CALIFORNIA CONVENTIONAL HOME WEATHERIZATION INSTALLATION STANDARDS

for use in

California's Low Income Energy Efficiency Programs

administered by

San Diego Gas and Electric Company
Southern California Edison
Southern California Gas Company
Pacific Gas and Electric Company

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ABBREVIATIONS AND ACRONYMS

AAMA	American Architectural Manufacturers Association
ACCA	Air Conditioning Contractors of America
ACDD	Annual Cooling Degree Days (also see CDD)
AFUE	Annual Fuel Utilization Efficiency
AGA	American Gas Association
AHDD	Annual Heating Degree Days (also see HDD)
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG, awg	American Wire Gage
BEAR	Bureau of Electronic and Appliance Repair
BEF	Ballast Efficacy Factor
BOCA	Building Officials and Code Administrators
Btu	British Thermal Unit
Btu/hr	British Thermal Units per Hour
°C	Degrees Centigrade
CABO	Council of American Building Officials
Cal OSHA	California Occupational Safety and Health Administration
CAS	Combustion Appliance Safety

ABBREVIATIONS AND ACRONYMS

CASIF	Combustion Appliance Safety Inspection Form
CAZ	Combustion Appliance Zone
CBC	California Building Code
CBM	Certified Ballast Manufacturers
CBO	Community Based Organization
CCR	California Code of Regulations
CDD	Cooling Degree Days (also see ACDD)
CEC	California Energy Commission and California Electrical Code
CFL	Compact Fluorescent Lamp
CFM, cfm	Cubic Feet per Minute
CFM_{25}	Cubic Feet per Minute of Air Flow at 25 Pascals of Pressure
CFM_{50}	Cubic Feet per Minute of Air Flow at 50 Pascals of Pressure
CFR	Code of Federal Regulations
CMC	California Mechanical Code
CO	Carbon Monoxide
COP	Coefficient of Performance
CPSC	Consumer Products Safety Commission
CSD	(California Department of) Community Services and Development
DOE	(United States) Department of Energy
DV	Direct Vent (Furnace/Heater)
EER	Energy Efficiency Ratio

ABBREVIATIONS AND ACRONYMS

EPA	Environmental Protection Agency
ESP	Economic Stop Parameters/Economic Stop Policy
°F	Degrees Fahrenheit
F.S.	Federal Specifications
FAU	Forced Air Unit
fpm	Feet per Minute
GFCI	Ground Fault Circuit Interrupter
HCD	(California Department of) Housing and Community Development
HDD	Heating Degree Days (also see AHDD)
HDL	House Depressurization Limit
HPD	Heat Producing Device
HUD	(U.S. Department of) Housing and Urban Development
HVAC	Heating Ventilation and Air Conditioning
Hz	Hertz
ICBO	International Conference of Building Officials
ID	Inside Diameter
IWC, iwc	Inches of Water Column (Same as IWG, Inches of Water Gauge)
IWG, iwg	Inches of Water Gauge (Same as IWC, Inches of Water Column)
KHz	Kilohertz
MVR	Minimum Ventilation Requirement

ABBREVIATIONS AND ACRONYMS

NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NFVA, NFV Area	Net Free Venting Area: Total vent opening area minus the blocking effect of louvers, grilles, and screens
OC	On Center
OD	Outside Diameter
OSHA	Occupational Safety and Health Administration
P&P	Policies & Procedures
Pa	Pascal (See Definitions)
PPM, ppm	Parts per Million
psf	Pounds per Square Foot
psi	Pounds per Square Inch
RTV	Room Temperature Vulcanization (e.g., RTV Silicone)
SEER	Seasonal Energy Efficiency Ratio
T&P Valve	Temperature and Pressure Relief Valve
TPE	Thermoplastic Elastomer
UBC	Uniform Building Code
UL	Underwriters Laboratories
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code

ABBREVIATIONS AND ACRONYMS

UV	Ultraviolet
WC, wc	Water Column (Same as Water Gauge)
WG, wg	Water Gauge (Same as Water Column)
WIS	Weatherization Installation Standards
Wx	Weatherization

DEFINITIONS

Abandoned Appliance — An appliance which is no longer used and has been removed from service and: (1) the flexible gas connector has been, and (2) the gas line shut-off valve has been capped, or the valve has been removed and the pipe capped.

Backdrafting — The reverse flow of combustion gases down the vent pipe and out the draft hood of a natural vent open combustion appliance. Intermittent backdrafting can be caused by wind gusts. Ongoing backdrafting can be the result of a negative pressure in the combustion appliance zone (CAZ) caused by (a) duct system return leaks in the vicinity of the appliance, and/or (b) the excessive influence of mechanical systems exhausting air from the structure (e.g., bathroom and utility room exhaust fans, range hood fan, clothes dryer, built-in vacuum system, etc.).

Built-up Roof (Low-Slope) — A low-slope roof that is "built up" with roofing felt laminated in overlapping layers to form a membrane that is two to four plies thick. To protect the membrane from sunlight and physical wear, a layer of aggregate (crushed stone or other mineral granules) is embedded in the surface.

Closure System — The sum total of components utilized to secure and seal a duct system joint or seam against air leakage (e.g., pressure sensitive tape, or heat activated tape, or mastic with fiberglass mesh reinforcement). Closure systems for non-metallic flexible ducts also include one or more drawbands.

Combustion Air — The total amount of air provided to the space, which contains fuel-burning equipment; it includes air for fuel combustion, for draft hood dilution, and for ventilation of the equipment enclosure. (Reference 2001 UMC, Section 205).

Combustion Appliance Zone(CAZ) — The room or area of a home in which an open combustion natural draft appliance (typically a furnace, water heater, wood burning stove or fireplace) is located. It could be a living room containing a wood burning

	stove, a kitchen or utility porch containing a water heater, or an appliance enclosure. Excessive depressurization of the CAZ causes backdrafting and spillage of combustion gases into the room.
Conditioned Space	An area, room, or space normally occupied and being heated or cooled by any equipment for human habitation. (Reference 2001 CMC, Section 205.)
Confined Space	A room or space having a volume less than 50 cubic feet per 1,000 Btu/h of aggregated input rating of all-fuel burning appliances installed in that space. (Reference 2001 CMC, Section 205.)
Drawband	A device which encircles a duct and mechanically secures the core-to-fitting attachment (i.e., a synthetic duct tie or a worm drive stainless steel clamp). Duct ties are also used to secure fiberglass duct wrap and to seal jacket overlaps at flexible duct splices.
Duct Systems	All ducts, duct fittings, plenums, and fans assembled to form a continuous passageway for the distribution of air. (Reference 2001 CMC, Section 206.)
Enclosed Cavity	A building cavity that is totally enclosed and inaccessible for installation of measures. An example is a low-profile section of attic that is closed off by drywall, plywood or other sheathing. Because of inadequate crawl clearance, proper installation of insulation would not be feasible even if an access hole were cut.
FAU	Forced air unit, which is that portion of a central heating and/or air conditioning (A/C) system which contains the air handler (blower section). In a “Split System,” it is the furnace. In a “Package System,” the entire heating and A/C “Package Unit” may be referred to as the FAU.
Heat Activated Tape	Metallic tape with an adhesive coating that is activated and cured by the application of heat and pressure.

Inaccessible Appliance — A combustion appliance that cannot be accessed for NGAT testing, due to a locked passage or a physical impediment. Examples include a water heater in a locked room/enclosure for which a key is not available, an attic-mount furnace that requires entry through an inaccessible MUD unit, and a floor furnace in a crawl space with inadequate crawl clearance. A floor furnace may also be inaccessible because it has been covered over by plywood or attached floor covering (e.g., wall-to-wall carpet or vinyl). A floor or wall furnace may be inaccessible because it has been turned off and blocked by heavy furniture (e.g., a hutch or cabinet).

Labeled — Equipment or materials to which has been attached a label of a nationally recognized testing agency that maintains periodic inspection of the production of labeled equipment or materials. Labeling indicates compliance with nationally recognized standards. (Also see “Listed” and “UL Classified, Labeled, Listed”.)

Lapped Seam — The seam (joint) formed where two pieces of material (usually sheet metal) are overlapped.

Listed — Equipment or materials included in a list published by a nationally recognized testing agency (e.g., UL, CSA, ITS, ETL, etc.) that maintains periodic inspection of the production of listed equipment or materials. Listing indicates compliance with nationally recognized standards. (Also see “Labeled” above and “UL Classified, Labeled, Listed” below.)

Longitudinal Joint — Lengthwise joint along a piece of duct (e.g., the joint running the full length of a snap-together sheet metal duct). [Note: *longitudinal* means "lengthwise"...in contrast with *transverse,* which means "across".]

NFPA 90B — Standards governing installation of "Warm Air Heating and Air Conditioning Systems" in one- or two-family dwellings and structures not exceeding 25,000 cu. ft. Provides specifications for the manufacture and installation of rigid metal ductwork and references UL

	181 regarding factory made air ducts (e.g., flexible ducts). Installations in larger structures are addressed by NFPA 90A.
NFV, NFVA	NFV stands for "net free venting." NFVA is "net free venting area," the net amount of venting area provided by a vent after the blocking effect of mesh and/or louvers has been subtracted from the gross area of the vent opening(s).
Package Unit	A combination heating and air conditioning system contained within one housing unit, which is installed outdoors (on the roof or on a slab next to the house). (Also see "Split System.")
Pascal (Pa)	A small unit of pressure equivalent to 0.004 inches of water column (IWC). 1 Pa = 0.004 IWC, and 1 IWC = 250 Pa. 25 Pa, the pressure typically used to test duct systems for leakage, is equivalent to 0.1 IWC. Conversion formulas are: [Pa = IWC ÷ 0.004] and [IWC = Pa x 0.004].
Perm	A unit of permeance, which refers to how permeable a material is (e.g., how well moisture will pass though a vapor barrier).
Plenum	An air compartment or chamber, including uninhabited crawl spaces, areas above a ceiling or below a floor, to which one or more ducts are connected and which forms part of either the supply-air or return-air system. Typically on residential HVAC systems, the supply and return plenums are the large rectangular boxes/chambers that connect the FAU to the supply duct system and the return-air system. (Reference 1998 CMC, Section 215-P.)
Pressure Sensitive Tape	Duct tape with a tacky adhesive coating (e.g., butyl, acrylic, etc.) which will adhere to a surface with the application of pressure (heat not required). Duct tapes must be listed and marked per UL 181A and 181B standards.

DEFINITIONS

Repair — Corrective work performed by a qualified technician, intended to make a natural gas appliance operate properly, when correction is beyond the scope of "Service/Adjustment".

Replacement — Complete replacement of a defective natural gas appliance, when repair is not feasible: i.e., the cost to repair the appliance exceeds program guidelines, or parts required to make the appliance safely operable cannot be obtained.

Service/Adjustment — Minor corrective work, within the normal scope of service, performed by utility gas service personnel, or designated representative, intended to make a natural gas appliance operate properly without repair or replacement.

Spillage — In a natural draft open combustion appliance, the unwanted outflow of combustion gases from the draft hood into the atmosphere of the room or area where the appliance is located. Spillage occurs when the vent system draft is inadequate to carry combustion gasses up through the vent pipe and outdoors. Spillage occurs briefly when combustion first begins in a cold appliance, because cold air in the vent pipe impedes exhaust flow until the systems warms up. Continuous spillage may result when the vent pipe is blocked by an obstruction or is improperly constructed (too many elbows, improper slope, inadequate diameter, etc.).

Split System — A heating and cooling system in which the air conditioning evaporator coil is attached to the furnace, which is located indoors (typically in the garage, attic, or interior closet), and the condenser unit (with coil, compressor, and fan) is installed outdoors, usually on a slab next to the house. (Also see "Package Unit.")

Transverse Joint — The joint formed when two pieces of duct are spliced together (e.g., the joint around the circumference where two round ducts are joined together, and the joint around the perimeter where two rectangular ducts are

joined together). [Note: *transverse* means “across”...in contrast with *longitudinal*, which means “lengthwise”.]

UL 181 — UL "Standard for Factory-Made Air Ducts and Connectors".

UL 181A — UL standard for pressure sensitive aluminum tapes, heat activated aluminum tapes, and mastic closure systems for use with rigid fiberglass air ducts.

UL 181B — UL standard for pressure sensitive tapes and mastic closure systems for use with flexible air ducts.

UL Class 0 Duct — Air duct materials having a fire hazard classification of zero (flame spread and smoke developed).

UL Class 1 Duct — Air duct materials having a flame-spread rating not over 25 without evidence of continued progressive combustion and a smoke-developed rating not over 50.

UL Classified, Labeled, Listed, Recognized

- **UL Classified** means that UL testing was limited to examination of one potential hazard.
- **UL Labeled** means that a product is either UL Listed or UL Classified. Note that a product can be certified and "listed" without involving UL. Other accredited laboratories (e.g., CSA International, ITS Intertek Services, ETL SEMKO, etc.) can test products and certify conformance with established standards. Such products can thus be "listed and labeled" without reference to UL. (See “Listed” and “Labeled” above.)
- **UL Listed** means that UL testing included examination of *all* foreseeable hazards.
- **UL Recognized** means that a component (such as a motor) is approved for use in a UL Listed product (such as an evaporative cooler). The complete cooler is UL Listed, but the tested and approved components used in it are “UL Recognized components.” Each UL Recognized component is tested to a UL standard applicable to that component, and

it is “recognized” for use in a UL Listed product.

SECTION 2 PREFACE

FOR

DOOR WEATHERSTRIPPING

1. INSTALLATION POLICIES

1.1. The contractor may adjust existing weatherstripping in lieu of replacement only if existing weatherstripping is functional and creates a proper seal.

1.2. Door shoe and threshold combinations must be installed unless proven to be nonfeasible.

1.3. A threshold should not be installed which exceeds 1" in height from the finished floor (1/2" in height for handicapped).

1.4. When the installation of a door shoe and threshold combination is not feasible for the following reasons, an automatic sweep may be used:

- Medical reasons, such as wheelchairs or walkers, require that the floor be as flat as possible.
- Metal doors cannot be cut to accommodate a shoe.
- Doors open outward and do not overlap a floor surface when closed. “Bumper” type thresholds may be used in this circumstance if a tripping hazard will not be created.
- The installation of a proper threshold requires carpet cutting or repair to wooden or concrete sills.
- The door is unusually expensive and might be aesthetically damaged by cutting.

1.5. A stationary sweep can be used in lieu of an automatic sweep if a door shoe and threshold combination is not feasible and an automatic sweep cannot be installed. The use of flip up sweeps is not allowed.

SECTION 9 PREFACE

FOR

EVAPORATIVE COOLER AND AIR CONDITIONER VENT COVERS

1. INSTALLATION POLICIES

1.1. Shop-built wood vent covers can only be used whenever a factory-made cover is not available.

1.2. Each cover must be checked for proper fit. Removal and reinstallation must be demonstrated to the customer.

1.3. In the cooling season when the cooler or window/wall air conditioner is in use, Contractor can leave the cooler cover uninstalled after the initial installation and customer instruction.

SECTION 15 PREFACE

FOR

HARD-WIRED COMPACT FLUORESCENT FIXTURES

1. INSTALLATION POLICIES

1.1. This measure is limited to the installation of hard-wired compact fluorescent porch light fixtures.

1.2. Hard-wired compact fluorescent porch light fixtures may be installed only in single family non-mobile homes.

1.3. No more than an average of three fixtures may be installed.

1.4. Replaced porch light fixtures may be left with the customer or the property manager only if requested.

SECTION 17 PREFACE

FOR

REFRIGERATOR REPLACEMENT

1. INSTALLATION POLICIES

1.1. The minimum size for primary refrigerators replaced under the LIEE Program is 10 cubic feet.

1.2. Refrigerators may be replaced only if the existing refrigerator was manufactured before 1993.

1.3. One of the refrigerators replaced under the Program must be a primary refrigerator. The primary refrigerator is the main refrigerator in the home, usually the kitchen refrigerator.

1.4. The size of the replacement refrigerator shall be approximately equal to the size of the existing unit, not to exceed 19 cubic feet. When two refrigerators and/or freezers are exchanged for a single unit, the replacement unit may not be larger than the combined size of the two existing units, and may not be larger than 23 cubic feet.

1.5. Space must be physically large enough to accommodate the new refrigerator, with entrance and passageways sufficient to allow removal of the existing refrigerator.

1.6. Contractor shall dispose and recycle (de-manufacture) replaced refrigerators in an environmentally safe manner and in accordance with federal, state, and local regulations and codes. Contractor represents that it has knowledge of the Metal Discard Act, effective January 1, 1994, which prohibits disposal of refrigerators/freezers in landfills.

SECTION 18 PREFACE

FOR

NATURAL GAS CENTRAL FORCED AIR HEATING SYSTEM REPAIR AND REPLACEMENT

1. FURNACE REPAIR/REPLACEMENT POLICIES

1.1. Furnace repair or replacement may be provided only when the appliance fails NGAT, and correction cannot be achieved with Service/Adjustment by utility gas service personnel (or their designated representative).

1.2. A furnace may be replaced only if the cost of repairing the unit would be more than 50% of the cost of replacement.

1.3. Furnace replacements and major furnace repairs may be provided only if the residence is owner-occupied. Service/Adjustment may also be conducted in renter-occupied homes.

1.4. Furnace repairs and replacements will be provided only if the fuel used by the furnace is supplied by the utility providing LIEE Program services.

1.5. Furnace replacement will not include hazardous material abatement, major structural alteration, concrete work, painting, or floor covering.

1.6. An air conditioning unit may be replaced in conjunction with a furnace replacement if:

- The unit being replaced is a combined forced air heating and central AC package system, also referred to as a dual-pack (i.e., the AC and furnace is manufactured as one unit and is housed in a single sheet metal housing); or
- The furnace being replaced is part of a split forced air heating and AC system and the AC evaporative coil and/or the outside system cannot be matched with the new furnace.

1.7. Replaced units must be de-manufactured in compliance with all laws and regulations.

1.8. Installer must have C-20 HVAC license.

2. PROGRAMMABLE THERMOSTAT INSTALLATION POLICIES

2.1. Programmable thermostats are installed only when the central furnace is replaced and only when required by state or local code.

2.2. Before installing a programmable thermostat, contractor shall explain its operation and provide the customer an opportunity to refuse the measure.

3. CENTRAL SYSTEM AIR FILTER INSTALLATION POLICIES

3.1. Filters are installed only in conjunction with central forced air heating system repair.

3.2. Contractors must show customers how to remove, clean, and re-install the filters.

SECTION 19 PREFACE

FOR

NATURAL GAS WALL AND FLOOR FURNACE REPAIR AND REPLACEMENT

1. FURNACE REPAIR/REPLACEMENT POLICIES

1.1. Furnace repair or replacement may be provided only when the appliance fails NGAT, and correction cannot be achieved with Service/Adjustment by utility gas service personnel (or their designated representative).

1.2. A furnace may be replaced only if the cost of repairing the unit would be more than 50% of the cost of replacement.

1.3. Furnace repair or replacement may be provided only if the residence is owner-occupied. Service/Adjustment may also be conducted in renter-occupied homes.

1.4. Furnace repairs and replacements will be provided only if the fuel used by the furnace is supplied by the utility providing the weatherization service.

1.5. Furnace replacement will not include hazardous material abatement, major structural alteration, concrete work, painting, or floor covering.

SECTION 25 PREFACE

FOR

NATURAL GAS WATER HEATER REPLACEMENT

1. WATER HEATER REPAIR/REPLACEMENT INSTALLATION POLICIES

1.1. Water heater repair or replacement may be provided only when the appliance fails NGAT, and correction cannot be achieved with Service/Adjustment by utility gas service personnel (or their designated representative).

1.2. A water heater may be replaced only if the cost of repairing the unit would be more than 50% of the cost of replacement.

1.3. The replacement water heater must have an energy factor of 0.60 or greater.

1.4. Water heater repair or replacement may be provided only if the residence is owner-occupied. Service/Adjustment may also be conducted in renter-occupied homes.

1.5. Water heater repairs and replacements will be provided only if the fuel used by the furnace is supplied by the utility providing the weatherization service.

1.6. Water heater replacement will not include hazardous material abatement, major structural alteration, concrete work, painting, or floor covering.

SECTION 29 PREFACE

FOR

NATURAL GAS APPLIANCE TESTING (NGAT)

1. INSTALLATION POLICIES

1.1. Combustion appliance testing will be conducted only for homes that receive infiltration reduction measures and that have at least one natural gas appliance affecting the living space. (Appliances affecting the living space are those identified as such in this section of this WIS manual.)

1.2. Homes with non-IOU (e.g., propane) space heating fuel are <u>not</u> eligible for combustion appliance testing or infiltration reduction measures.

1.3. For Program Year 2005, pending further CPUC action, homes with IOU space heating, but with other appliances using non-IOU fuel, will be treated in accordance with the following utility-specific policies:

- In the SDG&E and SoCalGas programs, these homes will not be subjected to combustion appliance testing of non-IOU fueled appliances. Instead, they will be assessed using the PY2003 Minimum Standard adopted by the Commission in D. 01-12-020, which does not involve testing of appliances other than space heating.
- In the SCE program (for which electric space heating is present), combustion appliance testing will not be conducted.
- In the PG&E Program, these homes will be subjected to combustion appliance testing on all combustion appliances prior to weatherization (and, for a sample of homes, after weatherization). For homes failing the pre-weatherization test, infiltration-reduction measures will be deemed non-feasible

1.4. In order to avoid cases in which post-weatherization NGAT protocol would discover nonconforming conditions that: (a) preclude installation of infiltration reduction measures, and (b) cannot be corrected within the scope of the program, some pre-weatherization evaluations are performed as part of the initial home assessment. Pre-weatherization evaluations include the following components:

- Gas Leaks. Each gas-burning appliance is checked for the presence of gas leaks. When a natural-gas leak is found, the utility is contacted for gas service repairs. Non-IOU gas leaks are treated in accordance with utility-specific policies. All gas leaks must be repaired before weatherization commences.

- Combustion and Ventilation Air (CVA) Evaluations. CVA is evaluated for furnaces and water heaters to determine if it is adequate and, if inadequate, whether correction is feasible.
- Flue and Vent Pipe Termination Evaluations. Flue and vent pipe terminations are checked to determine if any violate NGAT protocol and, if nonconforming, whether correction is feasible.
- Appliance Operation and Accessibility. All gas-burning appliances are checked to determine whether: (a) they are accessible for testing, and (b) they are operable. Non-operable natural gas appliances are referred to the appropriate utility service department. Non-operable propane appliances are treated in accordance with utility-specific policies.
- Unvented Space Heater. The dwelling is checked for presence of an unvented combustion appliance used for heating the living space (which will preclude installation of infiltration reduction measures if not removed).
- Whole House Fan. When a whole house fan is present, the attic is checked for the presence of a gas water heater or gas furnace with standing pilot (which will preclude installation of infiltration reduction measures).
- Gas Clothes Dryer. If located within the living space, the clothes dryer moisture exhaust is checked to determine if it is properly vented outdoors. If not properly vented outdoors, infiltration reduction measures will not be installed. This restriction does not apply to a gas clothes dryer located in an attached garage.

Required corrections will be performed before weatherization commences. The owner will be informed of conditions that preclude installation of infiltration reduction measures and cannot be remedied by the LIEE program (e.g., exhausting clothes dryers outdoors, and repair or replacement of appliances and gas vents for which repair or replacement is not available).

1.5. After completion of weatherization that includes infiltration reduction measures, NGAT is performed for all natural gas appliances affecting the living space. Testing of appliances using non-IOU fuels is conducted in accordance with utility-specific policies (see 1.3 and 1.8). NGAT includes the following components:

- Visual Examinations, including flue and vent system checks, appliance component checks, and re-check for gas leaks.
- Combustion and Ventilation Air (CVA) Verification.
- Carbon Monoxide Tests, as prescribed below in 1.6.
- Draft Tests, using smoke, on appliances for which draft tests are applicable (natural draft space- and water-heating appliances).

1.6. For IOU-fueled natural gas appliances, CO Testing will be conducted using the following protocol:

- Heating Appliances: Appliance ambient CO testing is performed.
- Water Heaters: Appliance ambient CO testing is performed if the water heater is in a location affecting the living space.
- Kitchen Appliances: Room ambient CO tests are performed in the kitchen separately during operation of each cooking appliance component (cook top, oven, and broiler).
- Gas Logs: Exhaust/flue CO test is performed inside the top edge of the fireplace opening.
- Clothes Dryers: No CO tests are performed.

1.7. If a problem is identified through application of the overall NGAT protocol, (i.e., elevated CO, inadequate draft, or defect causing an unsafe condition), the case will be referred for resolution to qualified utility-trained personnel or a contractor licensed to repair appliances. Such resolution may involve the use of flue CO testing as well as other procedures.

1.8. Timing of combustion appliance testing will be as follows:

- Homes using only natural gas: Combustion appliance testing is conducted after weatherization.
- Homes using non-IOU combustion fuel: Timing of testing will be in accordance with utility-specific policies. For SDG&E, SoCalGas and SCE, no tests will be conducted on appliances using non-IOU fuels. For PG&E, tests for homes with non-IOU combustion appliances will be conducted prior to weatherization and, in a sample of homes, after weatherization.
- Post-weatherization NGAT protocol shall be conducted the same day as infiltration reduction measures are installed.

1.9. Temporary sealing of defective windows and doors, in order to perform post-weatherization NGAT, is allowed when required materials (such as specialty glass or special-order windows or doors) are not available to be installed concurrently with the other weatherization measures. NGAT will be conducted with the defect sealed (e.g., with plastic sheeting) to simulate infiltration reduction achieved by the completed repair/replacement. A repeat of NGAT following the completed repair/replacement is not required.

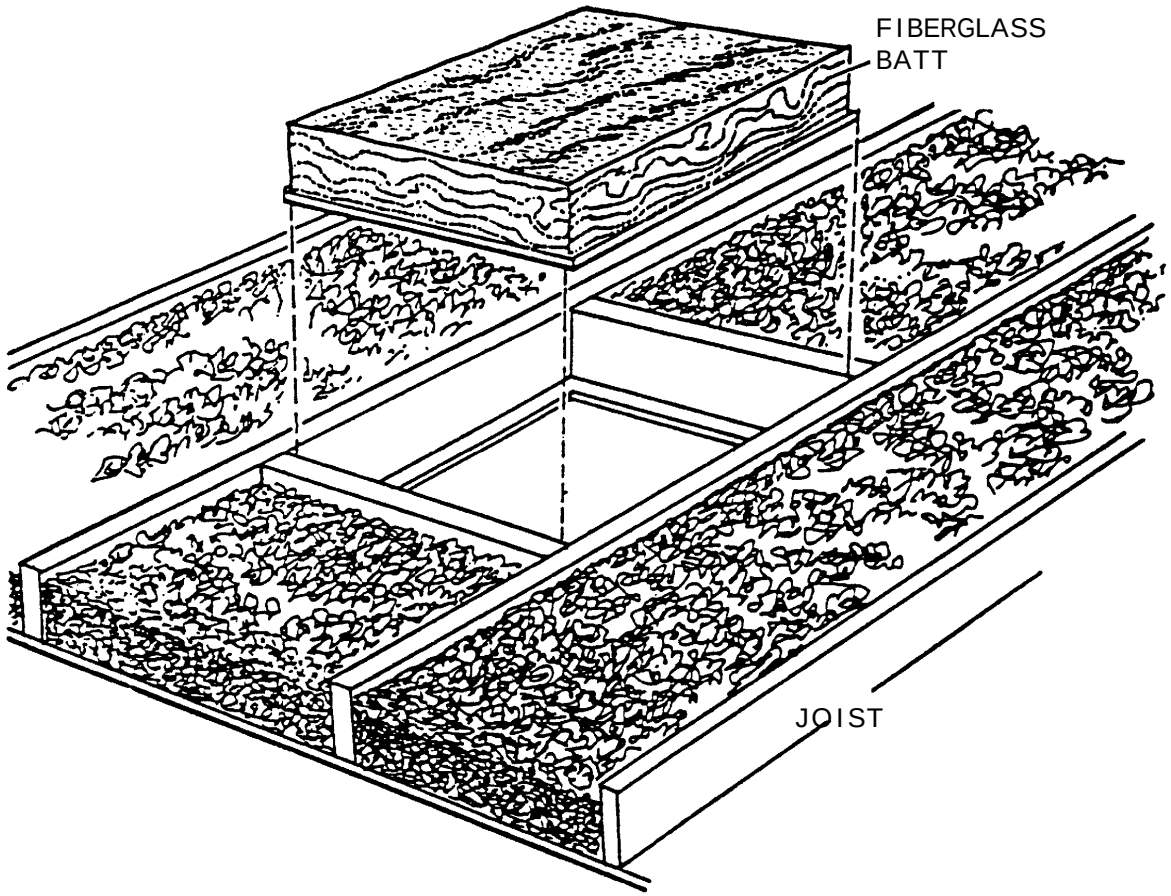
1.10. The following actions will be taken when appliances are found to have problems:

- In owner-occupied homes, natural gas space heaters and water heaters failing one or more of the tests covered by the NGAT protocol will be provided with Service/Adjustment and, if necessary, will be repaired or replaced.

- In owner-occupied homes, non-program appliances failing one or more of the tests covered under the NGAT protocol will be provided with Service/Adjustment. If Service/Adjustment does not correct the problem in question, the appliances in question will be shut off, tagged, and reported to the owner.
- In renter-occupied homes, appliances failing one or more of the tests covered by the NGAT protocol will be provided with Service/Adjustment. If Service/Adjustment does not correct the problem in question, the appliance be will be shut off, tagged, and reported to the tenant and the landlord.

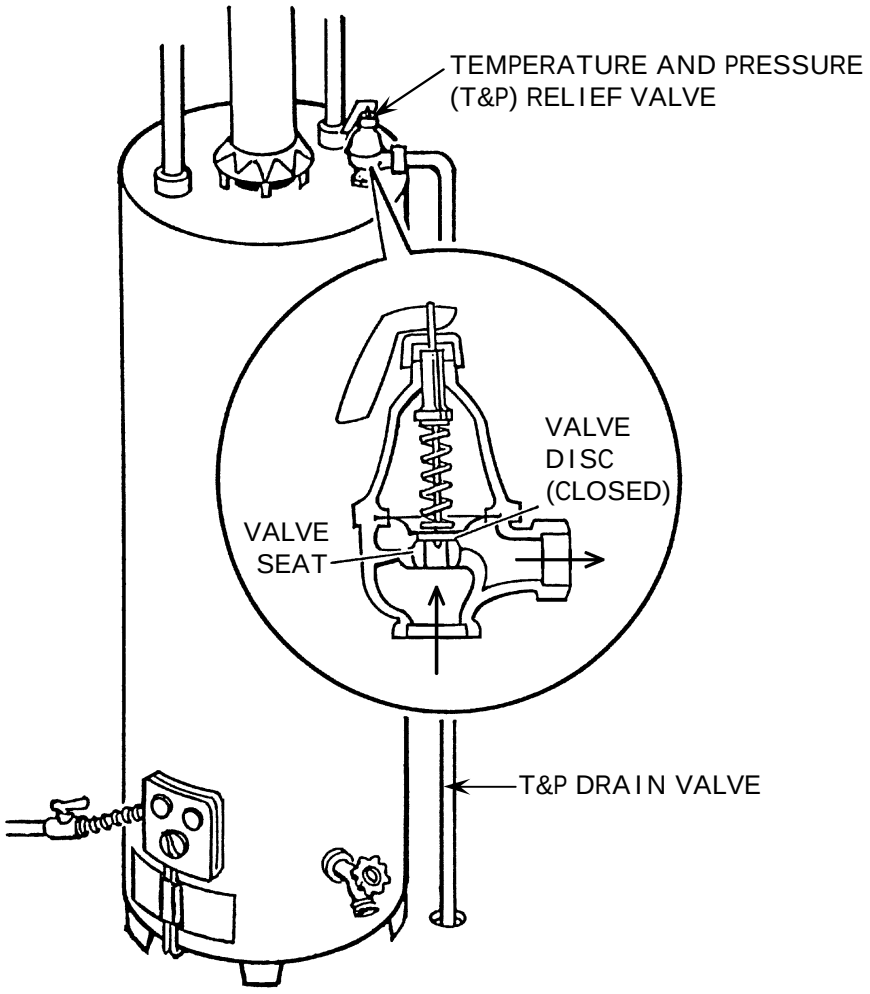
23. ATTIC ACCESS DOOR INSULATION

- **All Insulation**
  - **All attic entry doors accessed from conditioned space shall be insulated:**
    - **Horizontal: same R-value as attic floor.**
    - **Vertical: same R-value as knee walls and skylight wells.**
    - **Rigid or flexible insulation shall be used.**
    - **Insulation shall be permanently attached.**
  - **Multiple Accesses**
    - **All applicable attic entry doors shall be insulated.**



7. TEMPERATURE AND PRESSURE PROTECTION

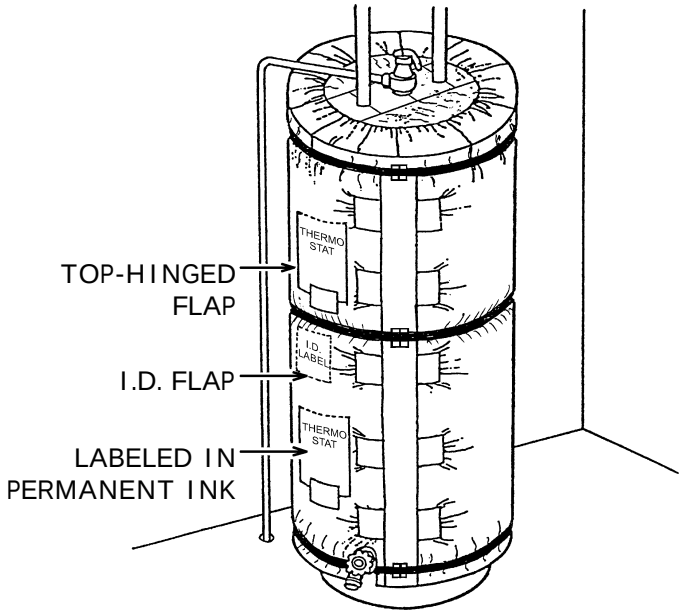
- **All Water Heaters**
  - **Tank shall be protected by a:**
    - **Temperature and pressure (T&P) relief valve, or**
    - **Gas shutoff valve (e.g., a "Watts 210" valve).**
  - **T&P relief valve, or gas shutoff valve, shall be:**
    - **Present and located within 6" of the tank.**
    - **In conformance with local codes.**
  - **Valves shall not be covered by the blanket.**
  - **End of T&P drain line:**
    - **Shall be open and unobstructed (not capped or plugged).**
    - **Shall not be covered or obstructed by the blanket.**



ELECTRIC WATER HEATERS

15. THERMOSTATS AND IDENTIFICATION LABEL

- **Upper and Lower Thermostats and ID Label**
  - **Locations shall be identified and made easily accessible.**
    - **Blanket shall be cut on sides and bottom to create a top-hinged flap over each thermostat cover plate.**
    - **Flap shall be held closed with tape installed along bottom slit.**
    - **Each flap shall be labeled in permanent ink: "Thermostat" or "ID Label".**
- **Identification Label**
  - **Flaps shall be held closed with tape.**
    - **A minimum of one tape strip shall be installed along slit opposite flap hinge.**
    - **All slits longer than 12" shall be secured with tape installed lengthwise along the slit.**
  - **Flaps shall be labeled in permanent ink to identify what is underneath.**

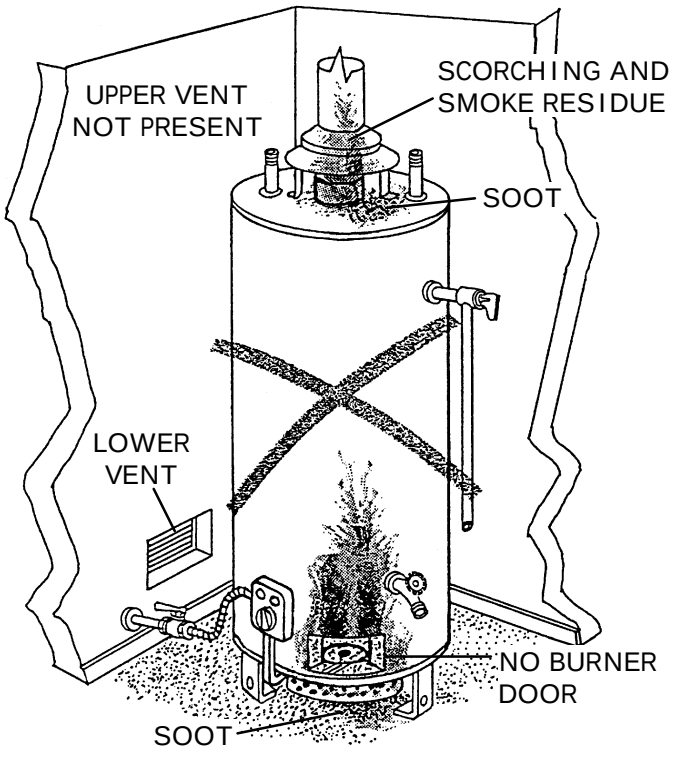


17. COMBUSTION SAFETY REQUIREMENT—GAS UNITS

- **Combustion Air Supply**
  - **Both an upper and lower combustion air vent shall be present.**
  - **Vents shall <u>not</u> be obstructed.**
- **Evidence of Improper Combustion**
  - **Insulation shall <u>not</u> be installed when there is evidence of improper combustion, such as:**
    - **Soot accumulation near draft hood or on floor underneath tank.**
    - **Scorching or smoke residue at the draft hood or combustion chamber access.**
- **Combustion Chamber Access Cover**
  - **At least one access cover shall be present.**
  - **There shall be no signs of scorching or incomplete combustion.**

18. WATER HEATER COMPARTMENT FLOOR

- **The tank shall be in a stable position on flooring that is adequately sound to support the weight of the water heater.**
- **If the floor is weak or damaged and/or the tank is leaning abnormally, water heater insulation shall <u>not</u> be installed.**



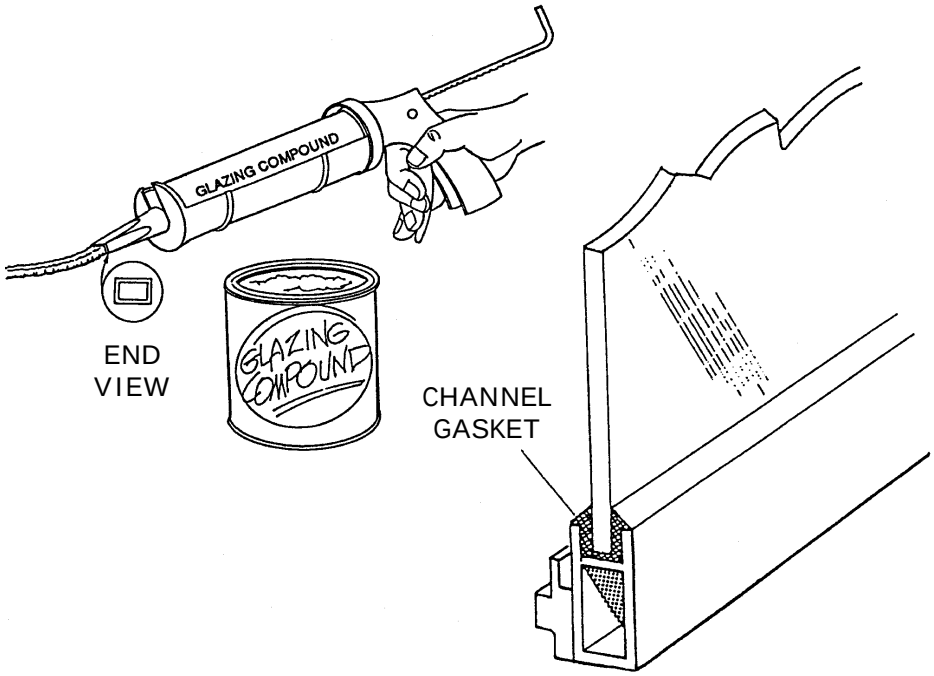
DO <u>NOT</u> INSULATE TANK

3. GLAZING COMPOUND

- **Required in sashes designed to use glazing compound.**
- **Caulk <u>not</u> allowed in lieu of glazing compound.**
- **Glazing compound shall:**
  - **Be the type which remains pliable.**
  - **Conform to ASTM C669 for metal sashes.**

4. CHANNEL GASKETS

- **Gasket shall make watertight seal all around the metal sash.**
- **New replacement gasket shall be:**
  - **Installed when feasible.**
  - **Proper size to form snug fit in channel.**
- **Existing gasket may be reused.**
  - **Shall be in satisfactory condition to provide a complete seal.**
  - **Clear silicone caulk or equivalent may be added to fill in the gaps.**
- **Where proper gasket cannot be provided, glass shall be stabilized in clear silicone caulk or equivalent.**



7. CLUSTER LIGHTING

- **All Types**
  - **CFLs shall not be installed in chandeliers or other cluster lighting fixtures unless the CFL is specifically designed for such applications.**
  - **The fixture shall remain level after installation of the CFL.**

8. DIMMERS, PHOTOSENSORS, AND OCCUPANCY SENSORS

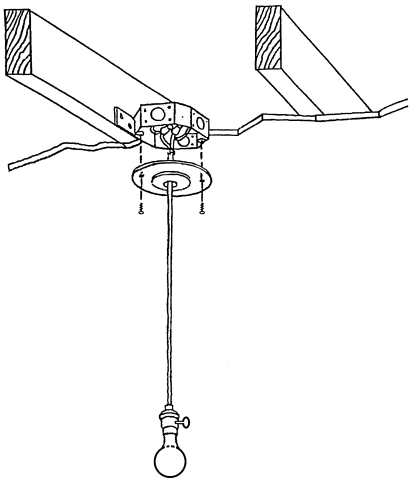
- **All Types**
  - **Only CFLs rated for use with dimmers, photosensors, and occupancy sensors shall be installed in fixtures controlled by such devices.**

9. TIMERS

- **Mechanical**
  - **CFLs may be installed in fixtures equipped with mechanical timers.**
- **Solid State**
  - **CFLs shall not be installed in fixtures equipped with solid state timers.**

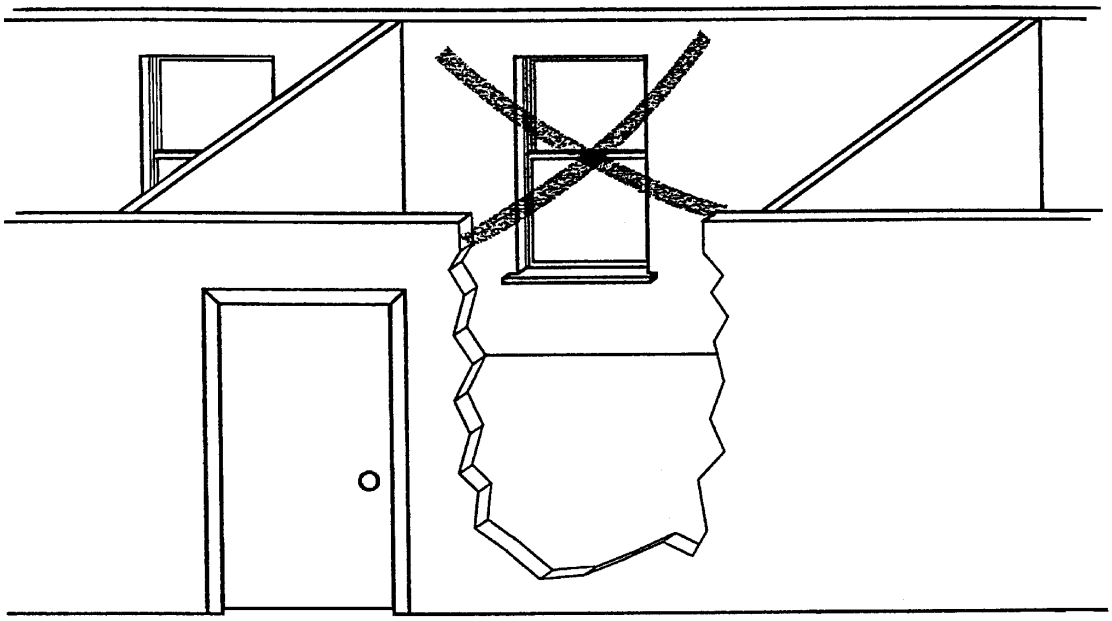
10. LAMP CORD SUPPORTED

- **All Types**
  - **CFLs shall not be installed in fixtures supported only by a lamp cord unless the manufacturer allows the use of CFLs in such fixtures.**



10. EGRESS WINDOWS (continued)

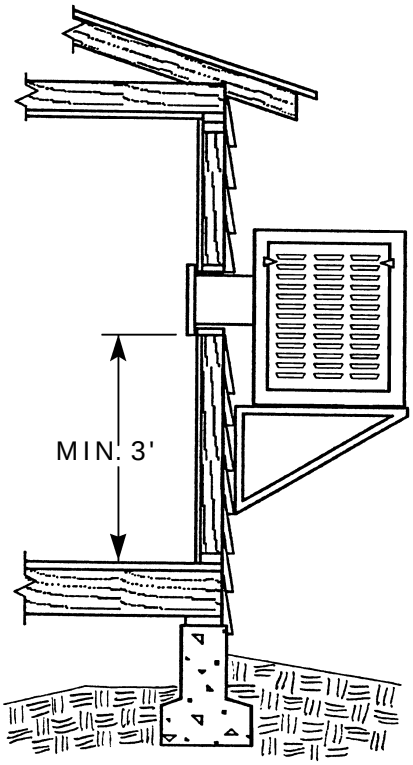
- **Cooler shall not be installed in egress windows <u>unless</u>:**
  - **Allowed by customer, <u>and</u>**
  - **One of the following is present in the same room:**
    - **Another operable window which meets egress requirements, <u>or</u>**
    - **An operable exterior door which meets egress requirements.**



