The GreenChill Advanced Refrigeration Partnership

GreenChill Best Practices Guideline
Ensuring Leak-Tight Installations of Commercial Refrigeration Equipment

U.S. Environmental Protection Agency
Stratospheric Protection Division

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GreenChill recommends the following procedures as best practices, to ensure that your refrigeration equipment is leak-free when installed, unless local codes or system design restraints require otherwise. **Always adhere to testing procedures required by local codes, and do not exceed system design pressures. Make sure pressure used is in compliance with local codes and that you meet all local code requirements for rough-in inspection.**

Attention: Always follow safety standards. Ensure proper ventilation at all times.

1. Pre-Check

Before beginning the leak check procedures, carry out the following pre-check:

- visually inspect refrigerant lines and joints for proper piping assembly and installation;
- ensure proper bracing;
- ensure that there are no metal to metal contact points;
- manually verify that all mechanical joints are tight;
- ensure tightness of all electrical connections; and
- check phase monitor for correct polarity.

2. Isolate components not suitable for the pressure levels contained in these Guidelines. Warning: some components are not suitable for high pressure levels, including, but not limited to, some compressors, pressure transducers, and safety relief valves. Check with the component manufacturer if any doubt exists as to whether certain components should be isolated from the rest of the system during pressure tests.

3. Before beginning the pressure test in step 5, ensure all defrost heaters are disconnected or by-passed.

4. Open all valves, either manually or by energizing the solenoids, including the following:

- ball valves to circuits, branches, satellites, condenser, heat reclaim, receiver, etc.;
- main liquid line solenoid valve;
- suction stop EPR valves;
- both sides of condenser and heat reclaim piping; and
- de-energize the solenoid valves (which are normally open).

5. Pressure Testing for leaks

- Charge system with regulated dry nitrogen and the appropriate tracer gas to bring system pressure up to 300 psig minimum. GreenChill does not condone the use of fluorinated refrigerants (all CFCs including R-12, all HCFCs including R-22, HFCs) as tracer gases. CFCs and HCFCs may not be used due to the harm they cause to the earth's ozone layer.
- Check system access points to verify pressurization.
  - Note: Branches may be tested in segments to reduce the time needed to locate leaks and associated wasted test gas. However, for the final test, all valves must be open.
- If leak is found, carry out the following procedure:
  - isolate leak from rest of system;
  - repair leak;
  - retest area to verify leak has been repaired;
  - re-pressurize the area to 300 psig; and
  - before continuing, make sure all valves that were closed to isolate the leak are opened again after the leak has been repaired.
- After system has been checked for leaks and all leaks have been repaired and retested, the system must stand, unaltered, for 24 hours with no more than a +/- 1 pound pressure change from 300 psig, using the same gauge. Ambient air temperature changes may lead to a slight increase or decrease in pressure.
- If system does not drop below 300 psig within the 24 hours, the system is then ready to be evacuated.
- Release the nitrogen charge to the atmosphere (make sure you have adequate ventilation).

6. Pre-Evacuation

Nitrogen, air, and moisture can remain in the system if the system is not properly evacuated. Moisture causes expansion valve ice blockage, wax build up, and acid in the oil.

Before beginning the evacuation process, make sure you observe the following:

- ensure system is completely depressurized;
- plan procedures so breaking the vacuum with refrigerant does not introduce contaminates into the system;
- the evacuation pump should be connected to three points on the rack, unless the system is small (if the system is small, the evacuation pump may only need to be connected at 2 points);
  - the $^{3}/_{8}$ inch flare ports are ideal for these connections,
  - copper lines are preferred over hoses, and
  - if any hoses are used, they must be special vacuum hoses, as standard pressure hoses tend to collapse under high vacuum and increase the time required to fully evacuate the system;
- Vacuum pump:
  - Vacuum pumps should be rated at 8 cfm or larger. Pumps should be connected to several branch circuits to access all components of the system.

