REFRIGERANT MANAGEMENT/LEAK CHECKING 101

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WHY A REFRIGERANT MANAGEMENT SYSTEM?

- EPA COMPLIANCE!!!
- Ease of gathering data for Carbon Footprint, Climate Registry, Green Chill & other sustainability initiatives.
- Money- Easy to manage what is accurately measured.
- Great way to identify source of leaks and work with contractors to correct.

Leak Repair Requirements

- Refrigeration and a/c systems with charge sizes greater than 50 lbs
  - Industrial process refrigeration
  - Commercial refrigeration
  - Comfort cooling a/c
- Must repair within 30 days
  - Or convert to non-ODS
  - Or retire within 1 year
- Leak repair is the responsibility of the equipment owner/operator NOT the technician

Recordkeeping & Reporting Requirements

- Technicians must keep copy of certification card at their place of business

- Technicians must provide service record to their customers
  - Date and type of service
  - Amount of refrigerant added to the system

How Do We Begin to Comply?

One Retailer's Journey

- Hy-Vee outsources all refrigeration service. Store directors have A LOT of autonomy. We deal with over 50 refrigeration contractors.
- Paper-based system was used until 2005.
- Paper system left us with "Opportunities".

OPTIONS CONSIDERED

- A paper-based system with better checks and balances.
- Proprietary software
- “Off the shelf” software package
- Web-based software service - We chose this one

Hurdles

- Sell it internally
- Get good data for initial database for 200+ stores
- Educate 50+ contractors
- Ensure use of the system

Lessons Learned

- We now know exact cost impact leaks have on our business.
- We know where our leaks are occurring.
- Leak rates have dropped every year!
- We can track quality of installs.
- INSTALLS ARE KEY!!!

LEAK DETECTION 101

ADVANCED REFRIGERATION & AIR

Topics to be covered…

The importance of leak detection from the contractor's perspective

- Tools and Methods used for Leak Detection
- Leak Detection – Construction / Installation Procedures
- Leak Detection – Service Procedures
- Leak Detection – Specific Equipment
- Historical Trends

CONSTRUCTION / INSTALLATION PERSPECTIVE

- All leaks need to be found on a new installation to ensure that good vacuums can be pulled
- Poor Vacuums = Unreliable Equipment for the life of the Equipment

Service - Preventative Maintenance Agreement Perspective

- A majority of PM agreements hold the contractor responsible for losses of refrigerant with the exception of vandalism or natural disasters.
- Large amounts of refrigerant being lost affect the contractor’s bottom line.

Service (Service Related)

- Reputation – Customer's will not want to continue doing business with a company that has to continually come back to recharge the units.

Environmental Concerns

- Everyone has a responsibility to think about what condition we leave the earth in for future generations.
- We can achieve sustainability by meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Section 608 of the Clean Air Act

- This is the law of the land in our industry and it's guidelines must be strictly adhered to.
- This law requires the repair of leaks in refrigeration and air conditioning equipment

Tools and Methods used for Leak Detection

- Electronic Leak Detector
- Halide Torch Leak Detector
- Bubble Soap Solution
- Nitrogen and Pressure Gauges

Electronic Leak Detectors

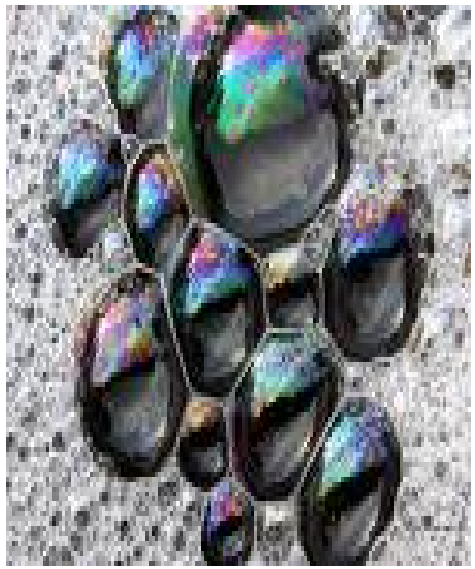



- Many different types on the market
- It is very important to determine which detector is best at finding certain gases (Example: some work great at detecting R-22 but not 404a)
- We continually try new leak detectors to determine which gases they are suitable for detecting.

