

**SECTION 23 81 00  
UNITARY HVAC EQUIPMENT**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. The spec writer shall review the Physical Security Design Manual for VA Facilities to determine and include any Life Safety requirements called out.

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies split-systems: including air handling units, furnaces, and air cooled condensing units; room-type air conditioners; and packaged terminal air conditioners.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Definitions:
  1. Seasonal Energy Efficiency Ratio (SEER): (Btu/W-hour) is equal to the measured cooling capacity of the unit by its electrical input.
  2. Unitary: A Unitary Air Conditioner consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. Where such equipment is provided in more than one assembly, the separated assemblies are connected with refrigerant piping and designed to be used together. The requirements of rating are based upon use of matched assemblies.

**1.2 RELATED WORK**

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. //Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects.//
- B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Section 01 42 19, REFERENCE STANDARDS.
- E. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- F. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

SPEC WRITER NOTE: If Section 13 05 41 is included in this project the section shall be obtained from VA Masters.

- G. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for pre-test of non-structural equipment and piping.//
- H. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- I. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
- J. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Requirements for different types of vibration isolators and noise ratings in the occupied areas.
- K. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Requirements for testing and adjusting air balance.
- L. Section 23 07 11, HVAC INSULATION: Requirements for piping insulation.
- M. //Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- N. Section 23 11 23, FACILITY NATURAL-GAS PIPING.
- O. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant pipes, fittings, and installation.
- P. Section 23 31 00, HVAC DUCTS AND CASINGS.
- Q. Section 23 34 00, HVAC FANS.
- R. Section 23 40 00, HVAC AIR CLEANING DEVICES: Requirements for air filtration.
- S. Section 23 82 16, AIR COILS.

### 1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all mechanical systems. Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

- B. Air-Conditioning, Heating and Refrigeration Institute (AHRI):
  - 210/240-2008 (R2012)....Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
  - 300-2008.....Standard for Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment
  - 310/380-2014.....Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA C744-14)
- C. American National Standard Institute (ANSI):
  - Z21.47/CSA 2.3-2012.....Gas-Fired Central Furnaces
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
  - 15-2013.....Safety Standard for Refrigeration Systems
  - 52.2-2012.....Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
  - 62.1-2013.....Ventilation for Acceptable Indoor Air Quality
  - 90.1-2013.....Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings
- E. American Society of Testing and Materials (ASTM):
  - E331-2000(R2009).....Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
  - F438-2015.....Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
  - F441/F441M-2015.....Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
  - F493-2014.....Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
- F. National Fire Protection Association (NFPA):
  - 54-2015.....National Fuel Gas Code
  - 70-2014.....National Electrical Code (NEC)
- G. Underwriter Laboratories (UL):
  - 484-2014 (R2015).....Standard for Room Air Conditioners

**1.4 SUBMITTALS**

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 81 00, UNITARY HVAC EQUIPMENT", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity:
  - 1. Include clearly presented sufficient information, such as capacities, pressure drops, octave sound data, and piping connections to determine compliance with drawings and specifications for units noted below:
    - a. Unitary air conditioners:
      - 1) Self-contained units
      - 2) Split systems
    - b. Window air conditioners
    - c. Through-the-wall units
  - 2. Unit dimensions, required clearances, operating weights accessories, and start-up instructions.
  - 3. Electrical requirements, wiring diagrams, interlocks, and control wiring showing which are to be factory-installed and which portions are to be field-installed.
- D. Certification: Submit proof of specified AHRI Certification.
- E. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible heat-ratio, seasonal energy efficiency ratio (SEER), and coefficient of performance (COP).
- F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
  - 1. Include complete list indicating all components of the systems.
  - 2. Include complete diagrams of the internal wiring for each item of equipment.
  - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

- G. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- H. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

#### **1.5 QUALITY ASSURANCE**

- A. Refer to paragraph QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

#### **1.6 AS-BUILT DOCUMENTATION**

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) or Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects). O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version //\_\_\_\_// provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall

not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

## **PART 2 - PRODUCTS**

### **2.1 SPLIT-SYSTEM AIR HANDLING UNIT**

- A. Description: Factory assembled and tested air handling unit, //floor-mounted// //base-mounted// //suspended// evaporator-fan combination air handling unit//, with an air cooled remote condensing unit and field-installed refrigeration piping//. Unit shall include //an electric-resistance heating coil// //a heating hot water coil//.
- B. Air Handling Unit Components:
1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  2. Insulation: Factory-applied.
  3. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.
  4. Airstream Surfaces: Ensure surfaces in contact with the airstream comply with requirements in ASHRAE 62.1.
  5. Refrigerant Coil: Copper tube, with mechanically bonded //aluminum// //copper// fins, complying with AHRI 210/240, and with thermal-expansion valve.
  6. //Electric-Resistance Heating Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.//
  7. Fan: //Air foil// //backward inclined// //plug fan// //forward-curved// //double-width wheel// of galvanized steel; //directly connected to motor// //belt drive//.
  8. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT //for multi-tapped, multi-speed motors// with internal thermal protection and permanent lubrication.

