# Technical Requirements

## Refrigerant Charging and Leak Prevention (Formerly Appendix A)

These Technical Requirements apply to all HPD projects that include field-charged and connected refrigerant lines (i.e., not self-contained "packaged" heat pump systems). These are in addition to all requirements outlined in NYC codes, zoning, NYS Clean Heat program requirements (and the associated requirements of participating utilities) and the HPD Design Guidelines. In some cases, these Technical Requirements are more stringent than required by codes or by the Clean Heat requirements, and in those cases, these requirements shall be followed.

All technicians charging refrigerant lines and connecting refrigerant piping shall:

- Certify in writing that they have received and read this document using signature block on Page 8.
- Be certified to EPA 608 and shall have copies of their certification on-site.

### Introduction

Refrigerant charging and leak prevention is critical for several reasons:

1. Refrigerant leaks contribute substantially to climate change. The beneficial effects of electrification can be lost if refrigerant leaks.
2. Refrigerant leaks can increase the energy usage and operational costs for the building.
3. Refrigerant leaks can lead to system performance issues that cause inadequate heating in winter and inadequate cooling in summer. These comfort issues may create substantial health risks and could result in potential code violations for indoor temperature control.
4. Refrigerant overcharging increases compressor wear and tear and energy use.
5. A2L refrigerants are mildly flammable so leak prevention is especially important.

### General

- Use digital pressure and vacuum gauges for pressure and vacuum measurement.
- Minimize refrigerant pipe lengths (locate outdoor unit as close as possible to indoor units), to minimize refrigerant quantity.
- Use continuous line sets where practicable.
- Use brazed joints in less accessible future locations or press fit method with press fit tools.
- Protect line sets from damage during transportation and storage, before installation.

- Allow for pipe expansion and properly support and protect line sets both inside and outside the structure.
- Avoid enclosing line sets in wall cavities, where they cannot be inspected and where they may be inadvertently punctured. If line sets are enclosed in a wall, or run through studs, joists or rafters they must be continuously protected by shield plates. Protective steel shield plates having a minimum thickness of 0.0575 in. (15-gauge plain steel or 16-gauge galvanized steel) shall cover the area of the tube and shall extend a minimum of 2.0 in. (51 mm) beyond the outside edge of the tube.
- Avoid joints in hidden locations such as wall cavities, where leaks are harder to find and repair. Where joints are located in such locations, provide an access panel at each joint to allow finding and repairing leaks at joints.
- Contractor shall confirm pipe lengths by field measurements of refrigerant piping, the total length of one pipe only (not all pipes), from the connection at the outdoor unit to the connection at all indoor units. Calculate the refrigerant charge to be added using manufacturer requirements. Submit the record of measured pipe lengths and refrigerant charge calculation with the charging report (see Quality Control below).

## Flare Joints

- Cut tubing, leaving a few inches of slack in case a flare is defective and must be re-made.
- Use a good quality tubing cutter, work gradually to avoid deforming the tubing, and inspect to make sure that the cut is square.
- Debur to remove the thin lip of copper inside the tubing but be careful not to gouge or thin the tubing wall.
- Some line sets come shipped from the factory pre-flared. These factory flares vary widely in quality and are sometimes damaged in transit. We recommend always making new flares on-site.
- Use good quality flaring tools that have the following features:
    - A gauge or stop that ensures that tubing is positioned at the correct depth
    - An “eccentric” cone that rolls around the interior of the tubing, forming it into shape
    - A clutch that disengages the cone when the flare is complete.
- Check the size and roundness of the flare using a flare sizing gauge.
- Used and maintained in accordance with manufacturers’ directions, battery-powered flaring tools produce consistent, high-quality flares.
- Prior to assembly, inspect the flare to ensure that it is symmetrical and that contact surfaces are clean, shiny, and free of scratches.
- Apply a thin coat of refrigeration oil or an approved assembly lubricant to the contact surface to improve the seal and to the back of the flare nut to keep it from binding.
- Align the cones and hand-tighten the flare nut.

- Tighten the flare nut to the manufacturer-recommended torque using a torque wrench. If the assembly is too loose, the surfaces will not form a good seal; if it is too tight, the flare will crack or split. Torque specs are found in manufacturers' instructions and range from around 13 ft-lbs for ¼" tubing to around 56 ft-lbs for ⅝" tubing. Use a torque wrench with a digital gauge.
- Only use flare nuts supplied with the equipment. Manufacturers' torque specs are for OEM flare nuts, which tend to be longer (with more threads) and of better quality than aftermarket ones.
- If subsequent testing reveals a leak at any flare connection, do not attempt to tighten it further; cut out the defective flare and make a new flare.

