SECTION 23 7413

PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

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LANL MASTER SPECIFICATION SECTION

|  |
| --- |
| Rev. 4 Summary of changes Updated manufacturers’ names and fan types, inserted notes to use variable speed compressors if available, and minor editorial updates. |

Word file at <https://engstandards.lanl.gov>

This template must be edited for each project.  In doing so, specifier must add job-specific requirements.  Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.  Once the choice is made or text supplied, remove the brackets.  The specification section must also be edited to delete requirements for processes, items, or designs that are not included in the project -- and specifier’s notes such as these.  This template is tailored to meet requirements contained in the LANL Engineering Standards Manual (ESM). To seek a variance from requirements in this section that are applicable, contact the ESM Mechanical[POC](http://engstandards.lanl.gov/POCs.shtml#mech). Please contact POC with suggestions for improvement as well.

When assembling a specification package, include applicable specification sections from all Divisions, especially Division 1, General Requirements.

This template was developed for ML-4 projects.  For ML-1, 2, and 3 applications, additional requirements and independent reviews should be added if increased confidence in procurement or execution is desired; see ESM Chapter 1 Section Z10 Specifications and Quality sections.

This template was developed to meet the requirements of ASHRAE 90.1-2019. The designer is responsible to update the template if the edition differs from the above for the specific project.

Seismic: If all outdoor units are not exempt from seismic design per ASCE 7 paragraph 13.1.4 then, prior to attempting to edit this section to be project-specific, refer to Sections 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems*, and 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, as applicable. To edit this section for job-specific seismic requirements, refer to author notes that begin with “Seismic.” Also, see the Seismic Specification Guide for Mechanical Non-Structural Components webposted with the LANL Master Specifications [here](https://engstandards.lanl.gov/seismic-editing.shtml) for guidance on properly editing this section.

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1. GENERAL
	1. SUMMARY
		1. Section Includes:
			1. Packaged air conditioning units (AHUs) [up to 25 Tons] [25 Tons to 60 Tons]
	2. PERFORMANCE REQUIREMENTS
2. Air conditioning units and associated motors shall perform satisfactorily in the following service conditions:
	* + 1. Elevation: 7500 feet above sea level.
			2. Maximum ambient temperature: 104 degrees F.
			3. Minimum ambient temperature: Minus 20 degrees F.
			4. 24-hour average temperature: not exceeding 86 degrees F.
			5. Maximum solar heat gain: 110 W/sq ft.
3. Supplier-provided control systems, including instruments, signal transmissions, panels, cabinets, and other instrumentation and control (I&C) requirements shall be coordinated with the I&C Subcontractor and in accordance with Section 25 5000, *Integrated Automated Facility Controls*. Some equipment controls are specified in other portions of the subcontract documents. As part of the work of this section, coordinate with these other suppliers and trades to provide complete and working equipment controls.
4. It is the responsibility of the subcontractor to read and conform to all specification sections, review all drawings, and coordinate with all equipment suppliers under other specification sections.

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Seismic: Delete paragraph below if units are exempt from seismic design. However, if paragraph applies:

* Edit it in accordance with content of 22 0548.23 and/or 01 8734
* The Electrical drawings for the controller shall also state that the controller is a Designated Seismic System

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1. Seismic Performance Requirements: The unit(s) shall remain in place without separation of any parts when subjected to the design basis earthquake [per Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*] [as represented by the seismic forces derived from the criteria indicated [on the Drawings] [in Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems]].*

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Seismic: If the AHUs are exempt from seismic design, then delete both 01 8734 and 22 0548.23. Otherwise, see the seismic portion of the previous author note.

