4. Heating and Cooling

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1. MEASURE OBJECTIVES

1.1 Properly functioning heating and cooling appliances provide economical temperature control, reduce fuel consumption, and reduce pollution.

2. INSTALL THIS MEASURE WHEN:

2.1. Repair/Install

2.1.1 The heating and/or cooling appliance provides primary heating and/or primary cooling for the dwelling unit and

2.1.2 Agency assessment identifies an operational or combustion appliance safety (CAS) issue (or inoperability) and a qualified/licensed technician determines that the heating and/or cooling appliance requires repair or replacement or

2.1.3 Absence of an operable heating and/or cooling appliance poses imminent harm to the safety and well-being of the occupants

2.2. Repair

2.2.1 Repair costs are <50% of replacement costs

2.2.2 Unsafe secondary units, including space heaters, must be repaired, removed or rendered inoperable, or deferral is required

2.3. Install

2.3.1 Repair costs are ≥50% of replacement costs or

2.3.2 Parts are obsolete and no longer available or

2.3.3 An energy audit shows replacement or energy efficiency upgrade is justified with a savings-to-investment ratio (SIR) ≥1.0

2.3.4 Replacement for fuel switching is justified in accordance with the Appendix D Energy Audit/ Priority List Protocol

3. DO NOT INSTALL THIS MEASURE WHEN:

3.1. Do Not Repair/Install

3.1.1 An operable primary heating/cooling source exists elsewhere in the dwelling

3.1.2 A repair can be completed by installing an electrically commutated motor (ECM) per Section 5 ECM Blower Motors

3.1.3 Accessibility or clearance requirements cannot be met, per Section 1 General Installation Guidelines, Attic & Crawlspace Accessibility Requirements or heating and cooling measure clearance requirements

3.1.4 Removal of the existing unit will create structural damage, dwelling siding is decayed or damaged, or the opening cannot properly support a new unit without substantial reconstruction

3.1.5 The installation location is unsafe and cannot be corrected per Section 1 General Installation Guidelines, Limited Home Repair

3.1.5(a) Unsafe locations may include, but are not limited to, those with pest or animal infestation, deteriorated framing members, environmental hazards, water damage, etc.

3.1.6 Ducted heating and/or cooling appliance has ducts that are disconnected, damaged, deteriorated, or abandoned, or do not provide adequate airflow and it is not feasible to bring the duct system into compliance with Section 8 Ducting Repair, Sealing, and Insulation

3.1.7 Repair/installation would violate the Appendix E Health & Safety Requirements

3.1.8 The client refuses after measure benefits have been explained by the assessor

4. INSTALLATION GUIDELINES

4.1. General Requirements

4.1.1 The policies in Appendix E Health and Safety Requirements, Identification of Appliance Issues shall apply to all heating and cooling repairs/replacements.

4.1.1 (a) Before any heating or cooling system may be repaired/replaced, a qualified technician/licensed contractor must perform a diagnostic inspection to determine if the appliance is defective or requires repair.

4.1.1 (b) It shall be determined if a cleaning and adjustment (appliance maintenance) would resolve an appliance performance or health and safety issue before the appliance is repaired or replaced.

4.1.1 (c) Documentation justifying any appliance replacement with a cost comparison between replacement and repair must be maintained in the client file.

4.1.1 (d) If permits are required for heating/cooling system work, and are coordinated and secured by Agency staff, they shall be billed to Other Program Cost Wages – Field Staff. The permit fees and any subcontractor cost associated with pulling of the permit shall be billed to the Permits line item under Assessments/Diagnostics.

4.1.2 Heat Sources

4.1.2 (a) No home may be left without a safe primary heating system. If unable to meet this requirement, deferral is required.

4.1.2 (b) When dwelling deferral is necessary, provide information to the client on the CSD 542 Deferral Form, describing conditions that must be met in order for weatherization to resume.

4.1.2 (b1) A copy of this notification must also be placed in the client file.

4.1.3 Complete Design Before Installation

4.1.3 (a) Before installation of any heating and/or cooling appliance, confirm that appliance location and support, appliance venting, combustion ventilation air (CVA), clearances, gas piping, electrical requirements, and all other feasibility criteria will be met for the replacement unit.

4.1.4 Primary Heating and/or Cooling Source

4.1.4 (a) The primary heating and/or cooling source (one unit per dwelling) shall be repaired or replaced.

4.1.4 (a1) Exception: Unsafe secondary units, including space heaters, must be repaired, removed, or rendered inoperable, or deferral is required.

4.1.4 (a2) If there is an operable secondary system, a defective primary heating and/or cooling system may still be repaired/replaced.

4.1.4 (a3) Primary heating and/or cooling appliances are defined as follows:

- The appliance that provides conditioned air for the dwelling's primary common living area (i.e., occupied during waking hours) or
- The unit relied upon most for heating and/or cooling by the client or
- The unit that provides conditioned air to the largest volume of living space or
- The unit with the largest heating/cooling capacity/output (British thermal units [Btuh] or tons)
  - Exception: Portable heaters shall not be considered a primary heat source.

4.1.4 (b) A multi-story home may be constructed with a synchronized system (i.e., one forced air unit [FAU] and duct system per story, designed to run concurrently). Repair or replacement of components to the synchronized system may be allowed with approval of a CSD programmatic waiver only.

4.1.5 Audited Measures

4.1.5(a) When this measure will be installed under the Low Income Home Energy Assistance Program (LIHEAP) and an energy audit is performed, if the measure will be fully leveraged or co-funded it must comply with Appendix D Energy Audit/Priority List Protocol.

4.1.5(b) When part of a combined work scope (DOE + LIHEAP) and this measure is fully paid for by LIHEAP, LIHEAP-specific assessment and installation policies will apply.

4.1.6 HERS Rater Verification

4.1.6(a) In all climate zones, duct leakage must be verified by a HERS Rater when replacing a package unit, air handler, AC condenser, AC evaporator coil, heating coil, furnace heat exchanger, or more than 25' of ducts in unconditioned space in a conventional home.

4.1.7 Replace HVAC Appliances Before Duct Sealing

4.1.7(a) When an HVAC appliance will be replaced, the replacement must be completed before duct sealing work is done.

4.1.8 New HVAC Appliances

4.1.8(a) For new installations, all parts shall be new. Do not reuse existing parts.

4.1.8(a1) Exception: Vent components may be reused if in they are good condition and will meet current code requirements.

4.1.8(b) A damaged or defective appliance shall not be installed.

4.1.9 LIHEAP Weatherization Repair and Replacement Policy

4.1.9(a) An existing primary heating and/or cooling appliance that is "red tagged," has a qualifying CAS issue, or is inoperable may quality for repair or replacement.

4.1.9(b) Inoperable primary or non-existing heating and/or cooling may be installed or replaced if absence of the heating and/or cooling appliance poses imminent harm to the safety and well being of the occupants.

4.1.10 Energy Crisis Intervention Program (ECIP) Repair and Replacement Policy

4.1.10(a) Appliance Repair/Replacement Criteria

4.1.10(a1) The repair or replacement of a heating and/or cooling appliance qualifies under ECIP if it has a hazardous condition that poses a direct risk of fire or dangerous indoor air quality, including:

- High carbon monoxide (CO) levels, gas leak, or cracked or defective heat exchanger per Appendix A Combustion Appliance Safety Protocol
- A condition that violates a significant state or local building code including improper clearances, inadequate combustion ventilation air, or non-conforming location and/or venting
- A refrigerant leak
- A condition that violates a significant state or local building code, e.g., a wood-burning stove in a mobile home that draws combustion air from the living space
- Another hazardous condition, upon the preapproval of CSD

4.1.10(b) Heating and/or Cooling Hardship Cases:

4.1.10(b1) The replacement of a heating and/or cooling appliance qualifies under ECIP if using the existing appliance creates a hardship, including:

- A wood-burning stove in the home of an elderly or disabled occupant who cannot physically handle the fuel
- There is no heating or cooling appliance present

4.1.10(c) Non-existent or Inoperable Appliances

4.1.10(c1) A non-existent or wholly inoperable heating and/or cooling appliance may be repaired, replaced, or installed when the applicant meets at least one of the following requirements:

- An occupant has a qualifying “medical condition” that requires temperature control. The condition must be verified by a doctor’s recommendation or other objective evidence gathered at the time of application.
- An occupant is a member of a vulnerable population as identified in the LIHEAP Local Plan and the absence of heating and/or cooling creates an emergency health and safety need.

4.1.11 Change of Heating/Cooling Type

4.1.11(a) Replacement of a heating or cooling system with a different type of unit (e.g., a ductless mini-split heat pump or a unitary system) shall be allowed under the following conditions:

4.1.11(a1) When an energy audit is conducted (with the SIR ≥1.0) per Appendix D Energy Audit/Priority List Protocol or

4.1.11(a2) By approved CSD waiver

4.1.12 Fuel Switching

4.1.12(a) Fuel conversion from a non-electric to electric appliance is allowed for energy efficiency or for H&S when an energy audit is conducted per Appendix D Energy Audit/Priority List Protocol and Section 1 General Installation Guidelines, Fuel Switching Policy.

4.1.12(b) An unused appliance gas line valve shall be capped.

4.1.13 Accessibility and Clearances

4.1.13(a) The appliance shall meet the clearance requirements described in the Appendix A Combustion Appliance Safety Protocol.

4.1.13(b) Equipment shall be accessible for inspection, service, repair, and replacement without removing permanent construction.

4.1.13(c) Heating, ventilation, and air conditioning (HVAC) units shall not be obstructed by landscaping, structures, etc.

4.1.13(d) If located in an attic or crawlspace, the heating/cooling unit shall meet the following clearance requirements:

4.1.13(d1) A minimum access opening of 22" x 30" with an unobtructed passeway large enough to remove the largest appliance and no more than 20’ from the appliance

4.1.13(d2) A minimum working area of 30" x 30" at the front or service side of the appliance

4.1.13(e) Egress requirements

4.1.13(e1) See Section 1 General Installation Guidelines, Window Egress (Conventional Homes).

4.1.14 Electrical Supply and Grounding

4.1.14(a) If an electrical upgrade is required beyond the standard scope of HVAC installation, electrical work shall be performed by a licensed electrician.

4.1.14(b) The electrical outlet and circuit must:

4.1.14(b1) Comply with Section 1 General Installation Guidelines, Electrical Guidelines and Section 1 General Installation Guidelines, Grounding Guidelines, manufacturer’s requirements, and local code

4.1.14(b2) Have adequate current capacity, be grounded, and have the correct polarity

4.1.14(b3) Have no evidence of hazardous conditions (e.g., charring, frayed insulation, loose wires or box, etc.)

4.1.14(b4) Have overcurrent protection (i.e., fuse or breaker)

4.1.14(b5) Be on the supply side of the disconnect switch

4.1.14(b6) Have a receptacle that:

- Conforms to manufacturer's instructions and local code
- Matches the plug on the unit's power cord
- Be located within sight of the equipment
- Be on the roof, adjacent to the equipment (if the unit is roof-mounted)

4.1.14(c) With outlets of ≤120 volts, plug the unit into a dedicated receptacle when required by the manufacturer.

4.1.14(d) For outlets of ≥208 volts, the unit must have a dedicated receptacle outlet.

4.1.14(e) If allowed per the appliance manufacturer's instructions, an extension cord may be used.

4.1.14(e1) Cord specifications must match or exceed manufacturer's instructions.

4.1.14(e2) Cords shall not be draped over a countertop or furnishings in a manner that:

- Allows children to reach and pull on them
- Creates a tripping hazard

4.1.14(f) Additional electrical requirements for central air conditioner (AC), heat pump, and furnace

4.1.14(f1) Voltage drop shall be within manufacturer specifications.

4.1.14(f2) Blower amperage shall not exceed manufacturer full load amperage.

4.1.14(f3) Compressor amperage shall not exceed manufacturer's specification.

4.1.14(f4) Blower compartment safety switch operation will be verified.

4.1.14(f5) Emergency heat circuit functions will be verified for heat pumps.

4.1.14(f6) Branch circuit protection

- AC equipment shall be provided with overcurrent protection and a means of disconnecting in accordance with the and local code.
- The overcurrent protection device shall be in compliance with the AC equipment nameplate.

4.1.14(f7) Service disconnect

- The unit shall be connected to a circuit with a service disconnect (Fig. 4-1) and shall be:
  - Located within sight of, and readily accessible from, the AC equipment, or as required by local code
  - Installed on or within the AC equipment

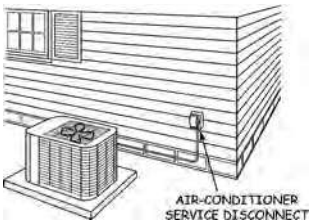

FIG. 4-1: SERVICE DISCONNECT

4.1.15 Unit Protection

4.1.15(a) Units subject to mechanical damage shall be protected.

4.1.15(b) Unit shall be level, stable, secured to ductwork, and be attached to base to prevent movement (with seismic straps, when required by local code).

4.1.15(c) When an AC is repaired or replaced, locking caps shall be installed on accessible refrigerant service valves.

4.1.16 Refrigerant-Based Systems

4.1.16(a) Refrigerant-carrying components (compressor and coils) shall only be moved, adjusted, repaired, or charged by a qualified technician.

4.1.16(b) Refrigerant lines shall:

4.1.16(b1) Be properly sized

4.1.16(b2) Provide the rated seasonal energy efficiency ratio for the combination condenser and evaporator coil match, per the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) directory

4.1.16(b3) Be routed, supported, and secured to house in a manner that protects the line from damage by workers or occupants

- If the line is located where damage could result from contact, install a rigid sleeve that provides protection

4.1.16(b4) Be installed without kinks, crimps, or excessive bends

4.1.16(b5) Be insulated, sealed, and installed with ultraviolet-resistant, code-approved line set protection

4.1.16(c) Refrigerant charging

4.1.16(c1) The refrigerant system shall be properly charged using the methods specified by Title 24 for home energy rating system (HERS) verification.

4.1.16(c2) Before adjusting refrigerant, verify that the system is leak-free, airflow is correct, and temperatures are in the proper range for testing.

4.1.16(c3) Non-condensable gas and moisture shall be bled from the refrigerant circuit using a vacuum pump.

4.1.16(c4) In climate zones 2 and 8–15, when a new or replacement AC or heat pump is installed, or when the condenser coil or a refrigerant-containing component is installed, the correct refrigerant charge must be measured by the installer and verified by a HERS Rater.

4.1.16(d) Refrigerant recovery

4.1.16(d1) When refrigerant lines will be disconnected, refrigerant will be recovered in accordance with Environmental Protection Agency (EPA) regulation 40 Code of Federal Regulations (CFR) 608 by a licensed contractor.

4.1.17 Duct-Based Systems

4.1.17(a) Title 24 verification by a HERS Rater

4.1.17(a1) Duct leakage testing

- In all climate zones, duct leakage must be verified by a HERS Rater when replacing a package unit, air handler, AC condenser, AC evaporator coil, heating coil, furnace heat exchanger, or more than 25' of ducts in unconditioned space.

4.1.17(a2) Minimum airflow and maximum fan wattage

- In all climate zones, when an entirely new space-conditioning system is installed (all equipment and ducts replaced) or 75% of the duct system is replaced, minimum airflow and maximum fan watt draw must be verified.

4.1.18 Recall Considerations

4.1.18(a) A current list of recalled heating and/or cooling appliances is available at https://www.cpsc.gov/Recalls/.

4.1.18(b) Certain nitrogen oxide (NOx) rod furnaces have been identified as being dangerous, and a list of the recalled units is provided in Appendix A Combustion Appliance Safety Protocol.

4.1.18(c) An attempt must be made to have the manufacturer pay for repair or replacement of the potentially dangerous appliance. If reimbursement from the manufacturer for a recalled appliance is not possible, a CSD waiver shall be requested.

4.1.18(d) When an FAU is repaired or replaced by the manufacturer at no cost, the weatherization contractor shall be reimbursed only for costs actually incurred, generally limited to ancillary components and installation labor.

4.1.19 Roof-Mount Appliances

4.1.19(a) The roof and support frame or curb shall be structurally adequate to properly support the installed equipment (Fig. 4-2).

