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

- Insulation
- Traps
- Leak Checking
- Copper Pipe
- Breaker strips
- 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

- Cooling Water Out
- Refrigerant Condenser
- Expansion Valve
- Chilled Water Out
- Evaporator
- Water In
- Refrigerant Compressor
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 (-20°) suction
  - 16.3 psig
- R404A (-22°) suction
  - 15 psig
- Resulting pressure drop = (16.3 – 15)
High Side

- R404A- 100° discharge gas = 237 psig
- R404A- 98° discharge gas = 230 psig
- A 2° 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

INTERMEDIATE TRAPS REQUIRED AT 15'-0" FROM BASE OF SUCTION RISER

WALL

8' MAX

REFRIGERATION RISERS WITH INSULATION

12' MAX

FLOOR

P-TRAP REQUIRED AT BASE OF ALL SUCTION RISERS EXCEEDING 6'-0" IN LENGTH

1/8 UNISTRUT

REFRIGERATION BOX

6 RISER SUPPORT DETAIL

R421

NOT TO SCALE
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 <2° F rule
Liquid Lines-

- Pressure drop of 1° to 2°
- 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
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
Inverted P-trap at top of suction riser

Approved Pipe Hanger w/ ¾” Installation Adhered
Inverted trap required at top of all suction risers.

Approved pipe hanger.

18" max.

\( \frac{3}{8} \) flexible elastomeric insulation, type "D" in accord with specification 24 0719, glued to metal stud (typical).

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

Thermal Blocking

Vapor Barrier

Insulation
RED FLAG #8-
BREAKER STRIPS
Caulk is Cheap
Vinyl Gasket

½" Dia. Continuous Bead of Butyl Caulk

Panel to Panel Joint
Ceiling to Wall Panel Joint

- ½” Dia. Continuous Bead of Butyl Caulk
- Vinyl Gasket
- Continuous Wall Panel
- Box Interior
Ceiling to Wall Panel Joint

Continuous bead of silicone caulk refer section 07 2000

% filler

Fill void space completely with foam if gap exceeds 1/4". Trim off excess foam that squeezes out the top. Refer to spec section 24 3623.

Continuous wall panel

Panel gasket

1/2" dia. continuous bead of butyl caulk

CEILING TO WALL PANEL JOINT

NOT TO SCALE
Ceiling to Wall Panel Joint

- ¾” Lag Bolts and Washers @ 24” O.C.
- Fill Void Space Completely with Foam and seal with continuous bead of Silicone caulk. See Specification for Foam and Silicone Types
Wall to Ceiling

Ceiling from Above
Evaporator Coil Support

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

- 4x4 To Span Minimum of two panel joints
- Hanger Bracket Assembly
- Elastomeric Insulation Required on Detail not Shown for Clarity
Cooler/Freezer Fire Sprinkler and Conduit Penetration
Flexible elastomeric insulation sealed to box and sprinkler pipe
Condensate Drain Piping Installation

Union (Typical)

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

Clean Out (Typical)
Cooler/Freezer Pipe Penetration

Silicone sealant (box interior and exterior)

Pipe insulation continuous through insulated panel
Cooler/Freezer Pipe Penetration
Remove Gatorade bottle

Seal Around All Pipes At Box Penetrations

Condenser Pipe Support Detail
CUT REFRIGERATION PENETRATIONS WITH HOLE-SAWE, ONE SIZE LARGER THAN INSULATION DIAMETER
RED FLAG #9 - Penetrations

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

• Required by code
  – Life-safety issue
• Good refrigerant management
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
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
Target
612-761-5327
sandy.sandahl@target.com