Halide Torch Leak Detectors

- Oldest Style
- Used to get in the general vicinity of a leak
- When the sniffer hose crosses a leak the flame changes color from blue to a bluish-green

Bubble Soap



- This method is used to pinpoint small leaks once a halide torch or electronic leak detector gets it in the general vicinity

Nitrogen and Pressure Gauges

- These items are used in new construction and during services when leaks occur in underground pits and whenever else other methods are not working

Leak Detection
Construction / Installation Procedures

New Store Construction - Parallel Rack

- Assuming all connections between mechanical frame, rack, condenser, systems, cases, and walk-ins have been made
- Isolate the rack from all systems connected to it
- A system is defined as a liquid line entering, and a suction line returning from a case, set of cases, or a walk-in

There may be up to four valves on a parallel rack that need to be closed in order to isolate the individual systems

- Liquid Valves
- Suction Valves
- Hot gas / cool gas valves
- Equalizer valve

New Store Construction Continued

- To insure every valve is addressed we have adapted the following procedure.
- Take every valve and schrader cap off of the rack. Make sure this is doubled or tripled checked none are missed before moving to the next step.
- Starting on one side of the rack begin by tightening each schrader core. As each is tightened replace the cap. Move around the rack until each schrader valve is tightened and the caps are replaced. Once this procedure is complete walk around the rack and double check that all schrader caps are on, ensuring all valves have been addressed.
- Move to king valves next. Follow the exact same procedure until all kings valves have been opened, packing tightened, and caps replaced. Again double check to make sure all caps are on.

New Store Construction Continued

- Move to ball valves next. Make sure they are all opened and if pack nuts are provided tighten them.
- Move to flare nuts next. Moving in the same direction around the rack tighten each and every flare nut.
- Remove any check valve parts. Make sure gaskets are in good condition and replace and tighten caps.
- Move compressors. Tighten all bolts on suction king valve ports, oil pot bolts, head bolts, and discharge rotor lock nuts and bolts, and oil screen bolts.
- Move to condenser and tighten schrader cores and any flares if splitter valves are used.

New Store Construction Continued

- Move to walk-Ins and make sure all hand valves are open, schrader cores and caps tightened, flare nuts on expansion valves tightened, solenoid valve nuts tightened, and manually open solenoid valve stems. Tighten valve stem nut and replace and tighten cap.
- Move to cases and tighten all schrader cores and caps. If expansion valves have flares tighten them and tighten screen nut on soldered valves. Tighten all solenoid valves and open all hand or ball valves.
- Pressurize rack/ condenser/ heat reclaim with nitrogen up to 100lbs to build volume so the systems can be checked next. At this point the focus will be on identifying just large leaks that can be heard or seen on a pressure gauge.

New Store Construction Continued

- Begin with the first system.
- Connect pressure gauge on suction side
- Open liquid ball valve.
- Nitrogen will flow through the liquid line to the expansion valve through the evaporator and into the suction line.
- When the pressure reaches approximately 60 pounds on gauge, re-isolate the system.

New Store Construction Continued

- Watch suction gauge briefly in order to spot a large leak that might allow the pressure to drop quickly on gauge. If this is not evident within 30 seconds move on to next system and follow same procedure. Continue until all systems have been checked for large leaks.