  - ∗ *Be sure each pump is tested prior to use and vacuum sensors are in working order. The pump must be able to achieve a vacuum of at least 300 microns. Test vacuum gauges and vacuum sensors according to manufacturer's instructions.*
  - Use clean vacuum pump oil as recommended by the pump manufacturer.
  - Make sure electrical connections to the pump are secure and uninterrupted.
  - Check all vacuum pump connections for leaks.
  - Monitor the pump for signs of normal operation (e.g. "vapor" from the pump exhaust early in the procedure that tapers off).
- Lines and valves:
  - Use all copper lines or hoses that are suitable for vacuum duty.
  - Use packless valves.
  - One large vacuum pump can be used, if a header is connected to three different points on the system.
  - All schrader valve caps need to be properly tightened and checked. Check the condition of o-ring in Schrader valve caps.
  - All access valves need to be properly tightened and o-rings intact. In a deep vacuum, the stems will draw in and cause a loss of vacuum. This will not be noticed during a pressure test.
- Micron vacuum gauge (digital, analog, LED)
  - Before beginning evacuation, calibrate the micron gauges per manufacturer's instructions.
  - Verify with a gauge that the vacuum pump can pull a vacuum of at least 300 microns.
  - Measure vacuum at a minimum of two locations. These two locations must be at the most extreme positions of the system.

7. Stairstep Evacuation Procedure

Vacuum requirements may be dictated by customer and/or code requirements.

- Pull a system vacuum down to at least 1000 microns (+/- 50 microns) and close the vacuum header valves. If the system cannot pull a vacuum at any step and returns to atmospheric pressure, which is an indication of a leak, test for and repair the leak using the previously described procedure with tracer gas.
- If the 1000 micron vacuum holds for 30 minutes, break the vacuum with dry nitrogen to a pressure of 2 psig
  - ∗ ***<u>Do not exceed micron gauge transducer limits or transducer will be damaged!</u>***
- Install system suction and liquid drier cores.
- Pull a second vacuum to a minimum of 500 microns.
- Close vacuum header valves.
- If the 500 micron vacuum holds for a minimum of 30 minutes, then break the vacuum with the refrigerant to be used in the system to a pressure of 2 psig.
- Pull a third vacuum to a minimum of 300 microns.
- Close vacuum header valves and allow system to stand for a minimum of 24 hours.

- If the 300 micron vacuum holds for 24 hours with a maximum drift of 100 microns over the 24 hour period, then the system is ready to be charged with refrigerant.
- Break the vacuum with the refrigerant to be used in the system and charge the system with refrigerant.
- Add oil to the compressors, oil separator and oil reservoirs, if equipped.

8. Charging

- Leave open:
  - Ball Valves – to circuits, satellites, condenser, heat reclaim, receiver
  - Main liquid line solenoid valve - should now be under control of the electronic controller
  - Branch circuit liquid line solenoid valves – back out manual open stems
  - Suction Stop EPR – should now be under control of the electronic controller
  - Split condenser – should be operating under pressure controls
  - Verify operation of condenser fans and rotation direction
  - Verify operation of case and evaporator fans to avoid flood back
- Close ball valve immediately downstream of the receiver.
- Connect proper refrigerant tank to receiver access port through a liquid line drier.
- Charge receivers to 60% on the liquid gauge or to the point of pressure equalization
- Disconnect refrigerant tank from the receiver access port
- Open ball valve immediately downstream of the receiver
- Continue charging system by connecting proper refrigerant drum to the suction header
  - Start the compressor with the lowest capacity rating to speed up charging process
  - Isolate refrigerant circuit liquid line and charge through that port
  - Charge system to 30% of the receiver on the liquid gauge
  - Set compressor and all pressure controls
  - Suction pressure should remain below a pressure corresponding to zero degrees Fahrenheit low temp system. Suction pressure should remain below a pressure corresponding to forty degrees Fahrenheit for medium temp system
  - Turn on additional compressors as needed
  - Avoid adding more oil until system is properly charged

9. Final Check

- Now that the system is operational, conduct a complete walk-through of the system with a leak detector to make sure no leak has occurred in mechanical fittings due to vibration or pipes rubbing together.

The GreenChill Advanced Refrigeration Partnership is an EPA cooperative alliance with the supermarket industry and other stakeholders to promote advanced technologies, strategies, and practices that reduce refrigerant charges and emissions of **ozone-depleting substances** and **greenhouse gases**.

Working with EPA, GreenChill Partners:

Transition to non-ozone-depleting refrigerants;
Reduce refrigerant charges;
Reduce both ozone-depleting and greenhouse gas refrigerant emissions; and
Promote supermarkets' adoption of advanced refrigeration technologies.

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