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* 1. RELATED SECTIONS
1. Section 01 2500, *Substitution Procedures*
2. Section 01 6000, *Product Requirements*
3. [Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, for requirements.]
4. [Section 01 8113.13 *Sustainable Design* **[LEED v4 and]**Guiding Principles 2020: Requirements for water efficiency, energy efficiency, material composition, and indoor air quality requirements]
5. [Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems*, for [seismic-design criteria,] submittal requirements, devices for seismic restraint, and installation requirements for these devices.]
6. Section 23 1123, *Facility Natural-Gas Piping*
7. Section 23 2113, *Hydronic Piping*
8. Section 23 2115, *Steam and Condensate Heating Piping and Specialties*
9. Section 23 3101, *HVAC Ducts*
10. Section25 5000*, Integrated Automated Facility Controls*
	1. REFERENCES
		1. Air-Conditioning, Heating and Refrigeration Institute (AHRI)
			1. AHRI 210/240 – *Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.*
			2. AHRI 270 – *Sound Performance Rating of Outdoor Unitary Equipment.*
			3. AHRI 340/360 – *Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.*
		2. Air Movement and Control Association International (AMCA)
			1. AMCA 500-D – Laboratory Methods of Testing Dampers for Rating
		3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
			1. ASHRAE 52.2 – *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*
			2. ASHRAE 90.1 – *Energy Standard for Buildings Except Low-Rise Residential Buildings.*
		4. ASTM International
			1. ASTM B117 – *Standard Practice for Operating Salt Spray (Fog) Apparatus*
		5. Institute of Electrical and Electronics Engineers (IEEE)
			1. IEEE 841 – *Premium-Efficiency, Severe-Duty, Totally Enclosed Squirrel Cage Induction Motors from 075 kW to 370 kW (1 HP to 500 HP)*
		6. National Fire Protection Association (NFPA)
			1. NFPA 54 – *National Fuel Gas Code*
			2. NFPA 70 – *National Electric Code*
			3. NFPA 90A – *Standard for the Installation of Air-Conditioning and Ventilating Systems*
	2. ACTION SUBMITTALS
		1. Product Data: For each AHU:
			1. Include manufacturer's technical data.
			2. Include rated capacities, dimensions, required clearances, characteristics, and furnished specialties and accessories.
			3. Include energy efficiency ratings that meet ASHRAE 90.1 [FEMP designated product requirements] [Energy Star].
		2. [Sustainable Design Submittals:]

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Additional submittals may be required if the project is seeking LEED certification. Consult with the project’s LEED Accredited Professional.

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* + 1. Shop Drawings:
			1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
			2. Include diagrams for power, signal, and control wiring.
	1. INFORMATIONAL SUBMITTALS
		1. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
			1. Structural members to which AHUs will be attached.
			2. Roof openings.
			3. Roof curbs and flashing.
		2. Field quality-control reports.
		3. At Closeout:
			1. Operation and Maintenance Data: For AHUs to include in operation, and maintenance manuals.
			2. Refrigeration Appliance Inventory Form: Complete form as required by LANL (e.g., procedure EPC-CP-QP-0311).
			3. Sample Warranty: For special warranty.
	2. QUALITY ASSURANCE
		1. Cooling Capacity: Rate in accordance with [AHRI 210/240] [AHRI 340/360].

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Coordinate any special acoustical requirements with the project requirements

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* + 1. Sound Rating: Measure in accordance with AHRI 270.
		2. Energy Efficiency: Comply with the requirements of ASHRAE 90.1 [FEMP designated product requirements] [Energy Star].
		3. Performance Requirements: Conform to minimum [EER] [SEER] [IPLV] prescribed by ASHRAE 90.1 [FEMP designated product requirements] [Energy Star] when tested in accordance with [AHRI 210/240] [AHRI 340/360].
		4. Electrical: Meet the requirements of NFPA 70, Article 100.
		5. Insulation and adhesives: Meet requirements of NFPA 90A.
		6. Outside Air Damper Leakage: Test in accordance with AMCA 500-D.
	1. DELIVERY, STORAGE, AND HANDLING
		1. Section 01 6000, *Product Requirements*: Product storage and handling requirements.
		2. Protect units from weather and construction traffic by storing in dry, roofed location.
		3. [Protect AHUs from damage by storing off roof until roof mounting curbs are in place.]
	2. WARRANTY
		1. Furnish [five] [ ] year manufacturer’s warranty for compressors.
		2. Furnish [five] [ ] year manufacturer’s warranty for heat exchangers.
	3. EXTRA MATERIALS
		1. Furnish [one set] [ ] of [filters] [fan belts] for each unit.
1. PRODUCTS

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For AHUs that are not exempt from seismic, if project specification package includes 22 0548.23, and if mounting and/or anchorage devices are to be used that differ from those specified in 22 0548.23, they must be described herein (in PART 2).

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* 1. PRODUCT OPTIONS AND SUBSTITUTIONS
		1. Alternate products may be accepted; follow Section 01 2500, Substitution Procedures.
	2. AIR CONDITIONING UNITS, (SMALL CAPACITY) UP TO 25 TONS
		1. Manufacturers:
			1. [Trane Technologies] Model [ ].
			2. [Daikin Industries] Model [ ].
			3. [Aaon] Model [ ].

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Edit the following descriptive paragraphs to identify project requirements and to eliminate conflicts with manufacturers specified above.