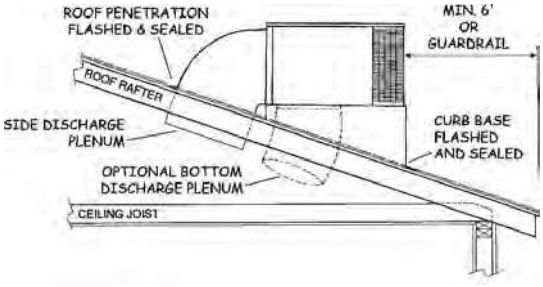

FIG. 4-2: ROOF-MOUNT APPLIANCES

4.1.19(b) Curb base and exposed roof penetrations shall be properly installed, flashed, and sealed watertight.

4.1.19(c) Roofing materials shall be in good condition and not in need of repair or replacement.

4.1.20 Repair of Roof, Walls, and Floors Following Heating/Cooling Unit Installation

4.1.20(a) Any holes or damage to the roof/wall/floor resulting from installation or removal of an HVAC unit shall be repaired to:

4.1.20(a1) Match the plane of the adjacent material

4.1.20(a2) Match the texture of, and blend with, surrounding surfaces

4.1.21 Heating and Cooling Measures Directory

- Central AC/Central Heat Pump
- Ductless Mini-Split Heat Pump
- Wall/Window Air Conditioner
- Evaporative Cooling
- Central Furnace
- Floor, Wall, and Freestanding Furnace
- Wood Stove/Fireplace Insert
- Appliance Enclosure, Platform, and Plenum
- Mobile Home Central AC/Heat Pump
- Mobile Home Evaporative Cooling
- Mobile Home Central Furnace
- Mobile Home Floor/Wall and Freestanding Furnace
- Mobile Home Wood Stove/Fireplace Insert

4.1.22 Table 4-1 provides a reference for specific measures and activities.

TABLE 4-1: HVAC SUPPORTING ACTIVITY DIRECTORY

Supporting Activity	Technical Reference Manual Section
Access and Service Space	• Section 1 General Installation Guidelines, Attic & Crawlspace Accessibility
	• Accessibility and Clearances
	• Central AC/Central Heat Pump, Clearances
	• Wall/Window Air Conditioner, Location
	• Evaporative Cooling, Location
	• Appliance Enclosure, Platform, and Plenum
Air Filter Installation	• Section 10 Air Filters
	• Air filter installation

TABLE 4-1: HVAC SUPPORTING ACTIVITY DIRECTORY

Supporting Activity	Technical Reference Manual Section
Appliance Electrical System Wiring	• Section 1 General Installation Guidelines, Electrical Guidelines
	• Section 1 General Installation Guidelines, Grounding Guidelines
	• Electrical Supply and Grounding
	• Window/wall electrical requirements
	• Roof-mount units, Wall-mounted Controls
	• Roof-mount electrical requirements
	• Mobile Home Central AC/Heat Pump, Electrical Wiring, Grounding, and Accessibility
Appliance Flue Vent Systems	• Appendix A Combustion Appliance Safety Protocol
	• Wall/Window Air Conditioner, Exterior clearance
	• Evaporative Cooling, Setbacks and clearances
	• Central Furnace, Appliance vent system installation
	• Floor, Wall, and Freestanding Furnace, Venting
	• Floor, Wall, and Freestanding Furnace, Freestanding furnace
	• Mobile Home Evaporative Cooling, Window/wall exterior clearances
	• Mobile Home Evaporative Cooling, Roof-mount clearances
	• Mobile Home Central Furnace, Appliance Vent System
CVA	• Appendix A Combustion Appliance Safety Protocol
	• Central Furnace, CVA
	• Floor, Wall, and Freestanding Furnace, CVA
	• Wood Stove/Fireplace Insert, CVA
	• Appliance Enclosure, Platform, and Plenum, Enclosures
	• Mobile Home Central Furnace, CVA
	• Mobile Home Wood Stove/Fireplace Insert, CVA
Ducting (Return and Supply)	• Section 8 Ducting Repair, Sealing, and Insulation
	• Duct-Based Systems
	• Evaporative Cooling, Cooler ducting
	• Evaporative Cooling, Roof-mount barometric damper
	• Central Furnace, Air distribution (duct) system
	• Appliance Enclosure, Platform, and Plenum
	• Mobile Home, Roof jack and duct start collar
Fuel Switching	• Section 1 General Installation Guidelines, Fuel Switching Policy
	• Appendix D Energy Audit/Priority List Protocol

TABLE 4-1: HVAC SUPPORTING ACTIVITY DIRECTORY

Supporting Activity	Technical Reference Manual Section
Gas Lines, Fittings, and Valves	• Appendix A Combustion Appliance Safety Protocol
	• Central Furnace, Gas line and fittings installation
	• Floor/Wall/Freestanding Furnace, Gas piping and valves
	• Floor/Wall/Freestanding Furnace, Gas control valve
Thermostats	• Section 7 Thermostats—Smart, Programmable, and Manual
	• Central AC/Central Heat Pump, Thermostats and controls
	• Central AC/Central Heat Pump, Heat pump controls
	• Central Furnace, Thermostats and controls
	• Floor, Wall, and Freestanding Furnace, Thermostat
Upgrade ECM Blower Motor	• Section 5 ECM Blower Motors
Upgrade Efficient Fan Controller	• Section 6 Efficient Fan Controllers
Vent Covers	• Section 32 Infiltration Reduction
	• Wall/Window Air Conditioner, Winter protection/closure
	• Evaporative Cooling, Window/wall winter protection
	• Evaporative Cooling, Roof-mount units

4.2. Central AC/Central Heat Pump

4.2.1 General Requirements

4.2.1(a) None

4.2.2 Procedure

4.2.2(a) Repair

4.2.2(a1) A tune-up may be performed on an existing package unit or split system when a qualified technician identifies an operational issue that will be resolved by the tune-up procedure as described below.

- System verification
  - Confirm the temperature of the supply air (unit must be cooling) and the temperature of the suction line (must be cold).
- Unit set-up
  - All register dampers shall be open, and duct dampers and zone dampers shall be correctly positioned.
- Air handler
  - The air handler blower wheel shall be brushed and cleaned.
  - Visually inspect the capacitors and wiring.
  - Check the motor bearings for wear and oil them as needed (Fig. 4-3).
  - With the blower operating at high speed, check the blower motor amperage for compliance with the manufacturer's specified range.
  - Seal (e.g., with cork tape) air leaks at plumbing or wiring penetrations.

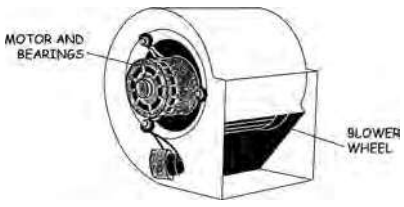

FIG. 4-3: AIR HANDLER BLOWER

- Air filter
  - Clean or replace dirty, defective, or missing AC filters per Section 10 Air Filters (Fig. 4-4).
    - Exception: Electrostatic filters may be cleaned (but shall not be replaced).

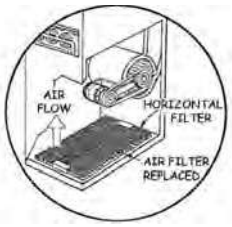

FIG. 4-4: AIR HANDLER FILTER

- Evaporator (indoor coil)
  - The evaporator coil will be checked and cleaned when it can be accessed through removable panels.
    - The coil will be cleaned using a coil brush, vacuum, and/or air pressure.
    - If dirt remains, use a water-based, non-acid, non-corrosive coil cleaning spray or foam applied per product instructions.
    - Water may be sprayed on coils to clean or rinse them, with care taken to avoid wetting the electronic controls or motor.
    - Wet coils must be dry before operating the unit.
    - Accessible coil fins will be checked for damage and combed as needed using a fin comb that matches the fins-per-inch spacing.
  - The condensate drain system (including pump, when present) will be checked and cleaned as needed (Fig. 4-5).
  - Ensure access panels are closed and sealed with Underwriters Laboratories (UL) 181A/B or B-FX metallic tape with non-butyl adhesive.

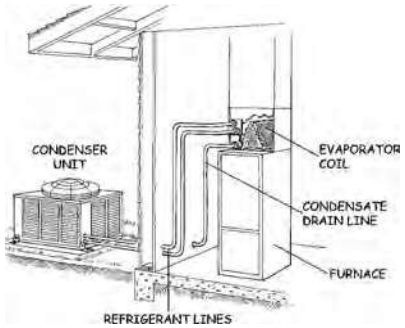

FIG. 4-5: CHECK AND CLEAN CONDENSATE DRAIN SYSTEM

- Condenser
  - Clean the inside of the unit and fan blades with vacuum brush attachment.
  - Check the condenser coil and clean as described above for the evaporator coil.
  - Inspect compressor contact points, compressor terminal block, and capacitors to ensure all connections are proper and tight.
  - Check compressor and condenser amperage with unit operating in AC mode (Fig. 4-6).
  - Check fan motor bearings for wear, and oil as needed.

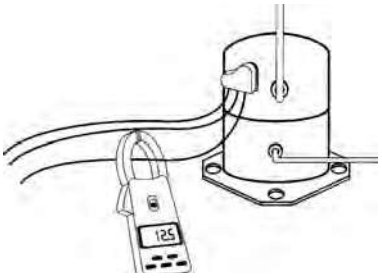

FIG. 4-6: CHECKING COMPRESSOR AMPERAGE

- All equipment integrity
  - Tighten loose items (e.g., screws, bolts, panels, etc.).
  - Repair or replace missing or damaged components critical to proper operation.
- Return and supply ducts
  - Duct testing shall be conducted in accordance with Appendix B Duct Leakage Testing Protocol.
  - Duct sealing shall be conducted in accordance with Section 8 Ducting Repair, Sealing, and Insulation.

- Thermostats and controls
  - The anticipator shall be correctly set, when applicable.
  - Wiring connections must be correct and tight.
  - The thermostat shall be level and securely installed.
  - Adjust the AC controls, including the limit switch and blower fan switch, to operate in accordance with the manufacturer's specifications.
  - Power switches must function properly, including:
    - The blower access lockout/safety switch
    - The switch controlling power to the unit (disconnect)
    - The blower speed control switch
- Airflow assessment
  - Airflow through the indoor coil shall meet manufacturer's specifications.
- Refrigerant charge
  - Leak detection, airflow, and refrigerant line inspection will be checked and repaired to determine need for refrigerant charge
  - After determining airflow, the proper refrigerant charge metering procedure shall be used:
    - Superheat—Fixed-orifice metering device
    - Sub-cooling—Thermal expansion valve metering device
    - Other manufacturer recommended methods
    - Weigh-in
  - The outdoor temperature shall be at or above the minimum required for the diagnostic procedure used (e.g., 55°F for superheat and sub-cooling).
  - If the outdoor temperature is <55°F, a manufacturer-approved "weigh-in" procedure must be utilized.

4.2.2(b) Install

4.2.2(b1) Location

- Roof-mount
  - Refer to Roof-Mount Appliances.
  - Roofing materials shall be in good condition and not in need of repair or replacement.
  - The roof and support frame or curb shall be structurally adequate to properly support the installed equipment.
  - Curb base and exposed roof penetrations shall be properly installed, flashed, and sealed watertight.
- Ground-mount
  - The unit shall rest on concrete or other approved base extending at least 3" above the adjoining ground level (Fig. 4-7).
  - The condenser unit labels shall be visible.
- Clearances
  - Minimum clearance between AC equipment or electrical panels and the adjacent structure/wall/obstruction shall be:
    - 30" on side(s) containing service access panels and
    - 12" on all other sides or
  - 5' from clothes dryer moisture exhaust
- Overhead clearance shall be provided.

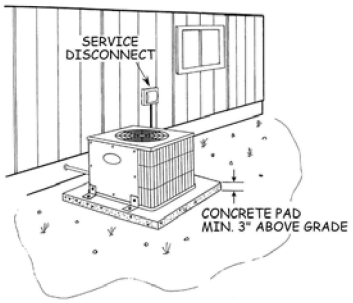

FIG. 4-7: GROUND-MOUNT BASE

4.2.2 (b2) Evaporator coil replacement

- An evaporator coil shall be installed that is verified to be a rated match with the condenser unit, as listed in the current AHRI directory (Fig. 4-8).
- An access panel shall be provided for coil cleaning.
- The evaporator coil unit labels shall be visible.
- Airflow through the coil shall be adequate to meet the manufacturer's specifications.

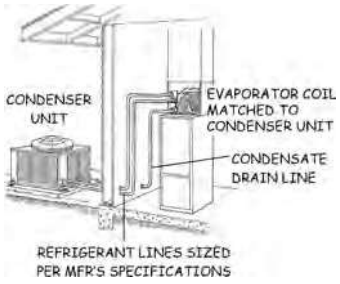

FIG. 4-8: CONDENSER UNIT COMPATIBLE WITH EVAPORATOR COIL

4.2.2 (b3) After installation, the condenser unit and evaporator coil shall be verified to function properly.

4.2.2 (b4) Condensate drain

- A condensate drain line shall be installed on evaporator coils and heat pump units.
- Condensate shall be drained to an approved place of disposal (e.g., exterior of the building or sanitary drain).
- Drain line shall maintain a minimum horizontal slope not less than ⅛" vertical in 12" horizontal (1% slope) in the direction of discharge.
- An indoor unit condensate drain shall be insulated, be covered with a vapor barrier, and slope downward to a code-approved connection in the drainage system or to a suitable exterior drain site away from walking areas.
- Condensate shall not discharge into a street, alley, or other area where it would cause a nuisance.
- Connections and piping in the condensate drain system shall be sealed and watertight.
- The end of the drain line shall be visible and directed downwards with an elbow fitting.
- Installed lines shall allow for cleaning without cutting the existing pipe
- Condensate drain pumps shall be installed when condensate cannot be drained by gravity.
  - A power source for the pump shall be installed if one is not present.
  - Operation and drainage of pump shall be verified.
- Vents and traps shall be installed on condensate drain lines.
  - The trap supplied with the equipment shall be used.
- Roof-mounted units
  - Run the condensate drain line to a nearby gutter, when present, or in accordance with local code.
  - Paint the line to resist ultraviolet (UV) degradation if polyvinyl chloride (PVC) is used.
- When overflow could damage finished surfaces, install:
  - A float switch in the primary condensate drain (for upflow systems) or
  - A secondary drain pan and float switch
    - All secondary drain pans will have a float switch and be sloped to be drained away through a drainline.
  - The float switch(es) will be connected to the system for automatic shutoff in the event of a clogged condensate drain.

4.2.2 (b5) Air distribution (duct) system

- See Section 8 Ducting Repair, Sealing, and Insulation.

4.2.2(b6) Preparation of platform returns and plenums

- See Appliance Enclosure, Platform, and Plenum.

4.2.2(b7) Heat pump controls

- Unless a properly functioning thermostat is present, a new thermostat shall be installed in accordance with Section 7 Thermostats—Smart, Programmable, and Manual.
- A thermostat with supplementary heat lockout that can interface with an outdoor temperature sensor will be selected and set according to manufacturer requirements.

4.2.2(b8) Air filters

- All new AC units installed shall be fitted with new air filters.
- Unframed filters shall be properly supported to prevent them being drawn into the air handler, as prescribed in Section 10 Air Filters.

4.3. Ductless Mini-Split Heat Pump

4.3.1 General Requirements

4.3.1(a) The client shall be allowed to select a recessed or flush-mount system.

4.3.2 Procedure

4.3.2(a) Repair

4.3.2(a1) A tune-up for an existing ductless mini-split system may be performed by qualified technicians using the procedure from Central AC/Central Heat Pump and as recommended by the manufacturer.

4.3.2(b) Install

4.3.2(b1) Indoor unit

- The indoor unit location shall:
  - Be structurally sound and capable of supporting the weight of the unit
  - Provide maximum coverage of the living space for conditioned airflow
  - Not be exposed to direct sunlight and sources of heat
  - Provide the required clearances to facilitate installation
  - Not exceed the manufacter specifications for refrigerant line total length

4.3.2(b2) Outdoor unit

- The outdoor unit location shall:
  - Be a minimum of 5' from clothes dryer moisture exhaust termination.
  - Provide adequate shade, drainage, airflow, and clearances
  - Located to avoid water run-off from the roof
  - Be level and secured to a solid pad a minimum of 3" above the adjoining ground level
  - Be placed on adjustable risers or a wall-mount bracket when debris or snow build-up could impede drainage under the unit.
  - Have a pan heater in cold locations.

4.3.2(b3) Condensate drain (see Condensate drain).

4.3.2(b4) The thermostat shall be placed outside of the direct airflow of the indoor unit and sense the temperature at the controller, not in the return path.

