15650 REFRIGERATION

PART 1 GENERAL

1.01 All refrigeration equipment submittals shall be forwarded to the Planning, Design & Construction Department for comment by the reviewing engineer and by a designated representative of the Refrigeration Shop.

1.02 The Construction Contract Documents shall require an additional cost alternate price to provide and install refrigeration equipment. The intent of this breakout cost is to provide an opportunity to make the PDC Refrigeration Shop resource directly and competitively available for the Cornell University project manager.

1.03 The Construction Contract Documents shall require all refrigeration work to be done by certified refrigeration technicians, and shall be labeled in accordance with 40 CFR part 82, subpart F “Proper Refrigerant Practices.”

1.04 All refrigeration equipment and associated appurtenances shall be designed, installed, and accessorized in accordance with ASHRAE:

   A. Guideline 3–1990: Reducing emission of fully halogenated chlorofluorocarbon refrigerants in refrigeration and air conditioning equipment and applications.


   C. Mechanical code of New York.

1.05 The following requirements shall augment Standard 15–1994:

   A. Provide positive ventilation of all mechanical rooms with refrigeration equipment. Ventilation shall be activated from an emergency switch located outside any of the mechanical room access doors.

   B. Provide a pre-approved (by PDC) refrigerant leak detection panel (e.g.: Mine Safety Instruments, MSI) in all mechanical rooms with refrigeration systems of combined capacity greater than 50 tons. Tie the alarm output to the building DDC.

   C. Ergonomic considerations – Refrigeration systems shall be designed with consideration for maintenance ergonomics. Crawl space locations for equipment shall be avoided. Instead, equipment shall be mounted to facilitate maintenance efforts to both reduce maintenance costs and reduce risk for injury.
D. **Refrigerator Power and Heat Rejection:** In new facility design, dedicated corridor space shall be provided for anticipated refrigerated storage needs. Fan coil units or dedicated (plate heat exchanger based) process chilled water loops shall be utilized for removing heat energy whenever the heat load exceeds the ability of the ventilation flow for cooling. Refrigerators of all temperature classifications, medium temperature through ultra-low temperature, shall be provided with sufficient ventilation to assure sufficient heat rejection for reliable operation. Additionally, backup requirements shall be established prior to installation and critical long-term storage shall be provided with liquid nitrogen backup and/or emergency backup power. At a minimum, a dedicated power supply shall be provided for ultra-low temperature freezers.

In existing facilities, ventilation capabilities must be shown to provide sufficient heat rejection for the local load conditions.

**PART 2 DESIGN GUIDELINES**

2.01 **REFRIGERANT AND REFRIGERANT ACCESSORIES**

A. Liquid line filter-dryers and suction line filters shall be included in all systems. All filter connections are to be soldered and a full line size valved bypass will be installed. Schrader Gauge connections shall be provided on the filter housing.

B. Thermal expansion valve systems are preferred over capillary tubes for field-assembled systems.

C. A receiver shall be provided for refrigerant on all pump-down systems.

D. New refrigeration systems shall not require Chlorofluorocarbon (CFC) refrigerants.

E. All refrigerant relief lines shall be piped to outdoor locations. All systems with a 50 lb. or greater refrigerant charge shall have refrigerant relief lines.

F. Capillary tubing associated with sensing lines shall be provided with silicon vibration damping at all coiled excess locations. Provide silicone damping on two sides of each coil.

G. On all centrifugal or screw chillers, provide a pump-out unit and receiver for refrigerant charge transfer and storage.

H. A rupture disc shall always have a relief valve with sniffer connection downstream such as the Henry Valve Corp. “Sentry Rupture Disc Assembly.” Integral alarm contacts shall be provided with connections to the EMCS system.
2.02 CONTROLS

A. As-built documentation requirements shall include:

A complete control diagram and wiring connection diagram permanently affixed to the inside of the compressor control cabinet and included in the Building Maintenance and Operating Manual. It shall include a material list of all refrigeration system control components and building automation controls interfaces for external control, system alarming, and monitoring.

A complete and separate refrigeration system schematic, including a material list of all refrigeration components: part name, manufacturer, and part number. All refrigerant line sizes shall be indicated.

