Refrigeration Installation 101

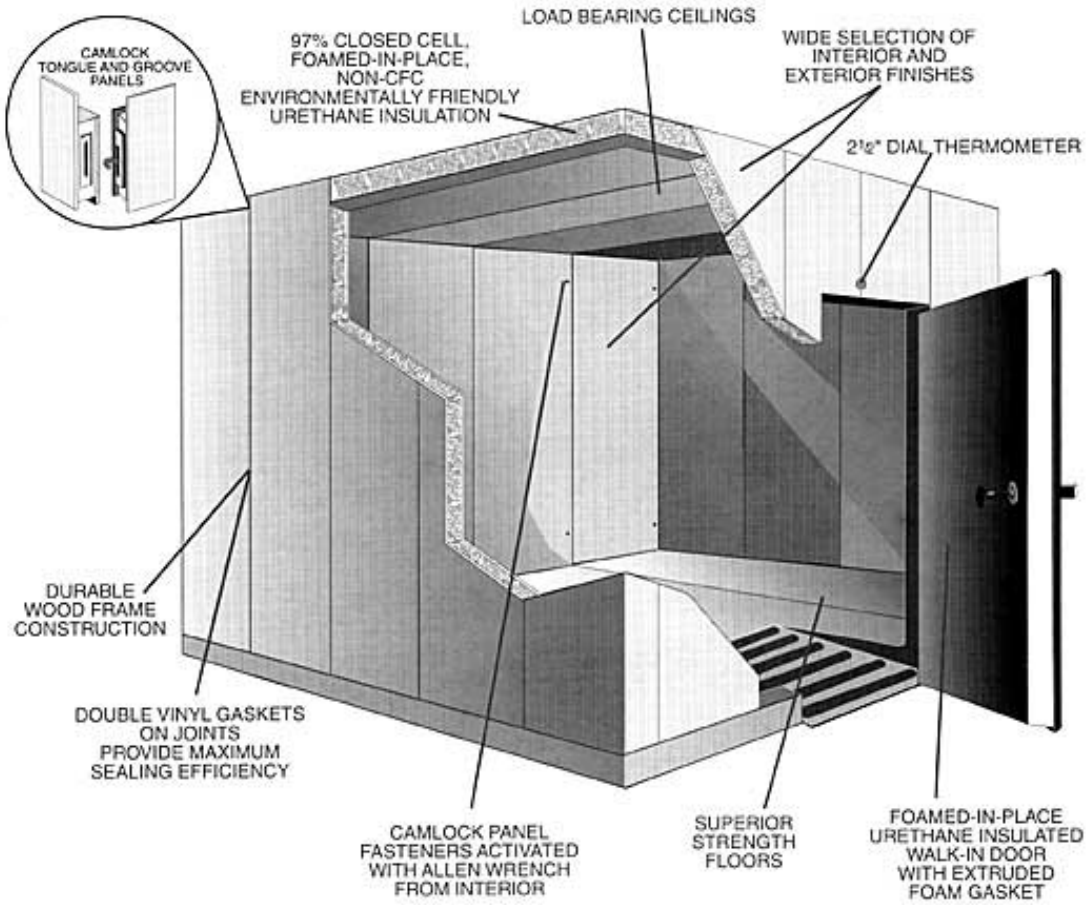
Hundreds of Installations

Refrigerated Cases

Compressor Racks

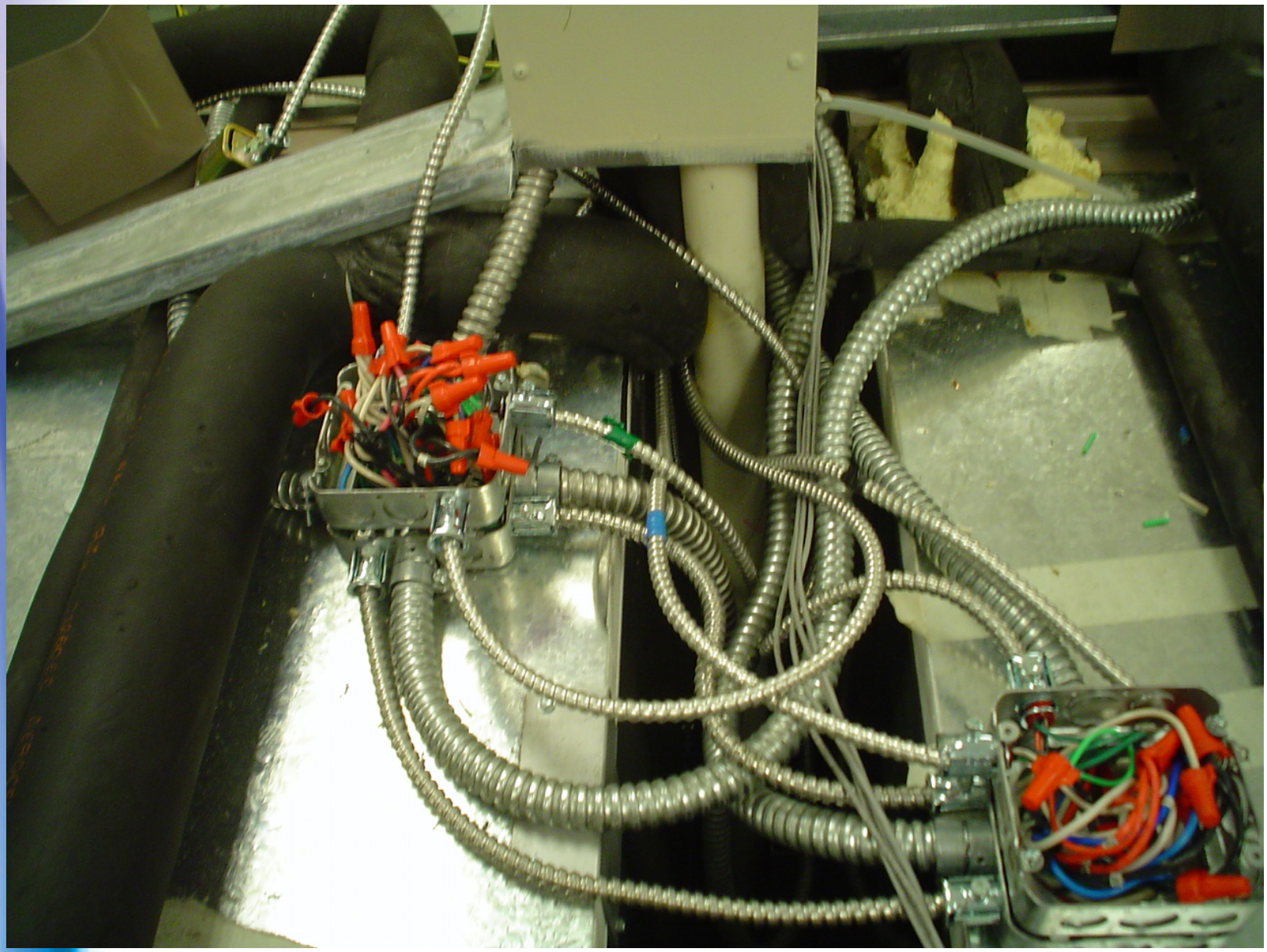
Condensing Units

Walk-in Boxes



- Some were done very well

- Some had some issues.....



- Some seemingly minor issues have the potential to create long term problems

We weren’t happy and we wanted to know why

So we.....

- Began an improvement process
- Hundreds of photos of things we didn’t like
- Realized very quickly that we needed to start taking photos of good stuff

- We knew:
  - That we weren't getting what we wanted
- We learned
  - That we weren’t asking for the right things
- So we
  - Began revising details and our specifications

We concluded that detailed details and specific specifications are worth their weight in gold.

Define and understand what you want

The contractor will deliver it.

ASHRAE Handbook

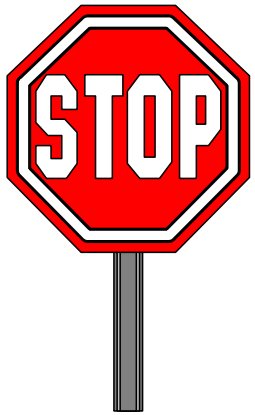
+ Code requirements
+ Conversations with mechanics
+ Team experience
+ Commercial Practices
+ Industrial Practices

Best Practices

Red Flags

Copper Pipe

Insulation



Traps

Breaker strips

Leak Checking

Hangers

Purging

Topics of the day.....

- We are talking about:
  - Refrigerant Piping
  - Case Installation
  - Walk-in Cooler Installation
- We are not talking about
  - Compressors
  - Condensers
  - Evaporators
  - Cases
  - Brand names

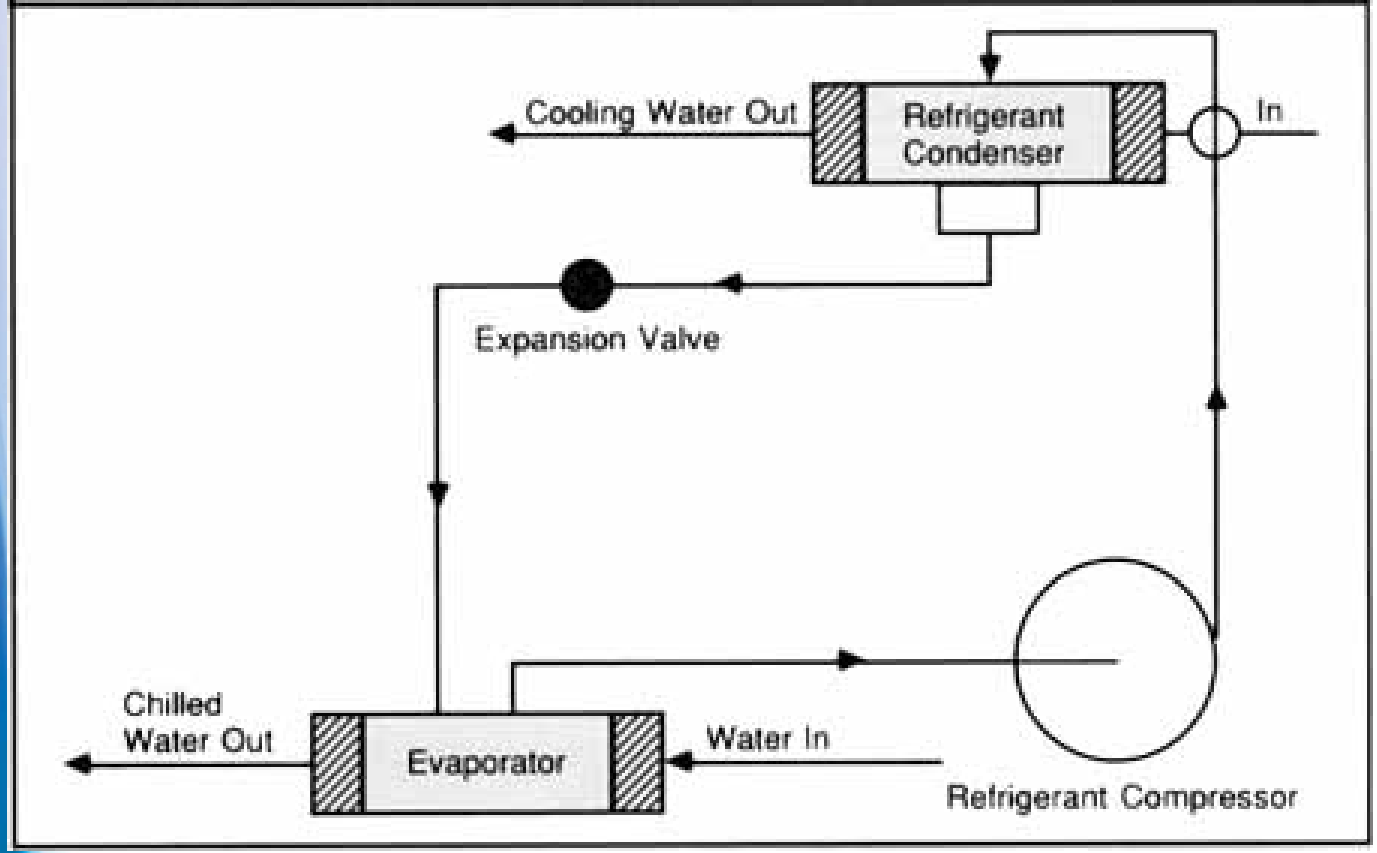
Disclaimer

- This presentation contains photos
- You will recognize the brands
- We are discussing the installation technique
- I am not commenting on the equipment

Figure 12

Schematic Diagram

Refrigeration, Air Conditioning Cycle



Refrigerant Piping

- Oil Return
- Insulation to reduce heat gain and condensation
- Supports
- Code Issues
- Cutting
- Brazing
- Purging

COPPER PIPE- BLUE STRIPE

- Hard drawn
- ACR Type L seamless tubing
- Dehydrated to remove moisture
- Factory Sealed
- Plugs

RED FLAG #1

- Copper Pipe-
  Blue Stripe

ASHRAE

- Suction lines
  - Pressure drop < 2°F
  - Suction gas velocities to maintain oil flow
- Liquid Lines
  - Pressure drop < 2°F
  - Too high of pressure drop will cause flashing within the liquid line

Pressure drop (psig) < 2° F?