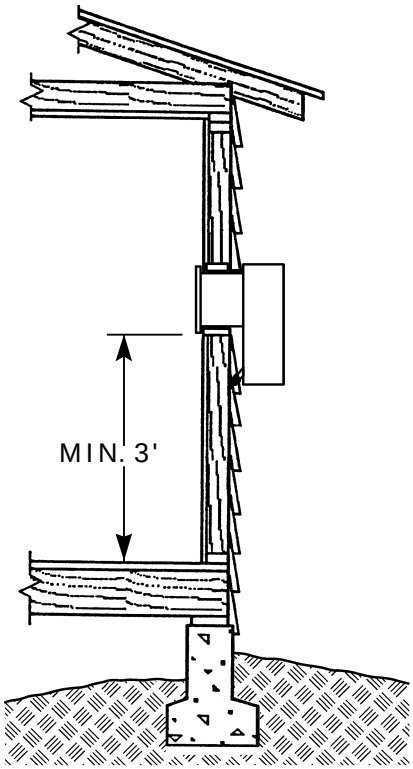
COOLER <u>NOT</u> INSTALLED
IN THE ONLY EGRESS OPENING

11. LOCATION

- **All Units**
  - **Clearances and mounting height shall be in compliance with local code.**
  - **Unit shall be installed only in a window or wall opening.**
  - **Exterior portion of unit shall be located a minimum of 1' above grade.**
  - **Discharge shall <u>not</u> be located where it can disturb combustion appliance burners/pilots (e.g., in kitchen near gas range).**
- **Wall-Mount Units**
  - **Air discharge outlet shall be located a minimum of:**
    - **3' above the floor unless mounted under window.**
    - **18" above floor if:**
      - **Discharge grille is equipped with directional louvers, and**
      - **Location is allowed by manufacturer.**



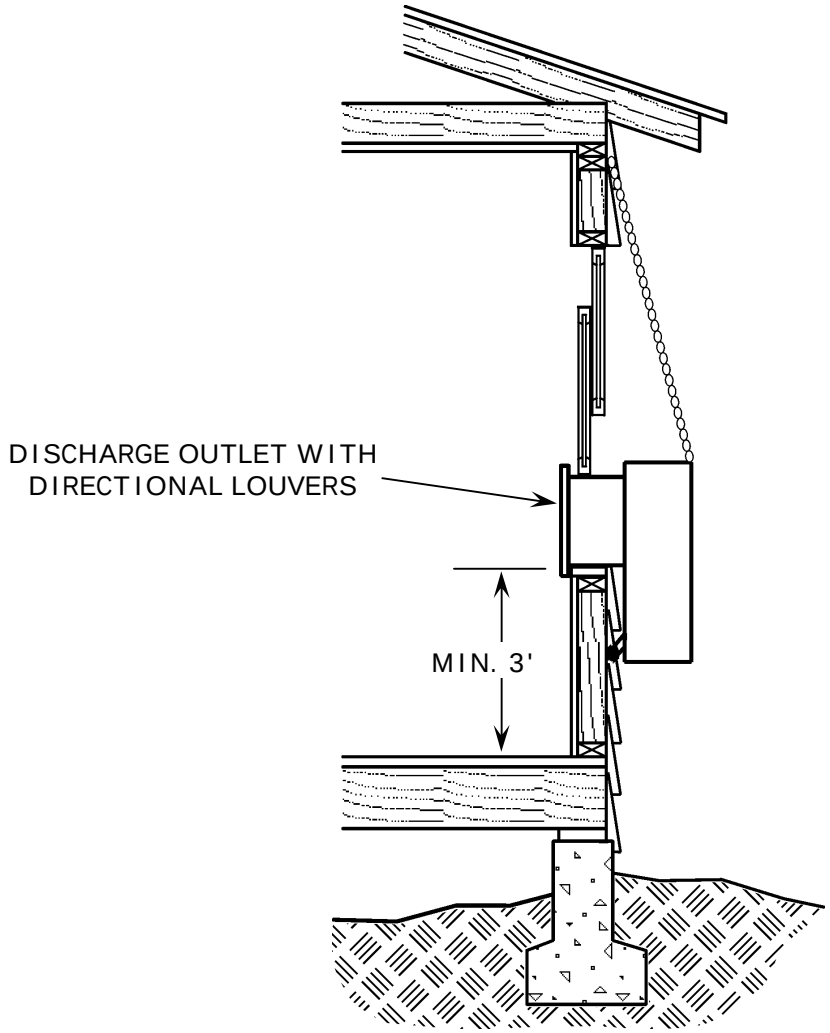
STANDARD
WALL UNIT



HIGH-EFFICIENCY
WALL UNIT

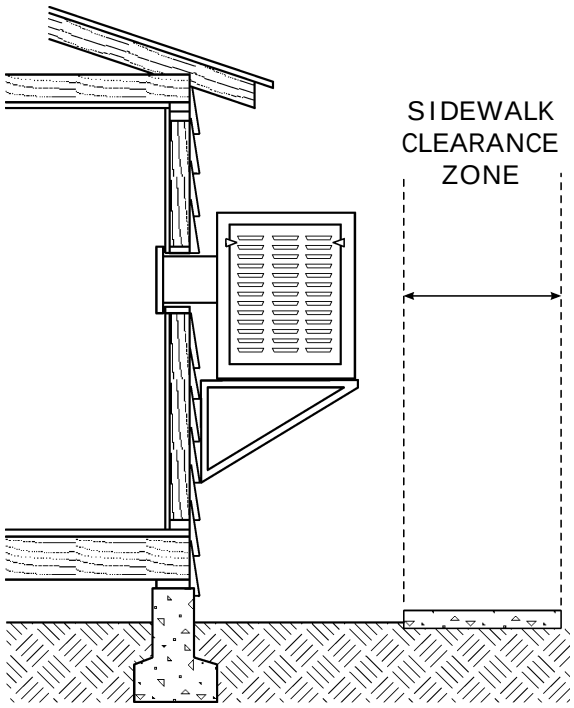
11. LOCATION (continued)

- **Window-Mount Units**
  - **Air discharge outlet shall be located a minimum of:**
    - **3' above the floor unless mounted under window.**
    - **18" above floor if:**
      - **Discharge grille is equipped with directional louvers, and**
      - **Location is allowed by manufacturer.**

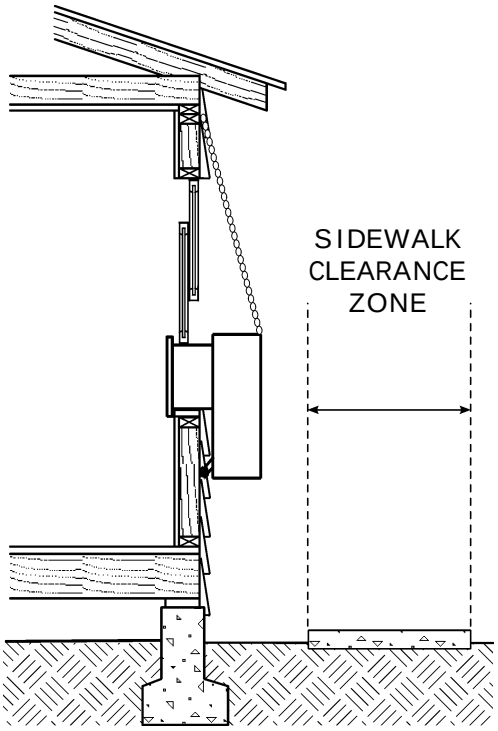


11. LOCATION (continued)

- **Sidewalk Clearance**
  - **Unit shall <u>not</u> extend into sidewalk clearance zone (i.e., over sidewalk).**
  - **Clearance from sidewalk shall be 21" if allowed by local code.**



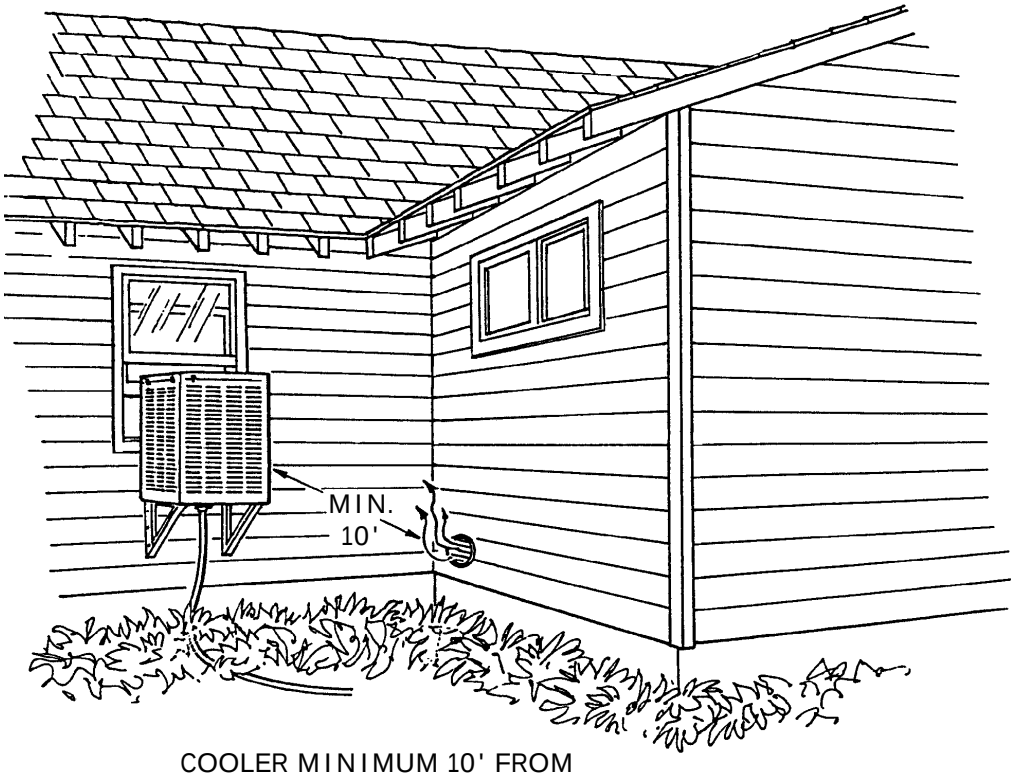
STANDARD
WALL UNIT



HIGH-EFFICIENCY
WINDOW UNIT

11. LOCATION (continued)

- **Exterior Clearance**
  - **Clearance shall comply with local code.**
  - **Cooler air intake shall be located:**
    - **Minimum of 3' from the gas meter.**
    - **Minimum of 10' away from, or 3' below, the following:**
      - **Combustion appliance flue/vent terminations.**
      - **Clothes dryer moisture exhaust termination.**
      - **Plumbing vent terminations.**
      - **Exhaust fan vent termination.**
  - **Unit shall <u>not</u> be installed if clearance requirements cannot be met.**
- **Interior Clearance**
  - **Unit shall be free of obstructions, such as furniture, curtains, plants, etc.**



COOLER MINIMUM 10' FROM
CLOTHES DRYER MOISTURE EXHAUST

21. PRE-OPERATION CHECK (continued)

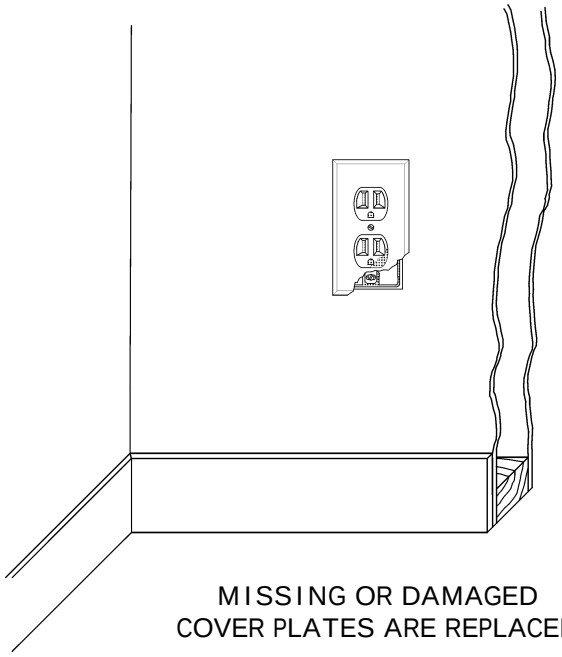
- **Water system shall be checked for:**
  - **Proper flow and no leaks.**
  - **Proper float and splash shield adjustment.**
  - **Even water distribution over pads.**
- **Pump and screen shall be checked for:**
  - **Properly installed screen.**
  - **Debris-free inlet with proper clearance from obstructions.**
  - **Proper pump impeller operation (turns freely).**
- **Blower fan shall be checked to assure:**
  - **Proper clearance from housing.**
  - **Free rotation.**
  - **Proper operation of both motor and fan.**
- **Drain line shall be checked to determine that it:**
  - **Is properly installed and free of leaks.**
  - **Terminates correctly.**
- **Other procedures recommended by manufacturer shall be followed.**

SAMPLE PRE-OPERATION CHECKLIST

#	✓	ITEMS TO BE VERIFIED (CHECK OFF EACH AS IT IS COMPLETED)
1.	❑	Installation requirements
2.	❑	Electrical circuitry
3.	❑	Blower and motor
4.	❑	Water system
5.	❑	Pump and screen
6.	❑	Drain line
7.	❑	Other…

6. ELECTRICAL REQUIREMENTS

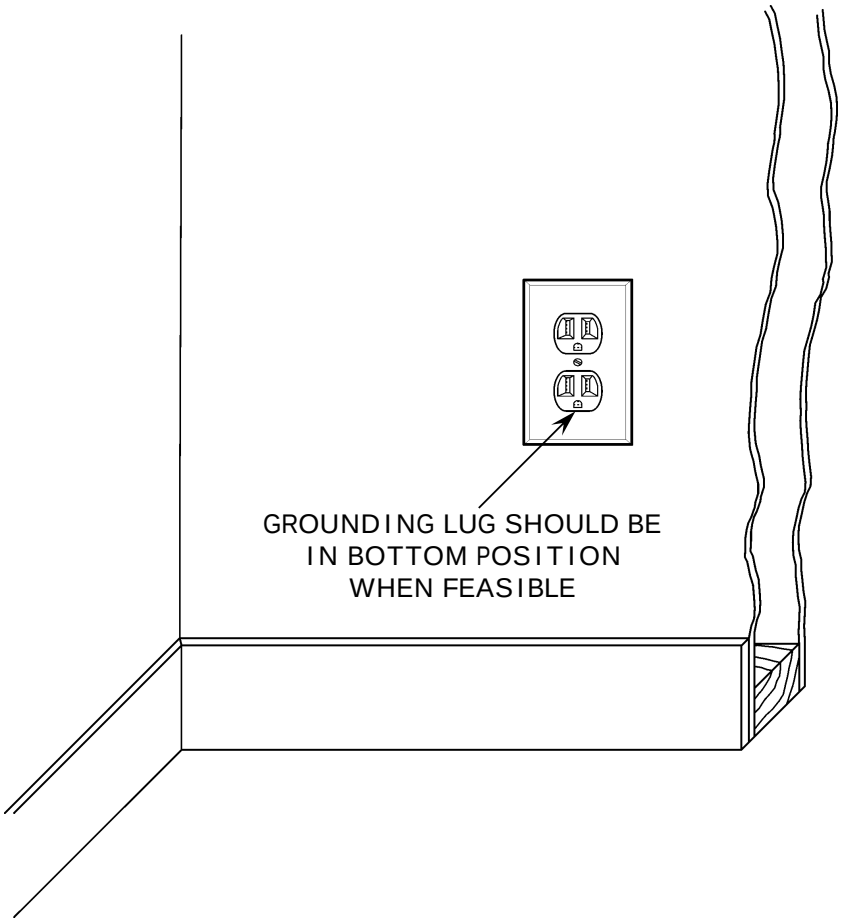
- **Electrical Circuit**
  - **Overcurrent protection and size of conductors shall be in conformance with manufacturer's specifications and local code.**
  - **A GFCI-protected circuit or receptacle shall <u>not</u> be used.**
- **Electrical Outlet**
  - **Refrigerator shall be plugged into its own individual electrical outlet (not shared with another appliance).**
  - **The receptacle and cover plate shall be in good condition.**
  - **The receptacle shall be properly grounded in conformance with the California Electrical Code (CEC) and local code.**
- **Extension Cord**
  - **An extension cord may be used when allowed by manufacturer's instructions and with prior approval of Program Manager.**
  - **Extension cord shall be:**
    - **UL listed, 3-conductor cord, with 3-prong plug and receptacle.**
    - **Minimum 14 AWG.**
    - **Maximum 6' in length.**
- **Appliance cord and extension cord shall <u>not</u> be located where either can create a walking hazard (where people can trip).**



MISSING OR DAMAGED
COVER PLATES ARE REPLACED

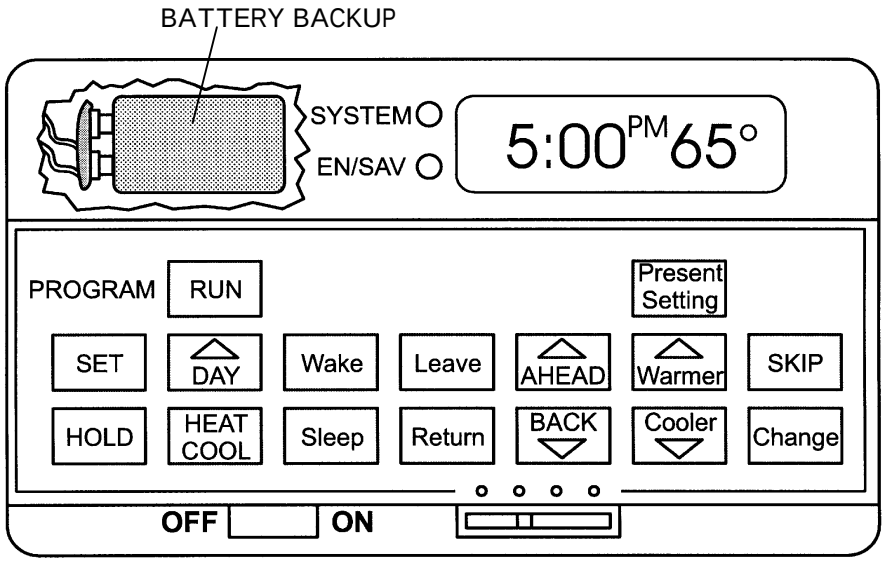
8. INSTALLATION OF A NEW GROUNDED RECEPTACLE

- **A new 3-prong receptacle with ground lug shall be installed when the preexisting receptacle is nonconforming.**
- **A building permit shall be obtained and finalized when required by the local jurisdiction.**
- **The new receptacle shall be properly grounded:**
  - **To the equipment grounding conductor (e.g., green or bare wire), or**
  - **To an alternative grounding means when an equipment grounding conductor is not present.**
  - **The new outlet must be installed with the ground lug in the bottom position, unless refrigerator cord has a right-angle plug designed to be installed with ground lug at top.**



1. APPROVED MATERIALS (continued)

- **Programmable Wall Thermostat**
  - **System powered, <u>not</u> battery powered, on 24 volt systems.**
  - **Digital with anti-short-cycle feature.**
  - **Minimum setback capability of 10°F.**
  - **At least two setback periods per 24 hour day, with change cycle increments being no greater than 30 minutes.**
  - **Manual override and standard alkaline battery backup or other program saving backup system.**
  - **Positive on/off switch that is easily accessible.**
  - **Compatible with the HVAC equipment.**
- **Standard Wall Thermostat**
  - **Alternative when customer refuses programmable thermostat.**
  - **Digital with built in anti-short-cycle feature.**
  - **Conforms with manufacturer's instructions.**
  - **Compatible with the HVAC equipment.**
  - **Includes a positive on/off switch.**



DIGITAL PROGRAMMABLE THERMOSTAT
WITH ON/OFF SWITCH

9. FLUE AND VENT SYSTEMS

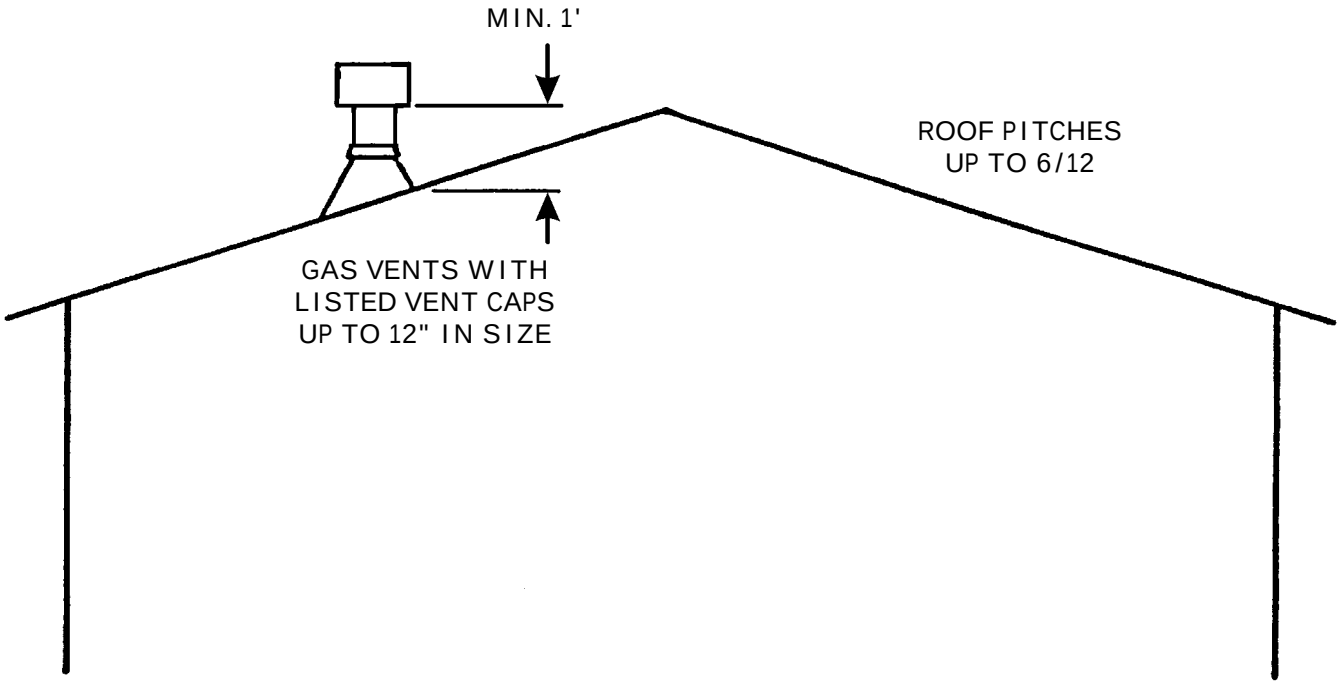
- **All Furnaces**
  - **New vent/flue system shall be installed and secured in conformance with manufacturer's instructions and local code.**
  - **Reference Standard: CMC Chapter 8.**

10. ELECTRICAL WIRING

- **All wiring shall be in conformance with local code.**
- **Air conditioning equipment shall be installed as prescribed in Part 5.**

11. WALL THERMOSTATS

- **When required by the Program Policies and Procedures, a programmable thermostat shall be installed as prescribed in Part 6.**



3. MANUFACTURER'S INSTRUCTIONS

- **Installer shall:**
  - **Review manufacturer's instructions before beginning the installation.**
  - **Properly install the air conditioner in accordance with those instructions.**

4. MAXIMUM SIZE UNIT

- **Replace like-for-like: The Btu output of the new unit shall match the Btu output of the unit being replaced (± 500 Btu).**
- **Unit may be down-sized with prior approval of Program Manager, but the new unit must comply with the chart below.**

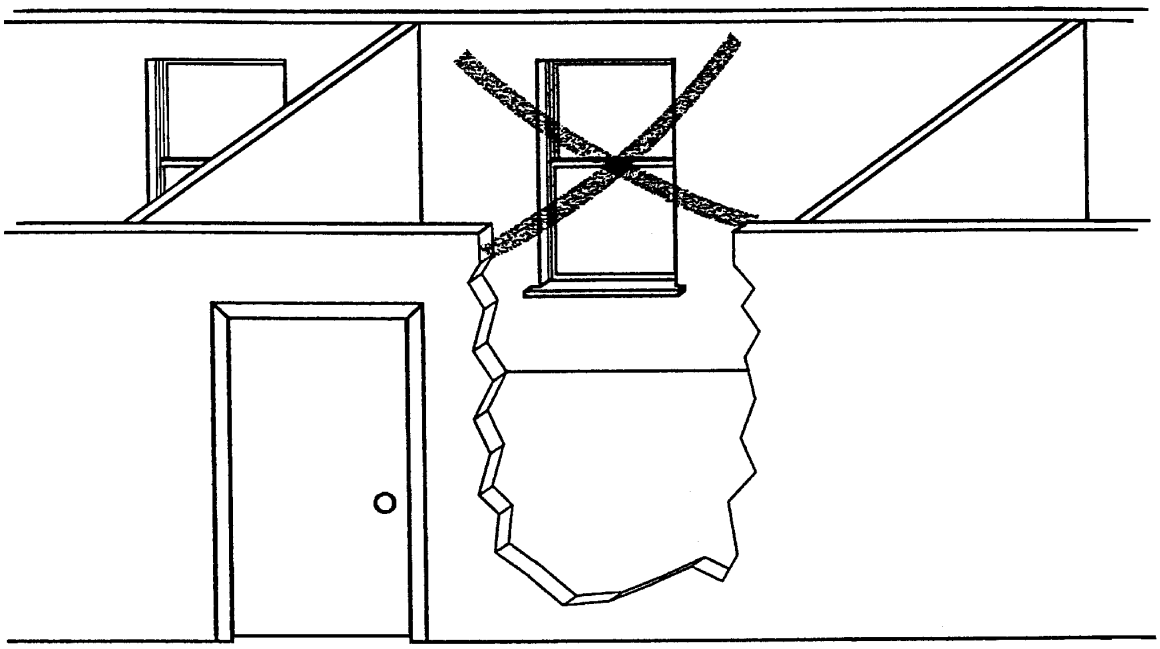
AREA TO BE COOLED (SQ. FT.)	CAPACITY (BTU/HR)*
100 TO 150	5,000
151 TO 250	6,000
251 TO 300	7,000
301 TO 350	8,000
351 TO 400	9,000
401 TO 450	10,000
451 TO 500	12,000
501 TO 700	14,000
701 TO 1000	18,000

***Adjustments to make:**

- **If the room is heavily shaded, reduce capacity by 10 percent.**
- **If the room is very sunny, increase capacity by 10 percent.**
- **If more than two people regularly occupy the room, add 600 Btu/Hr for each additional person.**
- **If the unit is for a kitchen, increase capacity by 4,000 Btu/Hr.**

10. EGRESS WINDOWS (continued)

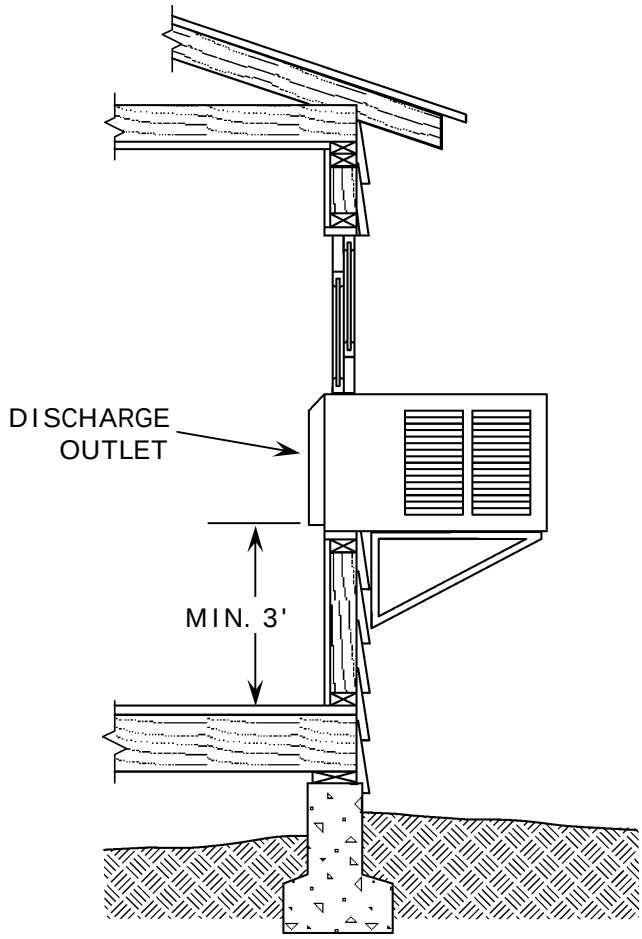
- **Air conditioner shall not be installed in egress windows <u>unless</u>:**
  - **Allowed by customer, <u>and</u>**
  - **One of the following is present in the same room:**
    - **Another operable window which meets egress requirements, <u>or</u>**
    - **An operable exterior door which meets egress requirements.**



AIR CONDITIONER <u>NOT</u> INSTALLED
IN THE ONLY EGRESS OPENING

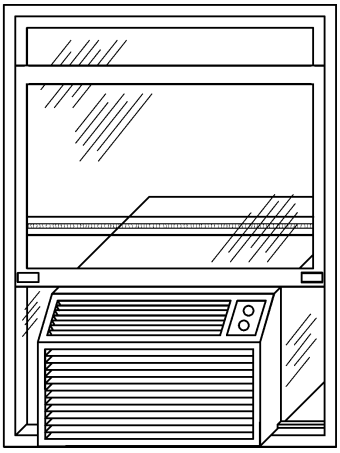
11. MINIMUM HEIGHT

- **All Units**
  - **Unit shall be installed only in a window or wall opening.**
  - **Exterior portion of unit shall be located a minimum of 2' above grade.**
- **Wall-Mount Units**
  - **Air discharge outlet shall be located a minimum of3' above the floor unless mounted below a window.**
  - **Shall be installed in existing location if the location meets requirements of local code, and is**
    - **18" above floor if:**
      - **Discharge grille is equipped with directional louvers, and**
      - **Location is allowed by manufacturer.**



12. LOCATION

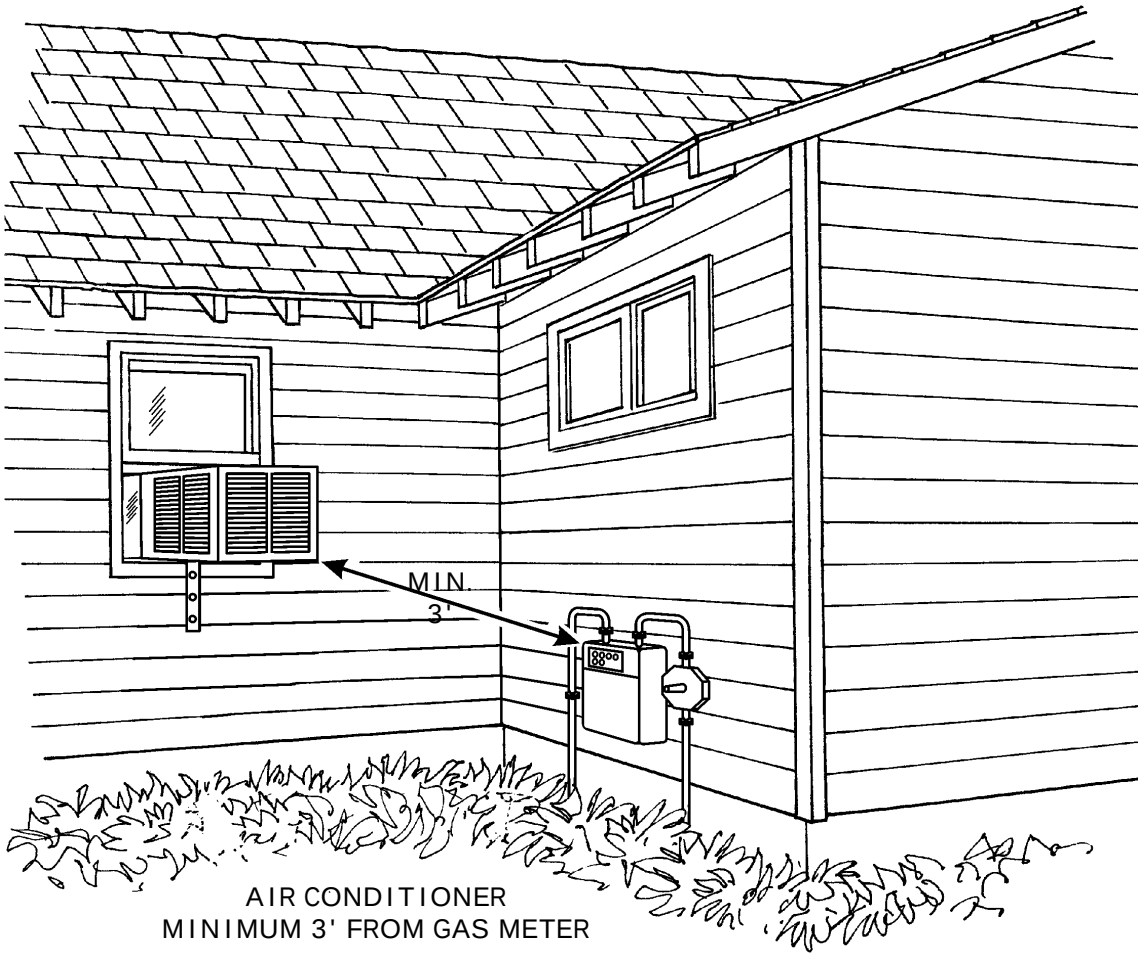
- **Window-Mount Units**
  - **All Windows**
    - **Air conditioner shall be placed in center of window opening.**
    - **Permanent window panels shall be installed to completely fill empty spaces over 12" wide.**
    - **Side window panels over 12" wide shall be transparent.**
    - **Window panels shall be sealed in place.**
    - **Unit shall be placed on north or east side of home out of direct sun when possible.**
    - **Place unit in the shade of trees and shrubs when feasible.**
  - **Double-Hung Windows**
    - **Air conditioner shall be installed in lower sash opening.**
    - **Lower sash shall seal against unit and side panels.**



AIR CONDITIONER CENTERED
IN WINDOW OPENING

12. LOCATION (continued)

- **Exterior Clearance (continued)**
  - **There shall be at least a 3' clearance from A/C inlet to the gas meter.**
  - **Property setback requirements shall <u>not</u> be violated.**
  - **Unit shall be free of obstructions, such as landscaping, plants, structures, etc.**
- **Interior Clearance**
  - **Unit shall be free of obstructions, such as furniture, curtains, plants, etc.**



AIR CONDITIONER
MINIMUM 3' FROM GAS METER

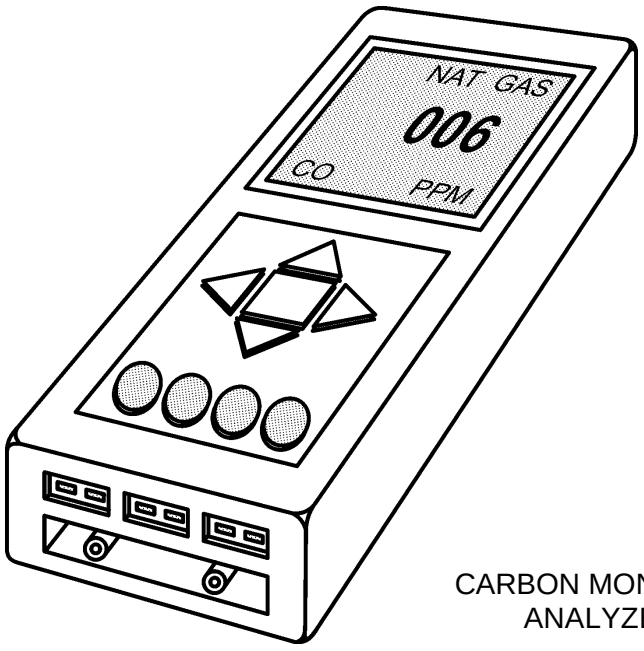
SECTION 29

NATURAL GAS APPLIANCE TESTING (NGAT) STANDARDS

PART 1: GENERAL CRITERIA

1. TEST EQUIPMENT AND ACCESSORIES

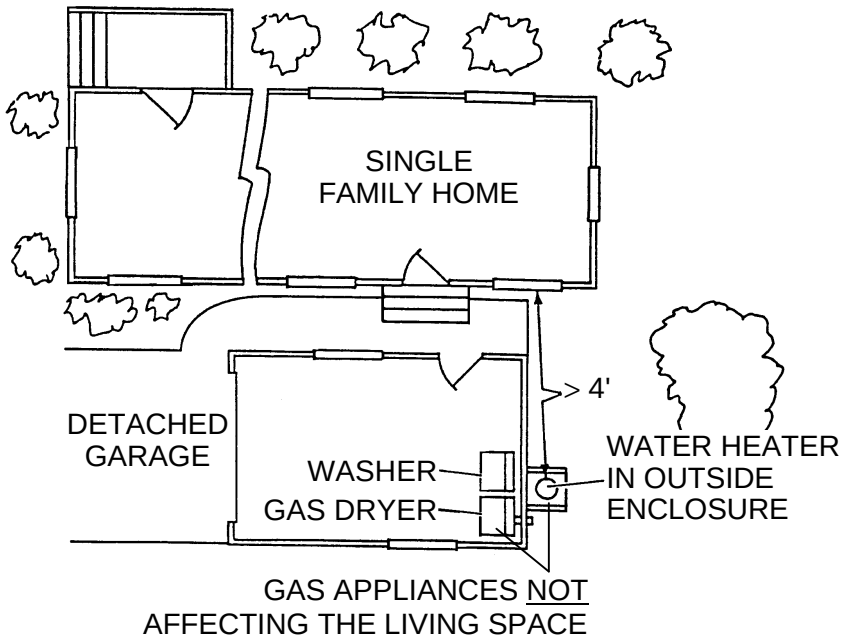
- **Carbon Monoxide Analyzers**
  - **Shall be manufactured under an ISO 9001 quality management system or be ISO 9001 Certified.**
  - **Must, at a minimum, measure CO levels from zero ppm to 999 ppm.**
- **Test Equipment Calibration**
  - **Carbon monoxide analyzers shall be maintained and calibrated in accordance with manufacturer's specifications.**



CARBON MONOXIDE ANALYZER

2. NGAT APPLICABILITY

- **In homes receiving infiltration reduction measures, NGAT shall be conducted when the home:**
  - **Is heated with natural gas, or**
  - **Has one or more other natural gas appliances affecting the living space.**
- **NGAT shall be conducted for all natural gas appliances affecting the living space *<u>except</u>* appliances that are: (a) abandoned*, or (b) inaccessible*.**
- **Natural Gas Appliances Affecting the Living Space**
  - **Appliances affecting the living space are all space heating appliances and other appliances in the following locations:**
    - **Partially or entirely within the living space (including closets located within the envelope but accessed from outdoors).**
    - **Attached garage, attic, or basement.**
    - **An outdoor location within 4' of an operable door or window leading into the living space.**
    - **A location where combustion products from the appliance could infiltrate a forced air duct system (e.g., in a garage or room containing supply or return plenum/ductwork).**
  - **Appliances in all other locations are considered to be appliances <u>not</u> affecting the living space.**
- **Natural Gas Appliances <u>Not</u> Affecting the Living Space**
  - **Only checks for gas leaks are performed.**

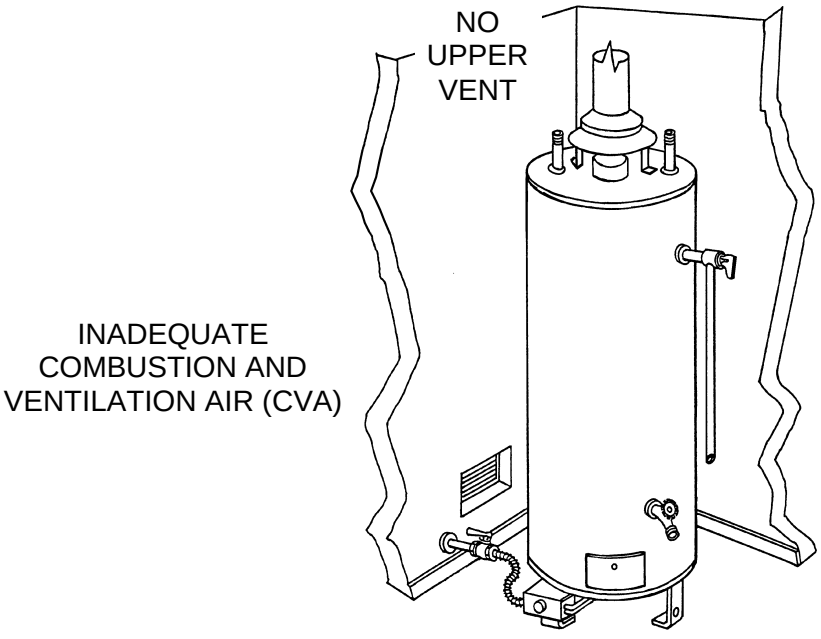


***See Definitions.**

PART 2: PRE-WEATHERIZATION EVALUATIONS

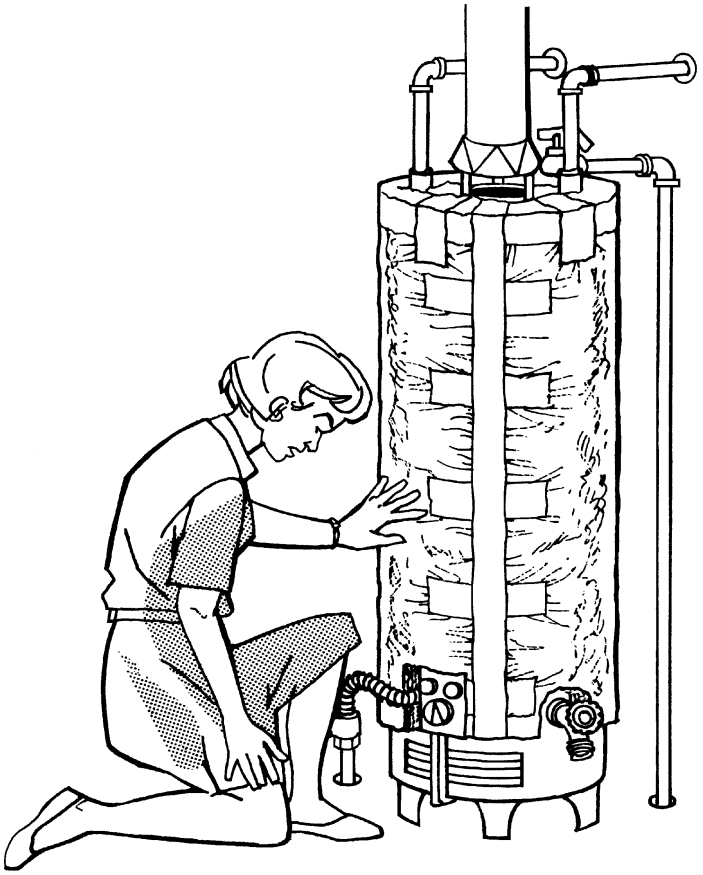
3. PRE-WEATHERIZATION ASSESSMENT

- **The assessment process shall include a check of the following:**
  - **Gas leaks (Item 4)**
  - **Inadequate CVA (Item 5)**
  - **Inadequate clearance between water heater vent termination and evaporative cooler inlet (Item 6)**
  - **Other improper flue/vent terminations (Item 6)**
  - **Inoperable gas appliance (Item 7)**
  - **Gas clothes dryer in the living space not exhausted outdoors (Item 7)**
  - **Unvented combustion space heater in the living space (Item 7)**
  - **When a whole house fan is in ceiling, gas water heater or open combustion furnace with standing pilot in the attic (Item 7)**
  - **Range with Space Heater/Incinerator not vented outdoors (Item 7)**
  - **Open combustion water heater located in a sleeping area (Item 7)**
- **Before weatherization work commences, (a) gas leaks shall be repaired, (b) inoperable appliances shall be checked by a utility gas service technician (or designee), and (c) all vent termination clearances/defects and combustion air deficiencies shall be confirmed feasible to correct.**