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* + 1. Product Description: Self-contained, packaged, factory assembled and prewired, consisting of [roof curb,] cabinet, supply fan, evaporator coil, compressor, refrigeration circuit, condenser, [gas-fired heating section,] [electric heating coil,] [hot water heating coil,] air filters, mixed air casing, controls, and accessories.
		2. Configuration: [Downflow air delivery.] [Horizontal air delivery.] [As indicated on Drawings].
		3. Roof Mounting Curb: [14] [24] [ ] inch high, galvanized steel, channel frame with gaskets, nailer strips. Full perimeter type for mounting under entire unit.
		4. Cabinet:
			1. Designed for outdoor installation with weatherproof construction.
			2. Panels: Constructed of [steel] [galvanized steel] with baked enamel finish [meeting salt spray test in accordance with ASTM B117]. Furnish access doors or removable access panels.
			3. Insulation: Factory applied to exposed vertical and horizontal panels. [1/2] [1] [2] inch thick [neoprene coated] [aluminum foil faced] glass fiber with edges protected from erosion.
		5. Supply Fan: [Forward curved][backward curved] centrifugal type, resiliently mounted with [direct drive] [V-belt drive,] [adjustable variable pitch motor pulley] [high efficiency motor] [premium efficiency motor][multiple direct-drive plenum fans in a fan-wall arrangement]. Motor permanently lubricated with built-in thermal overload protection.
		6. Relief [Exhaust] [Return] Fan: [Forward curved][backward curved] centrifugal type, resiliently mounted with [direct drive] [V-belt drive,] [adjustable variable pitch motor pulley] [high efficiency motor] [premium efficiency motor]. Motor permanently lubricated with built-in thermal overload protection.
		7. Motors: Provide motors that comply with the requirements of IEEE 841.
		8. Evaporator Coil: Constructed of copper tubes expanded onto aluminum fins. Galvanized drain pan with piping connection. Factory leak tested under water. [Furnish coil with corrosion resistant coating capable of withstanding salt spray test of [1000] [ ] hours in accordance with ASTM B117.]

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Choices in the following paragraphs vary between manufacturers and with unit capacity. Select appropriate items available with unit size.

When project conditions warrant include type of compressor in the following paragraph. This may make specification proprietary as type of compressor differs between manufacturers. Generally, compressor types are scroll although some manufacturers use reciprocating compressors.

Units with multiple compressors generally start at 7-1/2 tons.

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* + 1. Compressor: Hermetically sealed, resiliently mounted with positive lubrication, and internal motor overload protection. Furnish [internal vibration isolators,] [external vibration isolators,] [short cycle protection].
			1. Use variable speed compressor when available
		2. Refrigeration circuit: [Furnish] [Furnish the following for each circuit] [fixed orifice control] [expansion device,] [thermal expansion valve,] [filter-drier,] [suction, discharge, and liquid line service valves with gauge ports,] [high and low pressure safety controls,] [and] [ ]. Dehydrate and factory charge [each circuit] with oil and refrigerant.
		3. Condenser:
			1. Coil: Constructed of Copper tube [aluminum] [copper] fin coil assembly [with subcooling rows] [and coil guard]. Factory leak tested under water. [Furnish coil with corrosion resistant coating capable of withstanding salt spray test of [1000] [ ] hours in accordance with ASTM B117.]
			2. Condenser Fan: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Motor permanently lubricated with built-in thermal overload protection. [Furnish high efficiency fan motors.]
			3. Furnish factory installed hail protection coil guard.

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Packaged AHUs shall include at least one of the following heating methods.

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* + 1. Gas-Fired Heating Section:
			1. Fuel: Natural gas.
			2. Heat Exchangers: [Aluminized] [Stainless steel, of welded construction].
			3. Gas Burner: [Atmospheric] [Induced draft] [Forced draft] type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and [automatic 100 percent shut-off pilot]. Require unit fan operation before allowing gas valve to open.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + 1. Electric Heating Coil:

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Specify single source power connection for units supplied with electric heat. Electric heating coil is only allowed when natural gas and/or steam are not available, as determined by the Mechanical POC.

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* + - 1. [Finned tube heating elements] [or] [Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings] easily accessible with automatic reset thermal cut-out, built-in magnetic contactors, galvanized steel frame, [control circuit transformer and fuse,] [manual reset thermal cut-out,] [airflow proving device,] [pilot duty toggle switch,] load fuses. [Single source power connection.] [Number of stages as indicated on drawings.] [Mercury contactors are not acceptable.]
			2. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + 1. Hot Water Heating Coil:
			1. [Factory mounted] [Field installed].
			2. Coil: Constructed of copper tubes expanded into aluminum fins. Factory leak tested under water.
			3. Furnish factory installed piping package with [modulating] [two-way] [three-way] control valve.
			4. [Furnish coil with corrosion resistant coating capable of withstanding salt spray test of [1000] [ ] hours in accordance with ASTM B117.]
		2. Air Filters: [1] [2] [4] inch [thick glass fiber disposable media in metal frames.] [Minimum Efficiency Reporting Value [MERV 8], based on ASHRAE 52.2]
		3. Mixed Air Casing:

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ASHRAE 90.1 requires outside air dampers to have the following maximum air leakage. Verify availability with basis for design manufacturer.

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* + - 1. Outside Air Damper Leakage: Maximum leakage rate of [3] [ ] cfm per square foot at [1] [ ] inch water column pressure differential.