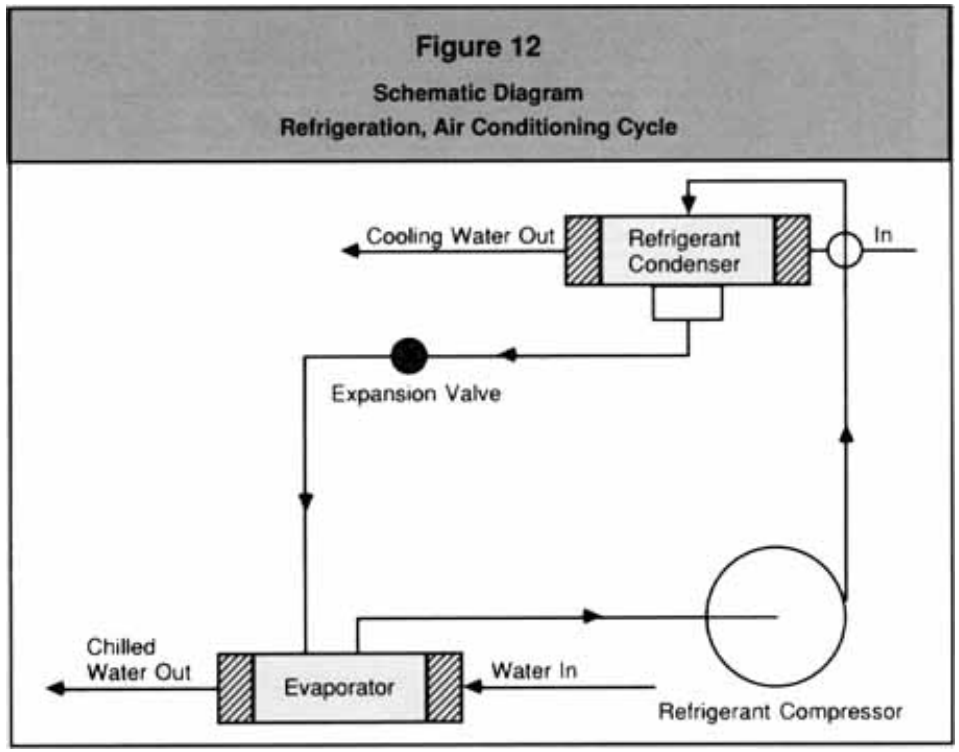
- Normal pressure loss associated with change in saturated temperature
- R404A (-20º) suction
  - 16.3 psig
- R404A (-22º) suction
  - 15 psig
- Resulting pressure drop = (16.3 – 15)

High Side

- R404A- 100º discharge gas = 237 psig
- R404A- 98º discharge gas = 230 psig
- A 2º change in temperature is 7 psig

Suction Lines

- Minimum pressure drop at full load
- Oil return at minimum load
- Prevent oil from draining from an active evaporator to an inactive one
- Slope towards compressor

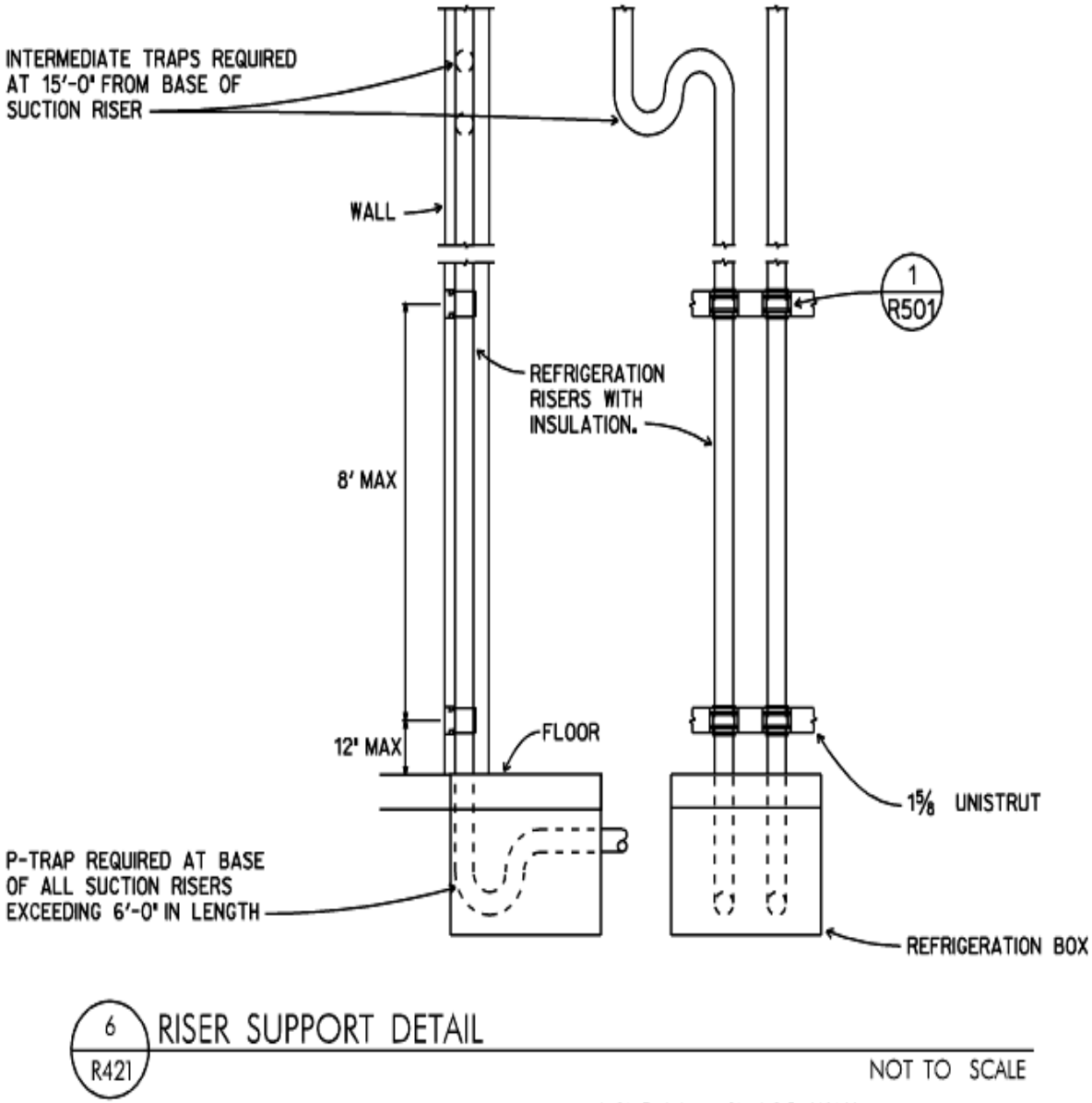


Suction Line Risers

- Pipes where the flow of refrigerant is “Up”
- Gas velocity must be greater than 1000 fpm to carry the oil
  - At full load and low load conditions
  - Be aware of pressure drop

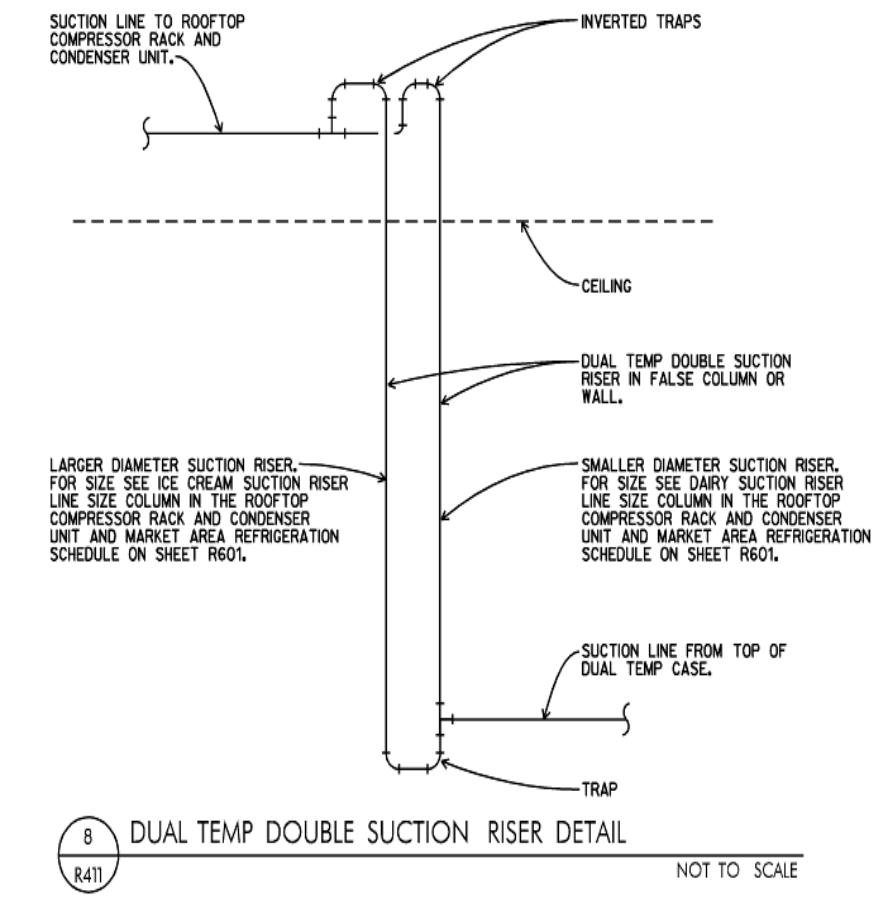
Traps

- Bottom of riser
- Every 15’
- Top of riser

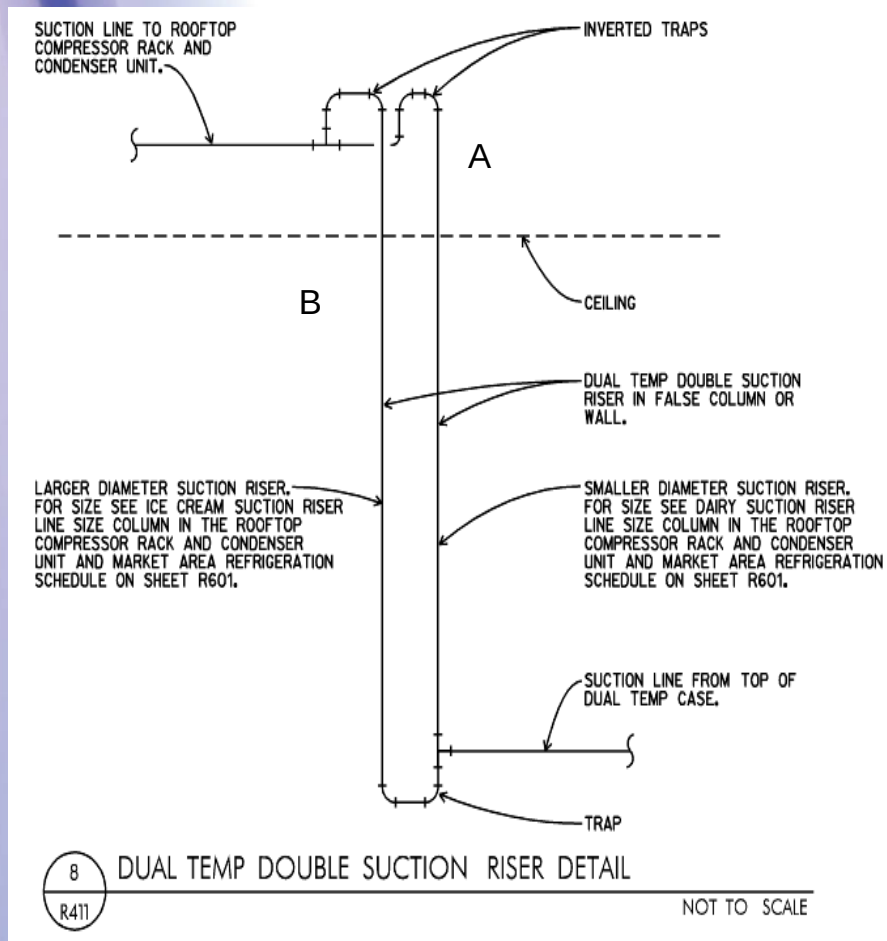


Riser Support Detail

Double Suction Riser



- Classic piping technique
- Allow for full load and minimum load conditions

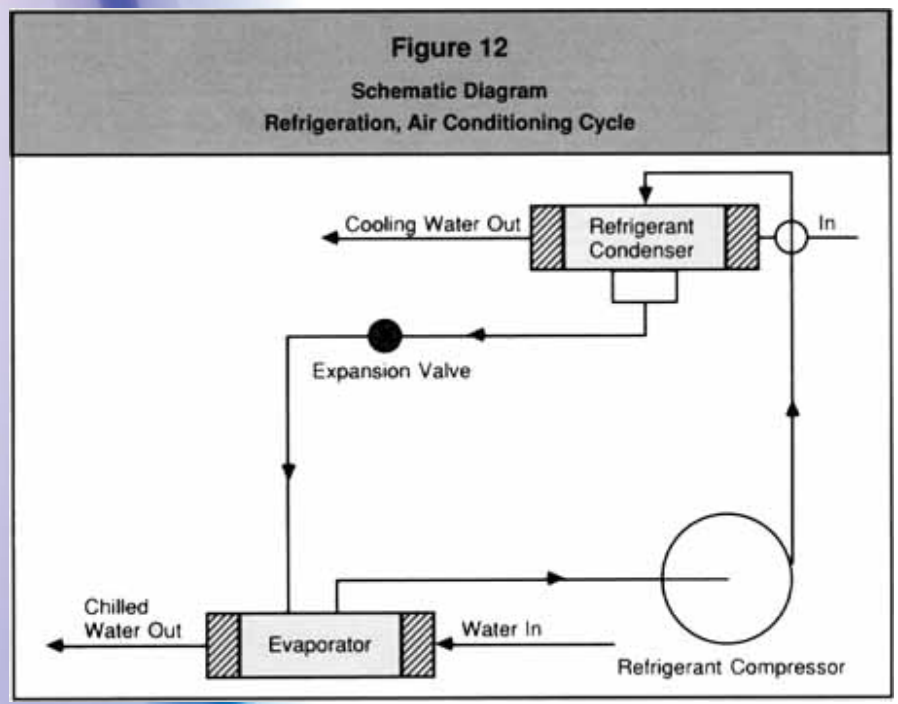


- Riser A- size at minimum possible load
- Riser B- size for satisfactory pressure drop through both at full load
- (Area of A + Area of B) is equal to or slightly greater than a single pipe sized for full load