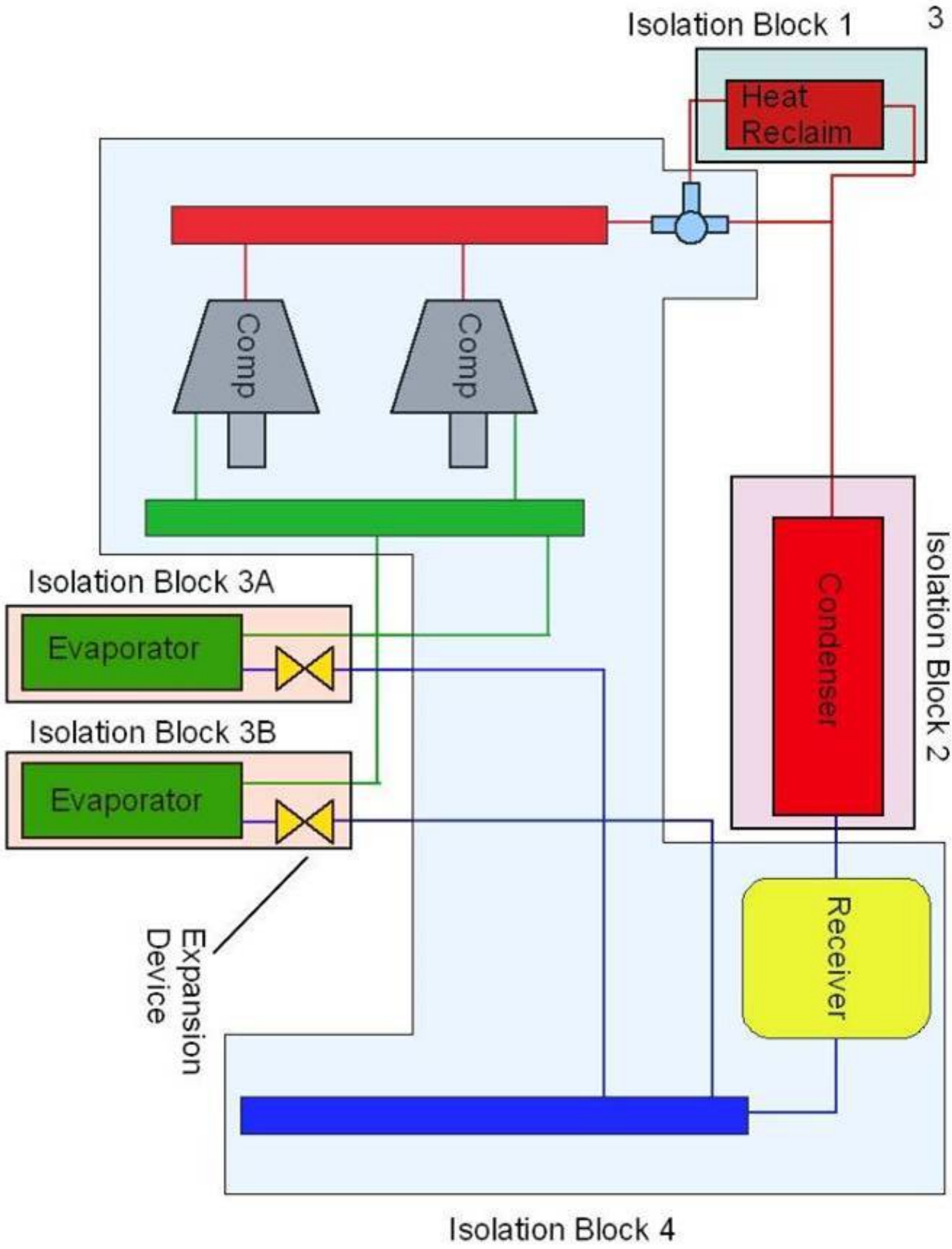
- Immediately recheck pressure on each system again on both suction and liquid side. The reason for this is that if a leak is present on the liquid side, pressure may not return through the expansion valve and the suction side would continue maintaining pressure but the liquid side would drop.