- a. //Special Motor Features: Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.//
  - b. //Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.//
9. Disposable Filters: //25 mm (1 inch)// // // // mm (// // // inch)// thick, in fiberboard frames with MERV rating of //8// // // according to //ASHRAE 52.2// //Section 23 40 00, HVAC AIR CLEANING DEVICES//.
10. Wiring Terminations: Connect motor to chassis wiring with //plug connection// //terminal block//.
- C. Air Cooled Condenser:
- 1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Ensure service valves, fittings, and gage ports are brass and located outside of the casing.
  - 2. Compressor: Hermetically sealed scroll compressor with crankcase heater and mounted on vibration isolation. Ensure compressor motor has thermal and current sensitive overload devices, start capacitor, relay, and contactor.
  - 3. Refrigerant: //R-407C// //R-410A// unless otherwise indicated.
  - 4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240//, and with liquid subcooler//. //Provide coil coating of //phenolic epoxy// // // // //Provide coil guard.//
  - 5. //Heat Pump Components: Reversing valve and low-temperature-air cut-off thermostat.//
  - 6. Fan: Aluminum, propeller type, directly connected to motor.
  - 7. Motor: Permanently lubricated, with integral thermal-overload protection.
  - 8. //Low Ambient Kit: Permit operation down to 7 degrees C (44 degrees F).//
  - 9. Mounting Base: Polyethylene.
  - 10. Minimum Energy Efficiency: Comply with ASHRAE 90.1.
  - 11. //Refrigerant Piping: Comply with requirements of //Section 23 23 00, REFRIGERNAT PIPING// //and// //Section 23 07 11, HVAC INSULATION.//

## 2.2 GAS-FIRED FURNACES, NONCONDENSING

- A. General Requirements for Gas-Fired, Noncondensing Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3 and with NFPA 54.
- B. Cabinet: Steel.
  - 1. Ensure cabinet interior around heat exchanger has factory installed insulation.
  - 2. Ensure lift-out panels expose burners and all other items requiring access for maintenance.
  - 3. Ensure external cabinets are factory painted in manufacturer's standard color.
- C. Fan: Centrifugal, factory balanced, resilient mounted, //direct// //belt// drive.
  - 1. Fan Motors: Comply with Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
  - 2. Motor Features: //Single speed,// premium efficiency with internal thermal protection, and permanent lubrication.
  - 3. //Special Motor Features: Multi-tapped, multi-speed with internal thermal protection, and permanent lubrication.//
  - 4. //Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.//
- D. Type of Gas: //Natural// //Propane//.
- E. AFUE: 85 percent efficiency.
- F. Heat Exchanger: Stainless steel.
- G. Burner:
  - 1. Gas Valve: 100 percent safety //modulating// // //2// // // stage// main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
  - 2. Ignition: Electric pilot ignition, with hot-surface igniter.
- H. Gas-Burner Safety Controls:
  - 1. Electronic Flame Sensor: Ensure gas valve is prevented from opening until pilot flame is proven; and signals to stop gas flow on ignition failure.
  - 2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
  - 3. Limit Control: Fixed-top at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.



- I. Combustion-Air Induced Air Fan: Provide centrifugal fan with thermally protected motor and sleeve bearings. Ensure fan pre-purges heat exchanger and vents combustion products. Provide pressure switch that will prevent furnace operation if combustion-air inlet or flue outlet is blocked.
- J. Furnace Controls: Solid-state board integrating ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; and terminals for connection to accessories.
- K. Vent Materials: Type B metal vents.
- L. Characteristics:
  - 1. Airflow Configuration: //Upflow// //Counterflow// //Horizontal//.
  - 2. Venting Type: //Power venter.// //Power venter with combustion-air intake.//
- M. Evaporator Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
  - 1. Drain Pan: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.
  - 2. Airstream Surfaces: Ensure surfaces in contact with the airstream comply with requirements in ASHRAE 62.1.

