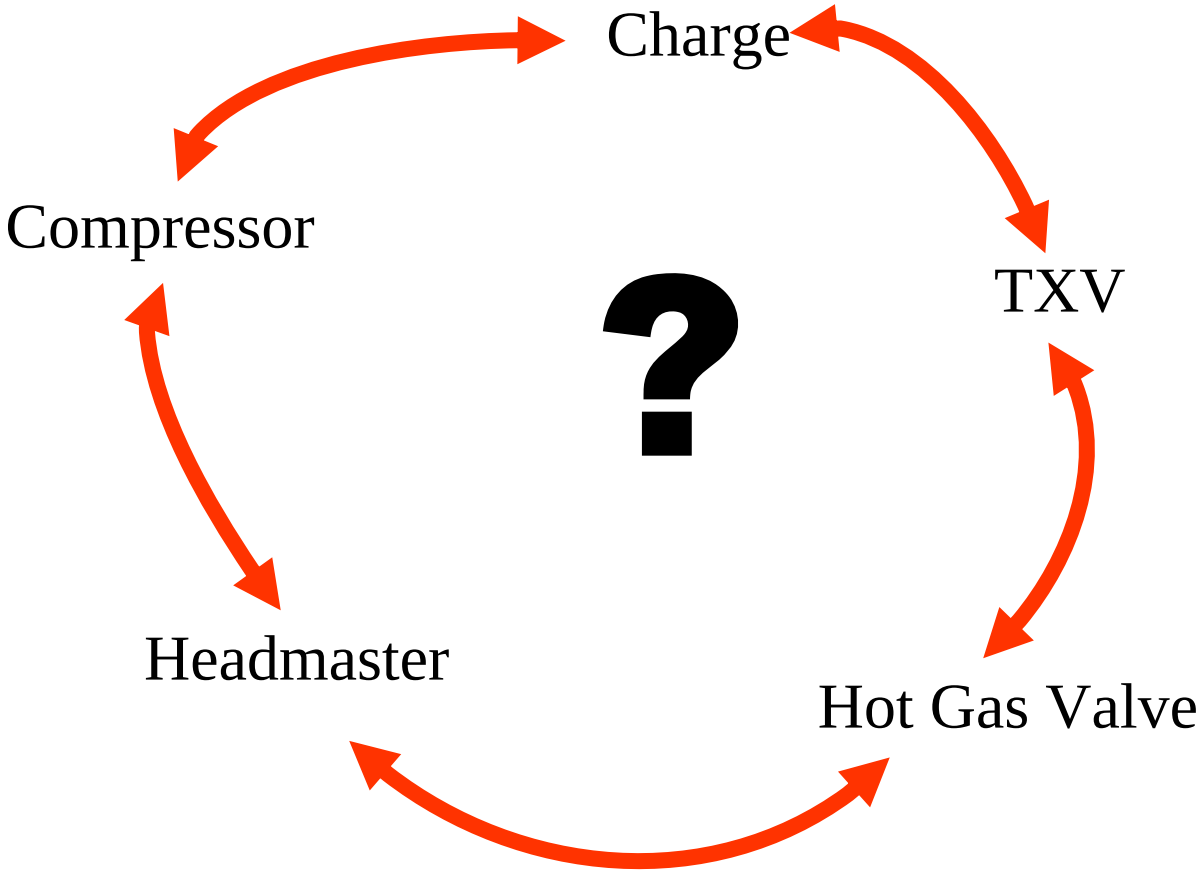
Refrigeration Diagnosis



Scotsman® Compressor Will Not Start

- Check for voltage to compressor
- Check resistance of windings
  - Overheated internal overload will show “open” windings
- Check start relay
- Check start capacitor