New Store Construction Continued

- If a leak is discovered, bring the pressure up in the system to a point where it can be heard.
- If leak is found = Repair
- If the leak is not found = Make record and move on to the following system

New Store Construction Continued

- Once all systems have been completely checked, return to system or systems that are leaking and apply bubble soap to all schrader's, solenoid valves, expansion valves, case piping, and welds. If leak cannot be located make note and keep this system isolated.
- Once all systems are leak free, open ball valves on all systems (with the exception of any with leaks that have not been found) and bring rack, condenser, and heat reclaim system pressure up to 1 ½ time operating pressure. This is usually 250bs. Let systems equalize for at least 30 minutes.
- Re-isolate systems, condensers, and heat reclaim systems from the rack and make pressure recordings of each isolated block. For systems that are known to be leaking add small amount of refrigerant as trace gas and bring pressure up to 250lbs with nitrogen. Re Check every component on that system with electronic till leak is found.
- Let unit sit over night.


Isolation Block 1
Heat Reclaim
Comp
Comp
Isolation Block 3A
Evaporator
Isolation Block 3B
Evaporator
Expansion Device
Condenser
Isolation Block 2
Receiver
Isolation Block 4

New Store Construction Continued

- Re-check the pressures in the morning.
- Depending on any temperature changes, there might be a slight pressure change but this will be seen in all isolation blocks.
- If an isolation block has a less then normal pressure drop, all components within that isolation block including valves, schrader's, weld's, and factory welds need to have bubble soap applied.
- If leak can not be found refrigerant 22 can be added as a trace gas and an electronic or halide torch leak detector can be used to detect the leak.

New Store Construction Continued

- Once leaks are repaired, open all systems and allow everything to equalize. Add pressure as necessary to bring rack to 250lbs. After equalizing re-isolate components and allow systems to sit for at least 2 days with no indication of any pressure drops.
- Once confident all leaks have been found all valves are opened and holding pressure is released and vacuums are pulled
- The vacuums need to be pulled from both the high and low sides of the rack
- Some manufacturers provide vacuum access points

New Store Construction Continued

- Pull vacuum to five hundred microns and break with nitrogen
- Re-Pull vacuum to five hundred microns and break with nitrogen
- Pull final vacuum to a lowest point below 500 Microns
- The vacuum should not increase more then 500 microns above initial point over a 24 hour period

New Store Construction Continued

- Some owners may have different vacuum requirements
- If vacuum is good break final vacuum with refrigerant. Bring to a holding pressure above 30lbs.
- Once power arrives the unit can be fully charged

Remodels

- If new racks are being added or old racks are being replaced during the remodel the process is the same as a new store.

- If only new systems are being added or replaced, the process is as follows…

Remodels Continued

- The liquid and suction line are run as close to the racks, cases, and/or walk-ins as possible.
- If time permits, the walk-ins or cases may be tied on.
- If not, both ends are looped together with a schrader and pressurized with nitrogen.

Remodels Continued

- After a reasonable amount of time, the pressure is verified.
- If the pressure did not hold, the pressure is increased so that the leak can be heard.
- If the leak is still not found, all components of the system are checked with bubble soap.

Remodels Continued

- Once systems are leak free, they are tied into the rack.
- A small amount of refrigerant is allowed to enter the system from the rack
- All new welds made after the previous pressurization are checked with an electronic leak detector and bubble soap.
- If the cases and walk-ins were not tied in before pressurization they are also checked with an electronic leak detector and bubble soap.

Remodels Continued

- Once the system is in good shape, the small amount of refrigerant is reclaimed and a good vacuum is pulled on the system.
- Once the vacuum has been pulled, the system is restarted.

Leak Detection – Service Procedures

Pro-Active (Preventative Maintenance Program)

- Log sheets should be maintained on every rack and air-conditioner
- These should have a place to log or graph the refrigerant levels on a monthly basis
- If the logs show that levels are not dropping, visually inspect racks for oil leaks and make any repairs as necessary
- And if time permits, check with a leak detector

Leak Detection – Service Procedures Continued

- If the levels are dropping - all cases, walk-ins, condensers, rack, reclaim, and hot water valves need to be checked with an electronic leak detector and then pin pointed with a halide torch and bubble soap.