4.4. Wall/Window Air Conditioner

4.4.1 General Requirements

4.4.1 (a) Clearances

4.4.1 (a1) Interior clearance (Fig. 4-9)

- The wall-mount unit air discharge outlet should be located a minimum of 3' above the floor unless mounted below a window or in an existing location that is lower.

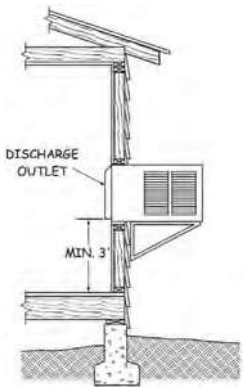

FIG. 4-9: WINDOW/WALL AC MINIMUM INTERIOR CLEARANCES

4.4.1 (a2) Exterior clearance (Fig. 4-10)

- The exterior portion of the unit should be located a minimum of 24" above grade.
- There should be at least 12" between the AC and adjacent walkway or wall.
- The unit's air intake should be located:
  - At least 10' away from or 3' below combustion appliance vent terminations.
  - At least 10' from:
    - Clothes dryer moisture exhaust termination
    - Plumbing vent terminations
    - Exhaust fan vent termination
  - At least 3' from the AC inlet to the gas meter.

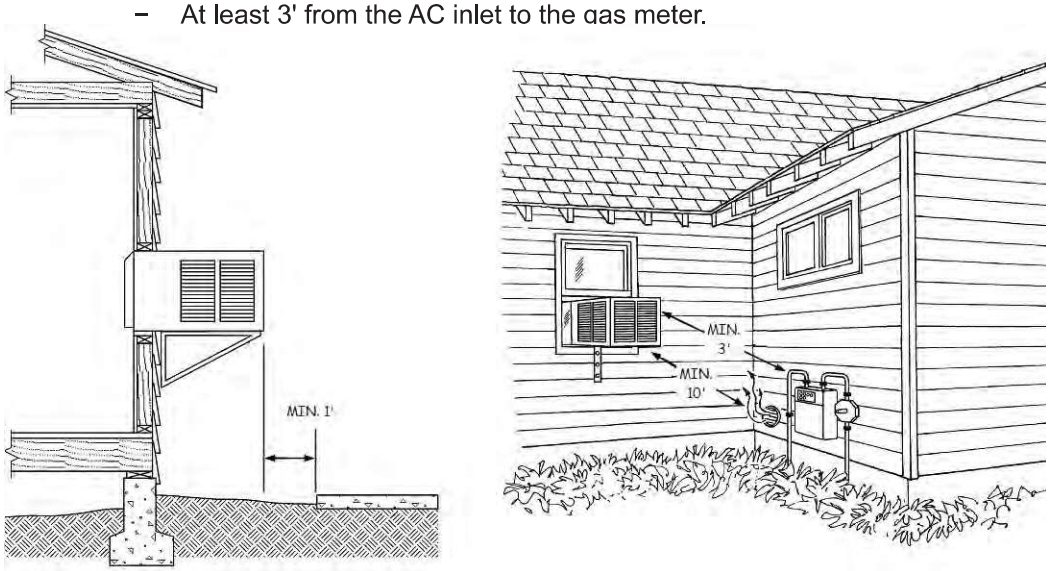

FIG. 4-10: WINDOW/WALL AC MINIMUM EXTERIOR CLEARANCES

4.4.1 (b) Condensate drain

4.4.1 (b1) Condensate drain shall slope downward to a suitable drain site away from the dwelling wall.

4.4.1 (b2) A drain hose/line is required when:

- The AC is located above first floor or
- Condensate will drain onto a patio or walking surface and create puddles

4.4.1 (c) Winter protection/closure

4.4.1 (c1) The installed unit must have interior or exterior closure system (to prevent infiltration in the winter season) (Fig. 4-11), per Section 32 Infiltration Reduction, Vent Covers.

4.4.2 Procedure

4.4.2(a) Repair

4.4.2(a1) American National Standards Institute (ANSI)/ Air Conditioning Contractors of America (ACCA) protocols will be used when conducting repair-related maintenance.

4.4.2(a2) Air filter

- Replace damaged/defective filters.
- Clean washable air filters with detergent and water. Allow to dry before reinstalling.
  - For other filter types, follow the guidelines in Section 10 Air Filters.

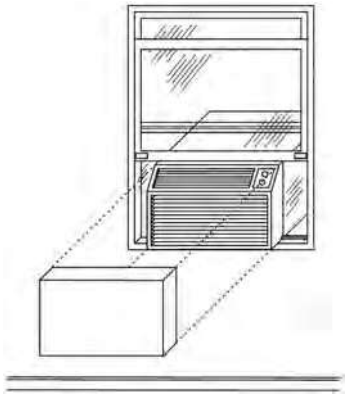

FIG. 4-11: INTERIOR COVER FOR DISCHARGE OPENING

4.4.2(a3) Coil care and cleaning

- See Evaporator (indoor coil) and Condenser.

4.4.2(a4) Drain port cleaning

- With a small wire brush, clean:
  - The condensate drain(s)
  - The drain port(s) on the evaporator side in conjunction with the coil cleaning
  - The condenser side drain port(s), if present

4.4.2(a5) Repair or replace defective gaskets and caulking.

4.4.2(a6) Appliance troubleshooting

- Noisy fan:
  - Tighten the fan blades, motor, and housing bolts if loose.
  - If the fan is damaged, crooked, broken, replace it with the same model.
  - Lubricate fan motor oil ports.
- Inoperable fan:
  - Use a voltmeter to troubleshoot.
- Removal of the fan motor:
  - Motor replacement must be performed by a qualified contractor or technician
- Thermostat or controls malfunction and/or the AC cycles on and off frequently:
  - Ensure the thermostat sensor behind the front grille is positioned near but not touching the evaporator (inside) coil. Adjust it if needed.
  - The front panel shall not be obstructed.
  - Repeat the coil cleaning procedure Evaporator (indoor coil) and Condenser.
  - If performance does not improve, a qualified technician should check for a refrigerant leak and repair and properly recharge the system.
- Unit is inoperable or the AC will not turn on:
  - Check for a tripped breaker or blown fuse.

4.4.2(b) Install

4.4.2(b1) Location

- Install the unit only in a window or wall opening that allows:
  - Free air circulation, free of obstruction
  - Stable and safe installation
  - Access for inspection and service without removing permanent construction

4.4.2 (b2) Window-mount units

- Place the AC in the center of the window opening (side-to-side), if feasible (Fig. 4-12).
- Install transparent, permanent window panels to completely fill empty spaces greater than 12" wide.
- Seal the panels in place.
- For installation in an alternate window type, manufacturer's instructions shall be followed.

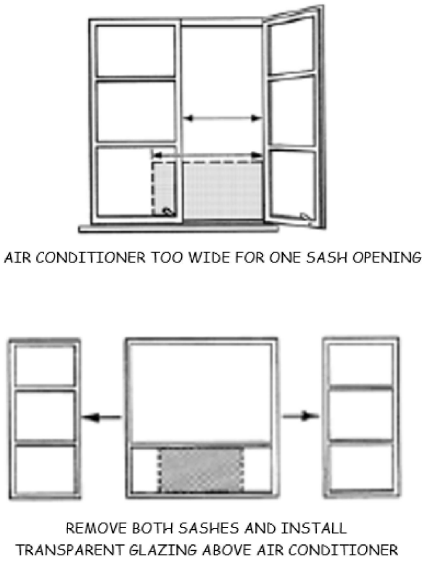

FIG. 4-12: WINDOW-MOUNT AC UNITS

4.4.2 (b3) Wall-mount units (Fig. 4-13)

- The wall must be structurally sound and able to support the unit's weight and vibration.
- Enlarge or reduce the hole to meet manufacturer's hole size and clearance specifications.
- The opening shall be framed with structural members.
- Neatly patch and trim interior and exterior sheathing with all exposed wood primed and painted to match adjacent trim appearance. Openings in brick veneer and block walls should have:
  - Lintel and flashing installed above the opening when required
  - Flashing (drip rail) installed below the unit
- Seal the unit in place.

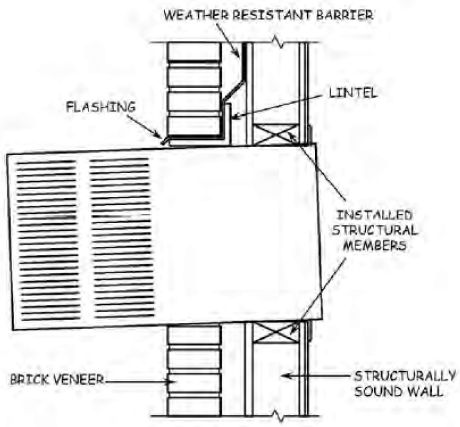

FIG. 4-13: WALL-MOUNT AC UNTS

4.4.2 (b4) Unit supports

- Brace supports should be anchored with non-corrosive screws to solid wood.
- All brace support materials must be metal.

4.4.2 (b5) Ensure the unit is level and plumb

- Front-to-back: The unit should be sloped one half bubble downward to the outside for condensate drainage.

4.5. Evaporative Cooling

4.5.1 General Requirements

4.5.1 (a) Unit shall be installed in a central location in the dwelling. Installation shall be allowed in a bedroom only when a medical or other special condition is granted by program waiver and documented in the client file.

4.5.1 (b) Adequate exhaust ventilation must be available.

4.5.1 (c) Setbacks and clearances

4.5.1 (c1) There shall be at least 3' between the cooler and the adjacent fence or wall, unless a shorter distance is allowed by local code or recommended by the manufacturer (Fig. 4-14).

4.5.1 (c2) The unit shall not extend over a sidewalk, and shall be set back at least 12" or as prescribed by local code.

4.5.1 (c3) Evaporative cooler inlet shall be at least:

- 10’ from or 3’ below any pollutant sources, including but not limited to:
  - Combustion appliance vent terminations, gas vent pipes, or solid-fuel chimneys
  - Attic vents or gas meter set assembly
- 10' from a bathroom or kitchen exhaust, clothes dryer exhaust, plumbing vent, vehicle exhaust source, or any other source of toxic contamination

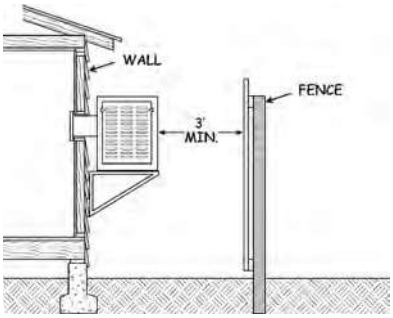

FIG. 4-14: CLEARANCE FROM FENCE OR WALL

4.5.1 (c4) A minimum of 24" clearance is required on the top and sides of the unit for maintenance.

4.5.1 (c5) If supported directly by the ground, the unit shall be installed on a concrete slab at least 3” above the ground.

4.5.1 (c6) If suspended on a raised platform, the unit shall be elevated at least 6” above the ground.

4.5.1 (d) Exhaust ventilation

4.5.1 (d1) Adequate exhaust ventilation shall be provided, which may consist of one or more of the following means:

- Screened window or door openings as shown in Table 4-2
- Ceiling-mounted exhaust vents or pressure relief dampers that exhaust cooled air through the attic
  - Attic net free ventilation area (NFVA) must equal or exceed the total NFVA of the ceiling vents (Table 4-2).
  - Vents must close completely to block backdraft/infiltration when the cooler is off.
  - Vents must be equipped with a positive closure mechanism that is automatically activated by high heat.
  - Ceiling vents may not be used when the attic contains open combustion appliances.
  - Ceiling vents may be used as the sole exhaust path only if the total NFVA or cu. ft. per minute (CFM) capacity of the vents equals or exceeds:
    - The NFVA/capacity recommended by the vent manufacturer or
    - The minimum NFVA shown under “Attic Exhaust Minimum NFVA” in Table 4-2

TABLE 4-2: EVAPORATIVE COOLER EXHAUST OPENINGS

Cooler Capacity (Airflow in CFM)	Window & Door Exhaust [1] Minimum Screened Openings	Attic Exhaust [2, 3] Minimum NFVA
3000	6 sq. ft.	4.0 sq. ft.
3500	7 sq. ft.	4.7 sq. ft.
4000	8 sq. ft.	5.3 sq. ft.
4500	9 sq. ft.	6.0 sq. ft.
5000	10 sq. ft.	6.7 sq. ft.
5500	11 sq. ft.	7.3 sq. ft.
6000	12 sq. ft.	8.0 sq. ft.
6500	13 sq. ft.	8.7 sq. ft.

[1] Values shown assume #16 mesh insect screening will be present.
[2] Values are calculated using the formula: Cooler capacity CFM ÷ 750 = Min. exhaust NFVA.
[3] See Section 40 Attic Ventilation, Tables 40-1 through 40-22.

4.5.1(e) Window/wall winter protection

4.5.1(e1) The installed unit must have interior or exterior closure system (to prevent infiltration in the winter season), per Section 32 Infiltration Reduction, Vent Covers.

4.5.2 Procedure

4.5.2(a) Repair

4.5.2(a1) The following items shall be checked and repaired or replaced when defective.

- Inlets and outlets shall be unobstructed.
- Platform/attachment repair
  - Check the existing platform and attachment to ensure that the following requirements are met:
    - The cooler is level and securely attached to the mounting assembly.
    - The mounting anchors are the correct size and are properly installed.
    - The unit is installed in a manner that will safely support the operating weight (cooler plus water).
- Blower motor
  - Verify that electrical connections are proper
  - Verify that the motor is safely and securely mounted and all nuts and bolts are tight.
  - Check the motor bearing for proper lubrication (Fig. 4-15).
  - Replace the blower motor if it is frozen or if the shaft does not spin freely.
    - Replacement motors shall be two-speed.
    - Exception: If the existing motor is single-speed, the replacement may be single-speed.

FIG. 4-15: LUBRICATE MOTOR BEARINGS

- Pulleys (Fig. 4-16)
  - Ensure that:
    - The set screws are tight and the pulley is secure on the shaft
    - The motor pulley and blower pulley are aligned to within ¼".
    - The pulley rim is perpendicular to the motor shaft
  - Replace bent blower pulleys.
  - Replace a bent motor pulley with an adjustable pulley for controlling the motor amperage and the speed of the blower.
    - Exception: A fixed pitch pulley may be installed in a window- or wall-mount cooler if the pulley and motor size/speed match the original equipment.

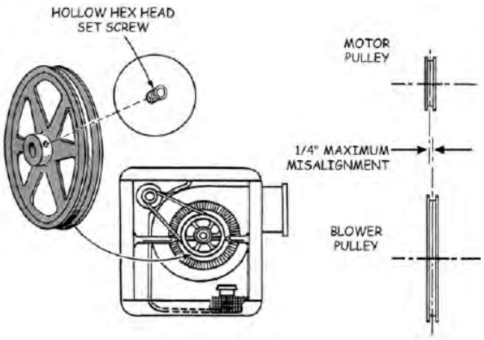

FIG. 4-16: PULLEY ALIGNMENT

- Blower assembly (Fig. 4-17)
  - Check the blower fan to ensure:
    - Proper clearance from housing
    - Free rotation

- Proper operation of both the motor and the fan

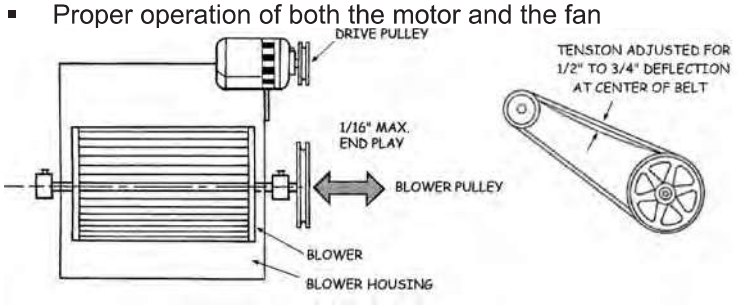

FIG. 4-17: BLOWER ASSEMBLY

  - Adjust the belt tension to ½"–¾" deflection at the center of the span.
  - Adjust the motor sheave to achieve the specified motor amperage as shown on the nameplate.
    - Exception: This does not apply to window/wall units with a fixed-pitch pulley.
  - Replace the belt if it is cracked or worn unevenly.
  - Verify that the blower shaft end play does not exceed 1/16".
  - Center the blower wheel end-to-end in the blower housing.