RED FLAG - #2

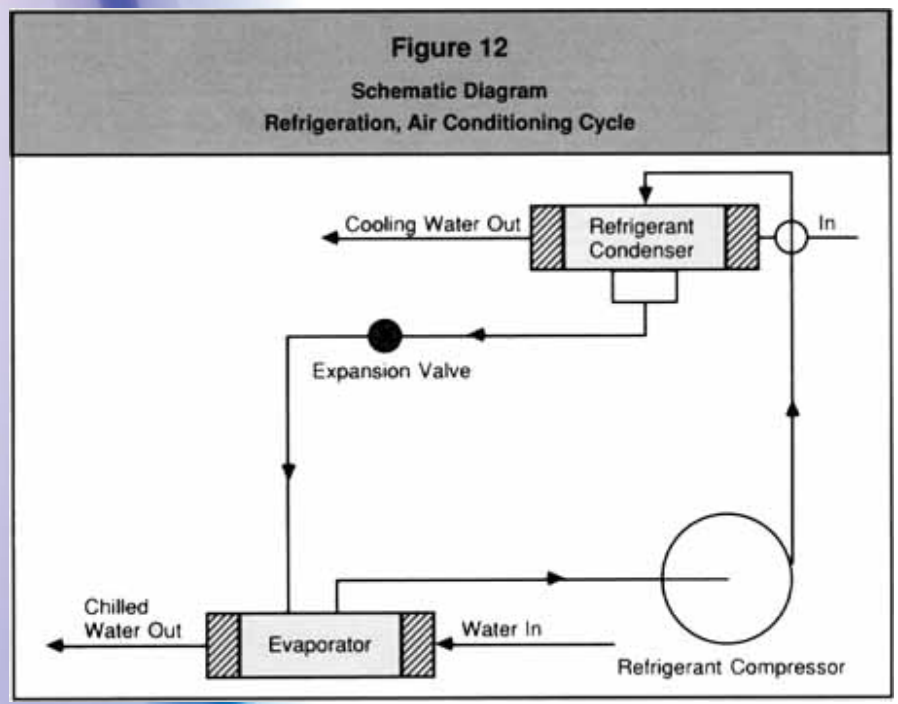
- Traps
  - Oil return
    - Compressor operation
  - Bottom of riser
  - Top of riser
  - Intermediate trap

Discharge Lines



- Lines from the compressor to the condenser
- Pressure drop in this line will cause an increase in required compressor horsepower
- Maintain the <2º F rule

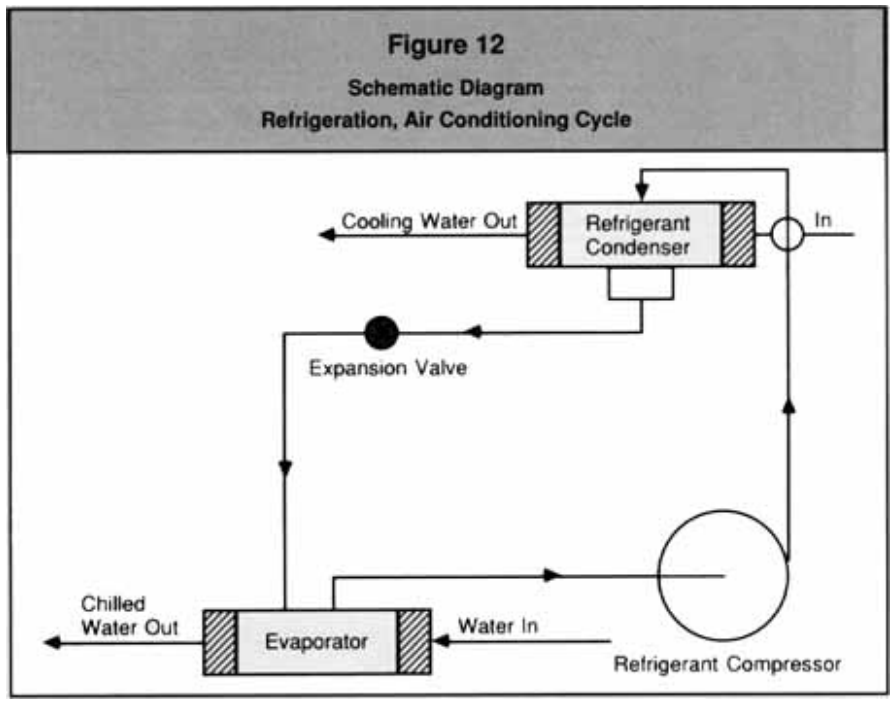
Liquid Lines-



- Pressure drop of 1º to 2º
- Liquid velocity < 300 fpm
- Liquid risers (liquid flow is up) adds pressure loss of .5 psig per foot
- Liquid flowing down gains pressure and can tolerate larger friction loss without flashing

Liquid Return Lines

- From condenser to receiver
- Size for two phase flow
- Liquid velocity < 100 fpm (feet per minute)



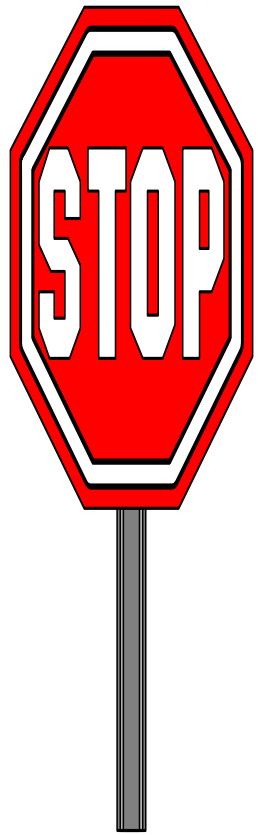
Joining Pipe

- Wheel type tube cutter
  - No hacksaws!
- Remove internal and external burr
- Sand the end of the pipe with sanding cloth
- Push the pipe all the way into the cup of the fitting
- Braze the joint

While they are brazing..

- Dry nitrogen purge required
  - Volume of flow is important
- Prevents ash (copper oxide) from forming
- Gives you a cleaner system

RED FLAG # 3- PURGING

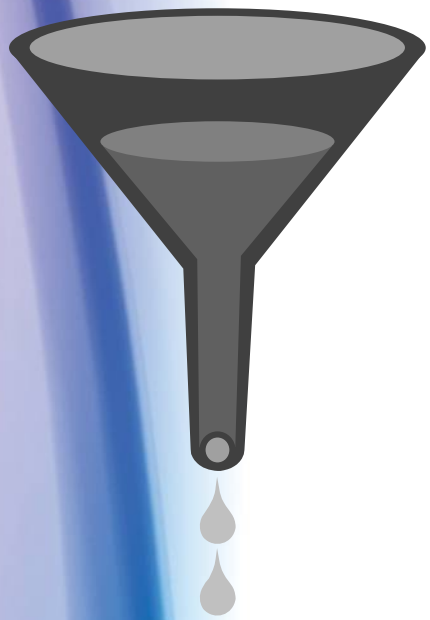


Leak Checking

- Pressurize system with dry nitrogen and tracer gas
  - Isolate pressure transducers, relief valves, pressure switches
  - Low side to 150 psig
  - High side to 300 psig
- Work systematically
    - Compressor racks
    - Condensers
    - Branch piping

- Leak check each joint with an electronic leak detector
- Repair leaks
- Standards:
  - Low side must hold 150 psig for 24 hours
  - High side must hold 300 psig for 24 hours
- Reduce pressure to 0 psig

RED FLAG # 4- LEAK CHECK

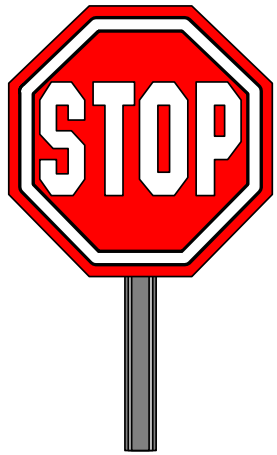


- Slow
- Time consuming
- Methodical

Evacuation

- Entire system must be evacuated
  - Last chance to find leaks
  - Removes air (non-condensables) from system
  - Removes moisture from system
- Connect vacuum pump to low side and high side
- Evacuate to absolute pressure not to exceed 1500 mm Hg.
- Increase pressure on entire system to 2 psig using non-cfc refrigerant
- Repeat the process 3 times
- Break final vacuum with refrigerant that will be used to charge the system

RED FLAG # 5- EVACUATION



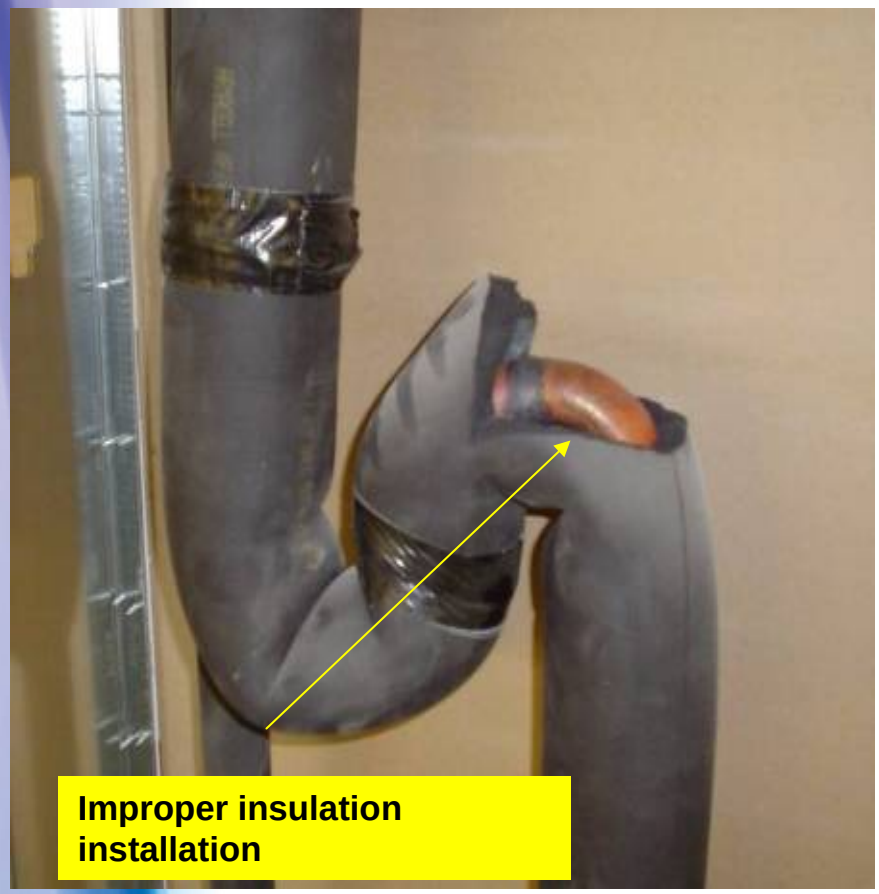
REMOVES THE AIR

REMOVES THE MOISTURE

THREE TIMES

Insulation

- Smoke and flame spread
  - Flame spread 25 or less
  - Smoke development of 50 or less
- Thickness to prevent heat gain and condensation
  - heat gain into a suction line has to be taken out at the condenser
- Mitered fittings around elbows and traps



Improper insulation installation

Proper mitered joints on piping insulation

Specification Item – Mitered joints on refrigeration insulation

Manufacturer Recommendations

- Glue the joints
- Glue the fittings
- Vapor stop
- Beware of crushing the insulation
- LEED may change your adhesives