B. Systems that operate all year shall be provided with automatic control components or system design to prevent liquid refrigerant slugging and associated compressor failures. On systems having reciprocating compressors, pump down systems are preferred with short cycle control monitoring.

C. All new refrigeration systems shall be provided with high and low pressure safety cutout switches. The high-pressure switch shall not reset automatically, and the status shall be integrated into the campus EMCS for alarm monitoring.

D. All compressor start circuits shall have an adjustable, solid-state time delay to prevent compressor short cycling.

E. All hot gas bypass, head pressure and suction pressure controls, or evaporator pressure regulator designs must be approved by Planning, Design & Construction.

F. Low Ambient Temperature Controls shall be provided on all systems with condensers or condensing units located outdoors, having year around operations.

2.03 COMPRESSORS

A. Compressor type shall be selected with careful consideration of the refrigeration system application.

1. Field Assembled Systems: Semi-hermetic reciprocating compressors are preferred for field-assembled systems such as walk-in cooler and environmental growth chambers applications. In existing facilities, provide new compressors and associated components to match the existing equipment and facilitate maintenance using the established parts inventories.
2.04 CONDENSERS

A. Air-cooled condenser design shall be optimized in order to meet minimum Seasonal Energy Efficiency Ratio requirements as established by New York State Energy Code. Indoor air-cooled condensing units should be remotely located in a mechanical room space that is ventilated with outside air (provides heat in winter and is inexpensively ventilated all year).

B. Heat rejection for refrigeration systems should be accomplished in the most economically efficient manner possible, subject to local constraints, physical limitations, and life cycle costs. Lowest first cost should not dictate the method by which refrigeration systems are applied. Where chilled water is readily available, it can be used for heat rejection. However, an isolation heat exchanger is necessary to prevent condenser fouling from reversion of water treatment chemicals. Multiple refrigeration installations may be the best candidates for this type of application. Single pass, domestic water-cooled installations shall not be installed.

C. If chilled water is used, provide back-up domestic water-cooling connections with removable spool pieces and backflow preventers on the domestic water.

D. Air-cooled condenser fin spacing should be as large as possible to prevent plugging.

E. Plate type fins are required. Do not specify expanded surface foil type fins.

2.05 PIPING

A. All pipe sizes and routings shall be clearly shown on the mechanical drawings. All trap locations and reduced suction risers shall be clearly denoted.

B. All coil connections shall be shown as part of a system refrigerant flow diagram or as a separate detail.

C. Systems requiring field run piping shall have a system refrigerant flow diagram.

PART 3 INSTALLATION GUIDELINES

3.01 PIPING

A. All refrigerant lines must be supported by Unistrut (or equal) hangers and supports. Horizontal suction lines (insulated) may lie on hangers without being clamped, provided they are reasonably free of movement and secure from vibration. All vertical liquid and suction lines must be clamped. All discharge piping to and from remote air cooled condensers shall also be securely clamped to supports. Clamp assemblies shall be manufactured by Hydra-Zorb, or as approved.
All lines that require clamping shall be installed according to the following recommended spacing:

<table>
<thead>
<tr>
<th>LINE SIZE</th>
<th>MAXIMUM SPAN</th>
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<tbody>
<tr>
<td>5/8&quot; and smaller</td>
<td>5' - 0&quot;</td>
</tr>
<tr>
<td>1-1/8&quot;</td>
<td>7' - 0&quot;</td>
</tr>
<tr>
<td>1-3/8&quot;</td>
<td>8' - 0&quot;</td>
</tr>
<tr>
<td>1-5/8&quot;</td>
<td>9' - 0&quot;</td>
</tr>
<tr>
<td>2-1/8&quot;</td>
<td>10' - 0&quot;</td>
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B. A cadmium-free silver bearing solder with a minimum of 45% silver shall be used on all connections in the suction discharge and liquid lines. When soldering components such as vibration eliminators, ball valves, etc., the manufacturer’s instruction for brazing or soldering must be followed (wrapping device in wet cloth, etc.). At all times during brazing or soldering, nitrogen purge shall be used.