4.5.2 (a2) Cooler pads and frames (Fig. 4-18)

- Clean and scrape the pad frames to remove mineral deposits.
- Replace deteriorated pads with new pads to achieve 1" thickness with a single 1" pad or two thinner pads.
- Trim the cooler pads to ensure complete coverage of the frame.

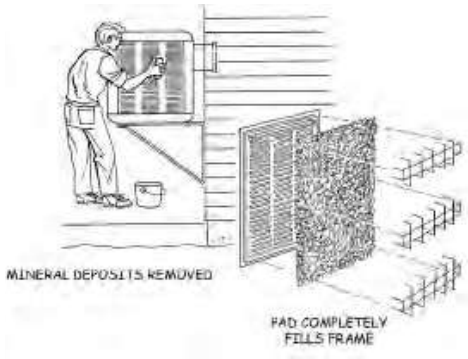

FIG. 4-18: COOLER PADS AND FRAMES

4.5.2 (a3) Water supply and distribution

- Verify the water supply line to the cooler is free of leaks and provides adequate water flow.
- Replace existing damaged or leaking plastic line with minimum ¼" outside diameter (OD) copper and secure it with tube straps/brackets.
- Valves and fittings:
  - Install a brass shut-off valve if no shut-off valve exists:
    - Install a ¼" x ⅛" needle valve, or as required by local code.
    - A self-tapping needle valve is not allowed.
    - Position the outdoor shut-off to be reachable from ground level.
    - Install a brass anti-siphon valve if an anti-siphon valve is not present (Fig. 4-19).

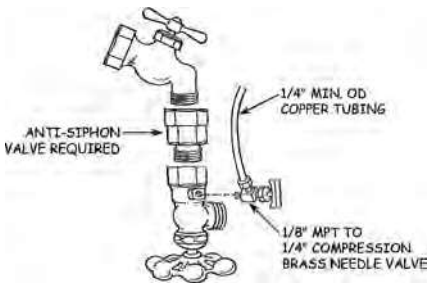

FIG. 4-19: VALVES AND FITTINGS

- Check the circulation pump, the purge pump (when present), and the screen for debris, mineral deposits, and adequate water flow.
- Verify the water distribution lines are free of obstructions and kinks and sealed at all connections.

4.5.2 (a4) Verify that drip trays are level and distribute water evenly to the cooler pads (Fig. 4-20).

4.5.2 (a5) Reservoir and float valve

- Check the reservoir and standpipe to verify that they are properly installed and free of leaks and debris.
- Clean rusted or deteriorated units and coat them with undercoating.
- Verify that the float valve shuts off incoming water completely when raised and the float splash shield prevents water from spraying away from the reservoir.
- Adjust the water level to be within ½"–1" of the top of the standpipe by turning the float level adjustment screw or bending the float rod.

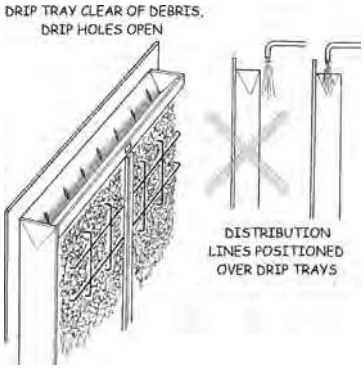

FIG. 4-20: WATER DISTRIBUTION TO DRIP TRAYS

- Do not install water additives (cooler cleaning and water treatment additives).

4.5.2 (a6) Drain system

- Install a drain line if it is missing.
- Verify drain lines are properly installed and free of leaks.
- Check wall/window-mount drain lines to ensure that:
  - Water flows away from the house
  - The end of the drain line is visible
- Check roof-mount drain lines to ensure that the drain line terminates in a rain gutter, in an approved drainage system, on the ground, or as required by the local jurisdiction.

4.5.2 (a7) Cooler ducting

- Repair disconnections and damage/leaks per Section 8 Ducting Repair, Sealing, and Insulation.
- When an evaporative cooler shares ducts with an FAU, a functional damper must be installed that will open while the evaporative cooler is being used and close at all other times to prevent the loss of conditioned air.

4.5.2 (b) Install

4.5.2 (b1) All units

- Install new units plumb, level, and securely attached to the mounting surface.
- Water supply and distribution
  - See Water supply and distribution
- Roof-mount unit drain:
  - Install a permanent drain line to prevent drain and overflow water from running onto the roof.
  - Terminate the drain line in a rain gutter, in an approved drainage system on the ground, or as required by the local jurisdiction.
  - Paint exposed PVC piping to resist ultraviolet degradation.

4.5.2 (b2) Window and wall units

- Location
  - Locate the cooler where only fresh air can enter and adequate room is available to service the unit (e.g., minimum 24" from side walls, solid fences, etc.).
  - Locate the cool air discharge where it will not disturb combustion appliance burners/pilots (e.g., in kitchen near gas range).
  - Window/wall-mount height
    - Locate the exterior portion of the unit a minimum of 12" above grade.

        - The air discharge outlet shall be located to conform with manufacturer's specifications. If no specifications exist, the location shall be a minimum of:
            - 3' above the floor unless mounted under a window
            - 18" above the floor if the discharge grille is equipped with directional louvers and the location is allowed by the manufacturer
                - Exception: The height of an existing location is acceptable if it is not in conflict with the manufacturer's instructions or local code.

- Window-mount opening:
    - Position the cooler in the center of the window opening.
    - Install permanent window panels to completely fill empty spaces.
        - Side window panels over 8" wide shall be transparent glass or polycarbonate.
    - Seal the window panels in place.
- Window/wall-mount cooler supports (Fig. 4-21):
    - Support the cooler with a metal brace, chain kit, or platform.
    - Anchor the brace supports with non-corrosive screws to solid wood
    - Anchors and chain support screws shall penetrate the framing members a minimum of ¾" (1" if the screws are self-drilling).
        - Brackets shall not be anchored to the window sash or trim.
    - The platform shall rest on a concrete pad or masonry supports and be braced.

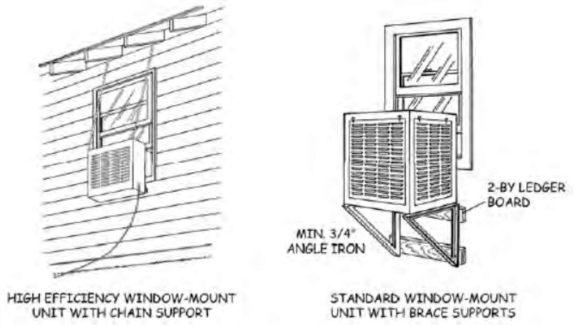

FIG. 4-21: WINDOW/WALL-MOUNT COOLER SUPPORTS

- Wall-mount installation opening:
    - The wall shall be structurally sound and able to support the unit's weight and vibration.
    - The opening shall be framed internally with 2-by lumber/structural members (Fig. 4-22).
    - Flash/seal the opening in accordance with local code.
    - Trim the opening on the interior and exterior.
    - Prime and paint new wood to protect it from moisture damage (non-cosmetic painting only).
    - Use exterior-grade materials outdoors.
    - Openings in brick veneer and block walls:
        - Install the lintel and flashing above the opening when required.
        - Install flashing (drip rail) below the unit.
    - Seal the unit in place.

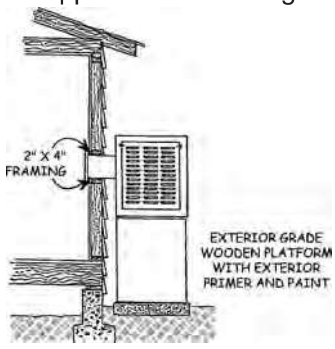

FIG. 4-22: WALL-MOUNT INSTALLATION

- Window/wall electrical requirements
    - Protect exposed wiring by housing it in a conduit.

- Properly ground the cooler cabinet and all metal junction boxes and conduits.
- Connect plug-in units to a grounded three-wire receptacle.

4.5.2 (b3)

Roof-mount units

- Refer to Roof-Mount Appliances.
- Roof-mount barometric damper (Fig. 4-23)
  - When an evaporative cooler is connected to the HVAC duct system and they share the same ducts, an automatic barometric damper is required.

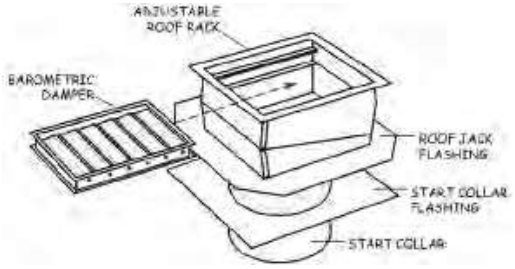

FIG. 4-23: ROOF-MOUNT BAROMETRIC DAMPER

    - Exception: An automatic barometric damper is not required if a manual winter closure damper is present and operable from inside the dwelling.
      - A mechanical damper requiring manual operation from the roof is not allowed.
      - When a manual damper is installed, interior vent covers will not be feasible.
- Supports
  - Bottom support system
    - Support the cooler with a wooden or angle iron stand, sheet metal curb, or support kit (e.g., roof jack and leg kit).
      - Do not support the cooler solely with the roof jack or duct.
    - The support system shall be stable, secure, and constructed in a manner that does not trap rain water.
  - A replacement unit may be installed on an existing support system that is the correct size, is in good condition, and meets all requirements of this section.
  - Platforms
    - See Appliance Enclosure, Platform, and Plenum.
  - Roof-mount support system attachments
    - Install support system attachments/anchors that are corrosion-resistant and chemically compatible screws, bolts, or lag bolts. (Nails and molly bolts are not allowed.)
    - Anchors must penetrate a minimum of 1" into solid wood.
      - Exception: Factory-fabricated leg kits and support systems may be anchored to the roof sheathing.
- Roof-mount cooler duct
  - See Section 8 Ducting Repair, Sealing, and Insulation.
- Diffuser/ceiling grille (Fig. 4-24) shall:
  - Direct air in at least two directions
  - Be equipped with adjustable/ closing louvers or with a positive damper
  - Be located where it will not disturb combustion appliance burners/pilots

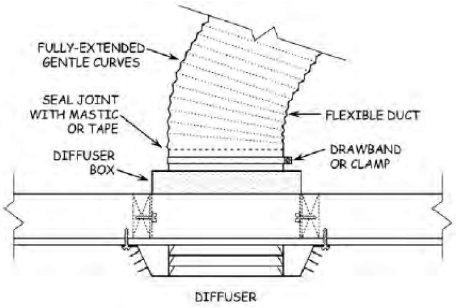

FIG. 4-24: DIFFUSER/CEILING GRILLE

- Cooler controls
  - Wall-mounted controls
    - Install controls in a switch/receptacle box.
    - Install the box and wiring inside the wall whenever possible.
    - When controls and/or wiring are surface-mounted, use an electrical box designed for surface mounting and enclose wiring in a raceway.
- Roof-mount electrical requirements
  - Hard-wire the cooler to an electrical circuit that has:
    - Proper overcurrent protection and grounding or ground fault circuit interrupter (GFCI) protection
    - Adequate current capacity to add the cooler
  - Install a service disconnect and service receptacle when required by local code.
  - Properly ground the cooler cabinet and all metal junction boxes and conduits.
  - Replacement units may use existing wiring if it is in good condition, safe, and adequate for the new cooler's controls and meets the requirements of this section.

4.6. Central Furnace

4.6.1 General Requirements

4.6.1 (a) Prohibited FAU locations

4.6.1 (a1) If an FAU is located in a bedroom (sleeping area) or bathroom and requires repair or replacement, refer to Appendix A Combustion Appliance Safety Protocol.

4.6.1 (b) Enclosure

4.6.1 (b1) See Appliance Enclosure, Platform, and Plenum.

4.6.1 (c) Access to equipment under floors and on roofs shall be provided in accordance with local code.

4.6.1 (d) Attic location requirements

4.6.1 (d1) See Fig. 4-25.

4.6.1 (d2) Refer to Section 1 General Installation Guidelines, Attic and Crawlspace Accessibility.

4.6.1 (d3) If not already present, permanent switch-controlled lighting shall be installed.

- The switch shall be located at the access/entrance and readily accessible.
- The lighting shall provide enough illumination to allow crew to safely approach the equipment and perform the task for which access is provided.

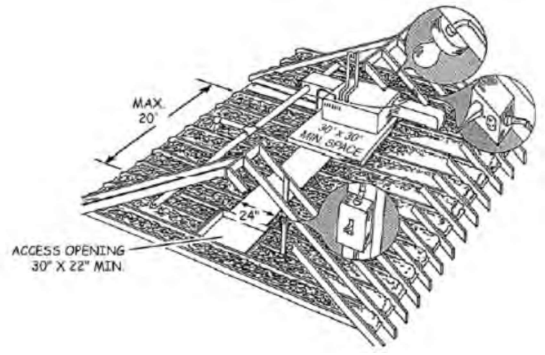

FIG. 4-25: ATTIC LOCATION REQUIREMENTS

4.6.1 (d4) If not already present, a permanent 120-volt convenience receptacle (outlet) shall be installed near the appliance.

4.6.2 Procedure

4.6.2 (a) Repair

4.6.2 (a1) Perform pre-combustion appliance safety testing to identify operational defects, as defined in the Appendix A Combustion Appliance Safety Protocol.

4.6.2(a2) Make all necessary corrections when within the scope of the weatherization program. The scope of repairs must also take into consideration, but is not limited to, the following operational repairs:

- Heating unit integrity
  - Tighten loose items (e.g., screws, bolts, panels, etc.).
  - Replace or repair missing/damaged components critical to proper operation (e.g., access doors, roll-out shield, etc.).
  - Correct improper alterations that adversely affect unit operation.

4.6.2(a3) Appliance filter(s)

- A dirty, defective, or missing furnace filter shall be corrected per Section 10 Air Filters.

4.6.2(a4) Blower chamber

- Clean a dirty blower chamber and fan blades.
- Lubricate the bearings.
- Replace bearings in need of repair.

4.6.2(a5) Evaporator coil box

- Clean or replace a dirty or damaged evaporator coil.
- Seal air leaks at plumbing or wiring penetrations (i.e., with cork tape).

4.6.2(a6) Duct system testing and sealing

- See Appendix B Duct Leakage Testing Protocol.
- See Section 8 Ducting Repair, Sealing, and Insulation.

4.6.2(b) Install

4.6.2(b1) Removal of existing equipment

- Turn off electricity and natural gas before removing the old appliance.
- Disconnect refrigerant lines, plumbing, ducts, electric, control wires, vents, and fuel.

4.6.2(b2) Appliance vent system installation (Fig. 4-26)

- Install and secure a new vent system in accordance with manufacturer's instructions, local code, and Appendix A Combustion Appliance Safety Protocol.
- When an existing furnace that shares a common vent with another appliance is replaced with a new unit, the contractor shall ensure that both appliances are properly vented.
- For natural gas furnaces and absorption heat pumps (gas-fired), an appliance vent system, CVA, and gas piping shall be installed in compliance with Appendix A Combustion Appliance Safety Protocol.

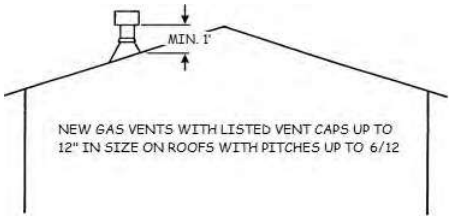

FIG. 4-26: APPLIANCE VENT SYSTEM INSTALLATION

4.6.2(b3) CVA

- The flow of CVA shall not be obstructed by any part of the installation.
- CVA shall be adequate to supply combustion air in accordance with local code and the Appendix A Combustion Appliance Safety Protocol.
  - Corrections shall be made as needed to limit CO to acceptable levels.

4.6.2(b4) Air distribution (duct) system

- See Section 8 Ducting Repair, Sealing, and Insulation.
- Verify the FAU is compatible with the existing duct system.
- Examine the duct system for leaks and disconnections and test it according to Appendix B Duct Leakage Testing Protocol.

- Repair and seal the duct system in accordance with manufacturer's instructions, Title 24 requirements, and Section 8 Ducting Repair, Sealing, and Insulation.
- Install new ductwork in accordance with manufacturer's instructions and Title 24 requirements.

4.6.2 (b5) Preparation of platform returns and plenums

- See Appliance Enclosure, Platform, and Plenum.

4.6.2 (b6) Gas line and fittings installation

- Install gas piping (e.g., risers, flexible connectors, fittings, and valves) in accordance with manufacturer's instructions.
- Install any additional components (e.g., drip leg, condensate drain, etc.) when required by the manufacturer or local code.
- Install a shut-off valve within 3' of the appliance and in the same room or space in which the appliance is located.