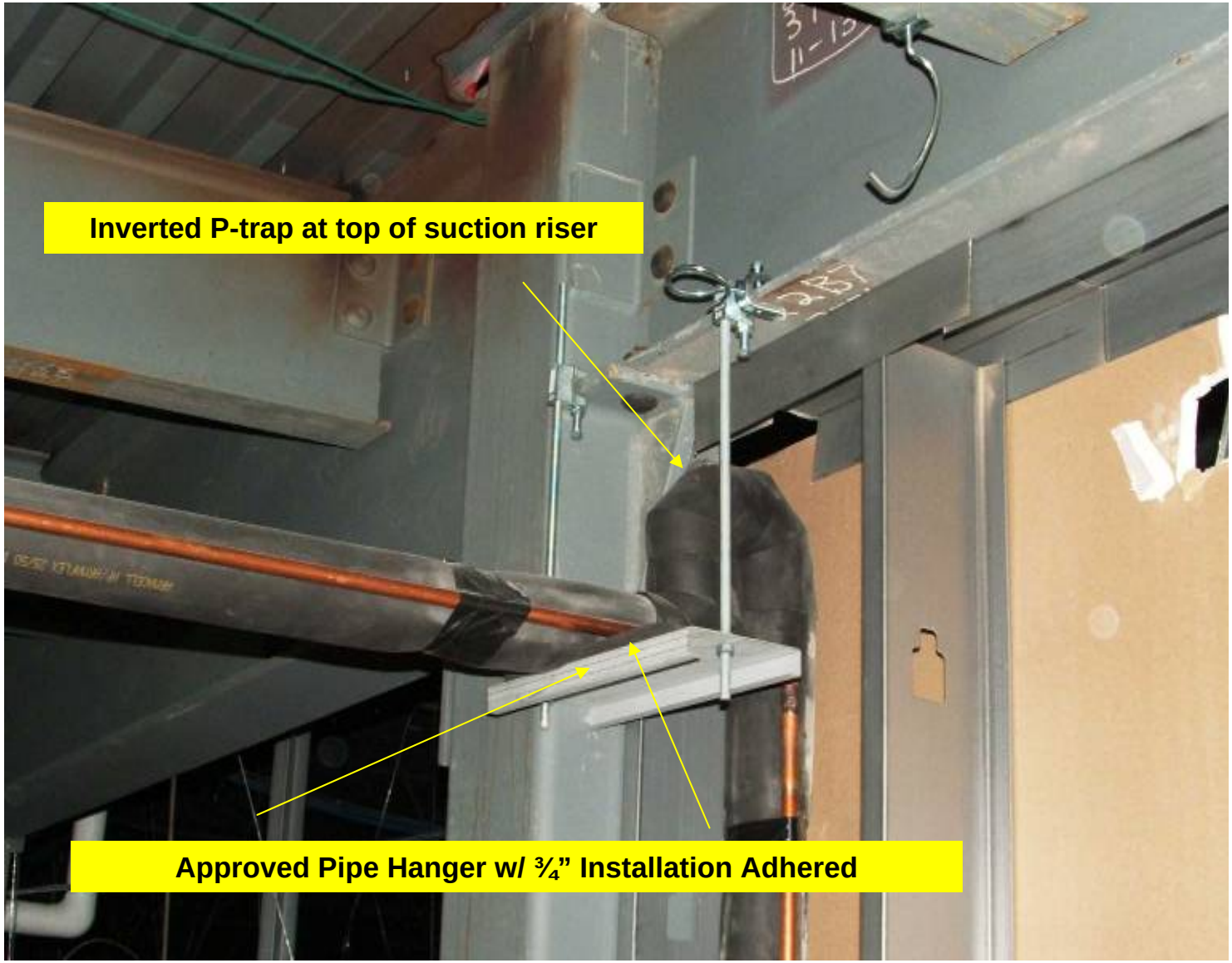
Outdoor insulation

- Birds love it
- Weather is hard on it
- Once it starts to break down, it's done
- Your choices:
  - Paint it with approved paint
  - cover it

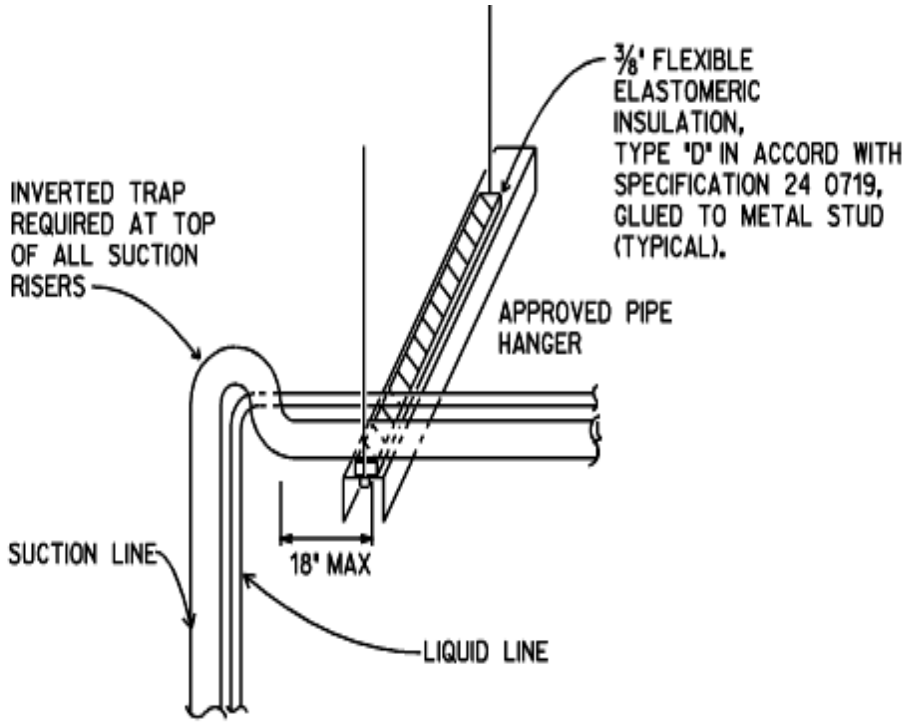
RED FLAG #6 - INSULATION

Pipe Hangers

- ASHRAE and the pipe manufacturers have recommendations for hanger spacing
- In general- if it looks like another hanger is needed..... It probably is



Top Of Riser Detail



2 / R501 TOP OF RISER DETAIL — NOT TO SCALE

6 / R501 TOP OF RISER DETAIL — NOT TO SCALE

Top Of Riser Detail

Refrigeration Pipe Hanger Detail

Riser Support Detail

Condenser Pipe Support Detail

RED FLAG #7- HANGERS

Walk-in Boxes

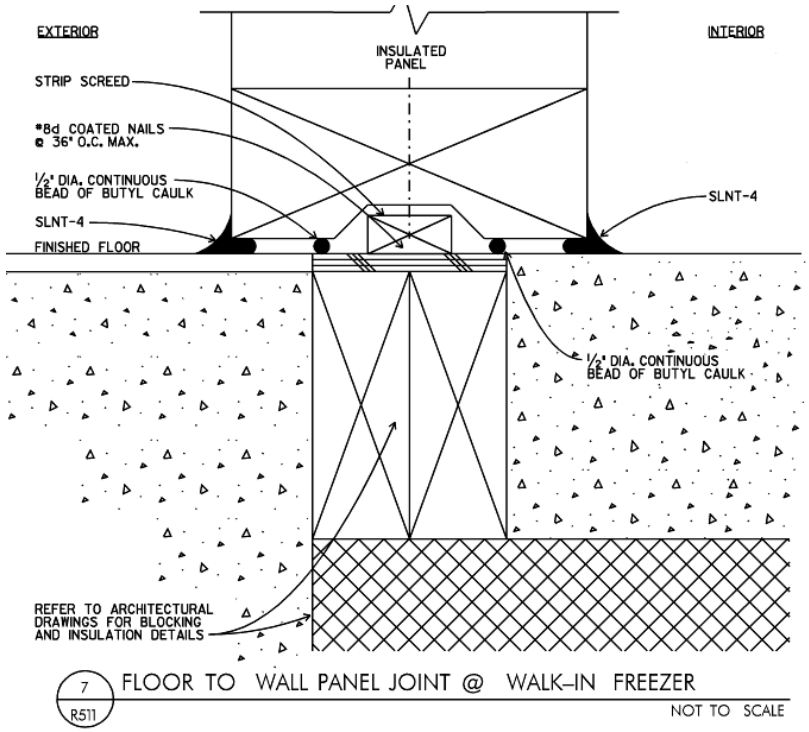
We all have at least one.....

Walk-in Coolers/ Freezers

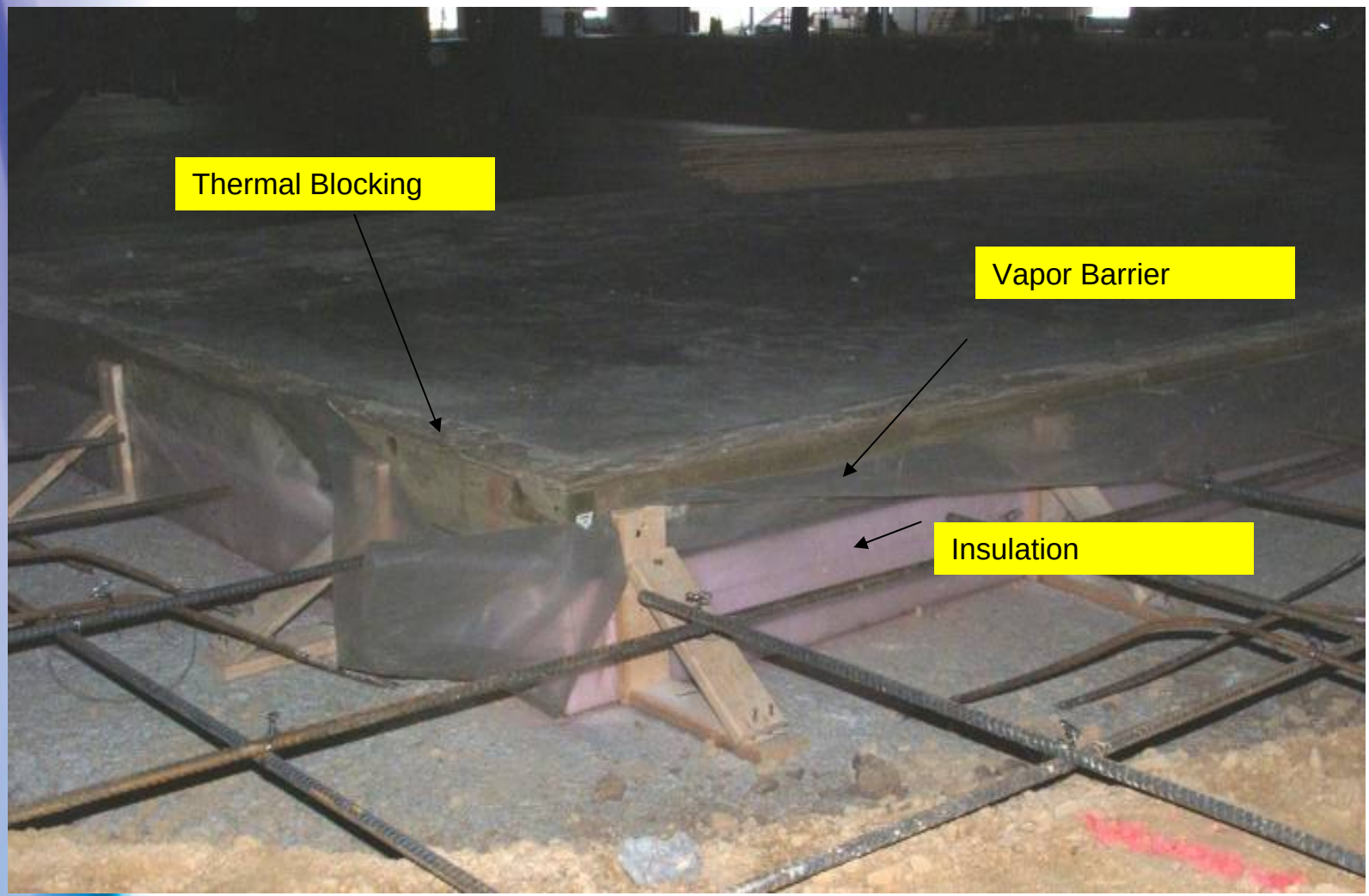
- Freezer floor
- Reduce infiltration
  - Wall panels
  - Penetrations
- Hanging evaporators
- Adjust the accessories

Freezer Floor

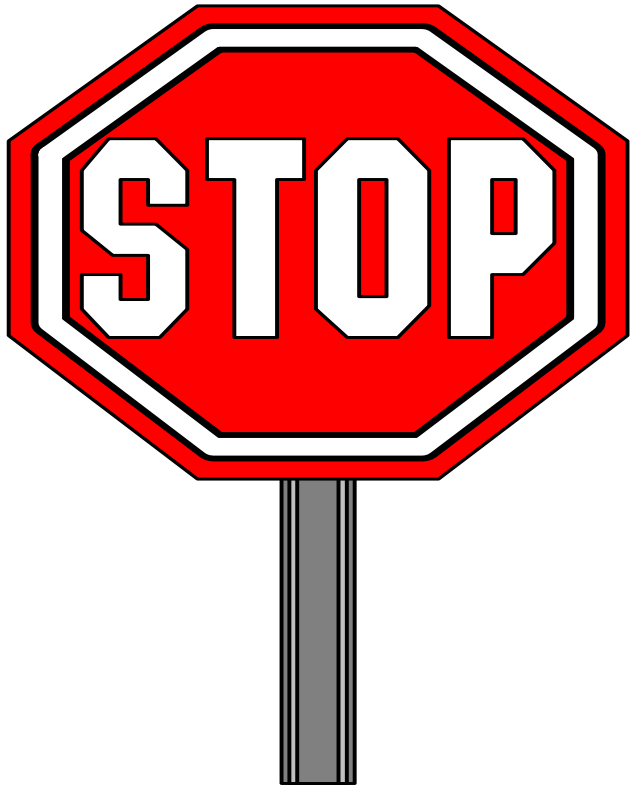
- Insulated slab required
- Thermal break location is critical
- Wall panel should be centered on thermal break