- If you check airflows and perform walk-in inspections monthly you can carry an electronic leak detector with you which will decrease the amount of time spent performing the maintenance program.

Leak Detection – Specific Equipment

Cases

- To detect a leak in a case, the leak sensor is put into the stream of air flow supply. Depending on which side of the case the expansion valve is located on will determine where in the case the leak is located.
- If refrigerant is detected any where other then where the expansion valve is located then the leak is most likely in the evaporator.
- Once a leak is confirmed, the case is pulled and inspected for oil. If no oil can be found, bubble soap or a halide torch can be used to pin point the leak.

Leak Detection – Specific Equipment

Walk-Ins

Since walk-ins are an enclosed environment, as soon as the door is open the leak will be detected.

Leak Detection – Specific Equipment

Racks

- Shut down the motor room or weather pack and listen for a leak. Thoroughly inspect rack with an electronic leak detector. This will get you in the general vicinity, but bubble soap will be needed to pinpoint the leak.
- If the leak is still not found, switch to a halide torch and inspect the rack again. Turn system back on and if the leak still can not be found it may be in the overhead.
- The system will have to be cut from the rack so no non-condensables will get mixed in with the rack. The liquid and suction line are looped together and pressurized.
- Once the leak is found the system is emptied of nitrogen, reconnected and a vacuum is pulled and the system is restarted.

Leak Detection – Specific Equipment

Condensers

Shut down power on rack and condenser. Inspect condenser for oil spots or stains. Use either a halide torch or electronic leak detector at the equipments headers then proceed on to the air intake side of the coil. If no leak is found, the condenser will have to be cut out and pressurized. Leak should now be heard. If the leak is in the middle of the coil it may have to be removed.

Leak Detection – Specific Equipment

Heat Reclaim Coils

- The same process for heat reclaim is the same as with the condensers. Before beginning the process you can valve off the heat reclaim and check the pressure.
- If leak is large enough a pressure drop should be noticed.

Leak Detection – Specific Equipment

Hot Water Tanks

- Begin by closing off valve to the tank. A pressure drop may be noticed. If not go over with an electronic leak detector.
- Sometimes you can check water leaving the tank, but be cautious because the foam insulation may give an incorrect reading.

Re-Active (Emergency Service Call)

- If the leak is small you may only lose a couple of systems on the rack. To determine if this is true, valve off the liquid lines to a couple of systems on the racks that are working properly.
- If the systems that are not working come down to temperature, the problem is refrigerant.
- From this point everything on that rack needs to be leak checked using the procedures previously mentioned.

Re-Active - Emergency Service Call Continued

- If the leak is large, everything on the entire rack may not be working.
- If it is determined that the leak is on a certain system - that system, the heat reclaim tank, or hot water tank, they may be isolated and refrigerant added to get the rest of the rack running properly while the leak is repaired.

Historical Trends (Data Analysis)