4.6.2 (b7) Air filter installation

- When an HVAC unit is replaced, install a filter (with minimum efficiency reporting value [MERV] 6 filtration or higher with no air bypass around the filter) in accordance with Section 10 Air Filters, local code, and manufacturer's instructions. The filter shall be considered part of the replacement measure.
  - A pre-manufactured or site manufactured durable filter slot cover will be installed

4.6.2 (b8) Thermostats and controls

- Install a wall thermostat in accordance with Section 7 Thermostats—Smart, Programmable, and Manual and manufacturer's instructions.

4.6.2 (b9) Power switches shall function properly, including the:

- Blower access lockout/safety switch
- Switch controlling power to the unit (disconnect)
- Blower speed control switch

4.7. Floor, Wall, and Freestanding Furnace

4.7.1 General Requirements

4.7.1 (a) Furnace design and performance

4.7.1 (a1) Heating capacity and system design shall conform with local code and the current Title 24 manuals.

4.7.1 (a2) The furnace shall perform as designed and be properly sized for the living space.

4.7.1 (b) Bedroom locations

4.7.1 (b1) If an open combustion heating appliance is located in a bedroom (sleeping area) and requires repair or replacement, refer to Appendix A Combustion Appliance Safety Protocol.

4.7.1 (c) Fire hazards

4.7.1 (c1) For these heating types, if the existing appliance location (or the proximity of the client's possessions to the appliance) poses a potential fire hazard, the client shall be informed of the non-conforming condition.

4.7.1 (c2) Minor fire hazards shall be removed/corrected by field personnel per Section 1 General Installation Guidelines, Limited Home Repair.

4.7.1 (d) Clearances

4.7.1 (d1) Appliance clearances shall be maintained in accordance with the requirements of the listing, manufacturer's installation instructions, California Mechanical Code (CMC), and local code.

4.7.1(e) CVA

4.7.1(e1) CVA shall be provided in accordance with manufacturer's instructions, local code, CMC, and Appendix A Combustion Appliance Safety Protocol.

4.7.2 Procedure

4.7.2(a) Repair

4.7.2(a1) Repairs may include, but are not limited to, the following operational repairs:

- Repair or replacement of missing/damaged components critical to proper operation (e.g., access doors, a roll-out shield, etc.)
- Correction of non-conforming venting
- Correct improper alterations that adversely affect unit operation
- Repair wiring defects (e.g., frayed or burned wires, loose or improper connections, etc.)
- Tightening of loose items (e.g., screws, bolts, panels, etc.)
- Flame adjustment

4.7.2(b) Install

4.7.2(b1) Floor/wall/freestanding furnaces (general)

- Seal all unnecessary holes in wall studs, floor, and bottom plate before installation of the unit.
- Do not modify the furnace unit (e.g., cutting support legs) unless allowed by manufacturer.
- Maintain proper clearances from combustibles (as described by the manufacturer).
- Install the furnace level and plumb.
- Properly align the unit to be free of metal stress expansion that causes banging and metal ticking.
- Controls
  - Furnace controls shall operate in accordance with manufacturer's specifications.
- Gas piping and valves
  - Replace non-conforming or unsafe connectors with code-compliant materials in accordance with Appendix A Combustion Appliance Safety Protocol.
  - A shut-off valve shall be present in accordance with local code.
- Gas control valve
  - Furnace valve shall turn properly and be free of fuel leaks and electrical defects (e.g., short or open).
  - Gas pressure shall comply with manufacturer's specifications.
- Venting
  - Appliance vent shall be installed and secured to conform with the manufacturer's requirements, CMC, and the venting tables in the Appendix A Combustion Appliance Safety Protocol.
  - Re-use of the existing vent system is only allowed if the vent is in good condition and complies with the unit listing, the manufacturer's requirements, and local code.
  - Direct vent terminal placement:
    - Locate the hole in the wall for the vent system between studs.
    - The vent terminal must meet clearance requirements from an opening into the home (openable window or door) or other air inlet in accordance with the Appendix A Combustion Appliance Safety Protocol.

4.7.2(b2) Thermostat

- Install the thermostat in a location and mounting that complies with manufacturer's instructions and Section 7 Thermostats—Smart, Programmable, and Manual.
- Set the anticipator to 24-volt heating control circuit amperage, when applicable.
- After installation is complete, calibrate the thermostat per the manufacturer's instructions.

4.7.2(b3) Wall furnace

- Wall furnace cabinet shall be secured to structural framing.
- Modifications shall not be made to the furnace (e.g., cutting support legs) unless allowed by manufacturer.
- Finished installation shall include blocking of all unnecessary holes in wall studs, floor, and bottom plate.
- Unit shall be properly aligned and free of metal stress expansion that causes banging and metal ticking.

4.7.2(b4) Floor furnace

- Floor opening shall be framed on all four sides, and furnace cabinet shall be secured to structural framing.
- When required, a seepage pan shall be installed per CMC requirement.
- Access
  - Foundation wall opening at least 24" x 18", or trapdoor 24" x 24".
  - Passageway with minimum 24" x 18" cross-section.
- Controls
  - Control valve operation must be accessible from inside the residence.
  - Pilot light must be accessible for lighting from inside the residence.

4.7.2(b5) Freestanding furnace

- Freestanding furnace shall be vented outdoors with correctly listed vent pipe. The vent shall extend above the roof line in conformance with the Appendix A Combustion Appliance Safety Protocol.
- Install floor protection when required.
- Room volume (CVA) must be adequate for installation.
- Controls
  - Control valve operation must be accessible from inside the residence.
  - Pilot light must be accessible for lighting from inside the residence.

4.7.2(b6) Repairs to home following installation, see Roof-Mount Appliances.

4.7.2(b7) All gas heat source appliances shall be tested after installation using the procedures outlined in the Appendix A Combustion Appliance Safety Protocol.

4.8. Wood Stove/Fireplace Insert

4.8.1 General Requirements

4.8.1(a) Bedroom locations

4.8.1(a1) When a gas log or wood-burning stove or fireplace is present in a bedroom (sleeping area), refer to Appendix A Combustion Appliance Safety Protocol.

4.8.1(b) The wood stove/insert shall be properly sized for the home.

4.8.1(c) The recipient and landlord (if not owner-occupied) shall agree that the wood stove/insert will remain in the residence where it is installed.

4.8.1(d) Safety clearances for the appliance and chimney pipe shall be met in accordance with the manufacturer's instructions and applicable codes.

4.8.1(e) If the primary heat source is a fireplace, pellet stove, or gas log system, it shall not be replaced.

4.8.2 Procedure

4.8.2(a) Repair

4.8.2(a1) The wood stove/insert inspection must be complete, including:

- Heating unit, vents, connectors, chimneys, and terminations
- Floor/wall protection
- Safety clearances
- Source of CVA

4.8.2(b) Install

4.8.2(b1) Check to determine that an appropriate location is available for proper, safe installation of a new wood stove/insert and chimney before:

- The existing unit is removed (when applicable)
- Structural preparation (e.g., cutting holes) for the new unit occurs

4.8.2(b2) Location

- The wood stove/insert shall be located in the living room or other central location (Fig. 4-27).
- The space surrounding the installed wood stove/insert shall be of sufficient size to ensure proper clearance from combustibles and provide safe operation.

FIG. 4-27: WOOD STOVE/INSERT CENTRAL LOCATION

4.8.2(b3) Chimney and components

- The existing chimney and components shall not be re-used, including the:
  - Ceiling support package when a vent connector is used
  - Insulation shield when penetrating an attic
  - Chimney cap and spark arrestor
- Connector/chimney sizing
  - The connector:
    - Shall be no smaller in diameter than the flue outlet, and
    - A maximum of 25% larger than the cross-sectional area of the flue outlet

4.8.2(b4) CVA

- The wood stove/insert shall be designed to obtain CVA ducted directly from the outdoors to the air inlet.

4.8.2(b5) Crawlspace ventilation

- When CVA is drawn from the crawlspace, instead of being vented to the outdoors, the crawlspace must be ventilated (Fig. 4-28).
- The crawlspace vents' NFVA shall be at least twice (double) the NFVA of the air intake opening for the stove.
- Vents shall be located on at least two opposite sides of the crawlspace in accordance with Section 41 Crawlspace Ventilation.

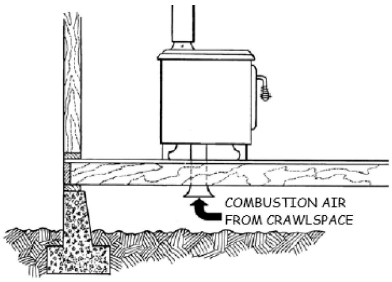

FIG. 4-28: COMBUSTION AIR FROM CRAWLSPACE

- When additional ventilation is needed, undampered crawlspace ventilation shall be installed.

4.8.2 (b6) Floor protection

- When required, a listed floor protector shall be installed in accordance with the manufacturer's requirement and applicable local codes.

4.8.2 (b7) Vent connector installation requirements

- Vent connectors shall be installed as follows unless otherwise specified by the wood stove/insert manufacturer.
- The vent run shall be as short and straight as possible and allow for proper and regular cleaning.
- Bends
  - Wood stoves/inserts with top vent outlet shall have a maximum of one 90º bend.
  - Wood stoves/inserts with rear vent outlet shall have a maximum of two 90º bends (including one at the wood stove/insert).
  - Installation of a tee is recommended at flue outlet to facilitate cleaning.
- Horizontal runs
  - There shall be a minimum ¼" rise per foot of run.
  - The maximum horizontal run will not exceed 75% of the vertical chimney height above the connector.
- Attachment
  - Single-wall vent connectors
    - Joints and connections shall be secured with a minimum of three sheet metal screws, evenly spaced.
  - Multi-wall vent connectors
    - Screws shall not be installed unless allowed in the manufacturer's instructions.
- Location restrictions
  - Vent connectors are limited to visible indoor locations and shall not be installed through a wall, ceiling, or roof or into any concealed space.

4.8.2 (b8) Factory-built chimney installation (Fig. 4-29)

- Chimney height shall be:
  - 3' above the highest point of roof penetration
  - 2' higher than any portion of a pitched roof, wall, evaporative cooler, or any other such object located within 10' of the chimney.
- Bracing
  - Chimneys extending more than 5' above the roof at the highest point of penetration shall be braced per manufacturer's instructions and applicable codes.

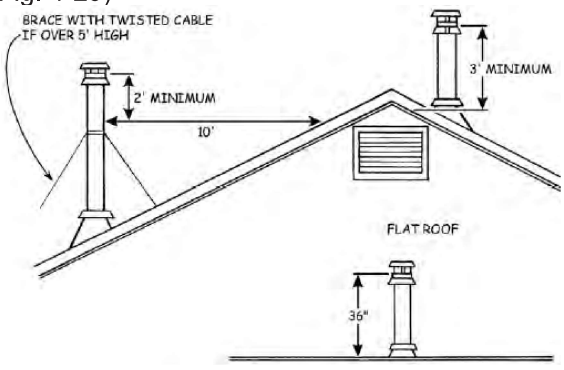

FIG. 4-29: FACTORY-BUILT CHIMNEY INSTALLATION

4.8.2 (b9) Penetrations

- Only listed chimney hardware shall be used at penetrations per the manufacturer's specifications (Fig. 4-30).
- Walls or ceilings: Heat protection specified by the manufacturer shall be installed.

4.8.2(b10) Use of existing chimneys

- A wood stove/insert shall have its own continuous vent with cap and spark arrestor and be installed in accordance with local code.
  - Units can not share the vent of another appliance.
  - Routing the wood stove/insert connector into a masonry chimney is not allowed.
- An insert installed in a fireplace must be properly vented and cannot use the existing masonry chimney alone.

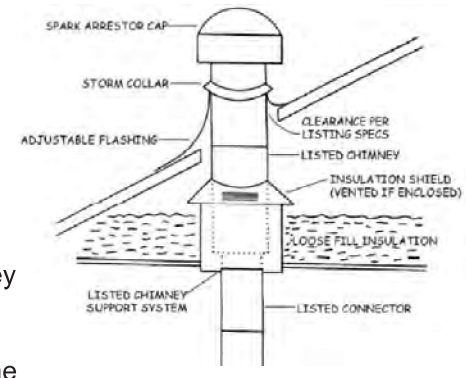

FIG. 4-30: CHIMNEY PENETRATIONS

4.8.2(b11) Floor anchors

- Freestanding wood stoves/inserts shall be firmly attached to the floor as specified by the manufacturer using their attachment hardware.

4.9. Appliance Enclosure, Platform, and Plenum

4.9.1 Enclosures

4.9.1(a) FAU enclosure

4.9.1(a1) Minimum access, service space, and enclosure size for required clearances and adequate CVA shall be provided in accordance with local code.

4.9.1(a2) The enclosure shall provide adequate service space for:

- A 120-volt receptacle and
- An appliance line valve

4.9.1(a3) The access door shall be:

- At least 24" wide, when installed by a crew
- High and wide enough to accommodate removal of the appliance

4.9.2 Attic Service Platforms

4.9.2(a) A code compliant walkway and service platform will be installed in the attic, if not present.

4.9.3 Exterior Equipment Platforms

4.9.3(a) Platforms shall be framed.

4.9.3(b) Ensure that water/debris is not trapped and that moisture can readily escape.

4.9.3(c) Cut ends and holes made in pressure-treated lumber shall be treated with preservative.

4.9.3(d) Plywood for bracing and sheathing shall be sealed with exterior primer and paint.

4.9.3(e) Wood components shall have at least 3" separation from the earth by concrete or other code-compliant base.

4.9.4 Platform Returns and Plenums

4.9.4(a) See Section 8 Ducting Repair, Sealing, and Insulation for sealing requirements of the duct system components.

4.9.4(b) Seal holes and gaps in the walls and floor of the appliance enclosure prior to installation of the appliance in accordance with Section 32 Infiltration Reduction.

4.9.4(c) Seal leaks in return air plenum and insulate plenum in accordance with Section 8 Ducting Repair, Sealing, and Insulation.

4.9.4(d) If platform return is accessed through an appliance enclosure door (a full-length door containing a return grille near the bottom):

4.9.4(d1) Verify the grille does not interfere with proper closure of the door.

4.9.4(d2) Isolate the return from the furnace enclosure (e.g., with weatherstripping that seals the gap between the platform and inside surface of the door).

4.9.4(e) Housing and plenum

4.9.4(e1) Mechanically attach and seal around the perimeter of the components (e.g., housing-to-platform, housing-to-plenum).

4.9.4(e2) Seal wiring and plumbing penetrations into the return air chamber with cork tape.

5. MOBILE HOME–SPECIFIC

5.1. Installation Requirements

5.1.1 Installation requirements for mobile homes are the same as for conventional homes except as specified in the following sections.

5.1.2 Permits, installation, and all materials used shall be in compliance with manufacturer's instructions and specifications, with requirements of Housing and Community Development (HCD), local code, and Appendix A Combustion Appliance Safety Protocol.

5.1.3 Egress requirements shall be comply with Section 1 General Installation Guidelines, Window Egress (Mobile Homes).

5.1.4 Mobile Home Air Distribution System for Ducted Heating/Cooling Types

5.1.4(a) Existing duct system and new ductwork

5.1.4(a1) Examination and testing shall conform with Appendix B Duct Leakage Testing Protocol.

5.1.4(a2) Repair and sealing of existing/new ducts shall conform with Section 8 Ducting Repair, Sealing, and Insulation.

5.2. Mobile Home Central AC/Heat Pump

5.2.1 Mobile Home Self-Contained AC

5.2.1(a) Installation of a self-contained AC (Fig. 4-31) sharing a common supply duct system with the furnace shall comply with the following requirements for damper and function control.

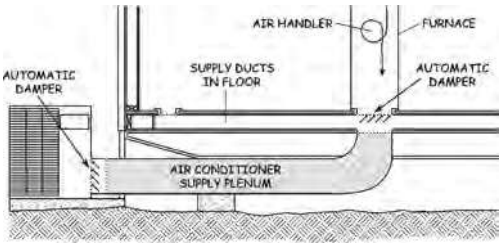

FIG. 4-31: MOBILE SELF-CONTAINED AC

5.2.1(a1) Automatic damper

- The furnace shall have an automatic barometric damper installed to prevent cold air from entering the furnace when the HVAC system is in cooling mode.
- The AC shall have an automatic damper installed to prevent hot air from entering the AC unit when the HVAC system is in heating mode.