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* + - 1. Outside Air Damper: Manual, for fixed outside air quantity. [Furnish rain hood with screen.]

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - 1. Outside Air Damper: Remote controlled with damper operator and remote rheostat for adjusting outside air quantity. [Furnish rain hood with screen.]

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - 1. Outside Air Damper: Automatic, two position [spring return]. Interlocked to open when supply fan starts. [Outside air damper normally closed and return air damper normally open.] Furnish rain hood with screen.

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Powered exhaust fan is generally available in units above 6 tons

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\*\*\*\*\*\* [OR] \*\*\*\*\*\*

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Economizer is required on units over 4.5 tons.

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* + - 1. Economizer: [Factory installed] fully modulating motorized outside air and return air dampers controlled by dry bulb temperature controller [with minimum position setting.] [Outside air damper normally closed and return air damper normally open.] [Furnish barometric relief damper capable of closing by gravity.] [Furnish barometric relief damper with powered exhaust.] [Furnish rain hood with screen.] Provide economizer components and controls in accordance with ASHRAE 90.1.

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Select applicable controls and controls combination. This paragraph deals with standard, factory available controls. More sophisticated controls or those for different types of units may be better specified in control sections and described in Sequences of Operation.

Control features will vary based on size of unit or application to system (i.e., constant volume single zone or changeover bypass).

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* + 1. Controls:

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Low ambient control is only required with units less than 5 tons without economizers, based on project requirements.

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* + - 1. Furnish control to provide low ambient cooling to [0] [-10] degrees Fahrenheit.
			2. Furnish low limit thermostat in supply air to close outside air damper and stop supply fan.
			3. Furnish terminal strip on unit for connection of operating controls to remote panel.
			4. Thermostat: Furnish space thermostat with [1] [2] stage heating and [1] [2] stage cooling with [manual] [automatic] changeover. Furnish system selector switch [heat-off-cool] [off-heat-auto-cool] [and fan control switch auto-on].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - 1. Thermostat: Furnish [7 day] programmable electronic space thermostat with [1] [2] stage heating and [1] [2] stage cooling with [manual] [automatic] changeover and heating setback and cooling setup capability. Furnish system selector switch [heat-off-cool] [off-heat-auto-cool] [and fan control switch, auto-on].

 \*\*\*\*\*\*\* [OR] \*\*\*\*\*\*\*

* + - 1. Furnish interface to Building Automation and Control System specified in Section 25 5000, *Integrated Automated Facility Controls*.
			2. Microprocessor Based Controls:
				1. [Factory mounted] [Field installed] with the following features:

Monitor each mode of operation.

Evaporator fan status.

Filter status.

Indoor air quality.

Supply air temperature.

Outdoor air temperature.

* + - * 1. Diagnostics for [thermostat] [temperature sensor] commands for staged heating, staged cooling, fan operation, and economizer operation.
				2. Zone space temperature sensor to interface with microprocessor controls with [Manual] [Automatic] programmable with night setback.
		1. Accessories:
			1. [Roof Curb Adaptor Package: Furnish duct support hardware to adapt unit to existing roof curb.]
			2. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.
			3. [ ].
		2. Capacity:
			1. See equipment schedule on the drawings.
	1. AIR CONDITIONING UNITS, (MEDIUM CAPACITY) 25 TONS TO 60 TONS
		1. Manufacturers:
			1. [Trane Technologies] Model [ ].
			2. [Daikin industries] Model [ ].
			3. [Aaon] Model [ ].

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Edit the following descriptive paragraphs to identify project requirements and to eliminate conflicts with manufacturers specified above.

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* + 1. Product Description: Self-contained, packaged, factory assembled and wired, consisting of [roof curb,] cabinet, supply fan, [variable frequency drive,] evaporator coil, compressor, refrigeration circuit, condenser, [gas-fired heating section,] [electric heating coil,] [hot water heating coil,] [steam heating coil,] air filters, [outdoor air section,] [exhaust-return section,] [return fan,] controls and accessories.
		2. Configuration: [Downflow air delivery.] [Horizontal air delivery.] [As indicated on Drawings].
		3. Roof Mounting Curb: [14] [24] [ ] inch high, galvanized steel, channel frame with gaskets, nailer strips. [Full perimeter curb under entire unit.] [Full perimeter curb under unit with separate support curb for condensing section.]
		4. Cabinet:
			1. Designed for outdoor installation with weatherproof construction.
			2. Panels: Constructed of [Steel] [Galvanized steel] with baked enamel finish [meeting [500] [ ] hour salt spray test in accordance with ASTM B117]. Furnish [removable access panels with handles] [hinged access doors with handles and rubber gaskets at edges].
			3. Insulation: Factory applied to exposed vertical panels, horizontal panels, and access [panels] [doors]. [1/2] [1] [2] inch thick, [0.75] [1.5] pound per cubic foot density, [neoprene coated] [aluminum foil faced] glass fiber with edges protected from erosion.