4. GAS LEAKS

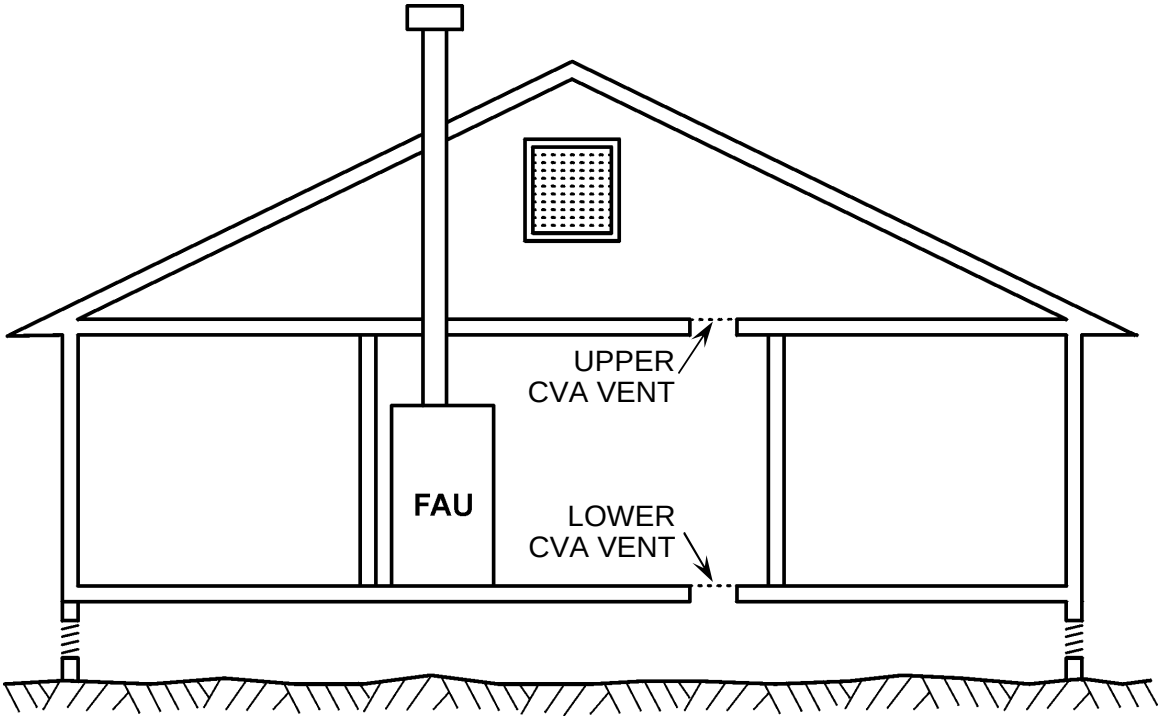
- **Natural gas appliances shall be checked for gas leaks.**
- **Acceptable methods include the following:**
  - **Olfactory (Sniff) Test performed above, but within 2' of, all valves and fittings.**
  - **Application of leak detection liquid to line valves and to fittings on valves, flexible gas connectors, and pipes.**
  - **Air sampling with electronic leak detection equipment near valves, fittings, flexible gas connectors, and pipes.**
- **Gas leaks shall be repaired by a utility gas service technician (or designee).**



CHECKING FOR NATURAL GAS ODOR

5. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION

- **CVA shall be evaluated for open combustion natural gas heating systems and water heaters (cooking appliances and clothes dryers are *excluded*).**
- **CVA shall comply with these guidelines and Appendix A.**
- **Appliances Drawing *Outdoor* Air through Combustion-Air Openings or Ducts**
  - **An *upper* opening or duct shall be located above the draft hood, <u>and</u> a *lower* opening or duct shall be located within 12" of the floor.**
  - **Combustion air openings and vertical ducts shall each provide 1 sq. in. net free venting area (NFVA) per 4,000 Btu/hr of input.**
  - **Horizontal ducts shall each provide 1 sq. in. NFVA per 2,000 Btu/hr of input.**
  - **Combustion air may also be obtained through a single <u>upper</u> vent or duct to outdoors under the following conditions:**
    - **Vent NFVA is at least: (a) 1 sq. in. per 3,000 Btu/hr input, and (b) not less than the sum of the cross-sectional areas of all vent connectors in the space.**
    - **Equipment has clearances of at least 1" sides and back, and 6" in front.**



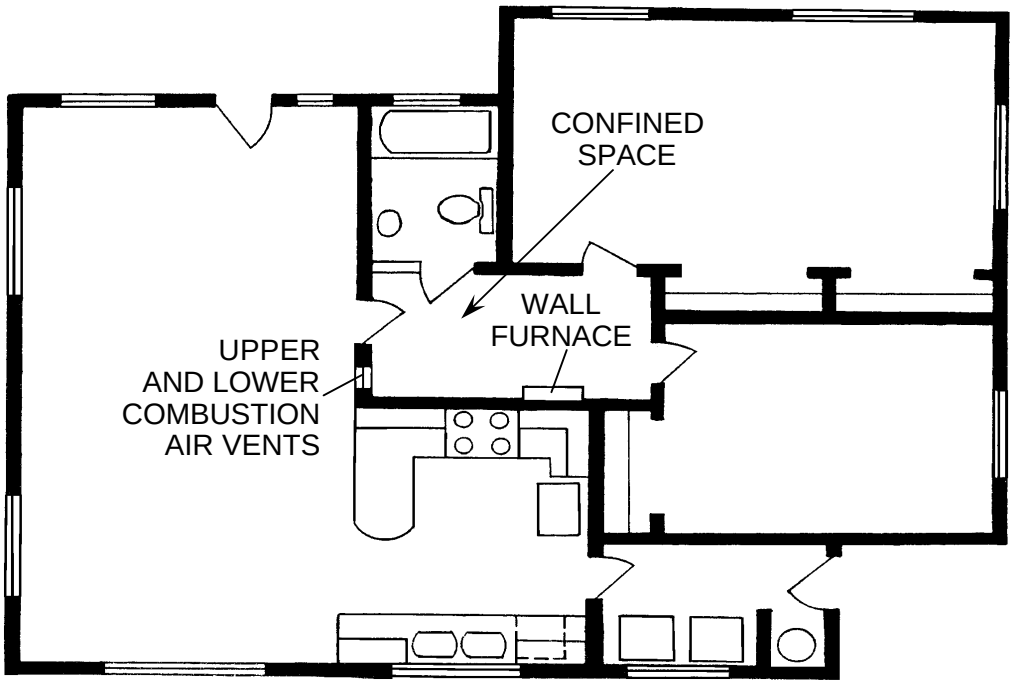
5. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

- **When Appliances Draw Combustion Air from Outdoors**
  - **Combustion air may be obtained from outdoors by means of:**
    - **Permanent openings (undampered vents) of the required size directly to outdoors through enclosure floor, roof or walls; or**
    - **Continuous vertical or horizontal ducts of the required cross-sectional area extending from the enclosure to outdoors.**
  - **Combustion air may be obtained from the attic, provided:**
    - **Attic vents are not subject to ice or snow blockage.**
    - **The attic vertical clear height is at least 30" at the peak (from top of ceiling joists to bottom of rafters/ridge board).**
    - **Attic ventilation is sufficient to provide the required volume of combustion air.**
  - **Combustion air may be obtained from under the floor, provided:**
    - **Under-floor spaces have free flow of air.**
    - **Unobstructed openings to outdoors exist that are at least twice the NFVA of the required combustion air vent openings.**
  - **Louvers, Grilles, and Screens**
    - **Blocking effects of louvers, grilles, and screens shall be considered when calculating NFVA of an opening (see Appendix A).**

SOURCES OF COMBUSTION AIR		
OUTDOORS	**ATTIC**	**UNDER FLOOR**
• **Permanent openings with undampered vents or continuous ducts (vertical or horizontal).** • **Vent directly to outdoors.** • **1/4" screen mesh on all combustion-air openings.**	• **Minimum 30" attic height at the peak.** • **Adequate attic ventilation that is unobstructed.** • **Duct/sleeve extending 6" above top of ceiling joists and insulation.**	• **Free flow of air.** • **Unobstructed openings to outdoors with at least twice the area of required combustion air vent NFVA.**

5. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

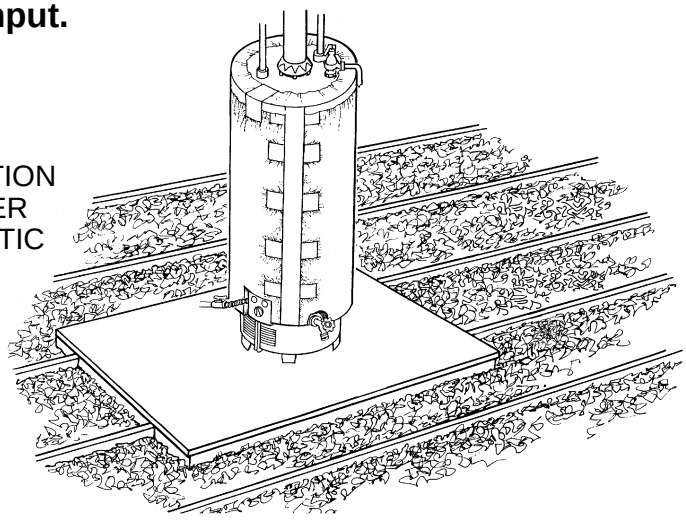
- **When Appliances Draw Combustion Air from Indoors**
  - **Unconfined Space:**
    - **A room/space that has a volume of at least 50 cu. ft. per 1,000 Btu/hr total input rating of the open combustion furnace and/or water heater in that room/space.**
    - **Combustion air is considered adequate.**
  - **Confined Space:**
    - **A room/space that has a volume of less than 50 cu. ft. per 1,000 Btu/hr total input of the open combustion furnace and/or water heater in that room/space.**
    - **Combustion air is not adequate, and**
    - **Proper vent openings to adjacent space(s) must be present.**
- **Appliances Located in an Indoor Confined Space**
  - **Upper and lower vent openings shall be present which: (a) freely communicate with other indoor rooms/spaces, and (b) provide a combined volume of at least 50 cu. ft. per 1,000 Btu/hr total input.**
  - **The vent openings shall meet the following requirements:**
    - **Each vent opening shall provide 1 sq. in. of NFVA per 1,000 Btu/hr input, and shall be no smaller than 100 sq. in. NFVA.**
    - **Lower vents shall be located within 12" of the floor, and upper vents shall be located above the draft hood.**



5. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

- **Appliances Located in a Garage**
  - **When a garage (finished or unfinished) is an unconfined space, combustion air is considered adequate.**
  - **When a converted (finished) garage is a confined space used as conditioned living space:**
    - **Appliance(s) shall be isolated from the conditioned space by an enclosure vented to outdoors (as specified on page 29-5).**
    - **The garage shall not be vented into the main body of the house to obtain additional indoor combustion air.**
  - **When a garage is a confined space that is (a) unfinished or (b) finished and unconditioned (not living space), upper and/or lower permanent venting to outdoors shall provide at least 1 sq. in. NFVA per 4,000 Btu/hr total input.**
- **Appliances Located in a Crawlspace or Partial Basement**
  - **When the underfloor area (crawlspace or crawlspace plus partial basement) is an unconfined space, combustion air is adequate.**
  - **When the underfloor area is a confined space:**
    - **The under-floor space shall have free flow of air.**
    - **Unobstructed openings to outdoors shall provide at least twice the NFVA of the required combustion air vent openings.**
- **Appliances Located in an Attic**
  - **When attic is unconfined space, combustion air is adequate.**
  - **When attic is a confined space:**
    - **Upper and/or lower permanent attic venting shall be present on two sides/ends of the attic, and**
    - **Venting on each side/end shall provide at least 1 sq. in. NFVA per 4,000 Btu/hr total input.**

OPEN COMBUSTION WATER HEATER LOCATED IN ATTIC



6. FLUE/VENT SYSTEM EXAMINATION

- **All gas vents shall terminate outdoors.**
- **Gas vents located 4' or more from a vertical wall or similar obstruction shall:**
  - **Extend at least 1' above the roof.**
  - **Comply with Table 29-1.**
- **Gas vents located less than 4' from a vertical wall or similar obstruction shall terminate at least:**
  - **2' above the highest point where they pass through the roof, and**
  - **2' higher than any portion of the building within 10'.**
- **Gas vents shall terminate no closer to a door, openable window, or gravity air inlet than the following minimum distances:**
  - **4' below, or**
  - **4' horizontally from, or**
  - **1' above.**

  ***Exception 1*: Vent terminals for Direct Vent furnaces:**
    - **At least 9" away for inputs up to 50,000 Btu/hr.**
    - **At least 12" away for inputs 50,100 to 65,000 Btu/hr.**

  ***Exception 2:* Vent terminals for Forced or Induced Draft systems (e.g., induced draft space/water heater or condensing furnace):**
    - **At least 12" away.**

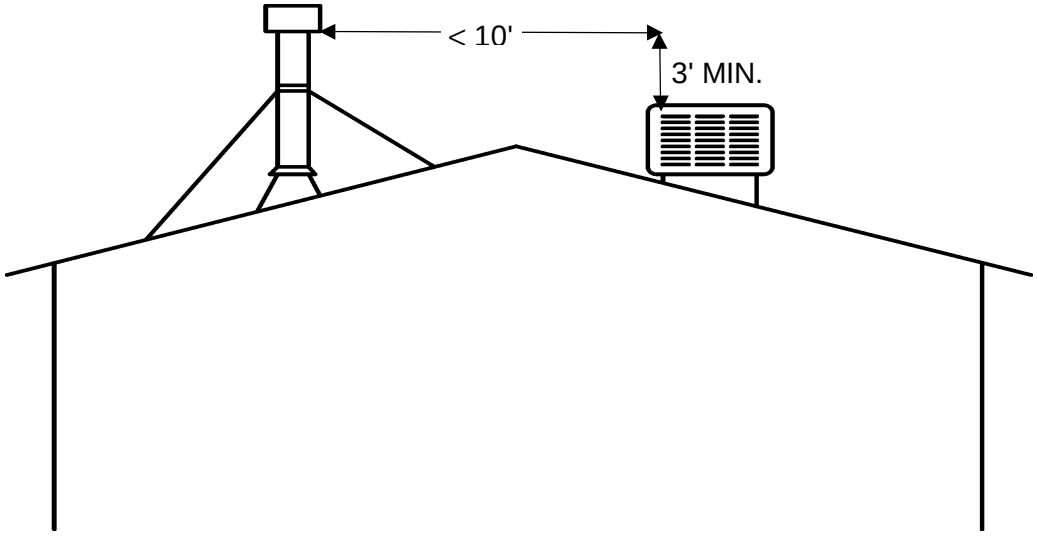
Table 29-1: Vent Termination Above a Roof

MINIMUM HEIGHT FROM ROOF TO LOWEST DISCHARGE OPENING	
ROOF SLOPE (INCHES)*	HEIGHT ABOVE ROOF
Flat to 6/12	1' – 0"
Over 6/12 to 7/12	1' – 3"
Over 7/12 to 8/12	1' – 6"
Over 8/12 to 9/12	2' – 0"
Over 9/12 to 10/12	2' – 6"
Over 10/12 to 11/12	4' – 0"
Over 11/12 to 12/12	5' – 0"

***For other slopes, see CMC Chapter 8.**

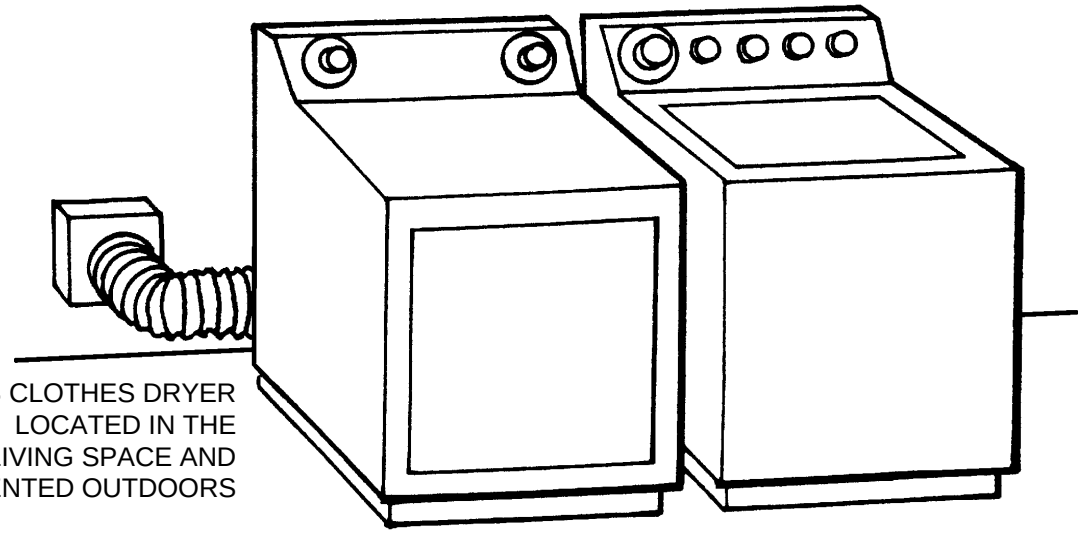
6. FLUE AND VENT SYSTEM EXAMINATION (continued)

- **Outdoor Water Heater Vent Termination**
  - **When an outdoor water heater is located within 4' of a first-floor wall, the vent pipe must terminate at least 1' above the first-floor roof.**
    - **The pipe may be offset from the roof overhang.**
    - **Offsets shall not exceed 45°, except one 60° offset is allowed.**
- **Flue and Vent Systems Terminating Near an Evaporative Cooler**
  - **A water heater flue/vent pipe located within 10' of an evaporative cooler shall terminate at least 3' above the cooler intake.**
  - **Furnace flue/vent pipes within 10' of an evaporative cooler shall terminate at least 3' above the cooler intake <u>unless</u>:**
    - **All cooler discharge openings are equipped with a vent cover.**
    - **The client is informed of the non-conforming flue/vent and advised to keep cover(s) in place during the heating season.**



7. ADDITIONAL EXAMINATIONS OF NATURAL GAS APPLIANCES

- **Inoperable Gas Appliances**
  - **Inoperable natural gas appliances must be checked by a utility gas service technician (or designee), *unless* they are: (a) abandoned*, or (b) inaccessible*.**
- **Infiltration reduction measures shall <u>not</u> be installed if any of the following conditions are present:**
  - **<u>Gas clothes dryer</u> located in the living space but <u>not</u> exhausted outdoors.**
  - **<u>Return leak</u> present that can draw in combustion products from the FAU or other open combustion appliances (e.g., in a garage or room containing supply or return plenum/ductwork).**
  - **<u>Whole house fan</u> vented into an attic that contains a gas water heater or an open combustion furnace with standing pilot.**
  - **<u>Unvented combustion space heater</u> (e.g., gas or kerosene unit) present in the living space.**
  - **<u>Open combustion water heater</u> present in a sleeping area.**
  - **<u>Gas range</u> present which has a <u>space heater or incinerator</u> that is not properly vented outdoors.**



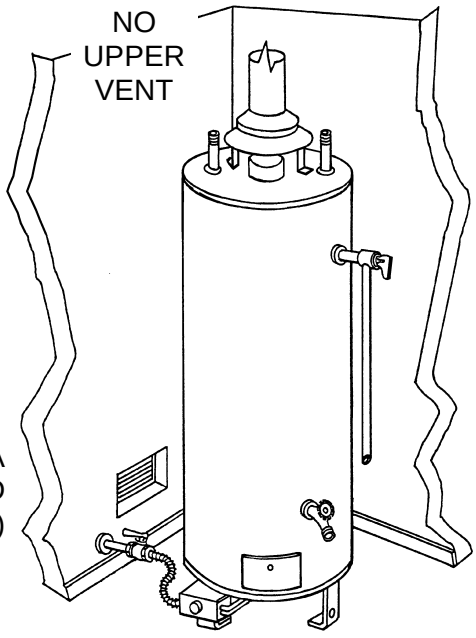
GAS CLOTHES DRYER LOCATED IN THE LIVING SPACE AND VENTED OUTDOORS

***See Definitions.**

PART 3: WEATHERIZATION CREW VERIFICATIONS

8. PRELIMINARY VISUAL EVALUATIONS

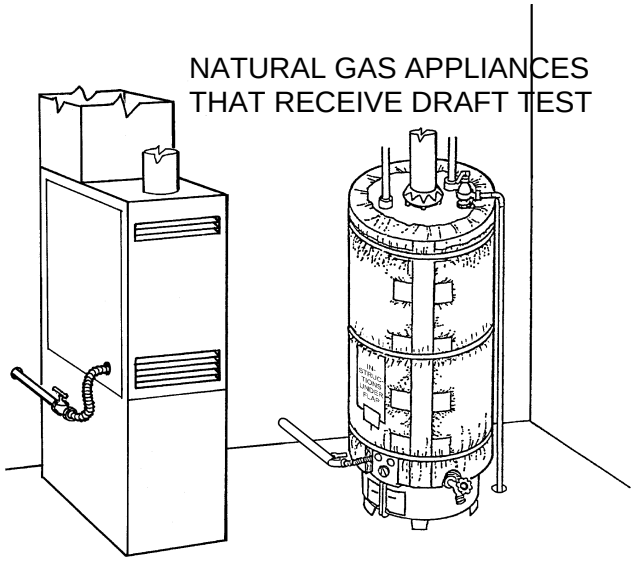
- **A check shall be made for the following conditions, which preclude installation of infiltration reduction measures unless repair is feasible:**
  - **Gas leaks and soldered gas connectors (Item 10)**
  - **Inadequate CVA (Item 11)**
  - **Inadequate clearance between water heater vent termination and evaporative cooler inlet (Item 12)**
  - **Other improper flue/vent terminations (Item 12)**
  - **Draft hood improper—misaligned, missing, or doubled (Item 12)**
  - **Flue/vent hazard, such as disconnection, hole/leak indoors, not extended outdoors (Item 12)**
  - **Flue/vent connection to a solid-fuel chimney (Item 12)**
  - **Inoperable gas appliance (Item 13)**
  - **Appliance components missing or damaged (Item 13)**
  - **Gas clothes dryer located in the living space but <u>not</u> exhausted outdoors (Item 13)**
  - **Return leaks that can draw in combustion products from the FAU or other open combustion appliances (Item 13)**
  - **Unvented combustion space heater in the living space (Item 13)**
  - **Gas range with heater/incinerator <u>not</u> vented outdoors (Item 13)**
  - **Whole house fan vented into an attic that contains gas water heater or open combustion furnace with standing pilot (Item 13)**
  - **Open combustion water heater located in a sleeping area (Item 13)**
  - **When gas log is primary heat source, fireplace damper <u>not</u> blocked partially open (Item 20)**



PART 4: POST-WEATHERIZATION NGAT PROCEDURES

9. POST-WEATHERIZATION NGAT

- **Post-Weatherization NGAT shall be performed, which shall include the following procedures:**
  - **CO Analyzer zeroed outdoors.**
  - **Room Ambient CO Test with gas appliances off.**
  - **Check for gas leaks.**
  - **CVA Evaluation.**
  - **Appliance-off visual inspection of appliances, components, and flue/vent systems.**
  - **Appliance Ambient CO Test with natural gas appliances operated individually.**
  - **Draft Test on natural draft space and water heating appliances.**
  - **Exhaust/flue CO Test and Draft Test on natural gas fireplace logs.**
  - **Appliance-on visual inspection of appliances.**
- **Appliances that Fail NGAT Protocol**
  - **If a Room Ambient or Appliance Ambient CO measurement equals or exceeds the action level of 10 ppm, unit(s) believed to be causing elevated CO reading shall be serviced/adjusted by a utility gas service technician (or designee) and, when applicable, repaired or replaced.**
  - **An appliance that has inadequate draft or is inoperable shall be serviced/adjusted by a utility gas service technician (or designee) and, when applicable, repaired or replaced.**
  - **All units repaired or replaced shall undergo post-repair/replacement testing per Item 24.**



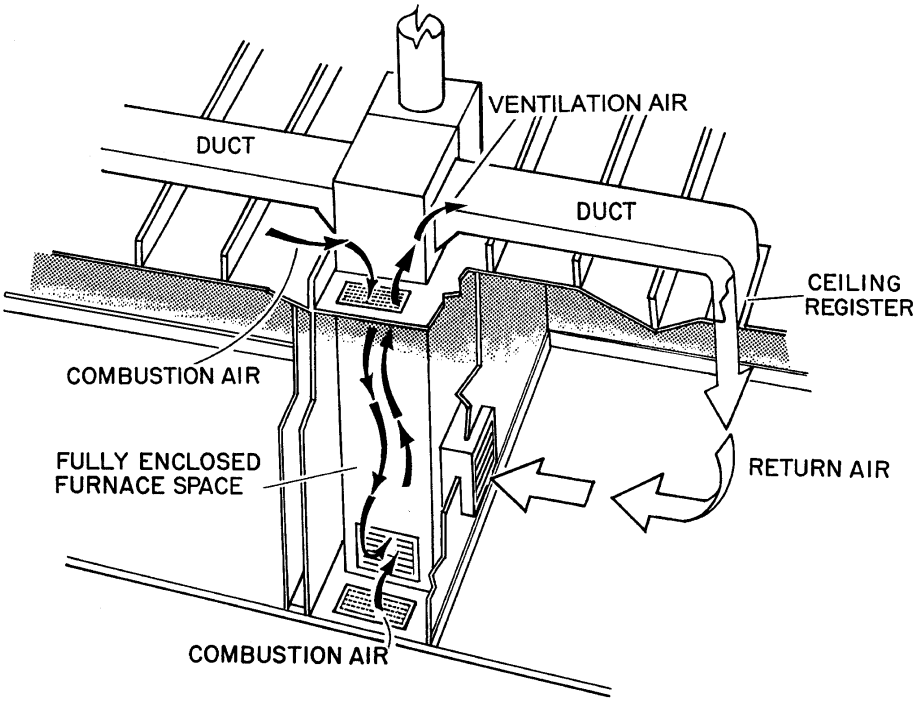
10. GAS LEAKS AND SOLDERED GAS CONNECTORS

- **Natural gas appliances shall be checked for gas leaks:**
  - **Prior to operating the appliance for testing.**
  - **With combustion appliances and exhaust fans/devices off.**
- **Appliances shall be checked for natural gas leaks using one or more of the following methods:**
  - **Olfactory (Sniff) Test performed above, but within 2' of, all valves and fittings.**
  - **Application of leak detection liquid to line valves and to fittings on valves, flexible gas connectors, and pipes.**
  - **Air sampling with electronic leak detection equipment near valves, fittings, flexible gas connectors, and pipes.**
- **When a gas leak is detected, inspection shall be conducted by a utility gas service technician (or designee).**
- **Leaks shall be repaired by a utility gas service technician (or designee) before appliances are operated for natural gas appliance tests.**
- **When faint gas odors are present prior, testing may occur; however, appliance shall be checked by a utility gas service technician (or designee).**
- **Soldered Gas Connectors**
  - **Old-style flexible gas connectors with soldered-on fittings shall be replaced with a new listed flexible gas connector.**

CHECKING FOR NATURAL GAS ODOR

11. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION

- **CVA shall be evaluated for open combustion natural gas heating systems and water heaters (cooking appliances and clothes dryers are *excluded*).**
- **CVA shall comply with these guidelines and Appendix A, unless superseded by manufacturer's instructions or local code.**
- **Appliances Drawing *Outdoor* Air through Combustion-Air Openings or Ducts**
  - **An *upper* opening or duct shall be located within 12" of the enclosure ceiling, <u>and</u> a *lower* opening or duct shall be located within 12" of the floor.**
    <u>*Exception*</u>: Pre-existing upper openings and ducts are acceptable at any height above the draft hood.
  - **Combustion air openings and vertical ducts shall each provide 1 sq. in. net free venting area (NFVA) per 4,000 Btu/hr of input.**
  - **Horizontal ducts shall each provide 1 sq. in. NFVA per 2,000 Btu/hr of input.**
  - **Combustion air may also be obtained through a single <u>upper</u> vent or duct to outdoors under the following conditions:**
    - **Vent NFVA is at least: (a) 1 sq. in. per 3,000 Btu/hr input, and (b) not less than the sum of the cross-sectional areas of all vent connectors in the space.**
    - **Equipment has clearances of at least 1" sides and back, and 6" in front.**



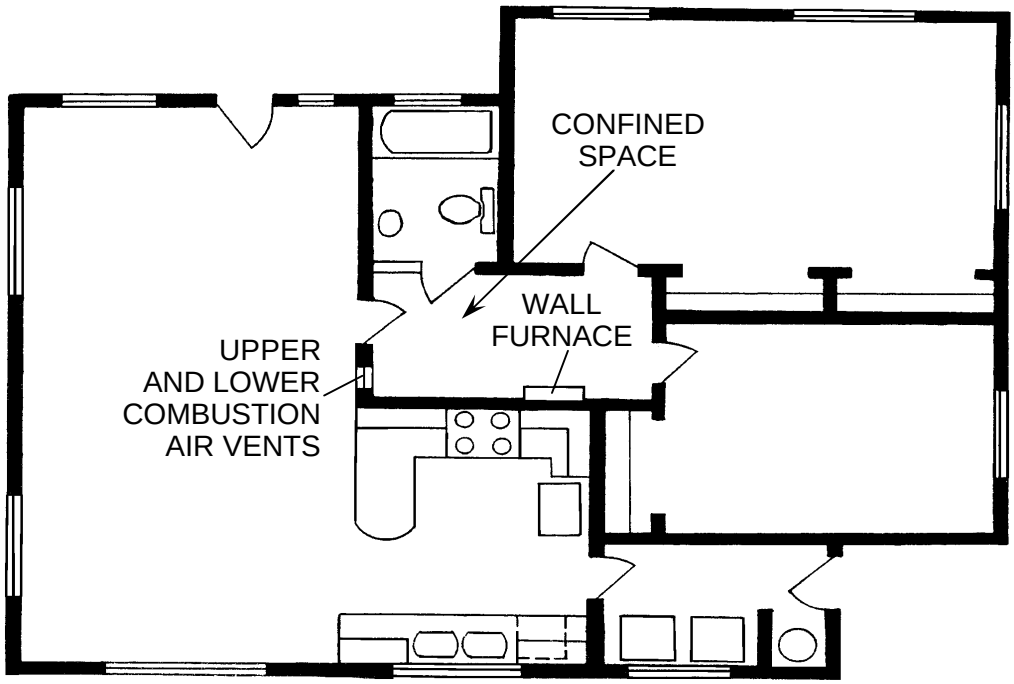
11. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

- **When Appliance s Draw Combustion Air from Outdoors**
  - **Combustion air may be obtained from outdoors by means of:**
    - **Permanent openings (undampered vents) of the required size directly to outdoors through enclosure floor, roof or walls; or**
    - **Continuous vertical or horizontal ducts of the required cross-sectional area extending from the enclosure to outdoors.**
  - **Combustion air may be obtained from the attic, provided:**
    - **Attic vents are not subject to ice or snow blockage.**
    - **The attic vertical clear height is at least 30" at the peak (from top of ceiling joists to bottom of rafters/ridge board).**
    - **Attic ventilation is sufficient to provide the required volume of combustion air.**
  - **Combustion air may be obtained from under the floor, provided:**
    - **Under-floor spaces have free flow of air.**
    - **Unobstructed openings to outdoors exist that are at least twice the NFVA of the required combustion air vent openings.**
- **Combustion-Air Ducts and Sleeves**
  - **Duct or sleeve into attic shall extend from appliance enclosure to at least 6" above the top of insulation.**
  - **Ducts and sleeves shall be a minimum of 26 gage galvanized steel or 24 gage aluminum, and ducts shall have a minimum cross-sectional dimension of 3".**
- **Louvers, Grilles, and Screens**
  - **Covering of 1/4" corrosion-resistant screen mesh is required on combustion air openings to outdoors, *except* ducts terminating in an attic, which shall not be screened on either end.**
  - **Blocking effects of louvers, grilles, and screens shall be considered when calculating NFVA of an opening (see Appendix A).**

SOURCES OF COMBUSTION AIR		
OUTDOORS	**ATTIC**	**UNDER FLOOR**
• Permanent openings with undampered vents or continuous ducts (vertical or horizontal). • Vent directly to outdoors. • 1/4" screen mesh on all CVA openings.	• Minimum 30" attic height at the peak. • Adequate attic ventilation that is unobstructed. • Duct/sleeve extending 6" above top of ceiling joists and insulation.	• Free flow of air. • Unobstructed openings to outdoors with at least twice the area of required combustion air vent NFVA.

11. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

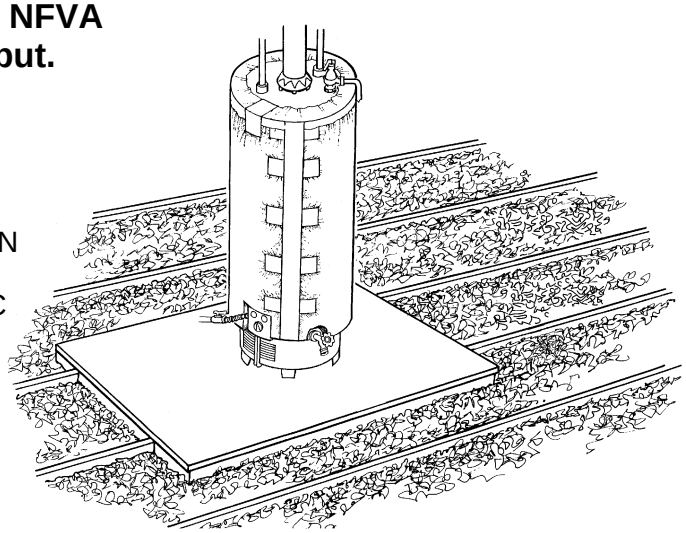
- **When Appliances Draw Combustion Air from <u>Indoors</u>**
  - **<u>Unconfined</u> Space:**
    - **A room/space that has a volume of at least 50 cu. ft. per 1,000 Btu/hr total input rating of the open combustion furnace and/or water heater in that room/space.**
    - **Combustion air <u>is</u> considered adequate.**
  - **<u>Confined</u> Space:**
    - **A room/space that has a volume of <u>less than</u> 50 cu. ft. per 1,000 Btu/hr total input of the open combustion furnace and/or water heater in that room/space.**
    - **Combustion air is <u>not</u> adequate.**
    - **Proper vent openings to adjacent space(s) must be present.**
- **Appliances Located in an Indoor <u>Confined</u> Space**
  - **Upper <u>and</u> lower vent openings shall be present which: (a) freely communicate with other indoor rooms/spaces, and (b) provide a combined volume of at least 50 cu. ft. per 1,000 Btu/hr total input.**
  - **The vent openings shall meet the following requirements:**
    - **<u>Each</u> vent opening shall provide 1 sq. in. of NFVA per 1,000 Btu/hr input, <u>and</u> shall be no smaller than 100 sq. in. NFVA.**
    - **Lower vents shall be located within 12" of the floor, and upper vents shall be located within 12" of the ceiling.**
      ***<u>Exception</u>*: Pre-existing upper vents are acceptable at any height above the draft hood.**



11. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

- **Appliances Located in a Garage**
  - **When a garage (finished or unfinished) is an unconfined space, combustion air is considered adequate.**
  - **When a converted (finished) garage is a confined space used as conditioned living space:**
    - **Appliance(s) shall be isolated from the conditioned space by an enclosure vented to outdoors (as specified on page 29-15).**
    - **The garage shall not be vented into the main body of the house to obtain additional indoor combustion air.**
  - **When a garage is a confined space that is (a) unfinished or (b) finished and unconditioned (not living space), upper and/or lower permanent venting to outdoors shall provide at least 1 sq. in. NFVA per 4,000 Btu/hr total input.**
- **Appliances Located in a Crawlspace or Partial Basement**
  - **When the underfloor area (crawlspace or crawlspace plus partial basement) is an unconfined space, combustion air is adequate.**
  - **When the underfloor area is a confined space:**
    - **The under-floor space shall have free flow of air.**
    - **Unobstructed openings to outdoors shall provide at least twice the NFVA of the required combustion air vent openings.**
- **Appliances Located in an Attic**
  - **When attic is unconfined space, combustion air is adequate.**
  - **When attic is a confined space:**
    - **Upper and/or lower permanent attic venting shall be present on two sides/ends of the attic, and**
    - **Venting on each side/end shall provide at least 1 sq. in. NFVA per 4,000 Btu/hr total input.**

OPEN COMBUSTION WATER HEATER LOCATED IN ATTIC



12. FLUE AND VENT SYSTEM EXAMINATION

- All gas vents shall terminate outdoors.
- Flue and vent systems shall be free of:
  - Draft hood defects:
    - Improperly installed or positioned.
    - Multiple (stacked) draft hoods on a single appliance.
    - Missing (no draft hood at all).
  - Disconnections or unsafe joints (e.g., loose, unsecured, etc.).
  - Holes or other hazardous conditions requiring repair.
  - Connection to a solid-fuel appliance chimney.
- Gas vents located 4' or more from a vertical wall or similar obstruction shall:
  - Extend at least 1' above the roof.
  - Comply with Table 29-1.
- Gas vents located less than 4' from a vertical wall or similar obstruction shall terminate at least:
  - 2' above the highest point where they pass through the roof, and
  - 2' higher than any portion of the building within 10'.

Table 29-1: Vent Termination Above a Roof

MINIMUM HEIGHT FROM ROOF TO LOWEST DISCHARGE OPENING	
ROOF SLOPE*	HEIGHT ABOVE ROOF
Flat to 6/12	1' – 0"
Over 6/12 to 7/12	1' – 3"
Over 7/12 to 8/12	1' – 6"
Over 8/12 to 9/12	2' – 0"
Over 9/12 to 10/12	2' – 6"
Over 10/12 to 11/12	4' – 0"
Over 11/12 to 12/12	5' – 0"

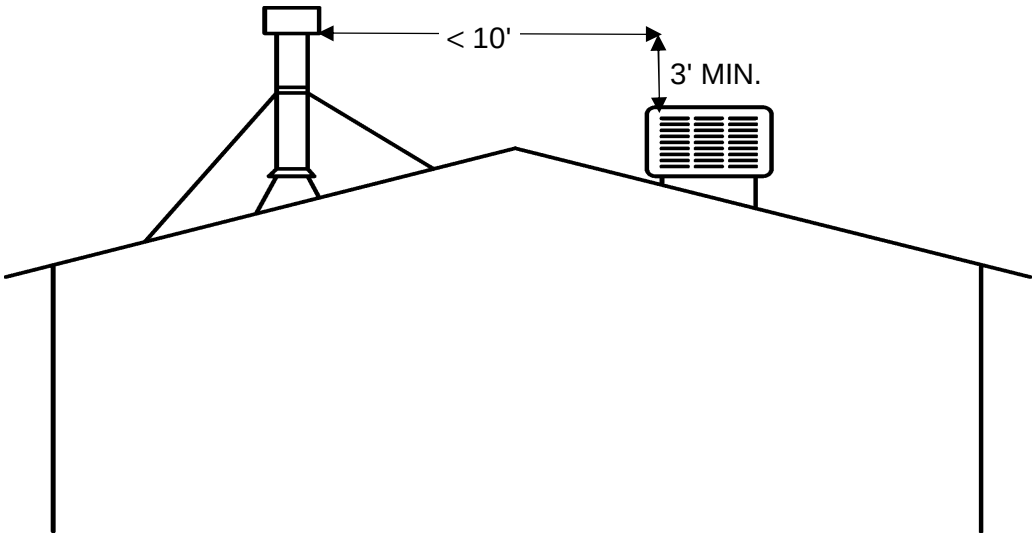
***For other slopes, see CMC Chapter 8.**

12. FLUE AND VENT SYSTEM EXAMINATION (continued)

- **Gas vents shall terminate no closer to a door, openable window, or gravity air inlet than the following minimum distances:**
  - **4' below, or**
  - **4' horizontally from, or**
  - **1' above.**

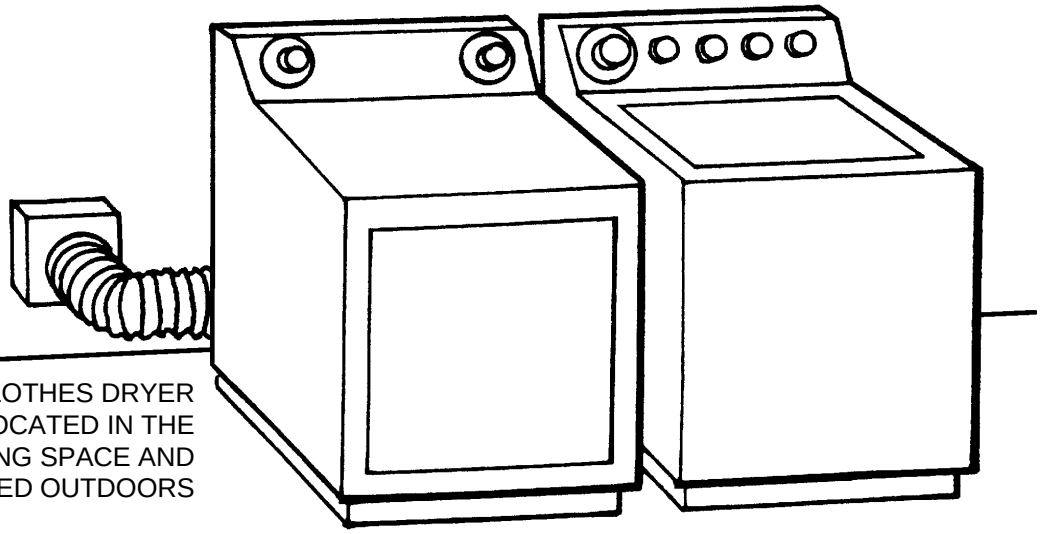
  ***Exception 1*: Vent terminals for Direct Vent furnaces:**
    - **At least 9" away for inputs up to 50,000 Btu/hr.**
    - **At least 12" away for inputs 50,100 to 65,000 Btu/hr.**

  ***Exception 2:* Vent terminals for Forced or Induced Draft systems (e.g., induced draft space/water heater or condensing furnace):**
    - **At least 12" away.**
- **Outdoor Water Heater Vents**
  - **When an outdoor water heater is located within 4' of a first-floor wall, the vent pipe must terminate at least 1' above the first-floor roof.**
    - **The pipe may be offset from the roof overhang.**
    - **Offsets shall not exceed 45°, except one 60° offset is allowed.**
- **Flue and Vent Systems Terminating Near an Evaporative Cooler**
  - **A water heater flue/vent pipe located within 10' of an evaporative cooler shall terminate at least 3' above the cooler intake.**
  - **Furnace flue/vent pipes within 10' of an evaporative cooler shall terminate at least 3' above the cooler intake unless:**
    - **All cooler discharge openings are equipped with a vent cover.**
    - **The client is informed of the non-conforming flue/vent and advised to keep cover(s) in place during the heating season.**



13. VISUAL APPLIANCE CHECKS

- **Inoperable Gas Appliances**
  - **Inoperable natural gas appliances must be checked by a utility gas service technician (or designee), *unless* they are: (a) abandoned*, or (b) inaccessible*.**
- **The following conditions are <u>not</u> acceptable when Infiltration Reduction Measures are installed:**
  - **<u>Gas clothes dryer</u> located in the living space but <u>not</u> exhausted outdoors.**
  - **<u>Return leak</u> present that can draw in combustion products from the FAU or other open combustion appliances (e.g., in a garage or room containing supply or return plenum/ductwork).**
  - **<u>Whole house fan</u> vented into an attic that contains a gas water heater or an open combustion furnace with standing pilot.**
  - **<u>Unvented combustion space heater</u> (e.g., gas or kerosene unit) present in the living space.**
  - **<u>Open combustion water heater</u> present in a sleeping area.**
  - **<u>Gas range</u> present which has a <u>space heater or incinerator</u> that is <u>not</u> properly vented outdoors.**

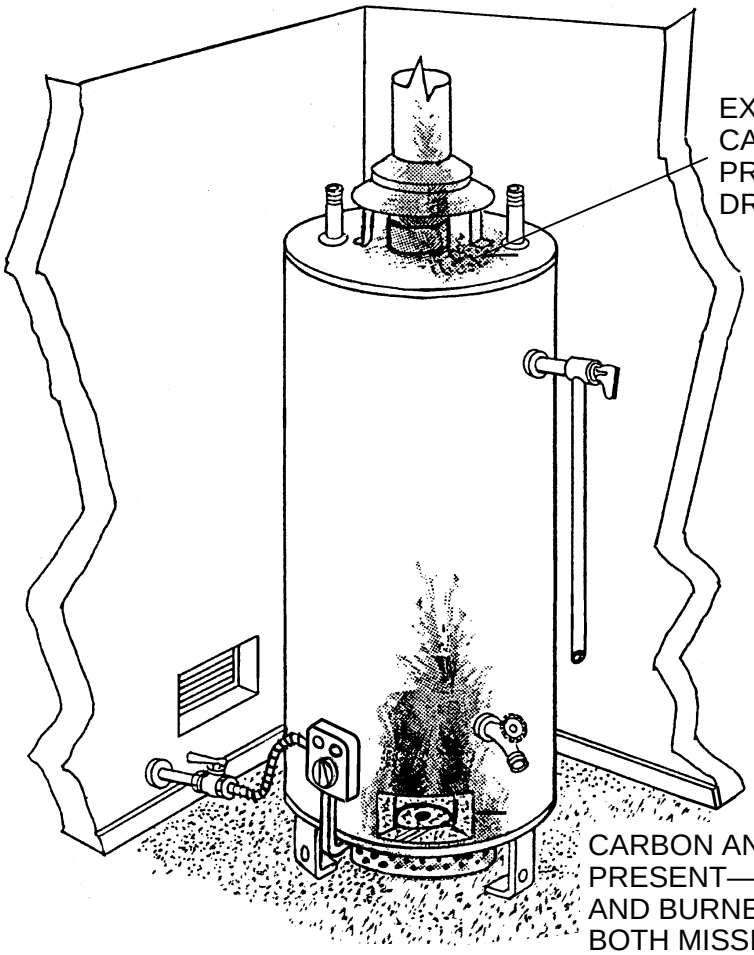


GAS CLOTHES DRYER LOCATED IN THE LIVING SPACE AND VENTED OUTDOORS

***See Definitions**

13. VISUAL APPLIANCE CHECKS (continued)

- **Appliance Components**
  - **The following appliance components shall be present:**
    - **Appliance door(s).**
    - **Combustion chamber access door(s).**
  - **Water heater shall have at least one access cover or roll-out shield.**
  - **Roll-out shield required on furnace when the unit was manufactured with a roll-out shield.**
- **Carbon and Rust**
  - **The top of the burner(s), the heat exchanger, draft hood and flue/vent pipe shall be examined for excessive amounts of carbon or rust.**