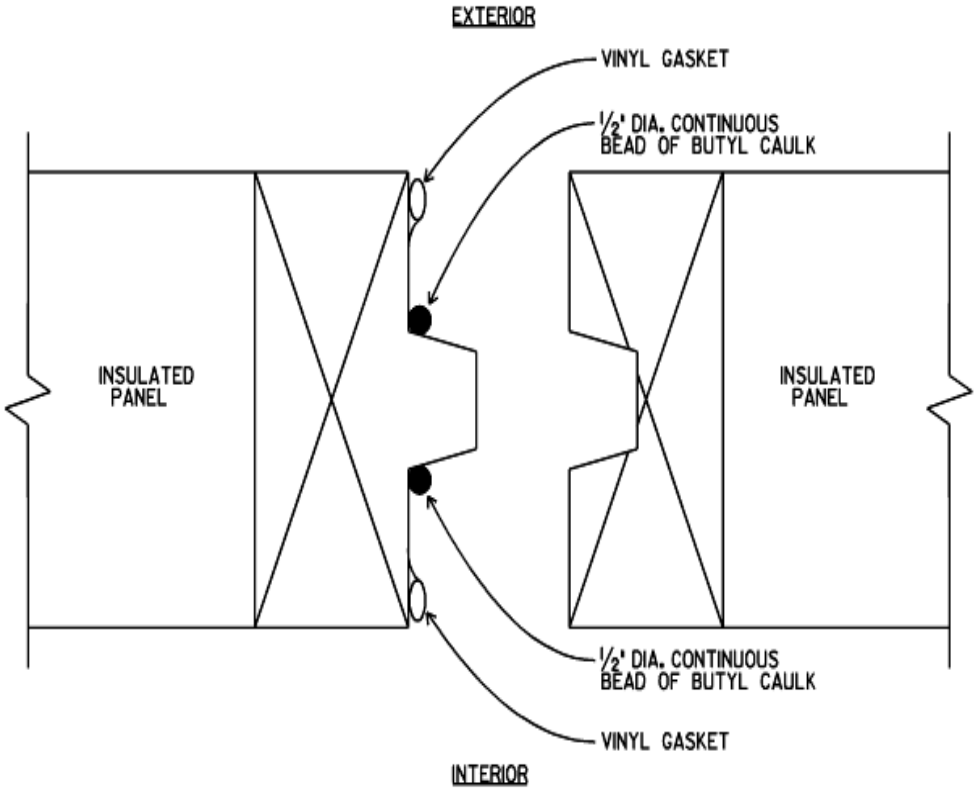
The Freezer Floor



RED FLAG #8- BREAKER STRIPS

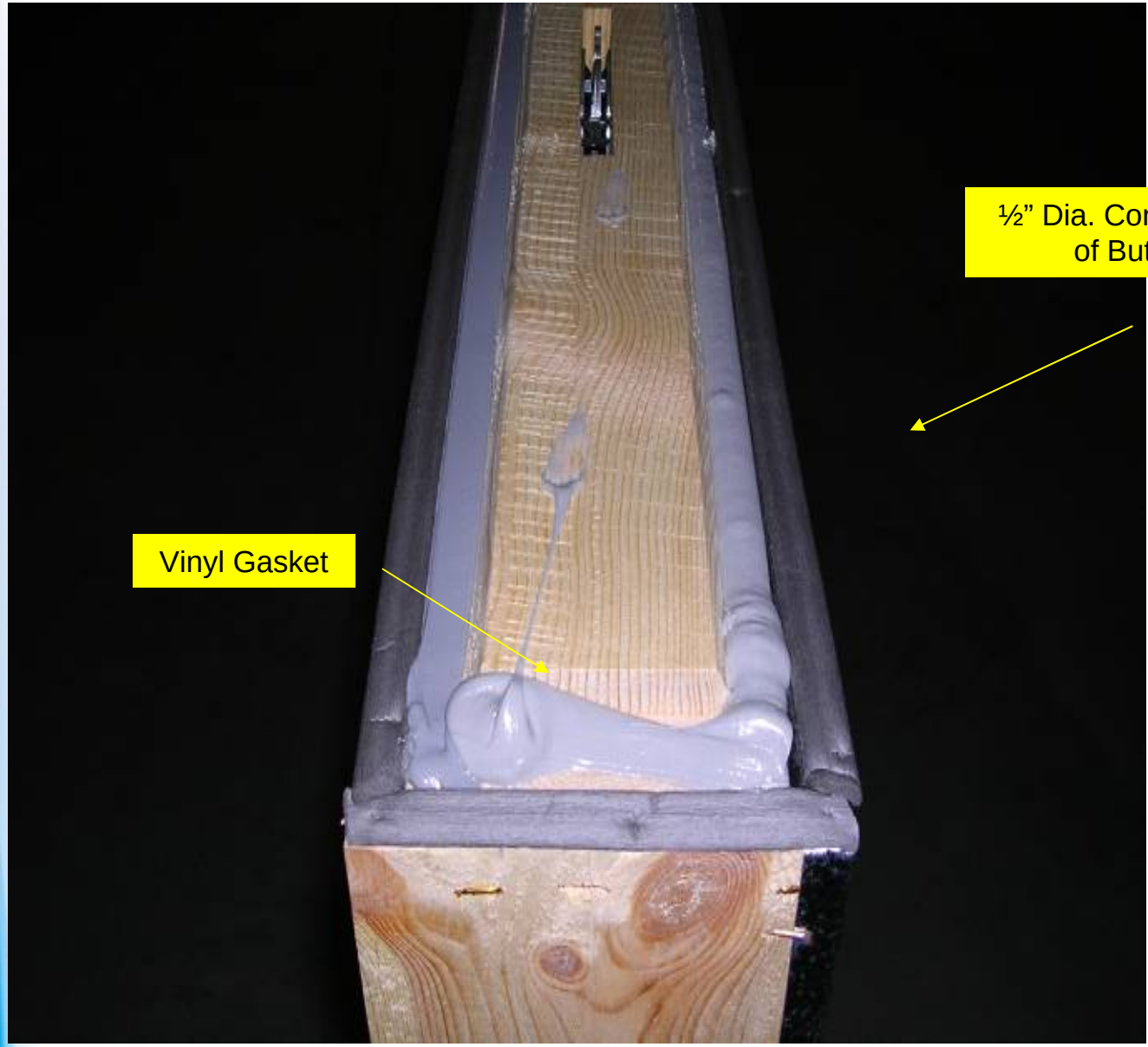


Caulk is Cheap

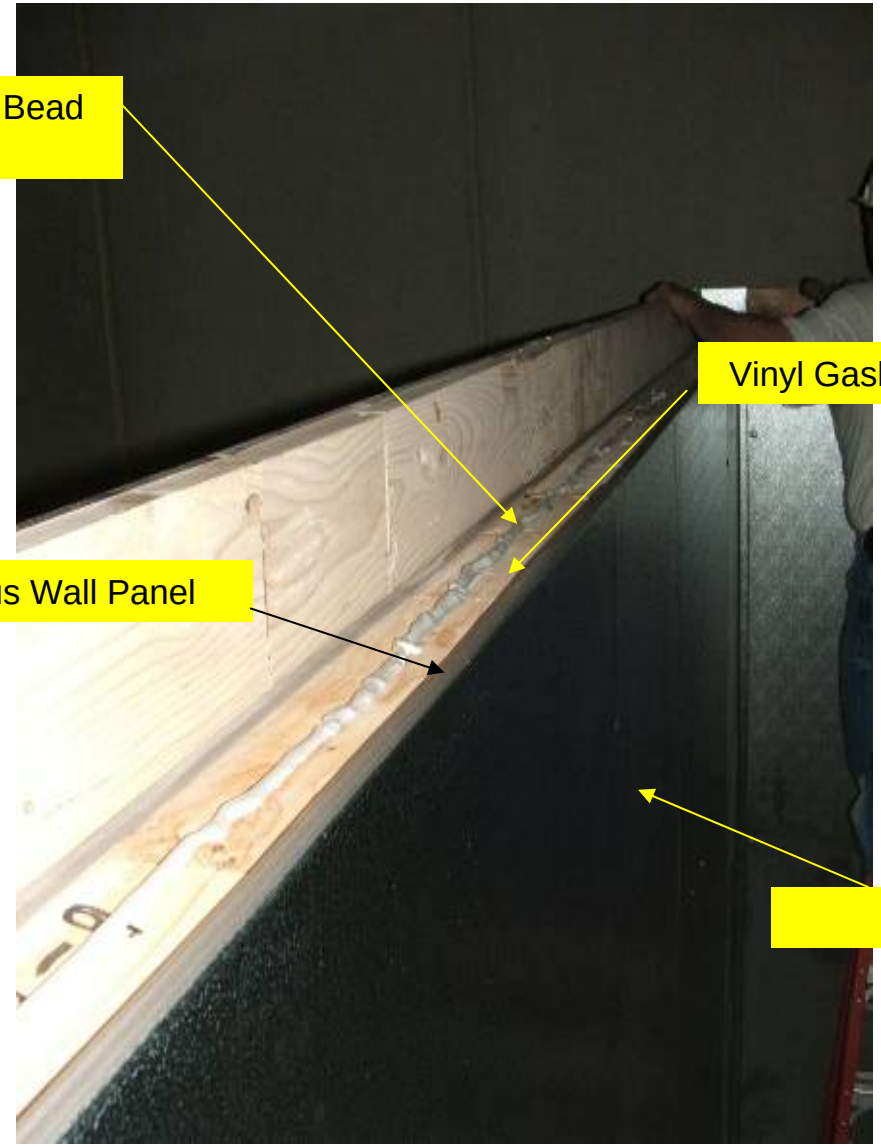


4 / R511 TYPICAL PANEL TO PANEL JOINT

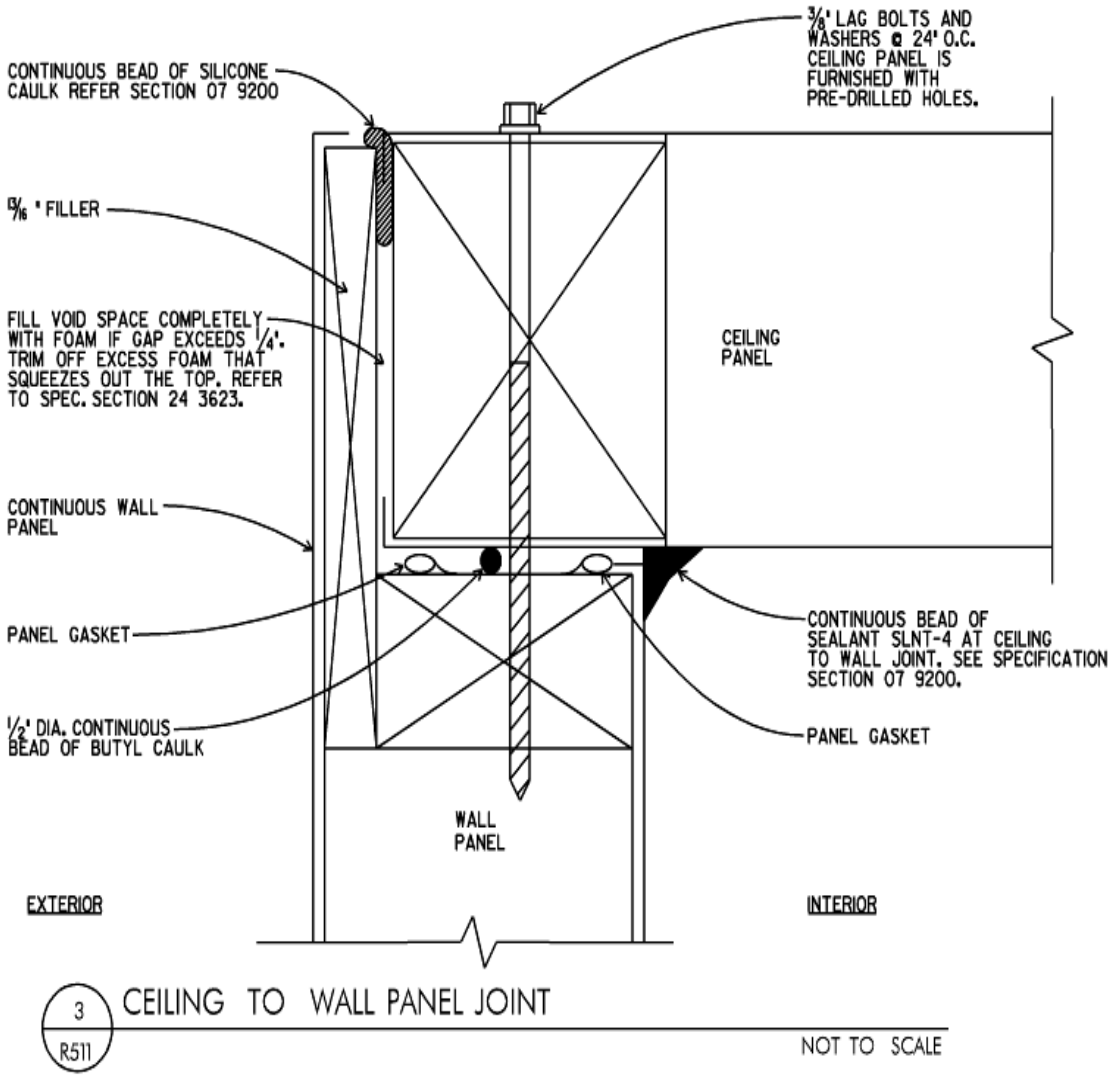
NOT TO SCALE



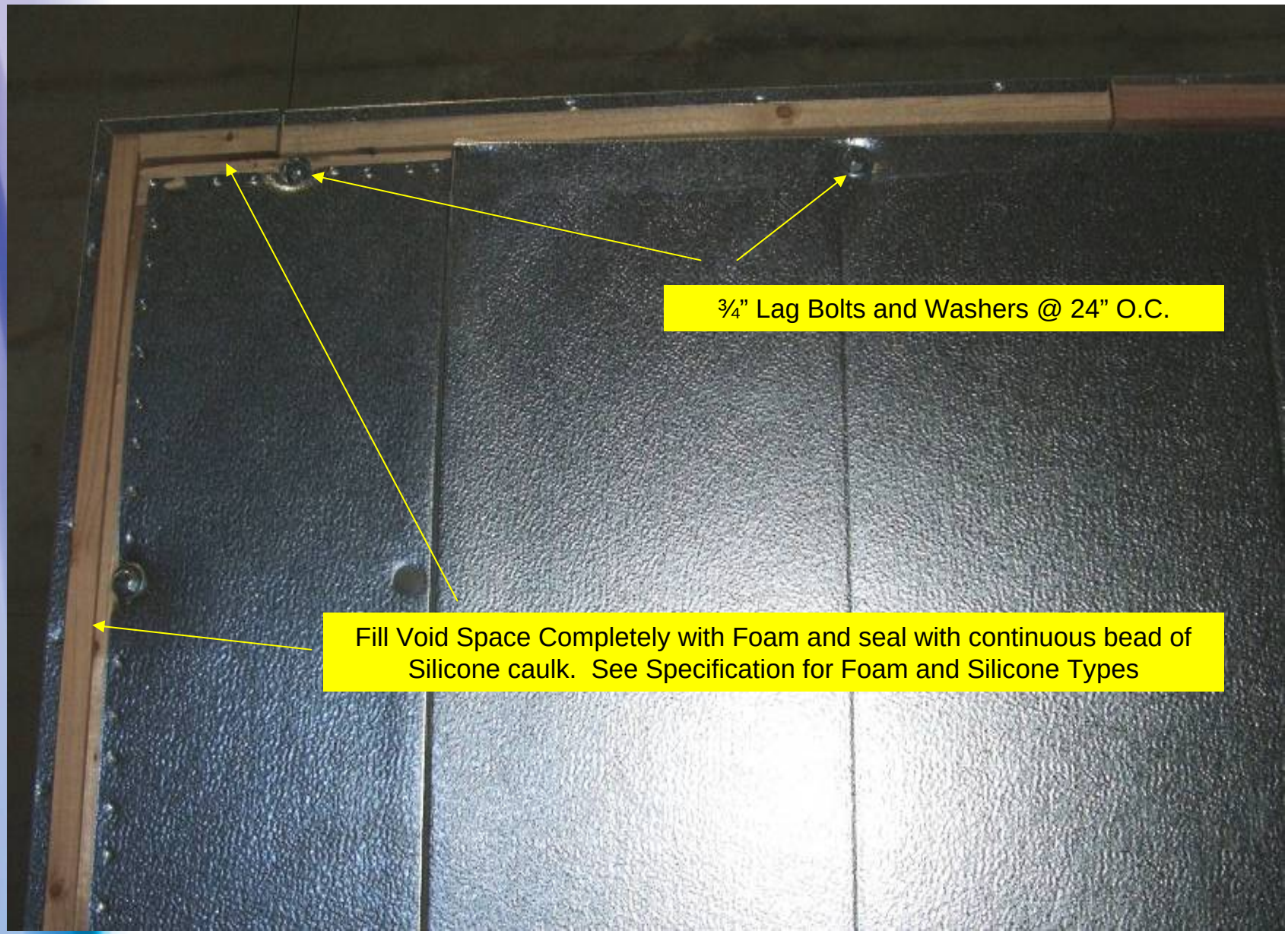
Panel to Panel Joint



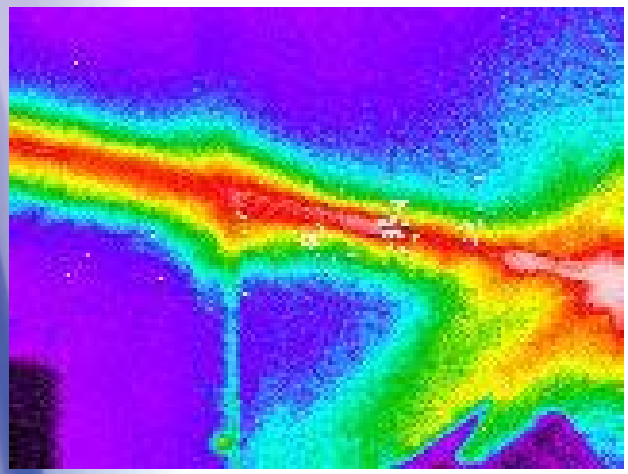
Ceiling to Wall Panel Joint