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Interior lined casing may not be available from all manufacturers. When available, generally it will be in 30 ton and larger capacity units. Coordinate availability with selected manufacturer.

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* + - 1. Interior Surfaces: Sheet metal lined creating double wall construction.
		1. Supply Fan:
			1. [Forward curved][backward curved] centrifugal type, resiliently mounted with [direct drive] [V-belt drive,] [adjustable variable pitch motor pulley] [high efficiency motor] [premium efficiency motor][multiple direct-drive plenum fans in a fan-wall arrangement]. Motor permanently lubricated with built-in thermal overload protection.
			2. Relief [Exhaust] [Return] Fan: [Forward curved][backward curved] centrifugal type, resiliently mounted with [direct drive] [V-belt drive,] [adjustable variable pitch motor pulley] [high efficiency motor] [premium efficiency motor]. Motor permanently lubricated with built-in thermal overload protection.
			3. Fan motor: Motors: Provide motors that comply with the requirements of IEEE 841.
			4. Fan Assembly Mounting: Furnish spring-type vibration isolators.
		2. Evaporator Coil:
			1. Constructed of seamless copper tubes mechanically expanded into aluminum fins. Factory leak tested under water.
			2. Galvanized drain pan and piping connection.
			3. Furnish for multiple circuited units [intertwined] [alternate] row circuiting.
			4. [Furnish coil with corrosion resistant coating capable of withstanding salt spray test of [1000] [ ] hours in accordance with ASTM B117.]

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Choices in the following paragraphs vary between manufacturers and with unit capacity. Select appropriate items available with unit size.

When project conditions warrant include type of compressor in the following paragraph. This may make specification proprietary as type of compressor differs between manufacturers. Generally, compressor types are scroll or reciprocating.

Compressor type whether hermetic or semi-hermetic varies with manufacturer.

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* + 1. Compressors:
			1. [Hermetically sealed] [Semi-hermetic], resiliently mounted with positive lubrication, and internal motor overload protection. Use variable speed compressor when available.
			2. Furnish each compressor with independent refrigeration circuit.
			3. Furnish [[internal] [external] vibration isolators.
			4. Furnish short cycle protection.
		2. Refrigeration circuit:
			1. Dehydrate and factory charge [each circuit] with oil and refrigerant.
			2. Furnish the following for each circuit:
				1. Thermostatic expansion device.
				2. Filter-drier.
				3. Suction, discharge, and liquid line service valves with gauge ports.
				4. Sight glass.
				5. High and low pressure safety controls.
				6. [ ].

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Select desired method of capacity control. Not all manufacturers offer this option.

Hot gas bypass is not allowed except in certain conditions. Use variable speed compressor when available.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + - 1. Furnish capacity control by [cycling compressors.] [cylinder unloading.] [cycling multi-speed compressors.] [modulating scroll compressors]
			2. Furnish control to provide low ambient cooling to [0] [-20] degrees Fahrenheit.
		1. Condenser:
			1. Coil: Constructed of copper tubing mechanically bonded to [aluminum] [copper] fins [with sub-cooling rows]. Factory leak tested under water.
			2. Condenser Fan: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Motor permanently lubricated with built-in thermal overload protection. [Furnish high efficiency fan motors.]
			3. Furnish factory installed hail protection coil guard.
			4. [Furnish coil with corrosion resistant coating capable of withstanding salt spray test of [1000] [ ] hours in accordance with ASTM B117.]

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Packaged AHUs shall include at least one of the following heating methods.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + 1. Gas-Fired Heating Section:
			1. Fuel: Natural gas.
			2. Heat Exchanger: [Aluminized] [Stainless steel, of welded construction].
			3. Gas Burner: [Induced draft] [ ] type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and [automatic 100 percent shut-off pilot].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + 1. Electric Heating Coil:

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Specify single source power connection for units supplied with electric heat. Electric heating coil is only allowed when natural gas and/or steam are not available, as determined by the Mechanical POC.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + - 1. [Finned tube heating elements] [or] [Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings] easily accessible with automatic reset thermal cut-out, built-in magnetic contactors, galvanized steel frame, [control circuit transformer and fuse,] [manual reset thermal cut-out,] [airflow proving device,] [toggle switch (pilot duty),] load fuses. [Single source power connection.] [Number of stages as indicated on Drawings.] [Mercury contactors are not acceptable.]
			2. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + 1. Hot Water Heating Coil:
			1. [Factory mounted] [Field installed].
			2. Coil: Constructed of seamless copper tubes mechanically expanded into aluminum fins. Factory leak tested under water.
			3. Furnish factory installed piping package with [modulating] [two-way] [three-way] control valve.
			4. Freezestat: Factory mounted on discharge side of coil.
			5. [Furnish coil with corrosion resistant coating capable of withstanding salt spray test of [1000] [ ] hours in accordance with ASTM B117.]