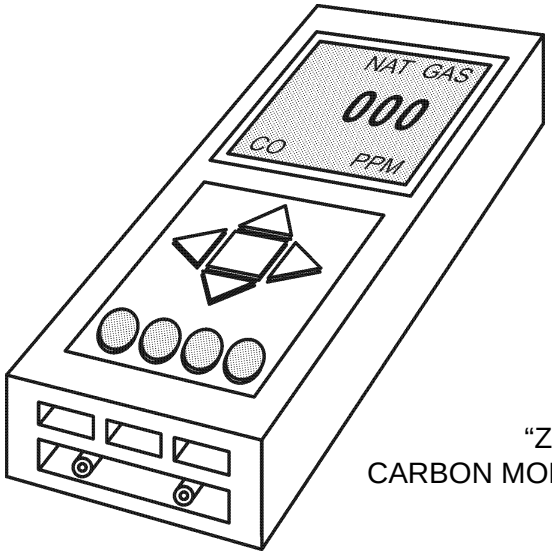


14. TEST CONDITIONS FOR ***ROOM*** AMBIENT CO TEST

- **Test shall be performed *prior* to operating any appliances.**
- **Test Conditions**
  - **All gas appliances in the living space turned off (e.g., at the thermostat).**
    ***Exception*: Water heater pilot may be operating, but main burner shall not be operating.**
  - **Air handler and all exhaust fans and air-exhausting devices turned off.**
  - **Exterior doors and windows closed.**
  - **Interior doors:**
    - **All interior room doors open.**
    - **Appliance enclosure doors closed.**
  - **Fireplace damper closed when feasible (no fire or hot coals).**
  - **If an interior cooler cover is available, it shall be in place.**

15. CO ANALYZER "ZEROING"

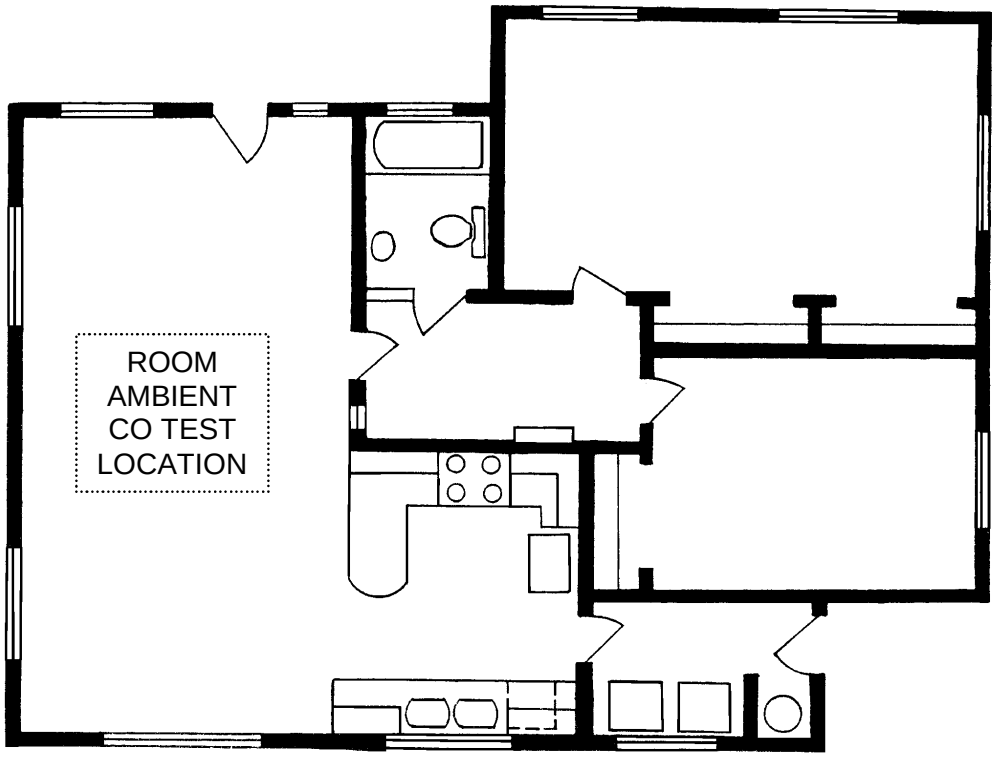
- **Just prior to performing *Room Ambient CO Test*, the analyzer shall be adjusted outdoors to read zero ppm CO.**
- **CO analyzer shall be protected from outdoor sources of CO and from wind bearing pollutants.**
- **Analyzer shall remain on during entire ambient test sequence when possible.**
- **If turned off during ambient testing, zeroing process shall be repeated before resuming tests.**



"ZEROED"
CARBON MONOXIDE ANALYZER

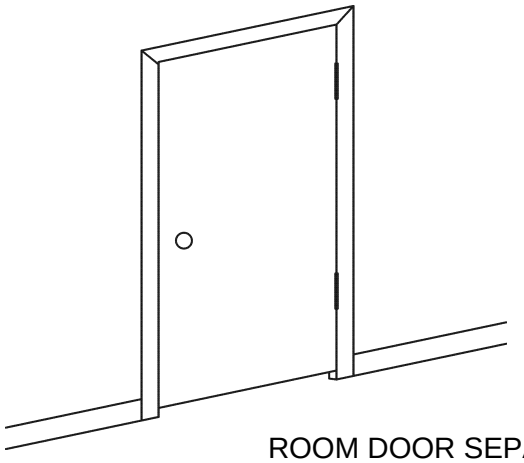
16. CONDUCTING ROOM AMBIENT CO TEST

- **Room Ambient CO Test shall be conducted immediately after zeroing the CO analyzer:**
  - **In an open area in the main body of the living space (e.g., in the center of the living room or living/dining combination area).**
  - **10' away from combustion appliances and supply registers (less than 10' away acceptable in smaller rooms).**
  - **6' above the floor.**
- **If Room Ambient CO Test measurement is 10 ppm or greater:**
  - **The living space shall be ventilated and the test repeated when a condition such as the following exists:**
    - **Heavy smokers are present, or**
    - **Wood-burning or unvented heating/cooking appliances were operating within the preceding half hour.**
  - **Appliance Ambient CO Tests shall be conducted even if CO is 10 ppm or greater after ventilation and repeat of the Room Ambient CO Test.**



17. TEST CONDITIONS FOR APPLIANCE-ON CO AND DRAFT TESTS

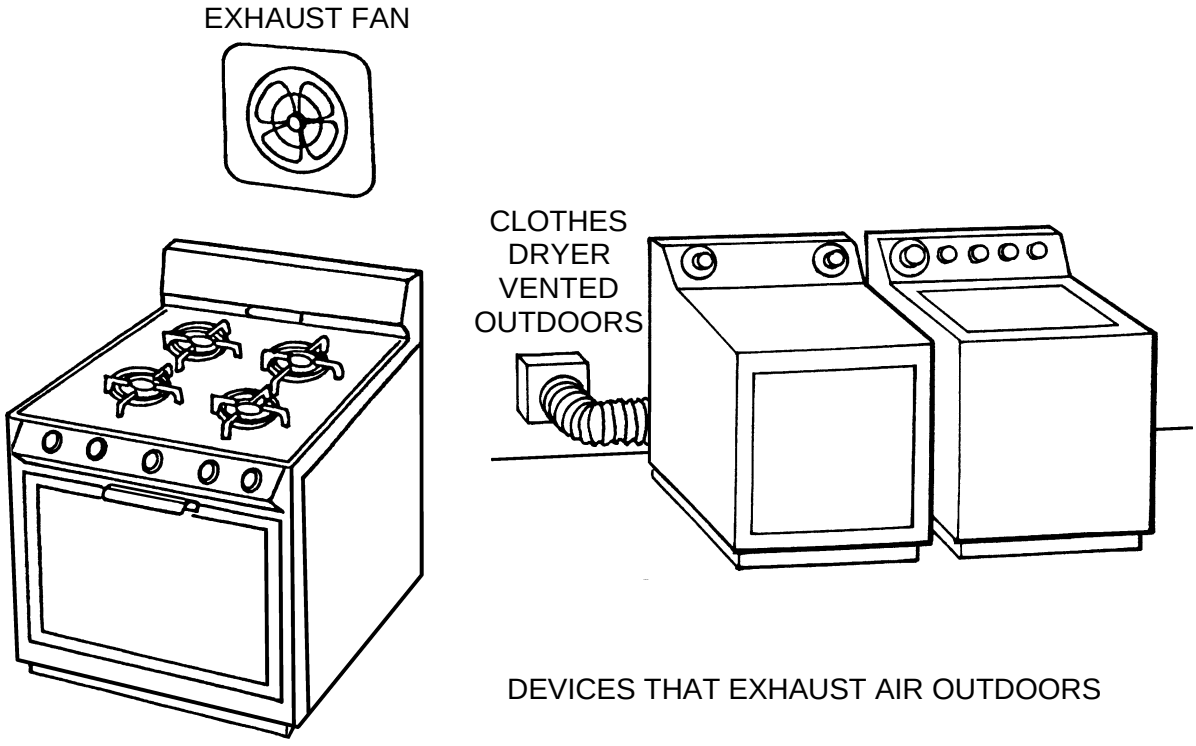
- **The following test conditions shall be established for Appliance Ambient CO Tests and Draft Tests.**
- **Door/Window Positions for Tests in the Living Space**
  - **The following shall be closed:**
    - **All exterior doors and windows.**
    - **Doors to rooms containing a supply register when a central return is outside the room.**
    - **Appliance enclosure doors (except during tests).**
  - **The following shall be open:**
    - **Doors to all other living areas and rooms.**
    - **Door to utility room with clothes dryer exhausted outdoors. Exception: When a natural draft appliance in that room is tested, the door shall be closed.**
- **Door/Window Positions for Tests in an Unconditioned Garage**
  - **Drive-through door and windows shall remain closed during all tests.**
  - **Door into the living space shall be opened when exhaust devices are in the living space or an FAU is present.**
  - **All exhaust devices in the living space and the garage shall be operating.**
- **Appliances Located in Attic and Crawl-space**
  - **Devices exhausting into the attic/crawlspace shall be off during Draft Tests on appliances in those locations.**



ROOM DOOR SEPARATING
SUPPLY REGISTERS
FROM A CENTRAL RETURN

17. TEST CONDITIONS FOR APPLIANCE-ON CO AND DRAFT TESTS (continued)

- **The following must be operating during tests:**
  - **FAU air handler.**
  - **All devices that exhaust air from the space containing an appliance being tested:**
    - **Include kitchen exhaust fans, bathroom and utility room fans, clothes dryer, central vacuum system, and manually-controlled attic ventilators.**
    - **Exclude whole house fan.**
- **FAU air filter(s) must be clean or shall be removed prior to testing.**
- **Clothes dryer lint screen shall be clean.**
- **Supply registers shall be open.**
  Exception: **Supply register(s) shall be closed when located in a utility room or basement containing a natural draft appliance.**
- **If an interior cooler cover is available, it shall be in place.**



DEVICES THAT EXHAUST AIR OUTDOORS

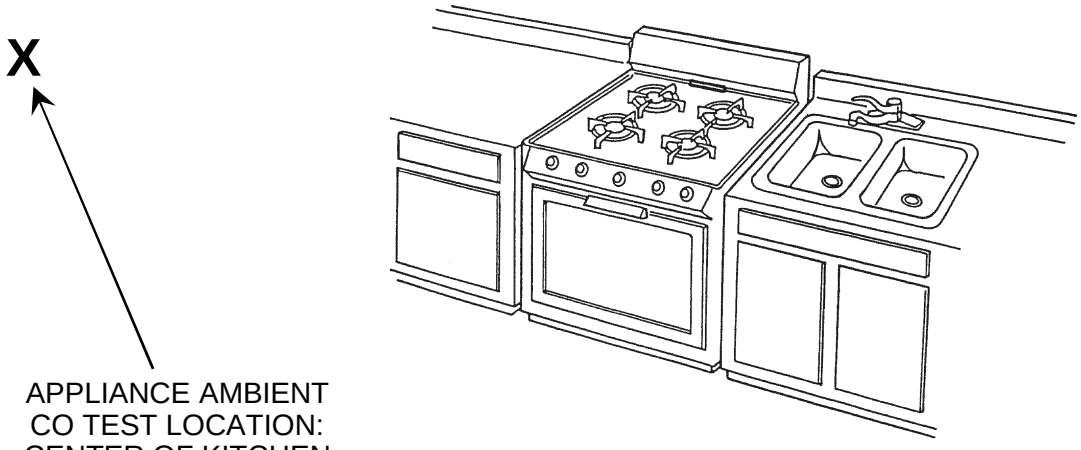
18. TEST PROCEDURES FOR APPLIANCE AMBIENT CO TEST

- Test conditions shall be established as prescribed in Item 17.
- Natural Gas Heating Appliances
  - Heating appliance shall be operated for a minimum of 5 minutes.
  - All other gas appliances shall remain off.
    Exception: Water heater pilot may be operating, but main burner shall not be operating.
  - CO shall be measured in the following locations:
    - Ducted units: In the supply register nearest the furnace.
    - Heaters without ducts (direct vent, wall and floor furnaces, and free-standing heaters): In the atmosphere directly above the top of the unit.
  - The heating system shall be checked by a utility gas service technician (or designee) if Appliance Ambient CO Test CO ppm is:
    - Higher than Room Ambient CO Test CO ppm, or
    - Above 9 ppm.
- Natural Gas Water Heater
  - Storage water heater shall be operated for a minimum of 5 minutes.
  - Tankless water heaters shall be operated for a minimum of 1 minute.
  - All other gas appliances shall remain off.
  - CO shall be measured in the atmosphere directly above the top of the water heater (and draft hood or inducer, if applicable).
  - The water heater shall be checked by a utility gas service technician (or designee) if Appliance Ambient CO Test CO exceeds 9 ppm.
- Natural Gas Log
  - An exhaust/flue CO test shall be conducted per Item 20.
- Natural Gas Clothes Dryer
  - No CO test required.

APPLIANCE AMBIENT CO TEST CO ANALYZER PROBE LOCATIONS FOR HEATING APPLIANCES AND WATER HEATERS
• DUCTED UNITS: INSIDE SUPPLY REGISTER NEAREST THE FAU WITH TEST PROBE DIRECTED INTO THE AIR FLOW.
• NON-DUCTED HEATERS: IN THE ATMOSPHERE ABOVE THE UNIT.
• WATER HEATERS: IN THE ATMOSPHERE ABOVE THE UNIT AND DRAFT HOOD.

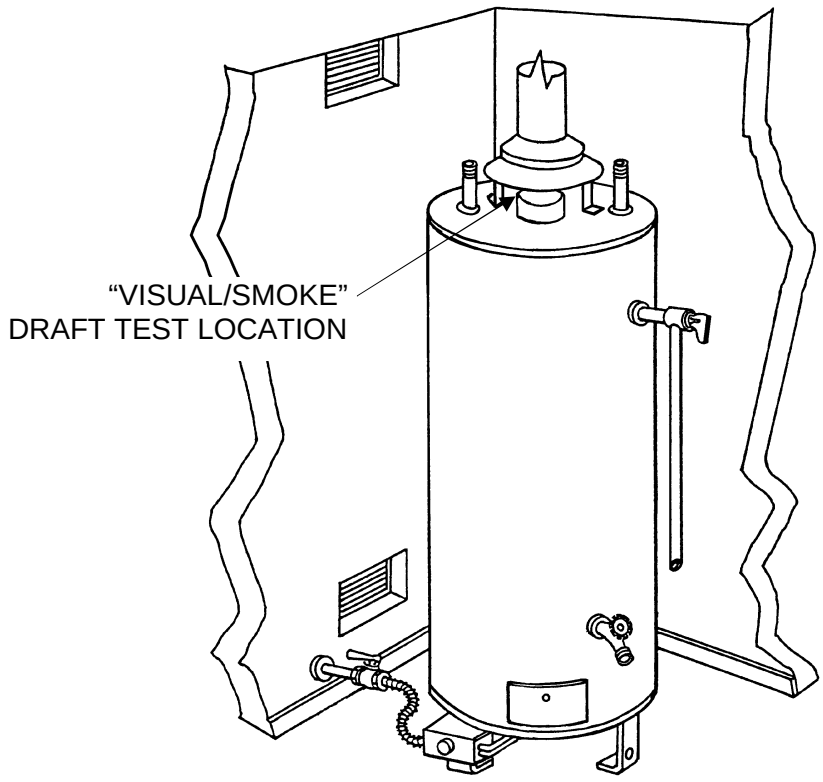
18. TEST PROCEDURES FOR APPLIANCE AMBIENT CO TEST (continued)

- **Natural Gas Kitchen Appliances**
  - **All other gas appliances shall remain off.**
    ***Exception*: Water heater pilot may be operating, but main burner shall not be operating.**
  - **Cooktop:**
    - **With ovens and broilers off, all cooktop burners, and griddle if present, shall be operated on highest setting for one minute.**
    - **CO shall be measured in the center of the kitchen.**
  - **Oven and Broiler Units:**
    - **With cooktop off, each oven shall be operated on highest setting (i.e., "Broil" when applicable) for a minimum or 5 minutes (with separate broiler burner off).**
    - **When a separate broiler burner is present, it shall be operated on highest setting for 5 minutes (with oven burner off).**
    - **CO shall be measured in the center of the kitchen for oven and separate broiler, when present.**
  - **Range with Space Heater or Incinerator**
    - **Heater/incinerator shall be operated for a minimum of 5 minutes on highest burner setting.**
    - **Unit shall be tested prior to operating oven/broiler or at least 15 minutes after oven/broiler has been turned off.**
    - **CO shall be measured in the atmosphere directly above the top of the unit.**
  - **CO Action Level**
    - **The appliance shall be checked by a utility gas service technician (or designee) if Appliance Ambient CO Test CO exceeds 9 ppm.**



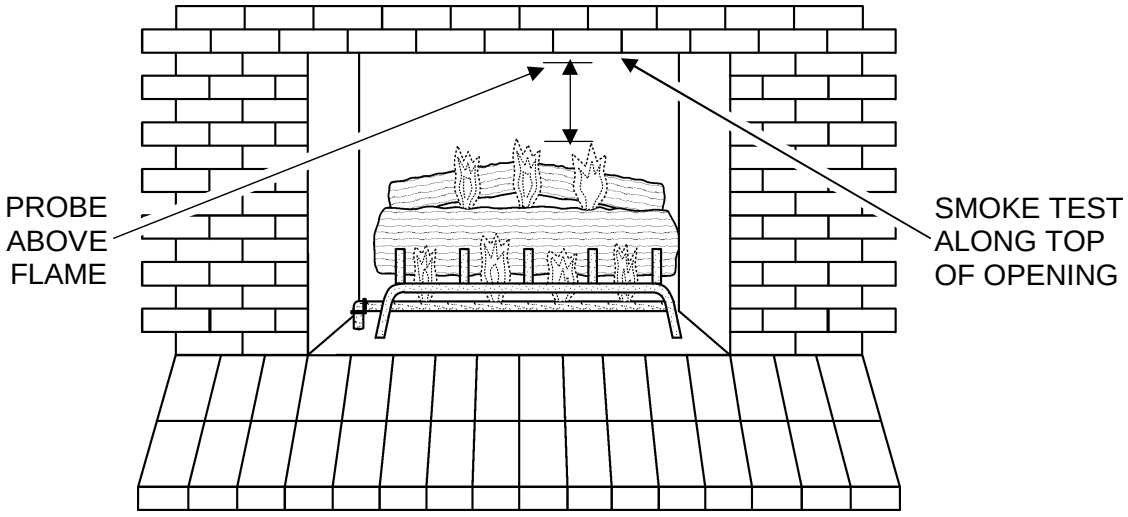
19. DRAFT EXAMINATION

- **Natural Gas Open Combustion Natural Draft Appliances**
  - **Draft tests shall be performed after a minimum of 5 minutes of appliance operation.**
  - **Visual/Smoke Draft Test shall be performed on Natural Draft appliances, including ovens vented outdoors.**
    - **Smoke shall be applied along the entire draft hood opening.**
    - **Draft is adequate <u>only if</u> smoke is drawn into the draft hood along the entire draft hood opening.**
- **Gas Logs**
  - **Visual/Smoke Draft Test shall be performed as prescribed in Item 20.**
- **All Units**
  - **Corrective action is required when Draft not adequate.**



20. CO AND DRAFT TESTING FOR NATURAL GAS LOGS

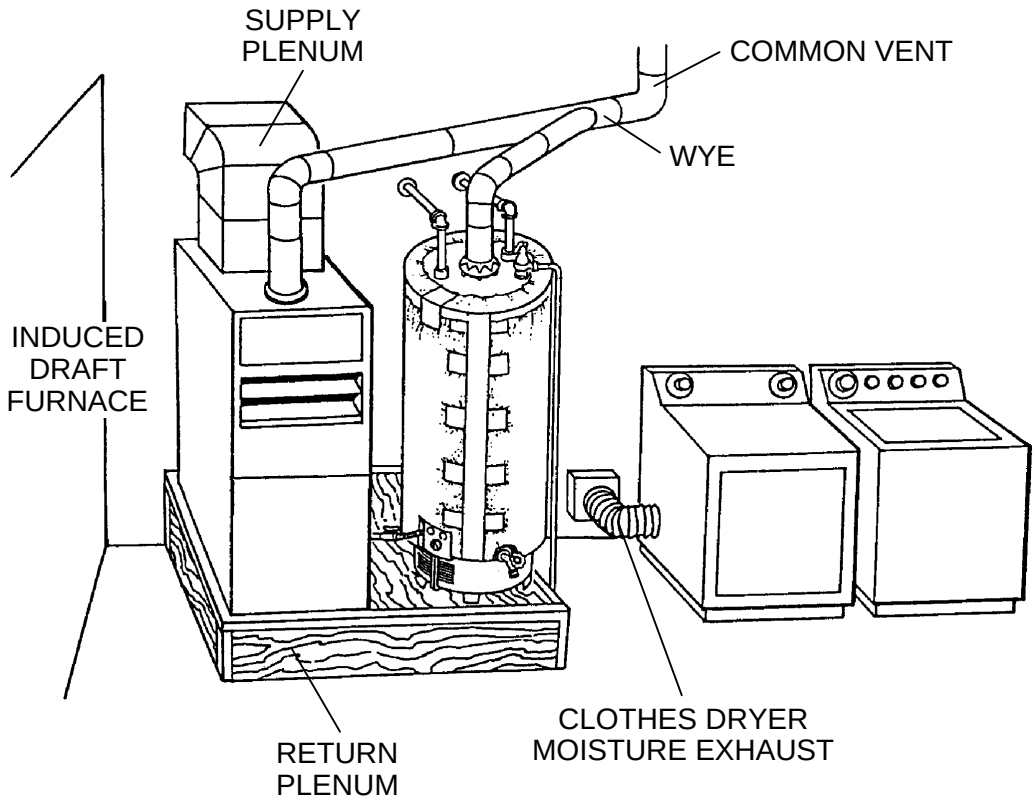
- **When gas log is the primary heat source:**
  - **Damper must be blocked partially open (e.g., with a damper clip).**
  - **Opening shall be sufficient to prevent spillage of combustion products into the room.**
- **Fireplace glass doors shall be open during tests.**
- **Exhaust/Flue CO Test**
  - **Gas burner shall be operated for a minimum of 5 minutes before checking CO.**
  - **CO shall be sampled just inside the fireplace opening at least 12" above the flame.**
  - **If CO exceeds action level after 5 minutes, warm up time shall be increased (up to 30 minutes) and unit shall be retested.**
  - **Service by a utility gas service technician (or designee) is required if CO exceeds action level.**
- **CO Action Level***
  - **As established by the utility.**
- **Visual/Smoke Draft Test**
  - **Smoke shall be applied along the top of the fireplace opening.**
  - **Draft is adequate only if smoke is drawn inward along the entire fireplace opening.**



***The CPUC is currently considering a proposed settlement that would set statewide flue testing CO thresholds. This section will be updated when the commission has acted upon the proposed settlement.**

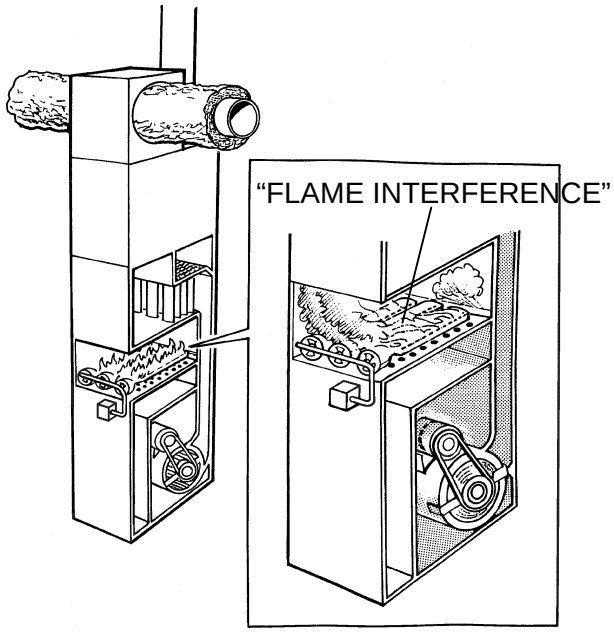
21. MULTIPLE APPLIANCES SHARING A COMMON VENT

- **Draft Tests**
  - **All commonly-vented natural gas appliances shall be operating simultaneously during Draft tests.**



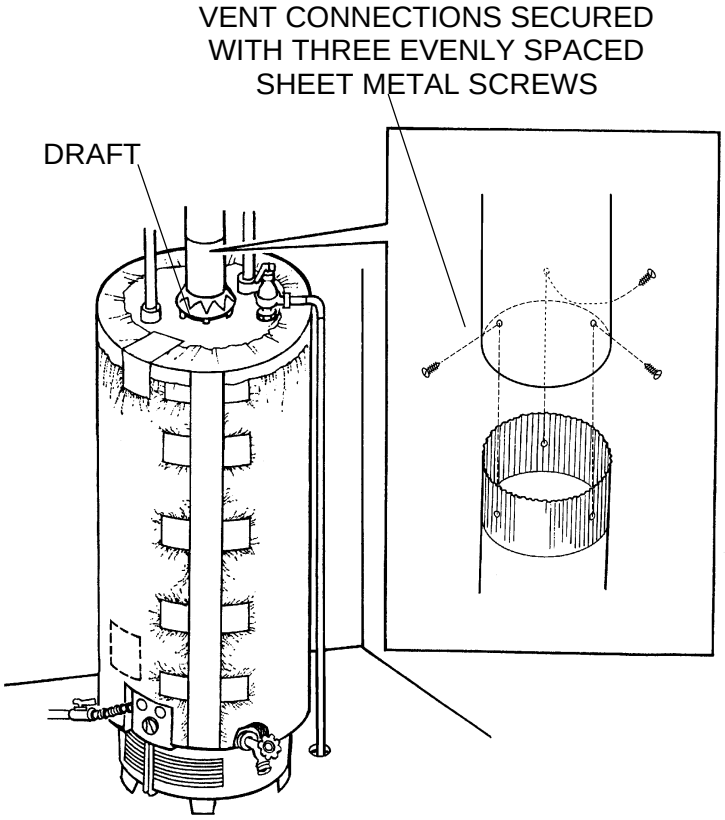
22. ADDITIONAL APPLIANCE EXAMINATIONS

- **Burner Performance**
  - **When the burner(s) ignite, checks shall be made for:**
    - **Delayed ignition.**
    - **Excessive roll-out.**
  - **Burner(s) shall be examined for flame abnormalities, including:**
    - **Large yellow flame (more than 50% yellow).**
    - **Soft lazy flame or smothering flame.**
- **Heat Exchanger Examination on Natural Gas Forced Air Heating Systems**
  - **Each accessible heat exchanger shall be inspected for cracks with a mirror and strong light.**
  - **The unit shall be further examined/serviced by a utility gas service technician (or designee) if any of the following conditions is present:**
    - **Flame interference caused by the air handler in an FAU.**
    - **A visually-detected crack.**
    - **Other evidence of a defective heat exchanger.**
  - **If a defect exists, the condition shall be corrected by a utility gas service technician (or designee), or designated contractor licensed to repair HVAC appliances.**



23. FLUE AND VENT SYSTEM REPAIR

- **Draft Hoods**
  - **The following conditions must be corrected:**
    - **Improperly installed or positioned draft hood.**
    - **Multiple (stacked) draft hoods on a single appliance.**
    - **No draft hood present where one is required.**
- **Repairing Flue and Vent Systems**
  - **New components shall conform to applicable codes.**
  - **All single-wall flue and vent pipe joints and connections shall be secured with 3 sheet metal screws (spaced as evenly as possible) where:**
    - **New components are installed.**
    - **Existing connections are loose and unsafe.**
  - **Double-wall Class B and BW flue and vent pipes shall <u>not</u> be drilled or have screws installed <u>if</u> doing so is prohibited by the pipe manufacturer or local code.**



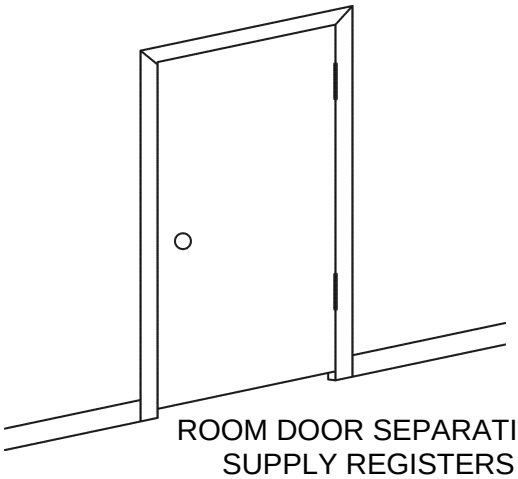
PART 5: POST-REPAIR/REPLACEMENT CHECKS

24. QUALITY ASSURANCE TESTING

- **Natural gas appliances that have been repaired or replaced shall be checked for proper operation, which includes:**
  - **No gas leaks (Item 26)**
  - **Adequate Draft (Item 27)**
  - **Acceptable level of Carbon Monoxide (Item 28).**
- **Problems identified during post-repair/replacement checks must be corrected.**

25. TEST CONDITIONS FOR POST-REPAIR/REPLACEMENT CO AND DRAFT TESTING

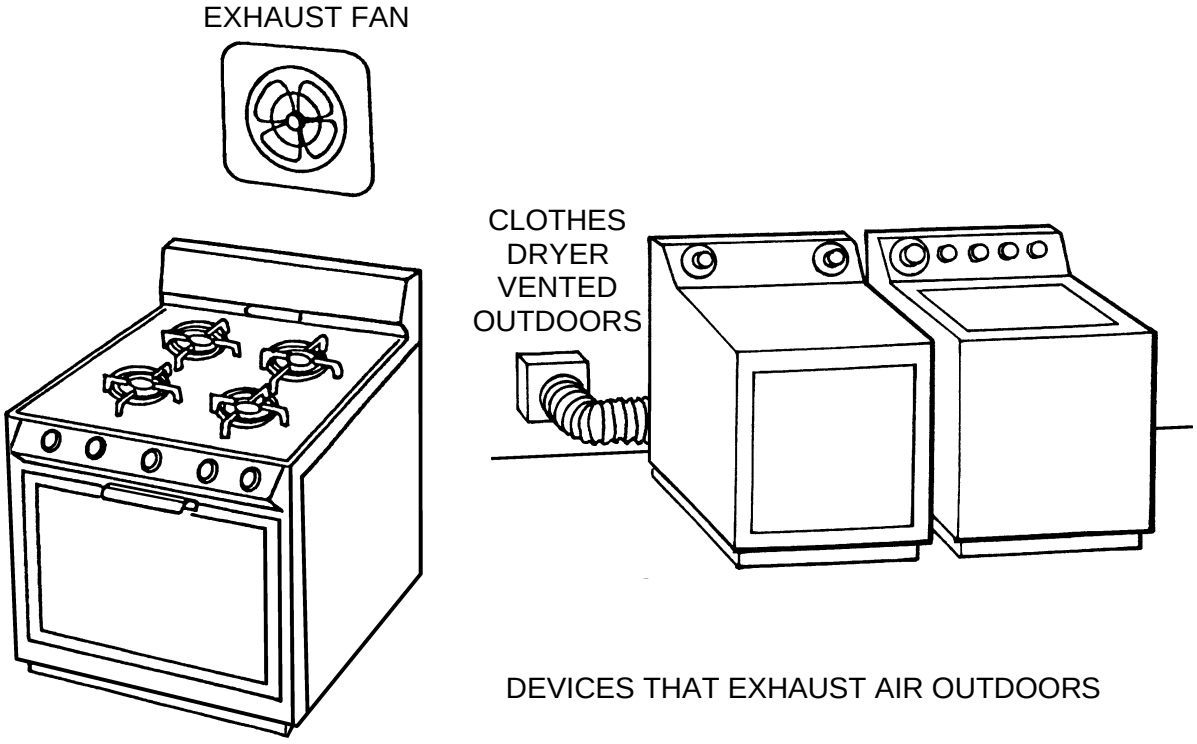
- **Door/Window Positions for Tests in the Living Space**
  - **The following shall be closed:**
    - **All exterior doors and windows.**
    - **Doors to rooms containing a supply register when a central return is outside the room.**
    - **Appliance enclosure doors (except during tests).**
  - **The following shall be open:**
    - **Doors to all other living areas and rooms.**
    - **Door to utility room with clothes dryer exhausted outdoors. *Exception:* When a natural draft appliance in that room is tested, the door shall be closed.**
- **Door/Window Positions for Tests in an Unconditioned Garage**
  - **Drive-through door and windows are closed during all tests.**
  - **Door into the living space shall be opened when exhaust devices are in the living space or an FAU is present.**
  - **All exhaust devices in the living space and the garage shall be operating.**



ROOM DOOR SEPARATING SUPPLY REGISTERS FROM A CENTRAL RETURN

25. TEST CONDITIONS FOR POST-REPAIR/REPLACEMENT CO AND DRAFT TESTING (continued)

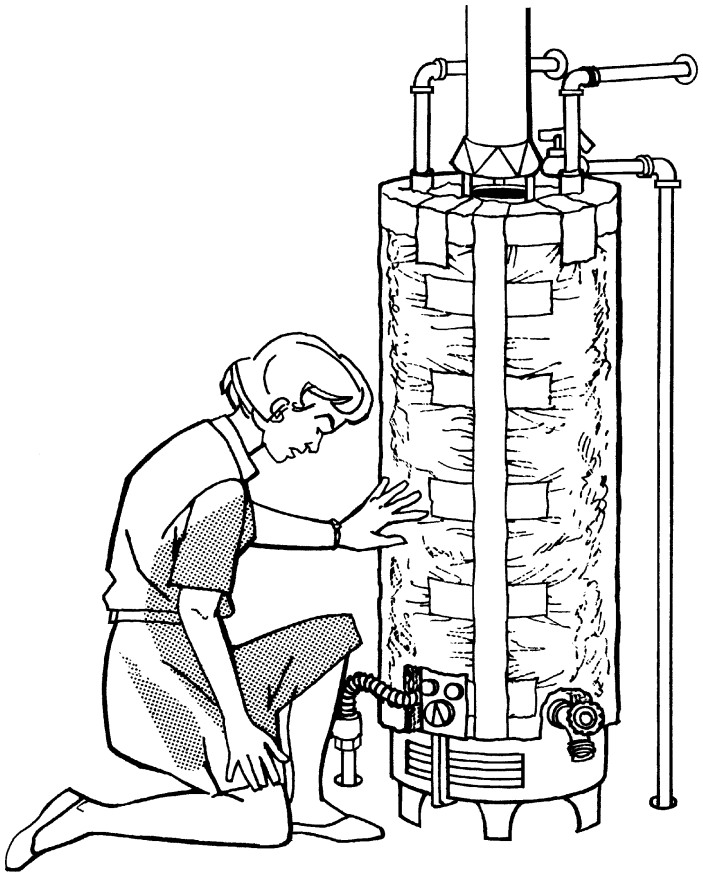
- **Appliances Located in Attic and Crawl-space**
  - **Devices exhausting into the attic/crawlspace shall be off during Draft Tests on appliances in those locations.**
- **The following must be operating during tests:**
  - **FAU air handler.**
  - **All devices that exhaust air from the space containing an appliance being tested (*exclude* whole house fan).**
- **FAU air filter(s) must be clean or shall be removed prior to testing.**
- **Supply registers shall be open.**
  Exception: **Supply register(s) shall be closed when located in a utility room or basement containing a natural draft appliance.**
- **If an interior cooler cover is available, it shall be in place.**



DEVICES THAT EXHAUST AIR OUTDOORS

26. GAS LEAKS

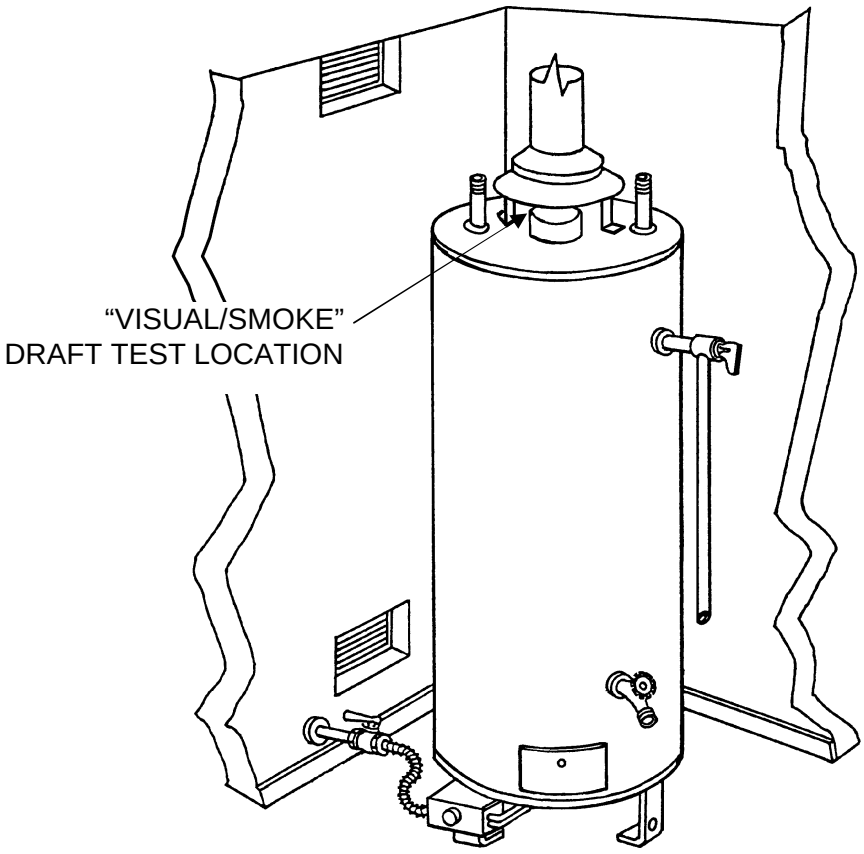
- **Repaired/replaced appliances shall be checked for natural gas leaks using one or more of the following methods:**
  - **Olfactory (Sniff) Test performed above, but within 2' of, all valves and fittings.**
  - **Application of leak detection liquid to line valves and to fittings on valves, flexible gas connectors, and pipes.**
  - **Air sampling with electronic leak detection equipment near valves, fittings, flexible gas connectors, and pipes.**
- **Gas leaks shall be repaired.**



CHECKING FOR NATURAL GAS ODOR

27. DRAFT EXAMINATION

- **Natural Gas Open Combustion Heating Systems and Water Heaters**
  - **Test conditions prescribed in Item 25 shall first be established.**
  - **Draft tests shall be performed after a minimum of 5 minutes of appliance operation.**
  - **Visual/Smoke Draft Test shall be performed on Natural Draft appliances.**
    - **Smoke shall be applied along the entire draft hood opening.**
    - **Draft is adequate <u>only if</u> smoke is drawn into the draft hood along the entire draft hood opening.**



28. CO TESTING FOR NATURAL GAS SPACE AND WATER HEATING SYSTEMS

- **Appliance Ambient CO or Flue CO testing shall be performed.**
- **Appliance Ambient CO Tests**
  - **CO Tests shall be conducted per Items 14 – 18.**
- **Flue CO Tests**
  - **Test conditions prescribed in Item 25 shall first be established.**
  - **CO Tests shall be performed after a minimum of 5 minutes of burner operation.**
  - **Flue Gas CO measurements shall be:**
    - **Taken in combustion gases free of dilution air.**
    - **Conducted in accordance with the Table 29-2.**

Table 29-2: Post-Repair/Replacement Flue CO Testing

APPLIANCE	MEASUREMENT LOCATION	MAXIMUM CO LEVEL
FURNACES		
• Natural Draft	Inside each flue (exhaust port) separately	*
• Induced Draft and Closed Combustion	At flue termination, when accessible from the ground	*
WATER HEATERS		
• Natural Draft	Inside center tube on each side of the baffle	*
• Induced Draft and Closed Combustion	At flue termination, when accessible from the ground	*

***The CPUC is currently considering a proposed settlement that would set statewide flue testing CO thresholds. This section will be updated when the commission has acted upon the proposed settlement. During the interim, the maximum allowable CO level following service or replacement shall be as established by the utility.**

NONFEASIBILITY CRITERIA FOR NGAT FOR ENTIRE DWELLING

1. **Non-IOU combustion fuel is used for space heating.**
2. **No infiltration-reduction measures are being installed.**
3. **No natural gas appliance affecting the living space is present.**

NONFEASIBILITY CRITERIA FOR NGAT FOR INDIVIDUAL APPLIANCE

1. **Non-IOU combustion fuel is used.**
   - **<u>Exception</u>: Appliances subject to PG&E-specific policy.**
2. **Appliance is abandoned*.**
3. **Appliance is inaccessible*.**

***See Definitions.**

NONFEASIBILITY CRITERIA FOR CAULKING

1. **The existing caulk is functional and performing properly, even if not installed in accordance with current Installation Standards.**

2. **Crack does not penetrate the building envelope.**

3. **Crack/gap too wide to be caulked (wider than 5/8") and must be repaired/patched.**

4. **Customer refuses.**

NONFEASIBILITY FOR WEATHERSTRIPPING DOORS

1. **The existing weatherstripping is functional and performing properly, even if not installed in accordance with current Installation Standards.**
2. **Door is located between two conditioned or two unconditioned spaces.**
3. **Door is in a multi-unit dwelling and separates the living space from a heated hallway.**
4. **Door is labeled to have a fire rating greater than 20 minutes.**
5. **Functional storm door is present.**
6. **Customer refuses.**

NONFEASIBILITY FOR WEATHERSTRIPPING APPLIANCE CLOSET DOORS

1. **Combustion appliance receives air from conditioned space (i.e. combustion air grilles present in the enclosure door or wall).**
2. **Inadequate combustion air (as defined in Appendix A) is being supplied to the appliance.**

NONFEASIBILITY CRITERIA FOR CEILING INSULATION

1. Already properly installed (see chart below):

CLIMATE ZONE	EXISTING INSULATION LEVEL
CEC Climate Zones 2 through 15	More than R-11
CEC Climate Zones 1 and 16	More than R-19

2. The roof is leaky or shows signs of water damage from leaks that have not been repaired.

3. Adequate venting is not present and cannot be installed per Attic Ventilation Standards (Section 4).

4. Hazardous electrical wiring or other hazardous conditions are present.

5. An enclosed cavity is present.

6. Exhaust vents terminating in the attic cannot be vented to the outside.

7. Disconnected or damaged space heating/cooling ducts are present and cannot be repaired.

8. Attic accessibility is inadequate:
- **An inspector can not gain safe physical access to all treated areas of the attic after insulation is installed.**
- **Clearance between top of ceiling joists and bottom of ridge board is less than 24 inches.**
- **Structural obstructions, such as cross members of truss systems, provide an opening of less than 18 inches.**
- **Access requires crawling over/under HVAC ducts, and clearance is less than 18 inches.**

9. The structure is unsound and will not support the weight of the insulation and installer, such as:
- **2" x 4" @ greater than 24" OC.**
- **Bowed and sagging joists.**
- **Fiberboard ceiling material.**
- **1/4" gypsum ceiling.**

NONFEASIBILITY CRITERIA FOR CEILING INSULATION (continued)

10. Knob-and-Tube (K&T) Wiring is present and:

- **<u>Functioning</u> knob-and-tube wiring cannot be certified safe by a C-10 contractor.**
- **<u>Abandoned</u> K&T wiring is present that cannot be disconnected and certified as abandoned and disconnected by a C-10 contractor.**
- **Insulation over K&T wiring (live or abandoned) is prohibited by local code.**

11. Customer refuses.

NONFEASIBILITY CRITERIA RELATING TO CATASHROPHIC DUCT LEAKS AND DISCONNECTIONS

1. The reconnection work would disturb asbestos or other hazardous material.

2. A combustion-related hazard exists with furnace or other fuel-burning appliance (e.g., excessive CO, cracked heat exchanger, backdrafting, etc.).

3. A health or safety hazard is present, such as sewage waste in the crawlspace, insect infestation, hazardous electrical wiring, or a structural hazard, etc.