## Brazed Joints

- Use brazed joints in locations recommended by the heat pump manufacturer, and in difficult-to-access locations for example, those enclosed in walls or high off the ground.
- Brazing requires a hot work permit. Safety measures, including personal protection, maintenance of a designated work area, clearance to combustibles, fire watch, and fire extinguishers, should be strictly observed.
- Use a heat shield, wet rag, or heat-blocking compound to protect nearby components, such as service valves, metering devices and refrigerant sensors, from damage.
- Flow nitrogen through the tubing while brazing to prevent formation of copper oxide scale. When servicing A2L systems, purge them thoroughly with nitrogen to remove residual refrigerant. Continue flowing nitrogen throughout the brazing process.
- Press fit Joints
- Installed correctly, press-fit refrigerant fittings offer a low-leakage, flame-free alternative to flaring and brazing. Be sure to follow manufacturer's instructions carefully.
- Use a good-quality tubing cutting with a sharp cutting wheel to make a clean, square cut.
- Debur the tubing to remove any lips or rough edges.
- Clean the tubing using a hand pad or sanding cloth to remove dirt and oxidation.
- Inspect the tubing for scratches or other defects.
- Mark the tubing with the correct insertion depth using a permanent marker.
- Insert the tubing to the correct depth.
- Align the press tool's jaws squarely over the fitting.
- Activate the tool to complete the press cycle.
- Check the joint for leaks under pressure with a bubble solution. Use the same testing procedure as for a flare connection.
- While correctly installed press fittings have very low leakage rates, we recommend that access panels be provided wherever press fittings are used

## Pressure Testing Checklist:

- ❑ Inspect lines sets for damage such as kinking.
- ❑ Fill the system with nitrogen for a standing pressure test. Once the system is pressurized, isolated, and allowed to stabilize, it must hold steady for a specified period. Pressurization should be done gradually so that catastrophic leaks are caught with minimal waste. The target pressure is 550psig or higher as specified by the manufacturer.
- ❑ Test for a minimum of one hour for systems with total line-set length <200' (typically single zone systems) or 24 hr for systems with line-set length > 200' (most VRF/multizone systems).
- ❑ Use a digital pressure gauge with a resolution of 0.1 psi, this increased accuracy allows for faster tests. Do not use analog pressure gauges. A drop in pressure indicates a leak, which should be repaired before evacuation.
- ❑ Measure the outdoor air temperature in the shade at the beginning and end of the test. Correct for the air temperature by 1 psi per °F change in temperature. Note that if the outdoor air temperature increases, an increase in pressure could still indicate a leak. For example, if average pipe/nitrogen temperature increases by 6°F, an increase in pressure of 6 psi is expected. A smaller increase of 3 psi indicates a likely leak. If any deviation from expected pressures is found, a leak should be suspected, investigated, and repaired.
- ❑ Apply an approved leak-testing solution (not household dish detergent) to all flares and other site-made connections. Check each fitting for bubble formation, using a flashlight and inspection mirror when necessary to inspect areas that are hidden.
- ❑ Make a record of test results, a photo of digital gauge with time stamp and add results to the Heat Pump Tracker Summary Report (see submittals section). Incremental partial tests are in contractors' interest to avoid reopening walls; however, only the final full system test must be documented with option for 3rd party witnessing.

## Evacuation & Vacuum Decay Test Checklist:

- ❑ Once the system has been successfully pressure-tested with nitrogen, evacuate the system. Evacuation removes air and moisture from the system and provides additional leak check.
- ❑ The vacuum pump should be correctly sized (typically 6-12 cfm), be approved for use with A2L refrigerants, and be capable of achieving an ultimate vacuum of 20 microns.
    - https://www.youtube.com/watch?v=QJTFESe2VhMU
    - Use a digital vacuum micron gauge with bluetooth app for vacuum decay charting such as the BluVac+ Pro in a time series chart. Do not use an analog vacuum gauge.
    - Fresh vacuum pump oil to change during evacuation of wet systems
- ❑ Once the system is pulled down into a deep vacuum (below 100 microns), isolate the system from the vacuum pump, and observe changes in vacuum pressure. If the system remains below a decay target of 200 microns after 15 minutes or more of isolation, the system passes.

If the system fails, it may be because air is entering through a leak or because excess moisture remains in the system.