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + 1. Steam Heating Coil:
			1. Tube-in-tube non-freeze type. Constructed of seamless copper tubes mechanically expanded into aluminum fins. Factory leak tested under water.
			2. Furnish [modulating] [two-way] control valve.
			3. Freezestat: Factory mounted on discharge side of coil.
			4. [Furnish coil with corrosion resistant coating capable of withstanding salt spray test of [1000] [ ] hours in accordance with ASTM B117.]
		2. [Antimicrobial Ultraviolet Lamp System
			1. Description: Lighting unit installation in rooftop unit with lamps, reflectors, remote water-resistant power supply and cable, and support brackets. Lamps emit 254 nm UV "C" (UVC) band. In metal housing with viewport arranged for and controlled to cycle on and off with cooling coil. Locate downstream of cooling coils and over condensate drain pans.]
		3. Air Filters: [1] [2] [4] inch [thick glass fiber disposable media in metal frames.] [MERV 8, based on ASHRAE 52.2.]

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + 1. Air Filters: Cartridge type, 12 inch deep, [MERV 11] [MERV 14], based on ASHRAE 52.2 Furnish with 2-inch-thick pre-filters (MERV 8).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + 1. Air Filters: Bag filters with [MERV 14] [ ] based on ASHRAE 52.2. Furnish 2-inch-thick pre-filters (MERV 8).
		2. Outdoor Air Section:

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

LANL, based on ASHRAE 90.1, requires outside air dampers to have the following maximum damper leakage. Verify availability with basis for design manufacturer.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + - 1. Outside Air Damper Leakage: Maximum [3.0] [ ] cfm per square foot at [1.0] [ ] inch wg pressure differential.
			2. Outside Air Damper: None. 100 percent return air.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - 1. Economizer: Provide economizer components and controls in accordance with ASHRAE 90.1. [Factory installed] fully modulating from 0 to 100 percent outside air. Motorized outside air and return air dampers controlled by dry bulb controller [with minimum position setting.] [Outside air damper normally closed and return air damper normally open.]

 \*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - 1. Economizer: Provide economizer components and controls in accordance with ASHRAE 90.1. Furnish [fully integrated] factory installed fully modulating from 0 to 100 percent outside air economizer. Economizer operation through microprocessor based primary temperature controls automatically modulate dampers to maintain space temperature conditions.
				1. Furnish economizer with dry bulb control.
				2. Furnish adjustable minimum position control located remotely in space.
				3. Furnish spring return motor for outside air damper closure during unit shutdown or power interruption.
		1. Exhaust and Return Section:
			1. No relief air capability.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - 1. Non-modulating exhaust fans: Forward curved centrifugal type, [direct drive] [belt drive], statically and dynamically balanced, [high efficiency motor]. Motor permanently lubricated with built-in thermal overload protection. Furnish barometric dampers at fan outlet to prevent backdraft. Operation of exhaust fans on or off based on economizer outdoor air damper position. [On-off setpoint selectable through remote potentiometer located in return air section.]
			2. Modulating exhaust fans: Forward curved centrifugal type, [direct drive] [belt drive], statically and dynamically balanced, [high efficiency motor]. Motor permanently lubricated with built-in thermal overload protection. Furnish barometric dampers at fan outlet to prevent backdraft. Fans operated with volume control device based on field adjustable interior space pressure setpoint.
		1. Return Fan:
			1. Fan: [Forward curved centrifugal type] [Backward inclined airfoil type], statically and dynamically balanced, resiliently mounted.
			2. Fan Drive: V-belt type, cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Furnish solid shaft construction. Select Variable and adjustable pitch motor sheave to obtain required rpm with sheaves set at mid-position as recommended by manufacturer.
				1. Drive Rating: Minimum [1.5] [ ] times nameplate rating of motor.
				2. Fan Sheave: [Fixed.] [Adjustable.]
				3. Motor Sheave: [Fixed.] [Adjustable.]
			3. Fan motor: Three phase, NEMA MG-1, Design B, continuously rated at 40 degrees C, [open drip-proof] [totally enclosed fan cooled] [high efficiency, open drip-proof] [premium open drip-proof efficiency] NEMA T frame, with permanently lubricated bearings and integral overload protection.
			4. Fan Assembly Mounting: Furnish spring-type vibration isolators.
		2. Return Fan Modulation:
			1. Controlled in conjunction with supply fan.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Supply and return fan can be controlled by either individual or single variable frequency drive. Edit the following.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + - 1. Variable frequency drive: [Controlled from same drive as supply fan.] [Individual drive for return fan.]
		1. Controls: Furnish space thermostat with [1] [2] [ ] stage heating and [1] [2] [ ] stage cooling with [manual] [automatic] changeover. Furnish system selector switch [heat-off-cool] [off-heat-auto-cool] [and fan control switch, auto-on].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + 1. Controls: Furnish [7 day] [ ] programmable electronic space thermostat with [4] [ ] time periods per day, [1] [2] stage heating, [1] [2] stage cooling, [manual] [automatic] changeover, heating setback, cooling setup, override capability, liquid crystal display, memory storage without batteries, security levels feature, and setpoint limiting. Furnish system selector switch [heat-off-cool] [off-heat-auto-cool] [and fan control switch, auto-on].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Use one of the following two paragraphs when controls are specified in other sections.