5.2.1(a2) Function control

- The controls shall prevent the AC and furnace from coming on at the same time.

5.2.2 Electrical Wiring, Grounding, and Accessibility

5.2.2(a) Electrical wiring, grounding, and unit accessibility shall conform with manufacturer's instructions, the Department of Housing and Urban Development (HUD) code, and/or, as applicable, the requirements of the local building department.

5.3. Mobile Home Evaporative Cooling

5.3.1 Window-/Wall-Mount Units

5.3.1(a) Window/wall exterior clearances

5.3.1(a1) Air conditioner air intake shall be located at least 10' from or 3' below pollutant sources such as a gas vent pipe, solid-fuel chimney, bathroom or kitchen exhaust, clothes dryer exhaust, plumbing vent, vehicle exhaust source, attic vent, gas meter assembly, or any other source of toxic contamination.

5.3.1(a2) Minimum 24" clearance is required on all sides for maintenance.

5.3.1(b) Window/wall location

5.3.1(b1) All units

- The exterior portion of the unit shall be located a minimum of 12" above grade.
- The discharge shall not be located where it can disturb combustion appliance burners/pilots (e.g., in a kitchen near a gas range).

5.3.1(b2) Wall-mount units

- Mobile homes with metal siding
  - The cooler shall be installed only in a window opening or an existing wall opening.
  - Cutting new wall openings is not allowed.

5.3.2 Roof-Mount Units

5.3.2(a) Roof-mount clearances

5.3.2(a1) The evaporative cooler intake shall be at least 3' from a gas vent pipe, solid-fuel chimney, bathroom or kitchen exhaust, clothes dryer exhaust, plumbing vent, vehicle exhaust source, attic vent, gas meter assembly, or other source of toxic contamination

5.3.2(b) Cooler supports

5.3.2(b1) The cooler shall be securely supported by such means as a rigid roof jack (minimum 18-gauge galvanized), angle iron or wooden stand, sheet metal curb, or factory-made support kit.

5.3.2(c) Roof jack and duct start collar

5.3.2(c1) Replacement units shall utilize the existing roof jack and duct start collar if they are the correct type and size, are in good condition, and meet all requirements of this section.

5.3.2(c2) Roof jack

- The roof jack shall match the roof slope or shall be adjustable.
- A leveling assembly (e.g., “levelers” at the top) may be used to compensate for the slight slope of a bow-string truss roof.

5.3.2(c3) The roof jack/cooler connection shall be sealed.

5.3.2(c4) Metal roofs

- The roof jack flashing shall be:
  - Under-coated with elastomeric sealant (e.g., polyurethane)
  - Installed over the metal roof (spanning two truss chords)
  - Secured with screws
    - At least four screws shall penetrate the chords and/or blocking.
  - Additionally sealed as needed to prevent water leakage at joints, seams, and anchor points
- In sloped locations, the metal skin may be slit on the high side, with the roof jack/flashing upper flange slid underneath.
- In locations adjacent to a ridge cap, the upper flange shall be placed under the ridge cap, when possible.

5.4. Mobile Home Central Furnace

5.4.1 An existing furnace in mobile home is not listed and approved for use in a mobile home shall be replaced (per current HUD code).

5.4.2 Location Restrictions

5.4.2(a) A gas or solid fuel furnace that draws CVA from a sleeping room or bathroom in a mobile home is a CAS hazard. See Appendix A Combustion Appliance Safety Protocol.

5.4.3 Preparation of Appliance Enclosure, Platform, and Plenum

5.4.3(a) Isolation of return air

5.4.3(a1) The return air system shall not have leaks that:

- Depressurize any open combustion appliance enclosure.
- Draw in CVA or combustion by-products from any open combustion appliance (e.g., from furnace itself or nearby water heater).
- Depressurize or draw air from a space where hazardous chemicals are stored, or toxic fumes may be present.

5.4.3(b) The following conditions are not allowed and shall be corrected, when feasible:

5.4.3(b1) An open-combustion FAU drawing non-ducted return air through a grille in the furnace cabinet.

5.4.3(b2) A closed-combustion FAU located in an appliance enclosure adjacent to an open combustion water heater when the furnace enclosure is part of the return system, and

5.4.3(b3) The two appliances are not separated by an airtight barrier.

5.4.3(b4) Any condition which allows pollutants to be drawn into the FAU return shall be corrected. If not correctable, the home shall be limited to non-infiltration measures only (the home shall be NIM).

5.4.3(c) Sealing of housing and plenum

5.4.3(c1) Components shall be mechanically attached and sealed around the perimeter (cabinet-to-duct connector, cabinet-to-plenum) using materials and methods prescribed in Section 8 Ducting Repair, Sealing, and Insulation.

5.4.3(c2) Plumbing and wiring penetrations into the evaporator coil box and return air chamber shall be sealed with cork tape.

5.4.4 CVA

5.4.4(a) CVA shall be supplied from outdoors in compliance with furnace listing, manufacturer's instructions, HCD regulations, and Appendix A Combustion Appliance Safety Protocol.

5.4.4(b) When a furnace draws CVA from undercarriage space:

5.4.4(b1) Undampered venting shall be present in the skirting

5.4.4(b2) Cross-ventilation shall be present, with venting located on at least two different sides of the mobile home skirting (Fig. 4-32)

5.4.4(b3) Skirting vents on each side shall provide at least 1½ sq. ft. NFVA for each 25 li. ft. of mobile home length

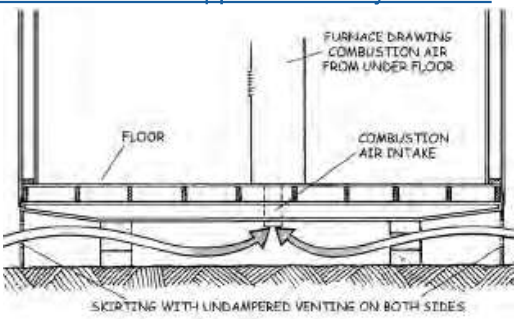

FIG. 4-32: FURNACES DRAWING CVA FROM UNDERCARRIAGE SPACE

5.4.5 Appliance Vent System

5.4.5(a) The existing vent system shall be replaced unless it:

5.4.5(a1) Is in good condition (free of leaks, deterioration, damage, etc.)

5.4.5(a2) Meets listing requirements of the replacement furnace

5.4.5(a3) Is in conformance with furnace manufacturer's instructions

5.5. Mobile Home Floor/Wall and Freestanding Furnace

5.5.1 When an existing furnace in a mobile home is not listed/approved for use in a mobile home (including open combustion unit in the living space) and it is the primary heat source, the furnace shall be replaced with a mobile home listed furnace in accordance with the current HUD code.

5.5.1(a) Replacement furnaces shall be closed combustion and listed for use in mobile homes.

5.6. Mobile Home Wood Stove/Fireplace Insert

5.6.1 An existing wood stove/insert in a mobile home that is not listed and approved for use in a mobile home (per current HUD Code) shall be replaced.

5.6.2 CVA

5.6.2(a) CVA shall come from outside the living space (outdoors) in accordance with HUD and HCD regulations.

5.6.2(b) CVA intakes shall be ducted through the envelope as specified by the manufacturer.

5.6.3 Crawlspace Ventilation

5.6.3(a) Skirting shall be ventilated when the undercarriage area is the source of CVA (Fig. 4-33).

5.6.4 Undampered venting shall be installed as needed.

5.6.5 Ventilation in the skirting shall be at least twice (double) the NFVA of the air intake opening for the stove.

5.6.6 Vents shall be installed and located on at least two opposite sides of the mobile home.

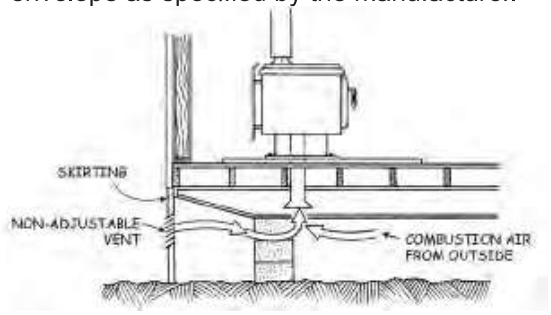

FIG. 4-33: MOBILE HOME CRAWLSPACE VENTILATION

6. MULTI-FAMILY–SPECIFIC

6.1. Installation Requirements

6.1.1 Installation requirements for multi-family homes (i.e., individual unit and whole-building) are the same as those for conventional homes.

6.1.2 Installation of a heating and/or cooling source for an individual unit or a common system serving multiple units is allowable due to Health & Safety (H&S) or as an energy efficiency upgrade as allowed by Appendix D Energy Audit/Priority List Protocol.

6.1.3 Common area installation is allowed when justified by an energy audit for a whole-building project (e.g., in a boiler room, utility room, etc. within the same thermal boundary as dwelling units). See Appendix D Energy Audit/Priority List Protocol.

6.1.3(a) Common area installation is not allowed when only an individual unit will be served.

7. DOE-SPECIFIC

7.1. Assessment Requirements

7.1.1 This measure may be a DOE Health & Safety measure, Audit path audit driven measure, or Priority List path Optional measure.

7.1.1(a) A heating and/or cooling "system" can mean a central unit or several individually operating units; however, when a central unit is in place, it shall be considered the primary unit, and all other units are to be considered secondary.

7.1.1(b) When an appliance condition is identified that would allow this measure to be repaired or replaced under H&S, an audit is required first to determine if the appliance could be replaced as an energy efficiency upgrade. If the SIR is <1.0, H&S repair or replacement may be allowed.

7.1.1(b1) DOE H&S measures must be installed when feasible, regardless of the funding source. If the client refuses the measure, or it cannot be physically installed due to a dwelling condition, the dwelling must be deferred.

7.1.2 When any amount of DOE funding is used toward the cost of this measure, DOE policies will apply.

7.1.3 When no DOE funds are used for a measure, the alternative funding source policies apply.

7.1.3(a) Exception: For Mandatory Priority List measures in a combined work scope, DOE policies will always be applied regardless of funding source and/or leveraging.

7.1.4 For additional details, refer to Appendix D Energy Audit/Priority List Protocol.

7.1.5 To assess for this measure (and the associated thermostat) as part of a DOE work scope, it is required to complete the CSD 710 Energy Audit/Priority List Checklist.

7.1.5(a) The form will determine if the measure will be installed in the Audit path or the Priority List (PL) path.

7.1.5(b) When assessing this measure for the Audit path, measure feasibility will be decided by the energy audit with a Measure savings-to-investment ratio (SIR) and Dwelling SIR.

7.1.5(c) When assessing for the measure in the PL path, the feasibility will be based on building type and characteristics.

7.1.5(c1) PL measures are classified as Mandatory or Optional based on building type.

- Mandatory measures on the PL path must be installed when feasible, or the dwelling shall be deferred.
- Optional measures may be installed only after all feasible Mandatory PL measures have been installed.

7.1.6 For the Priority List Path:

7.1.6(a) Specific types of heating and cooling replacements are Optional identified in the Priority List (PL) for each building type.

7.1.6(a1) Appliance efficiency values for PL measures are listed in the Priority List Tables in Appendix D and in the Material Specifications. They are identified separately.

7.1.6(a2) Programmable thermostats are a required part of the PL path heating and cooling appliance replacements, and must be installed or present where indicated by the Appendix D Priority List Tables.

7.1.6(a3) If not specifically listed, a site-specific energy audit shall be required.

7.1.6(b) All Mandatory H&S-related heating and cooling repairs and replacements (including the associated thermostat) must be fully leveraged to an alternative funding source.

7.1.7 For the Audit Path:

7.1.7(a) To install this measure (and the associated thermostat) in the DOE Audit path, a site-specific energy audit is required to determine if it will be an energy conservation measure or a Health and Safety measure.

7.1.7(b) Measure feasibility will be determined through the energy audit with a Measure savings-to-investment ratio (SIR) and Dwelling SIR.

7.1.7(b1) When the Measure SIR ≥1.0, the energy conservation measure may be paid for with DOE funds.

7.1.7(b2) When the Measure SIR <1.0, and a H&S condition exists, it is a H&S measure.

7.1.8 If a client refuses a feasible Major Audit path measure, Mandatory Priority List path measure, or Health & Safety measure, the entire dwelling shall be deferred.

7.1.9 Cooling Systems

7.1.9(a) Primary AC system replacement, repair, or installation is allowed only in homes where current occupants meet Grantee's definition of "at-risk", per the Appendix E Health and Safety Requirements.

7.1.10 Heating Systems

7.1.10(a) Primary Systems

7.1.10(a1) A safe primary heating system (vented to the outdoors) must be present, or repair/replacement/installation must be feasible.

- Refer to Appendix A Combustion Appliance Safety Protocol for policies specific to appliance types and building types.

- If an unvented combustion space heater is the primary heat source, it must be replaced with a vented heat source prior to weatherization and be sized to heat the entire dwelling unit.
- Appliance abandonment is not allowed.
- If repair/replacement/installation is not feasible, deferral is required.
- It is required to provide a cost comparison between replacement and repair when a H&S condition is identified.

7.1.10(b) Gas Log or Wood-burning Stove or Fireplace Insert

7.1.10(b1) When a gas log or wood-burning stove or fireplace insert is present in the living space, refer to Appendix A Combustion Appliance Safety Protocol. The woodstove/insert shall be properly sized for the home.

- Conduct a safety inspection including, but not limited to, visual inspection of the entire system, verification of adequate floor protection, and code-compliant clearances to walls and other combustible materials.
- It is required to perform visual draft testing of the fireplace/woodstove to ensure proper operation of the appliance as detailed in Appendix A Combustion Appliance Safety Protocol, Table 15.5.1.
- Fireplace or woodstove venting that is left operational after weatherization must meet current state (California Mechanical Code), local, and national standards or the home must be deferred.
  - If the primary heat source is a fireplace, pellet stove, or gas log system, it shall not be replaced.

7.1.10(c) Secondary Systems

7.1.10(c1) Unsafe secondary heat sources must be repaired, or removed and disposed of, or dwelling deferral is required.

7.1.10(c2) Unsafe secondary heat sources that cannot be repaired must be removed. Abandonment is not allowed.

- Unsafe portable space heaters must be removed.

7.1.10(c3) A secondary space heater is considered unsafe if it:

- Is not listed and labeled as meeting ANSI Z21.11.2
- Has an input rating of more than 40,000 BTU/hour
- Is in a bedroom and have an input rating of more than 10,000 BTU/hour
- Is in a bathroom and have an input rating of more than 6,000 BTU/hour
- Operates in an unsafe manner (e.g., high carbon monoxide (CO) readings, too close to combustible materials, lack sufficient combustion air volume, etc.)
- Is not allowed by the Authority Having Jurisdiction (AHJ)
- Is in a mobile home, and it is not vented to the outdoors.

7.1.10(c4) Removal of the appliance shall be billed under the “Disposal” line-item category for all labor and disposal fees pertaining to the appliance.

7.1.10(d) Mobile Home Combustion Appliances

7.1.10(d1) Combustion appliances in mobile homes must comply with the Manufactured Home Construction and Safety Standards, which mandates that:

- All combustion appliances installed by or left in place after weatherization in mobile homes must meet these standards.
- For mobile homes, malfunctioning combustion appliances shall be repaired or replaced before weatherization or they must be removed in accordance with Appendix A Combustion Appliance Safety Protocol.

- All fuel-burning appliances in mobile homes except ranges, ovens, illuminating appliances, clothes dryers, solid fuel-burning fireplaces and solid fuel-burning stoves, must be installed to provide for the complete separation of the combustion system from the interior atmosphere of the mobile home (i.e., to draw their combustion air from outside), and be vented to outside the dwelling.
- Repair or replacement of combustion gas venting shall be performed when necessary to ensure proper combustion gas venting to outside the dwelling for all combustion appliances, including but not limited to gas dryers and refrigerators, furnaces, vented space heaters, and water heaters.
- Nonconformance with this requirement will require correction or removal of the appliance.
- If a client will not allow removal of an unsafe combustion appliance (primary or secondary) from the home, deferral is required.