C. Reduced suction risers should be denoted on drawings, when required, for vertical suction line runs. A pre-formed trap should be installed (horizontal line size) at the foot of all suction risers.

D. All tubing shall be AC and R type “L” and remain capped until used. Soft copper may be used in non-accessible areas. Joints in non-accessible areas will not be permitted. All 90° fittings shall be of the long radius type. Close ruff or short turn ells will not be permitted on any installation. While soldering, an inert gas such as nitrogen must be used to prevent oxidation on the inside of tubing.

E. The refrigeration contractor, after system piping is complete, will leak check the entire system with a good electronic leak detector, after bringing the pressure up to 200 PSI with nitrogen and introducing Freon. After leak checking is complete, and all leaks are repaired, a good, high vacuum pump capable of handling 5 CFM shall be connected to both the low side and the high side of the system. Connections shall be made with copper tubing or high vacuum pump hoses having a diameter of at least 3/8" (three eighth inches). The pumps shall be operated until a vacuum of 200 microns is obtained, and can be maintained below 250 microns for 15 minutes. The vacuum shall be in microns and determined by an electronic micron meter. At this point, the vacuum shall be broken by the introduction of the correct refrigerant into the system. The refrigerant shall be supplied through a drier until the pressure is brought up to 0 PSIG. The system shall not be fully charged with refrigerant until the evacuation procedure specified above is completed and specified vacuum has been reached.

F. Refrigerant shall be charged in strict accordance with CFR 40 Requirements for Refrigerant Handling. Cylinders shall be weighed as necessary so that an accurate check of system charge can be recorded for each system. This record should be turned over to the Cornell University Refrigeration Shop Supervisor and included in the refrigerant compliance database.
G. Quick connect couplings are not allowed in any systems. Do not use them.

3.02 VIBRATION ELIMINATION

A. Manufacturer’s recommendations shall be followed in all cases.

B. All vibration eliminators shall be installed parallel to the compressor crankshaft.

3.03 START-UP AND CHECK-OUT

A. In addition to the manufacturer’s recommended start-up procedures, the following parameters are to be recorded once the system is stabilized.

- Compressor voltage (all phases)
- Compressor current (all phases)
- Compressor suction pressure/temperature (and superheat)
- Compressor discharge pressure/temperature
- Evaporator coil suction superheat (not to exceed 10°F)
- Outside air temperature

These readings are to be turned over to an authorized representative of Cornell and included in the O&M Manual when start-up is completed.

B. A final acceptance will only be made after inspection by an authorized representative of Cornell from the Department of Planning, Design and Construction, or the Air Conditioning and Refrigeration Shop.

C. All replaceable core filter and filter-drier elements shall be replaced by the Contractor thirty (30) days after system start-up.

3.04 REFRIGERANT PIPING INSULATION

A. The type of insulation required will be closed cell expanded foam in a tubular form (e.g.: Armstrong Armaflex).

B. Refrigerant suction piping is required to be insulated in its entirety, and all accessories that are a part of the refrigerant suction piping (e.g.: valves, vibration eliminators, P-traps and filters).

C. Refrigerant hot gas bypass piping is required to be insulated in its entirety.

D. Insulation must be of the proper size for the piping that it is to be installed on.

1. Insulation installed on horizontal runs of refrigerant piping will require that an insulation protection shield be installed between the insulation and the pipe hanger.
2. All seams and joints in the insulation will be required to be sealed with the proper adhesive, for the product being used, to provide a continuous vapor barrier.

3. Piping clamps that are in contact with the suction line are required to be covered with insulation.

4. Insulated piping that passes through a wall is required to be protected in a piping sleeve.

5. All thermostatic expansion valve sensor bulbs are required to be covered with insulation.

6. Insulation wall thickness requirements:
   - 3/4" Low temperature refrigeration equipment. (e.g.: freezers)
   - 1/2" Medium temperature refrigeration equipment. (e.g.: walk-in coolers)
   - 1/2" Air-conditioning equipment.

7. Requirements for insulation that will be exposed to the weather:
   - Install a vinyl covering.
   - Install an aluminum covering.

END OF SECTION