Where Leaks Occur

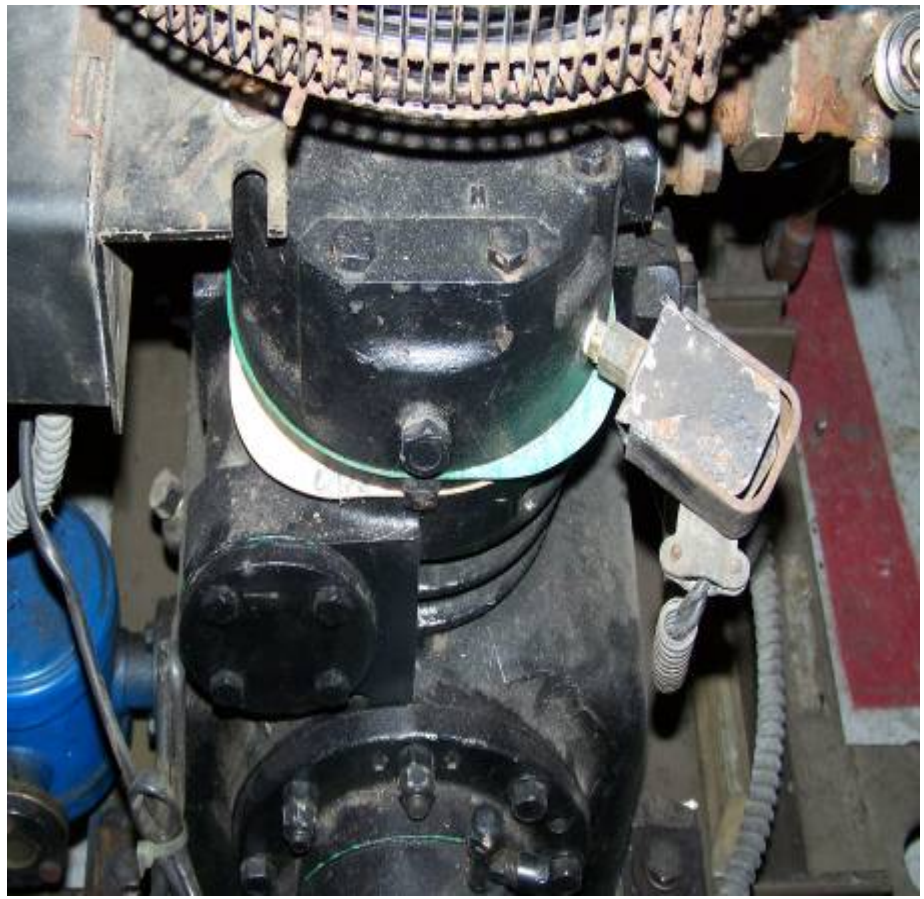
- Natural Disasters
- Compressor Change
- Levels / Top Off from Previous Repair
- Vibrations
- Deterioration
- Refrigerant Conversions
- Vandalism / Other
- Welds / Factory Welds
- Gaskets
- Caps / Cores
- Controls
- Flares
- Packing
- Evaporators
- Condensers
- Heat Reclaim Tanks and Coils

Deterioration

The longer the life of the equipment, the more we will face leaks through deterioration. Valves and other components are constantly in contact with water due to condensation. This creates rust which may potentially evolve into leaks.

Gaskets

The neoprene gaskets inside the component of a system wear over time. The longer the life of a piece of equipment, the more likely we are to face issues with the gaskets.



Natural Disasters

Natural disasters are beyond our control and can possibly cause damage to equipment that will cause a loss of refrigerant.

Welds / Factory Welds

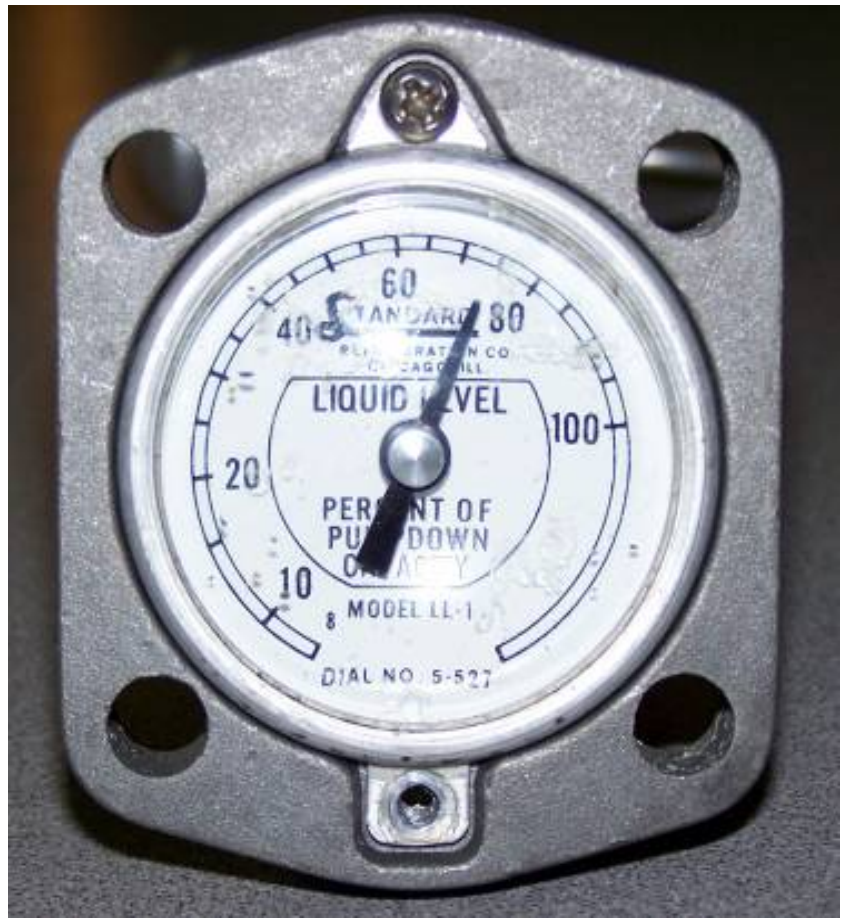
It is extremely important for the contractor and manufacturer to monitor the quality of all welds being performed on equipment that is being made in a store. This can be done by monitoring which pipefitters are installing which systems so that if a problem does arise, the installers in question can receive additional training.