4. Customer refuses.

NONFEASIBILITY CRITERIA FOR ATTIC VENTING

1. **The existing venting already meets Installation Standards.**
2. **Tiled hip roof without overhang, soffit, or accessible frieze blocks.**
3. **Ceiling insulation is nonfeasible.**
4. **Roof-mounted vents are the only option for adding venting, but the roof is tile, wood shingles, or in poor condition (e.g., more than three layers of roofing, roof unable to support additional vents).**
5. **Roof is a flat and/or built-up roof as defined in the installation standards.**
6. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR WATER HEATER INSULATION

All Water Heaters

1. **The existing blanket is functional and performing properly, even if not installed in accordance with current Installation Standards.**
2. **External insulation is prohibited by the manufacturer.**
3. **T&P relief valve, or gas shutoff valve, is not present, or is not located within 6" of the tank.**
4. **T&P valve outlet is plugged or capped.**
5. **Tank is exposed to weather.**
6. **Leak present in tank or water pipes.**
7. **Plastic pipe (e.g., CPVC) is present in the cold or hot water line to/from the tank.**
8. **Tank is located within 12" of a stove, range, or cooktop.**
9. **Tank capacity is greater than 100 gallons.**
10. **Customer refuses.**

Gas Water Heaters

1. **Perimeter clearances prior to blanket installation are less than 4" between tank and door and less than 1" on sides and back.**
2. ***Gas leak present.**
3. ***Vent pipe and/or draft hood are not properly installed, including:**
   - **No draft hood present.**
   - **Two draft hoods present.**
   - **Vent pipe defective or missing.**

***When these conditions exist, contact the designated utility personnel.**

NONFEASIBILITY CRITERIA FOR WATER HEATER INSULATION (continued)

4. ***Evidence of improper combustion and/or venting exists as characterized by:**
   - **Large accumulation of soot near draft hood or on floor underneath.**
   - **Scorching at draft hood or combustion chamber.**

5. **No gas shutoff valve present.**

6. ***Combustion air supply improper or inadequate as characterized by:**
   - **The absence of <u>both</u> low and high vents.**
   - **Vent size too small.**
   - **Room volume is inadequate.**
   - **Customer refuses modifications needed to create adequate combustion air supply.**

7. ***Both burner access doors missing.**

8. **Internal insulation is R-12 or greater.**

<u>Electric Water Heaters</u>

1. **Perimeter clearances prior to blanket installation are less than 1" on the front, sides and back.**

2. **Hazardous electrical wiring/conditions are present.**

3. **Thermostat cover plate(s) not present.**

4. **Internal insulation is R-16 or greater.**

***When these conditions exist, contact the designated utility personnel.**

NONFEASIBILITY CRITERIA FOR WATER HEATER PIPE INSULATION

1. **The existing pipe insulation is functional and performing properly, even if not installed in accordance with current Installation Standards.**

2. **An unsafe condition is present that causes tank insulation to be nonfeasible.**

3. **Water heater pipes are leaky.**

4. **Water heater pipes are exposed to the elements (especially sunlight, which can quickly degrade the insulation).**

5. **Less than 1 foot of continuous insulation can be installed.**

6. **Plastic piping (e.g. CPVC) is present in the cold or hot water tank lines.**

7. **Pipes are inaccessible, or the configuration prevents proper installation.**

8. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR COVER PLATE GASKETS

1. **Evidence of electrical malfunction or hazard, such as:**
   - **Electrical box not permanently attached.**
   - **Loose electrical connection.**
   - **Signs of burning or charring or other evidence of hazardous wiring condition.**

2. **Gaskets are already present, even if not installed in accordance with current Installation Standards.**

3. **Cover plate located on a wall between two conditioned or two unconditioned areas.**

4. **Cover plate located behind fragile furniture, heavy furniture, or major appliances too heavy to move.**

5. **Removal of the cover plate will damage the wall surface (paint, wallpaper, etc.).**

6. **Utility box is an odd size and standard gaskets will not work.**

7. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR ENERGY-SAVER SHOWERHEADS

1. **Showerarm and ball joint are not made from the same material.**

2. **Existing showerhead(s):**
   - **Have a flow rate less than or equal to 3.0 gpm.**
   - **Are required for medical reasons.**

3. **Existing showerarm:**
   - **Is made of plastic.**
   - **Is cracked, broken, or missing.**
   - **Requires removal.**

4. **Shower is not mechanically functional.**

5. **Standard metal adapters (i.e., American Standard®, Gerber®, and Price Pfister®) will not work.**

6. **Piping is in such poor condition that showerhead installation could cause plumbing problems.**

7. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR FAUCET AERATORS

1. **The aerator is functional and performing properly, even if not installed in accordance with current Installation Standards.**

2. **Faucet has special fitting for attaching appliance (e.g., portable dishwasher).**

3. **Faucet does not provide hot water.**

4. **The faucet or faucet threads are found to be damaged and/or leaky.**

5. **Removal of the existing aerator is likely to cause damage to the aerator or the faucet.**

6. **Standard aerators will not fit.**

7. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR WINDOW/WALL EVAPORATIVE COOLER INSTALLATION

1. **The existing cooler is operational.**
2. **Proper electrical service is not present.**
3. **Substandard wiring exists (e.g., ungrounded outlets, decayed insulation, or exposed wires).**
4. **No feasible window or wall location available.**
5. **Exterior clearance requirements cannot be met.**
6. **Egress requirements cannot be met.**
7. **Wood windows are decayed or deteriorated.**
8. **Siding is decayed or damaged.**
9. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR REPLACEMENT REFRIGERATORS

1. **The customer already has a refrigerator manufactured after 1992.**
2. **The electrical outlet used by the existing refrigerator is not properly grounded and cannot be properly grounded.**
3. **The refrigerator is not accessible for removal (e.g., doors from room are too small, refrigerator is encased in tile).**
4. **Floor is not level and cannot safely support a new refrigerator.**
5. **Hazardous electrical conditions exist at the outlet used by the existing refrigerator.**
6. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR CENTRAL FORCED AIR SYSTEM REPAIRS AND REPLACEMENTS

1. **The existing furnace passes NGAT, or is abandoned*, or is inaccessible*.**
2. **The property is renter-occupied.**
3. **Fuel used by the existing unit is not supplied by the utility providing LIEE Program services.**
4. **Disconnected ducts or catastrophic duct leaks cannot reasonably be repaired.**
5. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR CENTRAL FORCED AIR FURNACE REPLACEMENT

1. **The existing furnace can feasibly be repaired per the Program P&P.**
2. **For roof-mount unit, roof is not structurally adequate to support the installation.**
3. **For a unit in a confined location, adequate access and/or combustion air cannot be provided.**

NONFEASIBILITY CRITERIA FOR CENTRAL FORCED AIR FURNACE REPAIR

1. **Repair is not economically feasible per the program P&P (e.g., cost to repair is more than 50% of the cost to replace the unit).**

***See Definitions**

NONFEASIBILITY CRITERIA FOR CENTRAL AIR CONDITIONER REPLACEMENT

1. **Heating system can be repaired with existing refrigeration equipment intact.**

2. **For roof-mount unit, roof is <u>not</u> structurally adequate to support the installation.**

3. **Electrical service requirements cannot be met.**

4. **System air flow is inadequate.**

NONFEASIBILITY CRITERIA FOR REPAIR/ REPLACEMENT REQUIRING ATTIC OR CRAWL SPACE ACCESS

1. **Crawl clearance is inadequate:**
   - **Attic clearance is less than 24" between top of ceiling joists and bottom of ridge board.**
   - **Under-floor clearance is less than 18" from the ground to bottom of floor joist system.**

2. **Any of the following conditions is present in the crawl space area where access is required:**
   - **Hazardous insect or pest infestation.**
   - **Excessive ground moisture (standing water or mud).**
   - **Sewage waste is on the ground or other unsanitary condition is present which poses a health and safety hazard.**

NONFEASIBILITY CRITERIA FOR PROGRAMMABLE THERMOSTATS

1. **The furnace is not being replaced.**

2. **Already present and operational.**

3. **Furnace utilizes a millivolt system.**

4. **Upgraded thermostat wiring (heavier gage or more conductors) is required.**

5. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR HVAC AIR FILTER REPLACEMENT

1. **The furnace will not be repaired.**
2. **A serviceable, reusable filter is already present.**
3. **The types of filters provided by the Program are specifically prohibited by the appliance manufacturer.**
4. **Filter replacement would require removal of a flue, duct, or pipe.**
5. **The proper filter support or retaining device is not present, and installation is not feasible.**
6. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR WALL AND FLOOR FURNACE REPAIR AND REPLACEMENT

1. **The existing furnace passes NGAT, or is abandoned*, or is inaccessible*.**

2. **The property is renter-occupied.**

3. **Fuel used by the existing unit is not supplied by the utility providing LIEE Program services.**

4. **Location is confined, and adequate access and/or combustion air cannot be provided.**

5. **Existing open combustion appliance is in a location prohibited by the replacement unit instructions, and relocation to an approved location is not feasible.**

6. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR WALL AND FLOOR FURNACE REPAIR

1. **Repair is not economically feasible (i.e., cost to repair is more than 50% of the cost to replace the unit).**

NONFEASIBILITY CRITERIA FOR INSTALLATION OR REPAIRS REQUIRING CRAWL SPACE ACCESS

1. **Crawl space clearance is less than 18" from the ground to the bottom of the floor joist system.**

2. **Any of the following conditions is present in the crawl space area where access is required:**
   - **Hazardous insect infestation.**
   - **Excessive ground moisture (standing water or mud).**
   - **Sewage waste on ground or other unsanitary conditions posing a health and safety hazard.**

***See Definitions**

NONFEASIBILITY CRITERIA FOR WALL AND WINDOW AIR CONDITIONERS

1. **Unit is already present and operational, and is less than 15 years old.**
2. **Electrical requirements cannot be met.**
3. **A structurally sound mounting platform and/or suitable mounting location is not available.**
4. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR NATURAL GAS WATER HEATER REPLACEMENT

1. **The property is renter-occupied.**

2. **Fuel used by the existing unit is not supplied by the utility providing LIEE Program services.**

3. **The existing water heater:**
   - **Passes NGAT, or**
   - **Is inaccessible*, or**
   - **Can be feasibly repaired (i.e., cost to repair is less than 50% of the cost to replace the unit).**

4. **Drain line for T&P valve or drain pan cannot be properly terminated to outdoors or to an approved indoor drain if required by local code.**

5. **For a unit in a confined location: required access, clearance, or combustion air cannot be provided.**

6. **For a unit on a raised floor or in an attic: structure cannot properly and safely support the installation.**

7. **No suitable mounting locations for seismic bracing available.**

8. **A safety hazard is present which cannot be repaired (e.g., vent system defect, nonconforming gas piping).**

9. **A watertight pan cannot be installed under the unit when required.**

10. **A plumbing condition exists which prevents achieving satisfactory water pipe connections.**

11. **A whole house fan is present, the existing water heater is in the attic, and a closed combustion unit cannot be installed.**

12. **The unit is a central water heater serving more than one unit.**

13. **Customer refuses.**

***See Definitions**

NONFEASIBILITY CRITERIA FOR NATURAL GAS APPLIANCE TESTING (NGAT) FOR ENTIRE DWELLING

1. **Non-IOU combustion fuel is used for space heating.**
2. **No infiltration-reduction measures are being installed.**
3. **No natural gas appliance affecting the living space is present.**

NONFEASIBILITY CRITERIA FOR NGAT FOR INDIVIDUAL APPLIANCE

1. **Non-IOU combustion fuel is used.**
   - **<u>Exception</u>: Appliances subject to PG&E-specific policy.**
2. **Appliance is abandoned*.**
3. **Appliance is inaccessible*.**

***See Definitions.**

APPENDIX -A-

COMBUSTION AND VENTILATION AIR (CVA) REQUIREMENTS FOR GAS FURNACES/HEATERS AND WATER HEATERS

APPENDIX -A-

COMBUSTION AND VENTILATION AIR (CVA) REQUIREMENTS FOR NATURAL GAS FURNACES/HEATERS & WATER HEATERS

1.0 PURPOSE

This appendix is based on Chapter 7 of the 2001 CMC (California Mechanical Code) and Chapter 3 of the 2003 International Fuel Gas Code (IFGC). It is a quick reference to determine room volume or vent size requirements for open combustion *furnaces and water heaters*. This appendix does not apply to direct vent appliances and other closed combustion appliances drawing air from outdoors, listed cooking appliances, refrigerators, and domestic clothes dryers. Definitions listed below include those contained in CMC Chapter 2.

2.0 DEFINITIONS

Confined Space: A room or space having a volume of less than 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all fuel-burning open combustion furnaces/heaters and water heaters installed in that space.

Unconfined Space: A room or space having a volume of at least 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all fuel-burning open combustion furnaces/heaters and water heaters installed in that space. Adjacent rooms communicating directly with the space and not separated by doors are considered part of the unconfined space.

Homes of Ordinary Tightness: Homes not of unusually tight construction.

Homes of Unusually Tight Construction: Homes with the following construction features: (a) walls and ceilings exposed to the outside atmosphere have a continuous water vapor retarder rated 1 perm or less, with all openings sealed; (b) weatherstripping on openable windows and doors; and (c) caulking or sealants are applied to areas such as joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, and at plumbing/wiring penetrations and other openings.

NFVA: Net Free Venting Area, which is the gross opening area minus blocking effect of screen and/or louvers (see “Louvers, Grilles and Screens” below).

3.0 CALIFORNIA MECHANICAL CODE (CMC) CRITERIA

Many combustion air code requirements are addressed in the footnotes on page A-3. Others are covered in this section, and formulas used to calculate room volume and vent size are presented in Section 4.0.

Louvers, Grilles and Screens. (CMC 702.3) Combustion air openings must be covered with 1/4-inch mesh (except ducts which terminate in an attic, which are not screened on either end). The blocking affect of louvers, grilles and screens must be deducted from the gross opening of a vent to determine the “net free” venting area (NFVA). When an NFVA is not identified on the vent, it may be estimate by multiplying the *total (gross) opening area* by the suggested “reduction factors” shown in the table below. (Also see the2003 NFGC 304.10.)

SUGGESTED SCREEN AND LOUVER REDUCTION FACTORS FOR COMBUSTION AIR VENTS

1/4" Screen (Hardware Cloth)	1/4 Screen with Metal Louvers	1/4 Screen with Wood Louvers	Insect Screen (Mesh under 1/4")	Insect Screen w/ Metal Louvers	Insect Screen w/ Wood Louvers
0.90 (90%)	**0.75** (75%)	**0.25** (25%)	**0.50** (50%)	**0.50** (50%)	**0.25** (25%)

Prohibited Sources. (CMC 703.3) Vent openings and ducts cannot connect an appliance enclosure with a space in which the operation of a fan may adversely affect the flow of combustion air.

Combustion-Air Ducts. (CMC Section 704) Ducts must be galvanized steel or equivalent corrosion-resistant material approved for the use. A duct must have the same cross-sectional area as the free area of the opening to which it connects.

4.0 USING THE COMBUSTION AIR MATRIX

Column [A] in the CVA Requirements matrix on page A-3 lists several Btu/hour Input Rating totals. Columns [B] through [F] list corresponding room volumes (cu. ft.) and vent sizes (sq. in. of NFVA). For Btu/h totals not shown, the required room volume or vent NFVA can be calculated using the applicable formula from the table below (note: "KBtu" = 1,000 Btu).

Column	Application	Requirement [Formula in Brackets]
[B]	All air from *indoors*, based on room size	**50 cu. ft. of room volume per 1,000 Btu/h input. [KBtu x 50] or [Btu / 2 and drop last zero]**
[C]	All air from *indoors*, 1 upper vent and 1 lower vent to another room/space*	When the volume of the room/space containing an appliance is inadequate, an upper and a lower vent may be installed to communicate with an adjacent unconfined space. Each vent must provide **1 sq. in NFVA per 1,000 Btu/h input**, with a *minimum* size of 100 sq. in. **[100 + KBtu over 100]**
[D]	All air from *outdoors*, 1 upper vent or duct**	1 upper opening (or vertical or horizontal duct) may be used to provide the combustion air (lower vent not required). The vent/duct must provide **1 sq. in NFVA per 3,000 Btu/h input. [KBtu / 3]**
[E]	All air from *outdoors*, 1 upper vent or vertical duct and 1 lower vent or vertical duct*	Each opening and *vertical* duct must provide **1 sq. in NFVA per 4,000 Btu/h input. [KBtu / 4]**
[F]	All air from *outdoors*, 1 upper horizontal duct and 1 lower horizontal duct*	Each *horizontal* duct must provide **1 sq. in NFVA per 2,000 Btu/h input. [KBtu / 2]**

*See footnote 5 on page A-3 regarding placement of upper and lower vents and ducts. For ducts, also see the double-asterisk (**) note at the bottom of the page advising that the minimum cross-sectional area of a duct is 3" (3"x3" rectangular, or 3" round).

**See footnote 1 on page A-3 regarding the acceptability of just *one* combustion air vent or duct.

The matrix on page A-3 summarizes most combustion air venting options specified in Chapter 7 of the 2001 CMC. It is based on CMC Table 7-A (*except* [D], based on IFGC 304.6.2).

This appendix is only a guide. Each installer is responsible for meeting all requirements of the local jurisdiction and applicable codes and regulations.

CVA REQUIREMENTS FOR GAS FURNACES/HEATERS & WATER HEATERS

OPEN COMBUSTION FURNACE AND/OR WATER HEATER IN A ROOM/SPACE	HOMES OF ORDINARY TIGHTNESS*, WITH APPLIANCES LOCATED IN A CONFINED SPACE*, AND ALL COMBUSTION AIR OBTAINED FROM INDOORS		HOMES OF UNUSUALLY TIGHT CONSTRUCTION*, OR OF **INADEQUATE VOLUME**, WITH ALL COMBUSTION AIR OBTAINED FROM OUTDOORS		
			[D] 1 Upper Opening (or 1 Vertical or Horizontal Duct)[1,2,3,4] **[E]** 1 Upper Opening or **Vertical** Duct and 1 Lower Opening or Vertical Duct[2,3,4,5,6]		TWO **HORIZONTAL** DUCTS[2,5]
TOTAL INPUT	MIN. ROOM VOLUME	MIN. NFVA* PER VENT[4]	MIN. NFVA* FOR **1** VENT/**VERTICAL** DUCT[4]	MIN. NFVA* FOR EACH OF **2** VENTS/**VERTICAL** DUCTS	REQUIRED NFVA* PER DUCT FOR **2** DUCTS
[A] BTU/HR	**[B] CU. FT.**	**[C] SQ. IN.**	**[D] SQ. IN.**	**[E] SQ. IN.**	**[F] SQ. IN.**
20,000	1,000	100	6.7**	5.0**	10.0
25,000	1,250	100	8.3**	6.3**	12.5
30,000	1,500	100	10.0	7.5**	15.0
35,000	1,750	100	11.7	8.8**	17.5
40,000	2,000	100	13.3	10.0	20.0
45,000	2,250	100	15.0	11.3	22.5
50,000	2,500	100	16.7	12.5	25.0
55,000	2,750	100	18.3	13.8	27.5
60,000	3,000	100	20.0	15.0	30.0
65,000	3,250	100	21.7	16.3	32.5
70,000	3,500	100	23.3	17.5	35.0
75,000	3,750	100	25.0	18.8	37.5
80,000	4,000	100	26.7	20.0	40.0
85,000	4,250	100	28.3	21.3	42.5
90,000	4,500	100	30.0	22.5	45.0
95,000	4,750	100	31.7	23.8	47.5
100,000	5,000	100	33.3	25.0	50.0
105,000	5,250	105	35.0	26.3	52.5
110,000	5,500	110	36.7	27.5	55.0
115,000	5,750	115	38.3	28.8	57.5
120,000	6,000	120	40.0	30.0	60.0
125,000	6,250	125	41.7	31.3	62.5
130,000	6,500	130	43.3	32.5	65.0
135,000	6,750	135	45.0	33.8	67.5
140,000	7,000	140	46.7	35.0	70.0
145,000	7,250	145	48.3	36.3	72.5
150,000	7,500	150	50.0	37.5	75.0
155,000	7,750	155	51.7	38.8	77.5
160,000	8,000	160	53.3	40.0	80.0

[1]Just one opening within 12" of the ceiling (or one vertical or one horizontal duct) is allowed when the appliance has clearances of 1" on sides and back and 6" in front. Vent/duct NFVA must equal the sum of the vent connector areas.

[2]Combustion air must be obtained air from outdoors or from spaces freely communicating with outdoors.

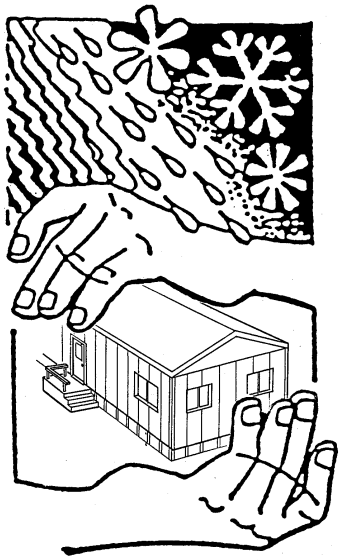
[3]Attic must be adequately vented to provide the required volume of combustion air. Attic must have at least 30" clear vertical height at peak. Vent openings must be protected from ceiling insulation (e.g., with sleeve 6" above it).

[4]Vertical ducts must extend 6" above ceiling insulation, and may not be screened on either end.

[5]Upper vent/duct termination shall be installed within 12" of the ceiling, and lower vent/duct termination shall be within 12" of the floor. However, a pre-existing upper vent at any location higher than the draft hood is acceptable.

[6]Crawl space must have free flow of air and unobstructed openings to outdoors totaling twice the required NFVA. Foundation vents should be screened with 1/4" mesh and provide at least twice the NFVA of required CVA openings.

*See definitions on page A-1. **The minimum cross-sectional dimension of **ducts** is 3". Minimum **rectangular duct** is 3"x3" (**9.0 sq. in.**); minimum **round duct** is 3" diameter (πr^2 = 3.1415 x 1.5" x 1.5" = **7.07 sq. in.**).



CALIFORNIA MOBILE HOME WEATHERIZATION INSTALLATION STANDARDS

for use in

California's Low Income Energy Efficiency Programs

administered by

San Diego Gas and Electric Company
Southern California Edison
Southern California Gas Company
Pacific Gas and Electric Company

JANUARY 18, 2005 –*REVISIONS*–

ABBREVIATIONS AND ACRONYMS

AAMA	American Architectural Manufacturers Association
ACCA	Air Conditioning Contractors of America
ACDD	Annual Cooling Degree Days
AFUE	Annual Fuel Utilization Efficiency
AGA	American Gas Association
AHDD	Annual Heating Degree Days
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG, awg	American Wire Gage
BEAR	Bureau of Electronic and Appliance Repair
BEF	Ballast Efficacy Factor
BOCA	Building Officials and Code Administrators
Btu	British Thermal Unit
Btu/hr	British Thermal Units per Hour
°C	Degrees Centigrade
CABO	Council of American Building Officials
Cal OSHA	California Occupational Safety and Health Administration
CAS	Combustion Appliance Safety
CASIF	Combustion Appliance Safety Inspection Form

ABBREVIATIONS AND ACRONYMS

CAZ	Combustion Appliance Zone
CBM	Certified Ballast Manufacturers
CBC	California Building Code
CBO	Community Based Organization
CCR	California Code of Regulations
CDD	Cooling Degree Days (also see ACDD)
CEC	California Energy Commission and California Electrical Code
CFL	Compact Fluorescent Lamp
CFM, cfm	Cubic Feet per Minute
CFM_{25}	Cubic Feet per Minute of Air Flow at 25 Pascals of Pressure
CFM_{50}	Cubic Feet per Minute of Air Flow at 50 Pascals of Pressure
CFR	Code of Federal Regulations
CMC	California Mechanical Code
CO	Carbon Monoxide
COP	Coefficient of Performance
CPSC	Consumer Products Safety Commission
CSD	(California Department of) Community Services and Development
DOE	(United States) Department of Energy
DV	Direct Vent (Furnace/Heater)
EER	Energy Efficiency Ratio
EPA	Environmental Protection Agency
ESP	Economic Stop Parameters/Economic Stop Policy
°F	Degrees Fahrenheit

ABBREVIATIONS AND ACRONYMS

F.S.	Federal Specifications
FAU	Forced Air Unit
fpm	Feet per Minute
GFCI	Ground Fault Circuit Interrupter
HCD	(California Department of) Housing and Community Development
HDD	Heating Degree Days (also see AHDD)
HDL	House Depressurization Limit
HPD	Heat Producing Device
HUD	(U.S. Department of) Housing and Urban Development
HVAC	Heating Ventilation and Air Conditioning
Hz	Hertz
ICBO	International Conference of Building Officials
ID	Inside Diameter
IWC, iwc	Inches of Water Column (Same as IWG, Inches of Water Gauge)
IWG, iwg	Inches of Water Gauge (Same as IWC, Inches of Water Column)
KHz	Kilohertz
MHCSS	HUD Manufactured Home Construction and Safety Standards
MVR	Minimum Ventilation Requirement
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council

ABBREVIATIONS AND ACRONYMS

NFVA, NFV Area	Net Free Venting Area: Total vent opening area minus the blocking effect of louvers, grilles, and screens
OC	On Center
OD	Outside Diameter
OSHA	Occupational Safety and Health Administration
P&P	Policy and Procedures
Pa	Pascal (1 Pa = 0.004 iwc, and 1 iwc = 250 Pa)
PPM, ppm	Parts Per Million
psf	Pounds per Square Foot
psi	Pounds per Square Inch
RTV	Room Temperature Vulcanization (e.g., RTV Silicone)
SEER	Seasonal Energy Efficiency Ratio
T&P Valve	Temperature and Pressure Relief Valve
TPE	Thermoplastic Elastomer
UBC	Uniform Building Code
UL	Underwriters Laboratories
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
UV	Ultraviolet
WC, wc	Water Column (Same as Water Gauge)
WG, wg	Water Gauge (Same as Water Column)
WIS	Weatherization Installation Standards
Wx	Weatherization

DEFINITIONS

Abandoned Appliance — An appliance which is no longer used and has been removed from service and: (1) the flexible gas connector has been removed, and (2) the gas line shut-off valve has been capped, or the valve has been removed and the pipe capped.

Backdrafting — The reverse flow of combustion gases down the vent pipe and out the draft hood of a natural vent open combustion appliance. Intermittent backdrafting can be caused by wind gusts. Ongoing backdrafting can be the result of a negative pressure in the combustion appliance zone (CAZ) caused by (a) duct system return leaks in the vicinity of the appliance, and/or (b) the excessive influence of mechanical systems exhausting air from the structure (e.g., bathroom and utility room exhaust fans, range hood fan, clothes dryer, built-in vacuum system, etc.).

Closure System — The sum total of components utilized to secure and seal a duct system joint or seam against air leakage (e.g., pressure sensitive tape, or heat activated tape, or mastic with fiberglass mesh reinforcement). Closure systems for non-metallic flexible ducts include a drawband.

Combustion Air — The total amount of air provided to the space, which contains fuel-burning equipment; it includes air for fuel combustion, for draft hood dilution and for ventilation of the equipment enclosure. (Reference 2001 UMC, section 205.)

Combustion Appliance Zone (CAZ) — The room or area of a home in which an open combustion natural draft appliance (typically a furnace, water heater, wood burning stove or fireplace) is located. It could be a living room containing a wood burning stove, a kitchen or utility porch containing a water heater, or an appliance enclosure. Excessive depressurization of the CAZ causes backdrafting and spillage of combustion gases.

Conditioned Space — An area, room or space normally occupied and being heated or cooled by any equipment for human habita-

	tion. (Reference 2001 UMC, section 205.)
Confined Space	A room or space having a volume less than 50 cubic feet per 1,000 Btu/h of aggregated input rating of all fuel burning appliances installed in the space. (Reference 2001 UMC, section 205.)
Drawband	A device which encircles a duct and mechanically secures the core-to-fitting attachment (i.e., a synthetic duct tie or a worm drive stainless steel clamp). Duct ties are also used to secure fiberglass duct wrap and to seal jacket overlaps at flexible duct splices.
Duct Systems	All ducts, duct fittings, plenums and fans assembled to form a continuous passageway for the distribution of air. (Reference 2001 UMC, section 206.)
Enclosed Cavity	A building cavity that is totally enclosed and inaccessible for installation of measures. An example is a low-profile section of attic that is closed off by drywall, plywood or other sheathing. Because of inadequate crawl clearance, proper installation of insulation would not be feasible even if an access hole were cut.
FAU	Forced air unit, which is that portion of a central heating and/or air conditioning (A/C) system which contains the air handler (blower section). In a "Split System," it is the furnace. In a "Package System," the entire heating and A/C "Package Unit" may be referred to as the FAU.
Heat Activated Tape	Metallic tape with an adhesive coating which is activated and cured by the application of heat and pressure.
Inaccessible Appliance	A combustion appliance that cannot be accessed for NGAT testing, due to a locked passage or a physical impediment. Examples include a water heater in a locked room/enclosure for which a key is not available, an attic-mount furnace that requires entry through an inaccessible MUD unit, and a floor furnace in a crawl space with inadequate crawl clearance. A floor furnace may also be inaccessible because it has been covered over by plywood or attached floor covering (e.g., wall-

to-wall carpet or vinyl). A floor or wall furnace may be inaccessible because it has been turned off and blocked by heavy furniture (e.g., a hutch or cabinet).

Labeled — Equipment or materials to which has been attached a label of a nationally recognized testing agency that maintains periodic inspection of the production of labeled equipment or materials. Labeling indicates compliance with nationally recognized standards. (Also see “Listed” and “UL Classified, Labeled, Listed”.)

Lapped Seam — The seam (joint) formed where two pieces of material (usually sheet metal) are overlapped.

Longitudinal Joint — Lengthwise joint along a piece of duct (e.g., the joint running the full length of a snap-together sheet metal duct). [Note: *longitudinal* means "lengthwise"...in contrast with *transverse,* which means "across".]

Mobile Home — Mobile homes are manufactured homes regulated by the Department of Housing and Urban Development (HUD) through a national code, called the Manufactured Housing Construction and Safety Standards—the “HUD Code” for short. A manufactured home is built on a trailer (chassis) and designed to be delivered over the road to a permanent location, either as a single- or multiple-section unit. A mobile home is a permanent, full-time residential dwelling with a floor area of at least 330 square feet.

NFPA 90B — Standards governing installation of "Warm Air Heating and Air Conditioning Systems" in one- or two-family dwellings and structures not exceeding 25,000 cu. ft. Provides specifications for the manufacture and installation of rigid metal ductwork and references UL 181 regarding factory made air ducts (e.g., flexible ducts). Installations in larger structures are addressed by NFPA 90A.

NFV, NFVA — NFV stands for “net free venting.” NFVA is “net free venting area,” the net amount of venting area provided by a vent after the blocking effect of mesh and/or louvers has been subtracted from the gross area of the

vent opening(s).

Package Unit — A combination heating and air conditioning system contained within one housing unit, which is installed outdoors (on the roof or on a slab next to the house). (Also see "Split System.")

Pascal (Pa) — A small unit of pressure equivalent to 0.004 inches of water column (IWC). 1 Pa = 0.004 IWC, and 1 IWC = 250 Pa. 25 Pa, the pressure typically used to test duct systems for leakage, is equivalent to 0.1 IWC. Conversion formulas are: [Pa = IWC ÷ 0.004] and [IWC = Pa x 0.004].

Perm — A unit of permeance, which refers to how permeable a material is (e.g., how well moisture will pass though a vapor barrier).

Plenum — An air compartment or chamber to which one or more ducts are connected and which form part of either the supply-air, return-air or exhaust-air system, other than the occupied space being conditioned. (Reference 1997 UMC, section 215-P, page 13.)

Pressure Sensitive Tape — Duct tape with a tacky adhesive coating (e.g., butyl, acrylic, etc.) which will adhere to a surface with the application of pressure (heat not required). Duct tapes used in the CSD-sponsored programs must be listed and marked per UL 181A and 181B standards.

Repair — Corrective work performed by a qualified technician, intended to make a natural gas appliance operate properly, when correction is beyond the scope of "Service/Adjustment".

Replacement — Complete replacement of a defective natural gas appliance, when repair is not feasible: i.e., the cost to repair the appliance exceeds program guidelines, or parts required to make the appliance safely operable cannot be obtained.

Service/Adjustment — Minor corrective work, within the normal scope of service, performed by utility gas service personnel, or

designated representative, intended to make a natural gas appliance operate properly without repair or replacement.

Spillage — In a natural vent open combustion appliance, the outflow of combustion gases from the draft hood and into the atmosphere of the room or area where the appliance is located (the combustion appliance zone, or CAZ). Spillage occurs when drafting through the vent system is inadequate to carry combustion gasses up through the vent pipe and out into the atmosphere. Spillage occurs briefly when combustion first begins in a cold appliance, because cold air in the vent pipe impedes exhaust flow until the systems warms up. Continuous spillage may result when the vent pipe is blocked by an obstruction or is improperly constructed (too many elbows, improper slope, inadequate diameter, etc.).

Split System — A heating and cooling system in which the air conditioning evaporator coil is attached to the furnace, which is located indoors (typically in the garage, attic, or interior closet), and the condenser unit (with coil, compressor, and fan) is installed outdoors, usually on a slab next to the house. (Also see “Package Unit.”)

Transverse Joint — The joint formed when two pieces of duct are spliced together (e.g., the joint around the circumference where two round ducts are joined together, and the joint around the perimeter where two rectangular ducts are joined together). [Note: *transverse* means “across”...in contrast with *longitudinal*, which means “lengthwise”.]

UL 181 — UL "Standard for Factory-Made Air Ducts and Connectors".

UL 181A — UL standard for pressure sensitive aluminum tapes, heat activated aluminum tapes, and mastic closure systems for use with rigid fiberglass air ducts.

UL 181B — UL standard for pressure sensitive tapes and mastic closure systems for use with flexible air ducts.

DEFINITIONS

UL Class 0 Duct

Air duct materials having a fire hazard classification of zero (flame spread and smoke developed).

UL Class 1 Duct

Air duct materials having a flame-spread rating of not over 25 without evidence of continued progressive combustion and a smoke-developed rating of not over 50.

UL Classified, Labeled, Listed, Recognized

- **UL Classified** means that UL testing was limited to examination of one potential hazard.
- **UL Labeled** means that a product is either UL Listed or UL Classified. Note that a product can be certified and "listed" without involving UL. Other accredited laboratories (e.g., CSA International, ITS Intertek Services, ETL SEMKO, etc.) can test products and certify conformance with established standards. Such products can thus be "listed and labeled" without reference to UL. (See “Listed” and “Labeled” above.)
- **UL Listed** means that UL testing included examination of *all* foreseeable hazards.
- **UL Recognized** means that a component (such as a motor) is approved for use in a UL Listed product (such as an evaporative cooler). The complete cooler is UL Listed, but the tested and approved components used in it are “UL Recognized components.” Each UL Recognized component is tested to a UL standard applicable to that component, and it is “recognized” for use in a UL Listed product.

SECTION 1 PREFACE

FOR

NATURAL GAS APPLIANCE TESTING (NGAT)

1. INSTALLATION POLICIES

1.1. Combustion appliance testing will be conducted only for homes that receive infiltration reduction measures and that have at least one natural gas appliance affecting the living space. (Appliances affecting the living space are those identified as such in this section of this WIS manual.)

1.2. Homes with non-IOU (e.g., propane) space heating fuel are <u>not</u> eligible for combustion appliance testing or infiltration reduction measures.

1.3. For Program Year 2005, pending further CPUC action, homes with IOU space heating, but with other appliances using non-IOU fuel, will be treated in accordance with the following utility-specific policies:

- In the SDG&E and SoCalGas programs, these homes will not be subjected to combustion appliance testing of non-IOU fueled appliances. Instead, they will be assessed using the PY2003 Minimum Standard adopted by the Commission in D. 01-12-020, which does not involve testing of appliances other than space heating.
- In the SCE program (for which electric space heating is present), combustion appliance testing will not be conducted.
- In the PG&E Program, these homes will be subjected to combustion appliance testing on all combustion appliances prior to weatherization (and, for a sample of homes, after weatherization). For homes failing the pre-weatherization test, infiltration-reduction measures will be deemed non-feasible

1.4. In order to avoid cases in which post-weatherization NGAT protocol would discover nonconforming conditions that: (a) preclude installation of infiltration reduction measures, and (b) cannot be corrected within the scope of the program, some pre-weatherization evaluations are performed as part of the initial home assessment. Pre-weatherization evaluations include the following components:

- Gas Leaks. Each gas-burning appliance is checked for the presence of gas leaks. When a natural-gas leak is found, the utility is contacted for gas service repairs. Non-IOU gas leaks are treated in accordance with utility-specific policies. All gas leaks must be repaired before weatherization commences.

- Combustion and Ventilation Air (CVA) Evaluations. CVA is evaluated for furnaces and water heaters to determine if it is adequate and, if inadequate, whether correction is feasible.
- Flue and Vent Pipe Termination Evaluations. Flue and vent pipe terminations are checked to determine if any violate NGAT protocol and, if nonconforming, whether correction is feasible.
- Appliance Operation and Accessibility. All gas-burning appliances are checked to determine whether: (a) they are accessible for testing, and (b) they are operable. Non-operable natural gas appliances are referred to the appropriate utility service department. Non-operable propane appliances are treated in accordance with utility-specific policies.
- Unvented Space Heater. The dwelling is checked for presence of an unvented combustion appliance used for heating the living space (which will preclude installation of infiltration reduction measures if not removed).
- Gas Clothes Dryer. If located within the living space, the clothes dryer moisture exhaust is checked to determine if it is properly vented outdoors. If not properly vented outdoors, infiltration reduction measures will not be installed. This restriction does not apply to a gas clothes dryer located in an attached garage
- Mobile Homes. Additional checks will be made in mobile homes to determine if: (a) gas cooking is present and the kitchen exhaust to outdoors is nonconforming, (b) an open combustion space or water heater is present within the living space, and (c) an exterior-accessed appliance enclosure has unacceptable isolation of furnace return-air. Item (a) may be corrected as a Minor Home Repair. Items (b) and (c) preclude installation of infiltration reduction measures

Required corrections will be performed before weatherization commences. The owner will be informed of conditions that preclude installation of infiltration reduction measures and cannot be remedied by the LIEE program (e.g., exhausting clothes dryers outdoors, and repair or replacement of appliances and gas vents for which repair or replacement is not available).

1.5. After completion of weatherization that includes infiltration reduction measures, NGAT is performed for all natural gas appliances affecting the living space. Testing of appliances using non-IOU fuels is conducted in accordance with utility-specific policies (see 1.3 and 1.8). NGAT includes the following components:

- Visual Examinations, including flue and vent system checks, appliance component checks, and re-check for gas leaks.
- Combustion and Ventilation Air (CVA) Verification.
- Carbon Monoxide Tests, as prescribed below in 1.6.

- Draft Tests, using smoke, on appliances for which draft tests are applicable (natural draft space- and water-heating appliances).

1.6. For IOU-fueled natural gas appliances, CO Testing will be conducted using the following protocol:

- Heating Appliances: Appliance ambient CO testing is performed.
- Water Heaters: Appliance ambient CO testing is performed if the water heater is in a location affecting the living space.
- Kitchen Appliances: Room ambient CO tests are performed in the kitchen separately during operation of each cooking appliance component (cook top, oven, and broiler).
- Gas Logs: Exhaust/flue CO test is performed inside the top edge of the fireplace opening.
- Clothes Dryers: No CO tests are performed.

1.7. If a problem is identified through application of the overall NGAT protocol, (i.e., elevated CO, inadequate draft, or defect causing an unsafe condition), the case will be referred for resolution to qualified utility-trained personnel or a contractor licensed to repair appliances. Such resolution may involve the use of flue CO testing as well as other procedures.

1.8. Timing of combustion appliance testing will be as follows:

- Homes using only natural gas: Combustion appliance testing is conducted after weatherization.
- Homes using non-IOU combustion fuel: Timing of testing will be in accordance with utility-specific policies. For SDG&E, SoCalGas and SCE, no tests will be conducted on appliances using non-IOU fuels. For PG&E, tests for homes with non-IOU combustion appliances will be conducted prior to weatherization and, in a sample of homes, after weatherization.
- Post-weatherization NGAT protocol shall be conducted the same day as infiltration reduction measures are installed.

1.9. Temporary sealing of defective windows and doors, in order to perform post-weatherization NGAT, is allowed when required materials (such as specialty glass or special-order windows or doors) are not available to be installed concurrently with the other weatherization measures. NGAT will be conducted with the defect sealed (e.g., with plastic sheeting) to simulate infiltration reduction achieved by the completed repair/replacement. A repeat of NGAT following the completed repair/replacement is not required.

1.10. The following actions will be taken when appliances are found to have problems:

- In owner-occupied homes, natural gas space heaters and water heaters failing one or more of the tests covered by the NGAT protocol will be pro-

vided with Service/Adjustment and, if necessary, will be repaired or replaced.

- In owner-occupied homes, non-program appliances failing one or more of the tests covered under the NGAT protocol will be provided with Service/Adjustment. If Service/Adjustment does not correct the problem in question, the appliances in question will be shut off, tagged, and reported to the owner.
- In renter-occupied homes, appliances failing one or more of the tests covered by the NGAT protocol will be provided with Service/Adjustment. If Service/Adjustment does not correct the problem in question, the appliance be will be shut off, tagged, and reported to the tenant and the landlord.

SECTION 3 PREFACE

FOR

DOOR WEATHERSTRIPPING

1. INSTALLATION POLICIES

1.1. The contractor may adjust existing weatherstripping in lieu of replacement only if existing weatherstripping is functional and creates a proper seal.

1.2. Door shoe and threshold combinations must be installed unless proven to be nonfeasible.

1.3. A threshold should not be installed which exceeds 1" in height from the finished floor (1/2" in height for handicapped).

1.4. When the installation of a door shoe and threshold combination is not feasible for the following reasons, an automatic sweep may be used:

- Medical reasons, such as wheelchairs or walkers, require that the floor be as flat as possible.
- Metal doors cannot be cut to accommodate a shoe.
- Doors open outward and do not overlap a floor surface when closed. “Bumper” type thresholds may be used in this circumstance if a tripping hazard will not be created and they do not exceed height requirements.
- The installation of a proper threshold requires carpet cutting.
- The door is unusually expensive and might be aesthetically damaged by cutting.

1.5. A stationary sweep can be used in lieu of an automatic sweep if a door shoe and threshold combination is not feasible and an automatic sweep cannot be installed. The use of flip up sweeps is not allowed.

SECTION 13 PREFACE

FOR

HARD-WIRED COMPACT FLUORESCENT FIXTURES

1. INSTALLATION POLICIES

1.1. This measure is limited to single family non-mobile homes.

SECTION 15 PREFACE

FOR

REFRIGERATOR REPLACEMENT

1. INSTALLATION POLICIES

1.1. The minimum size for primary refrigerators replaced under the LIEE Program is 10 cubic feet.

1.2. Refrigerators may be replaced only if the existing refrigerator was manufactured before 1993.

1.3. One of the refrigerators replaced under the Program must be a primary refrigerator. The primary refrigerator is the main refrigerator in the home, usually the kitchen refrigerator.

1.4. The size of the replacement refrigerator shall be approximately equal to the size of the existing unit, not to exceed 19 cubic feet. However, when two refrigerators and/or freezers are exchanged for a single unit, the replacement unit may not be larger than the combined size of the two existing units, and may not be larger than 23 cubic feet.

1.5. Space must be physically large enough to accommodate the new refrigerator, with entrance and passageways sufficient to allow removal of the existing refrigerator.

1.6. Contractor shall dispose and recycle (de-manufacture) replaced refrigerators in an environmentally safe manner and in accordance with federal, state, and local regulations and codes. Contractor represents that it has knowledge of the Metal Discard Act, effective January 1, 1994, which prohibits disposal of refrigerators/freezers in landfills.

SECTION 16 PREFACE

FOR

NATURAL GAS CENTRAL FORCED AIR HEATING SYSTEMS REPAIR AND REPLACEMENT

1. FURNACE REPAIR/REPLACEMENT POLICIES

1.1. Furnace repair or replacement may be provided only when the appliance ails NGAT, and correction cannot be achieved with Service/Adjustment by utility gas service personnel (or their designated representative).

1.2. A furnace may be replaced only if the cost of repairing the unit would be more than 50% of the cost of replacement.

1.3. Furnace replacements and major furnace repairs may be provided only if the residence is owner-occupied. Service/Adjustment may also be conducted in renter-occupied homes.

1.4. Furnace repairs and replacements will be provided only if the fuel used by the furnace is supplied by the utility providing LIEE Program services.

1.5. Furnace replacement will not include hazardous material abatement, major structural alteration, concrete work, painting, or floor covering.

1.6. An air conditioning unit may be replaced in conjunction with a furnace replacement if:

- The unit being replaced is a combined forced air heating and central AC package system, also referred to as a dual-pack (i.e., the AC and furnace is manufactured as one unit and is housed in a single sheet metal housing); or
- The furnace being replaced is part of a split forced air heating and AC system and the AC evaporative coil and/or the outside system cannot be matched with the new furnace.

1.7. Replaced units must be de-manufactured in compliance with all laws and regulations.

1.8. Installer must have C-20 HVAC license.

2. PROGRAMMABLE THERMOSTAT INSTALLATION POLICIES

2.1. Programmable thermostats are installed only when the central furnace is replaced, and only when required by state or local code.

2.2. Before installing a programmable thermostat, contractor shall explain its operation and provide the customer an opportunity to refuse the measure.

3. CENTRAL SYSTEM AIR FILTER INSTALLATION POLICIES

3.1. Filters are installed only in conjunction with central forced air heating system repair.

3.2. Contractors must show customers how to remove, clean, and re-install the filters.

SECTION 21 PREFACE

FOR

NATURAL GAS WATER HEATER REPLACEMENT

1. WATER HEATER REPAIR/REPLACEMENT INSTALLATION POLICIES

1.1. Water heater repair or replacement may be provided only when the appliance fails NGAT, and correction cannot be achieved with Service/Adjustment by utility gas service personnel (or their designated representative).

1.2. A water heater may be replaced only if the cost of repairing the unit would be more than 50% of the cost of replacement.

1.3. The replacement water heater must have an energy factor of 0.60 or greater.

1.4. Water heater repair or replacement may be provided only if the residence is owner-occupied. Service/Adjustment may also be conducted in renter-occupied homes.