- ❑ HPD does not require a triple vacuum. If the heat pump manufacturer requires a triple vacuum, use the triple vacuum procedure for the final of the three vacuums.
- ❑ Use a bluetooth-enabled vacuum gauge, paired with a mobile app, to provide a time-stamped record of the vacuum test result. Alternatively, take a photo of the measurements and append them to a completed test record card (sample test record card information is included at the end of this appendix; use of alternate approved documentation system with all critical information is also acceptable).

## Charging the System and Final Leak Checks

- ❑ Based on measured line set lengths, confirm how much additional refrigerant must be added.
- ❑ Charge the system with refrigerant. Use a digital scale to accurately measure the required refrigerant into the system after the vacuum test.
- ❑ Once the system has been charged with refrigerant, make a final leak check on the service valves and charging ports, with both an approved bubble solution and an electronic leak detector.
- ❑ Write the total measured liquid line lengths and final total charge in permanent marker on the outdoor unit and inside the control access panel of the outdoor unit.
- ❑ To minimize risk of tampering or refrigerant theft, install locking caps on charging ports.
- ❑ Avoid connecting hoses and gauges to charged systems unless absolutely required. Using gauges will cause unnecessary release of refrigerant that is trapped in the gauge hoses. Most variable-speed heat pumps and VRF systems are “critical charge” systems that can only be correctly charged by “weighing in.” Field charge adjustments using superheat/subcool are not allowed.

## Required Submittals[i]

**Submittals prior to Construction:**

- ❑ Refrigerant Testing Plan conforming to the requirements of these Technical Requirements
- ❑ Technician certifications (see above) prior to any work by these technicians, utilizing a copy of this Appendix A signed by all technicians who perform pipe connections and/or refrigerant charging (see signature block at end of this document)

**Submittals During Construction**

- ❑ Notice to REDi TAP and/or HPD project management team at least 2 weeks in advance of any field refrigerant testing, to allow oversight coordination and witness testing
- ❑ Refrigerant charging reports and Test Cards, as specified in this Technical Requirements Section, as work proceeds.

- ❑ Copies of signed and certified refrigerant testing reports for each refrigerant line section as work proceeds.

**Prior to Completion or Final Payment:**

- ❑ Project-specific Operations and Maintenance Manual (for Owner's use) describing all operations and maintenance requirements and recommendations for the life of the equipment.
- ❑ Complete refrigerant charging report, including:
  - A Heat Pump Tracker Summary Report (sample prepared for REDi:EB TAP is available through HPD). Report shall include, at a minimum, all of the following:
    - Project name & Building Address
    - Heat pump tag with model and serial number
    - Refrigerant charge from design/submittal
    - Measured line lengths by diameter
    - Added refrigerant charge per system "as-built"
    - Dates & Tech initials for pressure, Evac, & Charging of each system
    - Notes per heat pump
  - Organized/indexed supporting documents
    - As-built VRF report reflecting as-built lengths & field charge
    - A copy of manufacturer instructions
    - Photographs of bubble testing
    - Photographs of electronic leak tests
    - Time-stamped reports of vacuum decay tests generated by mobile apps.
    - A sheet that allows the facility manager to track leaks associated with each heat pump.

## Sample Refrigerant Test Cards[ii]

| **Refrigerant Test Record Card - Nitrogen Pressure Test** | | | | | | |
|---|---|---|---|---|---|---|
| Project: | | | | | | |
| Date: | Technician: | | | | | |
| System ID/Notes: | | | | | | |
| Test Parameter | Initial Reading | Final Reading (Actual) | Final Reading (Adjusted) | Observed Change | Pass/Fail | Notes |
| Test Pressure (PSI) | | | | | | |
| Ambient Temperature (F) | | | N/A | | N/A | |
| Total Test Time (Hrs) | | | N/A | | N/A | |

| **Refrigerant Test Record Card - Vacuum Test** | | | | | |
|---|---|---|---|---|---|
| Project: | | | | | |
| Date: | Technician: | | | | |
| System ID/Notes: | | | | | |
| Test Parameter | Initial Reading | Final Reading | Observed Change | Pass/Fail | Notes |
| Micron Level | | | | | |
| Total Test Time (Mins) | | | | | |

**Signature Section**[iii]

*By my signature below, I hereby certify that I have completely read, understand, and am in compliance with the requirements of this Technical Requirement document:*

| Name (print or type) | Signature | Company Affiliation | Cert # |
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[i] Submittals have been aggregated and moved to bottom of document
[ii] New section added for May 2026
[iii] New section added for May 2026