### **2.3 GAS-FIRED FURNACES, CONDENSING**

- A. General Requirements for Gas-Fired, Condensing Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3 and with NFPA 54.
- B. Cabinet: Steel.
  - 1. Ensure cabinet interior around heat exchanger has factory installed insulation.
  - 2. Ensure lift-out panels expose burners and all other items requiring access for maintenance.
  - 3. Ensure external cabinets are factory painted in manufacturer's standard color.
- C. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
  - 1. Fan Motors: Comply with Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
  - 2. Motor Features: //Single speed,// premium efficiency with internal thermal protection, and permanent lubrication.
  - 3. //Special Motor Features: Multi-tapped, multi-speed with internal thermal protection, and permanent lubrication.//

4. //Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.//
- D. Type of Gas: //Natural// //Propane//.
- E. AFUE: //90// //95// percent efficiency.
- F. Heat Exchanger:
1. Primary: Stainless steel.
  2. //Secondary: Stainless steel.//
- G. Burner:
1. Gas Valve: 100 percent safety //modulating// // //2// // // stage// main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
  2. Ignition: Electric pilot ignition, with hot-surface igniter.
- H. Gas-Burner Safety Controls:
1. Electronic Flame Sensor: Ensure gas valve is prevented from opening until pilot flame is proven; and signals to stop gas flow on ignition failure.
  2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
  3. Limit Control: Fixed-stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
- I. Combustion-Air Induced Air Fan: Provide centrifugal fan with thermally protected motor and sleeve bearings. Ensure fan pre-purges heat exchanger and vents combustion products. Provide pressure switch that will prevent furnace operation if combustion-air inlet or flue outlet is blocked.
- J. Furnace Controls: Solid-state board integrating ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories; and diagnostic light with viewport.
- K. Accessories:
1. Combination Combustion-Air Intake and Vent: PVC plastic fitting to combine combustion-air inlet and vent through //outside wall// //roof//.
  2. Plastic Vent Materials:
    - a. CPVC Plastic, Schedule 40 Pipe: ASTM F441/F441M.
    - b. CPVC Plastic, Schedule 40 Fittings: ASTM F438, socket type.
    - c. CPVC Solvent Cement: ASTM F493.

## L. Characteristics:

1. Airflow Configuration: //Upflow// //Counterflow// //Horizontal//.
2. Venting Type: //Power venter.// //Power venter with combustion-air intake//.

## M. Evaporator Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.

1. Drain Pan: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.
2. Airstream Surfaces: Ensure surfaces in contact with the airstream comply with requirements in ASHRAE 62.1.

**2.4 ROOM-TYPE AIR CONDITIONERS**

- A. Ensure units comply with NFPA 70, ASHRAE 15, and UL 484 except as modified herein, and are //window// //through-the-wall// //floor-mounted// type as indicated. Ensure capacity and electrical characteristics are as shown on drawings.
- B. Seasonal Energy Efficiency Ratio (SEER): Not less than 10.0.
- C. Outside Air: Ensure provisions made in the unit for exhaust and fresh air required for the room.
- D. Unit Supports: Comply with manufacturer's instructions, unless otherwise shown with mounting sleeves for through-the-wall units to suit the sill height, wall construction, and wall thickness, as shown.
- E. Fan Motor and Air Impeller: Permanent split-capacitor type with run capacitor. Ensure air impellers are //forward-curved blower wheel// //axial or radial-flow fan blade// type.
- F. Electronics: Ensure microprocessors monitor and control numerous functions for the unit using digital display and touch panels for programming desired temperature, on-off timing, modulating fan speeds, bypass capabilities, and sensing for humidity, temperature, and airflow control. //Provide wireless remote controller.//

**2.5 PACKAGED TERMINAL AIR CONDITIONERS**

- A. Description: Factory-assembled and tested, self-contained, air-cooled packaged terminal air conditioner with room cabinet, electric refrigeration //and electric-resistance heating// system, and temperature controls; fully charged with refrigerant and filled with oil; with //cord connected// //hardwired// chassis. Ensure the unit complies with ASHRAE 15 and with the safety requirements of UL 484.
- B. Chasis/Cabinet 1.3 mm (18 gage) minimum steel phosphatized, and finished with two coats of baked enamel. Ensure front panel is

removable with the use of tools to provide full access to filters and cooling unit. Ensure unit is tested according to ASTM E331, which assures no water infiltration when tested with 200 mm (8 inches) of rain per hour at 63 mph wind for 15 minutes.