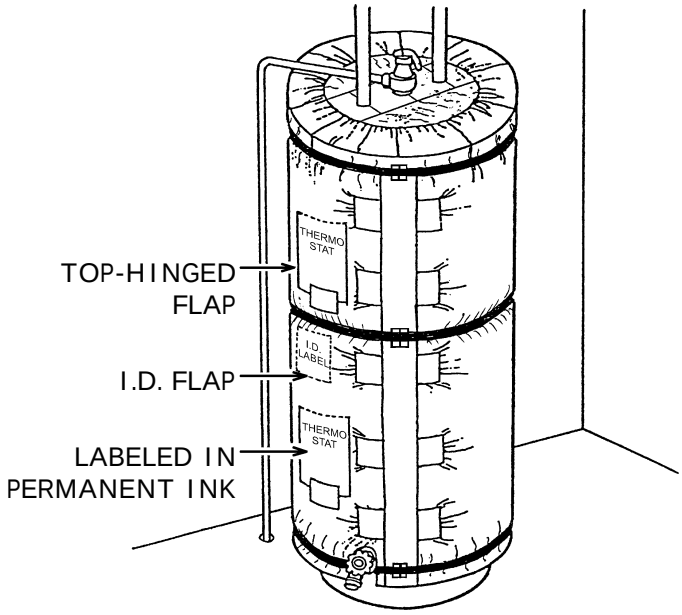
1.5. Water heater repairs and replacements will be provided only if the fuel used by the furnace is supplied by the utility providing the weatherization service.

1.6. Water heater replacement will not include hazardous material abatement, major structural alteration, concrete work, painting, or floor covering.

ELECTRIC WATER HEATERS

15. THERMOSTATS AND IDENTIFICATION LABEL

- **Upper and Lower Thermostats and ID Label**
  - **Locations shall be identified and made easily accessible.**
    - **Blanket shall be cut on sides and bottom to create a top-hinged flap over each thermostat cover plate.**
    - **Flap shall be held closed with tape installed along bottom slit.**
    - **Each flap shall be labeled in permanent ink: “Thermostat” or “ID Label”.**
- **Identification Label**
  -
  - **Flaps shall be held closed with tape.**
    - **A minimum of one tape strip shall be installed along slit opposite flap hinge.**
    - **All slits longer than 12" shall be secured with tape installed lengthwise along the slit.**
  - **Flaps shall be labeled in permanent ink to identify what is underneath.**



7. CLUSTER LIGHTING

- **All Types**
  - **CFLs shall <u>not</u> be installed in chandeliers or other cluster lighting fixtures unless the CFL is specifically designed for such applications.**
  - **The fixture shall remain level after installation of the CFL.**

8. DIMMERS, PHOTOSENSORS, AND OCCUPANCY SENSORS

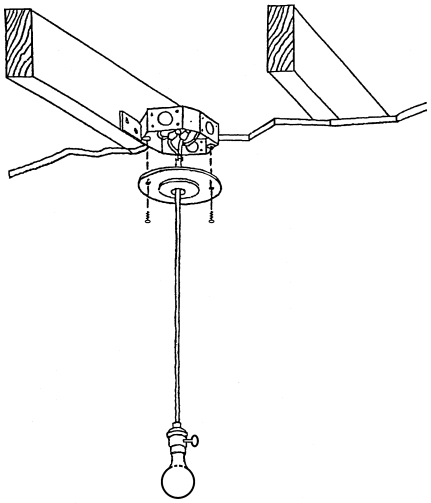
- **All Types**
  - **Only CFLs rated for use with dimmers, photosensors, and occupancy sensors shall be installed in fixtures controlled by such devices.**

9. TIMERS

- **Mechanical**
  - **CFLs may be installed in fixtures equipped with mechanical timers.**
- **Solid State**
  - **CFLs shall <u>not</u> be installed in fixtures equipped with solid state timers.**

10. LAMP CORD SUPPORTED

- **All Types**
  - **CFLs shall <u>not</u> be installed in fixtures supported only by a lamp cord unless the manufacturer allows the use of CFLs in such fixtures.**

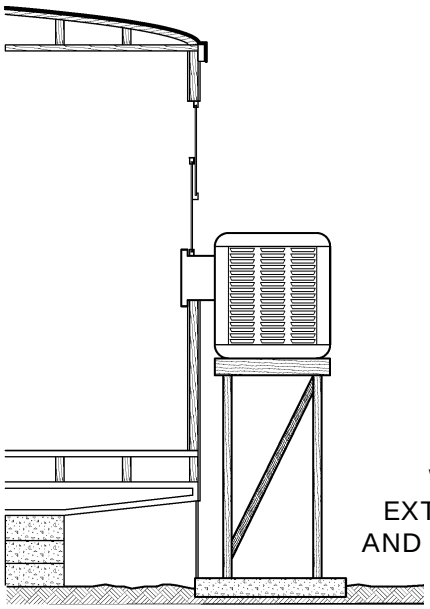


12. COOLER SUPPORTS (continued)

- **Platform Supports**
  - **Platform shall:**
    Be braced and stable.
    Rest on concrete pad or masonry supports.
  - **Materials for wooden platforms shall be:**
    Exterior grade.
    Sealed with exterior primer and paint.
    Separated from the earth (e.g., by concrete).

13. ATTACHMENTS

- **Units shall be attached with noncorrosive screws or lag bolts.**
  - **Nails and molly bolts <u>not</u> allowed.**
  - **Anchors shall penetrate framing members a minimum of 3/4" (1" if self-drilling screws).**
- **Attachment shall comply with manufacturer's minimum specifications, however:**
  - **Noncorrosive screws or lag bolts shall be used.**
  - **Nails and molly bolts are <u>not</u> allowed.**



WOODEN PLATFORM
EXTERIOR GRADE, SEALED,
AND SEPARATED FROM EARTH

21. PRE-OPERATION CHECK (continued)

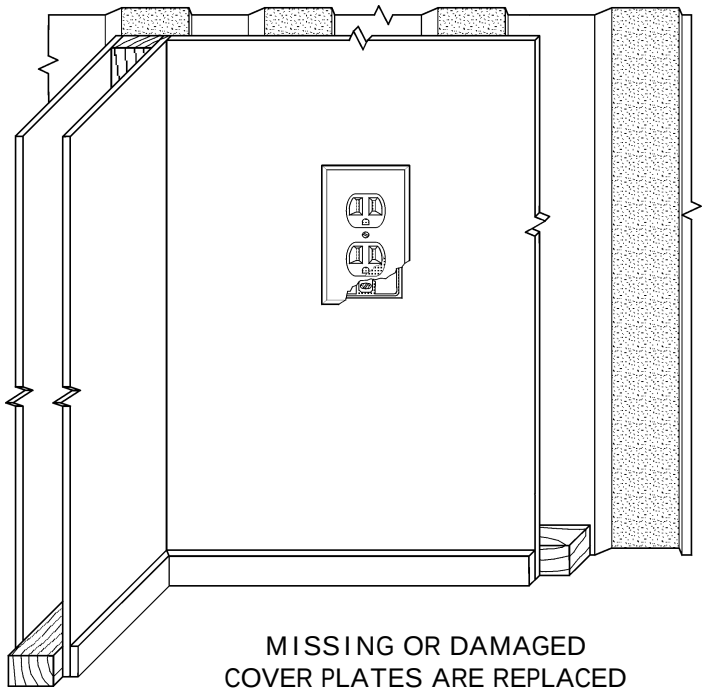
- **Water system shall be checked for:**
  - **Proper flow and no leaks.**
  - **Proper float and splash shield adjustment.**
  - **Even water distribution over pads.**
- **Pump and screen shall be checked for:**
  - **Properly installed screen.**
  - **Debris-free inlet with proper clearance from obstructions.**
  - **Proper pump impeller operation (turns freely).**
- **Blower fan shall be checked to assure:**
  - **Proper clearance from housing.**
  - **Free rotation.**
  - **Proper operation of both motor and fan.**
- **Drain line shall be checked to determine that it:**
  - **Is properly installed and free of leaks.**
  - **Terminates correctly.**
- **Other procedures recommended by manufacturer shall be followed.**

SAMPLE PRE-OPERATION CHECKLIST

	✓	ITEMS TO BE VERIFIED (CHECK OFF EACH AS IT IS COMPLETED)
1.	❑	Installation requirements
2.	❑	Electrical circuitry
3.	❑	Blower and motor
4.	❑	Water system
5.	❑	Pump and screen
6.	❑	Drain line
7.	❑	Other…

6. ELECTRICAL REQUIREMENTS

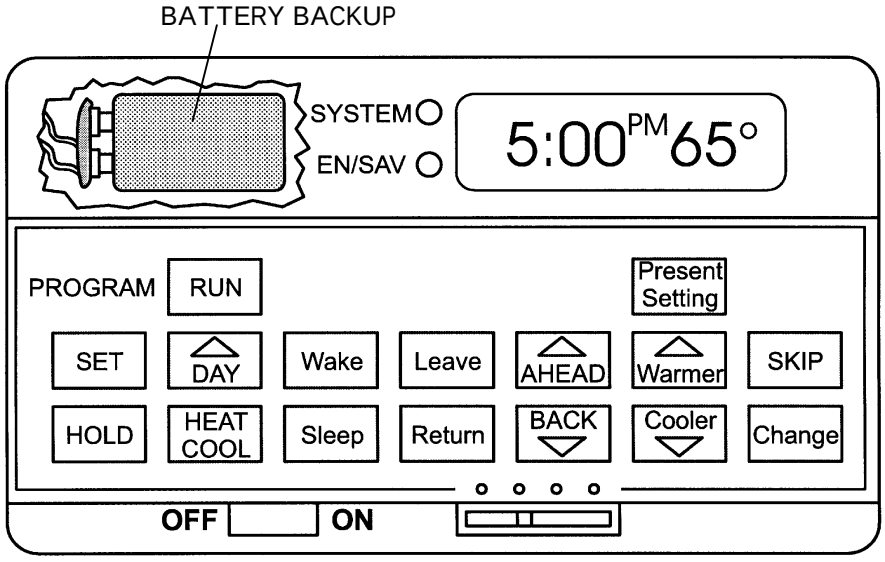
- **Electrical Circuit**
  - **Overcurrent protection and size of conductors shall be in conformance with manufacturer's specifications and local code.**
  - **A GFCI-protected circuit or receptacle shall <u>not</u> be used.**
- **Electrical Outlet**
  - **Refrigerator shall be plugged into its own individual electrical outlet (not shared with another appliance).**
  - **The receptacle and cover plate shall be in good condition.**
  - **The receptacle shall be properly grounded in conformance with the California Electrical Code (CEC) and local code.**
- **Extension Cord**
  - **An extension cord may be used when allowed by manufacturer's instructions and with prior approval of Program Manager.**
  - **Extension cord shall be:**
  - **UL listed, 3-conductor cord, with 3-prong plug and receptacle.**
  - **Minimum 14 AWG.**
  - **Maximum 6' in length.**
- **Appliance cord and extension cord shall not be located where either can create a walking hazard (where people can trip).**



MISSING OR DAMAGED
COVER PLATES ARE REPLACED

3. INSTALLATION COMPONENTS (continued)

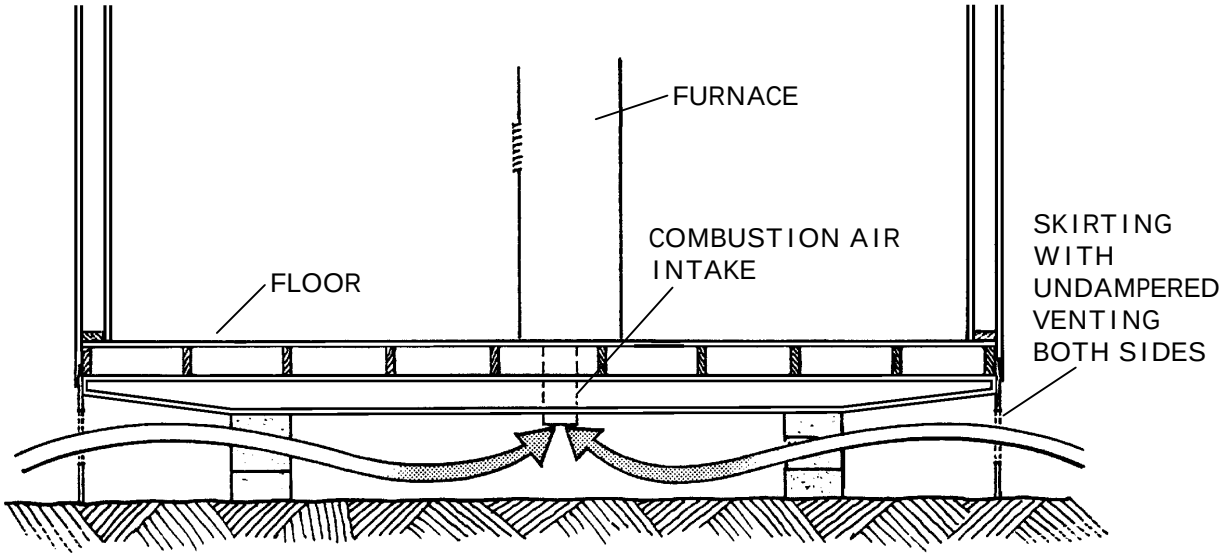
- **Programmable Wall Thermostat**
  - **System powered, <u>not</u> battery powered, on 24 volt systems.**
  - **Digital with anti-short-cycle feature.**
  - **Minimum setback capability of 10°F.**
  - **At least two setback periods per 24 hour day, with change cycle increments being no greater than 30 minutes.**
  - **Manual override and standard alkaline battery backup or other program saving backup system.**
  - **Positive on/off switch that is easily accessible.**
  - **Compatible with the HVAC equipment.**
- **Standard Wall Thermostat**
  - **Alternative when customer refuses programmable thermostat.**
  - **Digital with built in anti-short-cycle feature.**
  - **Conforms with manufacturer's instructions.**
  - **Compatible with the HVAC equipment.**
  - **Includes a positive on/off switch.**



DIGITAL PROGRAMMABLE THERMOSTAT
WITH ON/OFF SWITCH

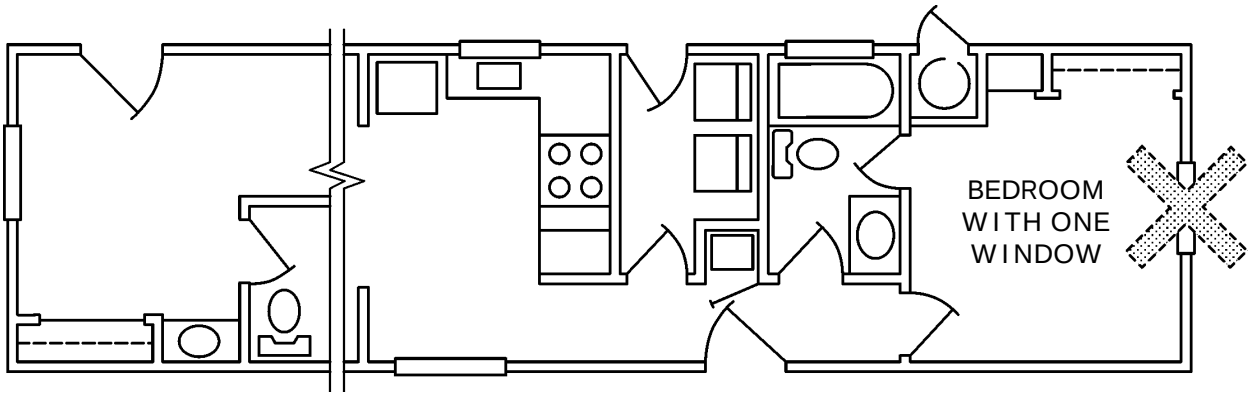
10. COMBUSTION AIR

- **All Furnaces**
  - **Combustion air shall be supplied from outdoors in conformance with furnace listing, manufacturer's instructions, and HCD regulations.**
- **Furnaces Drawing Combustion Air from Undercarriage Space**
  - **Undampered venting shall be present in the skirting.**
  - **Cross-ventilation shall be present, with venting located on at least two different sides of the mobile home skirting.**
  - **Skirting vents on each side shall provide at least 1.5 sq. ft. NFVA for each 25 lineal feet of mobile home length.**



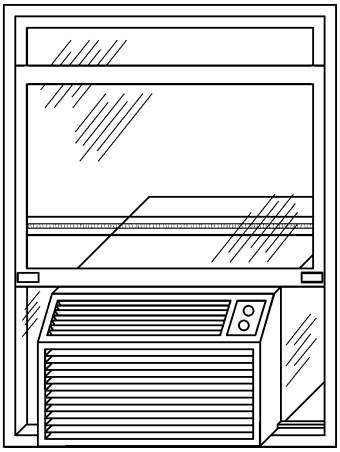
10. EGRESS WINDOWS (continued)

- **Air conditioner shall not be installed in egress windows <u>unless</u>:**
  - **Allowed by customer, and**
  - **One of the following is present in the same room:**
    - **Another operable window which meets egress requirements, <u>or</u>**
    - **An operable exterior door which meets egress requirements.**



12. LOCATION

- **Window-Mount Units**
  - **All Windows**
    - **Air conditioner shall be placed in center of window opening.**
    - **Permanent window panels shall be installed to completely fill empty spaces over 12" wide.**
    - **Side window panels over 12" wide shall be transparent.**
    - **Window panels shall be sealed in place.**
    - **Unit shall be placed on north or east side of home out of direct sun when possible.**
    - **Place unit in the shade of trees and shrubs when feasible.**
  - **Double-Hung Windows**
    - **Air conditioner shall be installed in lower sash opening.**
    - **Lower sash shall seal against unit and side panels.**



AIR CONDITIONER CENTERED
IN WINDOW OPENING

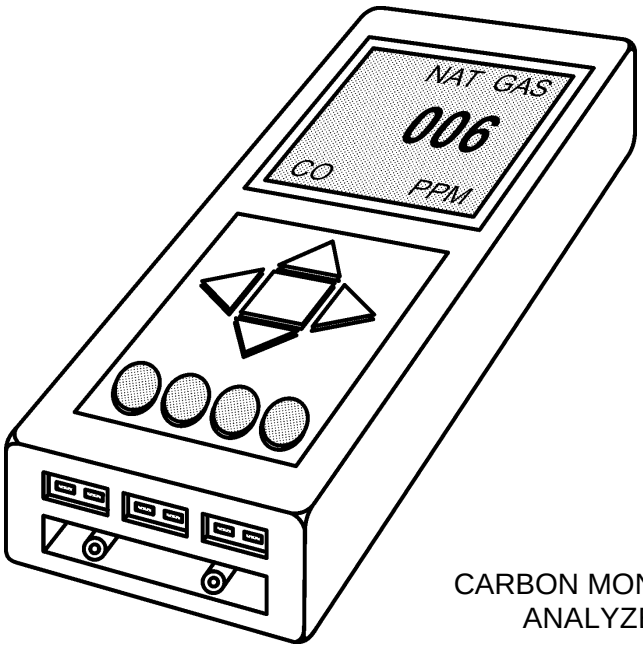
SECTION 1

NATURAL GAS APPLIANCE TESTING (NGAT) STANDARDS

PART 1: GENERAL CRITERIA

1. TEST EQUIPMENT AND ACCESSORIES

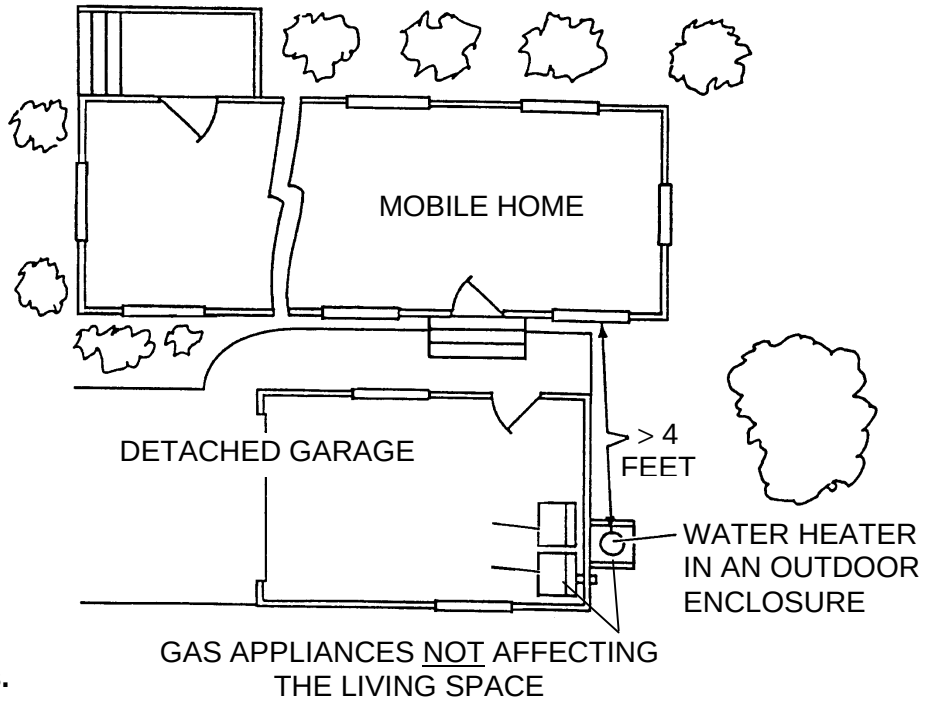
- **Carbon Monoxide Analyzers**
  - **Shall be manufactured under an ISO 9001 quality management system or be ISO 9001 Certified.**
  - **Must, at a minimum, measure CO levels from zero ppm to 999 ppm.**
- **Test Equipment Calibration**
  - **Carbon monoxide analyzers shall be maintained and calibrated in accordance with manufacturer's specifications.**



CARBON MONOXIDE ANALYZER

2. NGAT APPLICABILITY

- **In homes receiving infiltration reduction measures, NGAT shall be conducted when the home:**
  - **Is heated with natural gas, or**
  - **Has one or more other natural gas appliances affecting the living space.**
- **NGAT shall be conducted for all natural gas appliances affecting the living space *except* appliances that are: (a) abandoned*, or (b) inaccessible*.**
- **Natural Gas Appliances Affecting the Living Space**
  - **Appliances affecting the living space are all space heating appliances and other appliances in the following locations:**
    - **Partially or entirely within the living space (including closets located within the envelope but accessed from outdoors).**
    - **An outdoor location within 4' of an operable door or window leading into the living space.**
    - **A location where combustion products from the appliance could infiltrate a forced air duct system (e.g., through a return leak).**
  - **Appliances in all other locations are considered to be appliances not affecting the living space.**
- **Natural Gas Appliances Not Affecting the Living Space**
  - **Only checks for gas leaks are performed.**

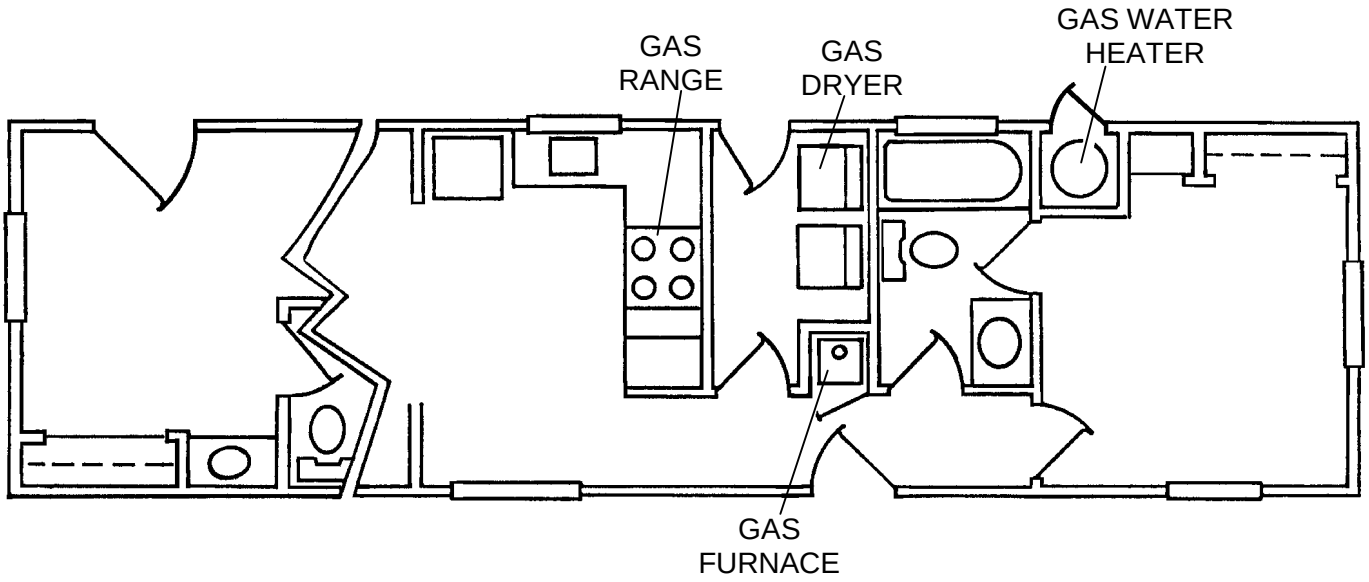


***See Definitions.**

PART 2: PRE-WEATHERIZATION EVALUATIONS

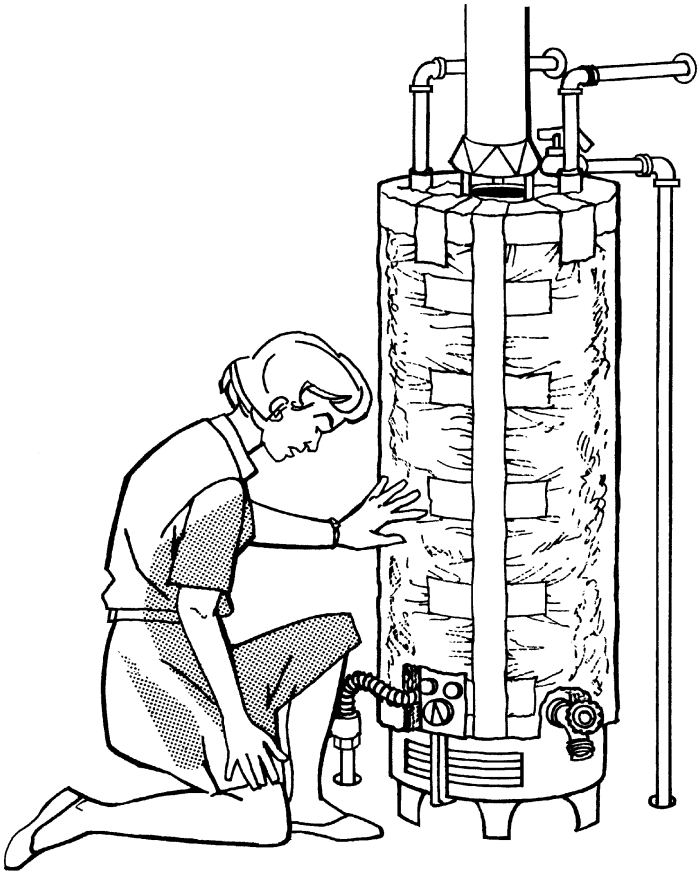
3. PRE-WEATHERIZATION ASSESSMENT

- **The assessment process shall include a check of the following:**
  - **Gas leaks (Item 4)**
  - **Inadequate CVA (Item 5)**
  - **Inadequate clearance between water heater vent termination and evaporative cooler inlet (Item 6)**
  - **Other improper flue/vent terminations (Item 6)**
  - **Inoperable gas appliance (Item 7)**
  - **Gas clothes dryer in the living space not exhausted outdoors (Item 7)**
  - **Unvented combustion space heater in the living space (Item 7)**
  - **Open combustion space or water heating appliance in the living space (Item 7).**
  - **Improper gas-cooking area ventilation (Item 7)**
  - **Defective isolation of return air (Item 7)**
- **Before weatherization work commences, (a) gas leaks shall be repaired, (b) inoperable appliances shall be checked by a utility gas service technician (or designee), and (c) all vent termination clearances/defects and combustion air deficiencies shall be confirmed feasible to correct.**



4. GAS LEAKS

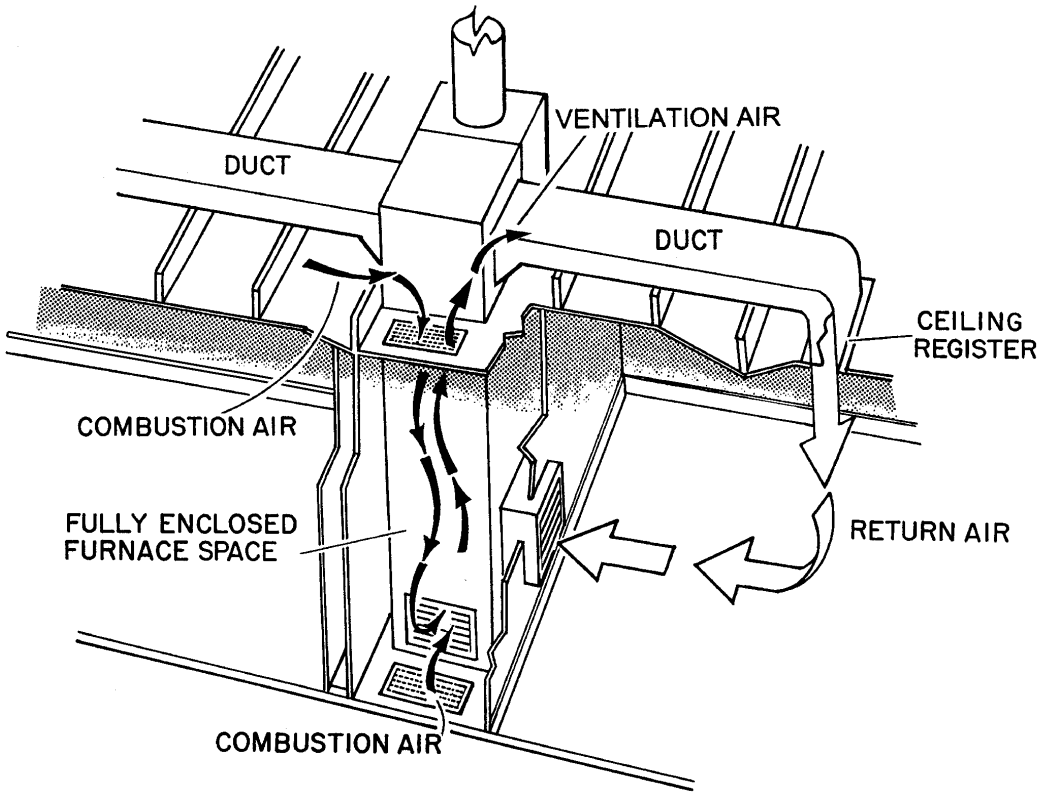
- **Natural gas appliances shall be checked for gas leaks.**
- **Acceptable methods include the following:**
  - **Olfactory (Sniff) Test performed above, but within 2' of, all valves and fittings.**
  - **Application of leak detection liquid to line valves and to fittings on valves, flexible gas connectors, and pipes.**
  - **Air sampling with electronic leak detection equipment near valves, fittings, flexible gas connectors, and pipes.**
- **Gas leaks shall be repaired by a utility gas service technician (or designee).**



CHECKING FOR NATURAL GAS ODOR

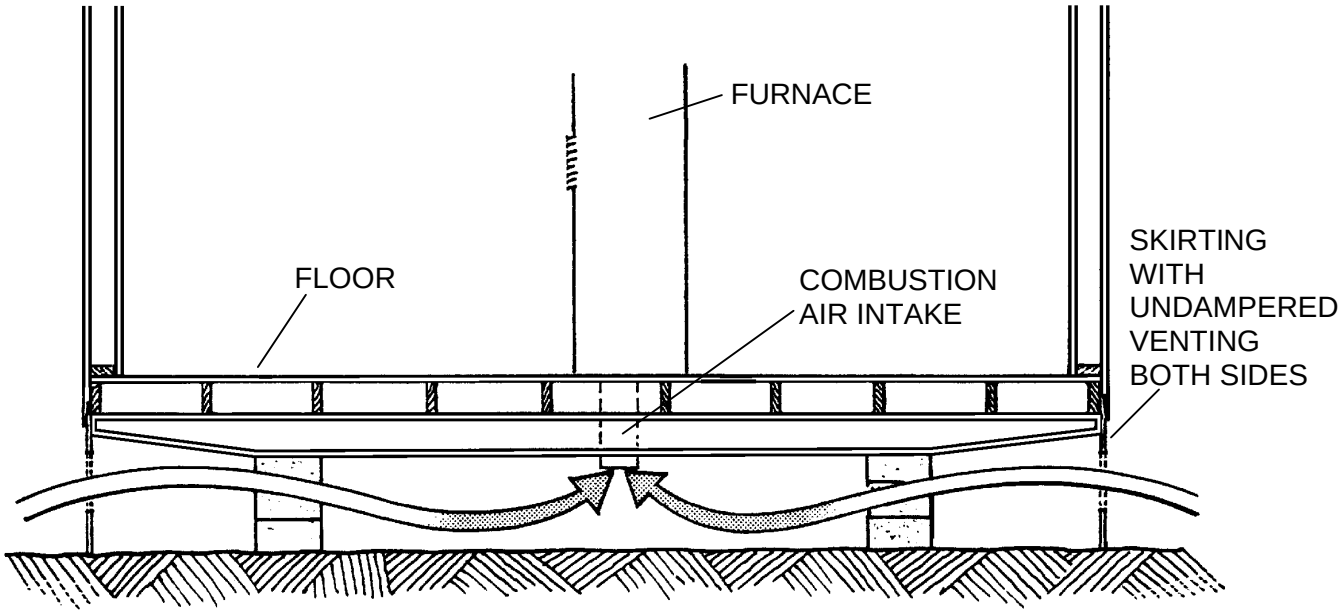
5. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION

- **CVA shall be evaluated for open combustion natural gas heating systems and water heaters (cooking appliances and clothes dryers are *excluded*).**
- **CVA shall comply with these guidelines and Appendix A.**
- **Appliances Drawing *Outdoor* Air through Combustion-Air Openings or Ducts**
  - **An upper opening or duct shall be located above the draft hood, and a lower opening or duct shall be located within 12" of the floor.**
  - **Combustion air openings and vertical ducts shall each provide 1 sq. in. net free venting area (NFVA) per 4,000 Btu/hr of input.**
  - **Horizontal ducts shall each provide 1 sq. in. NFVA per 2,000 Btu/hr of input.**
  - **Combustion air may also be obtained through a single upper vent or duct to outdoors under the following conditions:**
    - **Vent NFVA is at least: (a) 1 sq. in. per 3,000 Btu/hr input, and (b) not less than the sum of the cross-sectional areas of all vent connectors in the space.**
    - **Equipment has clearances of at least 1" sides and back, and 6" in front.**



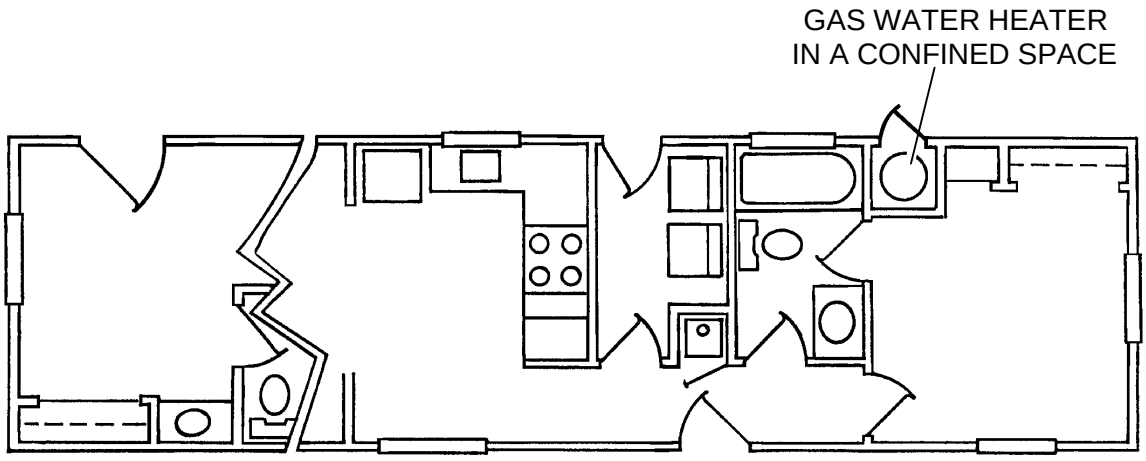
5. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

- **When Appliances Draw Combustion Air from Outdoors**
  - **Combustion air may be obtained <u>from outdoors</u> by means of:**
    - **Permanent openings (undampered vents) of the required size directly to outdoors through enclosure floor, roof or walls; <u>or</u>**
    - **Continuous vertical or horizontal ducts of the required cross-sectional area extending from the enclosure to outdoors.**
  - **Combustion air may be obtained <u>from under the floor</u>, provided:**
    - **Undampered venting is present in the skirting.**
    - **Cross-ventilation is present, with venting located on at least two different sides of the mobile home.**
    - **Skirting vents on each side provide at least 1.5 sq. ft. NFVA for each 25 lineal feet of mobile home length.**
  - **Louvers, Grilles, and Screens**
    - **Blocking effects of louvers, grilles, and screens shall be considered when calculating NFVA of an opening (see Appendix A).**



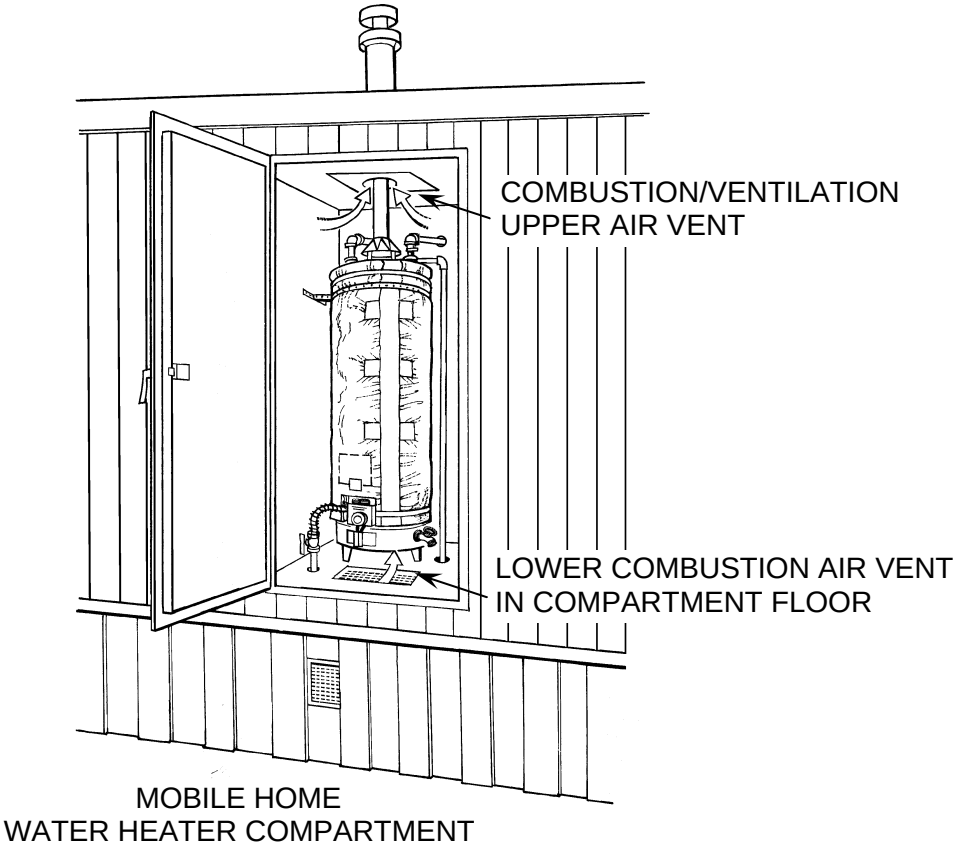
5. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

- **When Appliances Draw Combustion Air from <u>Indoors</u>**
  - **Unconfined Space:**
    - **A room/space that has a volume of at least 50 cu. ft. per 1,000 Btu/hr total input rating of the open combustion furnace and/or water heater in that room/space.**
    - **Combustion air <u>is</u> considered adequate.**
  - **Confined Space:**
    - **A room/space that has a volume of <u>less than</u> 50 cu. ft. per 1,000 Btu/hr total input of the open combustion furnace and/or water heater in that room/space.**
    - **Combustion air is <u>not</u> adequate, and**
    - **Proper vent openings to adjacent space(s) must be present.**
  - **Confined spaces outside the mobile home shall not be vented into the living space.**



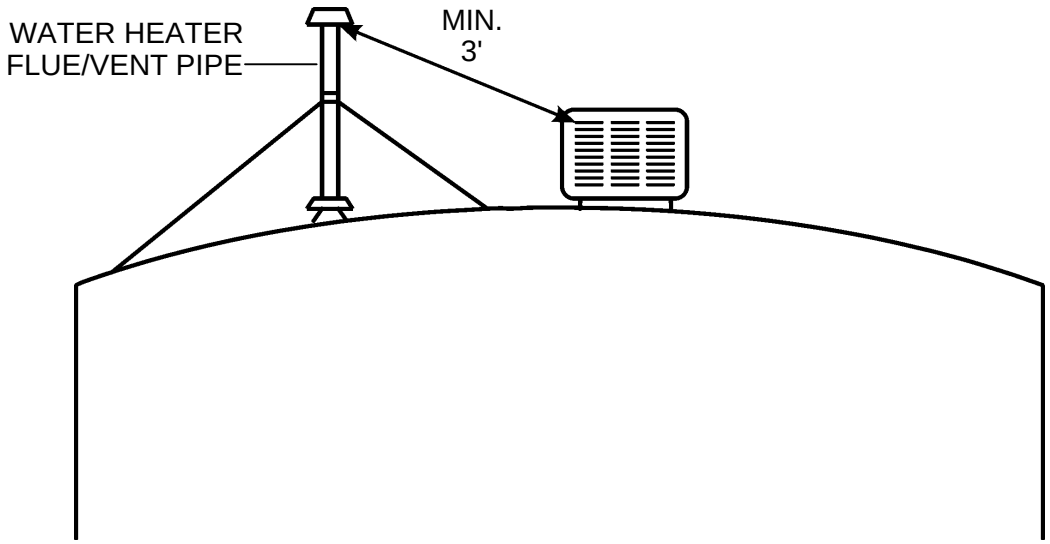
5. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

- **Water Heater Combustion Air Venting.**
  - **An *upper* combustion air vent shall be present, which may consist of one of the following:**
    - **A double concentric vent pipe in the ceiling:**
      - **Appliance vent pipe surrounded by air space and a larger-diameter outer pipe.**
      - **NFVA is the cross-sectional area of the larger pipe minus the cross-sectional area of the smaller pipe.**
    - **An undampered vent (screen or grille) installed in the door or outer wall and located higher than the draft hood.**
  - **A *lower* combustion air vent shall be present, which may be an undampered vent (screen or grille) to the outdoors, located in:**
    - **The enclosure floor, or**
    - **The door or wall and located not more than 1' above the floor.**
  - **A continuous duct extending from the enclosure to the outdoors may be used to supply upper or lower combustion air venting.**



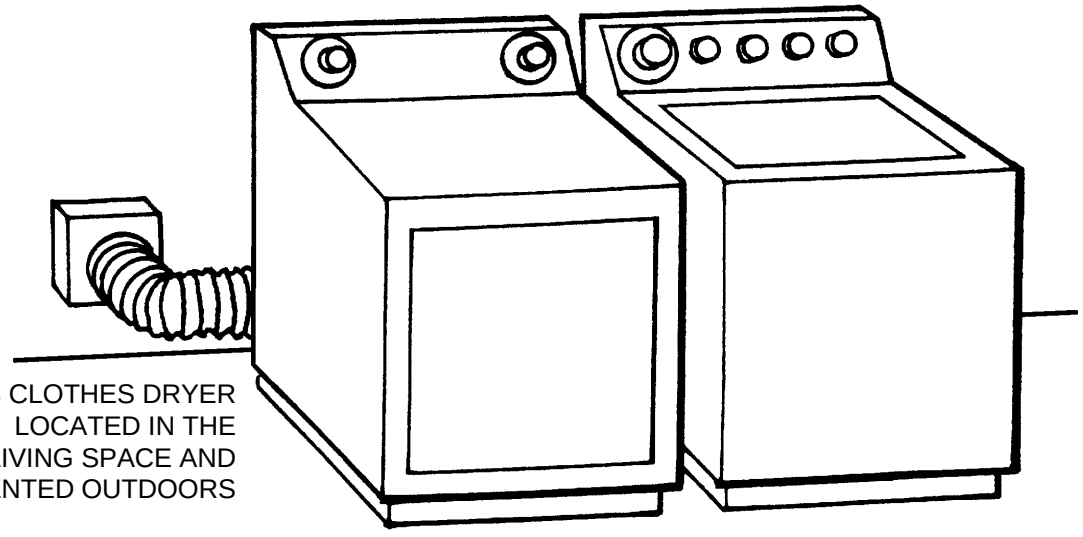
6. FLUE AND VENT SYSTEM EXAMINATION

- **All gas flues and vents:**
  - **Shall terminate outdoors.**
  - **Shall not terminate underneath the mobile home.**
- **Flue and Vent Systems Terminating Near an Evaporative Cooler**
  - **A Water Heater flue/vent pipe shall not terminate within 3' of the cooler air intake.**
  - **A Furnace flue/vent pipe shall not terminate within 3' of the cooler air intake unless:**
    - **All cooler discharge openings are equipped with a vent cover.**
    - **The client is informed of the non-conforming flue/vent and advised to keep cover(s) in place during the heating season.**



7. ADDITIONAL EXAMINATIONS OF NATURAL GAS APPLIANCES

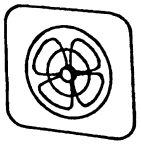
- **Inoperable Gas Appliances**
  - **Inoperable natural gas appliances must be checked by a utility gas service technician (or designee), *unless* they are: (a) abandoned*, or (b) inaccessible*.**
- **Infiltration reduction measures will not be installed if any of the following conditions are present:**
  - **<u>Gas clothes dryer</u> located in the living space but <u>not</u> exhausted outdoors.**
  - **<u>Return leak</u> present that can draw in combustion products from the FAU or other open combustion appliances (e.g., through a return leak).**
  - **<u>Unvented combustion space heater</u> (e.g., gas or kerosene unit) present in the living space.**
  - **Open combustion furnace or water heater present in the living space.**