Compressor

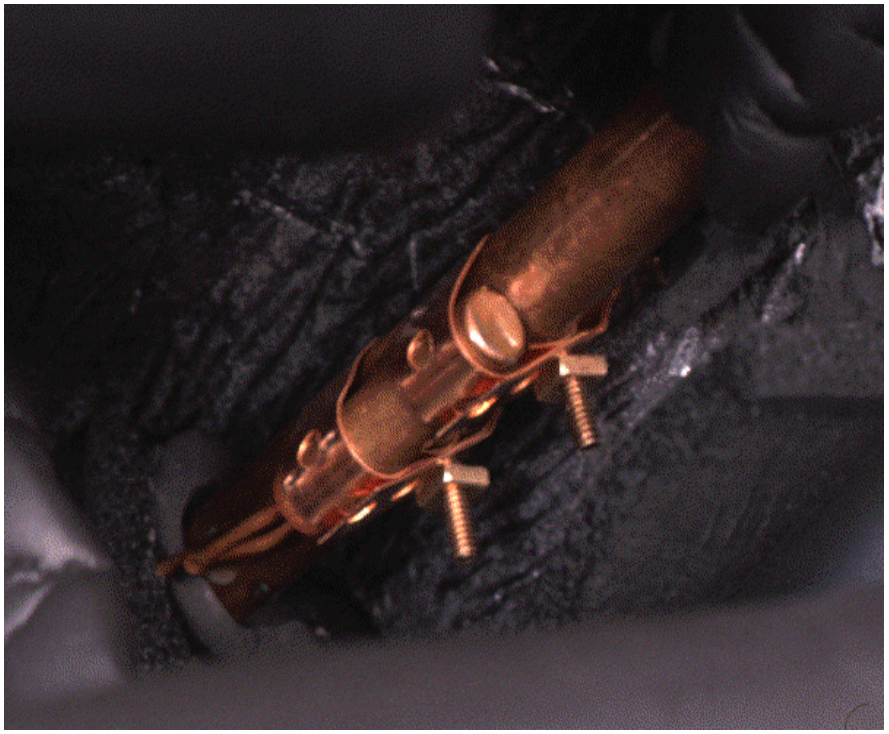
- Trips overload
  - Most likely it's a problem with a starting component
    - Start relay
    - Start capacitor
  - May be overheating
    - Too much superheat - should be no more than 20ºF. five minutes into freeze
    - Hot gas valve leaking thru
    - Low charge

Compressor

- Trips breaker
  - Check for shorted winding or short to ground
  - Could be defective breaker - check amp draw
- Low capacity
  - Check for ice machine cause - TXV, hot gas valve, low charge, inlet water valve leak thru OR high ambients!

Scotsman® Thermostatic Expansion Valve

- Controls refrigerant flow to maintain suction line temperature
- Bulb must be securely clamped to suction line AND insulated



Thermo Expansion Valve

- Superheat - most consistent near the end of freeze
  - Superheat control point will be between 8 and 14 degrees
  - Superheat also changes as the valve modulates
  - The valve is NOT adjustable

Low Refrigerant Charge

- Remotes
  - With a minimum charge the ice machine can start up BUT part way thru a freeze cycle refrigeration may stop and what ice has been made will fall off the evaporators
  - Will eventually stop on Maximum freeze cycle

Scotsman®

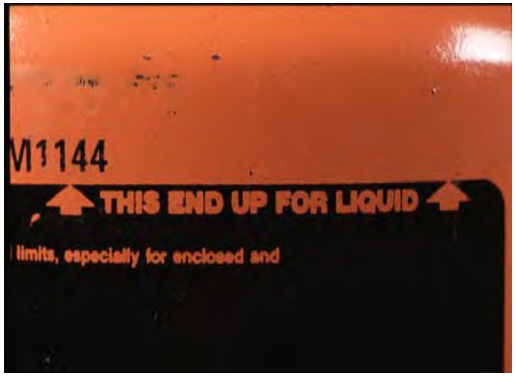
Hot Gas Valve

- Leaks thru during freeze
  - Check by temperature at valve
    - Should be warm but NOT hot on inlet
  - Hot inlet means valve is leaking thru
- Opens partially - no ice release
  - Very low (half normal) suction pressure in harvest
    - With normal amount of ice on evaporators
  - Hot thru the valve but cold at the refrigerant distributor

Remote: No refrigeration

- Controller: Refrigeration Light ON
- Low discharge pressure in Freeze
  - Low charge
    - Recover and weigh OUT charge
    - If low, locate and REPAIR the LEAK
  - Headmaster will not close liquid line
    - Can only check when condensing temp is below 70oF.
    - Replace headmaster IF confirmed

Scotsman® Refrigeration Service



Liquid Charge

R-404A

Use HFC Leak Detectors

Weigh In Charge

Evacuate to 300 microns

Use Nitrogen Purge

Summary

- Four models
  - CME1356 with 5 evaporators
  - CME1656 with 6 evaporators
  - CME1856W & CME2006R - scroll
- CM^3 technology
  - Controller aided diagnostics
- New enhanced remote system
- Reservoir purge valve
- R-404A