Compressor Changes

Often times on small systems, when the compressor is replaced the gas is reclaimed. If the compressor is burnt out it is usually more cost effective to replace the equipment with new gas rather then the old gas, as this may contaminate the entire system. Minimal losses may occur on large systems if the isolation valves for the compressors do not completely hold during a change out.

Levels

Often when leaks are repaired, only a minimal amount of gas is added to the equipment to achieve the proper temperature. After the equipment has operated over a period of time the fluid levels that were set by the owner will not appear at the proper levels.



Controls

- Many older controls have capillary tubes that connect to a port to directly measure the characteristics of the refrigerant using mechanical springs to open and close switches.
- Modern systems mainly use an electronic encapsulated transducer which sends an electrical signal to a control device.
- If the old style capillary tubes were not properly installed using silicone they could break, releasing large amounts of refrigerants. These leaks have been minimized by replacing the old controls.

Vibration

With anything in motion vibration can occur. To minimize leaks, pipes and other components need to be properly secured.

Caps / Cores

Schrader Valves along with their cores and caps are an entry point as well as sometimes an exit point for refrigerants. It is important to ensure that the valve was not leaking with the core installed and that the core is tight and the proper caps were used. For example, hard caps should be used with a copper gasket for high pressures.

Flares

Flares leak because of poor installation or condensation. Condensation can get into the threads and freeze, which expands the flare and causes it to back off.

Packing

- When oil comes in contact with the refrigerant it will cause the packing to break down over time.
- Continual tightening will also cause the packing to weaken.

Conversion

As certain refrigerants are phased out, they have to be replaced. This is not due to a leak but rather the conversion process.

Heat Reclaim Tank

Water is in constant contact with the copper inside the tank which can cause corrosion of the copper to occur and rust to build up.

Vandalism / Other

- One of the more recent causes of refrigerant loss has been the theft of copper. With the rise of copper prices, thefts have become much more prevalent.
- “Other” is defined as anything that can not be categorized into any of the previously mentioned items.

Historical Trends (Data Analysis) 2006-2007

- Natural Disasters (0.00%)
- Compressor Change (1.56%)
- Levels / Top Off from Previous Repair (8.89%)
- Vibrations (5.32%)
- Deterioration (3.96%)
- Refrigerant Conversions (1.02%)
- Vandalism / Other (5.68%)
- Welds / Factory Welds (18.01%)
- Gaskets (8.95%)
- Caps / Cores (9.89%)
- Controls (4.56%)
- Flares (9.38%)
- Packing (9.89%)
- Evaporators (9.26%)
- Condensers (3.48%)
- Heat Reclaim Tanks and Coils (0.82%)

Conclusions / Questions

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