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* + 1. Controls: Furnish interface to Building Automation and Control System specified in Section 25 5000, *Integrated Automated Facility Controls*.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + 1. Controls: Microprocessor-based controls, factory mounted with the following features:
			1. Constant Volume Controls: To operate rooftop from space temperature sensor, including economizer control.
				1. Furnish space temperature sensor [with setpoint adjustment] for control of unit equipped with override button for timed override of [1] [2] [3] [4] hours.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish space temperature sensor [with setpoint adjustment] for control of unit equipped with override button for timed override of [1] [2] [3] [4] hours. Furnish with space temperature offset of plus or minus 5 degrees Fahrenheit.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - 1. Variable Air Volume (VAV) Controls: To operate VAV AHU from supply air temperature including supply air sensor, and [inlet guide vanes] [variable frequency drive]. Microprocessor coordinates economizer control and stages of cooling with supply air temperature reset capability based upon outdoor air temperature.

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The following is a generic list of control functions. Edit or expand list based on project conditions. Coordinate availability with selected manufacturer. Place this information on the drawings.

Control Functions: Furnish the following:

* + - * 1. Unit scheduling.
				2. Occupied-unoccupied mode.
				3. Start-up and coast-down modes.
				4. Nighttime free-cool purge mode.
				5. Demand limiting.
				6. Night setback.
				7. Timed override.
				8. Alarm shutdown.
				9. Discharge air set point adjustment.
				10. Static pressure setpoint adjustment.

The following is a generic list of setpoints and alarms. Edit or expand list based on project conditions. Coordinate availability with selected manufacturer. Place this information on the drawings*.*

Furnish the following setpoints and diagnostic functions accessible in unit control panel:

* + - * 1. Unit operating mode.
				2. Unit failure status.
				3. Supply fan start-stop.
				4. Supply fan status.
				5. Supply fan variable frequency drive percent.
				6. Return fan start-stop.
				7. Return fan status.
				8. Return fan variable frequency drive percent.
				9. Exhaust fan start-stop.
				10. Exhaust fan status.
				11. Exhaust fan variable frequency drive percent.
				12. Supply air temperature.
				13. Supply air temperature high-low limit with alarm.
				14. Return air temperature.
				15. Return air temperature high-low limit with alarm.
				16. Mixed air temperature.
				17. Mixed air temperature high-low limit with alarm.
				18. Duct static pressure.
				19. Duct static pressure high-low limit with alarm.
				20. Cooling control.
				21. Cooling status - all stages.
				22. Heating control.
				23. Heating status.
				24. Number of stages activated.
				25. Damper control.
				26. Economizer status.
				27. Requested minimum position.
				28. Damper positions.
				29. Space temperature.
				30. Space temperature high-low limit with alarm.
				31. Filter status.
				32. Outside air temperature.
				33. Outside relative humidity.

The following are specialty control functions furnished by some manufacturers. Coordinate availability with selected manufacturer. Place this information on the drawings.

Ventilation Override: Factory installed. Binary input from independent fire or life safety panel causes unit to override standard operation and assumes one of two factory preset ventilation sequences - purge or pressurization.

Indoor Air Quality Control: Furnish demand ventilation control through economizer with carbon dioxide sensor. Sensor adjustable [duct mounted] [wall mounted] [wall mounted with display of parts per million].

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* + 1. Accessories:
			1. [Roof Curb Adaptor Package: Furnish duct support hardware to adapt unit to existing roof curb.]
			2. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.
			3. [ ].
		2. Capacity:
			1. See equipment schedule on the drawings.
1. EXECUTION

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

For AHUs that are not exempt from seismic, if project specification package includes 22 0548.23, and if requirements associated with installation, testing, and inspection of mounting and/or anchorage devices differ from those requirements in 22 0548.23, they must be described herein (in PART 3). Also, if this is applicable, identify special types of seismic-control devices required for each application using the same terminology used for those devices in PART 2.