- C. Mounting: //Wall with wall sleeve.// //Floor with subbase.//
- D. //Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.//
- E. Finish of Interior Surfaces: Ensure surfaces in contact with the airstream comply with requirements in ASHRAE 62.1.
- F. Subbase: Enameled steel, with adjustable leveling feet, and adjustable end plates //including an electrical power cord// //with factory-installed and wired, fused disconnect switch, and receptacle sized for unit//.
- G. Wall Sleeves: //Galvanized steel with polyester finish// //Molded polymer// //Molded fiberglass-reinforced polyester// //Not less than 1.3 mm (18 gage) zinc-coated steel, phosphatized//, with manufacturer's standard finish and completely insulated. Sleeve for field installation with provisions to fasten outside air louver.
- H. Refrigeration System: Direct expansion indoor coil with capillary restrictor; and hermetically sealed scroll compressor with vibration isolation and overload protection.
- I. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins with capillary tube distributor on indoor coil.
- J. //Heat Pump Unit:
  - 1. Accumulator.
  - 2. Constant-pressure expansion valve.
  - 3. Reversing valve.//
- K. Charge: //R407C// //R410A// unless otherwise indicated.
- L. Condenser/Evaporator Fans: Direct drive with permanent split capacitor two-speed motor. Ensure the condenser fan is a propeller type and the evaporator fan is a centrifugal blower type.
- M. Filters: Washable //polyurethane// //polypropylene// in molded plastic frame.
- N. Condensate Drain: Drain pan //to direct condensate to outdoor coil for re-evaporation// //to direct condensate to outside of building//. Ensure drain pan complies with ASHRAE 62.1 for construction and connections.

- O. Electric-Resistance Heating Coil: Nickel-chromium-wire, electric-resistance heating elements with contactor and high-temperature-limit switch.
- P. Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation. Include the following features:
  1. //Low Ambient Lockout Control: Prevent cooling-cycle operation below 5 degrees C (41 degrees F) outdoor air temperature.//
  2. //Heat-Pump Ambient Control: Field-adjustable switch changes to heat-pump heating operation above 5 degrees C (41 degrees F) and to supplemental heating below minus 4 degrees C (plus 25 degrees F).//
  3. Temperature-Limit Control: Prevent occupant from exceeding preset //setback// //and/or// //setup// temperature.
  4. //Building Automation System Interface: Allow remote on-off control with setback temperature control.//
  5. //Remote Control: Standard unit-mounted controls with remote-mounted, low-voltage adjustable thermostat with heat-off-cool-auto switch.//
- Q. Outdoor Air: //Manual// //Motorized// intake damper. Open intake when unit indoor air fan runs.
- R. Sound-Power Level Ratings: Factory test to comply with AHRI 300.
- S. Unit Performance Ratings: Factory test according to AHRI 310/380/CSA C744.
- T. //Provide outside grille/louver at condenser coil face.//

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
- B. Install units level and plumb maintaining manufacturer's recommended clearances and tolerances.
- C. Install ground-mounting, compressor-condenser components on //polyethylene mounting base // // mm (// // inch) thick// //concrete base // // mm (// // inch) thick//.
- D. //Install seismic restraints.//
- E. Install and connect //pre-charged// refrigerant tubing to component's //quick-connect fittings// //stub outs//. Install tubing to allow

access to unit. Install in accordance with Section 23 23 00,  
REFRIGERANT PIPING.

- F. //Install wall sleeves in finished wall assembly and weatherproof.//  
//Install and anchor wall sleeves to withstand, without damage, seismic forces as required by code.//

### **3.2 CONNECTIONS**

- A. Verify condensate drainage requirements.
- B. //Install condensate drain, minimum connection size, with trap and indirect connection to nearest floor drain.//
- C. //Install piping adjacent to units to allow service and maintenance.//
- D. //Gas Piping: Comply with applicable requirements in Section 23 11 23, FACILITY NATURAL-GAS PIPING. Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.//
- E. //Connect supply ducts to units with flexible duct connectors specified in Section 23 31 00, HVAC DUCTS AND CASINGS.//
- F. Ground equipment and install power wiring, switches, and controls for self-contained and split systems.
- G. //Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines.//

### **3.3 FIELD QUALITY CONTROL**

- A. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tie-down straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

### **3.4 STARTUP AND TESTING**

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

- C. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

**3.5 //COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

**3.6 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for //four// // // hour//s// to instruct each VA personnel responsible in the operation and maintenance of units.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

- - - E N D - - -