7.2. Installation Requirements

7.2.1 Installation requirements for DOE are the same as those for LIHEAP, except as specified below.

TABLE 4-3: DOE INSTALLATION REQUIREMENTS

#	Component	Specification	SF	MH	MF
ACCESS, INSTALLED APPLIANCES					
3.0104.2f	Installing New Crawlspace Access	If the depth of the crawlspace passageway or the appliance service space exceeds 12" below the adjoining grade, the walls of the passageway will be lined with concrete or masonry extending 4" above the adjoining grade in accordance with Chapter 4 IRC.	X		X
BOILERS (HYDRONIC SYSTEMS)					
5.0203.1c	Boilers	Install unit in a dry location and within conditioned space (when feasible). Install equipment in a location and manner to provide ease of access for routine maintenance/service.	X		X
5.0203.1e	Boilers	Situate equipment on a stable, non-wicking, and fireproof material. Ensure unit is level, stable and supported independently of the distribution system.	X		X
5.0203.1f	Boilers	Install electrical wiring according to NFPA 70. Provide an electrical disconnect within site of the unit. Install all high voltage wiring inside of protective conduit and approved junction boxes, no wiring connections (high or low voltage) will occur outside of appropriate junction box.	X		X
5.0288.1a	Boiler Room Water Drainage	Route maintenance blow-down piping to the nearest drain.			X
5.0288.1b	Boiler Room Water Drainage	Remove debris from the drainage system and flush the system to remove any blockages. Verify that drainage system is capable of handling maximum volume of water.			X
5.0288.1c	Boiler Room Water Drainage	Clean the blow-down pit out to handle the volume of water required to sufficiently reduce blow-down temperature for safe discharge. Clear the blow-down pit connection to the drain.			X
5.0288.1d	Boiler Room Water Drainage	Size the sump pit to handle the volume of water required to sufficiently reduce water temperature for safe discharge. Verify that sump pump is rated for high-temperature application, operates correctly, and contains a check valve.			X
COMPRESSORS					
5.0103.4a	Compressors	Size compressor based on ASNI/ACCA Standard 5 QI (HVAC Quality Installation Specification).			X
5.0103.4b	Compressors	Locate new compressor on a stable and level surface with adequate ventilation.			X

TABLE 4-3: DOE INSTALLATION REQUIREMENTS

#	Component	Specification	SF	MH	MF
5.0103.4c	Compressors	Size refrigerant lines to match compressor and desired return velocities. Install new filter dryers when installing new compressors. Install P-type oil traps at the base of suction line risers and inverted P-type oil traps at the top of risers. Slope horizontal runs 1" per 20' toward the compressor. Install vibration absorbers. Route refrigerant piping so as not to inhibit service access to compressor or associated equipment.			X
5.0103.4d	Compressors	Install field wiring in accordance with applicable codes (i.e., NFPA 70) ensuring proper voltage, frequency, and phase coincide with the nameplate.			X
CONDENSATE REMOVAL					
5.0102.1a	Furnaces	Condensate from condensing furnaces must first pass through a neutralizer if using waste lines for disposal.	X	X	X
5.0102.1g, 5.0108.1o, 5.0108.2k, 5.0108.3p, 5.0108.4l, 5.0301.3e, 5.0301.2d	Split Systems, Package Units, Mini-Splits, Furnaces, PTAC/PTHP	When there is potential for condensation or freezing of the drain line, insulate condensate drain lines to a minimum of R-4 (R-3 for wall furnances and PTAC/PTHP units) with insulation that contains a Class II or greater vapor retarder.	X	X	X
ECONOMIZERS					
5.0188.1a	Economizers	Design economizer outdoor air dampers in accordance with ASHRAE 90.1 minimum requirements or applicable code.			X
5.0188.1b	Economizers	Install the economizer intake as far from pollutant sources as possible, but no less than 20 feet. Install the economizer controls with carbon dioxide (CO2) control in high occupancy spaces (demand control ventilation).			X
EQUIPMENT SIZING / LOAD CALCULATIONS					
5.0108.1a, 5.0108.2a, 5.0108.3a, 5.0108.4a, 5.0203.1a, 5.0301.2a, 5.0301.3a	Split Systems, Package Units, Mini-Splits, Furnaces, Wall Furnaces, PTAC/PTHP Units, and Boilers	Use interior design temperatures of 75 degrees for cooling and 70 degrees for heating. Room by room load calculations must be performed when installing a new duct system or in retro-commissioning projects. Calculated loads shall be based on post-retrofit dwelling characteristics.	X	X	X
5.0108.1b, 5.0108.2b, 5.0108.3b, 5.0108.4b, 5.0203.1b	Split Systems, Package Units, Mini-Splits, Furnaces, and Boilers	Select cooling equipment capable of meeting the sensible and latent load of the building, that is not sized more than 115% of total load (or the next available size). Select heating equipment of the lowest capacity required to meet the design heating load, and will provide the air volume required by any air conditioning equipment installed. Select outdoor units that are corrosion-protected for marine climate zones.	X	X	X
FUEL PIPING					
5.0504.1c	Natural Gas/ Propane Fuel Piping	Locate/route gas piping so a trip hazard will not be created, the lines will not be damaged by water, and to create the least pressure drop possible.	X	X	X
5.0504.1e	Natural Gas/ Propane Fuel Piping	All piping installations must contain, at a minimum, a manual gas shut off valve, a union joint, and a sediment trap at each appliance.	X	X	X

TABLE 4-3: DOE INSTALLATION REQUIREMENTS

#	Component	Specification	SF	MH	MF
5.0504.1f	Natural Gas/ Propane Fuel Piping	If installed, vent all gas pressure regulators requiring venting to outside the building with code approved rigid pipe. Terminate the pipe in a safe location without any thread, coupling, fitting, etc. that would allow a plug to be easily fitted.	X	X	X
5.0504.1h	Natural Gas/ Propane Fuel Piping	Install a secondary LP safety detector system (e.g., valve, exhaust fan, alarm light) for propane piping installed below grade.	X	X	X
5.0504.1i	Natural Gas/ Propane Fuel Piping	If a gas pressure booster is necessary, confirm compatibility with the gas-fired equipment and check low and high gas pressure switches for proper operation.	X	X	X
5.0504.2a	Oil Piping	Select approved pipe type in accordance with applicable code (e.g., NFPA 31, IMC).	X	X	X
5.0504.2b	Oil Piping	Locate/route oil piping so a trip hazard is not created and the pipe will not be damaged by water.	X	X	X
5.0504.2d	Oil Piping	All piping installations must contain at a minimum: a fire valve, a manual oil shut off valve, a union joint, and a filter fitting for each appliance.	X	X	X
5.0504.2e	Oil Piping	If a fuel pump is required, design it based on fuel type, distance from tank, and equipment size. Install a serviceable strainer in the pump supply side. The pump must be interlocked with the appliance to cut off when the appliance is not functioning.	X	X	X
HVAC UNIT INSTALLATION					
5.0108.1e, 5.0108.1g, 5.0108.2e, 5.0108.3e, 5.0108.3g, 5.0108.4d, 5.0108.5c	Split Systems, Package Units, Mini-Splits, Furnaces, and Evaporative Coolers	Install unit(s) according to ANSI/ACCA Standard 5 (HVAC Quality Installation Standard).	X	X	X
5.0108.1d,	Split Systems, Package Units	Ensure unit is elevated on a non-wicking equipment pad a minimum of 6” above the ground (may use a combination of the existing 3” slab and manufacturer supplied appliance risers).	X	X	X
5.0108.3d	Mini-Splits	Locate the outdoor unit a minimum of 6” above the snow line.	X	X	X
5.0108.1i, 5.0108.1j, 5.0108.1k, 5.0108.4f, 5.0108.4g, 5.0108.4h	Split Systems and Furnaces (horizontal and upflow)	If required by the local jurisdiction, support equipment on a fireproof platform that is elevated above the insulation level or suspend the unit with threaded rod. Install vibration pads/isolators.	X	X	X
5.0108.1l, 5.0108.4i	Split Systems and Furnaces	Support equipment on ductwork capable of supporting the weight of the equipment.	X	X	X
5.0108.1r, 5.0108.2l, 5.0108.4n	Split Systems, Package Units, and Furnaces	If required by the local jurisdiction, install smoke detectors inside the supply duct plenum of systems that move more than 2,500 cubic feet per minute (CFM).	X	X	X
5.0108.3b	Mini-Splits	When applicable, supply multiple indoor units with a single outdoor unit using manufacturer specifications to determine allowable overage of indoor unit capacity in relation to the outdoor unit, and the derated capacity of indoor units based on outdoor design temperature. When applicable, select units that offer ducting options (e.g., ceiling cassette units have a knock out for a 5” or 6” duct) and/or have an outdoor air intake.	X	X	X

TABLE 4-3: DOE INSTALLATION REQUIREMENTS

#	Component	Specification	SF	MH	MF
5.0108.3h	Mini-Splits	Insulate the concealed ceiling cassette unit(s) to a minimum of R-6 when contained inside a building cavity, (even when inside the thermal boundary) without hindering access to serviceable parts. Insulation must include a sealed vapor retarder layer.	X	X	X
HYDRONIC SYSTEMS					
5.0202.2a	Distribution Insulation	Select insulation that: • Is rated for the maximum operating temperature of the system • Is R-3 or greater	X		X
5.0202.2b	Distribution Insulation	Install insulation over all distribution system components that allow insulation in a continuous manner without gaps. Seal all seams, joints, and connections of insulation with a durable sealant or mechanical fasteners (e.g., zip ties). Install removable/reusable insulation over components that require regular maintenance.	X		X
5.0202.2c	Distribution Insulation	Post a dated receipt signed by the installer that minimally includes: Installed insulation type, coverage area, installed thickness, and installed R-value.	X		X
PACKAGED TERMINAL AIR CONDITIONER (PTAC) / PACKAGED TERMINAL HEAT PUMP (PTHP)					
5.0301.2b	PTAC/PTHP Units	Select new unit that: • Is ENERGY STAR qualified or equivalent • Does not use electric resistance heat as the primary heat source (i.e., select Heat Pump units) • Is corrosion-resistant in marine climates • Is ducted, if conditioning multiple rooms	X		X
5.0301.2c	PTAC/PTHP Units	Where applicable, unit controls and thermostat must comply with the operable parts provisions of ICC A117.1 when the dwelling unit is required to be accessible per ADA. Where required, maintain egress requirements in accordance with ANSI/NFPA 101 and local laws.	X		X
5.0301.2e	PTAC/PTHP Units	Before installing through-wall unit, seal all adjacent framing and provide a sealed and sleeved opening. After installation, seal the perimeter with suitable materials (e.g., ASTM C1193).	X		X
5.0301.2f	PTAC/PTHP Units	If unit is ducted, insulate all cooling ducts (including those inside the thermal boundary).	X		X
REFRIGERANT					
5.0103.1c	Refrigerant Lines	Install proper filter dryer(s) on all systems. Install P-traps on suction line risers that are greater than 10' in height.	X	X	X
5.0103.1d	Refrigerant Lines	Insulate all suction lines to a minimum of R-4 with an insulation that is a class II or better vapor retarder. Insulate all high pressure lines that pass through spaces where condensation may occur to a minimum of R-4 with an insulation that is a class II or better vapor retarder.	X	X	X
5.0103.2b	Refrigerant Charge	Weigh in calculated refrigerant charge if outdoor conditions prevent accurate pressure measurements.	X	X	X
5.0103.2c	Refrigerant Charge	Provide occupant/owner with refrigerant charge documentation according to ANSI/ACCA Standard 5 (HVAC Quality Installation).	X	X	X
ISOLATE CAZ					
5.0501.1d	Isolate CAZ	If required by the local jurisdiction, insulate all surfaces of the isolated room between the room and conditioned space to the applicable code minimum for the climate zone according to the IECC.	X	X	X

7.2.2 If weatherization installs an appliance where the existing appliance was vented into a masonry chimney, the chimney must be lined in compliance with the International Fuel Gas Code (IFGC), California Mechanical Code, and local code (if more stringent).

8. POST-INSTALLATION GUIDELINES

8.1. Quality Check

8.1.1 Check that the unit was installed properly and that the heating and/or cooling source operates as intended by the manufacturer.

8.1.2 Verify that all electrical and refrigerant line connections are correct and secure.

8.1.3 Test the controls of the heating and cooling unit to ensure proper operation in all modes.

8.1.4 If provided, program the remote control per the manufacturer's instructions.

8.1.5 CAS Check (Combustion units)

8.1.5(a) All new and affected gas lines and components shall be checked for gas leaks by a method approved by the local jurisdiction

8.1.5(b) CO in flue gas shall be tested to be within limits specified by:

8.1.5(b1) Appendix A Combustion Appliance Safety Protocol or

8.1.5(b2) Manufacturer's instructions, if more stringent

8.2. Client Education

8.2.1 Provide the occupant with both verbal and written instructions for: the operation manual(s), proper maintenance requirements, safety information, warranty, and agency installer contact information.

8.2.2 Measure-specific verbal and written instructions include:

8.2.2(a) Removal and installation of winterizing materials

8.2.2(b) Safe placement of interior furnishings with respect to the heat source

8.2.2(c) Keeping the appliance area, return grilles and supply registers clear of furniture, dust, debris, hazardous chemicals, and other blockages

8.2.2(d) Combustion air inlet locations and the importance of keeping inlets open

8.2.2(e) Importance of leaving interior doors open as much as possible

8.2.2(f) Importance of keeping outside unit clear of debris, vegetation, decks, and other blockage

8.2.2(g) Indoor and outdoor electrical disconnects and fuel shut-offs

8.2.2(h) When applicable, information about the proper disposal of bulk fuel tanks when not removed as part of weatherization work

8.2.2(i) Where combustion equipment is present, information including how to recognize depressurization and the dangers of CO poisoning associated with combustion appliance use

8.2.2(j) Situations when the occupant should contact the HVAC contractor will be explained, including:

8.2.2(j1) Fuel odors

8.2.2(j2) Water draining from secondary drain line

8.2.2(j3) Emergency heat indicator always on for a heat pump system

8.2.2(j4) System blowing warm air during cooling season

8.2.2(j5) Icing of the evaporator coil during cooling mode

8.2.2(j6) Outside unit never defrosts

8.2.2(j7) Unusual noises or odors

8.2.2(j8) Warranty information

8.2.2(k) Issues regarding multiple systems running will be discussed with occupant

8.3. Clean-Up and Disposal Requirements

8.3.1 Replaced parts and materials will be recycled or disposed of in accordance with federal, state, or local regulations and Section 1 Decommissioning.

9. MATERIAL SPECIFICATIONS

9.1 Measure Effective Useful Life

9.1.1 Air Conditioner, Furnace, or Heat Pump

9.1.1(a) LIHEAP: 19 years

9.1.1(b) DOE: 15 years (Furnace: 20 years)

9.1.2 Evaporative Cooler or Wall Heater

9.1.2(a) LIHEAP: 15 years

9.1.2(b) DOE: 15 years

9.1.3 Window/Wall Air Conditioner

9.1.3(a) LIHEAP: 14 years

9.1.3(b) DOE: 14 years

9.2 All Heating and Cooling Units

9.2.1 Appliance Sizing and Selection

9.2.1(a) Building heating and cooling loads, used for equipment sizing and selection, shall be determined based on any one of the following:

9.2.1(a1) ACCA Manual J, or

9.2.1(a2) Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Residential Comfort System Installation Standards Manual, or

9.2.1(a3) American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Handbook (Equipment, Applications and Fundamentals Volumes)

9.2.1(a4) Equipment selection will be performed in accordance with ANSI/ACCA Manual S and manufacturer specifications

9.2.1(b) The unit shall be sized to meet the minimum requirements, but not larger than necessary and in accordance with Title 24 and local code.

9.2.2 Air Filter

9.2.2(a) Filters shall be selected in accordance with those prescribed in Section 10 Air Filters.

9.2.3 Ducts and Sealants

9.2.3(a) Materials shall conform with those prescribed in Section 8 Ducting Repair, Sealing, and Insulation.

9.2.4 Thermostats

9.2.4(a) Programmable, smart, and manual wall thermostats shall be selected in accordance with Section 7 Thermostats—Smart, Programmable, and Manual.

9.2.5 Gas Pipes and Valves

9.2.5(a) Gas valves must be UL-listed and American Gas Association (AGA)- or Canadian Standards Association (CSA)-certified.

9.2.5(b) Gas flexible connectors must be International Association of Plumbing and Mechanical Officials (IAPMO)–listed epoxy-coated or stainless-steel units.

9.2.5(c) Pilot tubing shall be aluminum. Copper is not allowed.

9.2.5(d) Fuel-gas piping shall be selected, sized, and installed per CMC, Chapter 13. Copper gas lines are not allowed.

9.2.6 Vent Pipes

9.2.6(a) Metal vent pipes

9.2.6(a1) All metal vent pipes, vent connectors and components shall be UL-listed.