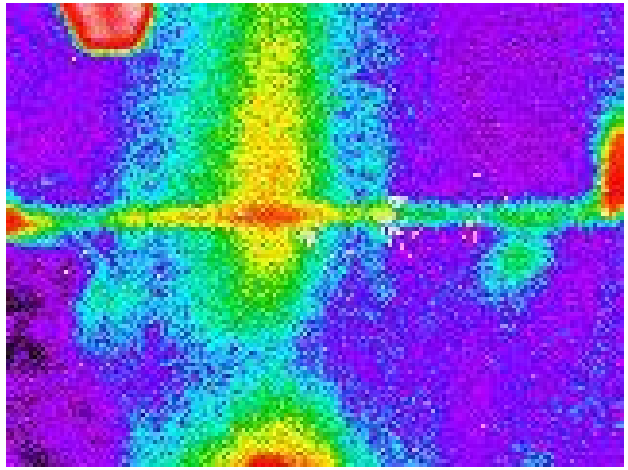


Ceiling to Wall Panel Joint

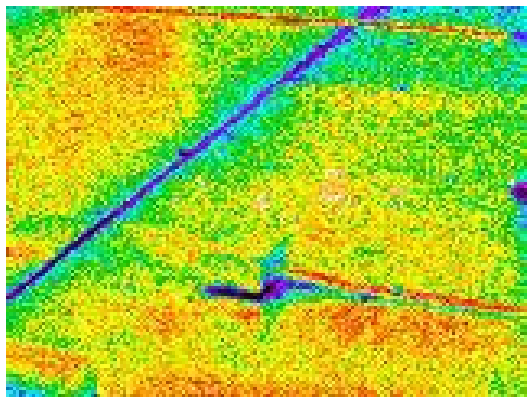


Ceiling to Wall Panel Joint

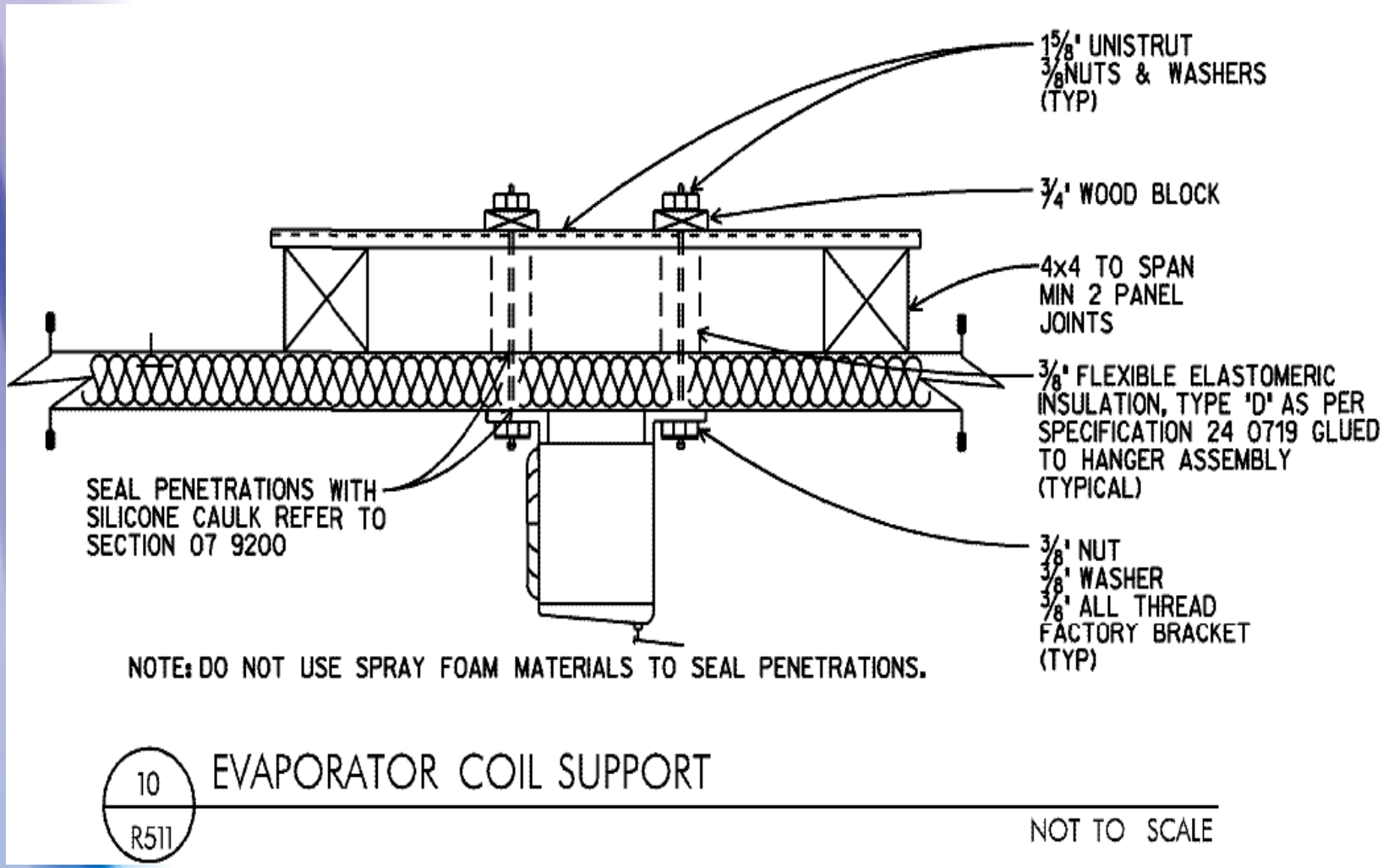




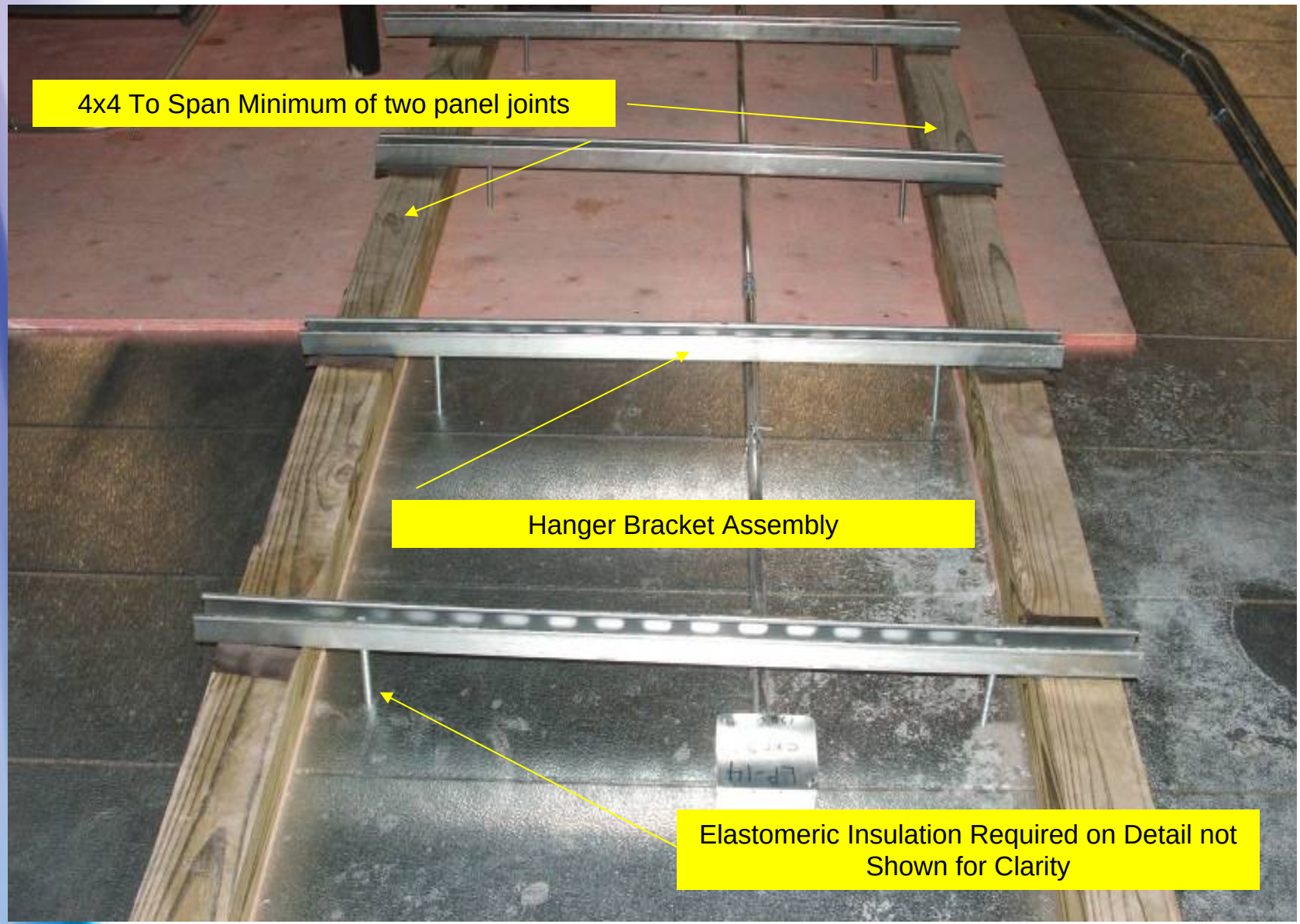
Wall to Ceiling



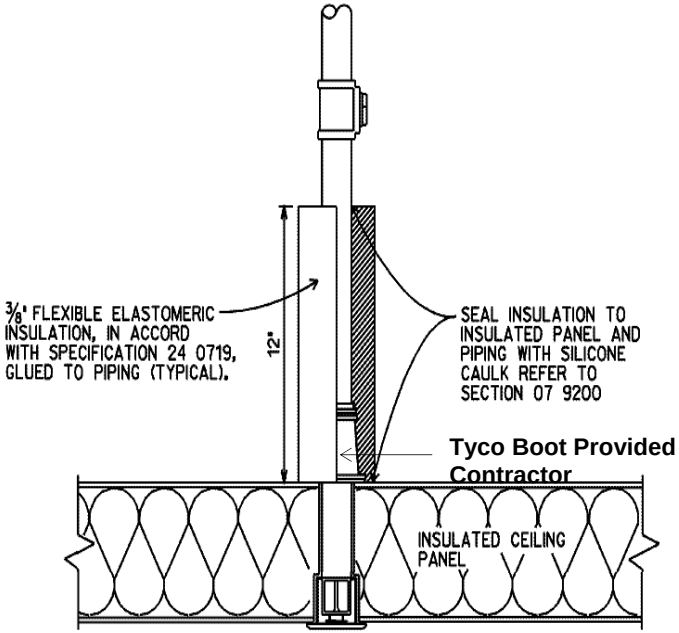
Ceiling from Above



Evaporator Coil Support



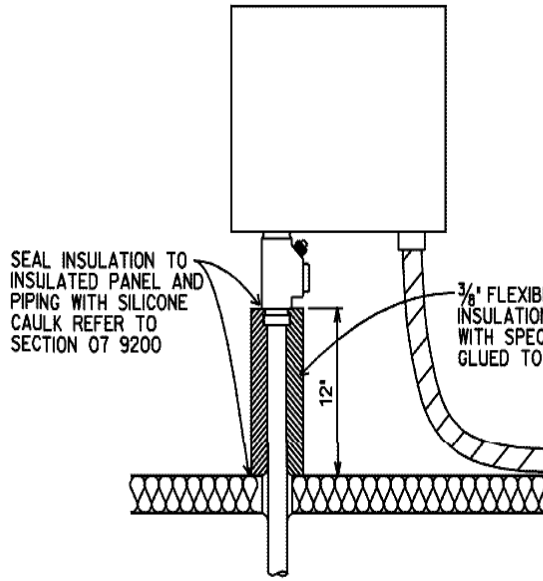
Evaporator Coil Support