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* 1. EXAMINATION
		1. Verify that roof is ready to receive work and opening dimensions are as [indicated on shop drawings] [shown on design drawings].
		2. Verify that proper power supply is available.
	2. INSTALLATION
		1. Roof Curb:
			1. Assemble roof curb.
			2. Install roof curb so unit is installed level.
			3. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
			4. Install gasket material between unit base and roof curb.
		2. [Install units on vibration isolators.]
		3. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 3101, *HVAC Ducts*.
		4. Install condensate piping with trap and route from drain pan to [splash block on roof] [nearest roof drain.] [floor drain] [\_\_\_\_\_\_\_\_.] Refer to Section 23 2113, *Hydronic Piping*.
		5. Install components furnished loose for field mounting.
		6. Install electrical devices furnished loose for field mounting.
		7. Install control wiring between unit and field installed accessories.
	3. INSTALLATION - NATURAL GAS HEATING SECTION
		1. Connect natural gas piping in accordance with NFPA 54.
		2. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.
		3. Install the following piping accessories on natural gas piping connections. Refer to Section 23 1123, *Facility Natural Gas Piping.*
			1. Strainer.
			2. Pressure gage.
			3. Shutoff valve.
			4. Pressure reducing valve.
		4. Install natural gas piping accessories [above roof] [within unit casing] [below roof].
	4. INSTALLATION - HOT WATER HEATING COIL
		1. Make connections to coils with unions or flanges.
		2. Connect water supply to leaving airside of coil (counter flow arrangement).
		3. Locate water supply at bottom of supply header and return water connection at top.
		4. Install water coils to allow draining and install drain connection at low points.
		5. Install valves and piping specialties in accordance with details as indicated on Drawings.
		6. Install [manual] [automatic] air vents at high points complete with shutoff valve. Refer to Section 23 2113, *Hydronic Piping*.
		7. Install hot water piping accessories [within unit casing] [below roof].
	5. INSTALLATION - STEAM HEATING COIL
		1. Make connections to coils with unions or flanges.
		2. Install steam traps with inlet minimum of 12 inches below coil return connection.
		3. Install [manual] [automatic] air vents at high points complete with shutoff valve. Refer to Section 23 2215, *Steam and Condensate Heating Piping and Specialties.*
		4. Install valves and piping specialties in accordance with details as indicated on Drawings.
	6. MANUFACTURER'S FIELD SERVICES
		1. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.
		2. Furnish service and maintenance of equipment for [one] [ ] year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.
		3. Furnish services of factory trained representative for minimum of [one] [ ] day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct LANL on operation and maintenance.
		4. Furnish 24-hour emergency service on breakdowns and malfunctions for this maintenance period.
	7. CLEANING
		1. Vacuum clean coils and inside of unit cabinet.
		2. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.
	8. DEMONSTRATION
		1. Demonstrate unit operation and maintenance.
		2. Furnish services of manufacturer's technical representative for [one] [ ] [8] [ ] hour day to instruct LANL personnel in operation and maintenance of units. Schedule training with LANL, provide at least 7 days notice to the LANL Subcontract Technical Representative (STR) of training date.
	9. SCHEDULES
		1. See the equipment schedule on the drawings.

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At a minimum, provide the following data in the equipment schedule on the drawings. Edit the following to identify project requirements.

ROOFTOP UNITS

Drawing Code HVA-001 HVA-002 HVA-003

Manufacturer

Model

Unit voltage

Minimum Circuit Ampacity

Maximum Overcurrent Protection

Altitude

Unit Sound Rating

Supply Fan

Supply airflow

Outside airflow

External Static Pressure

Fan Motor

Return Fan

Return airflow

External Static Pressure

Fan Motor

Exhaust Fan

Exhaust airflow

External Static Pressure

Fan Motor

Cooling

Total Cooling Capacity

Sensible Cooling Capacity

Entering air temperature (dry bulb)

Entering air temperature (wet bulb)

Leaving air temperature (dry bulb)

Leaving air temperature (wet bulb)

[Condenser ambient air temperature]

Energy Efficiency Ratio, (EER)

[Seasonal Energy Efficiency Ratio, (SEER)]

Number of [compressors] [refrigeration circuits]

Capacity steps: [ ].

Gas Heating

Input

Output

Stages

Entering Air Temperature

Leaving Air Temperature

Electric Heating

Electric resistance heating capacity

Capacity steps

Entering Air Temperature

Leaving Air Temperature

Hot Water Heating

Capacity

Water flow

Entering air temperature

Leaving air temperature

Entering water temperature

Leaving water temperature

Coil pressure drop

Steam Heating

Heating capacity

Steam flow

Entering steam pressure

Entering air temperature

Nominal Capacity (Tons)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

END OF SECTION

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Do not delete the following reference information:

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 23 7413 Rev. 4, dated July 24, 2024.