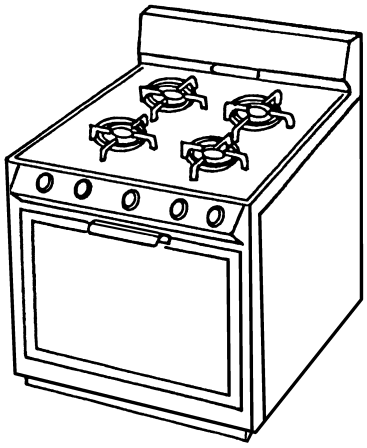
GAS CLOTHES DRYER LOCATED IN THE LIVING SPACE AND VENTED OUTDOORS

7. ADDITIONAL EXAMINATIONS OF NATURAL GAS APPLIANCES (continued)

- **Cooking Area Ventilation for Gas Appliances**
  - **A functional vent to outdoors must be present above gas cooking appliances:**
    - **In the ceiling or a wall.**
    - **Within 10' of the appliances.**
  - **The vent may be either of the following:**
    - **An operable exhaust fan equipped with an automatic or manual damper.**
    - **A metal duct with a cross-sectional area of at least 12.5 sq. in., and minimum dimension of 2" (e.g., 2" x 6.25" rectangular duct or 4" round duct).**

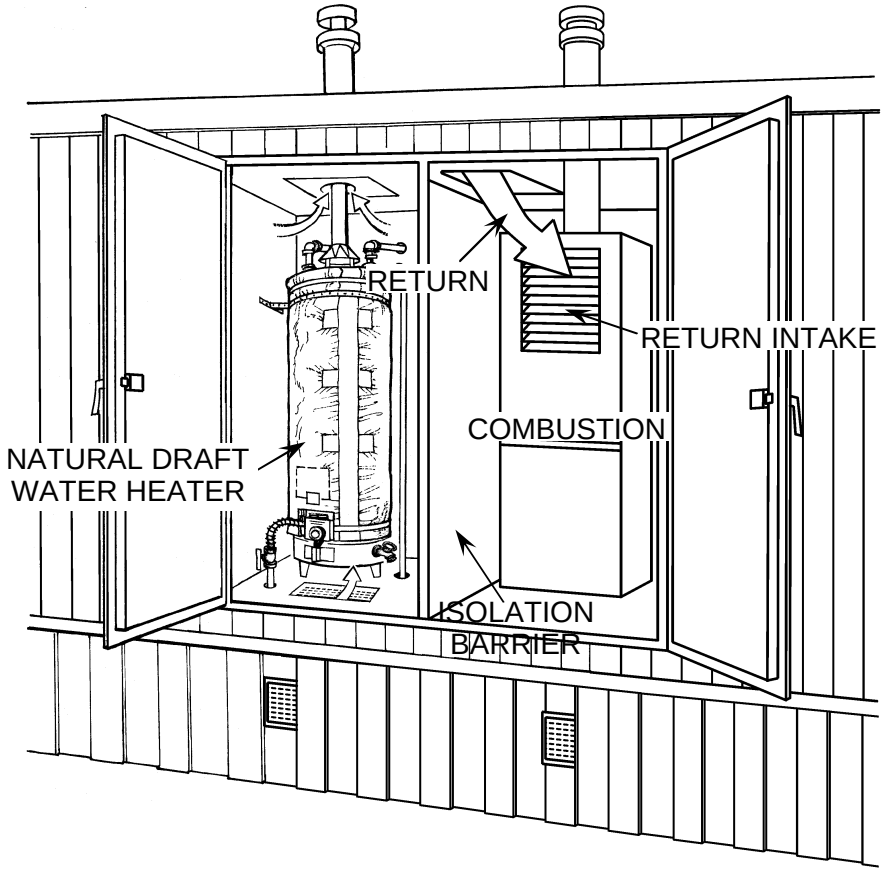


COOKING APPLIANCE VENTILATION PROVIDED BY A FUNCTIONAL EXHAUST FAN



7. ADDITIONAL EXAMINATIONS OF NATURAL GAS APPLIANCES (continued)

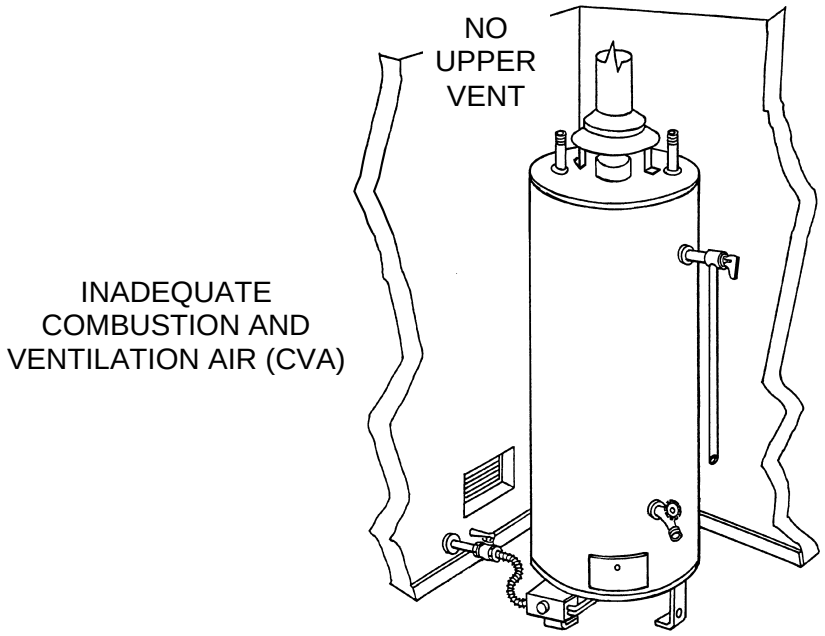
- **Isolation of Return Air**
  - **The return air system shall not have leaks which:**
    - **Depressurize any open combustion appliance enclosure.**
    - **Draw in combustion air or combustion byproducts from any open combustion appliance (e.g., from the furnace itself or a nearby water heater).**
    - **Depressurize or draw air from a space where hazardous chemicals are stored or toxic fumes may be present.**
  - **The following conditions are <u>not</u> allowed:**
    - **An open combustion FAU draws non-ducted return air through an intake in the furnace cabinet.**
    - **A closed combustion FAU is located in an appliance enclosure adjacent to an open combustion water heater when:**
      - **The furnace enclosure is part of the return system, <u>and</u>**
      - **The two appliances are <u>not</u> separated by an airtight barrier.**
  - **Any condition which allows pollutants to be drawn into the FAU return shall be corrected when Infiltration Reduction Measures are installed.**



PART 3: WEATHERIZATION CREW VERIFICATIONS

8. PRELIMINARY VISUAL EVALUATIONS

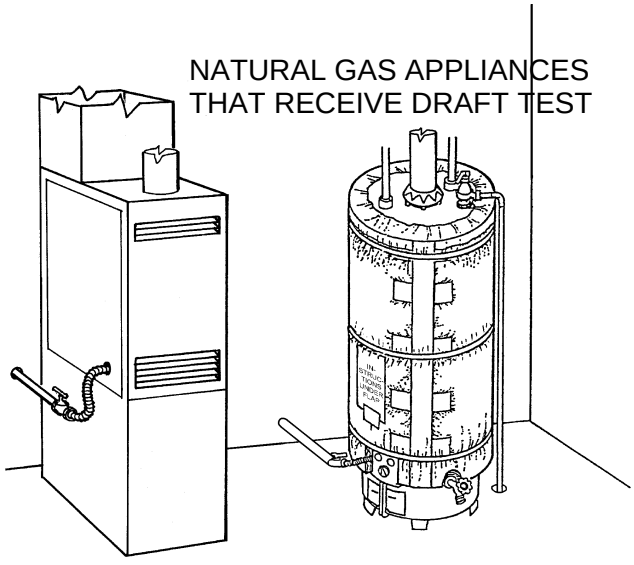
- **A check shall be made for the following conditions, which preclude installation of infiltration measures unless repair is feasible:**
  - **Gas leaks and soldered gas connectors (Item 10)**
  - **Inadequate CVA (Item 11)**
  - **Inadequate clearance between water heater vent termination and evaporative cooler inlet (Item 12)**
  - **Other improper flue/vent terminations (Item 12)**
  - **Draft hood improper—misaligned, missing, or doubled (Item 12)**
  - **Flue/vent hazard, such as disconnection, hole/leak indoors, not extended outdoors (Item 12)**
  - **Flue/vent connection to a solid-fuel chimney (Item 12)**
  - **Inoperable gas appliance (Item 13)**
  - **Appliance components missing or damaged (Item 13)**
  - **Gas clothes dryer located in the living space but <u>not</u> exhausted outdoors (Item 13)**
  - **Defective isolation of return air (Item 13)**
  - **Unvented combustion space heater in the living space (Item 13)**
  - **Open combustion space or water heating appliance located in the living space (Item 13)**
  - **When gas log is primary heat source, fireplace damper not blocked partially open (Item 20)**



PART 4: POST-WEATHERIZATION NGAT PROCEDURES

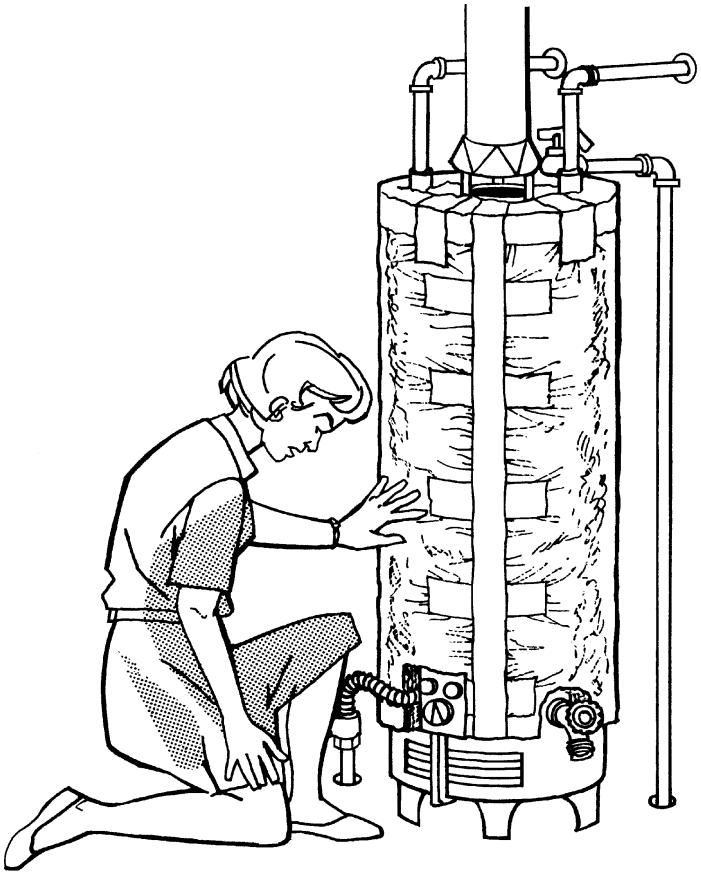
9. POST-WEATHERIZATION NGAT

- **Post-Weatherization NGAT shall be performed, which shall include the following procedures:**
  - **CO Analyzer zeroed outdoors.**
  - **Room Ambient CO Test with gas appliances off.**
  - **Check for gas leaks.**
  - **CVA Evaluation.**
  - **Appliance-off visual inspection of appliances, components, and flue/vent systems.**
  - **Appliance Ambient CO Test with natural gas appliances operated individually.**
  - **Draft Test on natural draft space and water heating appliances.**
  - **Exhaust/flue CO Test and Draft Test on natural gas fireplace logs.**
  - **Appliance-on visual inspection of appliances.**
- **Appliances that Fail NGAT Protocol**
  - **If a Room Ambient or Appliance Ambient CO measurement equals or exceeds the action level of 10 ppm, unit(s) believed to be causing elevated CO reading shall be serviced/adjusted by a utility gas service technician (or designee) and, when applicable, repaired or replaced.**
  - **An appliance that has inadequate draft or is inoperable shall be serviced/adjusted by a utility gas service technician (or designee) and, when applicable, repaired or replaced .**
  - **All units repaired or replaced shall undergo post-repair/replacement testing per Item 23.**



10. GAS LEAKS AND SOLDERED GAS CONNECTORS

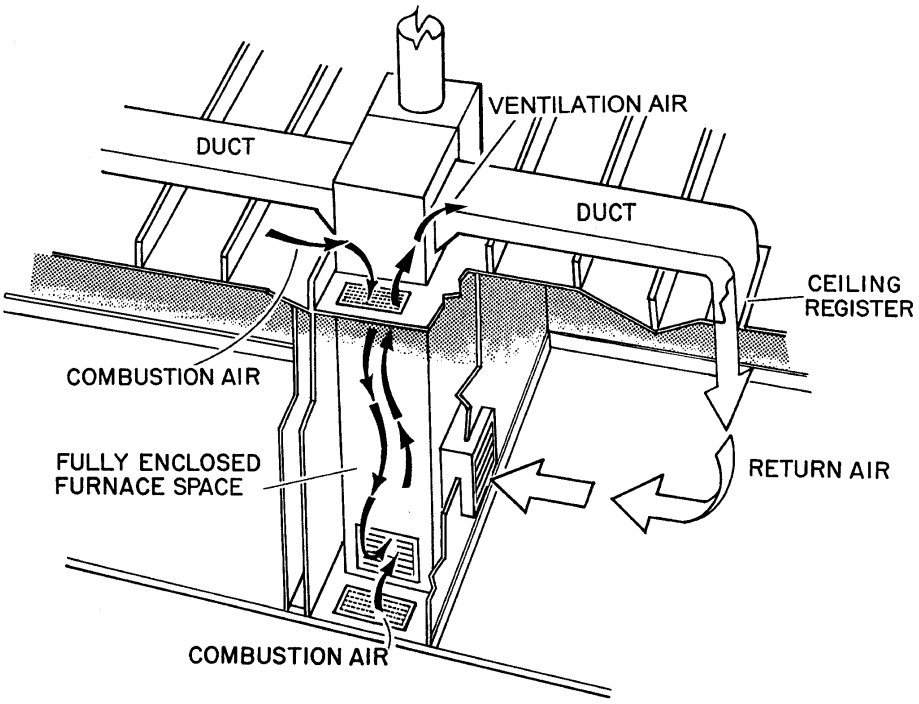
- **Natural gas appliances shall be checked for gas leaks:**
  - **Prior to operating the appliance for testing.**
  - **With combustion appliances and exhaust fans/devices off.**
- **Appliances shall be checked for natural gas leaks using one or more of the following methods:**
  - **Olfactory (Sniff) Test performed above, but within 2' of, all valves and fittings.**
  - **Application of leak detection liquid to line valves and to fittings on valves, flexible gas connectors, and pipes.**
  - **Air sampling with electronic leak detection equipment near valves, fittings, flexible gas connectors, and pipes.**
- **When a gas leak is detected, inspection shall be conducted by a utility gas service technician (or designee).**
- **Leaks shall be repaired by a utility gas service technician (or designee) before appliances are operated for natural gas appliance tests.**
- **When faint gas odors are present, testing may occur; however, appliance shall be checked by a utility gas service technician (or designee).**
- **Soldered Gas Connectors**
  - **Old-style flexible gas connectors with soldered-on fittings shall be replaced with a new listed flexible gas connector.**



CHECKING FOR NATURAL GAS ODOR

11. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION

- **CVA shall be evaluated for open combustion natural gas heating systems and water heaters (cooking appliances and clothes dryers are *excluded*).**
- **CVA shall comply with these guidelines and Appendix A, unless superseded by manufacturer's instructions or HCD requirements.**
- **Appliances Drawing *Outdoor* Air through Combustion-Air Openings or Ducts**
  - **An *upper* opening or duct shall be located within 12" of the enclosure ceiling, <u>and</u> a *lower* opening or duct shall be located within 12" of the floor.**
    <u>*Exception*</u>: Pre-existing upper openings and ducts are acceptable at any height above the draft hood.
  - **Combustion air openings and vertical ducts shall each provide 1 sq. in. net free venting area (NFVA) per 4,000 Btu/hr of input.**
  - **Horizontal ducts shall each provide 1 sq. in. NFVA per 2,000 Btu/hr of input.**
  - **Combustion air may also be obtained through a single upper vent or duct to outdoors under the following conditions:**
    - **Vent NFVA is at least: (a) 1 sq. in. per 3,000 Btu/hr input, and (b) not less than the sum of the cross-sectional areas of all vent connectors in the space.**
    - **Equipment has clearances of at least 1" sides and back, and 6" in front.**



11. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

- **When Appliance s Draw Combustion Air from Outdoors**
  - **Combustion air may be obtained from outdoors by means of:**
    - **Permanent openings (undampered vents) of the required size directly to outdoors through enclosure floor, roof or walls; or**
    - **Continuous vertical or horizontal ducts of the required cross-sectional area extending from the enclosure to outdoors.**
  - **Combustion air may be obtained from under the floor, provided:**
    - **Undampered venting is present in the skirting.**
    - **Cross-ventilation is present, with venting located on at least two different sides of the mobile home.**
    - **Skirting vents on each side provide at least 1.5 sq. ft. NFVA for each 25 lineal feet of mobile home length.**
- **Combustion-Air Ducts and Sleeves**
  - **Ducts and sleeves shall be a minimum of 26 gage galvanized steel or 24 gage aluminum, and ducts shall have a minimum cross-sectional dimension of 3".**
- **Louvers, Grilles, and Screens**
  - **Covering of 1/4" corrosion-resistant screen mesh is required on combustion air openings to outdoors.**
  - **Blocking effects of louvers, grilles, and screens shall be considered when calculating NFVA of an opening (see Appendix A).**
- **When Appliances Draw Combustion Air from Indoors**
  - **Unconfined Space:**
    - **A room/space that has a volume of at least 50 cu. ft. per 1,000 Btu/hr total input rating of the open combustion furnace and/or water heater in that room/space.**
    - **Combustion air is considered adequate.**

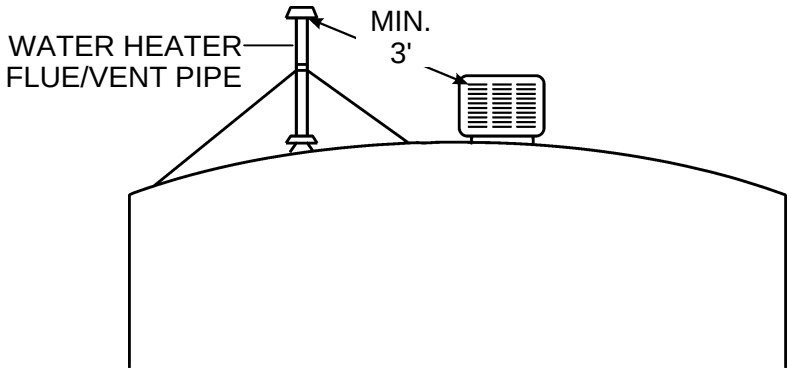
SOURCES OF COMBUSTION AIR	
OUTDOORS	**UNDER FLOOR**
• **Permanent openings with undampered vents or continuous ducts (vertical or horizontal).** • **Vent directly to outdoors.** • **1/4" screen mesh on all combustion-air openings.**	• **Free flow of air.** • **Unobstructed openings to outdoors on each side that provide at least 1.5 sq. ft. NFVA for each 25 lineal feet of the mobile home length.**

11. COMBUSTION AND VENTILATION AIR (CVA) EVALUATION (continued)

- **When Appliances Draw Combustion Air from Indoors (continued)**
  - **Confined Space:**
    - **A room/space that has a volume of less than 50 cu. ft. per 1,000 Btu/hr total input of the open combustion furnace and/or water heater in that room/space.**
    - **Combustion air is not adequate.**
    - **Proper vent openings to adjacent space(s) must be present.**
  - **Confined spaces outside the mobile home shall not be vented into the living space.**

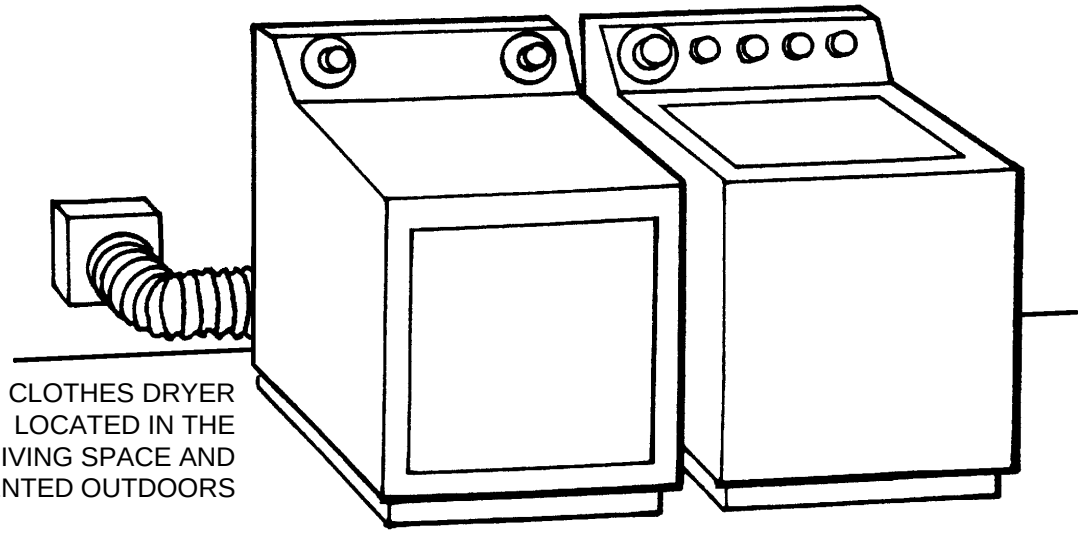
12. FLUE AND VENT SYSTEM EXAMINATION

- **Flue and vent systems shall be free of:**
  - **Draft hood defects:**
    - **Improperly installed or positioned.**
    - **Multiple (stacked) draft hoods on a single appliance.**
    - **Missing (no draft hood at all).**
  - **Disconnections or unsafe joints (e.g., loose, unsecured, etc.).**
  - **Holes or other hazardous conditions requiring repair.**
  - **Connection to a solid-fuel appliance chimney.**
- **All gas flues and vents:**
  - **Shall terminate outdoors.**
  - **Shall not terminate underneath the mobile home (reference HUD Code: 24 CFR, Chapter XX, Part 3280, Subpart H).**
- **Flue and Vent Systems Terminating Near an Evaporative Cooler**
  - **A Water Heater flue/vent pipe shall not terminate within 3' of the cooler air intake.**
  - **A Furnace flue/vent pipe shall not terminate within 3' of the cooler air intake unless:**
    - **All cooler discharge openings are equipped with a vent cover.**
    - **The client is informed of the non-conforming flue/vent and advised to keep cover(s) in place during the heating season.**



13. VISUAL APPLIANCE CHECKS

- **Inoperable Appliances**
  - **Inoperable natural gas appliances must be checked by a utility gas service technician (or designee), *unless* they are: (a) abandoned*, or (b) inaccessible*.**
- **The following conditions are <u>not</u> acceptable when Infiltration Reduction Measures are installed:**
  - **<u>Gas clothes dryer</u> located in the living space but <u>not</u> exhausted outdoors.**
  - **<u>Return leak</u> present that can draw in combustion products from the FAU or other open combustion appliances.**
  - **<u>Unvented combustion space heater</u> (e.g., gas or kerosene unit) present in the living space.**
  - **Open combustion furnace or water heater present in the living space.**

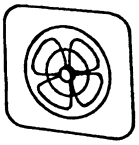


GAS CLOTHES DRYER LOCATED IN THE LIVING SPACE AND VENTED OUTDOORS

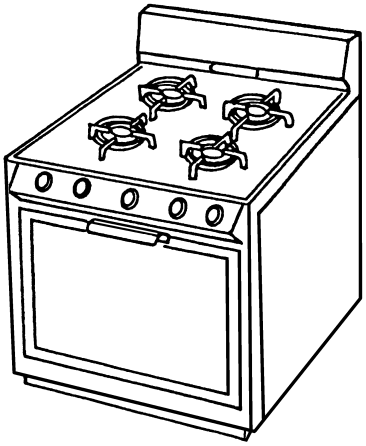
***See Definitions.**

13. VISUAL APPLIANCE CHECKS (continued)

- **Cooking Area Ventilation for Gas Appliances**
  - **A functional vent to outdoors must be present above gas cooking appliances:**
    - **In the ceiling or a wall.**
    - **Within 10' of the appliances.**
  - **The vent may be either of the following:**
    - **An operable exhaust fan equipped with an automatic or manual damper.**
    - **A metal duct with a cross-sectional area of at least 12.5 sq. in., and minimum dimension of 2" (e.g., 2" x 6.25" rectangular duct or 4" round duct).**

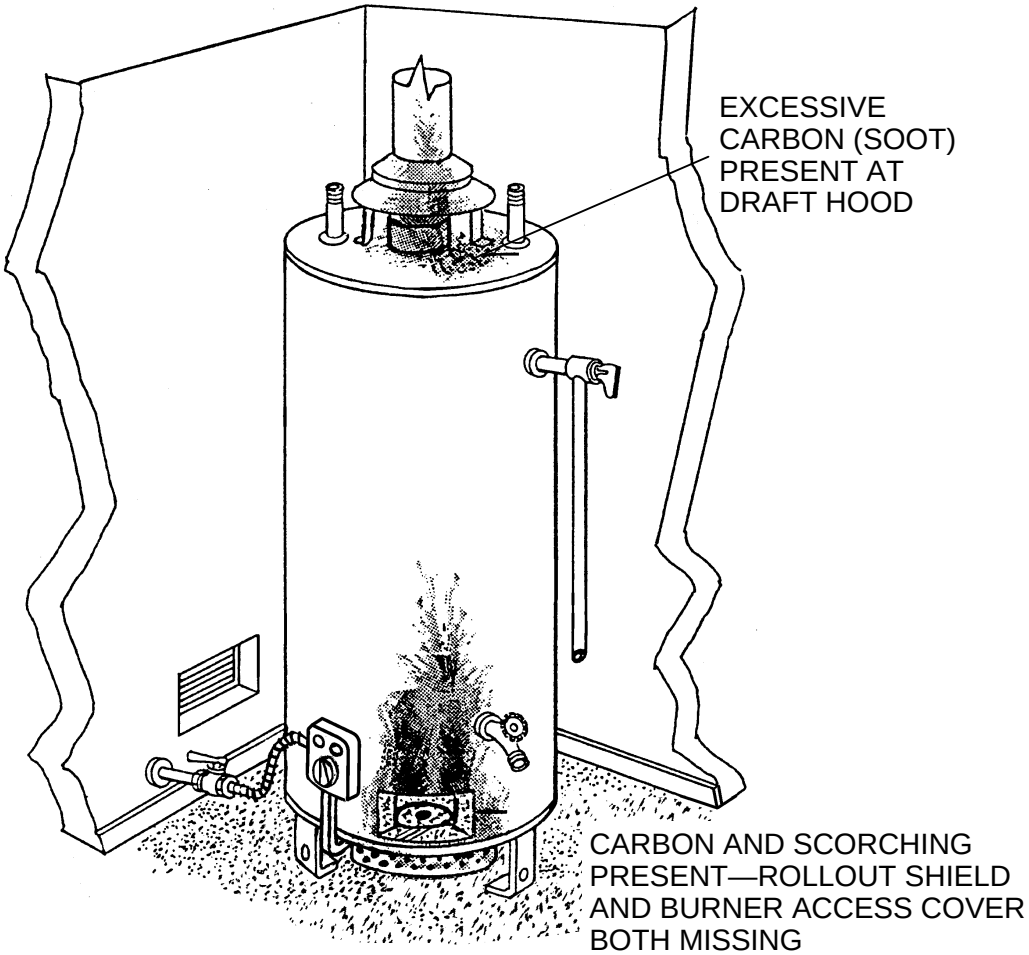


COOKING APPLIANCE VENTILATION PROVIDED BY A FUNCTIONAL EXHAUST FAN



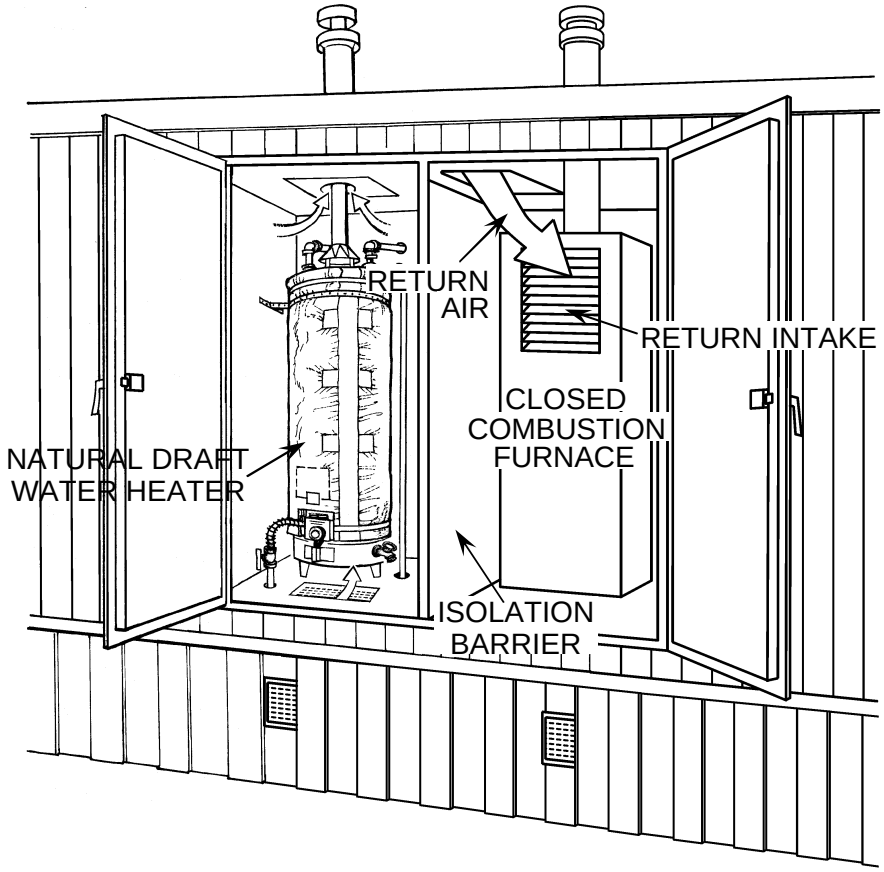
13. VISUAL APPLIANCE CHECKS (continued)

- **Appliance Components**
  - **The following appliance components shall be present:**
    - **Appliance door(s).**
    - **Combustion chamber access door(s).**
  - **Water heater shall have at least one access cover or roll-out shield.**
  - **Roll-out shield required on furnace when the unit was manufactured with a roll-out shield.**
- **Carbon and Rust**
  - **The top of the burner(s), the heat exchanger, draft hood and flue/vent pipe shall be examined for excessive amounts of carbon or rust.**



13. VISUAL APPLIANCE CHECKS (continued)

- **Isolation of Return Air**
  - **The return air system shall not have leaks which:**
    - **Depressurize any open combustion appliance enclosure.**
    - **Draw in combustion air or combustion byproducts from any open combustion appliance (e.g., from the furnace itself or a nearby water heater).**
    - **Depressurize or draw air from a space where hazardous chemicals are stored or toxic fumes may be present.**
  - **The following conditions are <u>not</u> allowed:**
    - **An open combustion FAU draws non-ducted return air through an intake in the furnace cabinet.**
    - **A closed combustion FAU is located in an appliance enclosure adjacent to an open combustion water heater when:**
      - **The furnace enclosure is part of the return system, <u>and</u>**
      - **The two appliances are <u>not</u> separated by an airtight barrier.**
  - **Any condition which allows pollutants to be drawn into the FAU return shall be corrected.**

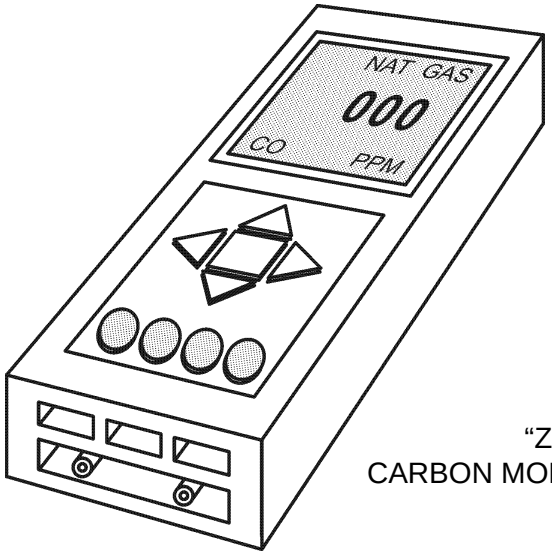


14. TEST CONDITIONS FOR ROOM AMBIENT CO TEST

- **Test shall be performed *prior* to operating any appliances.**
- **Test Conditions**
  - **All gas appliances in the living space turned off (e.g., at the thermostat).**
    ***Exception*: Water heater pilot may be operating, but main burner shall not be operating.**
  - **Air handler and all exhaust fans and air-exhausting devices turned off.**
  - **Exterior doors and windows closed.**
  - **Interior doors:**
    - **All interior room doors open.**
    - **Appliance enclosure doors closed.**
  - **Fireplace damper closed when feasible (no fire or hot coals).**
  - **If an interior cooler cover is available, it shall be in place.**

15. CO ANALYZER "ZEROING"

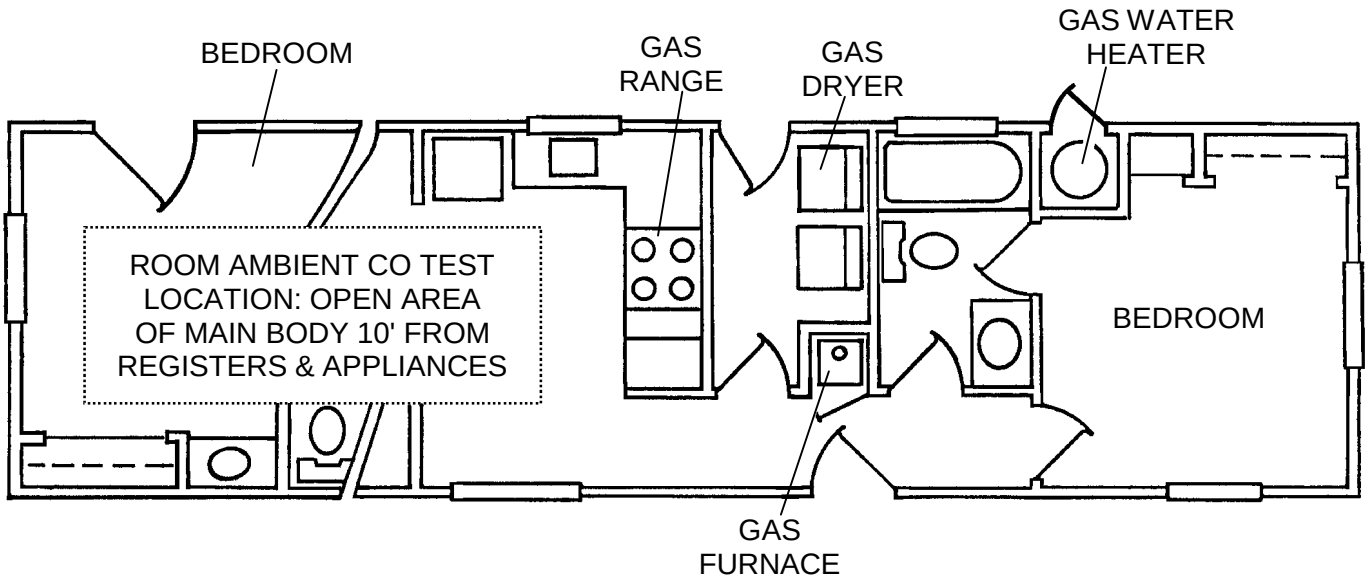
- **Just prior to performing Room Ambient CO Test, the analyzer shall be adjusted outdoors to read zero ppm CO.**
- **CO analyzer shall be protected from outdoor sources of CO and from wind bearing pollutants.**
- **Analyzer shall remain on during entire ambient test sequence when possible.**
- **If turned off during ambient testing, zeroing process shall be repeated before resuming tests.**



"ZEROED"
CARBON MONOXIDE ANALYZER

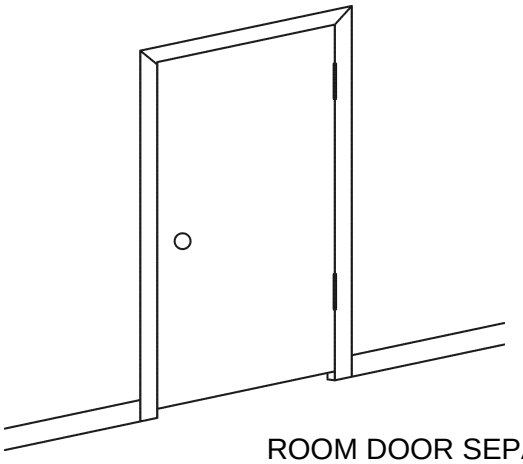
16. CONDUCTING ROOM AMBIENT CO TEST

- **Room Ambient CO Test shall be conducted immediately after zeroing the CO analyzer:**
  - **In an open area in the main body of the living space (e.g., in the center of the living room or living/dining combination area).**
  - **10' away from combustion appliances and supply registers (less than 10' away acceptable in smaller rooms).**
  - **6' above the floor.**
- **If Room Ambient CO Test measurement is 10 ppm or greater:**
  - **The living space shall be ventilated and the test repeated when a condition such as the following exists:**
    - **Heavy smokers are present, or**
    - **Wood-burning or unvented heating/cooking appliances were operating within the preceding half hour.**
  - **Appliance Ambient CO Tests shall be conducted even if CO is 10 ppm or greater after ventilation and repeat of the Room Ambient CO Test.**



17. TEST CONDITIONS FOR APPLIANCE-ON CO AND DRAFT TESTS

- **The following test conditions shall be established for Appliance Ambient CO Tests and Draft Tests.**
- **Door/Window Positions for Tests in the Living Space**
  - **The following shall be closed:**
    - **All exterior doors and windows.**
    - **Doors to rooms containing a supply register when a central return is outside the room.**
    - **Appliance enclosure doors (except during tests).**
  - **The following shall be open:**
    - **Doors to all other living areas and rooms.**
    - **Door to utility room with clothes dryer exhausted outdoors. Exception: When a natural draft appliance in that room is tested, the door shall be closed.**



ROOM DOOR SEPARATING
SUPPLY REGISTERS
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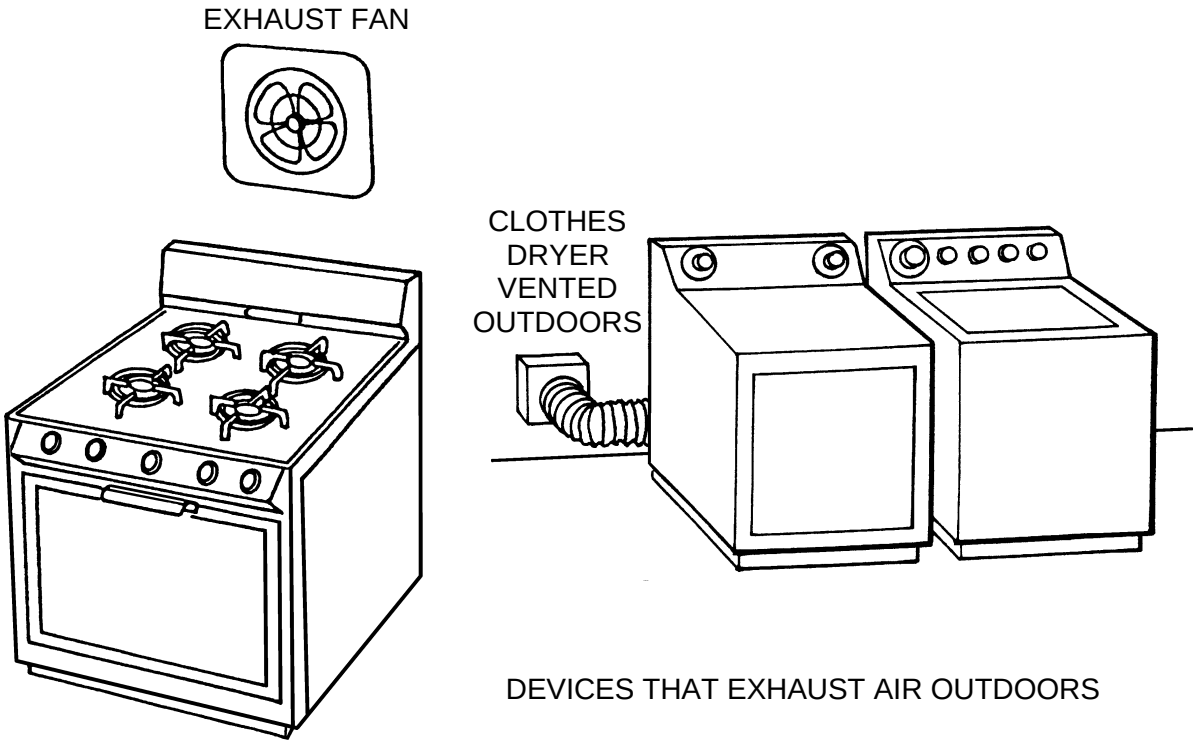
17. TEST CONDITIONS FOR APPLIANCE-ON CO AND DRAFT TESTS (continued)

- **The following must be operating during tests:**
  - **FAU air handler.**
  - **All devices that exhaust air from the space containing an appliance being tested:**
    - **Include kitchen exhaust fans, bathroom and utility room fans, clothes dryer, central vacuum system, and manually-controlled attic ventilators.**
    - **Exclude whole house fan.**
- **FAU air filter(s) must be clean or shall be removed prior to testing.**
- **Clothes dryer lint screen shall be clean.**
- **Supply registers shall be open.**
- **If an interior cooler cover is available, it shall be in place.**



DEVICES THAT EXHAUST AIR OUTDOORS

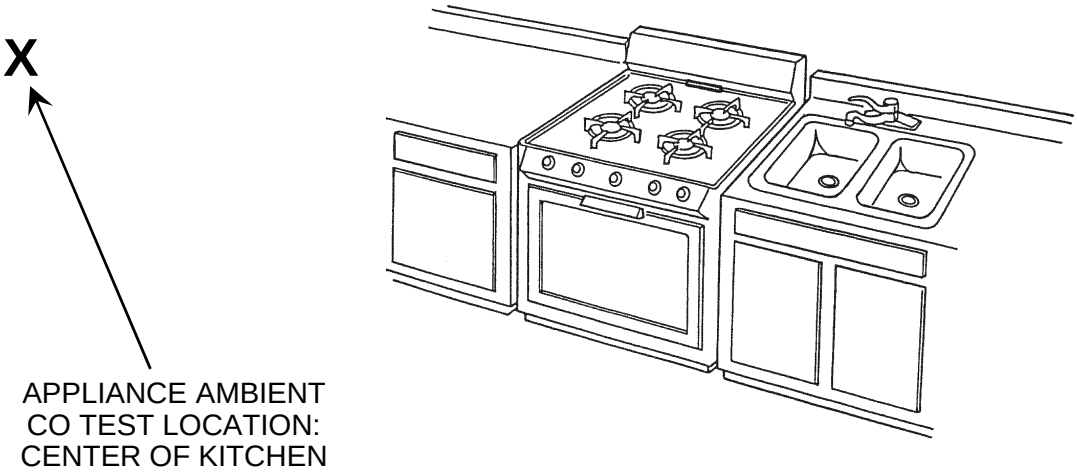
18. TEST PROCEDURES FOR APPLIANCE AMBIENT CO TEST

- **Test conditions shall be established as prescribed in Item 17.**
- **Natural Gas Heating Appliances**
  - **Heating appliance(s) shall be operated for a minimum of 5 minutes.**
  - **All other gas appliances shall remain off.**
    ***Exception*: Water heater pilot may be operating, but main burner shall not be operating.**
  - **CO shall be measured in the following locations:**
    - **Ducted units: In the supply register nearest the furnace.**
    - **Heaters without ducts (e.g., direct vent furnaces): In the atmosphere directly above the top of the unit.**
  - **The heating system shall be checked by a utility gas service technician (or designee) if Appliance Ambient CO Test CO ppm is:**
    - **Higher than Room Ambient CO Test CO ppm, or**
    - **Above 9 ppm.**
- **Natural Gas Water Heater**
  - **Storage water heater shall be operated for a minimum of 5 minutes.**
  - **Tankless water heaters shall be operated for a minimum of 1 minute.**
  - **All other gas appliances shall remain off.**
  - **CO shall be measured in the atmosphere directly above the top of the water heater (and draft hood or inducer, if applicable).**
  - **The water heater shall be checked by a utility gas service technician (or designee) if Appliance Ambient CO Test CO exceeds 9 ppm.**
- **Natural Gas Log**
  - **An exhaust/flue CO test shall be conducted per Item 20.**
- **Natural Gas Clothes Dryer**
  - **No CO test required.**

APPLIANCE AMBIENT CO TEST CO ANALYZER PROBE LOCATIONS FOR HEATING APPLIANCES AND WATER HEATERS
• DUCTED UNITS: INSIDE SUPPLY REGISTER NEAREST THE FAU WITH TEST PROBE DIRECTED INTO THE AIR FLOW.
• NON-DUCTED HEATERS: IN THE ATMOSPHERE ABOVE THE UNIT.
• WATER HEATERS: IN THE ATMOSPHERE ABOVE THE UNIT AND DRAFT HOOD.