NOTE: DO NOT USE SPRAY FOAM MATERIALS TO SEAL PENETRATIONS.

12 / R511 FIRE SPRINKLER PENETRATION AT WALK–IN COOLERS AND FREEZERS

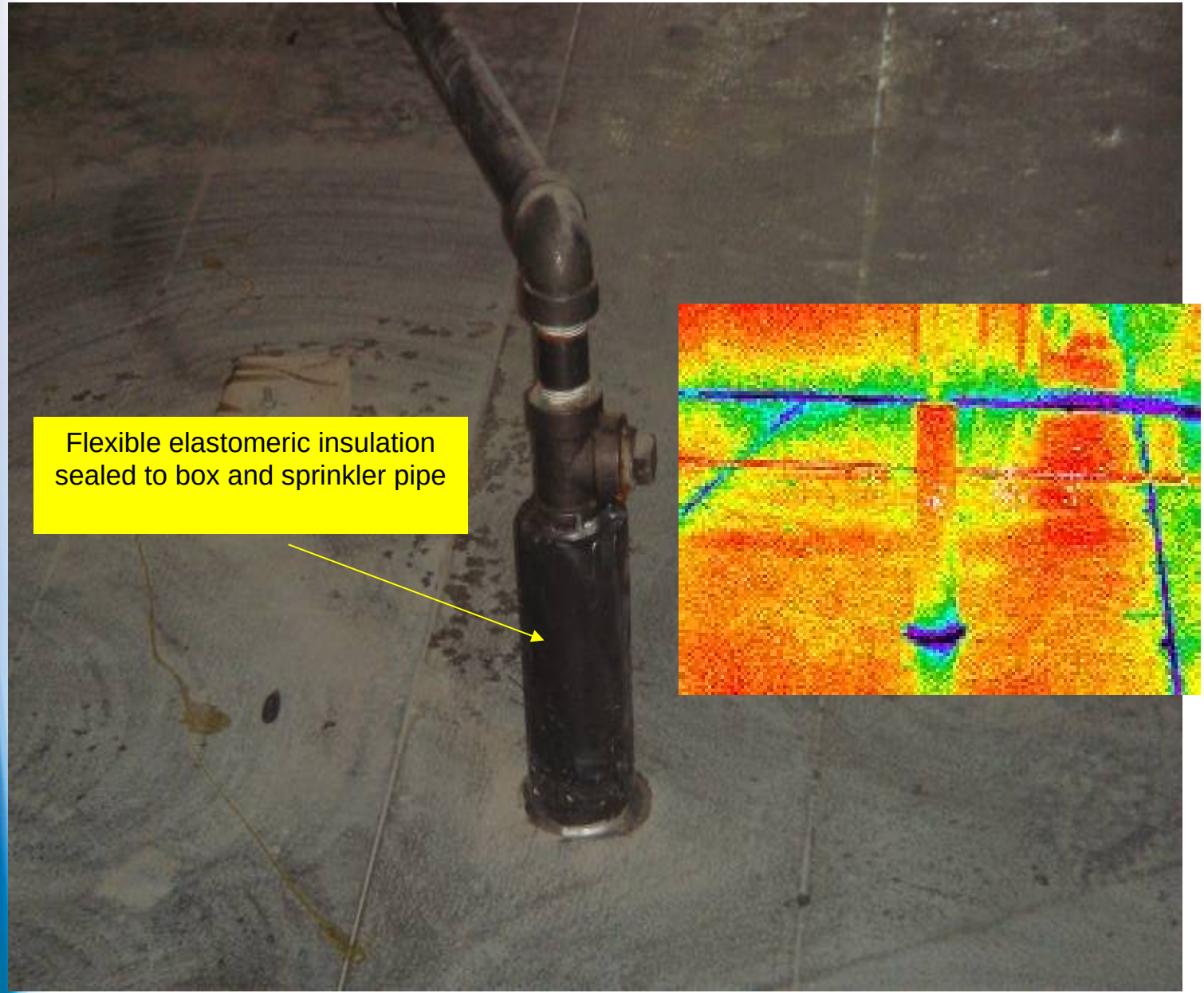
NOT TO SCALE



16 / R511 COOLER /FREEZER CONDUIT PENETRATION

NOT TO SCALE

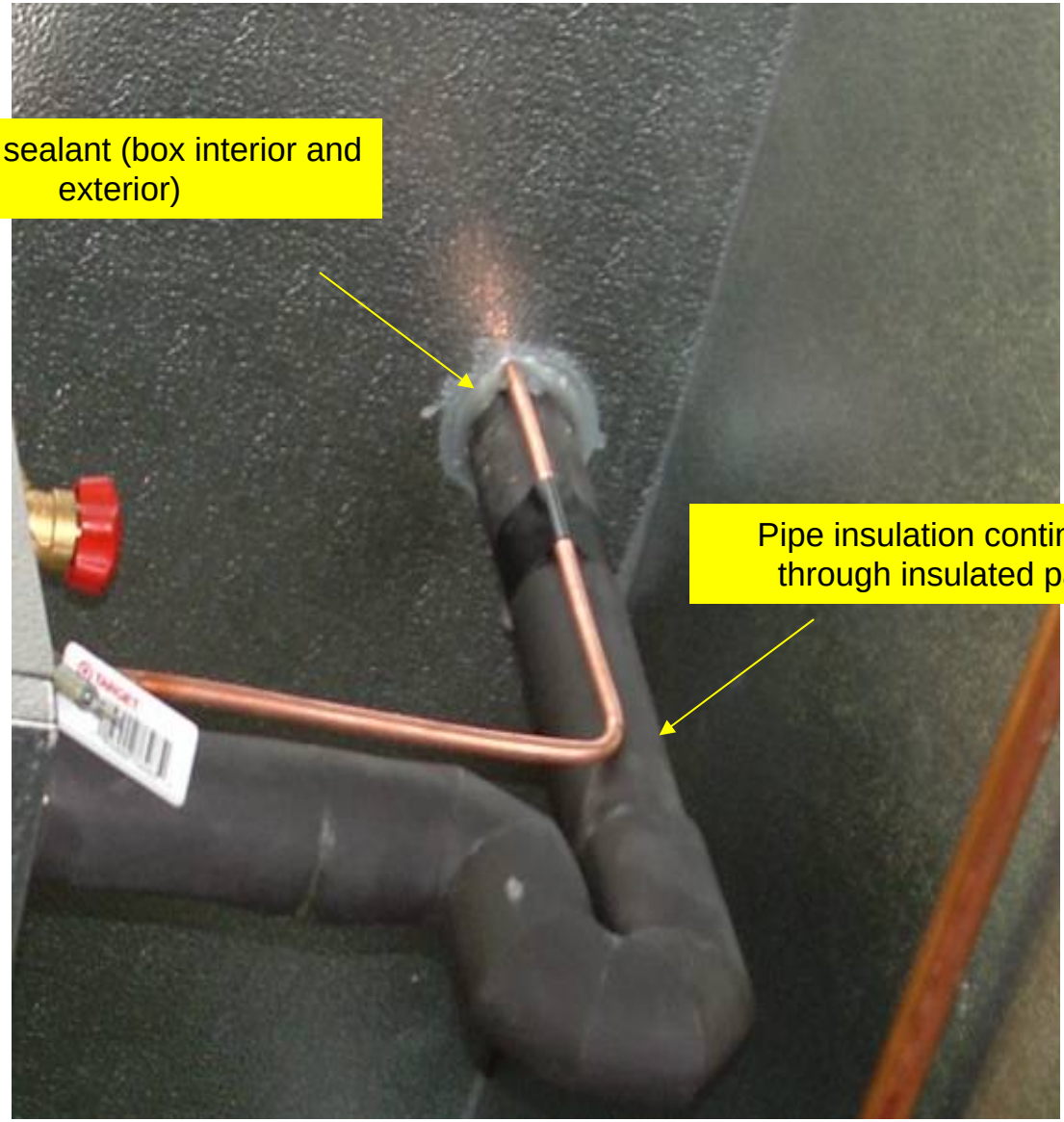
Cooler/Freezer Fire Sprinkler and Conduit Penetration



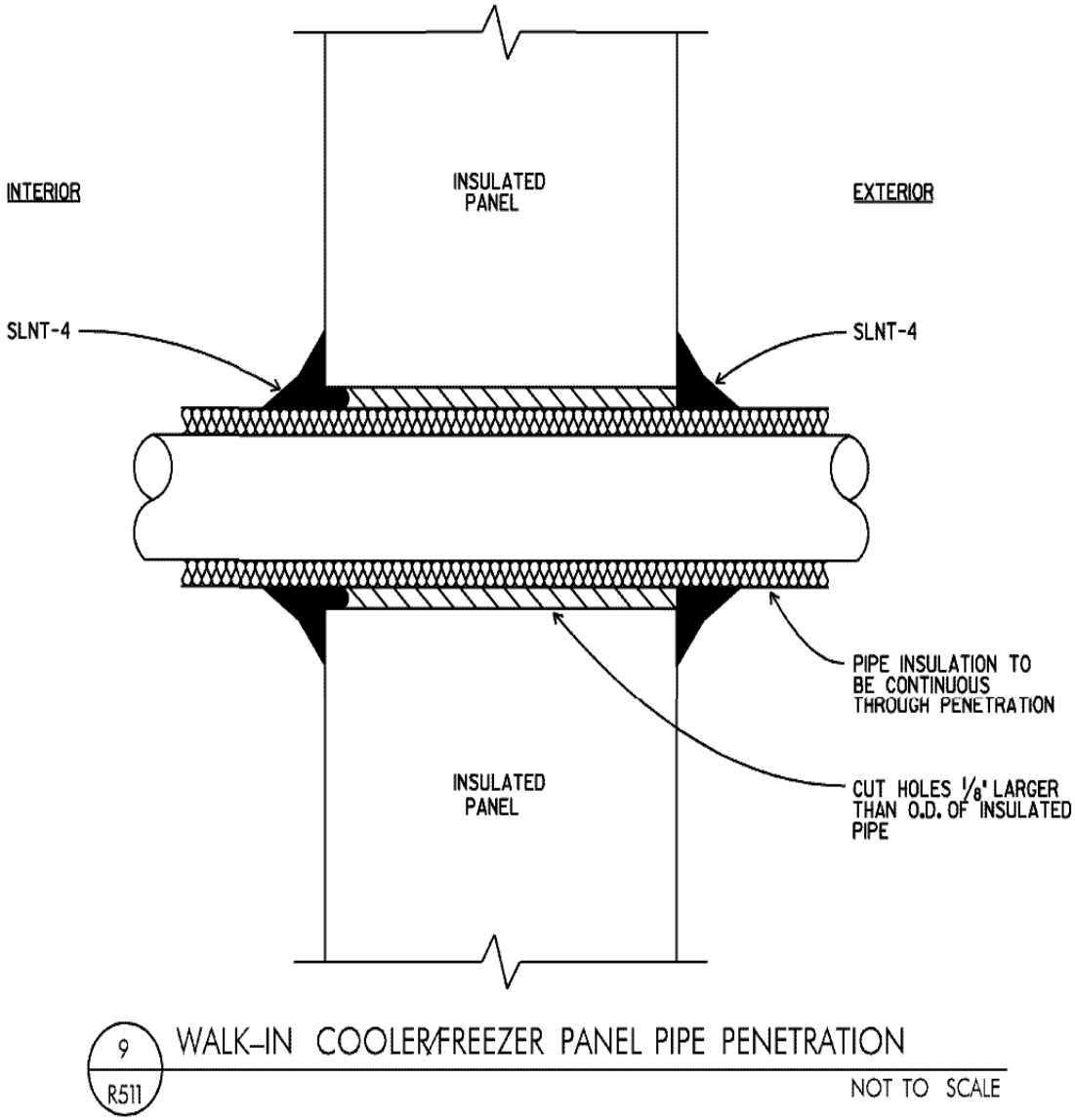
Cooler/Freezer Fire Sprinkler Penetration