9.2.6(a2) Gas vent pipe shall be Type B or B-W.

9.2.6(b) Non-metallic combustion air and vent pipes

9.2.6(b1) Pipes and fittings shall be labeled to conform to American Society of Testing and Materials (ASTM) D 1785 and D 2665.

9.2.6(b2) Pipe cement and primer shall be labeled to conform to ASTM D 2564.

9.2.7 Refrigerant Theft Protection

9.2.7(a) Locking caps shall be brass with integral O-ring and a covering that is color-coded or labeled for the refrigerant type.

9.3 Central Cooling

9.3.1 The AC shall have a minimum seasonal energy efficiency ratio 2 (SEER2) and energy efficiency ratio 2 (EER2) depending on AC type:

9.3.1(a) Package units

9.3.1(a1) Minimum SEER2 of 13.4 and EER2 of 10.6

9.3.1(a2) DOE WAP Replacements: Shall be ENERGY STAR®–certified or equivalent and a minimum 15.2 SEER2 / 11.5 EER2.

9.3.1(b) Split systems

9.3.1(b1) Less than 45 kBtuh: minimum SEER2 of 14.3 and EER2 of 11.7

9.3.1(b2) Greater than or equal to 45 kBtuh: minimum SEER2 of 13.8 and EER2 of 11.2

9.3.1(b3) If the split system is rated SEER of 16.0 or greater, the unit must have a minimum EER2 rating of 9.8.

9.3.1(b4) DOE WAP Replacements: Shall be ENERGY STAR®–certified or equivalent and a minimum 15.2 SEER2 / 12.0 EER2.

9.3.2 SEER shall be determined by the coil and condenser combination as listed in the current AHRI directory.

9.4 Central Heat Pumps

9.4.1 Package units

9.4.1(a) Minimum heating season performance factor 2 (HSPF2) of 6.7

9.4.1(b) Minimum SEER2 of 13.4

9.4.1(c) DOE Replacements (non-Priority List): Shall be ENERGY STAR®–certified and a minimum 15.2 SEER2 / 7.2 HSPF2

9.4.1(d) DOE Priority List Replacements: Shall be ENERGY STAR®–certified and a minimum 15.2 SEER2 / 7.8 HSPF2

9.4.2 Split systems

9.4.2(a) Minimum HSPF2 of 7.5

9.4.2(b) Minimum SEER2 of 14.3

9.4.2(c) DOE Replacements (including Priority List Replacements): Shall be ENERGY STAR®–certified and a minimum 15.2 SEER2 / 7.8 HSPF2

9.4.3 The SEER2 and HSPF2 shall be determined by the coil and condenser combination as listed in the current AHRI Directory.

9.4.4 Dual fuel heat pumps: The furnace shall conform with Central Furnace.

9.5 Mini-Split Heat Pumps

9.5.1 All ductless mini split heat pumps shall:

9.5.1(a) Be ENERGY STAR®–certified or equivalent

9.5.1 (b) A minimum 15.2 SEER2 / 8.5 HSPF2

9.5.1 (c) Be a wall-mount, floor-mount, or ceiling cassette type

9.5.1 (d) Include a programmable thermostat

9.5.1 (e) DOE Priority List Replacements: Shall be ENERGY STAR®–certified and a minimum 19 SEER2 / 10 HSPF2

9.5.2 Indoor and outdoor units performance shall be verified by AHRI listing.

9.5.3 In colder climates with >3,600 heating degree days (HDD), units must comply with National Energy Efficiency Guidelines (NEEP) guidelines.

9.6 Wall/Window AC

9.6.1 All replacement window/wall-mounted ACs and heat pumps shall be:

9.6.1 (a) UL-listed and ENERGY STAR®–certified

9.6.1 (b) Equipped with:

9.6.1 (b1) Minimum two-speed fan

9.6.1 (b2) Adjustable thermostat with a minimum of six positions

9.6.1 (b3) Removable filter

9.6.1 (b4) Minimum four-way air directional control

9.6.1 (c) Rated with a minimum Combined EER compliant with Table 4-4.

9.6.1 (c1) DOE Priority List Replacements shall be a minimum 12 Combined EER.

TABLE 4-4: MINIMUM COMBINED EER

Appliance	Cooling Capacity (Btuh) with Louvered Sides	Minimum Combined EER	Cooling Capacity (Btuh) without Louvered Sides*	Minimum Combined EER
Window/Wall AC	<6,000	13.1	<6,000	12.8
	≥6,000–7,999	13.7	≥6,000–7,999	12.8
	≥8,000–13,999	14.7	≥8,000–10,999	13.0
	≥14,000–19,999	14.4	≥11,000–13,999	12.8
	≥20,000–27,999	12.7	≥14,000–19,999	12.6
	≥28,000	12.2	≥20,000	12.7
Room AC Heat Pump	<20,000	13.2	<14,000	12.6
	≥20,000	12.6	≥14,000	11.7
Casement-Only Room AC	Any	12.8	Any	12.8
Casement-Slider Room AC	Any	14.0	Any	14.0
*Without louvered sides = Through-the-wall units				

9.6.1 (d) Wall units must be equipped with a through-the-wall chassis (sleeve).

9.6.1 (e) Unit sizing: The new unit shall comply with manufacturer's recommendations and the sizing guidelines outlined in Table 4-5

Table 4-5: Replacement Unit Capacity Based on Square Footage of Area to Be Cooled

Area to Be Cooled (Sq. Ft.)	Capacity (Btuh)*
100–150	5,000
151–250	6,000
251–300	7,000
301–350	8,000
351–400	9,000
401–450	10,000
451–500	12,000
501–700	14,000
701–1,000	18,000
*Adjustments: If the room is heavily shaded, reduce capacity by 10%. If the room is very sunny, increase capacity by 10%. If more than two people regularly occupy the room, add 600 Btuh for each additional person. If the unit is installed in a kitchen, increase capacity by 4,000 Btuh.	

9.6.1 (f) DOE only: In accordance with the Priority List, select heat pump units only.

9.7 Cooling—Evaporative

9.7.1 All Units

9.7.1 (a) UL-listed (or equivalent) and compliant with UL 507.

9.7.1 (b) Surface burning characteristics shall be per UL 723 and ASTM E-84.

9.7.1 (c) Air movement shall have been factory-tested per ANSI/Air Movement and Control Association Standard 210.

9.7.1 (d) Equipped with a code-compliant automatic cleaning device, such as an automatic flushing system (e.g., timed purging).

9.7.1 (d1) A bleed-off system may be used only when allowed by the local jurisdiction.

9.7.1 (e) Installed unit sizing requirements per Table 4-6:

Table 4-6: Cooler Sizing Guidelines

Cooler Capacity (Airflow in CFM)	Maximum Sq. Ft. Area	
	At 3.0 CFM per sq. ft. (22 air changes/hour [ACH]) (Average Climate)	At 4.0 CFM per sq. ft. (30 ACH) (Hot, Dry Climate)
3000	1000	750
3500	1165	875
4000	1330	1000
4500	1500	1125
5000	1665	1250
5500	1830	1375
6000	2000	1500
6500	2165	1625

9.7.1 (f) DOE: Select units that comply with UL 1995 or UL/CSA/ANCE 60335-2-40.

9.7.2 Media—Standard Pads (Fig. 4-34)

9.7.2(a) Pads shall be:

9.7.2(a1) Aspen excelsior bound in netting or

9.7.2(a2) Honeycomb cellulose fiber pad or

9.7.2(a3) The type specified by the cooler manufacturer

9.7.2(b) All pads shall have minimum 1" thickness. (Two thinner pads may be used to achieve 1" thickness.)

9.7.2(c) The size shall be as specified by the cooler manufacturer.

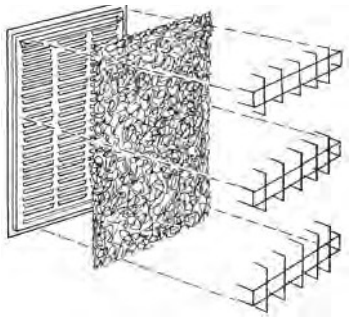

FIG. 4-34: STANDARD EXCELSIOR COOLER PAD

9.7.3 Media—High-Efficiency (Fig. 4-35)

9.7.3(a) Only rigid media shall be used.

9.7.3(b) The size shall be as specified by the cooler manufacturer.

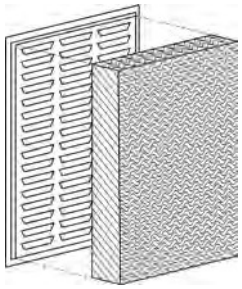

FIG. 4-35: HIGH-EFFICIENCY COOLER PAD

9.7.4 Replacement Blower Motor

9.7.4(a) The replacement motor shall be:

9.7.4(a1) UL-listed or a UL-recognized component designed for moist conditions

9.7.4(a2) Equipped with thermal overload protection

9.7.4(a3) Wired for at least two speeds

- Exception: If the existing motor is single-speed, the replacement may be single-speed.

9.7.4(a4) Rated at 115/120 volts, 60 Hz, single phase

9.7.5 Replacement belts shall be general purpose “A” or “4L” section utility belts.

9.7.6 Pump Requirements

9.7.6(a) The pump shall be:

9.7.6(a1) A UL-listed or a UL-recognized component

9.7.6(a2) A grounded UL-recognized motor with thermal overload protection

9.7.6(a3) Protected from water damage to the motor winding (e.g., by shaft sleeve, skirting, etc.)

9.7.6(b) The pump shall have a molded screen or other factory-supplied screening device to keep debris out of the impeller.

9.7.7 Water Supply Shut-Off Valve and Fittings

9.7.7(a) Valves and fittings shall be brass only.

9.7.7(b) A self-tapping needle valve is not allowed.

9.7.8 Drain Line

9.7.8(a) Acceptable drain line materials include copper, PVC, and galvanized pipe.

9.7.9 Supports

9.7.9(a) Window-/wall-mount cooler supports:

9.7.9(a1) All metal brace support material shall be minimum ¾" x ¾" angle iron or equivalent.

9.7.9(a2) All metal shall be primed, anodized, painted, galvanized, or corrosion-resistant (e.g., aluminum).

9.7.9(b) Metal frame components

9.7.9(b1) Use minimum ¾" x ¾" 16-gauge angle iron or equivalent for the support stand.

9.7.9(b2) All metal shall be primed, anodized, painted, galvanized, or corrosion-resistant (e.g., aluminum).

9.7.9(c) Materials for wooden platforms shall be:

9.7.9(c1) Exterior-grade

9.7.9(c2) Sealed with exterior primer and paint

9.7.9(d) Window/wall cooler attachments shall comply with the manufacturer's minimum specifications; however:

9.7.9(d1) Non-corrosive screws or lag bolts shall be used

9.7.9(d2) Nails and molly bolts are not allowed

9.7.9(e) Framing

9.7.9(e1) Use minimum 2x4 pressure-treated lumber or redwood.

9.7.9(f) Plywood for bracing and sheathing

9.7.9(f1) Use exterior-grade materials.

9.7.10 Supply Lines

9.7.10(a) Replacement supply lines shall be minimum ¼" OD copper tubing.

9.8 Central Furnace

9.8.1 Conventional Home Furnaces

9.8.1(a) Units shall conform with the requirements of the current California Building Code (CBC), CMC, DOE, Title 24 Residential Compliance Manual, and Title 20 Appliance Efficiency Regulations.

9.8.1(b) Unit efficiency shall be verified by inclusion in the California Energy Commission (CEC) database of certified appliances.

9.8.1(c) All units and components shall be UL-listed and/or certified by CSA, AGA, or AHRI.

9.8.2 Split systems

9.8.2(a) Minimum annual fuel utilization efficiency (AFUE) rating: 80%

9.8.2(b) DOE Replacements: Shall be ENERGY STAR®–certified or equivalent and ≥ 90% AFUE.

9.8.3 Package Units (Dual Packs)

9.8.3(a) Minimum AFUE rating: 81%. If replaced in conjunction with the furnace, the AC shall have a minimum SEER2 of 13.4.

9.8.3(b) DOE Replacements: Shall be ENERGY STAR®–certified or equivalent and ≥ 90% AFUE. If replaced in conjunction with the furnace, the AC shall have a minimum SEER2 of 15.2.

9.8.4 Oil-Fired Furnaces

9.8.4(a) Split system minimum AFUE rating: 83%

9.8.4(b) Package unit minimum AFUE rating: 78%

9.8.4(c) Mobile home minimum AFUE rating: 75%

9.8.4(d) DOE Replacements: Shall be ENERGY STAR®–certified or equivalent and a minimum 85% AFUE for all furnace types (i.e., package, split, or mobile home).

9.8.5 Mobile Home Gas Furnaces

9.8.5(a) HVAC equipment installed in a mobile home shall be listed for use in a mobile home.

9.8.5(a1) Materials installed inside a mobile home shall comply with HCD regulations.

9.8.5(a2) Materials installed outside a mobile home shall comply with HCD regulations or, as applicable, the requirements of the local building department.

9.8.5(b) Units shall be sealed combustion when inside the living space.

9.8.5(c) Minimum AFUE rating: 80%

9.8.5(d) DOE Replacements: Shall be ENERGY STAR®–certified or equivalent and ≥ 90% AFUE.

9.9 Floor/Wall and Freestanding Furnace

9.9.1 Units shall conform with the requirements of the current CBC, CMC, DOE, Title 24 Residential Compliance Manual, and Title 20 Appliance Efficiency Regulations.

9.9.2 Installed appliances shall be:

9.9.2(a) UL-listed and/or certified by CSA or AGA

9.9.2(b) Closed combustion and listed for use in a mobile home when installed in a mobile home

9.9.2(c) The most efficient model feasible to install, but no lower in efficiency than specified in Table 4-7

TABLE 4-7: MINIMUM HEATING EFFICIENCY FOR NON-DUCTED, NON-CENTRAL, GAS-FIRED HEATING EQUIPMENT

Furnace Type	Btuh Output Capacity	Minimum AFUE (%)
Wall Furnace with Fan	≤42,000	75%
	>42,000	76%
Wall Furnace without Fan	≤27,000	65%
	≥27,001–≤46,000	66%
	>46,000	67%
Floor Furnace	≤37,000	57%
	>37,000	58%
Freestanding Room Heater	≤20,000	61%
	>20,000–≤27,000	66%
	>27,000–≤46,000	67%
	>46,000	68%
Source: Title 24 2022 Residential Compliance Manual, Section 4.2		

9.10 Wood Stove/Fireplace Insert

9.10.1 Wood Stove/Insert

9.10.1(a) Only new wood stove/insert manufacturer–approved, factory-built, and laboratory-listed equipment and other hardware shall be installed.

9.10.1(b) All wood stoves/inserts shall bear a permanently-affixed label stating “For use with solid fuel only.”

9.10.1(c) Where applicable, any installed wood stove/insert shall comply with the EPA Phase II emission limits and shall bear temporary label(s) certifying it conforms to EPA emission standards.

9.10.2 Units Installed in Mobile Homes

9.10.2(a) Units installed in mobile homes shall:

9.10.2(a1) Draw CVA from outdoors and

9.10.2(a2) Bear a permanent manufacturer’s label stating the wood stove/insert is approved for use in mobile homes

9.10.3 Chimneys, Connectors, and Components

9.10.3(a) Chimneys and connectors must be factory-built, laboratory-listed, Class A–types specified by the manufacturer, including:

9.10.3(a1) A ceiling support package when a vent connector is used

9.10.3(a2) An insulation shield when penetrating an attic

9.10.3(a3) A chimney cap and spark arrestor

10. WARRANTY

Appliance	Manufacturer	Contractor
Central AC/Heat Pump		
Repair	90 days	1 year
Install	5 years (compressor) 1 year (other)	1 year
Central Heat Pump		
Repair	90 days	1 year
Install	5 years (compressor) 1 year (other)	1 year
Mini-Split Heat Pump		
Install	5 years	1 year
Evaporative Cooler		
Repair	90 days	1 year
Install	5 years (reservoir pan) 1 year (other)	1 year
Wall/Window AC		
Repair	90 days	1 year
Install	5 years (compressor) 1 year (other)	1 year
Central Furnace/Heat Pump		
Repair	90 days	1 year
Install	1 year	1 year
Floor/Wall and Freestanding Furnace		
Repair	90 days	1 year
Install	1 year	1 year
Wood Stove/Fireplace Insert		
Install	3 years (stove) 1 year (other)	1 year