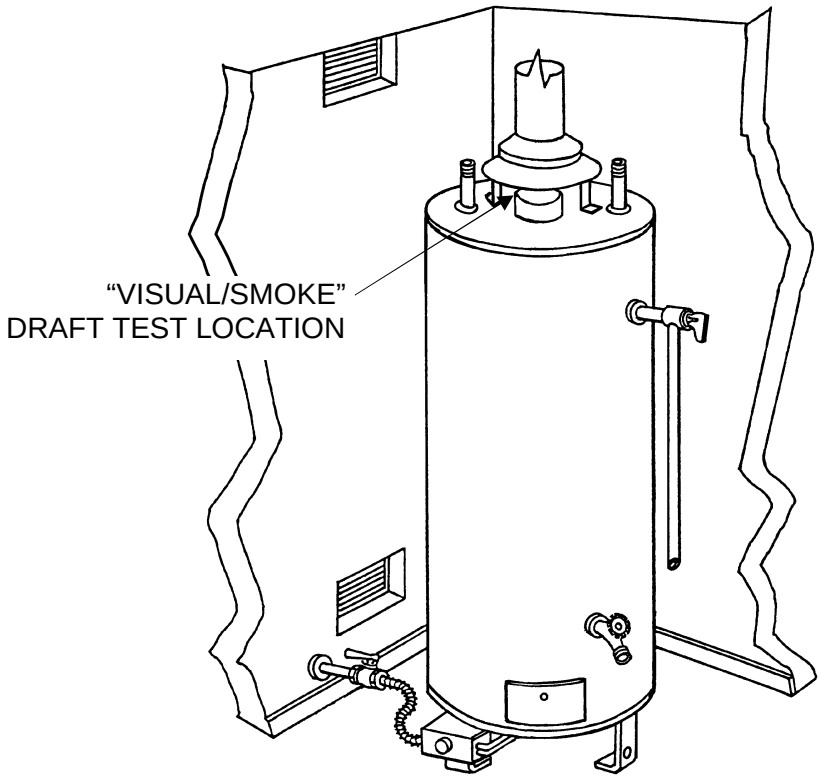
18. TEST PROCEDURES FOR <u>APPLIANCE</u> AMBIENT CO TEST (continued)

- **Natural Gas Kitchen Appliances**
  - **All other gas appliances shall remain off.**
    ***<u>Exception</u>*: Water heater pilot may be operating, but main burner shall <u>not</u> be operating.**
  - **Cooktop:**
    - **With ovens and broilers off, all cooktop burners, and griddle if present, shall be operated on highest setting for one minute.**
    - **CO shall be measured in the center of the kitchen.**
  - **Oven and Broiler Units:**
    - **With cooktop off, each oven shall be operated on highest setting (i.e., "Broil" when applicable) for a minimum or 5 minutes (with separate broiler burner off).**
    - **When a separate broiler burner is present, it shall be operated on highest setting for 5 minutes (with oven burner off).**
    - **CO shall be measured in the center of the kitchen for oven and separate broiler, when present.**
  - **CO Action Level**
    - **The appliance shall be checked by a utility gas service technician (or designee) if Appliance Ambient CO Test CO exceeds 9 ppm.**



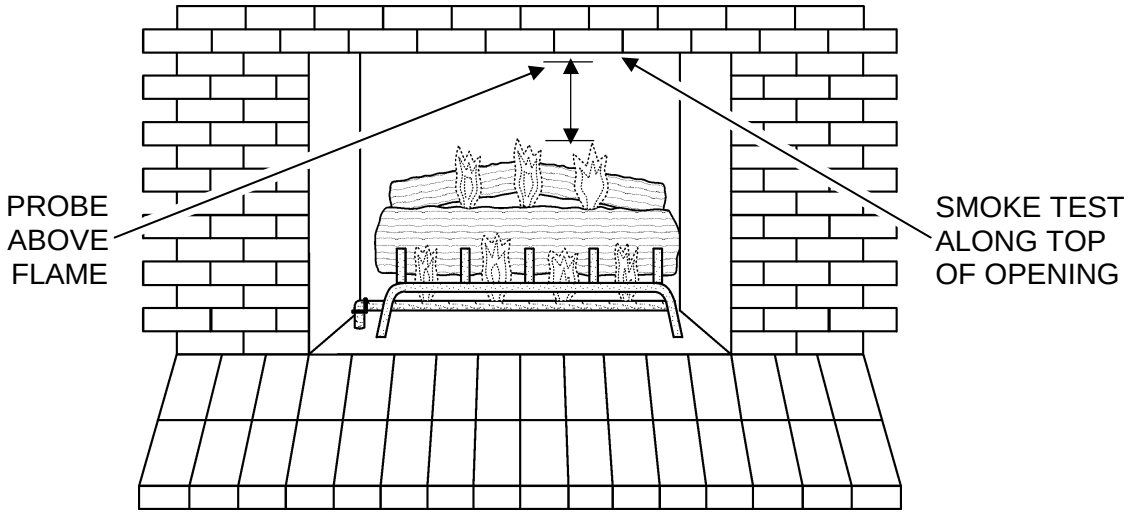
19. DRAFT EXAMINATION

- **Natural Gas Open Combustion Heating Systems and Water Heaters**
  - **Draft tests shall be performed after a minimum of 5 minutes of appliance operation.**
  - **Visual/Smoke Draft Test shall be performed on Natural Draft appliances.**
    - **Smoke shall be applied along the entire draft hood opening.**
    - **Draft is adequate <u>only if</u> smoke is drawn into the draft hood along the entire draft hood opening.**
- **Gas Logs**
  - **Visual/Smoke Draft Test shall be performed as prescribed in Item 20.**
- **All Units**
  - **Corrective action is required when Draft is <u>not</u> adequate.**



20. CO AND DRAFT TESTING FOR NATURAL GAS LOGS

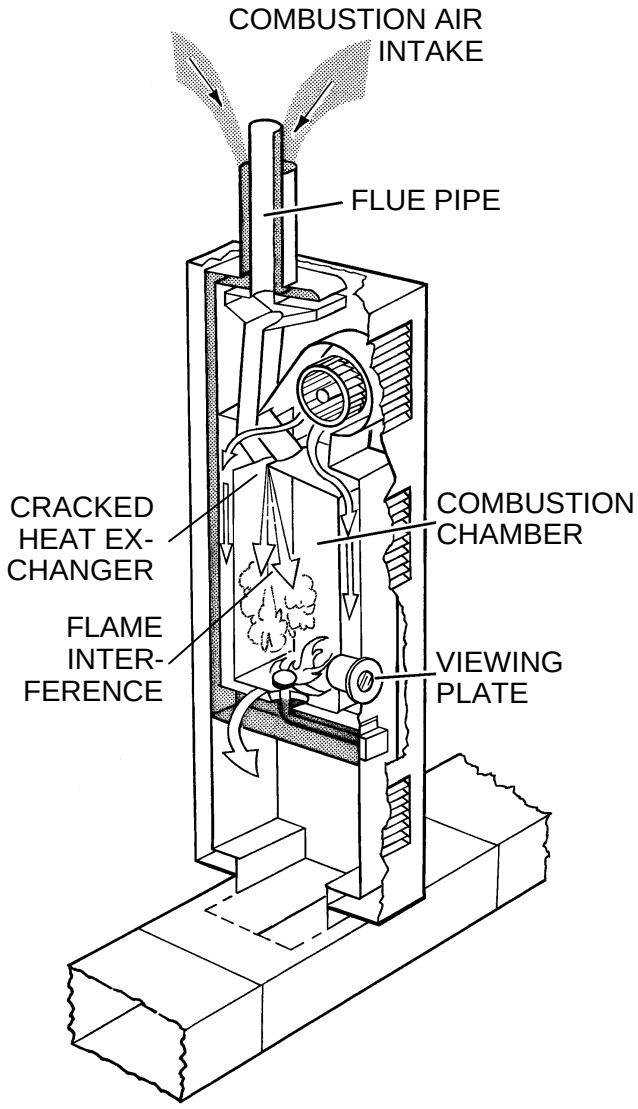
- **When gas log is the *primary* heat source:**
  - **Damper must be blocked partially open (e.g., with a damper clip).**
  - **Opening shall be sufficient to prevent spillage of combustion products into the room.**
- **Fireplace glass doors shall be open during tests.**
- **Exhaust/Flue CO Test**
  - **Gas burner shall be operated for a minimum of 5 minutes before checking CO.**
  - **CO shall be sampled just inside the fireplace opening at least 12" above the flame.**
  - **If CO exceeds action level after 5 minutes, warm up time shall be increased (up to 30 minutes) and unit shall be retested.**
  - **Service by a utility gas service technician (or designee) is required if CO exceeds action level.**
- **CO Action Level***
  - **As established by the utility.**
- **Visual/Smoke Draft Test**
  - **Smoke shall be applied along the top of the fireplace opening.**
  - **Draft is adequate only if smoke is drawn inward along the entire fireplace opening.**



***The CPUC is currently considering a proposed settlement that would set statewide flue testing CO thresholds. This section will be updated when the commission has acted upon the proposed settlement.**

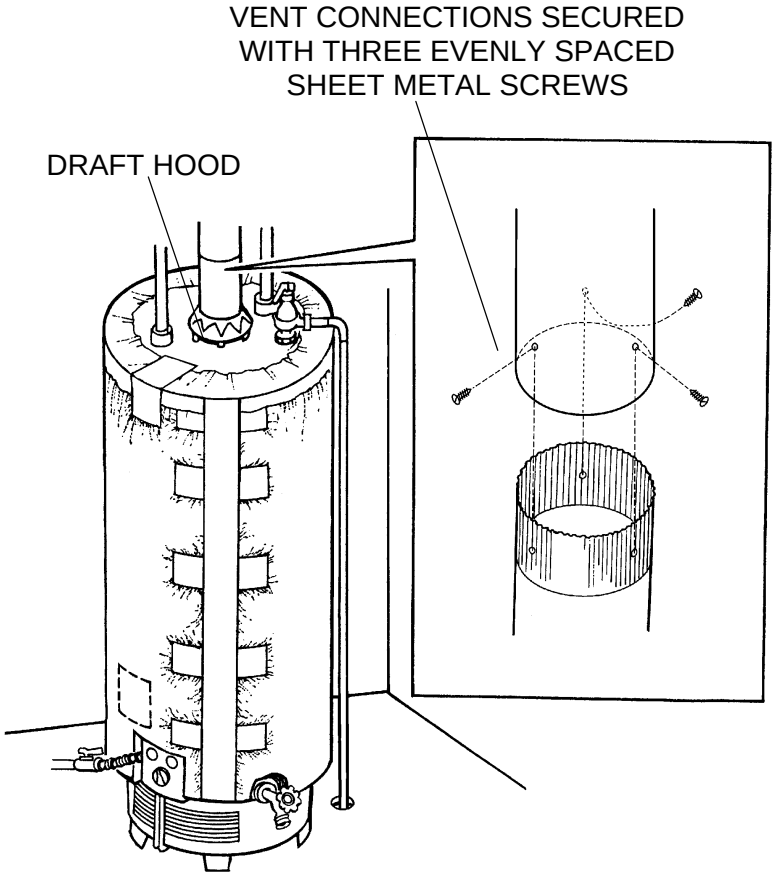
21. ADDITIONAL APPLIANCE EXAMINATIONS

- **Burner Performance**
  - **When the burner(s) ignite, checks shall be made for:**
    - **Delayed ignition.**
    - **Excessive roll-out.**
  - **Burner(s) shall be examined for flame abnormalities, including:**
    - **Large yellow flame (more than 50% yellow).**
    - **Soft lazy flame or smothering flame.**
- **Heat Exchanger Examination on Natural Gas Forced Air Heating Systems**
  - **Each accessible heat exchanger shall be rechecked for cracks with a mirror and strong light.**
  - **The unit shall be further examined/serviced by a utility gas service technician (or designee) if any of the following conditions is present:**
    - **Flame interference caused by the air handler in an FAU.**
    - **A visually-detected crack.**
    - **Other evidence of a defective heat exchanger.**
  - **If a defect exists, the condition shall be corrected by a utility gas service technician (or designee), or designated contractor licensed to repair HVAC appliances.**



22. FLUE AND VENT SYSTEM REPAIR

- **Draft Hoods**
  - **The following conditions must be corrected:**
    - **Improperly installed or positioned draft hood.**
    - **Multiple (stacked) draft hoods on a single appliance.**
    - **No draft hood present where one is required.**
- **Repairing Flue and Vent Systems**
  - **New components shall conform to applicable codes.**
  - **All single-wall flue and vent pipe joints and connections shall be secured with 3 sheet metal screws (spaced as evenly as possible) where:**
    - **New components are installed.**
    - **Existing connections are loose and unsafe.**
  - **Double-wall Class B and BW flue and vent pipes shall <u>not</u> be drilled or have screws installed <u>if</u> doing so is prohibited by the pipe manufacturer or the jurisdiction.**



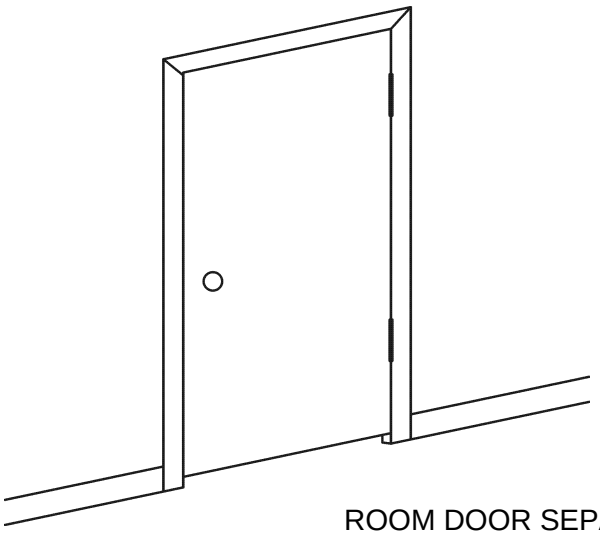
PART 5: POST-REPAIR/REPLACEMENT CHECKS

23. QUALITY ASSURANCE TESTING

- **Natural gas appliances that have been repaired or replaced shall be checked for proper operation, which includes:**
  - **No gas leaks (Item 25)**
  - **Adequate Draft (Item 26).**
  - **Acceptable level of Carbon Monoxide (Item 27).**
- **Problems identified during post-repair/replacement checks must be corrected.**

24. TEST CONDITIONS FOR POST-REPAIR/REPLACEMENT CO AND DRAFT TESTING

- **Door/Window Positions for Tests in the Living Space**
  - **The following shall be closed:**
    - **All exterior doors and windows.**
    - **Doors to rooms containing a supply register when a central return is outside the room.**
    - **Appliance enclosure doors (except during tests).**
  - **The following shall be open:**
    - **Doors to all other living areas and rooms.**
    - **Door to utility room with clothes dryer exhausted outdoors. *Exception:* When a natural draft appliance in that room is tested, the door shall be closed.**



ROOM DOOR SEPARATING
SUPPLY REGISTERS
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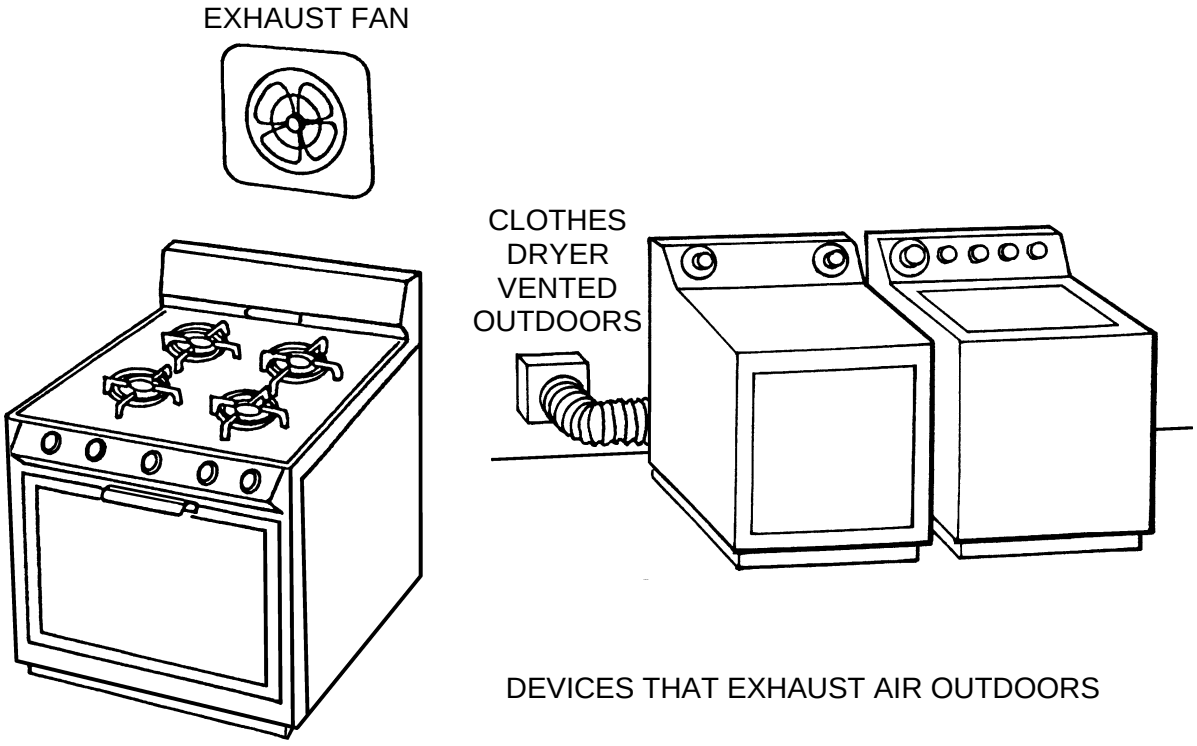
24. TEST CONDITIONS FOR POST-REPAIR/REPLACEMENT CO AND DRAFT TESTING (continued)

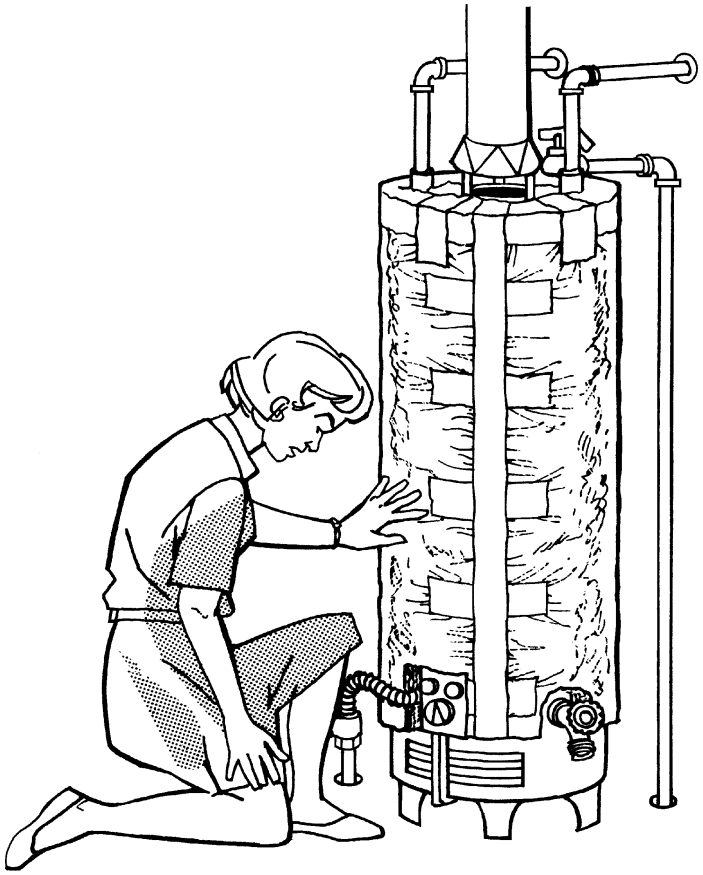
- **The following <u>must</u> be operating during tests:**
  - **FAU air handler.**
  - **All devices that exhaust air from the space containing an appliance being tested (exclude whole house fan).**
- **FAU air filter(s) must be clean or shall be removed prior to testing.**
- **Supply registers shall be open.**
  - ***<u>Exception</u>:* Supply register(s) shall be closed when located in a utility room containing a natural draft appliance.**
- **If an interior cooler cover is available, it shall be in place.**



DEVICES THAT EXHAUST AIR OUTDOORS

25. GAS LEAKS

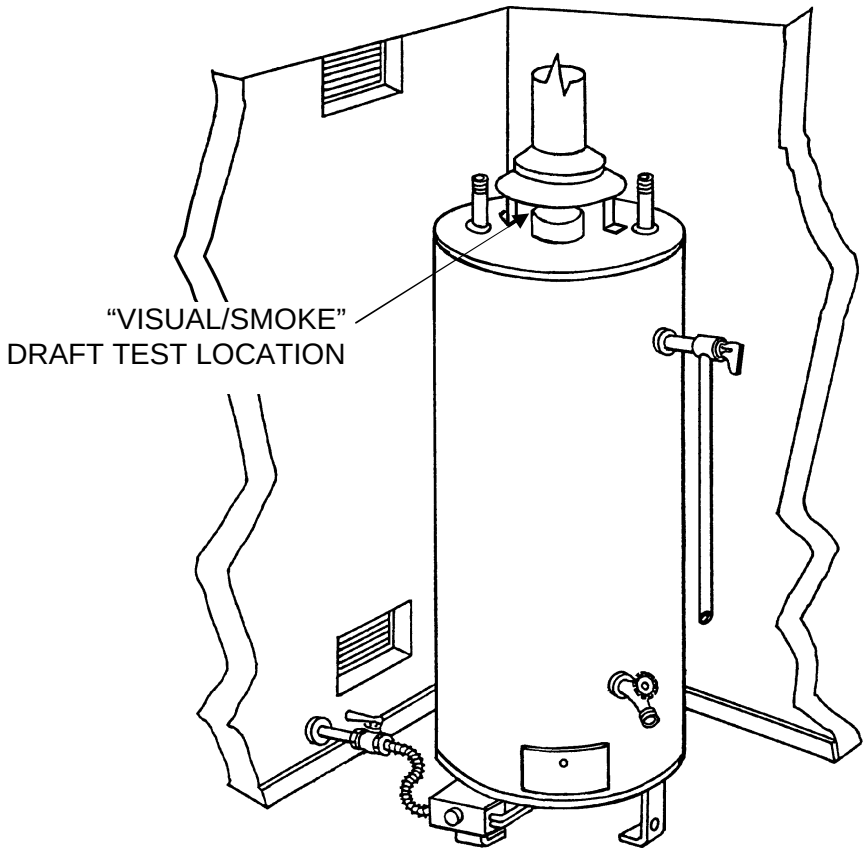
- **Appliances shall be checked for natural gas leaks using one or more of the following methods:**
  - **Olfactory (Sniff) Test performed above, but within 2' of, all valves and fittings.**
  - **Application of leak detection liquid to line valves and to fittings on valves, flexible gas connectors, and pipes.**
  - **Air sampling with electronic leak detection equipment near valves, fittings, flexible gas connectors, and pipes.**
- **Gas leaks shall be repaired.**



CHECKING FOR NATURAL GAS ODOR

26. DRAFT EXAMINATION

- **Natural Gas Open Combustion Heating Systems and Water Heaters**
  - **Test conditions prescribed in Item 24 shall first be established.**
  - **Draft tests shall be performed after a minimum of 5 minutes of appliance operation.**
  - **Visual/Smoke Draft Test shall be performed on Natural Draft appliances.**
    - **Smoke shall be applied along the entire draft hood opening.**
    - **Draft is adequate <u>only if</u> smoke is drawn into the draft hood along the entire draft hood opening.**



27. CO TESTING FOR NATURAL GAS SPACE AND WATER HEATING SYSTEMS

- **Appliance Ambient CO or Flue CO testing shall be performed.**
- **Appliance Ambient CO Tests**
  - **CO Tests shall be conducted per Items 14 – 18.**
- **Flue CO Tests**
  - **Test conditions prescribed in Item 24 shall first be established.**
  - **CO Tests shall be performed after a minimum of 5 minutes of burner operation.**
  - **Flue Gas CO measurements shall be:**
    - **Taken in combustion gases free of dilution air.**
    - **Conducted in accordance with the Table 1-1.**

Table 1-1: Post-Repair/Replacement Flue CO Testing

APPLIANCE	MEASUREMENT LOCATION	MAXIMUM CO LEVEL
FURNACES		
• Natural Draft	Inside each flue (exhaust port) separately	*
• Induced Draft and Closed Combustion	At flue termination, when accessible from the ground	*
WATER HEATERS		
• Natural Draft	Inside center tube on each side of the baffle	*
• Induced Draft and Closed Combustion	At flue termination, when accessible from the ground	*

***The CPUC is currently considering a proposed settlement that would set statewide flue testing CO thresholds. This section will be updated when the commission has acted upon the proposed settlement. During the interim, the maximum allowable CO level following service or replacement shall be as established by the utility.**

NONFEASIBILITY CRITERIA FOR NGAT FOR ENTIRE DWELLING

1. **Non-IOU combustion fuel is used for space heating.**
2. **No infiltration-reduction measures are being installed.**
3. **No natural gas appliance affecting the living space is present.**

NONFEASIBILITY CRITERIA FOR NGAT FOR INDIVIDUAL APPLIANCE

1. **Non-IOU combustion fuel is used.**
   - **<u>Exception</u>: Appliances subject to PG&E-specific policy.**
2. **Appliance is abandoned.***
3. **Appliance is inaccessible.***

***See Definitions.**

NONFEASIBILITY CRITERIA FOR NATURAL GAS APPLIANCE TESTING (NGAT) FOR ENTIRE DWELLING

1. **Non-IOU combustion fuel is used for space heating.**
2. **No infiltration-reduction measures are being installed.**
3. **No natural gas appliance affecting the living space is present.**

NONFEASIBILITY CRITERIA FOR NGAT FOR INDIVIDUAL APPLIANCE

1. **Non-IOU combustion fuel is used.**
   - **<u>Exception</u>: Appliances subject to PG&E-specific policy.**
2. **Appliance is abandoned*.**
3. **Appliance is inaccessible*.**

***See Definitions.**

NONFEASIBILITY CRITERIA FOR CAULKING

1. **The existing caulk is functional and performing properly, even if not installed in accordance with current Installation Standards.**

2. **Crack does <u>not</u> penetrate the envelope.**

3. **Crack/gap too wide to be caulked (wider than 5/8") and must be repaired/patched.**

4. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR WEATHERSTRIPPING DOORS

1. **The existing weatherstripping is functional and performing properly, even if not installed in accordance with current Installation Standards.**
2. **Door located between two conditioned or two unconditioned areas.**
3. **Functional storm door present.**
4. **Customer refuses.**

NONFEASIBILITY FOR WATER HEATER INSULATION

All Water Heaters

1. **The existing blanket is functional and performing properly, even if not installed in accordance with current Installation Standards.**

2. **External insulation is prohibited by the manufacturer.**

1. **T&P valve is not present, or is not located within 6" of the tank.**

2. **T&P valve outlet is plugged or capped.**

3. **Tank is exposed to weather.**

4. **Leak present in tank or water pipes.**

5. **Plastic pipe (e.g., PVC) is present in the cold or hot water line to/from the tank.**

6. **Tank is located within 12" of a stove, range, or cooktop.**

7. **Customer refuses.**

Gas Water Heaters

1. **Perimeter clearances prior to blanket installation are less than 4" between tank and door and less than 1" on sides and back.**

2. ***Gas leak present.**

3. ***Vent pipe and/or draft hood not properly installed, including:**
   - **No draft hood present.**
   - **Two draft hoods present.**
   - **Vent pipe defective or missing.**

***When these conditions exist, contact the designated utility personnel.**

NONFEASIBILITY CRITERIA FOR WATER HEATER INSULATION (continued)

4. ***Evidence of improper combustion and/or venting exists as characterized by:**
   - **Large accumulation of soot near draft hood or on floor underneath.**
   - **Scorching at draft hood or combustion chamber.**

5. **No gas shut-off valve present.**

6. ***Combustion air supply improper or inadequate as characterized by:**
   - **The absence of <u>both</u> low and high vents.**
   - **Vent size too small.**
   - **Room volume is inadequate.**
   - **Customer refuses modifications needed to create adequate combustion air supply.**

7. ***Both burner access doors missing.**

8. **Internal insulation is R-12 or greater.**

<u>Electric Water Heaters</u>

1. **Perimeter clearances prior to blanket installation are less than 1" on the front, sides and back.**

2. **Hazardous electrical wiring/conditions are present.**

3. **Thermostat Cover plate(s) not present.**

4. **Internal insulation is R-16 or greater.**

***When these conditions exist, contact the designated utility personnel.**

NONFEASIBILITY CRITERIA FOR WATER HEATER PIPE INSULATION

1. **The existing pipe insulation is functional and performing properly, even if not installed in accordance with current Installation Standards.**

2. **An unsafe condition is present that causes tank insulation to be nonfeasible.**

3. **Water heater pipes are leaky.**

4. **Water heater pipes are exposed to the elements (especially sunlight, which can quickly degrade the insulation).**

5. **Less than 1 foot of continuous insulation can be installed.**

6. **Plastic piping (e.g. CPVC) is utilized for the cold or hot water tank lines.**

7. **Pipes are inaccessible or the configuration prevents proper installation.**

8. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR COVER PLATE GASKETS

1. **Evidence of electrical malfunction or hazard, such as:**
   - **Electrical box not permanently attached.**
   - **Loose electrical connection.**
   - **Signs of burning or charring or other evidence of hazardous wiring condition.**
2. **Gaskets are already present, even if not installed in accordance with current Installation Standards.**
3. **The cover plate is located on a wall between two conditioned or two unconditioned areas.**
4. **Cover plate located behind fragile furniture, heavy furniture, or major appliances too heavy to move.**
5. **Utility box is an odd size and standard gaskets will not work.**
6. **Removal of cover plate will damage the wall surface (paint, wall paper, etc.).**
7. **Aluminum wiring is present.**
8. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR ENERGY-SAVER SHOWERHEADS

1. **Showerarm and ball joint are not made from the same material.**

2. **Existing showerhead(s):**
   - **have a flow rate less than or equal to 3.0 gpm.**
   - **are required for medical reasons.**

3. **Existing showerarm:**
   - **is made of plastic.**
   - **is cracked, broken, or missing.**
   - **requires removal.**

4. **Shower is <u>not</u> mechanically functional.**

5. **Standard metal adapters (i.e., American Standard®, Gerber®, and Price Pfister®) will not work.**

6. **Piping is in such poor condition that showerhead installation could cause plumbing problems.**

7. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR FAUCET AERATORS

1. **The aerator is functional and performing properly, even if not installed in accordance with current Installation Standards.**

2. **Faucet has special fitting for attaching appliance (e.g., portable dishwasher).**

3. **Faucet does <u>not</u> provide hot water.**

4. **The faucet or faucet threads are found to be damaged and/or leaky.**

5. **Removal of the existing aerator is likely to cause damage to the aerator or the faucet.**

6. **Standard aerators will <u>not</u> fit.**

7. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR WINDOW/WALL EVAPORATIVE COOLER INSTALLATION

1. **The existing cooler is operational.**
2. **Proper electrical service is not present.**
3. **Substandard wiring exists (e.g., ungrounded outlets, decayed insulation, or exposed wires).**
4. **No feasible window or wall location available.**
5. **Exterior clearance requirements cannot be met.**
6. **Egress requirements cannot be met.**
7. **Wood windows are decayed or deteriorated.**
8. **Siding is decayed or damaged.**
9. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR REPLACEMENT REFRIGERATORS

1. **The customer already has a refrigerator manufactured after 1992.**
2. **The electrical outlet used by the existing refrigerator is not properly grounded and cannot be properly grounded.**
3. **The refrigerator is not accessible for removal (e.g., doors from room are too small, refrigerator is encased in tile).**
4. **Floor is not level and cannot safely support a new refrigerator.**
5. **Hazard electrical conditions exist at the outlet used by the existing refrigerator.**
6. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR CENTRAL FORCED AIR REPAIRS AND REPLACEMENTS

1. **The existing furnace passes NGAT, or is abandoned*, or is inaccessible*.**

2. **The property is renter-occupied.**

3. **Fuel used by the existing unit is not supplied by the utility providing LIEE Program services.**

4. **Disconnected ducts or catastrophic duct leaks cannot reasonably be repaired.**

5. **Abandonment of leaky belly-cavity return is required but not feasible.**

6. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR CENTRAL FORCED AIR FURNACE REPLACEMENT

1. **The existing furnace can feasibly be repaired per the Program P&P.**

2. **Required furnace drawing combustion air from outdoors, and/or furnace components or flue system that are listed and labeled for manufactured home installation, cannot be obtained,**

3. **For a unit in a confined location, adequate access and/or combustion air cannot be provided.**

4. **Depressurization by FAU non-ducted return system adversely affects an open combustion appliance, and correction (proper isolation of return air) is not feasible.**

***See Definitions.**

NONFEASIBILITY CRITERIA FOR CENTRAL FORCED AIR FURNACE REPAIR

1. **Repair is not economically feasible.**
   - **Repair cost exceeds guidelines of Program P&P (i.e., cost to repair is more than 50% of the cost to replace the unit).**
   - **Required components listed and labeled for manufactured home installation cannot be obtained.**
   - **Depressurization by FAU non-ducted return system adversely affects an open combustion appliance, and correction (proper isolation of return air) is not feasible.**

NONFEASIBILITY CRITERIA FOR CENTRAL AIR CONDITIONER REPLACEMENT

1. **Heating system can be repaired with existing refrigeration equipment intact.**
2. **Electrical service requirements cannot be met.**
3. **System air flow is inadequate.**

NONFEASIBILITY CRITERIA FOR INSTALLATION REQUIRING UNDERCARRIAGE ACCESS

1. **Crawl clearance is less than 18" from ground to bottom of the floor joist system.**
2. **Any of the following conditions is present in the undercarriage area where access is required:**
   - **Hazardous insect or pest infestation.**
   - **Excessive ground moisture (standing water or mud).**
   - **Sewage waste on ground or other unsanitary condition is present which poses a health and safety hazard.**

NONFEASIBILITY CRITERIA FOR PROGRAMMABLE THERMOSTATS

1. **The furnace is not being replaced.**
2. **Already present and operational.**
3. **Furnace utilizes a millivolt system.**
4. **Upgraded thermostat wiring (heavier gage or more conductors) is required.**
5. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR HVAC AIR FILTER REPLACEMENT

1. **The furnace will not be repaired.**
2. **A serviceable, reusable filter is already present.**
3. **The types of filters provided by the Program are specifically prohibited by the appliance manufacturer.**
4. **Filter replacement would require removal of a flue, duct, or pipe.**
5. **The proper filter support or retaining device is not present, and installation is not feasible.**
6. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR WALL AND WINDOW AIR CONDITIONERS

1. **Unit is already present and operational, and is less than 15 years old.**
2. **A structurally sound mounting platform and/or suitable location is not available.**
3. **Electrical requirements cannot be met.**
4. **Customer refuses.**

NONFEASIBILITY CRITERIA FOR NATURAL GAS WATER HEATER REPLACEMENT

1. **The property is renter-occupied.**

2. **Fuel used by the existing unit is not supplied by the utility providing LIEE Program services.**

3. **The existing water heater:**
   - **Passes NGAT, or**
   - **Is inaccessible*, or**
   - **Can be feasibly repaired (i.e., cost to repair is less than 50% of the cost to replace the unit).**

4. **Drain line for T&P valve cannot be properly terminated beneath the mobile home.**

5. **Required access, clearance, or combustion air cannot be provided.**

6. **Structure/floor cannot properly and safely support the installation.**

7. **No suitable mounting locations for seismic bracing available.**

8. **A safety hazard is present which cannot be repaired (e.g., vent system defect, nonconforming gas piping, double-downdraft diverter).**

9. **A plumbing condition exists (e.g., substandard plastic piping) which prevents achieving satisfactory water pipe connections.**

10. **Customer refuses.**

***See Definitions.**

APPENDIX -A-

COMBUSTION AND VENTILATION AIR (CVA) REQUIREMENTS FOR GAS FURNACES/HEATERS AND WATER HEATERS

APPENDIX -A-

COMBUSTION AND VENTILATION AIR (CVA) REQUIREMENTS FOR NATURAL GAS FURNACES/HEATERS & WATER HEATERS

1.0 PURPOSE

This appendix is based on Chapter 7 of the 2001 CMC (California Mechanical Code) and Chapter 3 of the 2003 International Fuel Gas Code (IFGC). It is a quick reference to determine room volume or vent size requirements for open combustion *furnaces and water heaters*. This appendix does not apply to direct vent appliances and other closed combustion appliances drawing air from outdoors, listed cooking appliances, refrigerators, and domestic clothes dryers. Definitions listed below include those contained in CMC Chapter 2.

2.0 DEFINITIONS

Confined Space: A room or space having a volume of less than 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all fuel-burning open combustion furnaces/heaters and water heaters installed in that space.

Unconfined Space: A room or space having a volume of at least 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all fuel-burning open combustion furnaces/heaters and water heaters installed in that space. Adjacent rooms communicating directly with the space and not separated by doors are considered part of the unconfined space.

Homes of Ordinary Tightness: Homes not of unusually tight construction.

Homes of Unusually Tight Construction: Homes with the following construction features: (a) walls and ceilings exposed to the outside atmosphere have a continuous water vapor retarder rated 1 perm or less, with all openings sealed; (b) weatherstripping on openable windows and doors; and (c) caulking or sealants are applied to areas such as joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, and at plumbing/wiring penetrations and other openings.

NFVA: Net Free Venting Area, which is the gross opening area minus blocking effect of screen and/or louvers (see “Louvers, Grilles and Screens” below).

3.0 CALIFORNIA MECHANICAL CODE (CMC) CRITERIA

Many combustion air code requirements are addressed in the footnotes on page A-3. Others are covered in this section, and formulas used to calculate room volume and vent size are presented in Section 4.0.

Louvers, Grilles and Screens. (CMC 702.3) Combustion air openings must be covered with 1/4-inch mesh (except ducts which terminate in an attic, which are not screened on either end). The blocking affect of louvers, grilles and screens must be deducted from the gross opening of a vent to determine the “net free” venting area (NFVA). When an NFVA is not identified on the vent, it may be estimate by multiplying the *total (gross) opening area* by the suggested “reduction factors” shown in the table below. (Also see the2003 NFGC 304.10.)

SUGGESTED SCREEN AND LOUVER REDUCTION FACTORS FOR COMBUSTION AIR VENTS

1/4" Screen (Hardware Cloth)	1/4 Screen with Metal Louvers	1/4 Screen with Wood Louvers	Insect Screen (Mesh under 1/4")	Insect Screen w/ Metal Louvers	Insect Screen w/ Wood Louvers
0.90 (90%)	**0.75** (75%)	**0.25** (25%)	**0.50** (50%)	**0.50** (50%)	**0.25** (25%)

Prohibited Sources. (CMC 703.3) Vent openings and ducts cannot connect an appliance enclosure with a space in which the operation of a fan may adversely affect the flow of combustion air.

Combustion-Air Ducts. (CMC Section 704) Ducts must be galvanized steel or equivalent corrosion-resistant material approved for the use. A duct must have the same cross-sectional area as the free area of the opening to which it connects.

4.0 USING THE COMBUSTION AIR MATRIX

Column [A] in the CVA Requirements matrix on page A-3 lists several Btu/hour Input Rating totals. Columns [B] through [F] list corresponding room volumes (cu. ft.) and vent sizes (sq. in. of NFVA). For Btu/h totals not shown, the required room volume or vent NFVA can be calculated using the applicable formula from the table below (note: "KBtu" = 1,000 Btu).

Column	Application	Requirement [Formula in Brackets]
[B]	All air from *indoors*, based on room size	**50 cu. ft. of room volume per 1,000 Btu/h input. [KBtu x 50] or [Btu / 2 and drop last zero]**
[C]	All air from *indoors*, 1 upper vent <u>and</u> 1 lower vent to another room/space*	When the volume of the room/space containing an appliance is inadequate, an upper <u>and</u> a lower vent may be installed to communicate with an adjacent unconfined space. <u>Each</u> vent must provide **1 sq. in NFVA per 1,000 Btu/h input**, with a *minimum* size of 100 sq. in. **[100 + KBtu over 100]**
[D]	All air from *outdoors*, 1 upper vent or duct**	1 upper opening (or vertical or horizontal duct) may be used to provide the combustion air (lower vent <u>not</u> required). The vent/duct must provide **1 sq. in NFVA per 3,000 Btu/h input. [KBtu / 3]**
[E]	All air from *outdoors*, 1 upper vent or vertical duct <u>and</u> 1 lower vent or vertical duct*	<u>Each</u> opening and *vertical* duct must provide **1 sq. in NFVA per 4,000 Btu/h input. [KBtu / 4]**
[F]	All air from *outdoors*, 1 upper horizontal duct <u>and</u> 1 lower horizontal duct*	<u>Each</u> *horizontal* duct must provide **1 sq. in NFVA per 2,000 Btu/h input. [KBtu / 2]**

*See footnote 5 on page A-3 regarding placement of upper and lower vents and ducts. For ducts, also see the double-asterisk (**) note at the bottom of the page advising that the minimum cross-sectional area of a duct is 3" (3"x3" rectangular, or 3" round).

**See footnote 1 on page A-3 regarding the acceptability of just *one* combustion air vent or duct.

The matrix on page A-3 summarizes most combustion air venting options specified in Chapter 7 of the 2001 CMC. It is based on CMC Table 7-A (<u>*except*</u> [D], based on IFGC 304.6.2).

This appendix is only a guide. Each installer is responsible for meeting all requirements of the local jurisdiction and applicable codes and regulations.

CVA REQUIREMENTS FOR GAS FURNACES/HEATERS & WATER HEATERS

OPEN COMBUSTION FURNACE AND/OR WATER HEATER IN A ROOM/SPACE	HOMES OF ORDINARY TIGHTNESS*, WITH APPLIANCES LOCATED IN A CONFINED SPACE*, AND ALL COMBUSTION AIR OBTAINED FROM INDOORS		HOMES OF UNUSUALLY TIGHT CONSTRUCTION*, OR OF **INADEQUATE VOLUME**, WITH ALL COMBUSTION AIR OBTAINED FROM OUTDOORS		
			[D] 1 Upper Opening (or 1 Vertical or Horizontal Duct)[1,2] **[E]** 1 Upper Opening or **Vertical** Duct and 1 Lower Opening or Vertical Duct[2,3,4]		TWO **HORIZONTAL** DUCTS[2,3]
TOTAL INPUT	MIN. ROOM VOLUME	MIN. NFVA* PER VENT[4]	MIN. NFVA* FOR **1** VENT/**VERTICAL** DUCT[4]	MIN. NFVA* FOR EACH OF **2** VENTS/**VERTICAL** DUCTS	REQUIRED NFVA* PER DUCT FOR **2** DUCTS
[A] BTU/HR	**[B] CU. FT.**	**[C] SQ. IN.**	**[D] SQ. IN.**	**[E] SQ. IN.**	**[F] SQ. IN.**
20,000	1,000	100	6.7**	5.0**	10.0
25,000	1,250	100	8.3**	6.3**	12.5
30,000	1,500	100	10.0	7.5**	15.0
35,000	1,750	100	11.7	8.8**	17.5
40,000	2,000	100	13.3	10.0	20.0
45,000	2,250	100	15.0	11.3	22.5
50,000	2,500	100	16.7	12.5	25.0
55,000	2,750	100	18.3	13.8	27.5
60,000	3,000	100	20.0	15.0	30.0
65,000	3,250	100	21.7	16.3	32.5
70,000	3,500	100	23.3	17.5	35.0
75,000	3,750	100	25.0	18.8	37.5
80,000	4,000	100	26.7	20.0	40.0
85,000	4,250	100	28.3	21.3	42.5
90,000	4,500	100	30.0	22.5	45.0
95,000	4,750	100	31.7	23.8	47.5
100,000	5,000	100	33.3	25.0	50.0
105,000	5,250	105	35.0	26.3	52.5
110,000	5,500	110	36.7	27.5	55.0
115,000	5,750	115	38.3	28.8	57.5
120,000	6,000	120	40.0	30.0	60.0
125,000	6,250	125	41.7	31.3	62.5
130,000	6,500	130	43.3	32.5	65.0
135,000	6,750	135	45.0	33.8	67.5
140,000	7,000	140	46.7	35.0	70.0
145,000	7,250	145	48.3	36.3	72.5
150,000	7,500	150	50.0	37.5	75.0
155,000	7,750	155	51.7	38.8	77.5
160,000	8,000	160	53.3	40.0	80.0

[1]Just one opening within 12" of the ceiling (or one vertical or one horizontal duct) is allowed when the appliance has clearances of 1" on sides and back and 6" in front. Vent/duct NFVA must equal the sum of the vent connector areas.

[2]Combustion air must be obtained air from outdoors or from spaces freely communicating with outdoors.

[3]Upper vent/duct termination shall be installed within 12" of the ceiling, and lower vent/duct termination shall be within 12" of the floor. However, a pre-existing upper vent at any location higher than the draft hood is acceptable.

[4]Undampered venting in skirting must be present on each side which provide 1.5 sq. ft. NFVA per 25 lineal feet of mobile home.

*See definitions on page A-1.

The minimum cross-sectional dimension of **ducts is 3". Minimum **rectangular duct** is 3"x3" (**9.0 sq. in.**); minimum **round duct** is 3" diameter (πr^2 = 3.1415 x 1.5" x 1.5" = **7.07 sq. in.**).