Copper Condensate Pipe in Freezers Wrapped with Heat Tape and Insulation (Not Shown)

Condensate Drain Piping Installation

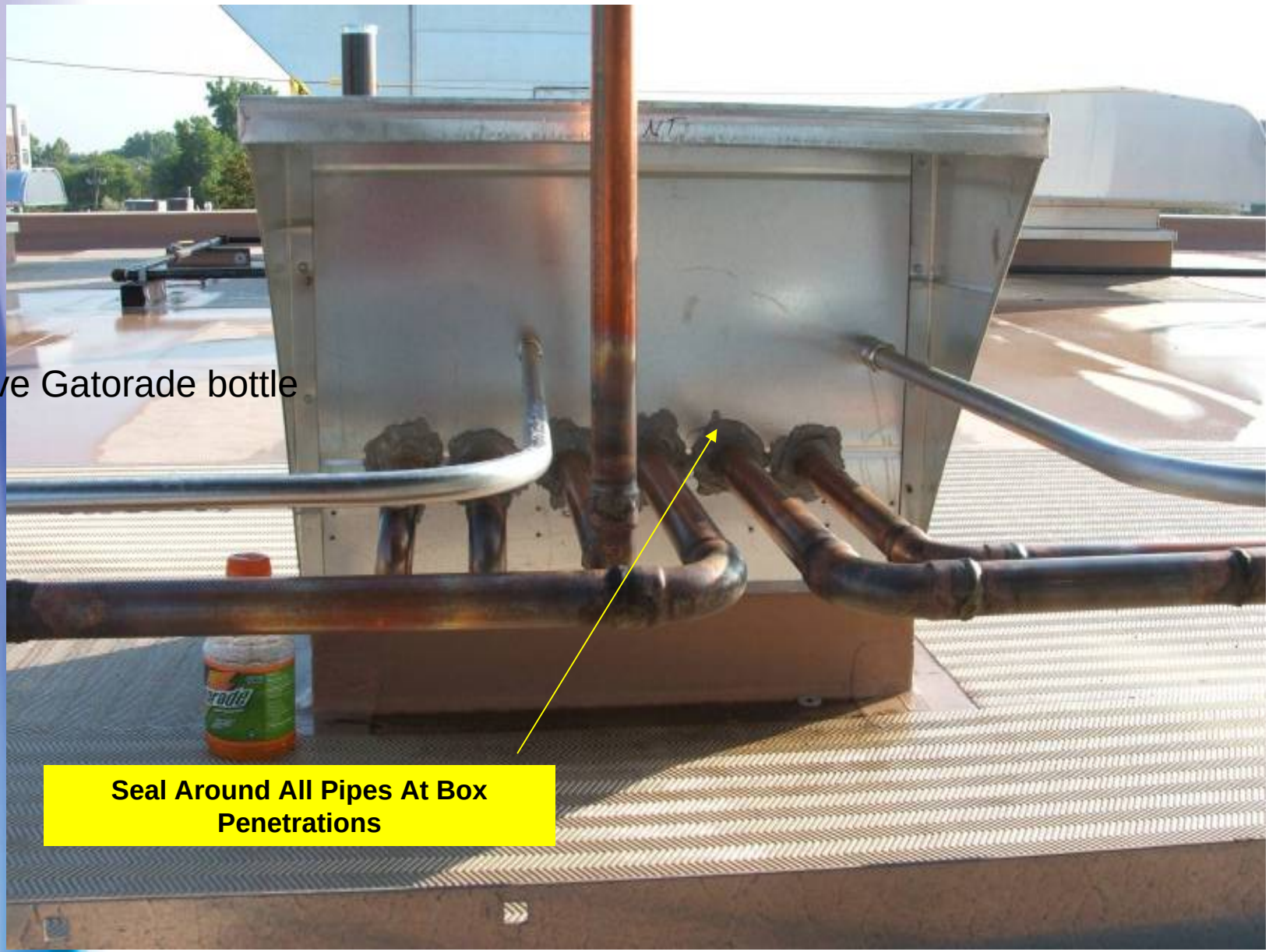


Cooler/Freezer Pipe Penetration



Cooler/Freezer Pipe Penetration

Remove Gatorade bottle



Condenser Pipe Support Detail

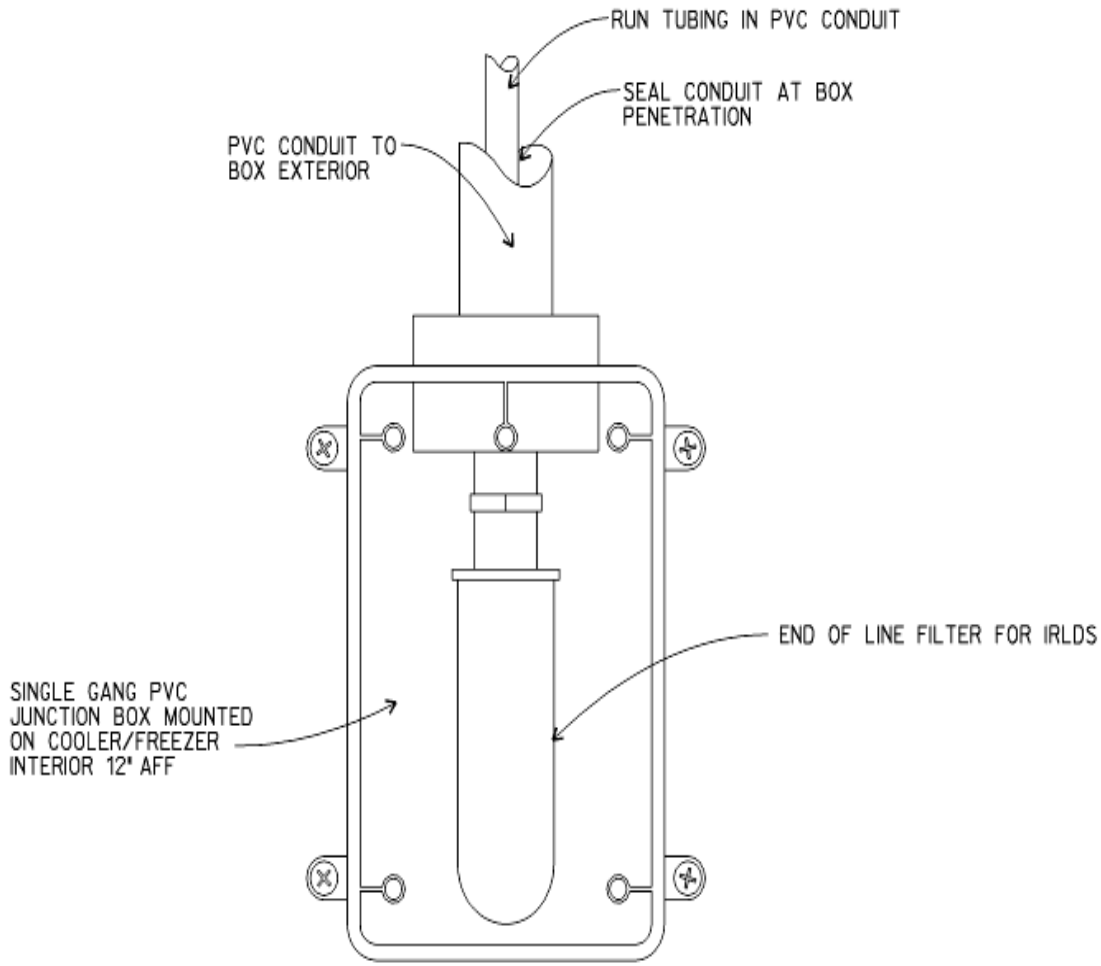
Refrigerant Piping For Sales Floor Cases @ Wall

RED FLAG #9- Penetrations

- Walk-in coolers/freezers
- Roof penetrations
- Walls
- Cases

Leak Detection

- Required by code
  - Life-safety issue
- Good refrigerant management



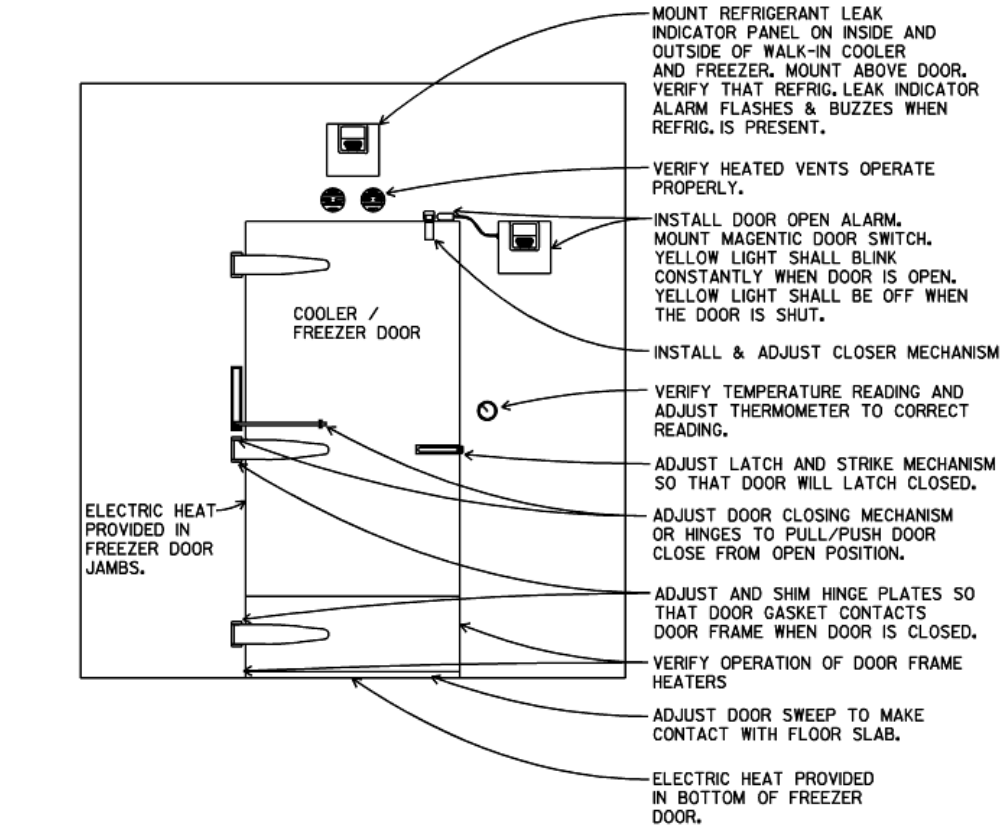
7 / R601 LEAK DETECTOR END OF LINE FILTER MOUNTING DETAIL

NOT TO SCALE

Leak Detector Probe Installation

Leak Detector Probe Installation

Don’t forget to finish



RED FLAG #10- Final Adjustements

- Door sweeps
- Latches
- Strikes
- Automatic closers
- Vents
  - Powered?

Refrigerated Cases

- Brand Issue
- Food Safety Issue
- Balance between merchandising and refrigeration needs
  - They usually win

Common Issues

- Utility connections
  - Refrigeration
  - Electrical
  - Drains
- Cosmetic
  - Level
  - Plumb
  - Trim


Barker
Cases are not properly buckled together

Case to Case Sealant Application

- Seal around the case
- Cold air going out = condensation
- Warm air in= energy

Two more slides.....

- Refrigerant piping
  - Oil management
  - Line sizing
  - Insulation
  - Hangers
  - Traps and risers
  - Expansion valve issues
- Case issues
  - They should be level
  - Seal the joints
- Walk-in boxes
  - Floor slab
  - Caulking
  - Penetrations
  - Adjust the accessories

Sandy Sandahl

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